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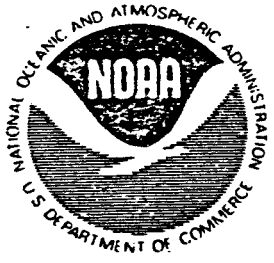

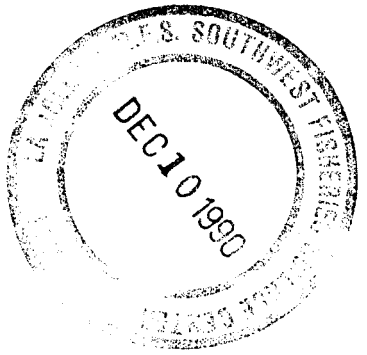

FEBRUARY 1986

ANNOTATED BIBLIOGRAPHY

ON IMPACTS OF GILLNETS ON NON-TARGET SPECIES

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NOAA-TM-NMFS-SWR-012

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TABLE OF CONTENTS

INTRODUCTION

This literature survey was initiated as a result of concerns about potential mortality of marine mammal species in net fishery gear, especially incidental catch in actively fished gillnets and entanglement in lost or discarded net material. As the literature search and information gathering proceeded, it became apparent that bycatch, on an incidental basis, of non-target species encompassed a much broader base than just marine mammals. Given the expanded extent of this interaction it was decided that any affected species of mammal, bird, fish, or invertebrate not targeted by a specific fishery should be an open subject for consideration in this bibliography.

The scope of the survey is worldwide, encompassing any drift or set gillnet fishery known to catch non-target species either incidental to operational fishing or in derelict gear. References that describe the nature and extent of a fishery and incidental take, gillnet size and material, and the manner in which nets are fished have been examined. Documentation of numbers and rates of catch, population impact, research methods, and mitigating measures has been sought.

The purpose of the bibliography and annotations is to bring together for review the widespread information on non-selectivity of species and derelict fishing by gillnet mesh. These problems have not been thoroughly investigated, in part because many gillnet fisheries and associated effects have developed relatively recently and rapidly. Focused research designed to understand these problems in many cases is just starting or has not yet produced conclusive, fully analyzed results. Thus, available reports and data are often preliminary, tentative, and/or unpublished.

As additional reports and manuscripts become available, they will be incorporated into this bibliography. Currently referenced papers have been accumulated and reviewed as thoroughly as time has allowed. Annotations of papers that have been obtained contain information relevant to gillnet impacts on non-target species, and do not always represent summaries of the entire work. They are abstracted to summarize type of article, type of information contained, and data or results discussed. In general, fishery, location, affected species, and quantitative characteristics of nets and impacts are mentioned. Specifically, such parameters as mesh size, effort, and numbers or rate of take are included. The main intent of the annotations is to help the user understand the state of knowledge regarding gillnet side effects and determine which articles merit further review.

How to use: References have been entered onto microcomputer disk storage and can be accessed by author. Citations and annotations are listed together alphabetically. About 100 references are included to date. An Author Index contains keywords, such as geographic area, fishery nationality, and non-target taxa, listed by author and sorted in a database program format. Conversely, a Keyword Index lists author and year by subject.

This bibliography is proposed to be maintained as a microcomputer database for interested workers. The intent is to update and correct the database periodically as new documents are received. Inquiries to the database are welcome, as is submission of references or complete articles to us for review and abstracting. Ideally this bibliography should serve as an initial step in communicating with authors and active investigators about their data and conclusions.

Ainley, D.G., A.R. DeGange, and L.L. Jones. 1981. Mortality of seabirds in high-seas salmon gillnets. Fish. Bull. 79(4):800-806.

Since 1952 the Japanese have operated a large driftnet fishery for salmon in the North Pacific Ocean and Bering Sea. Recent studies in those areas indicate that numerous seabirds are killed annually in that fishery. Such estimates were based on research sets only. This document investigates possible mesh size influence on seabird kills and reassesses previous estimates of the impact of gillnet fisheries on seabird mortality. Geographic variations in kill were also studied to determine possible severe impacts on local bird populations.

Anonymous. 1973. Japanese monofilament salmon nets found in Cook Inlet. Alaska Magazine (Dec., 1973), 25 pp.

A marine mammal skull was reported in a 75m wad of net.

Anonymous. 1978. Environmental impact statement for the renegotiation of the international convention for the high seas fisheries of the North Pacific Ocean. U.S. Dept. of State 147 pp.

Incidental take of Dall's porpoise take in salmon gillnets may be due to a common prey species that attracts porpoise and salmon, and inability of the porpoise to detect and avoid gillnets. No commensalism is suggested. Incidental take and injury of fur seals by salmon or ghost gillnets was considered minor, especially relative to the potential impact of competition between seals and fisheries for species like pollock. The huge scale of pelagic gillnetting may also produce problems of lost nets and indiscriminate mortality.

Anonymous. 1979. Annual report on Dall's porpoise-salmon research. A report to Congress. NMFS. 10 pp.

Due to incidental take of Dall's porpoise (perhaps up to 20,000 annually) and some northern fur seals in Japanese salmon gillnets, a cooperative observer and research program is being conducted in the North Pacific. The marine mammal research program involves catcher boats and dedicated vessels to study mammal mortality and populations.

Anonymous. 1982. Marlin and others drift gillnet fisheries. Japan Fisheries Agency manuscript. 8 pp. + tables.

Target species of this long existing fishery have increased to include marlin, skipjack, albacore, other tuna, and swordfish. Salmon and trout catching or retention is prohibited. The main target in the North Pacific is albacore, which seems to inhabit waters warmer than 16 degrees Centigrade.

Thus salmonids, which inhabit water between 1 and 15 degrees Centigrade, should not overlap albacore and other fisheries of these gillnetters. Mesh sizes used are also thought to allow salmonids possibly in the area to pass through easily, minimizing bycatch.

Anonymous. 1982. Proceedings of the 29th annual meeting, Int. North Pacific Fish. Comm.

The meeting addressed concerns that developing high seas drift gillnet fisheries for squid and marlin might incidentally catch salmon species. Flying squid (Ommastrephes bartrami) was the main target species discussed, and discussion centered on distributional factors of squid and salmon and potential for overlap and incidental take.

Anonymous. 1982. Report on the workshop on the incidental take of marine birds in Japanese salmon gillnets, March 23-24, 1982, Tokyo, Japan. Far Seas Fisheries Research Laboratory Final Rep. 8 pp.

An estimated 130,000 - 190,000 seabirds annually were taken incidental to the mothership salmon gillnet fishery from 1977 to 1981. Species identification was not completely reliable, but Short-tailed Shearwaters and Tufted Puffins composed about 61% and 21% respectively. Horned Puffins, murres, fulmars, auklets and others are also taken. Efforts to refine estimates and examine factors such as mesh size on species composition of the catch were planned.

Anonymous. 1982. Squid drift gillnet fishery. Japan Fisheries Agency manuscript. 9 pp. and figs.

Driftnets are set at night about 10m below the surface for the target species flying squid. The Japanese squid drift gillnet fishery started in 1978 and is more efficient and competitive than jigging operations. Mesh size must be between 100mm and 135mm. Salmon and trout catch is prohibited and incidental take seemingly has been prevented by area limitations on squid fishing.

Austin, B.C. and G.T. Waugh. 1983. Draft fishery management plan, regulatory impact review, and draft environmental impact statement for swordfish. South Atlantic Fishery Management Council. 73 pp. and appendices.

Several boats have augmented their fishing effort for swordfish in the last few years by using drift gillnets at night. Driftnets are proposed to be banned in the mid and northwest Atlantic to avoid this increased effort, which could possibly result in catch above optimum yield for the stock, and to avoid potential marine mammal and turtle interactions, as well as conflicts with other fishing gear.

Balazs, G.H. 1982. Driftnets catch leatherback turtles. ORYX 16(5):428-30.

In 1979 Japanese vessels began using monofilament gillnets for squid northwest of the Hawaiian Islands between 35° and 45°N. Some vessels may come from Taiwan and Korea also. United States vessels trolling for albacore have become inadvertently snarled in nets, and have reported at least five dead leatherback turtles (Dermochelys coriacea) floating wrapped in net sections. Porpoise, ocean sunfish, sharks, swordfish, and small albacore were also seen entangled. Lost net sections are also a hazard and have been found to drift into coastal areas. This net fishery may threaten leatherback turtle survival in their recently discovered North Pacific feeding grounds and migration routes, and other high-seas driftnet fisheries may affect other sea turtle species in their pelagic life history stages.

Bannister, J.L. 1977. Incidental catches of small cetacea off Australia. Rep. Int. Whaling Comm. 27:507. Paper L.25.

Shark nets off New South Wales beaches were rarely known to kill dolphins, perhaps one every two years, but shark nets off Queensland catch small cetaceans more frequently, for example 13, from several genera, for one area in one year.

Bartonek, J.C. 1968. Mortality of diving ducks on Lake Winnepegosis through commercial fishing. Canad. Field Nat. 79:15-20.

Gillnets set in the shallow lake waters from mid to late summer frequently caught waterbirds that feed by diving - mostly Redhead Duck and grebe species. Concentrations of these divers in areas used for fishing led to an incidental catch of roughly several thousand birds during the nine week fishing season in 1963.

Beach, R.J., A.C. Geiger, S.J. Jeffries, and S.D. Treacy. 1981. Marine mammal-fishery interactions on the Columbia River and adjacent waters, 1981. Ann. Rep., NOAA, NMFS Grant No. 80-ABD-0012. 186 pp.

This report covers the second year of a three year study, and contains information on fish loss and gear damage caused by marine mammals and information on rates of entanglement. 32.3 harbor seals were entangled for every 1,000 gillnet hours fished. California sea lions usually escape. The report also summarizes marine mammals stranded on Washington and Oregon coasts between March 4, 1980 and November 7, 1981. Some of these apparently died as a result of entanglement.

Bedford, D. 1983. Pelagic shark/swordfish drift gillnet fishery management information document. Calif. Dept. of Fish and Game, Report to the Legislature, 87 pp.

This study is in response to a California legislative directive to examine impacts of the new drift gillnet fishery for sharks that increased rapidly since 1977, amid concerns over competition, overfishing, and indiscriminate incidental take. Nets are effective at catching targeted thresher sharks and a valuable bycatch of swordfish. The greatest swordfish catch is in autumn, but concern about swordfish depletion due to gillnetting does not seem justified. Depletion of striped marlin should not result from the relatively few incidentally taken. Many valuable mako sharks were also taken during two years of warm coastal waters, but this catch may not continue. Large numbers of blue sharks were also taken incidentally. Incidental take of California sea lions is estimated at 500 - 1500 annually, and is concentrated in spring and early summer and around the outer Channel Islands. Other incidental catch is not considered significant by any standards. Recommendations for management focus on license limits, mesh size, and season and area closures to prevent or mitigate problems.

Bernard, F.R. 1981. Canadian west coast flying squid experimental fishery. Canadian Industry Rep. of Fish. and Aquat. Sci. No. 122. 23 pp.

An experimental drift gillnet fishery for squid off Vancouver Island was attempted by Japan and Canada. Monofilament gillnets in sets of at least 15 km up to 35-45 km were set either on the surface or down to 10m below the surface. Incidental take was low in properly placed nets, and comprised pomfret, blue shark, salmon shark, tuna, and salmon. Bycatch of these commercially valuable species is thought to be kept at acceptably low levels by following several guidelines on fishing area, water temperature, and net setting techniques.

Bibby, C.J. 1972. Auks drowned in fish nets. Seabird Rep. 2:48-49.

(Article not seen.)

Bourne, W.R.P. 1972. Threats to seabirds. International Council for Bird Preservation XI, Bull:200-218.

(Article not seen.)

Bourne, W.R.P. 1977. Nylon netting as a hazard to birds. Mar. Poll. Bull. 8(4):75-76.

This brief review discusses an increasing incidence of seabird mortality in durable nylon fishing material from several fisheries including gillnets. Large numbers of birds in a variety of species have been taken in drift and set nets, ghost net material, or flotsam. This type of debris is also collected as nest material which then may entangle chicks.

Brownell, R.L., Jr. 1975. Progress report on the biology of the Franciscana dolphin, (Pontoporia blainvillei), in Uruguayan waters. J. Fish. Res. Board Can. 32:1073-1078.

Biological information is reported from over 400 Franciscana dolphins (Pontoporia blainvillei) caught in a local gillnet fishery for sharks. The shark fishery off Punta del Diablo started in 1942, and the season lasts 12 months. Boats set 8 to 14 pairs of 197 by 10 foot gillnets, with 4.4 or 6 inch mesh size depending on the size of sharks sought. At least 536 Franciscanas, taken in all months, and an uncounted number of fur seals (Arctocephalus australis) and sea lions (Otaria flavescens) were gillnetted between 1969 and 1973, although fishermen estimated 1500-2000 Franciscanas were taken annually around 1969 and 1970. Boats fishing 30-40 km offshore did not catch Franciscanas.

Brownell, R.L. Jr., 1982. Status of the cochito, Phocoena sinus, in the Gulf of California. Mammals in the Seas. Vol. 4, 85-90, small cetaceans, seals, sirenians and otters. FAO Fisheries Series No. 5, Rome, Italy.

Gillnet fishing for totoaba (Cynoscion macdonaldi) was active in the northern part of the Gulf from the late 1940s, when small cetaceans of unknown species are known to have been taken, until Mexico banned totoaba fishing indefinitely in 1975. Incidental take of P. sinus in the early 1970s may have been in the range of tens to hundreds annually, but data are sparse. Good enforcement of the 1975 ban should have decreased this take, but gillnet fisheries in the area for other sciaenids and sharks likely take some P. sinus. Overall incidental mortality in this locally distributed and reduced species may be significant.

Carr, H.A., E.H. Amaral, A.W. Hulbert, and R. Cooper. In press. Underwater survey of simulated lost demersal and lost commercial gillnets off New England. Draft presented to A Workshop on the Fate and Impact of Marine Debris. Honolulu, Hawaii. 26-29 Nov 1984. FIMD/84/WP-II/11. 11 pp.

Bottom set gillnets, draggers, and recreational gear compete for areas or target species of groundfish off New England. Conflicts include gear fouling and continued fishing by ghost nets, which have been retrieved with fish,

lobsters, and crabs. Examination of ghost nets, bottom sets left in place, and actively fishing commercial nets showed that spiny dogfish (Squalus acanthias) was the most abundant species either caught incidentally or entangled, although a variety of finfish and crustaceans, some commercially valuable, were observed in ghost nets. Ghost nets had variable fates. Some were rapidly reduced in fishing ability or vertical profile by twisting and tangling, but several apparently in the water for more than two years still had some exposed profile. Economic and management conclusions are not yet clearly definable.

Carter, H.R. and S.G. Sealy. 1984. Marbled murrelet mortality due to gillnet fishing in Barkley Sound, British Columbia. 9th Annual Pacific Seabird Group Meeting, 6-8 January 1982, Seattle, Wash., p. 212-220.

Alcid mortality due to nearshore commercial fishing has been seldom examined. Little information is available on how it occurs and what effects it has on local populations. During studies of a breeding population of Marbled Murrelets (Brachyramphus marmoratus) in 1979 and 1980, in Barkley Sound, British Columbia, information was obtained mainly on Marbled Murrelet mortality due to a local, gillnet fishery for sockeye salmon (Oncorhynchus nerka). The fishing season coincided with murrelets' nesting period, and high-density aggregations of fishing boats and feeding murrelets regularly overlapped. Most mortality occurred at night in the southern part of Trevor Channel. This mortality is significant because 7.8 percent of the fall population size is killed annually. Mortality has probably occurred only recently, however, due to changes in fishing boundaries. Mortality could be effectively eliminated by excluding gillnet fishing from a small area where foraging Marbled Murrelets aggregate or by allowing fishing "daylight" only in this area.

Cary, F. and R.L. Burgner. 1983. Observations aboard a Japanese squid driftnet fishing vessel in September-October 1982. Fisheries Research Inst., Univ. of Wash. FRI-UW-8307. 23 pp.

A U.S. observer was placed aboard a Japanese vessel due to concerns about incidental take and net-marking of salmonids. The fishing operation is described and net pulls reported. No salmonid dropout or incidental catch was observed, but albacore (Thunnus alalunga) and yellowtail (Seriola aureovittata) were caught and kept. Also 284 shark (Isurus oxyrinchus, Lamna ditropis and one Prionace glauca), many pomfret (Brama japonica), four ocean perch (Mola mola), five pelagic armorhead (Pentaceros richardsoni), 11 North Pacific white-sided dolphin (Lagenorhynchus obliquidens) and seven northern right whale dolphin (Lissodelphis borealis) were caught but discarded. About 300 Japanese vessels were reported to be operating in that fishery at that season, along with 80-100 Taiwanese and about 40 South Korean vessels.

Christensen, O. and W.H. Lear. 1976. Bycatches in salmon driftnets at West Greenland in 1972. Medd. Gronl. 205(5):1-38.

On the basis of catch-per-unit-effort of bycatches by commercial vessels, estimates have been derived on numbers of individuals of various species captured by the non-Greenlandic vessels fishing for Atlantic salmon at West Greenland during 1972. Of all bycatches, seabirds were taken most frequently, Murres (Uria lomvia) being most common with an estimated kill of about 207,000 individuals. Estimated kills of other seabird species occurring less frequently were Dovekie (Plautus alle) - 10,000, Greater Shearwater (Puffinus gravis) - 2,700, Black Guillemot (Cepphus grylle) - 1,800, and Atlantic Puffin (Fratercula arctica) - 900. Of fish species only Atlantic cod (Gadus morhua) was taken in significant quantities (about 11,000 individuals).

Of marine mammals harbor porpoises (Phocoena phocoena) and seal species were taken most frequently with estimated kills of about 1,400 and 300 individuals respectively. (Auth. abstr.)

DeGange, A.R. 1978. An update on the incidental mortality of seabirds in Japanese gillnets. Pacific Seabird Group Bull. 5(2):34-35.

This update presents further information on gillnet mortality of seabirds in the Bering Sea. Possible changes in mortality in the future due to a reduction in fishing effort are discussed. (Auth. abstr.)

DeGange, A.R. 1978. Observations on the mortality of seabirds in Japanese salmon gillnets mades from the Oshoro Maru and Hokusei Maru. Summer 1978. Unpublished report. U.S. Fish and Wildl. Serv., Anchorage, Alaska. 38 pp.

This report provides information on the incidental catch of seabirds in driftnets set to catch salmon in the Bering Sea and North Pacific Ocean. Estimates of mortality are presented and ways to reduce mortality are discussed. (Auth. abstr.)

DeGange, A.R. 1978. Seabird mortality in high-seas gillnets. Pacific Seabird Group Bull. 5(2):84.

This note reports on gillnet mortality of seabirds on the high seas. (Auth. abstr.)

DeGange, A.R. and T.C. Newby. 1980. Mortality of seabirds and fish in a lost salmon driftnet. Mar. Poll. Bull., 11:322-323.

In 1978, the authors recovered 99 seabirds of five species (mainly Short-tailed Shearwaters), two salmon sharks, one ragfish, and over 200 chum and silver salmon from a 1,500m by 6m deep section of lost monofilament gillnet in

the western North Pacific. The net was estimated to have drifted at least 30 days. Other seabirds apparently attracted by entangled organisms were observed. Personal communications regarding gillnet entanglement of fur seals, Dall's porpoises, sea otters, and seabirds are related.

DeMaster, D.P., D.J. Miller, D. Goodman, R.L. DeLong and B.S. Stewart. 1982. Assessment of California sea lion fishery interactions. Trans. 47th North Am. Wildl. Nat. Res. Conf. 47: 253-264.

An estimated 678 to 1,277 California sea lion (Zalophus californianus) deaths occur per year due to interactions with the shark gillnet fishery, and the halibut gillnet fishery takes roughly 200 sea lions per year. The gillnet fisheries in turn experience significant gear damage, particularly trammel nets set for halibut, where sea lions caused 43 percent of the total dollar loss in halibut fishing.

Evans, P. and G. Waterston. 1976. The decline of the Thick-billed Murre in Greenland: an urgent plea for stricter conservation measures. Polar Record 18(14):283-287.

The article provides a general background on impacts of hunting and driftnet salmon fishing on populations of Thick-billed Murre in Greenland. The conclusion reached is that the salmon netting situation needs to be examined more closely to determine whether birds are at present falling victim in large numbers to driftnets, or whether hunting is the main cause of their decline.

Everitt, R.D., R.J. Beach, A.C. Geiger, S.J. Jeffries, and S.D. Treacy. 1981. Marine mammal-fisheries interactions on the Columbia River and adjacent waters, 1980. Ann. Rep., Washington State Department of Game. 109 pp.

The report presents preliminary results of the first of a three-year study to investigate interactions of marine mammals and commercial and sport fisheries on the Columbia River and adjacent waters of Oregon and Washington. Interactions of marine mammals with salmon gillnet activities appeared to correlate with seasonal abundance of harbor seals in local areas. Incidental take of marine mammals was documented in all areas commercially fished, but was greatest in Willapa Bay. A take of 389 marine mammals (mainly harbor seals) was recorded in the dockside sample for all fisheries, including at least 39 animals killed. Incidental take for the entire fishery was undoubtedly higher. Study results indicate that nearly one-third of all dead marine mammals examined died as a result of (presumed) fishery interactions. Possible measures to reduce interactions are outlined.

Everitt, R.D. and R.J. Beach. 1982. Marine mammal-fisheries interactions in Oregon and Washington: an overview. Trans. 47th North Am. Wildl. Nat. Res. Conf. 47:265-277.

Coastal and estuarine gillnet fisheries have experienced significant damage from or incidental catch of pinnipeds. Interactions with California sea lions (Zalophus californianus) are most acute in fall and winter months. Northern sea lions (Eumetopias jubatus) interact with gillnet fisheries also. Harbor seals (Phoca vitulina) interact with coastal and inland water gillnets, and may cause significant economic loss. In 1980 gillnetters had 0.6-2.2 cases of gear damage caused by marine mammals and 0.3-3.2 entanglements per 100 hours fished. At least 51 harbor seals were killed. Most lethal taken of California sea lions resulted form clubbing or shooting, with some drowning due to entanglement. During the winter chinook salmon season on the Columbia River in 1951, 50 cases of sea lion damage to nets were reported. This included seven entanglements, in which four sea lions died or were killed.

Fable, W.A. and L. Trent. 1984. Catches of king mackerel and cero in the Spanish mackerel gillnet fishery. NOAA Tech. Memo. NMFS-SEFC-138. 13 pp.

Incidental catch of king mackerel (Scomberomorus cavalla) in gillnets used in the Spanish mackerel (S. maculatus) fishery in Florida was low in 1980-81; less than 1 percent by number in overall state landings. Range of incidental catch among landings was large (0 percent to 41 percent) and there was an observed trend of an increasing rate as the fishing season progressed in some areas. Mixed mesh nets are commonly used in some areas, and lengths of mackerel seems to positively correlate with mesh size in which caught. One cero (S. regalis) was the only other non-target species observed.

Fiscus, C.H. and P. Kozloff. 1972. Fur seals and fish netting. Pages 124-132 (Appendix E) in Fur seal investigations, 1971. Unpublished manuscript. Nat. Marine Mammal Lab., NMFS, Seattle, Wash.

(Article not seen).

Fiscus, C.H. and R.W. Mercer. 1982. Squids taken in surface gillnets in the North Pacific Ocean by Pacific Salmon Investigations Program, 1955-1972. NOAA Tech. Memo. NMFS F/NWC-28. 32 pp.

Incidental catches of squid in nylon multifilament and monofilament gillnets set on the surface during salmon research fishing were analyzed. Seven species of cephalopods are discussed in the context of potential for commercial fishing.

Fowler, C.W. 1982. Entanglement as an explanation for the decline in northern fur seals of the Pribilof Islands. Background paper submitted to the 25th Annual Meeting of the Standing Scientific Committee, North Pacific Fur Seal Commission. 24 pp.

(Article not seen).

Fowler, C.W. 1982. Interactions of northern fur seals and commercial fisheries. Trans. 47th North Am. Wildl. and Nat. Res. Conf: 278-292.

Discussions presented cover the indirect and direct interactions between northern fur seals and commercial fishing activities in the North Pacific. Sections on incidental mortality and entanglement briefly address the issue of fur seal interaction with high seas gillnet fisheries.

Gilbert, J.R. and J.L. Stein. 1981. Harbor seal populations and marine mammal-fisheries interactions, 1981. Ann. Rep. to NE Fisheries Center, NMFS, Contract NA-80-FA-C-00029. 39 pp. + 21 pp. appendices.

This report on northeast marine mammal populations identifies real or potential fisheries interactions, including three gillnet fisheries, via several reporting sources. The groundfish set gillnets seem to involve minor fish loss but some gear loss, and some incidental take of seals and porpoises but little of large whales. The developing swordfish drift gillnetting has potential for incidental take but no real demonstrated effect yet. The mackerel fishery in winter has potential for high takes of porpoises with some known takes reported. Seals also may be entangled, and sometimes take mackerel from surface nets.

The appendix on permits for incidental take reported gillnets as significant in cetacean take: 23 of 45 reported takes from 1975 to 1981 were net related, and 12 of the 23 were gillnet takes. Incidental take of several species is expected to increase in the expanding inshore groundfish gillnet fishery but no populations are expected to be affected relative to their optimum sustainable population.

Gilbert, J.R. and K. M. Wynne. 1983. Harbor seal populations and marine mammal-fishery interactions, 1982. 2nd Annual Rep. to NE Fisheries Center, NMFS, Contract NA-80-FA-C-00029. 43 pp.

This second report focuses on groundfish and mackerel gillnet fisheries as the most significant in marine mammal interactions among northeast fisheries, as a follow-up to initial surveys of interactions the first year. Interviews and sea trips were used to quantify problems. Interactions varied greatly among years and areas, and involved predominantly Atlantic white-sided dolphins, harbor porpoises, and harbor seals. Fishermen generally viewed fish

and even gear losses by mammals as minor and acceptable. Details on rates, areas, and types of incidental take are discussed and preventive measures suggested.

Graham, F., Jr. 1982. An incidental catch. Audubon 84(2):24-25.

This editorial discusses the problem of seabird kills resulting during the Japanese high-seas drift gillnet fishery for salmon. The need for studies on an international level to address the problem of seabird losses, chiefly alcids, is raised.

Gray, S. and J. Lien. 1980. Fisherman's guide: whale alarm experiment. Whale Res. Group, Memorial Univ. of Newfoundland. 9 pp.

This illustrated brochure instructs inshore fishermen cooperating in experimental tests of the effectiveness of various alarms to prevent whales colliding with fishing gear. The test design includes placing electronic pingers on set gillnets.

Hamley, J.M. 1975. Review of gillnet selectivity. J. Fish. Res. Board Canada 32(11):1943-1969.

This review discusses fish length and girth, mesh size, twine thickness, material and color, and hanging and fishing of nets as factors influencing selectivity curves.

Hammond, C. in press. Derelict gillnet reported to National Marine Fisheries Service, Alaska Region in 1983. Draft presented to A Workshop on the Fate and Impact of Marine Debris. Honolulu, Hawaii. 26-29 Nov 1984. FIMD/84/BP/7. 3 pp.

A list of 16 reports of 19 monofilament gillnets lost in the North Pacific and Bering Sea is tabulated from March through August 1983. Estimated length ranged from about 100 yards to several miles. Condition varied from drifting to balled up and floating or beach cast. Four cases of fouling on fishing boats or gear are listed, and one disabled vessel had to be towed over 200 miles to port. As of November, 1984, no derelict nets were reported for that year in the Alaskan area.

Hanavan, M.G. and G.K. Tanonaka. 1959. Experimental fishing to determine distribution of salmon in North Pacific Ocean and Bering Sea, 1956. U.S.F.W.S. Special Scientific Report - Fisheries No. 302. 22 pp.

Incidental catch of species other than salmon are listed in tables, and includes steelhead, char, albacore, pomfret, blue shark, and jack mackerel as most numerous.

Harwood, M.B., K.J. McNamara, G.R.V. Anderson and D.G. Walter. In press. Incidental catch of small cetaceans in a gillnet fishery in northern Australian waters. Rep. Inter. Whaling Comm. 27, SC/35/SM21.

Taiwanese gillnetters have operated off northern Australia since 1974 and since late 1979 under Australian control. Thirty boats are licensed and gillnet for shark (mainly Carcharhinus limbatus), mackerel, and longtail tuna (Thunnus tonggol). Incidental take of 86 cetaceans comprising Tursiops truncatus, Stenella longirostris, S. attenuata and Pseudorca crassidens was documented in 157 gillnet sets over a 21 month period by an observer program that attended only these 2 percent of 7,921 sets reported. Some patterns in this catch were suggested, but very little is known about stocks involved. A regression of catch rate against cumulative fishing effort was used to estimate 4,463 +/- 1,550 cetaceans were incidentally caught from June 1981 to February 1983.

Henderson, J.R. 1984. Encounters of Hawaiian monk seals with fishing gear at Lisianski Island, 1982. Mar. Fish. Rev. 46(3):59-61.

The general propensity of monk seals, especially young of the year, to investigate and manipulate lost fishing gear and debris is described. Several incidents of entanglement involving monofilament and polypropylene netting are discussed.

Heneman, B. 1981. Seabirds in gillnets - the Monterey Bay problem. Point Reyes Bird Observatory Newsletter, Winter 1981.

The sudden growth in the gillnet fishery in Monterey Bay caused a drastic increase in seabird mortality. Species included primarily Common Murres, and Sooty Shearwaters with lesser numbers of scoters, cormorants, and Pigeon Guillemots. Almost the entire mortality occurred in waters of 10 fathoms or less.

Heneman, B. 1983. Gillnets and seabirds 1983. Point Reyes Bird Observatory Newsletter, Autumn 1983.

The problems of gillnet fishing in Monterey Bay and vicinity and kills of shearwaters, murres, and cormorants are discussed. Mortalities of harbor seals, sea lions, harbor porpoise, and sea otters are briefly referenced. The pressure to regulate gillnet fisheries and ban them from shallow coastal areas is discussed.

Heneman, B. 1984. Gillnets: progress report. Point Reyes Bird Observatory Newsletter, Winter 1984.

Progress toward solving the gill and trammel net issues in Marin, San Mateo, and San Francisco Counties are discussed. Draft regulations proposed after meetings among California Department of Fish and Game, Pacific Coast Federation of Fishermen's Associations, and Pt. Reyes Bird Observatory are outlined.

Heneman, B. in press. Records of pinniped entanglement in fishing gear at Southeast Farallon Island. Draft presented to A Workshop on the Fate and Impact of Marine Debris. Honolulu, Hawaii. 26-29 Nov 1984. FIMD/84/BP/6. 2 pp.

Nine California sea lions were sighted hauled out and entangled in green, multifilament netting between 1979 and May, 1983. The pieces were apparently from trammel nets. An additional four sea lions and three northern elephant seals were sighted entangled in synthetic rope thought to be from netting. Appearance of net entangled pinnipeds starting in 1979 coincided with increased commercial use of entangling nets.

High W.L. in press. Some consequences of lost fishing gear. Draft presented to A Workshop on the Fate and Impact of Marine Debris. Honolulu, Hawaii. 26-29 Nov 1984. FIMD/84/WP-II/10. 7 pp.

Significant loss of set gillnets occurs because setnet fisheries often concentrate on rough sea floor areas and sunken objects or other loss-prone areas. Three salmon gillnet segments lost in Washington have been observed, at depths 18 to 60 feet below the surface, for up to six years. Each continued to fish for more than two years, catching a variety of fish, birds, and invertebrates such as crabs. Entanglement of fish and birds decreased somewhat as algal growth on nets increased, but these animals continued to be caught for more than three years. Tidal-currents rolled some netting into bundles on the bottom. Fish and diving birds were less often entangled in piled netting than crabs, which continued after six years to become entangled in large numbers.

Jackson, T.D. 1983. Cost-effectiveness of management activities related to the interaction between the California sea lion and the southern California shark gillnet fishery. 88 pp. Masters Thesis, Naval Postgraduate School.

This thesis addresses the cost and effectiveness of five activities relating to the interaction between the shark drift gillnet fishery in Southern California and sea lions. The activities discussed are: assessing population levels, assessing incidental take, limiting the use of gillnets by area and time of year, estimating the loss of fish and gear due to

depredation, and estimating the value of an acoustical harassment playback device. Where applicable, the cost and effectiveness of different alternatives within an activity are compared to provide criteria for evaluation. Each activity is examined from an economic perspective of what it might cost the State or gillnet fishery if the activity were incorporated into an overall management plan of California sea lions. (Auth. abstr.)

Jones, L.L. 1980. Estimates of the incidental take of northern fur seals in Japanese salmon gillnets in the North Pacific. 1975-1979. Background paper submitted to the 23rd Annual Meeting of the Standing Scientific Committee, North Pacific Fur Seal Commission. 15 pp.

(Article not seen).

Jones, L.L. 1981. Incidental take of northern fur seals in Japanese salmon gillnets in the North Pacific Ocean, 1980. Background paper submitted to the 24th Annual Meeting of the Standing Scientific Committee, North Pacific Fur Seal Commission. 6 pp.

(Article not seen).

Jones, L.L. 1981. U.S. research on the incidental take of marine mammals by Japanese salmon mothership fishery: 1981 progress report. Document submitted to the Scientific Subcommittee of the Ad Hoc Committee on Marine Mammals, Int. North Pacific Fisheries Comm. 27 pp.

Incidental take of Dall's porpoise and northern fur seals by salmon gillnets is reported. Some 2,000 porpoises were taken in the U.S. FCZ in over 6,000 sets. The estimated take of seals was about 0.015 per set. Behavior of the marine mammals entangled or near nets is discussed, and biological data collected are reported.

Jones, L.L. 1982. Incidental take of northern fur seals in Japanese gillnets in the North Pacific Ocean in 1981. Background paper submitted to the 25th Annual Meeting of the Standing Scientific Committee, North Pacific Fur Seal Commission. 16 pp.

Japanese salmon driftnet fisheries in the North Pacific have operated since 1952 and have reported northern fur seal entanglement since 1975. Mothership, research, and landbased fishing occur. The commercial fisheries use stretch mesh sizes from 112-130 mm; research fishing uses a wider range, from less than 82 mm to 204 mm (a squid gillnet fishery for Ommastrephes bartrami began in 1980, using 115 mm mesh nets, but no incidental take data was available). Estimated take in the mothership fishery for 1981, from observer and reported data, was 94 seals, at a rate of 0.016 per set. Behavioral observations of net pulling operations also indicate gillnets

attract seals during the fishing period, but entanglement is infrequent and escape is possible. Distribution of entanglements in time and among fleets and mesh sizes was not uniform. The influence of mesh size was indicated by research fishing where larger mesh nets (179-204 mm) had higher rates of entanglement and of mortality after entanglement than smaller mesh sizes such as those used in commercial gillnetting. Rates of entanglement overall were higher in research fishing, thus those rates could not be extrapolated to estimate incidental take by commercial vessels.

Jones, L.L. 1982. Incidental take of Dall's porpoise and harbor porpoise by Japanese salmon driftnet fisheries in the Western North Pacific. Rep. Int. Whal. Comm. SC/35/SM8. 18 pp.

Reported rates of incidental catch did not agree with observer recorded rates. The paper discusses factors affecting these rates in order to better understand the problem of incidental take in both the northern mothership fishery and the southern landbased driftnet fishery.

Jones, L.L., and R.C. Ferrero. In Press. Observations of net debris and associated entanglements in the North Pacific Ocean. Draft presented to A Workshop on the Fate and Impact of Marine Debris. Honolulu, Hawaii. 26-29 Nov. 1984. FIMD/84/WP-I/6. 11 pp. plus tables & figs.

Observations of lost or discarded gillnet pieces were recorded by various methods since 1978. Sizes of observed debris and net discards range from small to very large sections. Entangled northern fur seals, salmon sharks, salmon, spiny dogfish, Dall's porpoise, Ancient Murrelet, Auklets, Horned Puffins, Tufted Puffins, murres, and shearwaters were reported.

Kajimura, H. 1976. Interrelationships of northern fur seals (Callorhinus ursinus) and actively fished gear. Background paper submitted to the 19th Annual Meeting of the Standing Scientific Committee, North Pacific Fur Seal Commission. 7 pp.

(Article not seen).

Katona, S.K., S.A. Testaverde, and B. Barr. 1978. Observations on a white-sided dolphin, Lagenorhynchus acutus, probably killed in gillnets in the Gulf of Maine. Fish. Bull. 76(2):475-476.

A recently drowned, immature female was salvaged in an area with many gillnets present. Fresh injuries indicated it had been entangled and drowned in net mesh. A humpback whale, Megaptera novaeangliae, was entangled in a gillnet that same day in the same general area for two hours before freeing

itself. Schools of Atlantic white-sided dolphins were unusually common in the Gulf of Maine in 1976, and groups were occasionally sighted close to humpback pods.

King, W.B., G.B. Brown, and G.A. Sanger. 1979. Mortality to marine birds through commercial fishing. Pp. 195-200. in J.C. Bartonek and D.N. Nettleship, eds. Conservation of marine birds of northern North America. U.S. Dept. Interior, Wild. Res. Rep. 11.

Commercial fishing has been responsible for incidental mortality of seabirds for centuries, but with the advent of offshore salmon gillnet fishing in the North Pacific in 1952 and in the North Atlantic in 1965, the magnitude of this kill has increased, and there is strong indication that populations of some seabirds are being adversely affected. Murres (Uria spp.) are most frequently killed, although several other species are caught in lesser numbers. The seabird resources of several nations are involved in this mortality. Longline fishing and inshore gillnet fishing for salmon and cod also are responsible for mortality of seabirds, although usually not in significant numbers. (Auth. abstr.)

Lear, W.H. and O. Christensen. 1975. By-catches of harbour porpoise (Phocoena phocoena) in salmon dirftnets at West Greenland in 1972. J. Fish. Res. Board Can. 32(7):1223-1228.

On the basis of catch-per-unit-effort, an estimated, 1,500 porpoises were killed in 1972 by the non-Greenlandic, commercial vessels. Twenty-two fishing vessels participated in the salmon season, from the end of July to mid-October, and eight had observers aboard. Over 90 percent of nets were monofilament nylon, with mesh size 130-140 mm. The rest were multifilament nylon. Nets were relatively tightly stretched from surface floats down 5 m to a lead-core line. On average about 7.8 nautical miles of net were put out per vessels set. Eighty percent of observed sets were from sunset to sunrise. The only effort data available from all vessels were numbers (length) of nets used and sets made. Incidental catch data was from the eight commercial vessels with observers, who reported 561 porpoises, one long-finned pilot whale (Globicephala melaena) and one unidentified whale killed. The estimate of total harbor porpoise take by the fleet was 1,500. Rates were not extrapolated to research vessels, which caught 13 porpoise, or the home salmon fishery, which involved set and drift nets, because of differences in nets and timing of sets.

Lien, J. 1981. Whale collisions with inshore fishing gear in Newfoundland. CAFSAC Working Pap. 81/99, Marine Mammal Committee Meeting April, 1981. Submitted to the Scient. Comm., Int. Whaling Comm.

The article provides an overview of Canadian cetacean research. Contains tabular presentation of data on whales entangled in fishing gear from 1969-80. Thirty minke, 43 humpback, 5 fin, and 15 other whales were reported dead over

that time period. Four Minke, 88 humpbacks, 5 fin, and 2 other large whales were released alive.

Lien, J. and D. Aldrich. 1982. Damage to inshore fishing gear in Newfoundland and Labrador by whales and sharks during 1981. CAFSAC Marine Mammal Committee Meeting, May, 1982. Newfoundland Inst. for Cold Ocean Science Contr. No. 6 abstract.

Fishermen's reports of gear losses tentatively show a decreased incidence involving large whales but an increased incidence of basking sharks and pilot whales.

Lien, J., D. Jinhai, L. Baraff, J. Harvey, and K. Chu. 1982. Whale entrapments in inshore fishing gear during 1982; a preliminary report to Fisheries and Oceans Canada. NICOS Contr. No. 26 abstract.

Fishermen's reports of incidental catch of whales and sharks overall decreased in 1982 from previous years.

Lien, J. and P. McLeod. 1980. Humpback collisions with fishing gear in Newfoundland: arbitration and education in a whale-fishermen dispute. N.E. Endangered Species Workshop, May 7-11, 1980, Provincetown, Mass. 33 pp.

Newfoundland's inshore fishery has a serious problem with baleen whales, primarily humpbacks, colliding with fixed fishing gear. At least 30 cetaceans died in 1979 as a result of these collisions. Losses of about $3 million in gear and fish were incurred that year by inshore fishermen as a result of whale collisions. Causes of the present problem are discussed. The problem is shown to have biological, economic, and social origins. Emphasis is put on the fishermen's attitudes and how they are being changed. (Auth. abstr.)

Lien, J. and B. Merdsoy. 1980. Questions and answers about the whale problem in the inshore fishery. Whale Research Group, Memorial Univ. of Newfoundland. 8 pp.

This informational article directed towards eastern Canadian fishermen discusses the increasing problem of whale collision and gear damage in gillnets as well as other fishing methods. Questions addressed include the geographic and economic extent of the problem, biological factors involved, and possibilities for prevention and mitigation of the problem. Increased collisions in Newfoundland inshore fishing gear seemed to be caused by whale behavior and population dynamics, shifts in distribution of whales and their prey, and increased fishing activities in those areas attractive to whales. In 1979, estimated losses were about 1 percent of the value of the fishery. But losses were not evenly distributed and could be locally severe. Some

success with trap alarms was achieved, but no successful tests of gillnet alarms has yet occurred. The article is descriptive with some quantification. Of several whale species involved, humpbacks comprise 70 percent of collisions.

Major, R.L. 1982. Yield loss of Western Alaska chinook salmon resulting from the large Japanese mothership catch of 1980. Document submitted to the annual meeting Int. North Pacific Fisheries Comm., Oct., 1982. 27 pp.

This report addresses the issue of mortality of fish that encounter high-seas gillnets but are not caught (non-catch mortality), which produces a loss in yield. Estimates for immature salmon of one killed for every one landed are mentioned, and for adults one killed for every three landed. A yield loss estimate to a potential inshore fishery capable of catching all fish available to it is 6.51 times the high-seas catch, or in other words the inshore fishery could increase yield 551 percent.

Marine Mammal Commission. 1982. Annual report to Congress, calendar year 1982. 106 pp.

Chapter V discusses the issue of Dall's porpoise incidental take in drift gillnets used by Japanese salmon fishermen in the North Pacific Ocean. Subjects include unsuccessful litigation by Friends of Animals to halt the take, research proposals to reduce it, and reported increases in both total take and rate of take in the 1982 Japanese salmon season. The final section deals with Congressional passage of H.R. 3942 requiring adoption in the fishery of gear and fishing techniques to reduce incidental porpoise take.

Mate, B.R. 1980. Workshop on marine mammal-fishery interactions in the Northeastern Pacific. U.S. Marine Mammal Commission Rep No MMC-78/09. 48 pp.

The workshop reviewed what is currently known of marine mammal-fisheries conflicts (except sea otter and tuna/porpoise problems) in Alaska, British Columbia, California, Hawaii, and Oregon. Set gear types (such as longlines and gillnets) are more troubled by marine mammals (principally harbor seals and Steller or California sea lions) taking the catch and damaging gear than are moving types of gear (such as trolled hooks or drag nets). There are increased conflicts with sport fisheries since the MMPA of 1972. The participants determined what data and methods are needed to make future management decisions and recommended that research be initiated on the conflicts of the Columbia River to develop these types of data. (Auth. abstr.)

Mate, B.R. in press. Incidents of marine mammal encounters with debris and fishing gear in Oregon. Draft presented to A Workshop on the Fate and Impact of Marine Debris. Honolulu, Hawaii. 26-29 Nov 1984. FIMD/84/WP-II/13. 3 pp.

In a 10 year period, three cases of cetacean entanglement were reported; all were gray whales in gillnets. One was a salmon gillnet from southeast Alaska taken from a live whale that likely dragged the net south. The other cases were Columbia River gillnets, a net with a live whale that died and a net with a recently dead whale that had drifted into the net. The author also refers briefly to harbor seal, northern sea lion, and California sea lion encounters with Columbia River gillnets.

Matkin, C.O., and F. H. Fay. 1979. Marine mammal-fishery interactions on the Copper River and in Prince William Sound, Alaska, 1978. Draft final report to the U.S. Marine Mammal Commission. Contract MM8AC013.

This report discusses rates of damage to netted fish and fishing gear caused by marine mammals and rates of incidental take of marine mammals in salmon gillnet fisheries. Approximately 1,000 marine mammals were reported taken by shooting or entanglement. Mammals entangled are harbor seals, northern sea lions, harbor porpoise, Dall's porpoise, and sea otters. Mortality of seals or sea lions probably is not affecting populations. Insufficient information is available on porpoise populations to predict effects of mortality. Mitigating measures are suggested.

Merrell, T.R., Jr. 1980. Accumulation of plastic litter on beaches of Amchitka Island, Alaska. Mar. Environ. Res. 3(3):171-184.

Synthetic debris from trawl fishing vessels was the predominant litter by weight, but gillnet floats were most common by number, and some monofilament gillnet pieces were observed. Gillnet floats were exclusively Japanese. Bird and fish bones were observed in some wads of Japanese monofilament salmon net, but these were not quantified.

Middleton, K. 1983. A profitable gillnetting venture depends on a lot more than gear. Nat. Fisherman Yearbook 1983, 63(13):106-108.

The history and nature of gillnetting in New England is described, and the methodology and factors involved in proper, successful gillnetting are discussed. Monofilament nets seem to be emerging as better fishing, more durable, less prone to snarling, and less detectable than multifilament nets. Mesh size, hanging, and handling of the net are controllable factors that determine selectivity of species and size. Incidental catch of bottom species and crustaceans attracted to rotting fish is mentioned.

Middleton, K. 1983. Ghost gillnets haunt both fishermen and scientists. Nat. Fisherman Yearbook 1983, 63(13):108.

This brief note discusses how gillnets are lost or discarded, possible problems from them, and the lack of understanding of actual and real impact of these nets on fish and lobster. Studies in the NW Atlantic to document fishing activity and fates of ghost nets are mentioned.

Middleton, K. 1983. Gillnetting: A viable alternative or a dead end? Nat. Fisherman Yearbook 1983, 63(13):102-105.

Gillnetting for groundfish in Massachussetts increased dramatically from 1978 to 1982 as a cost-effective, fuel-efficient fishing method that attracted many boats, until catches declined and smaller fish were being taken. Real or potential problems involving gear conflicts and claims of environmental damage, excessive incidental catch of lobster, unfair competition, and overfishing were exascerbated. Gear conflicts involved mobile-gear fishermen dragging through gillnets and recreational and charterboat fishermen snagging lures on gillnets. Gear mishandling and loss was a problem with gillnetters new to the method, but little information is documented yet on net numbers, net loss, and efficiency and destructiveness of the monofilament and multifilament nets used.

Middleton, K. 1984. Disputes raging in Gulf of Maine over rights to fishing grounds. National Fisherman 65(8):15.

Disputes over gillnetting among party boat fishermen, gillnetters, and draggers include issues of incidental catch and resource depletion, gear conflict and loss, and ghost nets. Gillnet gear and procedures are controversial, and negative effects on fish and lobster asserted. Due to claims and disputes, a cooperative research program involving gillnet design and submarine observation of ghost nets has begun.

Middleton, K. 1984. Spector of ghost gillnets prompts undersea research. National Fishermen 65(8):14-16.

One dive of a submersible on a research cruise to investigate ghost gillnets in the Gulf of Maine is described. From January to September 1983, fishermen reported 4,225 fathoms of gillnet lost. Two nets in various states of entanglement were found, with dead, entangled dogfish and lobster.

Mizue, K. and K. Yoshida. 1965. On the porpoises caught by the salmon fishing gillnet in Bering Sea and the North Pacific Ocean. Bull. Faculty of Fisheries Nagasaki Univ. 19:1-16.

A large number of porpoises are caught yearly by the Japanese salmon fishing gillnets in the Bering Sea and the North Pacific Ocean, the major species being the Dall's porpoise.

Nettleship, D.N. 1977. Seabird resources of eastern Canada: status, problems, and prospects. Pp. 96-108. in T. Mosquin and C. Suchal eds. Proceedings of the Symposium on Canada's Threatened Species and Habitats. Canadian Nature Federation, Ottawa.

The mortality of diving seabirds by drowning in nets used in commercial fishing is known to be high in the North Atlantic. Insufficient data exist to calculate the annual kill of birds off eastern Canada, but the magnitude and extent of the inshore and offshore fishery is considerable, and it is reasonable to assume that the kill toll is serious. Data recently collected in West Greenland support this view and show the highly destructive impact that a gillnet fishery can have on seabirds. It was estimated that the Danish salmon gillnet fishery off West Greenland was responsible for the incidental death of between one-half to three-quarters of a million Thick-billed Murres annually in the years 1968-1973, with the bulk of the kill being birds from colonies in the eastern Canadian Arctic that have migrated to southwest Greenland to spend the winter. This mortality, combined with deaths from other causes, brought the total annual kill well above 1 1/2 million birds, the annual production of this species in the NW Atlantic. An international agreement will soon restrict Greenland's gillnet catch of salmon with a consequential reduction in the associated kill of murres. Even so it will take very many years for the murre populations to recover from the massive losses around 1970. (Auth. abstr.)

The unknown mortality from fisheries in other areas of the NW Atlantic and eastern Canada is cause for great concern, and studies should be initiated to measure the present impact of fishery practices on birds in Canada and develop policy for the establishment and enforcement of necessary control regulations through national and international agreements.

Nettleship, D.N. and J. F. Piatt. 1982. Seabird mortality from gillnet fisheries in Newfoundland. Pp. 16-17. in P. Hope Jones, ed. Proceedings of the Seabird Group Conference, Denstone College, U.K., 12-14 February 1982. Nature Conservancy Council, Aberdeen.

Information derived primarily from studies in the vicinity of the Witless Bay Sanctuary indicate that large numbers of alcids are drowned in nets set inshore, and close to the colonies. Incidence of drowning associated with the offshore gillnet fishery is uncertain, though it may be significant since the

fishing effort is concentrated in areas known to be important to wintering populations of alcids.

A review of data collected between 1951 and 1979 (ringing recoveries, limited regional alcid bycatch studies) combined with preliminary results of a detailed examination made around the Witless Bay Sanctuary area and other major seabird colonies in 1980 and 1981 indicate that bird mortality from inshore gillnet fishery:

1. is high relative to local breeding populations and restricted largely to the alcids,

2. occurs mainly in June and July (95 percent of the kill) when capelin are present in the fishing area,

3. is highest when capelin first arrive inshore to spawn,

4. occurs mainly within 60 km of the colonies (90 percent),

5. increased dramatically from the 1950's to the early 1970's, but has decreased in recent years due to a decline in capelin abundance.

The potential for large numbers of alcids to be killed in the offshore gillnet fishery is great. The distribution of gillnet vessels encompasses all known major alcid wintering areas in eastern North America. (Auth. abstr.)

North Pacific Fur Seal Commission. 1980. Proceedings of the 23rd annual meeting - April 14-17, 1980, Moscow, USSR. 39 pp.

The Standing Scientific Committee reported continuing discussions on the problems of fur seal entanglement in net scraps and other debris in the North Pacific. Of the 2,900 seals harvested in 1979 on Robben Island 1.1 percent were entangled in debris. In recent years the rate of entanglement on St. Paul Island has remained at about .4 percent, compared to .7 percent in 1975. Japanese and Soviet representatives displayed posters, prepared for distribution among fishermen of their respective countries, portraying the dangers to fur seals of discarded debris. International cooperation in dealing with the problem of entanglement was again encouraged by the Commission.

Northwest and Alaska Fisheries Center. 1980. A report based on the workshop on stock assessment and incidental take of marine mammals involved in commercial fishing operations. Unpubl. rep. Nat. Mar. Mammal Lab., Seattle, Wash. 102 pp.

(Article not seen).

Ohsumi, S. 1975. Incidental catch of cetaceans with salmon gillnets. J. Fish. Res. Board Can. 32(7):1229-1235.

Because the pelagic salmon fishery in the North Pacific had been estimated to take over 10,000 Dall's porpoises annually in the 1960s, data from research vessels on incidental take from 1962 to 1971 were examined to estimate effects on cetacean populations. Research vessels used drift gillnets about 6 m deep. Mesh size ranged from 48-157 mm and net length 60 to 150 tans, whereas commercial gillnets were 121 to 131 mm in mesh size and 300 tans long. Nets were fished at night. Incidentally caught cetaceans were not recorded as to species, sex or length, but position, date, net length, and number and size-class of cetaceans were recorded. Independent evidence indicated mostly Dall's porpoises were taken, but harbor porpoises, pilot whales, and Baird's beaked whale were also occasionally taken. Catch rate per 1,000 tans fished varied over area, season, and year. The mean rate was .476, and the maximum for one area was 1.42. Rates tended to increase from late winter through early autumn. Annual rates varied from 0.37 to 0.65, but showed no tendency of a declining rate. Differences between research and commercial fishing practices precluded estimation of total incidental catch in the salmon fishery. But if catch rate by research vessels represents Dall's porpoise population density, the author concludes no indication of change in population size in the ten years 1962 to 1971.

Perkins, J.S. and P.C. Beamish. 1979. Net entanglement of baleen whales in the inshore fishery of Newfoundland. J. Fish. Res. Board Can. 36:521-528.

Entanglement of baleen whales in inshore waters off Newfoundland and Labrador is documented. Means of 2.6 minke and three humpback whales per year were reported tangled in cod traps and gillnets. Fin whales were less frequently taken. Five humpbacks were released alive. The timing of these entanglements corresponded with the spawning season for capelin. Some mitigating measures are suggested.

Piatt, J., D.N. Nettleship, and W. Threlfall. 1984. Net mortality of Common Murres and Atlantic Puffins in Newfoundland, 1951-81. Pp. 196-207. in 8th Annual Pacific Sea Bird Group Meeting, 6-8 January 1982, Seattle, Wash.

Band recoveries (N=315) over 26 years (1951-77) and three surveys of seabird bycatch in inshore fishing nets (1972, 1980-81) indicate that there has been substantial net-mortality of Atlantic Puffins (Fratercula arctica) and Common Murres (Uria aalge) in Newfoundland coastal waters for the past two decades. Offshore (e.g. Grand Banks) gillnetting is limited, but some data suggest that murre net-mortality also occurs offshore at murre wintering areas. The vast majority of inshore net-mortality incidents occurs over a two-week period during the annual inshore spawning migration of capelin (Mallotus villosus), the major prey item for alcids in eastern Canada. Most murres (83 percent) were drowned in bottom-set (30-185 m) cod (Gadus morhus)

gillnets, whereas more puffins were drowned in surface-set salmon (Salmo salar) gillnets or cod traps (55 percent) than in cod gillnets (45 percent). Murre band recoveries, colony censuses, and fishing-effort data suggest that at the second largest Common Murre colony in Newfoundland (Witless Bay Seabird Sanctuary, 77,000 breeding pairs) net-mortality was relatively low in the 1950s and early 1960s, but increased during the 1960s as the murre population grew in size and gillnet fishing effort increased in the colony area. By 1971, net-mortality accounted for 70 percent of murre band recoveries and calculations show that almost 30,000 breeding adults, or about 20 percent of the local breeding population, were drowned in that year. More reliable estimates of alcid bycatch in the Witless Bay area have been made on the basis of actual bycatch surveys. In 1972 about 20,000 adult murres, or 13 percent of the breeding stock, were killed in gillnets. Net-mortality of murres apparently diminished through the 1970s as capelin stocks declined and fewer birds foraged in heavily netted inshore areas. Bycatch surveys in the Witless Bay area in 1980-81 revealed that, relative to previous years, murre net-mortality was greatly reduced and resulted in the loss of only 3-4 percent of the breeding stock. Even these low mortality rates, however, are cause for concern as adult murre mortality from all sources (including hunting, oil, and natural mortality) should not exceed 6-12 percent per annum to maintain a stable breeding population. Little is known about the magnitude of net-mortality at other major Newfoundland murre colonies though it is known to be a problem in all colony areas. The bycatch of adult Atlantic Puffins in the Witless Bay area was low compared to murre bycatch and in three years of study never exceeded 1.6 percent of the breeding population. During the 1970s, fishing effort increased five-fold in colony areas and it can be predicted that if capelin spawning stocks return to early 1970s size, then net-mortality of puffins and murres in Newfoundland coastal regions will increase dramatically. Preliminary examination of 1982 capelin spawning and seabird bycatch data suggests that capelin were much more abundant inshore and murre bycatch increased two- to three-fold over 1981. (Auth. abstr.)

Piatt, J. and D.G. Reddin. 1984. Recent trends in the West Greenland salmon fishery, and implications for Thick-billed Murres. Pp. 208-210. in 8th Annual Pacific Seabird Group Meeting, 6-8 January 1982. Seattle, Wash., p. 208-210.

In the late 1960s and early 1970s, a high net-mortality of seabirds, particularly Thick-billed Murres (Uria lomvia), was associated with the West Greenland salmon gillnet fishery. Since 1972, the domestic fishery has been controlled by quotas and fishery opening dates, and the non-Greenlandic offshore driftnet fishery was phased out in 1975. These restrictions probably resulted in a substantial decrease in murre net-mortality. However, the Greenlandic fishery has changed considerably since 1972 when seabird bycatch was last examined in detail. Fishing vessels now use monofilament nylon nets almost exclusively; fishing effort has redistributed closer to murre breeding colonies and intensive driftnetting occurs offshore on the continental shelf.

These factors, combined with a change in 1981 to a later fishing season, have probably resulted in a renewal of significant murre net-mortality off West Greenland. (Auth. abstr.)

Prescott, J.H. and P.M. Fiorelli. 1980. Review of the harbor porpoise (Phocoena phocoena) in the U.S. Northwest Atlantic. U.S. Marine Mammal Commission Rep. No. MMC-78/08. 64 pp.

The section on human interactions and incidental take qualitatively describes the expansion of gillnetting since 1976 and reports of incidental take of harbor porpoises. A table of incidental take is included. Monofilament netting, in which one porpoise was found drowned, may be accoustically invisible.

Sanger, G.A. 1974. On the effect of fish net scraps and other oceanic debris in northern fur seals. Background paper submitted to the 17th Annual Meeting of the Standing Scientific Committee, North Pacific Fur Seal Commission. 5 pp.

(Article not seen).

Sano, O. 1978. Seabirds entangled in salmon driftnets. Enyo 30:1-2.

(Article not seen).

Scordino, J., G. Beekman, H. Kajimura, K. Yoshida, Y. Fujimaki, and M. Tomita. 1984. Investigations on fur seal entanglement in 1983 and comparisons with 1981 and 1982 entanglement data, St. Paul Island, Alaska. Submitted to the 27th Annual Meeting of the Standing Scientific Committee, North Pacific Fur Seal Commission. 26 pp. + tables and figs.

Very few of the number of fur seals observed entangled with debris were in gillnet material: zero in 1981, three in 1982, and two in 1983. These five were in 11 or 11.5 cm mesh monofilament gillnet. The two in 1983 were part of 112 seals observed with debris, out of 25,768 seals harvested. Most findings and conclusions relate to trawl net webbing, but some are relevant to gillnets and support at-sea observations such as infrequent fur seal entanglement in gillnets actively fished by the Japanese salmon driftnet fishery. Most seals observed entangled were in single mesh loops (as opposed to larger, torn holes) of mesh size greater than 20 cm. Correspondingly, most seals in Japanese salmon research gillnets in 1979-1981 were in mesh sizes greater than commercial gillnet mesh sizes of 11-13 cm. Fur seals generally do not entangle in actively fished gear, and most entanglements on shore were in small debris. Loss of, or escape from, debris and long-term survival was documented, but no rates of escape or survival from gillnet debris are available.

Stewart, B.S. and W.T. Everett. 1983. Incidental catch of a ribbon seal (Phoca fasciata) in the central North Pacific. Arctic 36(4):369.

A juvenile ribbon seal (Phoca fasciata) was incidentally caught and drowned in a Japanese salmon gillnet on 30 June 1981 in the central North Pacific.

Stewart, B.S. and P.K. Yochem. In press. Entanglement of pinnipeds in net and line fragments and other plastic debris in the Southern California Bight. Draft presented to A Workshop on Fate and Impact of Marine Debris. Honolulu, Hawaii. 26-29 Nov 1984. FIMD/84/Ab-II5. 14 pp.

Five California sea lions (one subadult, three yearlings, and a pup) were observed entangled with monofilament gillnet material on San Nicolas Island, out of 13,175 examined for entanglement since 1983. The pup was found dead five days after first sighting as entangled. A 70 gm, 20.3 cm-mesh-size piece of gillnet was removed from a sea lion, presumably the pup. No harbor seals at San Nicolas or elephant seals there or at San Miguel Island were observed entangled in gillnet debris.

Tull, C.E., P. Germain, and A.W. May. 1972. Mortality of Thick-billed Murres in the West Greenland salmon fishery. Nature (Lond.) 237:42-44.

Quantitative estimates of incidental take of murres in this driftnet fishery were derived, and the impact on population levels assessed. The fishery occurs August to December, and floats surface nets 6-10 feet deep in a line up to 10 miles long. Small numbers of Dovekies, Black Guillemots, Common Puffins, and Common Murres are known to be incidentally taken, but only Thick-billed Murres in large numbers. Incidental catch rates for effort and for salmon caught were determined from an experimental salmon-tagging cruise and analyzed various ways. Roughly 500,000 murres annually, with large variation, were estimated taken from 1969-1971. One to two murres per salmon were caught. This incidental mortality plus a large hunting kill and other unknown mortality sources exceed annual production, thus human caused mortality should be reduced. Birds caught in driftnets should be used in local economies, so that hunting demand would be reduced.

Waugh, G.T., C.B. Austin, J. Davis, B.S. Anderson, and L.J. Glatfelter. 1982. Source document for the swordfish fishery management plan. South Atlantic Fishery Management Council. 135 pp. + appendices.

This document contains comprehensive and detailed scientific information from which draft plans were excerpted. Recent use of drift gillnets at night in the Northwest Atlantic by a couple of boats is seen as a potential impact on marine mammals and turtles. The gillnet fishery is adapted from the California drift gillnet fishery, which has existed longer and with more

boats. There the target species is the thresher shark, but blue and mako sharks are commonly taken. A valuable incidental take of swordfish has emerged, and fishing tactics were adapted to capitalize on swordfish. Some incidental take of soupfin sharks, striped marlin, and sea lions occurs also. Swordfish take is not seen as dangerous to the stock, but as efficient competition to other gear. Extensive gillnet use in the Western Pacific for swordfish, striped marlin, and tuna has led to rapid replacement of harpoon gear in Japanese billfisheries.

Whilde, A. 1979. Auks trapped in salmon drift nets. Irish Birds 1:370-376.

(Article not seen).

Wild, P.W. 1984. Summary of gill and trammel net fishing observations within California Fish and Game District 10. Unpubl. ms. Marine Resources Branch, Cal. Dept. Fish and Game, Monterey. 12 pp. + 9 tables.

This is a progress report of the Central California Gill and Trammel Net Fishery Investigation, whose objective is to document take of target and non-target species, including marine mammals and seabirds. The fisheries and types of information collected by observers at sea are described, and a narrative summary and tables of results presented. 169 net pulls of some 36.6 miles of various net types were observed. 1,074 seabirds were caught. Ninety-eight percent were Common Murres, but six other species were also caught. Some differences between area, season, and net type, material, and size were identified. Twenty-two marine mammals of four species were caught, and more reported as shore strandings. Non-target fish species were caught, including commercially valuable salmon, striped bass, and green sturgeon. Dungeness and rock crabs were also taken in variable numbers.

Yonemori, T. and M. Honma. 1981. Large mesh drift gillnet (ome-ami) fishery in the North Pacific. Far Seas Fisheries Research Laboratory manuscript. 7 pp.

This brief manuscript describes gillnet fisheries in general terms. Tuna species are targeted, but incidental takes of marlin and swordfish are considered valuable.

Young, R. 1984. Humpback whale rescued from gillnet. Outdoor California 45(5):26-27. September-October 1984.

A humpback whale about 25 feet long was cut free from a gillnet about five miles south of Dana Point in southern California on 8 July 1984. The eight inch mesh gillnet was presumed to have been set for halibut, and was 600 feet by 12 feet.

AUTHOR INDEX

AUTHOR	YEAR	KEYWORDS
Bourne, W.R.P.	1972	seabirds
Bourne, W.R.P.	1977	seabirds, gillnets, ghost net debris, worldwide
Brownell, R.L., Jr.	1975	gillnets, shark, pinnipeds, Uruguay, South America, marine mammals, porpoise
Brownell, R.L., Jr.	1982	pinnipeds, Gulf of California, gillnets, misc. fish, shark, Mexico
Carr, H.A., et al	Press	New England, ghost net debris, misc. fish, crustaceans
Carter, H.R., et al	1984	seabirds, gillnet, British Columbia, salmon, gillnets
Cary, F., et al	1983	Japan, squid, gillnets, salmon, misc. fish, shark, porpoise, Taiwan, South Korea, whale
Christensen, O., et al	1976	salmon, gillnets, Greenland, seabirds, marine mammals, porpoise, pinnipeds
DeGange, A.R.	1978	Japan, gillnets, North Pacific, salmon, Bering Sea, seabirds
DeGange, A.R.	1978	Japan, gillnets, North Pacific, salmon, Bering Sea, seabirds
DeGange, A.R.	1978	Japan, gillnets, seabirds, Bering Sea
DeGange, A.R., et al	1980	gillnets, North Pacific, salmon, misc. fish, seabirds, porpoise, pinnipeds, marine mammals, shark
DeMaster D.P., et al	1982	California, pinnipeds, marine mammals, misc. fish, sharks
Evans, P., et al	1976	gillnets, salmon, seabirds, Greenland
Everitt, R.D., et al	1981	Columbia River, salmon, gillnets, Oregon, Washington, pinnipeds, marine mammals

AUTHOR	YEAR	KEYWORDS
Everitt, R.D., et al	1982	North Pacific, Oregon, Washington, Columbia River, marine mammals, pinnipeds, salmon
Fable, W.A., et al	1984	gillnets, misc. fish, Florida
Fiscus, C.H., et al	1972	pinnipeds, gillnets
Fiscus, C.H., et al	1982	squid, gillnets, salmon
Fowler, C.W.	1982	pinnipeds, Pribilof Islands
Fowler, C.W.	1983	North Pacific, gillnets, pinnipeds
Gilbert, J.R.	1983	misc. fish, gillnets, Maine, porpoise, pinnipeds
Gilbert, J.R., et al	1981	misc. fish, gillnets, porpoise, pinnipeds, northeast U.S.
Gilbert, J.R., et al	1983	misc. fish, gillnets, porpoise, pinnipeds, northeast U.S.
Graham, F. Jr.	1982	Japan, seabirds, gillnets, salmon, North Pacific
Gray, S., et al	1980	Newfoundland, whales, gillnets
Hamley, J.M.	1975	gillnets
Hammond, C.	Press	Alaska, North Pacific, Bering ghost net debris, Japan
Hanavan, M.G., et al	1959	salmon, North Pacific, Bering Sea, misc. fish, shark
Harwood, M.B. et al	Press	Australia, porpoise, gillnets, Taiwan, shark, misc. fish
Henderson, J.R.	1984	pinnipeds, ghost net debris, marine mammals, Pacific, Hawaii
Heneman, B.	1981	gillnets, Monterey Bay, seabirds
Heneman, B.	1983	gillnets, Monterey Bay, seabirds, pinnipeds, porpoise, marine mammals

AUTHOR	YEAR	KEYWORDS
Heneman, B.	1984	gillnets, California, seabirds, pinnipeds, porpoise
Heneman, B.	Press	California, marine mammals, pinnipeds, ghost net debris, Pacific
High, W.L.	Press	North Pacific, Washington, ghost net debris, seabirds, salmon, misc. fish, crustacean
Jackson, T.D.	1983	gillnets, California, shark, pinnipeds
Jones, L.L.	1980	Japan, pinnipeds, gillnets, North Pacific
Jones, L.L.	1981	Japan, pinnipeds, gillnets, salmon, porpoise
Jones, L.L.	1981	Japan, pinnipeds, North Pacific, gillnets, salmon
Jones, L.L.	1982	North Pacific, gillnets, salmon, Japan
Jones, L.L.	1982	North Pacific, gillnets, salmon, porpoise, Japan
Jones, L.L., et al	Press	North Pacific, Japan, Bering Sea, salmon, squid
Kajimura, H.	1976	pinnipeds
Katona, S.K., et al	1978	NW Atlantic, whale, porpoise, marine mammals
King, W.B., et al	1979	seabirds, North Pacific, North Atlantic, misc. fish
Lear, W.H., et al	1975	Greenland, marine mammals, porpoise, salmon, whale
Lien, J.	1981	North Atlantic, Canada, gillnets, marine mammals, whales
Lien, J., et al	1980	Newfoundland, whales

AUTHOR	YEAR	KEYWORDS
Lien, J., et al	1980	Canada, whales, gillnets, Newfoundland
Lien, J., et al	1982	Newfoundland, Labrador, sharks, whales,ghost net debris
Lien, J., et al	1982	Canada, whales, shark
Major, R.L.	1982	Western Alaska, salmon, gillnets
Marine Mammal Commission	1982	porpoise, Japan, North Pacific, salmon, gillnets, marine mammal, Marine Mammal Commission
Mate, B.R.	1980	Alaska, British Columbia, California, Hawaii, Oregon, gillnets, pinnipeds, Columbia River
Mate, B.R.	Press	Pacific, Oregon, Columbia River, marine mammals, whale, pinnipeds, salmon
Matkin, C.O., et al	1979	salmon, gillnets, pinnipeds, porpoise, Alaska
Merrell, T.R., Jr.	1980	ghost net debris, gillnets, Japan, seabirds, misc. fish, salmon, Alaska
Middleton, K.	1983	gillnets, misc. fish, Massachusetts, economic loss, crustaceans
Middleton, K.	1983	gillnets, New England, crustaceans
Middleton, K.	1983	gillnets, NW Atlantic, misc. fish, crustaceans, ghost net debris
Middleton, K.	1984	NW Atlantic, New England, ghost net debris, sharks, misc. fish, crustacean
Middleton, K.	1984	Maine, Massachusetts, New England, NW Atlantic, misc. fish, crustacean, ghost net debris

AUTHOR	YEAR	KEYWORDS
Mizue, K., et al	1965	salmon, gillnets, Bering Sea, North Pacific, Japan, porpoise
Nettleship, D.N.	1977	seabirds, North Atlantic, Greenland, gillnets, salmon
Nettleship, D.N., et al	1982	seabirds, gillnets, Newfoundland, misc. fish
North Pacific Fur Seal Commission	1980	pinnipeds, marine mammal, North Pacific, ghost net debris, North Pacific Fur Seal Commission
Northwest and Alaska Fisheries Center	1980	marine mammals
Ohsumi, S.	1975	porpoise, salmon, gillnets, North Pacific, whales
Perkins, J.S., et al	1979	whales, Newfoundland, Labrador, gillnets, misc. fish, marine mammals, NW Atlantic, Canada
Piatt, J., et al	1984	Greenland, salmon, seabirds, gillnets
Piatt, J., et al	1984	Newfoundland, NW Atlantic, seabirds, misc. fish
Prescott, J.H., et al	1980	porpoise, NW Atlantic, gillnets
Sanger, G.A.	1974	ghost net debris, pinnipeds
Sano, O.	1978	seabirds, Japan, salmon, gillnets
Scordino, J., et al	1984	Alaska, gillnets, ghost net debris
Stewart, B.S., et al	1983	North Pacific, Japan, salmon, gillnets, pinnipeds
Stewart, B.S., et al	Press	Pacific, California, marine mammals, pinnipeds, ghost net debris
Tull, C.E., et al	1972	seabirds, gillnets, Greenland, salmon

AUTHOR	YEAR	KEYWORDS
Waugh, G.T., et al	1982	misc. fish, gillnets, NW Atlantic, marine mammals, sea turtles, shark, pinnipeds
Whilde, A.	1979	seabirds, salmon, gillnets
Wild, P.W.	1984	gillnets, California, marine mammals, seabirds, misc. fish, crustaceans
Yonemori, T., et al	1981	gillnets, North Pacific, misc. fish
Young, R.	1984	Pacific, California, marine mammals, whale

KEYWORD INDEX

AUTHOR	YEAR
ALASKA	
Anonymous	1973
Hammond, C.	Press
Major, R.L.	1982
Mate, B.R.	1980
Matkin, C.O., et al	1979
Merrell, T.R., Jr.	1980
Scordino, J., et al	1984
AUSTRALIA	
Bannister, J.L.	1977
Harwood, M.B., et al	Press
BERING SEA	
Ainley, D.G., et al	1981
DeGange, A.R.	1978
DeGange, A.R.	1978
DeGange, A.R.	1978
Hammond, C.	Press
Hanavan, M.G., et al	1959
Jones, L.L., et al	Press
Mizue, K., et al	1965
BRITISH COLUMBIA	
Carter, H.R., et al	1984
Mate, B.R.	1980
CALIFORNIA	
Bedford, D.	1983
Brownell, R.L., Jr.	1982
DeMaster D.P., et al	1982
Heneman, B.	1984
Heneman, B.	Press
Jackson, T.D.	1983
Mate, B.R.	1980
Stewart, B.S., et al	Press
Wild, P.W.	1984
Young, R.	1984

AUTHOR	YEAR
CANADA	
Bartonek, J.C.	1968
Bernard, F.R.	1981
Lien, J.	1981
Lien, J., et al	1980
Lien, J., et al	1982
Perkins, J.S., et al	1979
COLUMBIA RIVER	
Beach, R.J., et al	1981
Everitt, R.D., et al	1981
Everitt, R.D., et al	1982
Mate, B.R.	1980
Mate, B.R.	Press
CRUSTACEAN	
Carr, H.A., et al	Press
High, W.L.	Press
Middleton, K.	1983
Middleton, K.	1983
Middleton, K.	1983
Middleton, K.	1984
Middleton, K.	1984
Wild, P.W.	1984
FLORIDA	
Fable, W.A., et al	1984
GHOST NET DEBRIS	
Anonymous	1973
Anonymous	1978
Balazs, G.H.	1982
Bourne, W.R.P.	1977
Carr, H.A., et al	Press
Hammond, C.	Press
Henderson, J.R.	1984
Heneman, B.	Press
High, W.L.	Press
Lien, J., et al	1982
Merrell, T.R., Jr.	1980
Middleton, K.	1983
Middleton, K.	1984
Middleton, K.	1984
North Pacific Fur Seal Commission	1980

AUTHOR	YEAR
GHOST NET DEBRIS continued	
Sanger, G.A.	1974
Scordino, J., et al	1984
Stewart, B.S., et al	Press
GREENLAND	
Christensen, O., et al	1976
Evans, P., et al	1976
Lear, W.H., et al.	1975
Nettleship, D.N.	1977
Piatt, J., et al	1984
Tull, C.E., et al	1972
GULF OF CALIFORNIA	
Brownell, R.L., Jr.	1982
HAWAII	
Balazs, G.H.	1982
Henderson, J.R.	1984
Mate, B.R.	1980
JAPAN	
Anonymous	1973
Anonymous	1982
Anonymous	1982
Balazs, G.H.	1982
Cary, F., et al	1983
DeGange, A.R.	1978
DeGange, A.R.	1978
DeGange, A.R.	1978
Graham, F. Jr.	1982
Hammond, C.	Press
Jones, L.L.	1980
Jones, L.L.	1981
Jones, L.L.	1981
Jones, L.L.	1982
Jones, L.L.	1982
Jones, L.L., et al	Press
Marine Mammal Commission	1982
Merrell, T.R., Jr.	1980
Mizue, K., et al	1965
Sano, O.	1978
Stewart, B.S., et al	1983

AUTHOR	YEAR
LABRADOR	
Lien, J., et al	1982
Perkins, J.S., et al	1979
MAINE	
Gilbert, J.R.	1983
Middleton, K.	1984
MARINE MAMMAL COMMISSION	
Marine Mammal Commission	1982
MARINE MAMMAL	
Anonymous	1973
Austin, B.C., et al	1983
Bannister, J.L.	1977
Beach, R.J., et al	1981
Brownell, R.L., Jr.	1975
Christensen, O., et al	1976
DeGange, A.R., et al	1980
DeMaster D.P., et al	1982
Everitt, R.D., et al	1981
Everitt, R.D., et al	1982
Henderson, J.R.	1984
Heneman, B.	1983
Heneman, B.	Press
Katona, S.K., et al	1978
Lear, W.H., et al.	1975
Lien, J.	1981
Marine Mammal Commission	1982
Mate, B.R.	Press
North Pacific Fur Seal Commission	1980
Northwest and Alaska Fisheries Center	1980
Perkins, J.S., et al	1979
Stewart, B.S., et al	Press
Waugh, G.T., et al	1982
Wild, P.W.	1984
Young, R.	1984
MASSACHUSETTS	
Middleton, K.	1983
Middleton, K.	1984

AUTHOR	YEAR
MEXICO	
Brownell, R.L., Jr.	1982
MISC. FISH	
Anonymous	1978
Anonymous	1982
Anonymous	1982
Austin, B.C., et al	1983
Bedford, D.	1983
Bernard, F.R.	1981
Brownell, R.L., Jr.	1982
Carr, H.A., et al	Press
Cary, F., et al	1983
DeGange, A.R., et al	1980
Fable, W.A., et al	1984
Gilbert, J.R.	1983
Gilbert, J.R., et al	1981
Gilbert, J.R., et al	1983
Hanavan, M.G., et al	1959
Harwood, M.B. et al	Press
High, W.L.	Press
King, W.B., et al	1979
Merrell, T.R., Jr.	1980
Middleton, K.	1983
Middleton, K.	1983
Middleton, K.	1984
Middleton, K.	1984
Nettleship, D.N., et al	1982
Perkins, J.S., et al	1979
Piatt, J., et al	1984
Waugh, G.T., et al	1982
Wild, P.W.	1984
Yonemori, T., et al	1981
MONTEREY BAY	
Heneman, B.	1981
Heneman, B.	1983
NEW ENGLAND	
Carr, H.A., et al	Press
Middleton, K.	1983
Middleton, K.	1984
Middleton, K.	1984

AUTHOR	YEAR
NEWFOUNDLAND	
Gray, S., et al	1980
Lien, J., et al	1980
Lien, J., et al	1980
Lien, J., et al	1982
Nettleship, D.N., et al	1982
Perkins, J.S., et al	1979
Piatt, J., et al	1984
NORTH ATLANTIC	
King, W.B., et al	1979
Lien, J.	1981
Nettleship, D.N.	1977
NORTHEAST U.S.	
Gilbert, J.R., et al	1981
Gilbert, J.R., et al	1983
NORTH PACIFIC	
Ainley, D.G., et al	1981
Anonymous	1973
Anonymous	1978
Anonymous	1979
Anonymous	1982
Balazs, G.H.	1982
DeGange, A.R.	1978
DeGange, A.R.	1978
DeGange, A.R., et al	1980
Everitt, R.D., et al	1982
Fowler, C.W.	1983
Graham, F. Jr.	1982
Hammond, C.	Press
Hanavan, M.G., et al	1959
High, W.L.	Press
Jones, L.L.	1980
Jones, L.L.	1981
Jones, L.L.	1982
Jones, L.L.	1982
Jones, L.L., et al	Press
King, W.B., et al	1979
Marine Mammal Commission	1982
Mizue, K., et al	1965
North Pacific Fur Seal Commission	1980
Ohsumi, S.	1975
Stewart, B.S., et al	1983
Yonemori, T., et al	1981

AUTHOR	YEAR
NORTH PACIFIC FUR SEAL COMMISSION	
North Pacific Fur Seal Commission	1980
NW ATLANTIC	
Austin, B.C., et al	1983
Katona, S.K., et al	1978
Middleton, K.	1983
Middleton, K.	1984
Middleton, K.	1984
Perkins, J.S., et al	1979
Piatt, J., et al	1984
Prescott, J.H., et al	1980
Waugh, G.T., et al	1982
OREGON	
Everitt, R.D., et al	1981
Everitt, R.D., et al	1982
Mate, B.R.	1980
Mate, B.R.	Press
PACIFIC	
Ainley, D.G., et al	1981
Anonymous	1973
Anonymous	1978
Anonymous	1979
Anonymous	1982
Balazs, G.H.	1982
DeGange, A.R.	1978
DeGange, A.R.	1978
DeGange, A.R., et al	1980
Everitt, R.D., et al	1982
Fowler, C.W.	1983
Graham, F. Jr.	1982
Hammond, C.	Press
Hanavan, M.G., et al	1959
Henderson, J.R.	1984
Heneman, B.	Press
High, W.L.	Press
Jones, L.L.	1980
Jones, L.L.	1981
Jones, L.L.	1982
Jones, L.L.	1982
Jones, L.L., et al	Press
King, W.B., et al	1979

AUTHOR	YEAR
PACIFIC continued	
Marine Mammal Commission	1982
Mate, B.R.	Press
Mizue, K., et al	1965
North Pacific Fur Seal Commission	1980
Ohsumi, S.	1975
Stewart, B.S., et al	1983
Stewart, B.S., et al	Press
Yonemori, T., et al	1981
Young, R.	1984
PINNIPED	
Anonymous	1978
Anonymous	1979
Beach, R.J., et al	1981
Bedford, D.	1983
Brownell, R.L., Jr.	1975
Brownell, R.L., Jr.	1982
Christensen, O., et al	1976
DeGange, A.R., et al	1980
DeMaster D.P., et al	1982
Everitt, R.D., et al	1981
Everitt, R.D., et al	1982
Fiscus, C.H., et al	1972
Fowler, C.W.	1982
Fowler, C.W.	1983
Gilbert, J.R.	1983
Gilbert, J.R., et al	1981
Gilbert, J.R., et al	1983
Henderson, J.R.	1984
Heneman, B.	1983
Heneman, B.	1984
Heneman, B.	Press
Jackson, T.D.	1983
Jones, L.L.	1980
Jones, L.L.	1981
Jones, L.L.	1981
Kajimura, H.	1976
Mate, B.R.	1980
Mate, B.R.	Press
Matkin, C.O., et al	1979
North Pacific Fur Seal Commission	1980
Sanger, G.A.	1974
Stewart, B.S., et al	1983
Stewart, B.S., et al	Press
Waugh, G.T., et al	1982

AUTHOR	YEAR
PORPOISE	
Anonymous	1978
Anonymous	1979
Bannister, J.L.	1977
Brownell, R.L., Jr.	1975
Cary, F., et al	1983
Christensen, O., et al	1976
DeGange, A.R., et al	1980
Gilbert, J.R.	1983
Gilbert, J.R., et al	1981
Gilbert, J.R., et al	1983
Harwood, M.B. et al	Press
Heneman, B.	1983
Heneman, B.	1984
Jones, L.L.	1981
Jones, L.L.	1982
Katona, S.K., et al	1978
Lear, W.H., et al.	1975
Marine Mammal Commission	1982
Matkin, C.O., et al	1979
Mizue, K., et al	1965
Ohsumi, S.	1975
Prescott, J.H., et al	1980
PRIBILOF ISLANDS	
Fowler, C.W.	1982
SALMON	
Ainley, D.G., et al	1981
Anonymous	1973
Anonymous	1978
Anonymous	1979
Anonymous	1982
Anonymous	1982
Beach, R.J., et al	1981
Bernard, F.R.	1981
Carter, H.R., et al	1984
Cary, F., et al	1983
Christensen, O., et al	1976
DeGange, A.R.	1978
DeGange, A.R.	1978
DeGange, A.R., et al	1980
Evans, P., et al	1976
Everitt, R.D., et al	1981
Everitt, R.D., et al	1982
Fiscus, C.H., et al	1982

AUTHOR	YEAR
SALMON continued	
Graham, F. Jr.	1982
Hanavan, M.G., et al	1959
High, W.L.	Press
Jones, L.L.	1981
Jones, L.L.	1981
Jones, L.L.	1982
Jones, L.L.	1982
Jones, L.L., et al	Press
Lear, W.H., et al.	1975
Major, R.L.	1982
Marine Mammal Commission	1982
Mate, B.R.	Press
Matkin, C.O., et al	1979
Merrell, T.R., Jr.	1980
Mizue, K., et al	1965
Nettleship, D.N.	1977
Ohsumi, S.	1975
Piatt, J., et al	1984
Sano, O.	1978
Stewart, B.S., et al	1983
Tull, C.E., et al	1972
Whilde, A.	1979
SEABIRD	
Ainley, D.G., et al	1981
Anonymous	1982
Bartonek, J.C.	1968
Bibby, C.J.	1972
Bourne, W.R.P.	1972
Bourne, W.R.P.	1977
Carter, H.R., et al	1984
Christensen, O., et al	1976
DeGange, A.R.	1978
DeGange, A.R.	1978
DeGange, A.R.	1978
DeGange, A.R., et al	1980
Evans, P., et al	1976
Graham, F. Jr.	1982
Heneman, B.	1981
Heneman, B.	1983
Heneman, B.	1984
High, W.L.	Press
King, W.B., et al	1979
Merrell, T.R., Jr.	1980
Nettleship, D.N.	1977
Nettleship, D.N., et al	1982

AUTHOR	YEAR
SEABIRD continued	
Piatt, J., et al	1984
Piatt, J., et al	1984
Sano, O.	1978
Tull, C.E., et al	1972
Whilde, A.	1979
Wild, P.W.	1984
SEA TURTLE	
Austin, B.C., et al	1983
Balazs, G.H.	1982
Waugh, G.T., et al	1982
SHARK	
Bedford, D.	1983
Bernard, F.R.	1981
Brownell, R.L., Jr.	1975
Brownell, R.L., Jr.	1982
Cary, F., et al	1983
DeGange, A.R., et al	1980
DeMaster D.P., et al	1982
Hanavan, M.G., et al	1959
Harwood, M.B. et al	Press
Jackson, T.D.	1983
Lien, J., et al	1982
Lien, J., et al	1982
Middleton, K.	1984
Waugh, G.T., et al	1982
SOUTH AMERICA	
Brownell, R.L., Jr.	1975
SOUTH KOREA	
Cary, F., et al	1983
SQUID	
Anonymous	1982
Anonymous	1982
Balazs, G.H.	1982
Bernard, F.R.	1981
Cary, F., et al	1983
Fiscus, C.H., et al	1982
Jones, L.L., et al	Press

AUTHOR	YEAR
TAIWAN	
Balazs, G.H.	1982
Cary, F., et al	1983
Harwood, M.B. et al	Press
URUGUAY	
Brownell, R.L., Jr.	1975
WASHINGTON	
Everitt, R.D., et al	1981
Everitt, R.D., et al	1982
High, W.L.	Press
WESTERN ALASKA	
Major, R.L.	1982
WHALE	
Bannister, J.L.	1977
Cary, F., et al	1983
Gray, S., et al	1980
Katona, S.K., et al	1978
Lear, W.H., et al	1975
Lien, J.	1981
Lien, J., et al	1980
Lien, J., et al	1980
Lien, J., et al	1982
Lien, J., et al	1982
Mate, B.R.	Press
Ohsumi, S.	1975
Perkins, J.S., et al	1979
Young, R.	1984
WORLDWIDE	
Bourne, W.R.P.	1977