Bycatch is a massive problem in our nations's fisheries. In 1996, Congress recognized the ecological and economic importance of the issue and called on National Marine Fisheries Service (NMFS) and the regional councils to act. Ten years later, most of the councils are still floundering, having failed to make substantive progress toward meeting the mandates of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) in the nations's dirtiest fisheries.

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compiled and designed by Abbie Thibodeaux

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Introduction
Bycatch

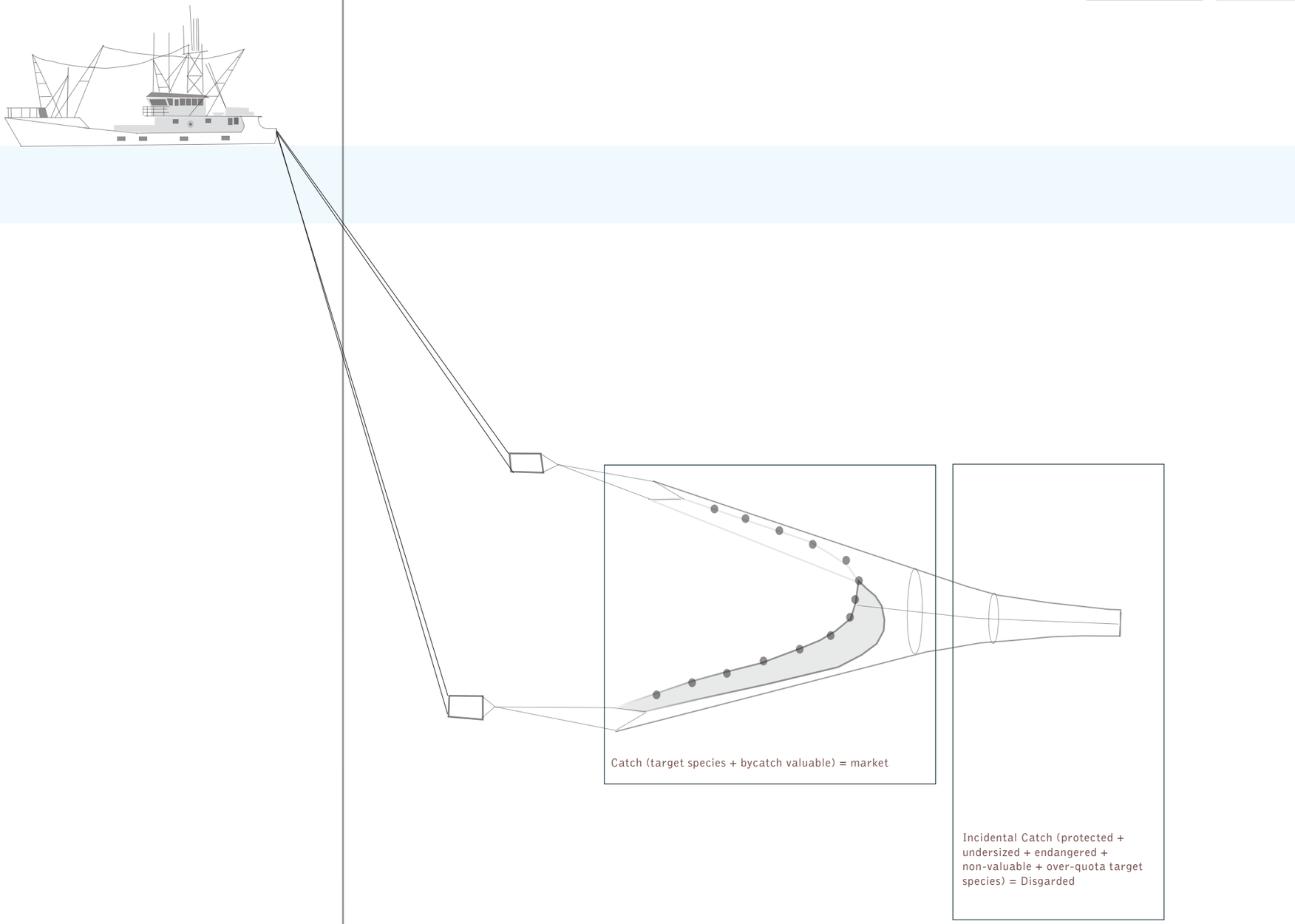
What is the Problem?

American fishing operations discard more than a fifth of what they catch each year, according to a new report by a team of U.S. and Canadian scientists. The study, which was commissioned by the marine advocacy group Oceana and appears in the December issue of the journal Fish and Fisheries, represents the first comprehensive accounting of the amount of "bycatch" in the United States. Fisheries consultant Jennie M. Harrington, Dalhousie University professor Ransom A. Myers and University of New Hampshire professor Andrew A. Rosenberg used federal data collected from 1991 to 2002 to calculate which regional fisheries inadvertently kill the most unwanted fish. The Gulf of Mexico topped the list, largely because its shrimp fishery had 1 billion pounds of bycatch, half the nation's wasted fish in 2002. Gulf shrimpers, which typically drag trawl nets with steel doors across the ocean floor, discard about four times as many fish as they keep, according to the study.

"The scale of the problem here is enormous," Myers said, adding that the annual wasted fish would fill every bathtub in a city of 1.5 million people. "And it's an insidious problem, because we cannot have the recovery of fish stocks as long as they keep getting caught as bycatch." A variety of unwanted marine species become trapped in fishing gear by vessels seeking a different catch and are then thrown away, including noncommercial species such as jellyfish and small crustaceans. The researchers did not include protected species, such as turtles, as well as mammals and birds in their study.

Southern Shrimp Alliance President Joey Rodriguez, a third-generation shrimper in Alabama who represents fishermen from North Carolina to Texas, said that shrimpers have adopted more environmentally sensitive gear in recent years but that they continue to go after shrimp "the only way we know how to catch 'em." Rodriguez, who said the Gulf of Mexico's shrimping fleet is wasting fewer fish because overseas competition and recent hurricane damage has cut its size to half of what it was four years ago, said his members are open to adopting new techniques as long as they are affordable.

Bob Mahood, executive director of the South Atlantic Fishery Management Council, said his region had helped reduce bycatch over the past decade by demanding that fishing operations adopt different gear. In the snapper and grouper fishery, the council has barred entanglement nets, trawling and mesh traps that lure fish with bait. Mahood said that his regional council had called on shrimpers in 1996 to use gear aimed at reducing bycatch by 40 percent but that he did not know if the strategy had worked. "There hasn't been a whole lot of follow-up," he said.



There is growing acceptance by fishing industry leaders of the need to reduce bycatch. Proven solutions do exist, such as modifying fishing gear so that either fewer nontarget species are caught or non-target species can escape. In many cases, these modifications are simple and inexpensive, with the best innovations usually coming from fishers themselves.

The Bycatch Numbers are Truly Frightening

The bycatch of fishery resources, marine mammals, sea turtles, seabirds, and other living marine resources has become a central concern of the commercial and recreational fishing industries, resource managers, conservation organizations, scientists, and the public, both nationally and globally.

Many of the fish and other animals caught in fishing gear are thrown away as unwanted bycatch - amounting to many millions of metric tons of marine life wasted each year.

Over 300 thousand small whales, dolphins, and porpoises die from entanglement in fishing nets each year, making bycatch the single largest cause of mortality for cetaceans and pushing many species to the verge of extinction.

Over 250 thousand endangered loggerhead turtles and critically endangered leatherback turtles are caught annually on longlines set for tuna, swordfish, and other fish, with thousands more killed in shrimp trawls.

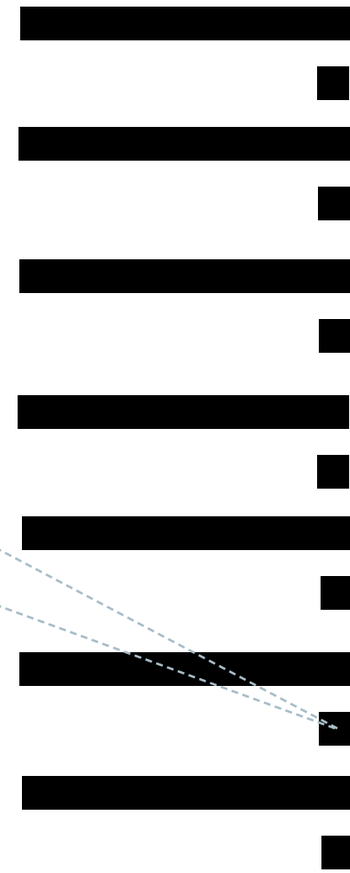
26 species of seabird, including 23 albatross species, are threatened with extinction because of longlining, which kills more than 300 thousand seabirds each year.

89 percent of hammerhead sharks and 80 percent of thresher and white sharks have disappeared from the Northeast Atlantic Ocean in the last 18 years, largely due to bycatch.

Shrimp trawlers catch as many as 35 million juvenile red snappers each year inthe Gulf of Mexico, enough to have an impact on the population.

Billions of corals, sponges, starfish, and other invertebrates are caught as bycatch every year.

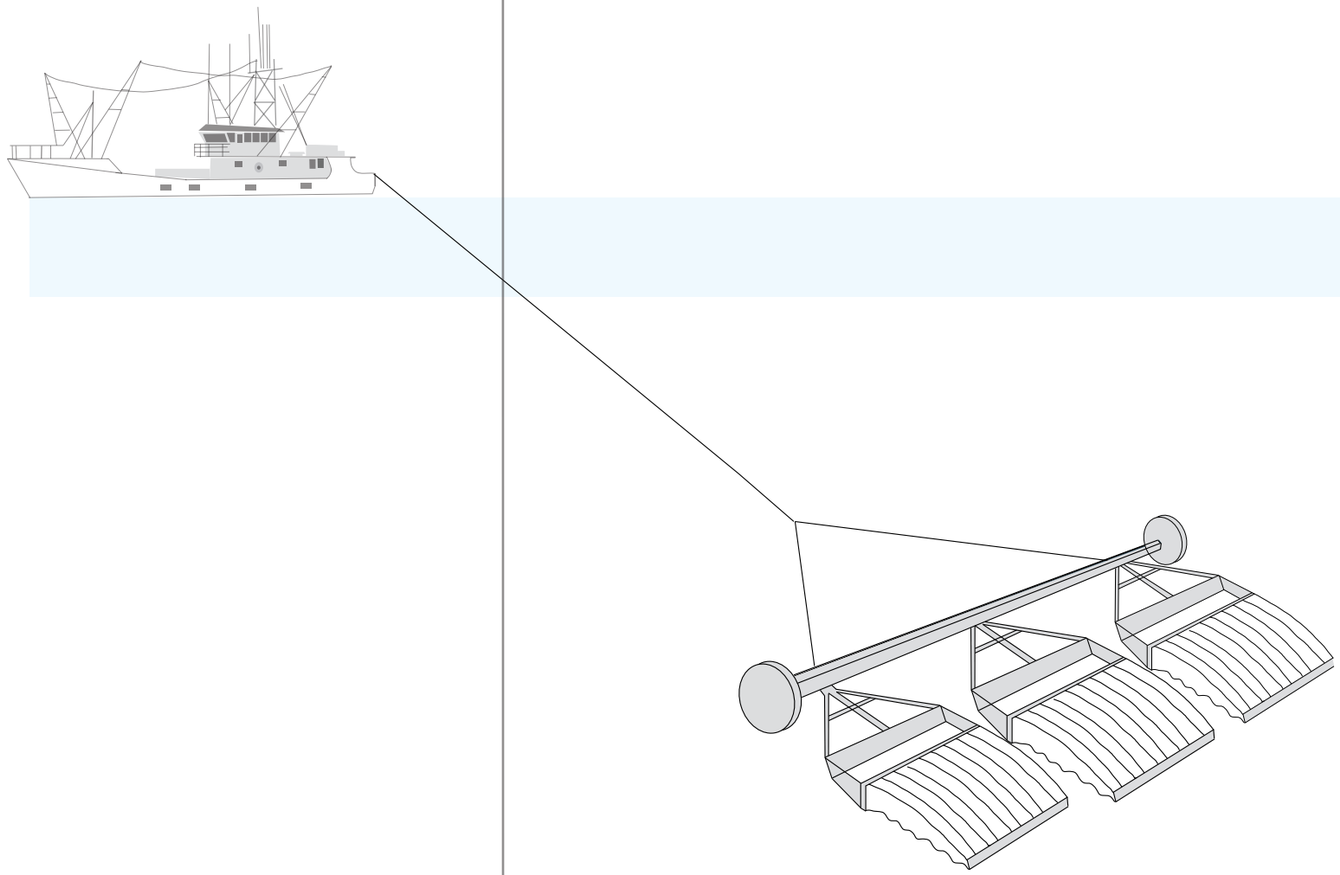
For every One pound of Shrimp caught,
up to Ten pounds of Marine Life is thrown away.



During the past 26 years, the regional fishery management councils and NMFS have responded to this concern by taking a variety of actions to address the issue of bycatch. The actions have included research to develop better methods for monitoring and reducing bycatch, outreach programs to explain the bycatch problem and search for solutions, and regulatory actions to monitor and decrease bycatch.

Congress has responded to this concern by addressing bycatch in the Magnuson-Stevens Fishery Conservation and Management Act, the Marine Mammal Protection Act, and the Endangered Species Act. For example, National Standard 9 was added to the MSA when it was amended in the year 1996. It states that "Conservation and management measures shall, to the extent practicable, minimize bycatch and to the extent bycatch cannot be avoided, minimize the mortality of such bycatch."

Bycatch mortality can decrease the sustainability of fisheries and the net benefits provided by the fisheries in several ways. First, if bycatch mortality is not monitored adequately, it increases the uncertainty concerning total fishing-related mortality, which in turn makes it more difficult to assess the status of stocks to set the appropriate optimum yield and overfishing levels and ensure that the optimum yields are attained and that the overfishing does not occur. Second, if discards are sufficiently concentrated in time and space, they will result in localized environmental degradation. Third, bycatch mortality precludes some other uses of fishery resources. For example, juvenile fish that are subject to bycatch mortality cannot be used to contribute directly to the growth of that stock and to future catch. Bycatch is a wasteful use of living marine resources if it precludes a higher valued use of those resources.



A dredge consists of a rugged triangular steel frame and tooth-bearing bar, behind which a mat of linked steel rings is secured. A heavy netting cover joins the sides and back of this mat to form a bag in which the catch is retained. Shellfish are raked out of sand or gravel and swept into the bag.

Chapter One
Regulations

Statutory Requirements and Agreements

Review of the Government rules and regulations.

Magnuson-Stevens Fishery Concervation and Management Act

1996 admendment defines bycatch.

Endangered Species Act

Requiring Federal Government to protect and conserve endangered species and populations.

Marine Mammal Protection Act

Enacted to eliminate mortality of marine mammals due to commercial fishing.

Zero Mortality Rate Goal

Requirement of fisheries to reduce mortality to insignificant levels.

FAO Code of Conduct

FAO Code of Conduct (FAO) adopted the Code of Conduct for Responsible Fisheries in 1995.

Statutory Requirements and International Agreements

NMFS has a variety of bycatch monitoring and reduction responsibilities. They are identified in its governing statutes and in international agreements. The former (e.g., the MSA, ESA, and MMPA) include bycatch responsibilities that were constructed to respond to bycatch concerns for different species in different ways. Throughout this report, bycatch monitoring and reduction activities and responsibilities should be viewed within the context of relevant statutory requirements and standards for fish, marine mammals, and other protected species, including seabirds and sea turtles.

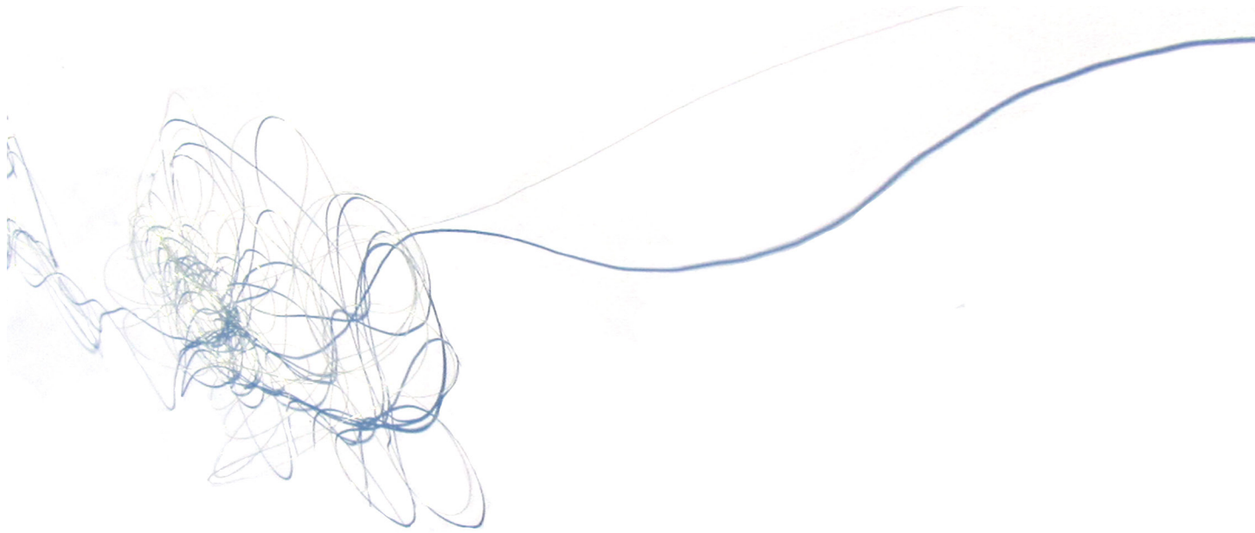
Magnuson-Stevens Fishery Conservation and Management Act

The 1996 amendments to what is now titled the Magnuson-Stevens Fishery Conservation and Management Act (MSA) defined the term "bycatch" and required that it be minimized to the extent practicable. Bycatch, as defined by the MSA (16 U.S.C. § 1802 (2)), "means fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards. Such a term does not include fish released alive under a recreational catch and release fishery management program." The term "fish" is defined in the MSA to mean "finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and seabirds." Therefore, the bycatch reduction and monitoring requirements in the MSA apply to a broad range of living marine species, including finfish and shellfish, as well as sea turtles and deep-water corals, but they do not apply to marine mammals and birds. Economic discards are "fish which are the target of a fishery, but which are not retained because of an undesirable size, sex, or quality, or other economic reason." "The term 'regulatory discards' means fish harvested in a fishery which fishermen are required by regulation to discard whenever caught, or are required by regulation to retain but not sell."

National Standard 9 of the MSA requires that "conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch" (16 U.S.C. § 1851(9)). Sec. 303 of the MSA expands on this requirement somewhat, stating that fishery management plans are required to "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority (A) minimize bycatch; and (B) minimize the mortality of bycatch which cannot be avoided".

NMFS regulations at 50 CFR 600.350(d)(3) provide the following guidance on factors that should be considered in determining the practicability of a particular management action to minimize bycatch or the mortality of bycatch. They state, "A determination of whether a conservation or management measure minimizes bycatch or bycatch mortality to the extent practicable, consistent with other national standards and maximization of net benefits to the Nation, should consider the following factors: (A) Population effects for bycatch species; (B) Ecological effects due to changes in the bycatch of that species (effects on other species in the ecosystem); (C) Changes in the bycatch of other species of fish and the resulting population and ecosystem effects; (D) Effects on marine mammals and birds; (E) Changes in fishing, processing, disposal, and marketing costs; (F) Changes in fishing practices and behavior of fishermen; (G) Changes in research, administration, and enforcement costs and management effectiveness; (H) Changes in the economic, social, or cultural value of fishing activities and non-consumptive uses of fishery resources; (I) Changes in the distribution of benefits and costs; and (J) Social effects."

Although the MSA excludes fish released alive under a recreational catch and release fishery management program, from its definition of bycatch, Section 303(a)(12) of the MSA, states that any fishery management plan shall "assess the type and amount of fish caught and released alive during recreational fishing under catch and release fishery management programs and the mortality of such fish, and include conservation and management measures that, to the extent practicable, minimize mortality and ensure survival of such fish." Therefore, for purposes of this report, bycatch will be defined more broadly over both commercial and recreational fisheries. However, the distinction between commercial and recreational bycatch will be addressed when developing mechanisms and strategies for monitoring bycatch.

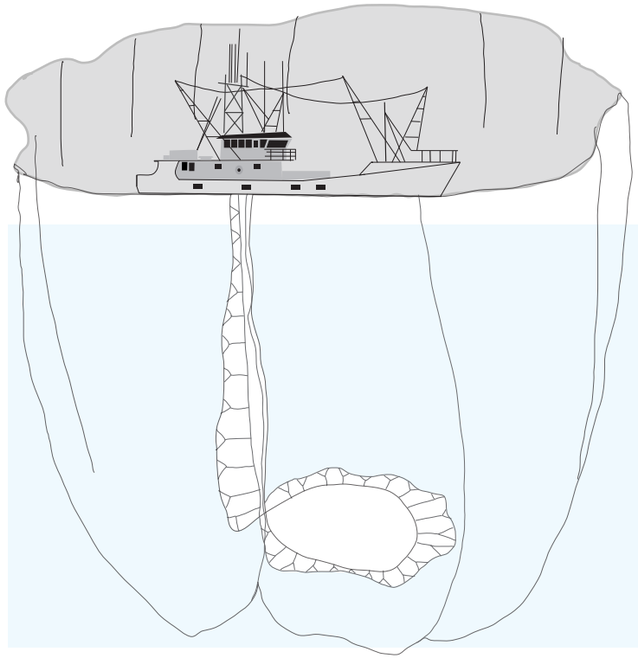


Endangered Species Act

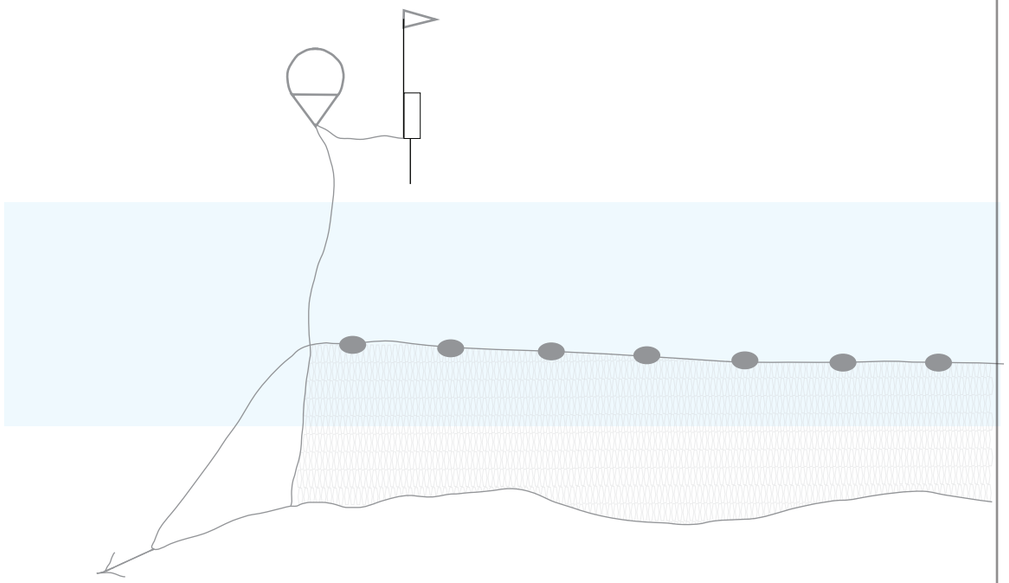
The ESA requires the federal government to protect and conserve species and populations that are endangered, or threatened with extinction, and to conserve the ecosystems on which these species depend. Some of these threatened and endangered species, including certain species of sea turtles, Pacific salmon, seabirds and marine mammals, are captured as bycatch in the Nation's fisheries. Under the ESA's protection process, after a species is identified as threatened or endangered, a recovery plan that outlines actions to improve the species' status is prepared and implemented. Recovery plans for marine species generally include a prescription for reducing incidental capture of protected species in commercial fishing operations. In some cases, fisheries can be restricted or terminated because they impose mortality rates on protected species that impede the recovery of the listed population. Other provisions of the ESA ensure that sources of mortality for protected species are identified and minimized or mitigated.

The bycatch reduction requirements of the ESA follow from Section 9(a)(1)(B) and 9(a)(1)(C) of the ESA, which prohibit the take of endangered species within the United States or the territorial sea of the United States, and on the high seas, respectively. "Take" is defined by the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct" (16 U.S.C. 1536(18)). ESA Sections 4, 6, 7 and 10 provide mechanisms for the limited take of ESA-listed species. Of particular relevance for fisheries bycatch is Section 7, which provides that "Each Federal agency shall ... insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species ..." (16 U.S.C. §1536(a)(2)).

Both NMFS and the U.S. Fish and Wildlife Service develop Biological Opinions pursuant to a formal consultation under Section 7 of the ESA to assess the impact of proposed activities on species under their respective jurisdictions. If the resulting Biological Opinion finds that the proposed activity is likely to result in jeopardy to the species or adverse modification of its habitat, the Biological Opinion will outline Reasonable and Prudent Alternatives (RPAs) that must be taken to ensure that the species is not jeopardized. If the Biological Opinion finds that the proposed activity is likely to result in bycatch of an endangered species, then an Incidental Take Statement is issued that specifies the impact of any incidental taking, as well as RPAs, and terms and conditions to implement the measures, necessary to minimize such impacts. Commerical fisheries that result in bycatch of listed sea turtles, for example, would be required to implement the relevant RPAs as applicable to protect sea turtles from fishing gear.



Fish are encircled by a large 'wall' of net, which is then brought together to retain the fish by using a line at the bottom that enables the net to be closed like a purse.



Pelagic gillnets or 'set nets' are fine-filament nets that are kept at or below the surface by numerous floats and weights and held in position by anchors. If a fish's head goes through the net but its body can't follow, it is 'gilled' or entangled in the netting when it tries to get out. Gillnets are used either alone or in large numbers placed in a row.

Marine Mammal Protection Act

The MMPA seeks to maintain marine mammal stocks at optimum sustainable population levels, principally by regulating the human induced mortality and serious injury of marine mammals. This includes fishing-related mortality and serious injury. Although the MMPA prohibits the "take" of marine mammals, it provides exceptions for incidental mortality and serious injury in the process of commercial fishing activities as well as a limited number of other activities.

"Take" is defined in the MMPA as, "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal". In 1994, Congress amended the MMPA to include Section 118, which established a regime to regulate the take of marine mammals incidental to commercial fishing so that it does not occur at a level that jeopardizes a marine mammal stock's ability to reach its "optimum sustainable population", defined as "the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element". Section 118 of the MMPA requires that NMFS classify each U.S. fishery according to whether there is a frequent (Category I), occasional (Category II), or remote (Category III) likelihood of incidental mortality and serious injury of marine mammals. It also requires the establishment of take reduction teams to develop take reduction plans (TRPs) for those fisheries with the greatest impact on marine mammal stocks (Category I and Category II).

FAO Code of Conduct

More than 170 Members of the Food and Agriculture Organization of the United Nations (FAO) adopted the Code of Conduct for Responsible Fisheries in 1995. The Code is voluntary and aimed at everyone working in and involved with fisheries and aquaculture, irrespective of whether they are located in inland areas or in the oceans. The Code of Conduct, which consists of a collection of principles, goals, and elements for action, took more than two years to develop. Among other things, the Code of Conduct maintains that fishing methods and gear should be selective and designed to minimize waste and promote high survival rates for escaping fish.

Gear should also minimize the catch of fish species that are not wanted or that are endangered. Fishing gear and fishing methods that are not selective or that cause high levels of waste should be phased out, according to the Code of Conduct. NMFS has been very active in promoting the implementation of the FAO's International Plan of Action (IPOA) for Reducing Incidental Catch of Seabirds in Longline Fisheries and the FAO IPOA for the Conservation and Management of Sharks, both of which have grown out of the Code of Conduct.

Zero Mortality Rate Goal

In 1994, Congress amended the MMPA and established a requirement for fisheries to reduce incidental mortality and serious injury of marine mammals to insignificant levels approaching a zero rate. To implement the ZMRG, NMFS must establish a threshold level for mortality and serious injury to meet this requirement. This final rule establishes an insignificance threshold as 10 percent of the Potential Biological Removal level of a stock of marine mammals.

These targets result in upper limits ranging from two animals per 10,000 animals in the population stock for endangered whales to six animals per 1,000 in the population for robust pinniped stocks. The Assistant Administrator has discretion to modify this simple formula if certain parameters (e.g., maximum net production rate or the recovery factor in the calculation of the stock's PBR level) can be estimated or otherwise modified from default values or when information is insufficient to estimate the level of mortality and serious injury having an insignificant effect on the affected population stock.

Federal Register /Vol. 69, No. 138/Tuesday,

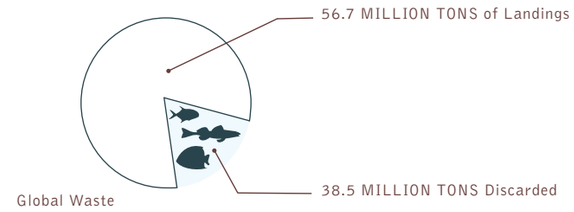
PART 229—AUTHORIZATION FOR

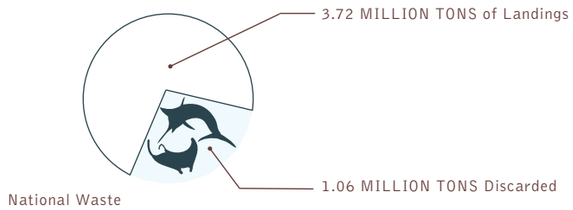
_ 1. The authority citation for part 229

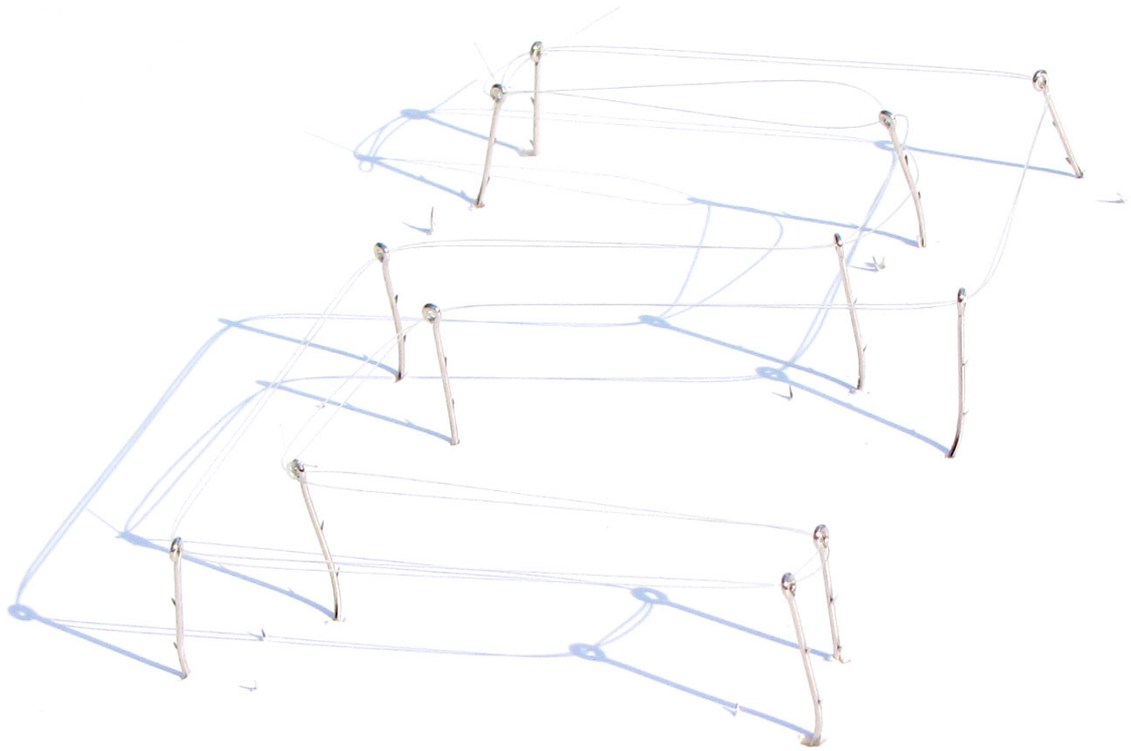
_ 2. In § 229.2, the definition for "Insignifance

§ 229.2 Definitions.

An insignificance threshold is estimated as 10 percent of the Potential Biological Removal level for a stock of marine mammals. If certain parameters can be estimated or otherwise modified from default values, the Administrator may use a modification of the number calculated from the simple formula for the insignificance threshold. The Administrator may also use a modification of the simple formula when information is insufficient to estimate the level of mortality and serious injury that would have an insignificant effect on the affected population stock and provide a rationale for using the above modification.







Chapter Two
Species

Sea Turtles

Two species of most concern are loggerhead and leatherback turtles.

Marine Mammals

Marine mammal interactions with longline gear result in serious injuries or mortalities.

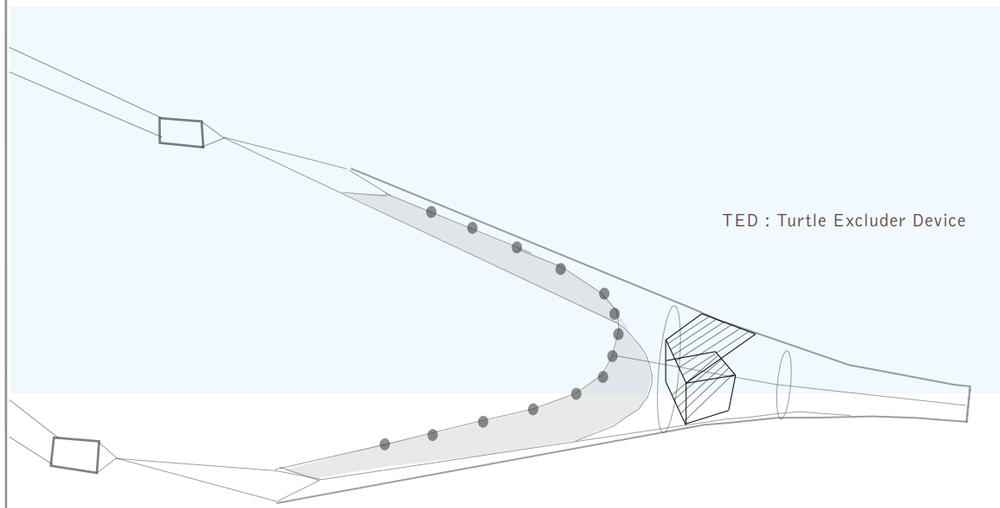
Seabirds

Requiring Federal Government to protect and conserve endangered species and populations.

Sea Turtles

The U.S. has two pelagic longline observer programs monitoring tuna and swordfish fisheries in the Pacific Ocean, one based in Hawaii and the other in California (CA). The Hawaii-based program began in 1994 and observer coverage averaged approximately 4% of fishing effort until 2000. In 2001, sea turtle conservation measures were implemented; therefore, a higher level of coverage was needed to adequately document effectiveness of those measures. The CA-based program has maintained nearly 12% coverage since its inception in 2001. Prior to the implementation of conservation measures, annual sea turtle catch in the Pacific was nearly 1,500 sea turtles per year (McCracken 2000, NMFS 2004a). Catch has dropped significantly (100/year) since the measures were implemented (NMFS 2004a, NMFS 2004b).

In the Atlantic Ocean, the U.S. has observed the pelagic longline fishery since 1992 averaging 2.5% to 5% annual coverage (NMFS 2004c). Turtle catch estimates have ranged widely fromyear to year (between 800 and 3,500) with high sea turtle interaction rates in the Gulf of Mexico through the mid-Atlantic and Grand Banks (NMFS 2004c).

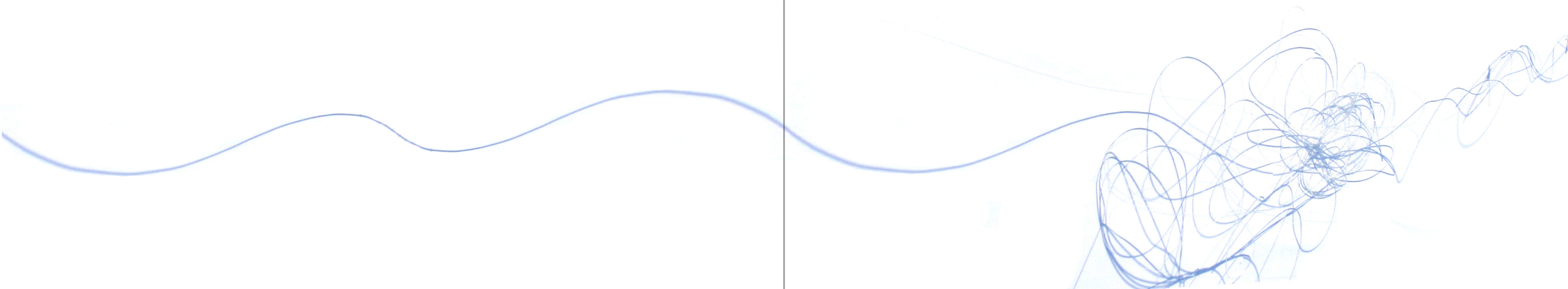


Leatherback turtles have likely declined over 95% since 1980

Although most sea turtle species interact with U.S. pelagic longline fisheries (with the possible exception of Kemp's Ridley turtles; Lepiochelys kempii), two species are of most concern: leatherback (Dermochelys coriacea) and loggerhead. In the Pacific, [redacted] and are likely to become extirpated in parts of the Pacific. [redacted] key nesting sites in Japan and Australia. In the Atlantic, leatherback turtles appear to be stable or increasing at certain key nesting beaches (e.g., St. Croix, U.S. Virgin Islands), but extirpated from others (e.g., St. John and St. Thomas, U.S. Virgin Islands). Loggerhead turtles appear to be stable, but some subpopulations may still be vulnerable in the Atlantic.

Due to concern for these populations the U.S. has implemented several measures to reduce bycatch in domestic longline fisheries. The U.S. has implemented regulations to control effort, mostly in the swordfish fishery, such as prohibiting shallow sets in areas of Atlantic and Pacific Oceans. A tuna fishing closure also occurs in Pacific during certain times of year. In addition, the U.S. has conducted and supported research on gear modifications to reduce sea turtle bycatch over the last 3-4 years, finding that large (18/0) circle hooks and the use of different bait combinations have been very effective at reducing sea turtle

Loggerhead turtles have likely declined over 75% since 1980



2000 NOAA Fisheries Service and the U.S. Department of State developed a strategy to address turtle bycatch in global longline fisheries.

2003 NOAA Fisheries created a International Technical Workshop on Marine Turtle Bycatch Longline Fisheries, nineteen nations contributed.

2003 The ICCAT encouraged Parties to collect all available information, and sought the development of data collection and reporting methods.

2003 IATTC created a Bycatch Working Group to develop a 3-year program to include mitigation of bycatch, biological research, and improvement of fishing gears.

2004 FAO convens a Technical Con sultation on Sea Turtles in all fisheries. Prior to the consulta tion, an Expert Working Group convened in March 2004 to review relevant information.

2007 FAO published Guidelines to Reduce Sea Turtle Strategies by fishery gear-type.

2009 Loggerheads have declined by at least 80 percent over the past 20 years and could become functionally or ecologically extinct by the mid-21st century.

2010 The biggest wildlife relocation efforts on record: the transfer of 25,000 sea turtle eggs from Gulf shores to the Atlantic coast of Florida due to the oil-tainted waters of the Gulf.

2010 6 out of 7 species of turtles are currently listed as vulnerable, endangered or critically endangered by the IUCN Red List.

Marine Mammals

Marine mammals interactions with longline gear primarily take the form of depredation by marine mammals on the bait and/or caught fish on longline gear. Marine mammals have been observed to prey on the bait and/or catch and in the process either become fouled or entangled in the line or ingest the hook. These types of interactions may result in serious injuries or even mortalities to the marine mammal species involved. They may also result in significant fish or gear loss to fishermen.

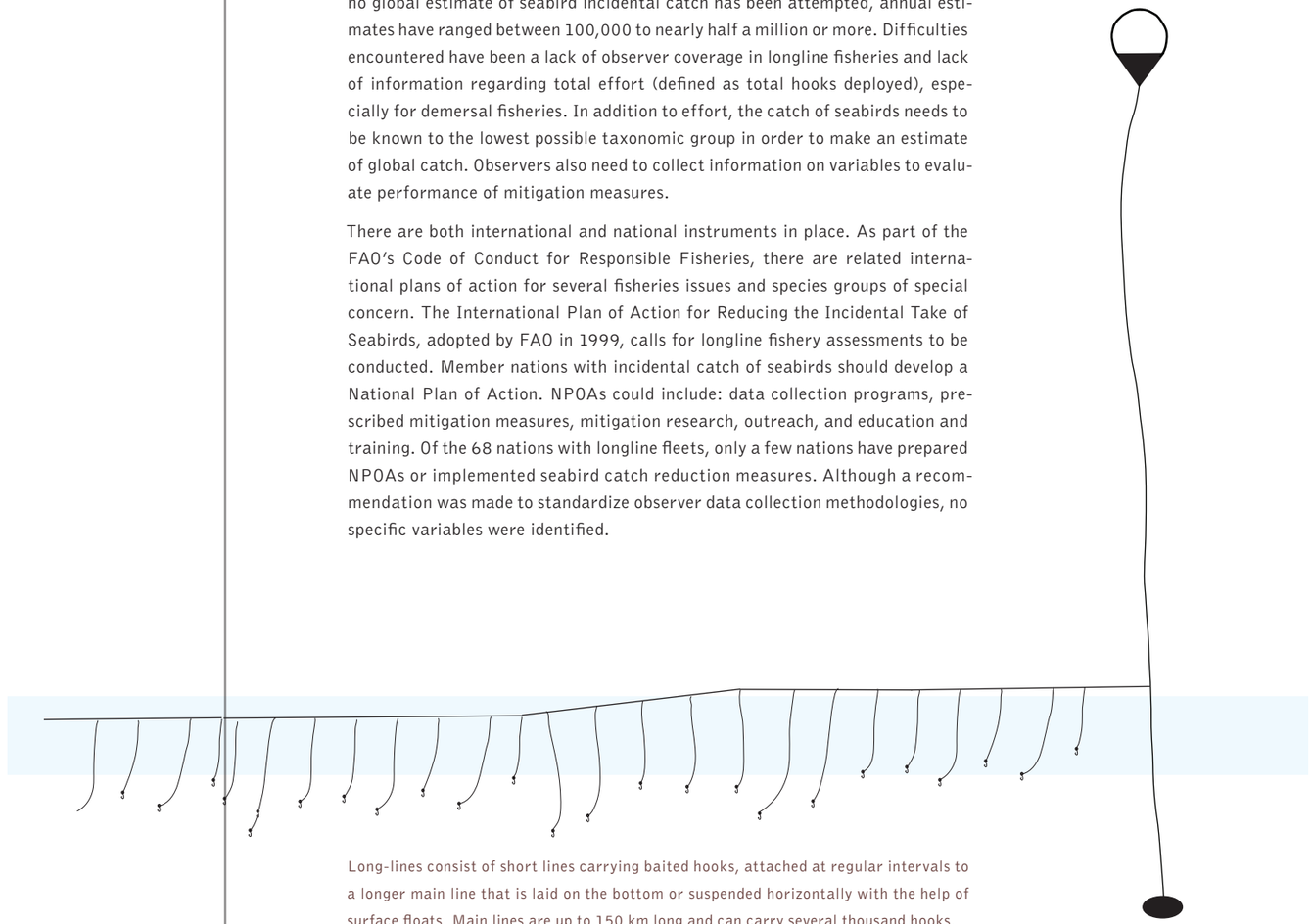
Marine mammal interactions with longline gear were the focus of a Workshop on Interactions Between Cetaceans and Longline Fisheries held in Apia, Samoa, in November 2002. At the workshop, researchers noted that depredation on longline gear by marine mammals is an increasing problem. Marine mammals seem to be interested in what is caught on the gear, as fish caught on longline gear may represent a foraging opportunity for certain marine mammal species. Workshop participants noted that depredation may result in loss of catch, loss of bait, damage to or loss of gear, and loss of time spent fishing. All of this results in increased vessel costs, so fishermen are highly motivated to find a solution to this problem.

Various mitigation measures to reduce depredation by marine mammals were explored at the Samoa workshop. Such mitigation measures included: using acoustic deterrents, such as seal scarers or tuna bombs, which participants noted as not being particularly effective; shooting at animals, also not particularly effective and which could actually cause injury to marine mammals; moving to a new fishing area; retaining bait and offal instead of dumping it overboard; masking vessel noises so that vessels do not know when a haul is occurring; and avoiding hot spots where depredation by marine mammals is known to occur. Additional measures included delaying the setting or hauling of gear until animals have left the area, or luring marine mammals away from the area and "dropping them off" on competing vessels.

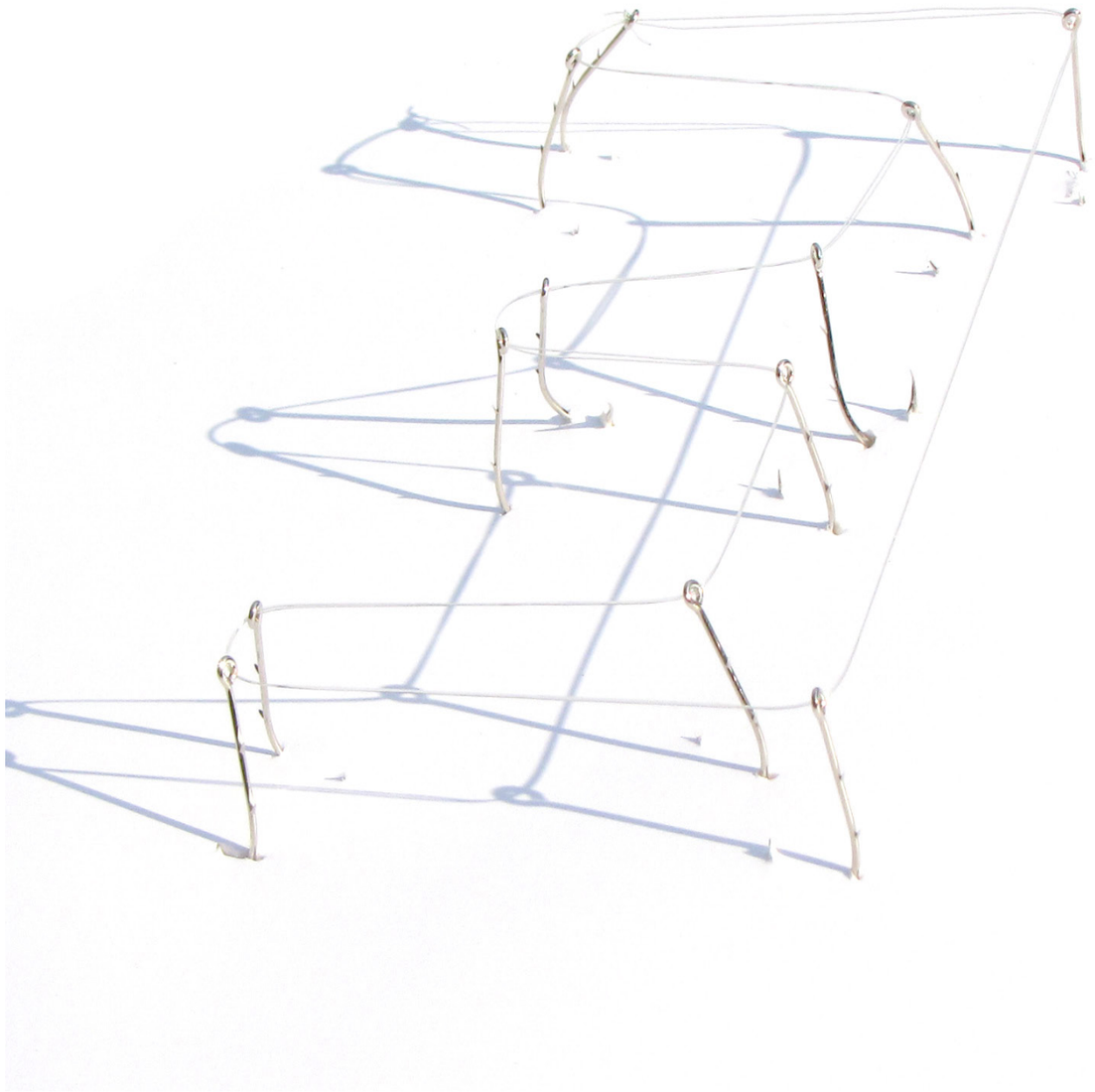
Seabirds

The declines of many seabird populations, predominantly Southern Hemisphere albatrosses and petrels, have been linked to longline fisheries. Unlike sea turtles, no global estimate of seabird incidental catch has been attempted, annual estimates have ranged between 100,000 to nearly half a million or more. Difficulties encountered have been a lack of observer coverage in longline fisheries and lack of information regarding total effort (defined as total hooks deployed), especially for demersal fisheries. In addition to effort, the catch of seabirds needs to be known to the lowest possible taxonomic group in order to make an estimate of global catch. Observers also need to collect information on variables to evaluate performance of mitigation measures.

There are both international and national instruments in place. As part of the FAO's Code of Conduct for Responsible Fisheries, there are related international plans of action for several fisheries issues and species groups of special concern. The International Plan of Action for Reducing the Incidental Take of Seabirds, adopted by FAO in 1999, calls for longline fishery assessments to be conducted. Member nations with incidental catch of seabirds should develop a National Plan of Action. NPOAs could include: data collection programs, prescribed mitigation measures, mitigation research, outreach, and education and training. Of the 68 nations with longline fleets, only a few nations have prepared NPOAs or implemented seabird catch reduction measures. Although a recommendation was made to standardize observer data collection methodologies, no specific variables were identified.



Long-lines consist of short lines carrying baited hooks, attached at regular intervals to a longer main line that is laid on the bottom or suspended horizontally with the help of surface floats. Main lines are up to 150 km long and can carry several thousand hooks.



Chapter Three
Regional Characteristics

Southwest

The California Department of Fish and Game and NMFS have conducted an observer program to collect data on protected species.

Southeast

These fisheries target several species and provide important fishing opportunities.

Northeast

These fisheries are diverse both with respect to the species sought and gear types employed.

Alaska

These fisheries are diverse with respect to the species sought, the gear types employed and the sizes of both their harvesting and processing operations.

Southwest Region

Fisheries of importance to the Southwest Region include coastal pelagic species fisheries, the drift gillnet fishery for swordfish, and the fisheries for highly migratory species, including the U.S. purse seine fleet that operates in the eastern Pacific Ocean.

The coastal pelagic species (CPS) fishery targets northern anchovy, jack mackerel, Pacific sardine, and Pacific mackerel. CPS vessels fish with encircling nets, targeting a specific school, and the most common incidental catch in the CPS fishery are other CPS species. A few measures have been proposed to minimize bycatch. In California, limited amounts of information are available from at-sea observations; the bulk of bycatch data is derived from port sampling.

The California/Oregon Drift Gillnet (DGN) fishery targets swordfish and thresher shark. It had been classified as a Category I fishery under the MMPA as a result of interactions with marine mammals, some of which are listed under the ESA, but was reclassified as Category II in 2003 due to successful bycatch reduction efforts. Since 1980, with the exception of a few years, the California Department of Fish and Game and NMFS have conducted an observer program to collect data on the bycatch of protected species. The DGN fishery was the subject of the Pacific Offshore Cetacean Take Reduction Plan. The Take Reduction Plan reduced marine mammal entanglements by an order of magnitude in its

In 2000, NMFS conducted an internal ESA Section 7 consultation on the DGN fishery and evaluated the incidental take of listed sea turtles and marine mammals by the DGN fishery. The opinion found the incidental take was likely to jeopardize the continued existence of certain populations and specified a reasonable and prudent alternative under which the fishery could operate. NMFS authorized the take of nine leatherback turtles in three years, and similarly low numbers of loggerhead turtles, and implemented fishery time-area closures under ESA regulations to ensure these levels were not exceeded. NMFS determined that the DGN fishery, operating under the Take Reduction Plan, will have a negligible effect on listed marine mammals in 2000. As with most pelagic gillnet fisheries, the catch of non-target species in the DGN fishery is high.

The Take Reduction Plan reduced marine mammal entanglements by an order of magnitude.

Southeast Region

Southeast fisheries (North Carolina to Texas and the U.S. Caribbean) generate about one billion dollars in ex-vessel gross revenues per year. Fisheries of the Southeast reflect the very diverse fauna of the region, with relatively few large fisheries and many small fisheries. The fisheries have catches from more than 200 stocks of fish and fishery resources.

Two fisheries dominate economically. The menhaden purse seine fishery is the volume leader in the Southeast, with annual landings approaching 2 million. About 60 percent of the landings come from the Gulf of Mexico and 40 percent from the Atlantic. The shrimp trawl fishery generates the largest revenue regionally, and sometimes nationally. The Gulf of Mexico shrimp fishery accounts for about 75 percent of the entire U.S. wild shrimp production. About half the commercial value of fisheries other than shrimp and menhaden consists of shellfish fisheries, generally harvested from state waters, and managed by the states.

Marine recreational fishing is a very important part of the Southeast harvest. Typically, 4-6 million participants make 30-40 million trips annually. The magnitude of recreational participation in the Southeast is much larger than in other regions of the United States. The bulk of recreational harvest consists of small fish from the drum family (croakers and seatrouts), but many of the prized commercial species are also prized by recreational fishermen (e.g., red snapper and other reef species, and king and Spanish mackerel). This shared usage makes every conservation issue an allocation issue as well.

The Southeast formally began to address finfish bycatch in the shrimp trawl fishery in 1990 and developed a strategic research document focusing on this important issue. Previously, gear research had focused on excluding sea turtles from trawls through the development of turtle excluder devices (TEDs). Initially, this research effort lead to the development of several dozen TEDs that were approved for use in the fishery. However, in recent years the number of approved TEDS has been reduced, and only a few larger-opening TEDs are now approved for use in the fishery. The bycatch strategic document led to implementation of a formal Regional Research Program, coordinated by the Gulf and South Atlantic Fishery Development Foundation. The major components of the program were observer programs to quantify bycatch mortality, and gear technology research and development to reduce finfish bycatch. A four-phase development program for bycatch reduction devices (BRDs) for shrimp trawls was successfully used under the Regional Research Program structure to develop several BRD designs that are used in the fishery. Establishing and maintaining the distinction among these four phases proved surprisingly useful, both to the orderly progression of candidate gear through the development program, and to communicating the nature of different types of data and research. Within this framework, actual research and development of candidate devices have been carried out independently by NMFS, Sea Grant, state agencies, universities, and industry, drawing on a variety of funding sources, primarily the Saltonstall-Kennedy and Marine Fisheries Initiative grants programs.

Northeast Region

Northeast fisheries are diverse both with respect to the species sought and the gear types employed. Fisheries for invertebrate species including American lobster, sea scallop, and Atlantic surfclam are currently the most valuable in the Northeast Region. Lobster landings are mostly taken with baited traps, with about 70 percent of landings from the Gulf of Maine. Sea scallop landings are derived principally from dredge fisheries. The greatest volume of landed fish is derived from small pelagics. Groundfish fishing is primarily by otter trawling, which accounts for about 70 percent of landings. In the Gulf of Maine, otter trawl target species include gadoids and flatfishes. Fixed-gear fisheries using gill nets and longlines target primarily cod, pollock, white hake, dogfish, and monkfish. On Georges Bank, gadoids, flatfish and mixed groundfish species are generally targeted. In Southern New England, groundfish fisheries primarily of the West Coast (coastal California, Washington and Oregon) target several species of groundfish and salmon, while anchovy, sardines, mackerel, shrimp, crab, squid, and other shellfish and molluscs provide other important fishing opportunities. These fisheries are harvested using a variety of gear types (e.g., trawls, seines, pots, hook and line) that produced about 338,000t during 2002, and had an ex-vessel value of approximately $229 million.

Pacific hake (whiting), the largest proportion of groundfish landed on the West Coast, are taken by large mid-water trawl and catcher/processor vessels that have replaced the foreign and joint-venture fleets of the 1970s and 1980s. The At-Sea Hake Observer Program has provided information on the bycatch of other groundfish species and salmon in the at-sea hake fishery since the early 1990s. The shoreside hake fishery is sampled by programs run by each state. Further, a project to deploy electronic monitoring systems on the entire shoreside hake fleet for the 2004 season was a success and the analysis of the data will be available by late 2004.

Some species of rockfish are occasionally taken as bycatch in large numbers but are accounted for by the monitoring programs. Marine mammal bycatch is also monitored by the At-Sea Hake Observer Program. Since 1990, limited mortality takes have included individuals from six marine mammal species, specifically, California sea lion, Steller sea lion, harbor seal, northern elephant seal, Pacific white-sided dolphin, and Dall's porpoise. During the 2002 fishing season, observers reported three marine mammal mortalities, a level that is not considered significant.

Vessels discard groundfish at sea for many reasons, such as to comply with regulatory constraints and because a portion of the catch is economically undesirable. Trip limit-induced discards also can occur when fishermen continue to harvest other species when the OY of a single species is reached and further landings of that species are prohibited. Discretionary discards of unmarketable species or sizes were known to occur widely in the bottom trawl fishery and were largely unmeasured until the establishment of the WCGOP.

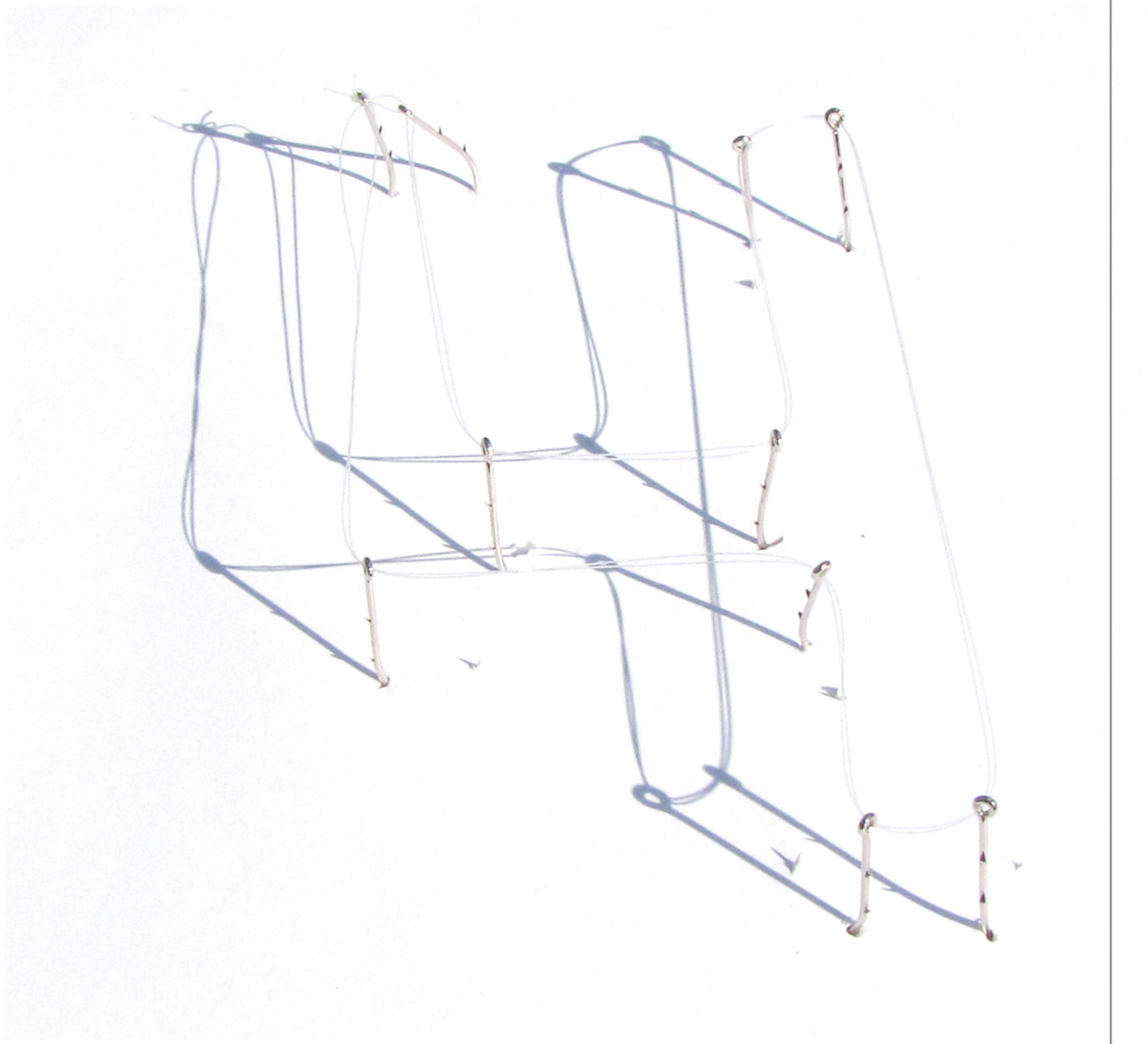
Alaska Region

Alaska fisheries are diverse with respect to the species sought, the gear types employed and the sizes of both harvesting and processing operations. They target Pacific halibut, Pacific herring and several species of groundfish, Pacific salmon, crab, and other shellfish. Since 1985, the annual ex-vessel revenue for the commercial fisheries approached or exceeded 1 billion. The recreational and subsistence fisheries are important parts of the Alaska fisheries for some species and regions.

There is an FMP for each of the following five fisheries off Alaska: the Bering Sea/Aleutian Islands area groundfish fishery, the Gulf of Alaska groundfish fishery, the BSAI king and Tanner crab fishery, the scallop fishery, and the salmon troll fishery in the Exclusive Economic Zone off Southeast Alaska. In addition, the Pacific halibut fishery off Alaska is managed under federal regulations, and NMFS is responsible for monitoring the incidental mortality and serious injury of marine mammals in state-managed fisheries under the MMPA.

This section focuses on the bycatch of all living marine resources in the BSAI and GOA groundfish fisheries and the halibut fishery and on the bycatch of marine mammals in the state-managed Category II fisheries (there are no Category I fisheries in Alaska). There are two reasons for this focus. First, the FMPs for the crab, scallop and EEZ salmon fisheries defer most management authority, including basically all bycatch monitoring and management authority, to the State of Alaska. Second, with respect to the state managed Category II fisheries, the management responsibilities and authorities of NMFS are limited principally to marine mammals. In those fisheries, monitoring and controlling the bycatch of other living marine resources is principally a stewardship responsibility of the State of Alaska or the U.S. Fish and Wildlife Service.

A variety of factors contribute to the bycatch problems in the Alaska fisheries and the state-managed MMPA Category II fisheries and make them more difficult to solve. These factors include: (1) the multi-species nature of the bycatch problem; (2) limited information concerning the biological, ecological, social, and economic effects of alternative methods for reducing bycatch; (3) substantial excess harvesting capacity; (4) with few exceptions, the use of the race for fish to allocate quotas among competing fishing operations; and (5) the external benefits and costs associated with bycatch.



Chapter Four
Evaluations

A National Approach

The National Marine Fisheries Service (NMFS) issued a National Bycatch Strategy to address issues related to the management of bycatch within the Nation's fisheries.

Protected Species

A strategy for bycatch monitoring was developed based upon the vulnerability of a fishery, the adequacy of current monitoring programs and sampling cost estimates.

A National Approach to Bycatch Monitoring Programs

On March 6, 2003, the National Marine Fisheries Service (NMFS) issued a National Bycatch Strategy to address issues related to the management of bycatch within the Nation's fisheries. One component of that strategy was the establishment of a National Working Group on Bycatch (NWGB) to develop a national approach to standardized bycatch reporting methodologies and monitoring programs. This work is to be the basis for regional teams to make fishery-specific recommendations.

The NWGB reviewed regional issues related to fisheries and bycatch and discussed advantages and disadvantages of various methods for estimating bycatch, including: (1) fishery independent surveys; (2) self-reporting through logbooks, trip reports, dealer reports, port sampling, and recreational surveys; (3) at-sea observation, including observers, digital video cameras, digital observers, and alternative platform and remote monitoring; and (4) stranding networks. All of the methods may contribute to useful bycatch estimation programs, but at-sea observation provides the best mechanism to obtain reliable and accurate bycatch estimates for many fisheries. Often, observer programs also will be the most cost-effective of these alternatives.

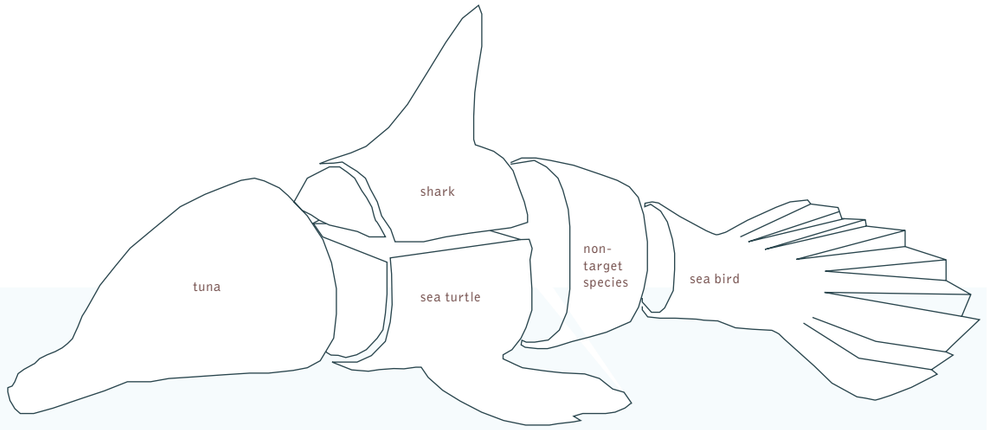
At-sea sampling designs should be formulated to achieve precision goals for the least amount of observation effort, while also striving to increase accuracy. This is done through random sample selection, by developing appropriate sampling strata and sampling allocation procedures and by implementing appropriate tests for bias. These designs and tests are needed for each fishery. Sampling programs will be driven by the precision and accuracy required by managers to address management needs: for estimating management quantities such as allowable catches through a stock assessment, for evaluating bycatch relative to a management standard such as allowable take and for developing mitigation mechanisms. The recommended precision goals for estimates of bycatch are defined in terms of the coefficient of variation (CV) of each estimate.

Protected Species

For marine mammals and other protected species, including seabirds and sea turtles, the recommended precision goal is a 20-30% CV for estimates of bycatch for each species/stock taken by a fishery.

For fishery resources, excluding protected species, caught as bycatch in a fishery, the recommended precision goal is a 20-30% CV for estimates of total discards (aggregated over all species) for the fishery; or if total catch cannot be divided into discards and retained catch then the goal is a 20-30% CV for estimates of total catch. These CV goals are the levels of precision that NMFS will strive to achieve.

Eighty-four fisheries were evaluated for bycatch monitoring and classified into one of five categories. Additionally all of these fisheries were rated as to their vulnerability (High, Moderate or Low) to bycatch of three types of resources: (1) fishery resources (excluding protected species); (2) marine mammals; and (3) other protected species, that is, ESA-listed species (excluding marine mammals), other sea turtles and other seabirds. Of the 84 fisheries, 5% have a Mature observer program, 20% were Developing (25% were either Mature or Developing), 10% have a Pilot program, 29% have a Baseline program and 37% do not have a program. Thirty-one percent of these 84 fisheries are rated High for bycatch vulnerability of one or more of the three resource types (thus, 69% are rated Moderate or Low for all three types of resources); 6% of these fisheries are rated High for bycatch vulnerability. One or more of the three resource types and recommended for establishment of Baseline or Pilot observer programs. A strategy for bycatch monitoring was developed based upon the vulnerability of a fishery, the adequacy of current monitoring programs and sampling cost estimates.

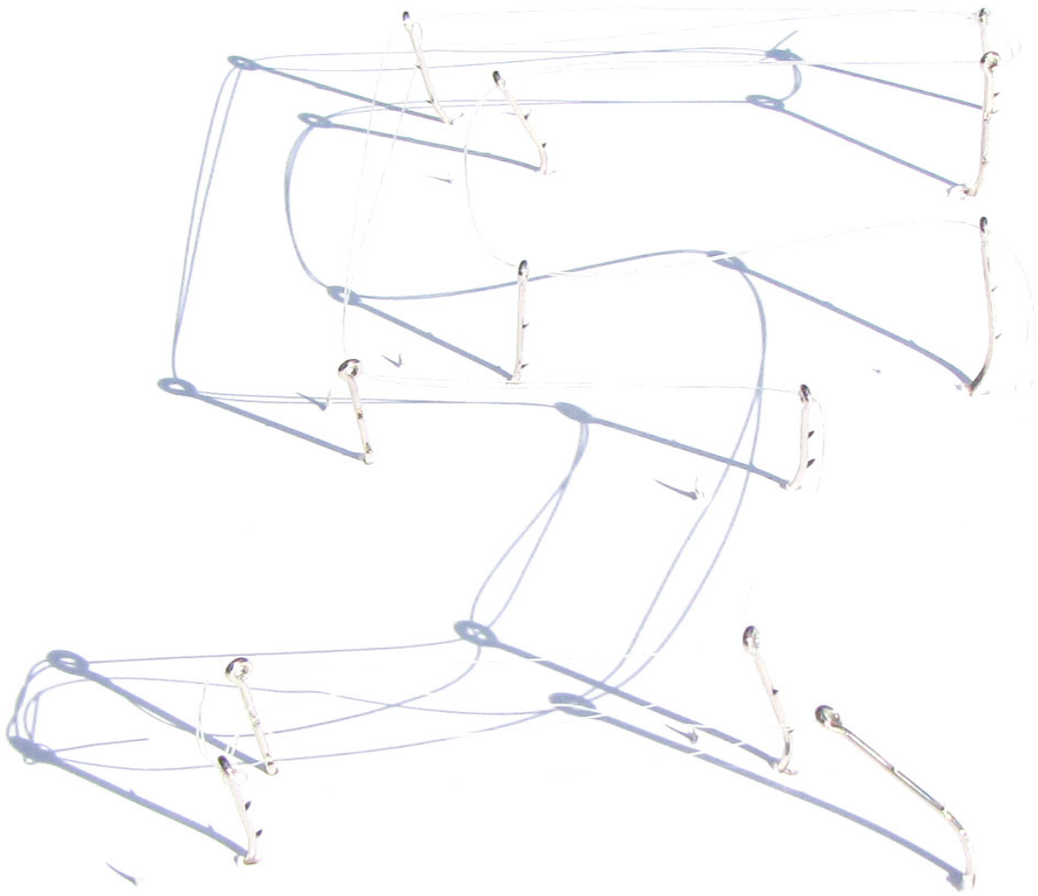


Only a portion of the catch in long line tuna fishing is tuna.

Bycatch is defined as the discarded catch of any living marine resource plus unobserved mortality1 due to a direct encounter with fishing gear. This definition is based on the bycatch definition that appears in the 1998 National Marine Fisheries Service (NMFS) report Managing the Nation's Bycatch but it does not include retained incidental catch as a component of bycatch. However, NMFS is aware that for some species, such as protected species, the primary management concern is the level of incidental catch, not the disposition of that catch. To meet its stewardship responsibilities, NMFS is committed both to account for target catch, retained incidental catch and bycatch and to decrease each of these three sources of fishing morality as appropriate to prevent overfishing, to rebuild overfished stocks and in general to provide the greatest net benefits to the Nation over time from the fisheries.

Bycatch occurs if a fishing method is not perfectly selective. A fishing method is perfectly selective if it results in the catch and retention only of the desired size, sex, quality, and quantity of the desired species without other fishing-related mortality. Very few fishing methods are perfectly selective and typically the discard survival rate is less than 100 %; therefore, bycatch is a source of fishing mortality in most fisheries.

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), and international agreements identify the stewardship responsibilities of NMFS (NOAA Fisheries) to lead and coordinate the Nation's collaborative effort to monitor and reduce the bycatch of living marine resources. As part of its efforts to meet these responsibilities, NMFS reported on the scope and complexity of bycatch in the United States and approaches to addressing bycatch problems (NMFS 1998a). In early 2003, NMFS developed a National Bycatch Strategy to monitor and mitigate bycatch within the Nation's fisheries. Within that strategy, a National Working Group on Bycatch (NWGB) was appointed to formulate procedures for monitoring bycatch, in particular to provide information that could be used to develop standardized bycatch reporting.



Chapter Five
Reports

Fishery-Independent survey

The California Department of Fish and Game and NMFS have conducted an observer program to collect data on the bycatch of protected species.

Fishery-Dependent Self-Reporting

Self-reporting programs include fishing logbooks, landings reports, and interviews of commercial and recreational fishermen.

Port Sampling

Port samplers collect information primarily on catch, but also on bycatch when such information is available

Recreational Sampling

The objective of this survey is to provide estimates of recreational catch and effort over fairly large strata.

At-Sea Observers

Fisheries observers are biologists trained to collect information onboard fishing vessels.

Digital Observers

This technology takes video monitoring one step further to using a digital scanner to record images of individual fish.

Logbooks

Logbooks may provide qualitative estimates of bycatch where bycatch is required to be reported; however, the accuracy of these data is of concern.

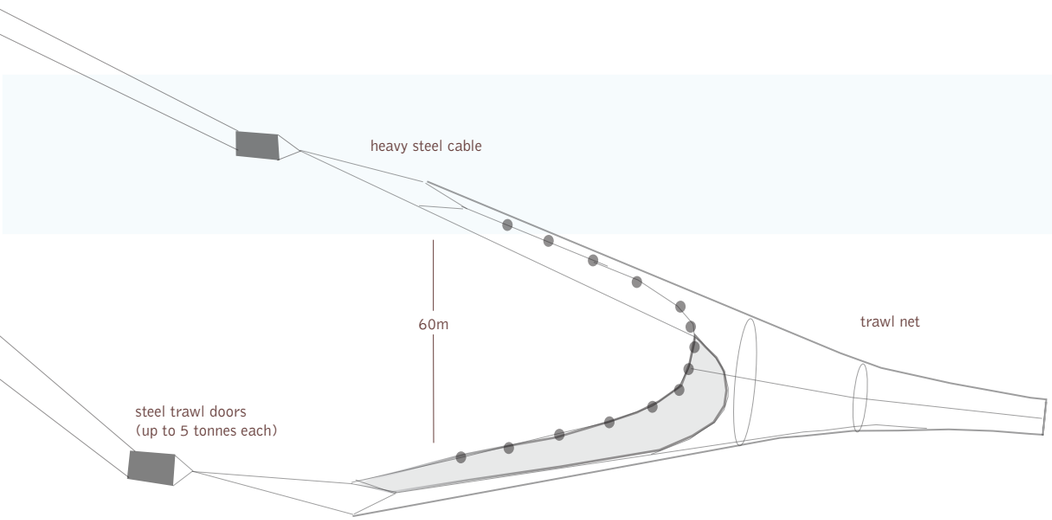
A single pass of a trawl removes up to 20% of the seafloor fauna and flora.

Fishery-Independent Surveys

Fishery-independent and fishery-dependent sources of information may differ in several key respects. Fishery-independent surveys are intended to provide unbiased estimates of important population attributes such as abundance or size and age composition. Although it also is important that information derived from the fishery itself is unbiased, fishery operations are not intended to provide unbiased estimates of population attributes. It is therefore possible to have different signals from fishery-independent sources and those derived from the fishery. For example, a research vessel survey may detect a declining trend in overall population size while catch-per-unit-effort remains relatively stable as fishermen target concentrations of fish. Inferences can be made from research surveys regarding what commercial bycatch might be. Fishery-independent surveys may be useful in estimating total bycatch for fisheries in which observer data are discontinuous. However, fishery-independent estimates do not replace the need for direct fishery-dependent observer data, and the models that are used to generate such estimates are best applied to complement direct observations of fishing effort from a developed observer program or as a beginning point for developing more mature observer programs. Fishery-independent estimates of bycatch will always be subject to criticism that the characteristics of the research effort are different from those of the fishery and that those differences are not adequately incorporated in the estimation process.

Fishery-Dependent Self-Reporting

Fishery-dependent data are data collected from commercial and recreational fishing activities, thereby providing information on removals associated with actual fishing operations. Self-reporting programs include fishing logbooks completed by fishermen, landings reports completed by fishermen and/or dealers (i.e., buyers or processors), and interviews of commercial and recreational fishermen. In some cases these programs collect bycatch data, but in most cases they provide effort or landed catch data that can be used with bycatch rate estimates from other sources (e.g., observer programs) to estimate bycatch. Dealer reporting is one type of selfreporting in which dealers are required to report the amounts of fish bought and sold, by vessel and by species. Dealer reporting is required by nearly all state resource agencies, but does not generally include reporting of at-sea discards. One exception to this is the Alaska Department of Fish and Game's requirement that all discards be reported; however, compliance is a concern.



Pelagic Trawl Diagram

Port Sampling

Port samplers are federal or state government-employed or contracted biologists trained to collect fishery information and biological samples from fishermen and/or dealers, at or near the time of landing. In some cases, the presence of a port sampler is required to offload fish (the port sampler is making direct observations of what is landed); in other cases, a random sampling strategy is employed, while taking advantage of opportunistic sampling where possible.

Port samplers collect information primarily on catch, but also on bycatch when such information is available. Bycatch data collected by port samplers are similar to logbook data in that there are significant concerns about the completeness and accuracy of these reports. Because fish discards are not observed by the port sampler, information on discards is less reliable than information on landings. Data from interviews with fishermen or dealers may not be representative of total catch, as they depend on the ability and willingness of these individuals to report catches accurately. Biological sampling is limited to only the landed catch. In addition, port sampling typically results in only a small sample of total fishing effort, and port samplers are not consistently used in all U.S. ports. An advantage over logbooks, though, is the timeliness of these reports and their usefulness in directing further sampling towards potential problem areas.

Recreational Sampling

In most coastal states, recreational fishery data have been collected under the annual Marine Recreational Fisheries Statistics Survey (MRFSS) since 1979. The objective of this survey is to provide estimates of recreational catch and effort over fairly large strata (by state and two-month period). In 1997, nearly 17 million anglers made 68 million marine fishing trips to the Atlantic, Gulf, and Pacific coasts. The estimated marine recreational fish catch was 366 million fish, and more than 50% of the fish caught were released alive. The survival rates for the released fish are highly variable.

The MRFSS data are collected by two independent but complementary surveys: (1) a telephone survey of households in coastal counties, and (2) an intercept (i.e., interview) survey of anglers at fishing access sites. The telephone survey is used to collect reliable data on recreational fishing effort. Information on the actual catch (and bycatch), such as species identity, number, and both weights and lengths of fish are collected via the intercept survey. Estimates of landed catches are based primarily on direct observations made by trained samplers. Estimates of bycatch are based on self-reporting during the intercept interviews. However, because fish discards are not observed by the interviewer, information on bycatch is less reliable than information on landings.

In an effort to increase the quality of data on bycatch, NMFS has also initiated an at-sea component of the intercept survey on the party/headboat fleets. This sampling is currently focused on vessels operating in the Atlantic. NMFS also funds at-sea data collection in Pacific states through the Pacific States Marine Fisheries Commission's Recreational Fisheries Information Network (also known as RecFIN). If this program is successful, it would improve the accuracy of counts and species identifications of discards and provide estimates of size distribution of discarded fish, which are currently unavailable.

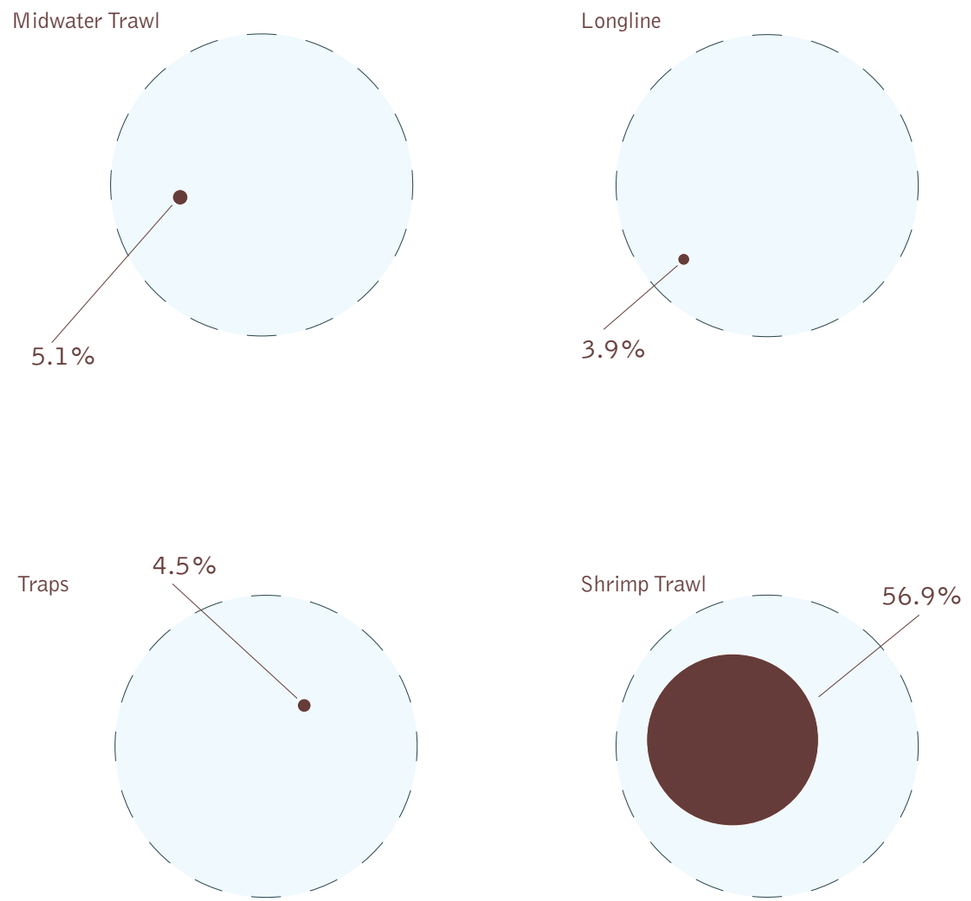
At-Sea Observers

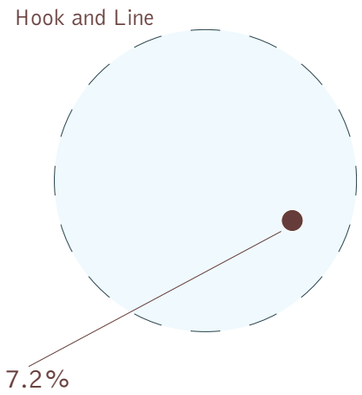
At-sea fisheries observers are biologists trained to collect information onboard fishing vessels. Observers may be deployed for various reasons, including monitoring of protected species interactions or total removals (including discarded species), monitoring compliance with fishery regulations or other environmental laws, validating or adjusting self-reported data, providing vessel-by-vessel catch, providing data to support in-season quota management, and monitoring experimental or exempted fishing activities. See NMFS (2004) for a more detailed discussion of observer program goals and objectives.

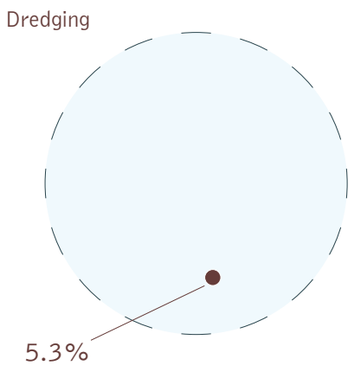
Regardless of the primary objective for placing observers in a fishery, at-sea observers are generally trained to collect information on the catch and bycatch, as well as information on the disposition (e.g., released alive vs. dead, or where hooked in the case of protected species taken in longline fisheries) of some or all of the bycatch species. Observers routinely collect biological samples and also may assist with fisheries research or tagging studies. Besides data on catch and bycatch, observers may also collect information on gear used, vessel type and power, fishing techniques, fishing effort, gear characteristics, environmental conditions, and, in certain fisheries, economic information (e.g., crew size, crew shares and the cost of fuel, bait and ice).

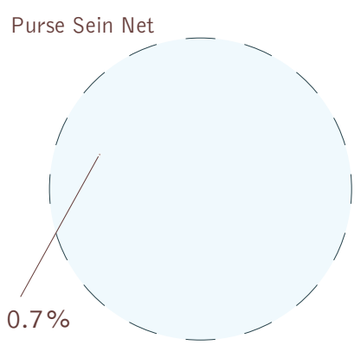
The wide range of information collected by observers is useful for analyzing life history, determining gear selectivity and fishing efficiency over time, and studying the behavior of fish and fishermen. Observer data can also be used in combination with information collected from fishery-independent sources, port observations, and landings receipts to estimate the relative abundance of target and bycatch species in some fisheries. NMFS' authority to place observers on certain fishing vessels comes from the MSA, the MMPA, and the ESA, as well as other marine laws.

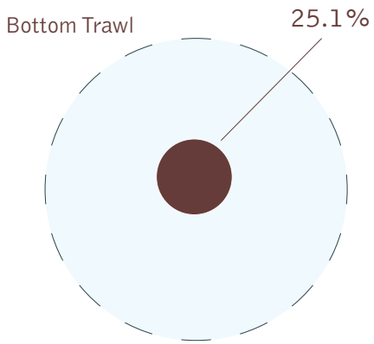
Attributed to overall bycatch deaths:











Digital Observers

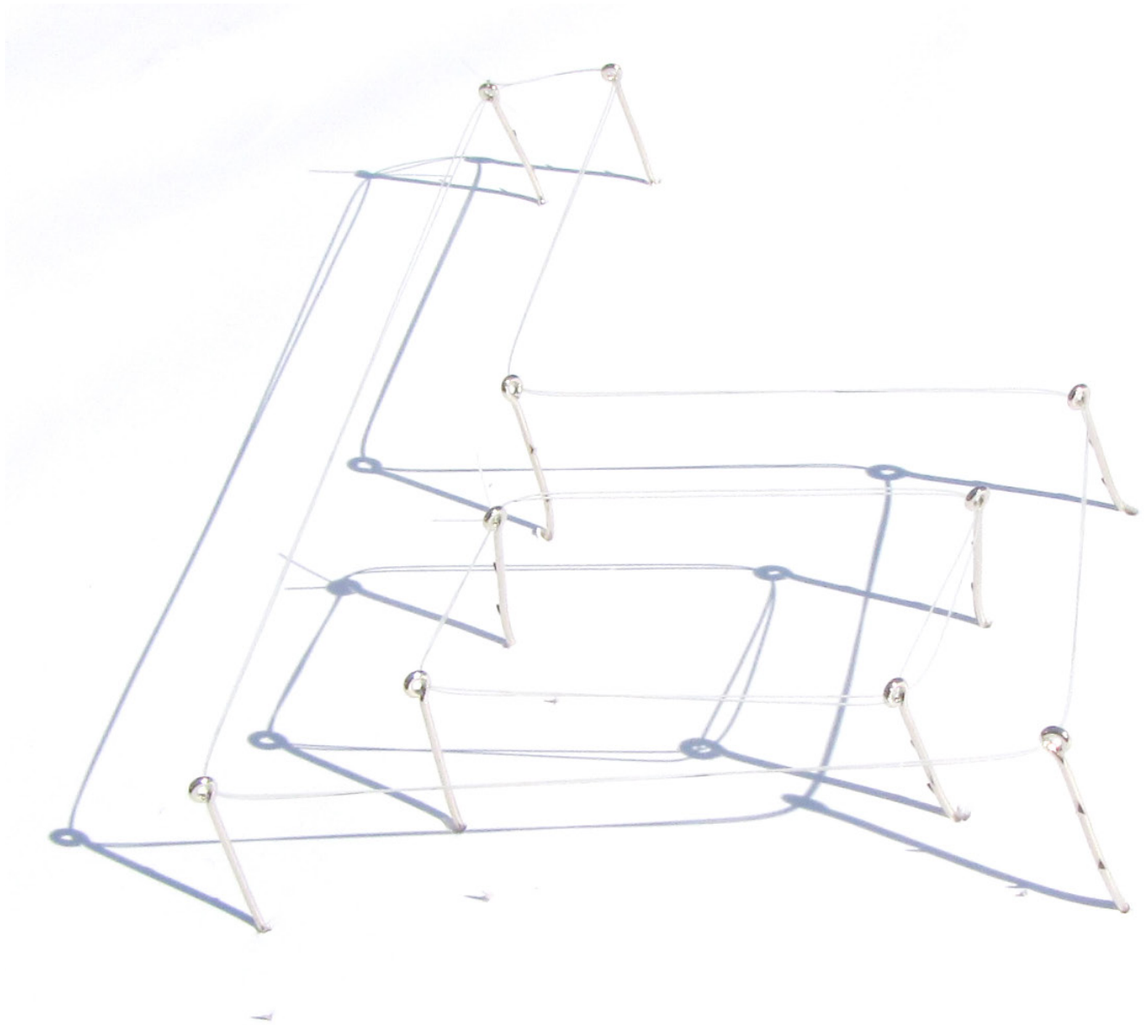
Digital observer technology takes the use of video cameras for monitoring fishing activities one step further to using a digital scanner to record images of individual fish for electronic species identification and for length/frequency estimates. The scanner records several images of a fish as it passes through the scanner on a conveyor belt, and uses the best of these images to make its predictions and calculations. The primary developer of this technology is Digital Observer LLC of Kodiak, Alaska, for use in Alaska groundfish fisheries. Although this technology is still in a pilot phase, it appears to be software and hardware intensive. Further testing needs to be done to determine its potential utility for specific fisheries and/or gear types, and associated costs.

Logbooks

Mandatory reporting for logbooks are alwaysa type of self-reporting and are generally more detailed, and may include information on the type of gear used, date, time of day, and position of fishing activity, weather conditions, fishing characteristics of the deployment of the gear, and catch of non-target species. Bycatch data reported in logbooks can be useful in estimating bycatch, but only if fishermen are willing and able to report bycatch accurately in the logbooks. Outreach and compliance programs can be of assistance with both. However, many logbook programs do not require the reporting of bycatch, or do not place a strong emphasis on accurate reporting of bycatch.

Under the Marine Mammal Authorization Program all fishermen participating in a state or federal fishery that operates in U.S. waters are required to report all injuries and mortalities of marine mammals associated with fishing operations to NMFS within 48 hours of returning to port. This requirement was enacted by the 1994 amendments to the MMPA. However, the Program has not succeeded in obtaining reliable marine mammal bycatch data.

Logbooks may provide qualitative estimates of bycatch where bycatch is required to be reported; however, the accuracy of these data is of concern. Logbooks are more useful in providing estimates of total effort by area and season that can then be combined with observer data to estimate total bycatch.

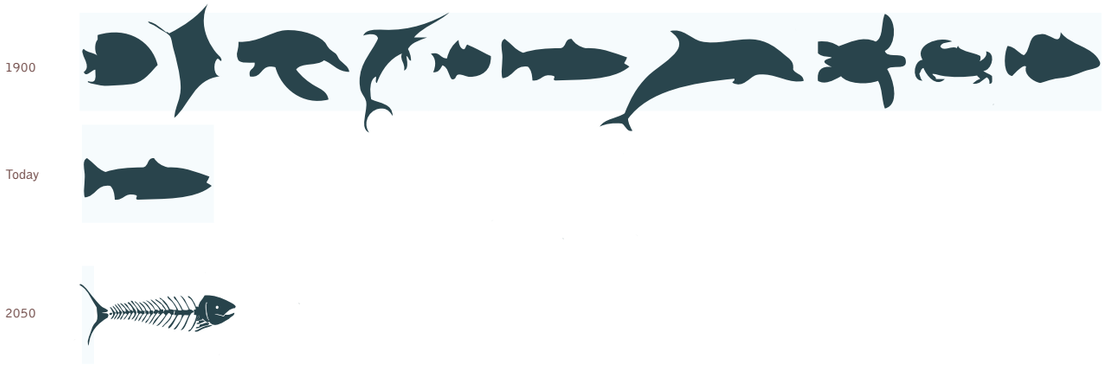


Chapter Six
Estimates

Precision of Bycath Estimates
In most fisheries, it is neither physically nor economically feasible to monitor all fishing effort, catch and bycatch and to do so without measurement error.

Accuracy and Bias of Bycatch Estimates
Observer programs strive to achieve samples that are representative of both fishing effort and catches.

For every 10 fish that were in the ocean about 100 years ago, only 1 is left today. In 40 years that will be no more fish, whales, dolphins, turtles, etc. in the ocean if current levels continue.



Precision of Bycatch Estimates

The measure of precision commonly used in reference to estimates of bycatch is the coefficient of variation, or CV, which is given by the ratio of the square root of the variance of the bycatch estimate to the estimate, itself. The lower the CV, the greater the level of precision. The CV of an estimate can be decreased by increasing the number of observations which increases sampling cost. However, as the number of observations is increased, the CV decreases at a decreasing rate. For large samples, the CV of an estimate is inversely proportional to the square root of the size of a sample. This means that at some point a further increase in the number of observations cannot be justified in terms of the reduction in the CV and the associated benefits of the more precise estimate given the increase in sampling cost. Therefore, managers seek to achieve a level of sampling that has an acceptable balance between precision (CV) and cost.

The specific relationships will vary by fishery and species. Fogarty and Gabriel calculated first-order estimates of relative precision for discard rates based on observed bycatch. The relative precision is determined by scaling the standard error of the discard estimates and dividing by the discard level. However, this analysis was based on non-target species that are easy to identify. The true challenge occurs when species are not readily identifiable and when several species need to be identified in a single haul.

Accuracy and Bias of Bycatch Estimates

Observer programs strive to achieve samples that are representative of both fishing effort and catches. Representativeness of the sample is critical not only for obtaining accurate estimates of bycatch, but also for collecting information about factors that may be important for mitigating bycatch. Bias may be introduced at several levels: when vessels are selected for coverage, when hauls are selected for sampling, or when only a portion of the haul can be sampled. By having an observer onboard the vessel is referred to as the observer effect.

Vessel selection strategies vary from fishery to fishery, depending on how the fishery is prosecuted, the nature of the observer program, the distribution of fishing vessels, and safety and accommodation concerns. In the West Coast groundfish fishery, vessels are selected for coverage for an entire two-month cumulative trip limit (NWFSC 2003). This selection strategy minimizes bias associated with estimation of discards, as the tendency to discard certain species that are managed by trip limit quotas may increase as the trip limit period draws to an end. Voluntary programs may be designed to achieve a representative sample, but may be subject to bias if there are refusals by selected vessels. The fishing effort associated with vessels fishing out of one or a few major ports may be easier to track to ensure randomization of observer coverage than with vessels fishing out of many smaller ports. Concerns regarding safety or accommodations may limit the pool of sampled vessels and affect NMFS's ability to achieve a random sample. Therefore, vessel selection strategies must be representative of actual fishing effort, in terms of time (i.e., over the entire fishing season) and space, as well as vessel type, gear type and targeting strategy.

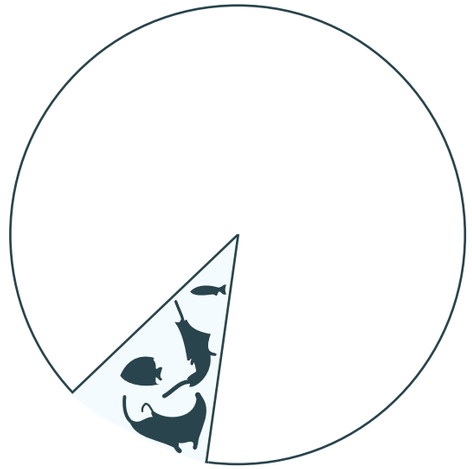
Once the vessel has been selected for coverage, either all hauls are sampled, or a portion of the hauls are sampled. For fisheries that operate around the clock, where only a portion of the hauls can be sampled, methodologies must be used that randomize which hauls are chosen for sampling. The North Pacific Groundfish Observer Program uses a combination of Random Sampling Tables and Random Break Tables to assist observers in determining which hauls should be sampled to ensure randomness.

Another source of bias is known as the "observer effect". The observer effect is the change in fishing behavior caused by having an observer onboard a vessel. This can result in avoidance of known "hot spots," reduced fishing effort, or extra attention paid to the quick release of live animals. This may also result in interference with observer sampling by the crew or intimidation of the observer in order to prevent observers from making accurate estimates for observed hauls. When it is reported, such interference and intimidation can be addressed by observer program managers and enforcement officials. The management regime can affect both the nature and magnitude of the observer effect. For example, if there are bycatch limits that can either close a fishery or trigger time and area closures, fishermen will have a greater incentive to take actions that result in an observer effect bias.

The observer effect can be difficult to measure and account for. Although increases in observer coverage may increase the accuracy of bycatch estimates by decreasing the chances that observed operations are not representative of all operations, this is not recommended without first attempting to quantify this effect through some other, independent assessment of fishing activity. This could include analysis of data from logbooks, landings reports, Vessel Monitoring Systems, or electronic monitoring programs. In some cases, a third party compliance program will be needed to decrease some of the bias introduced by the observer effect.

It can be difficult to determine how representative the observed catch and effort are of total catch and effort in a fishery and how accurate the observer estimates are for the sampled catch. It is more difficult to do either for new programs or programs with low levels of coverage, where knowledge is limited regarding the unobserved portion of the fleet.

Babcock et al. (2003) examine important issues related to the potential for bias in bycatch estimates derived from observer programs due to factors such as non-random sampling and changes in fishing tactics when observers are onboard (the "observer effect"). The difficulty in obtaining a strictly random sample is evident in many observer programs where logistical constraints in scheduling and variable levels of cooperation are common.



Only 10% of fish caught are eaten. Due to human's selective apetite, cultural norms, and quotas which need to be met on land, up to 90% of animals caught on fishing nets are thrown back dead into the sea.

Often, sampling has been undertaken on an opportunistic basis, particularly during the initial stages of development of an observer program. The potential for changes in the behavior of fishermen when observers are onboard must be recognized. Avoidance of areas where bycatch might be high and changes in trip duration or other aspects of fishing operations when observers accompany the vessel can result in bias in estimates of bycatch. Babcock recommend that comparisons of observed and unobserved vessel trips be routinely made to check for potential bias.

Possible checks based on widely readily available information include comparisons between observer-reported information and the landed component of the catch for the fleet as a whole. Such comparisons should be implemented in all observer programs, although it must be recognized that these checks cannot ensure that bias in bycatch estimates is not present.

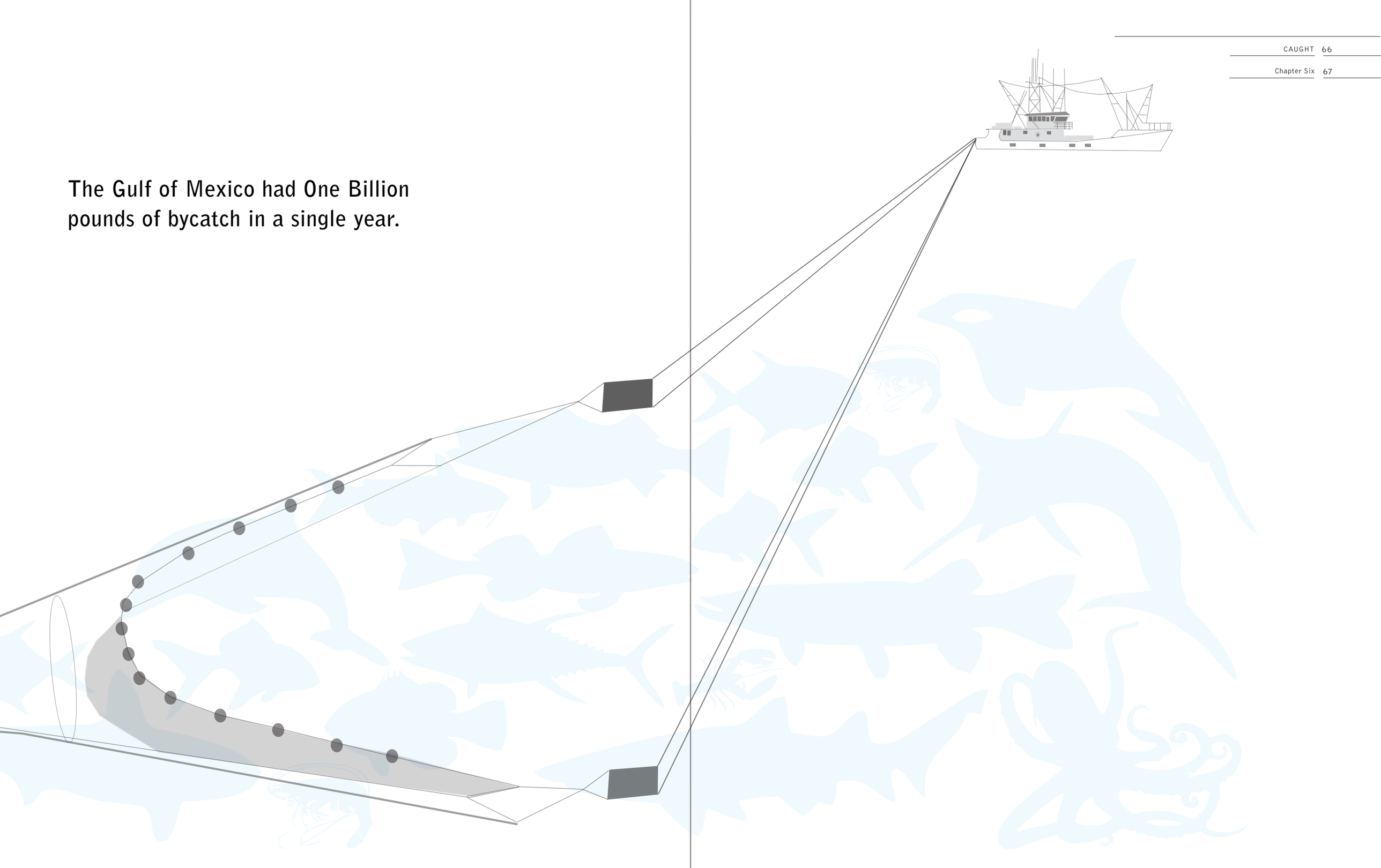
Comparisons of factors such as trip duration, tow or haul duration, fishing location, and catch-per-unit-effort and other metrics characterizing a fishing trip made between observed and unobserved trips can also provide important checks on the adequacy of sampling. These comparisons will often necessarily be made against self-reported information from the fishing fleet, and appropriate care must be taken in interpretation.

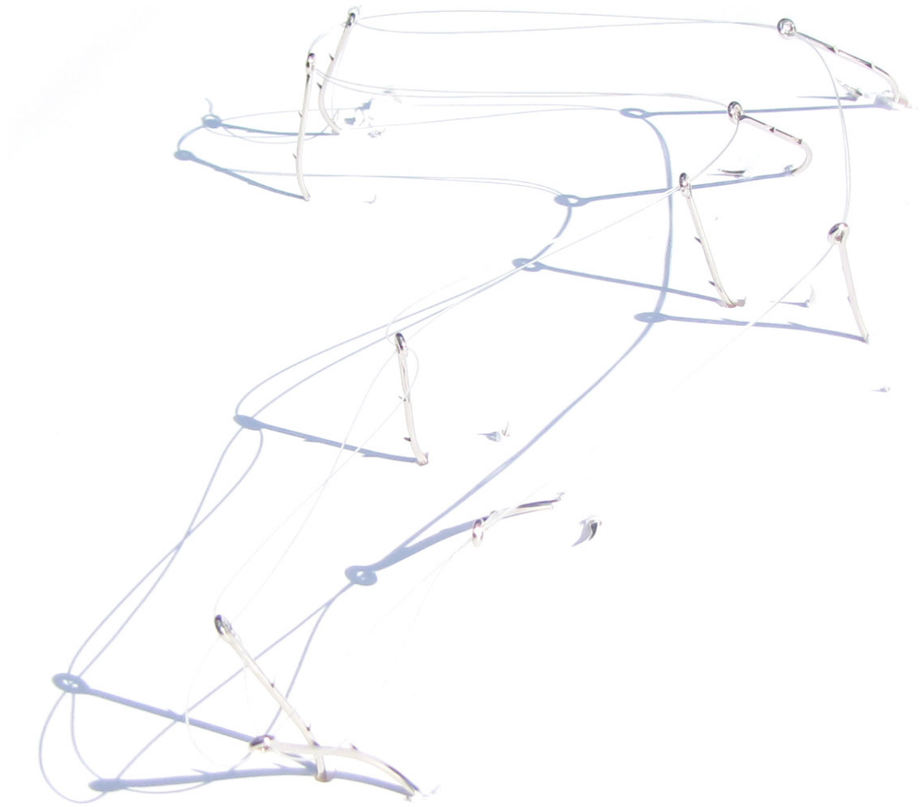
As the level of coverage is increased for a specific vessel, the cost of altering fishing tactics when an observer is on the vessel is increased; therefore, the net incentive to alter fishing tactics is decreased. Although there is substantial uncertainty concerning both the extent of this behavior and the change in behavior that would be associated with a given increase in observer coverage, the expectation is that both would tend to vary by fishery, if not by vessel or fisherman. Fishery specific research would be necessary to provide the information necessary to determine whether an increase in coverage can be justified in terms of a reduction in this type of observer effect. It may be possible to test for such behavioral change in observer programs in which increases in the coverage level have occurred over time.

Observer programs can be a reliable source of date for estimating bycatch.

The precision and accuracy of bycatch estimates are determined by sample size and the design and execution of a robust sampling scheme. Identifying and accounting for sources of bias is critical, as are measures to increase both the cost effectiveness and safety of observers.

The Gulf of Mexico had One Billion pounds of bycatch in a single year.





Chapter Seven
Experiments

Bycatch Initiative
The WWF, the IATTC and other partners joined forces to save marine turtles from long-line fisheries bycatch.

Conservation Relevance
The mortality of marine turtles when they are caught in long-line fishing is one of the major factors affecting their population survival.

Bycatch Interactions
There are two basic types of bycatch interactions of marine turtles with long-lines.

Post-hooking/Entanglement Mortality
The retrieval of the gear and manipulation of turtles by fishermen is another factor affecting turtles mortality.

The Challenge: Long-line Fleets Fishing in the Eastern Pacific Ocean
Fishermen, boat owners, governments and other key stakeholders identify and test means to reduce marine turtle bycatch.

Participatory Approach to Marine Turtle Bycatch Mitigation
It allows direct trials of circle hooks by fishermen.

Bycatch Initiative

WWF started a joint venture project with the Inter-American Tropical Tuna Commission (IATTC) and other partners to save marine turtles from long-line fisheries bycatch in the Eastern Pacific Ocean. Key initial partners of this program include IATTC, NOAA, Ocean Conservancy, the Western Pacific Regional Fishery Management Council (WPRFMC), the Overseas Fisheries Cooperation Foundation of Japan (OFCFJapan), and WWF.

The objective is to reduce the threat to marine turtle populations in the Eastern Pacific Ocean due to bycatch interactions in long-line fishing operations. To achieve this objective, the program is working cooperatively with fishermen, boat owners, governments and other key stakeholders to identify and test means to reduce marine turtle bycatch and reach a massive transformation of the long-line fleets towards the adoption of best fishing practices for sustainable fisheries.

Clearly, there are other challenges to make the transformation of the fleet to circle hooks a reality. These are, among others: a) making circle hooks and other bycatch tools available in local markets at reasonable and competitive prices; b) promoting the institutional adoption of the observer program by local actors to provide sustainability to the program in the medium and long term; c) continue and strengthen the awareness and education of fishermen; d) facilitate the technological adaptation and transformation of the fleet with proper regulatory measures; and e) find and develop potential markets for fish coming from fisheries with circle hooks and turtlefriendly practices.

Therefore, the work of this program will expand from its original fishing experiments focus (which will be continued) to other areas, such as those mentioned above. The intention will remain the same though, that being to ensure that solutions to bycatch can be effectively implemented to save marine turtles and at the same time laying the foundations to move the artisanal long-line fishery in the Eastern Pacific Ocean toward sustainability.

Three ruling principles of the program:

1. Nobody wants to harm or kill turtles.
2. Nobody wants to be put of out of business.
3. Participation of fishermen and vessels in the program is voluntary.

The method of work is unique as it is testing alternative gear and best practices under "real life" fishing conditions operating in several fisheries, in vessels of different sizes and navigational autonomy, at a regional scale.

Conservation Relevance

The mortality of marine turtles when they are caught in long-line fishing is, among others, one of the major factors affecting their population survival. In the Eastern Pacific Ocean (EPO), Leatherback turtles (Dermochelys coriacea) and Loggerhead turtles (Caretta caretta) are the species of most concern because of their critical population condition. The Eastern Pacific Leatherback turtles are critically endangered, and could disappear entirely within a decade, if the main threats are not abated effectively and soon. Bycatch of marine turtles must be reduced in order to minimize fishing related mortality and to increase the chances of survival of these marine reptiles.

Solutions to marine turtle bycatch problems must be beneficial to both marine turtles and fishermen. Industrial and artisanal fleets targeting tuna, billfishes, sharks, mahi-mahi, and other large pelagic fishes, sustain important economies along the Pacific coast of Latin America, where thousands of families depend on fishing resources for their food security, income, and livelihood. Surface long-line fishing for large pelagic species, and bottom long-line fishing (targeting snappers, groupers, catfish and other coastal finfish), are very popular fishing gears and are most commonly used with baited J-shaped hooks.

Circle Hook

J Hook

Bycatch Interactions

Two basic types of bycatch interactions of marine turtles with long-lines:

1. Hookings, Baited long-line hooks attract swimming turtles close to the fishing gear. When the turtle bites at the bait, the hook can become lodged in the beak, tongue, or throat. Hookings in the beak or tongue cause injuries that normally are not fatal. However, if the hooking is in the throat it can cause serious or even fatal injuries when hooked turtles are pulled during line recovering operations, or when cutting the line fishermen leave part of the line in the hook. The line can actually cause more serious injuries than the hook and eventually kill the turtle. Other hookings occur in the fins or tail, but even if the injury is not serious the turtle may drown if it cannot reach the surface to breathe.
2. Entanglements, Turtles can also be caught when swimming near the long-line gear. If for example, the turtle is attracted (for any reason) to a float, it can become entangled with the float's line when "playing" with and around the float. If the gear is subsequently lost or it sinks, the turtle will also sink and can drown if not retrieved and released in time.

Post-hooking/Entanglement Mortality

Another important factor affecting turtles incidentally caught in long-lines is the retrieval of the gear and manipulation of turtles by fishermen. Improper handling of hooked or entangled turtles can further injure them, or reduce their survival chances when released. Therefore, any technical solution to marine turtle bycatch must be matched with proper education, awareness and training of captains, crew and boat owners, so the fishing operation can be adapted to implement fishing gear modifications and adopt adequate fishing practices, especially with regard to gear retrieval, and turtle handling and release techniques.

The Challenge: Long-line Fleets Fishing in the Eastern Pacific Ocean

As of the beginning of 2008, there are 4521 tuna vessels operating in the EPO, according to the data of the IATTC's Vessel Register. There are 255 purse-seiners, 2,564 long-liners, 856 trollers, 147 poll & line vessels, 36 gill-netters, 373 multipurpose vessels, 12 hand-liners, 6 harpooners, 192 recreational vessels, 2 of non-specified gear, and 83 vessels of unknown gear.

Despite long-liners representing around 56% of all fishing vessels in the Vessel Register of the tuna commission, the majority of the tuna and tuna-like catches are taken by the purse-seine fleet (around 86% in 2005). In the tuna fishery, marine turtle bycatch is mainly caused by long-line vessels. Current observers' data in the purse-seine tuna fishery shows very little marine turtle bycatch. Data from IATTC show that 1,290 long-line vessels authorized to fish in the EPO are longer than 24 m, but no precise estimates exist for the number of smaller long-liners. This is due in part to the resolution on Illegal, Unreported and Unregulated (IUU) fishing which applies to any fishing vessel greater than 4m. Nonetheless, some countries have reported to IATTC vessels under 24 m in length. Distant Water Long-line fleets from Japan, Korea, Chinese Taipei, and China constitute 74% of the large long-line vessels.

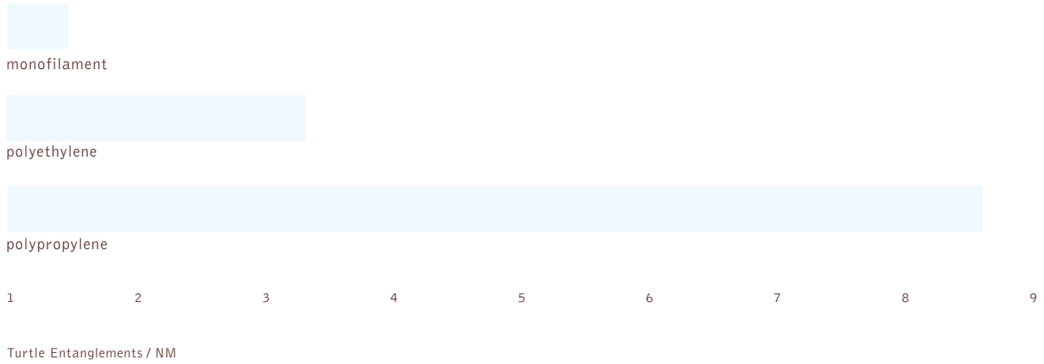
In Latin America, an artisanal long-line fleet is also fishing on tuna and tuna-like species with in-board engine vessels and outboard skiffs. Industrial and artisanal fleets are probably interacting with marine turtles in different ways, as the characteristics of the long-line gear and related equipment vary across the different fisheries and technological capabilities of the fleet. No precise accounts of the number of artisanal long-line vessels are available. Conservative estimations of the artisanal long-line fleet range anywhere between 10,000 to 16,000 small vessels in the region. The number of hooks deployed by the artisanal fleet, therefore, may well be in a similar order of magnitude to those of the industrial fleet. The relative contribution of the artisanal fleet to the overall bycatch of marine turtles in the EPO is therefore likely to be significant.

In long-line fishing, effort is the total number of hooks fishing in a given time period, while BCPUE is the bycatch per unit effort, usually measured as a rate such as the number of non-target individuals caught per thousand hooks. Means to reduce effort may include regulatory limits or bans, market incentives and gear changes, while means to reduce BCPUE may include some of these factors, but also technological and operational changes, changes in fishing practices through awareness, education and training, and regulatory limits to total bycatch.

However, bycatch does not necessarily translate into mortality, though. For example, an incidentally caught specimen (such as marine turtles) is often still alive when the gear is retrieved and when correctly handled, can be released without causing further injuries that could compromise its survival. For this reason, bycatch mortality reduction strategies can address two fronts: avoiding the interaction between the gear and the non-target species altogether, and reducing the harm inflicted by the gear to the specimen when an interaction does occur. Both avenues are pursued under this program.

To achieve this objective, the program is working cooperatively with fishermen, boat owners, governments and other key stakeholders to identify and test means to reduce marine turtle bycatch, and reach a massive transformation of the long-line fleets towards the adoption of best fishing practices for sustainable fisheries.

The expected result of this transformation is an overall reduction of long-line fishing related marine turtle mortalities in the Eastern Pacific Ocean caused by long-line fishing. Key elements of this are the use of proper fishing gear and the education of captains and crew in best fishing practices so they can reduce interactions and know how to handle and release hooked or entangled turtles and return them to the sea.



Participatory Approach to Marine Turtle Bycatch Mitigation has Several Benefits:

» It allows direct trials of circle hooks by fishermen. In this way, after returning to port and meeting their peers, collaborating captains and crew can inform other fishermen about the new technology. This is what we call fishermen-to-fishermen convincing, an important cultural aspect of the process of technology appropriation.

» Data collected by observers are checked for errors, edited and entered into the database. Consequently, as more fishermen join the program and accept an onboard observer, this participatory project is building a critical mass of information about the performance of the fishery and the nature of the interaction with marine turtles. This will allow managers, fishermen and their organizations to make educated decisions about the regulatory measures that may be needed to improve the fishery and further reduce bycatch interactions.

» As the number of fishermen participating in the program increases, and thus more fishermen gain experience in being part of marine conservation, eventual regulations coming from the fishing authority have a better chance of being supported by fishermen. This is critical for artisanal fisheries in developing countries where capacity and resources for surveillance and enforcement of regulations are poor.

» The project provides a practical and current opportunity for fishermen to be part of a major effort to save marine turtles to become key drivers of change. This is a novel experience for them, as true custodians of marine resources, and distinguishes them from the traditional, negative way they are usually portrayed. We believe that this "ownership" will lead to the dawn of a new culture of multi-sector collaboration and continuous improvement. This is essential for a long-term program and for fishermen's commitment to sustainable fisheries.

» Innovative ideas coming from the direct experience of fishermen can greatly contribute to enhancing the performance of bycatch mitigation tools, and direct the adaption of solutions to particular fishery circumstances.

List of Acronyms

AFMA Australian Fisheries Management Authority

CCAMLR Commission for the Conservation of Antarctic Bluefin Tuna

CCSBT Commission for the Conservation of Southern Bluefin Tuna

CSFOP Commercial Shark Fishery Observer Program

DFO Department of Fisheries and Oceans

ESA Endangered Species Act

FAO Food and Agriculture Organization of the United Nations

FFA Forum Fisheries Agency

GIS Geographic Information System

GPS Geographic Positioning System

IATTC Inter-American Tropical Tuna Commission

ICCAT International Commission for the Conservation of Atlantic Tunas

INIDEP Insitiuto Nacional de Investigacion y Dessarrollo Pesquero

IOTC Indian Ocean Tuna Commission

ISMP Integrated Scientific Monitoring Program

LORAN Long-range navigational System

MAFF Ministry of Agriculture, Forestry, and Fisheries

MARPOL International Convention for the Protection of Pollution From Ships

MMPA Marine Mammal Protection Act

MSA Magnuson-Stevens Fishery Conservation and Management Act

NMFS National Marine Fisheries Service

NMPA Marine Mammal Protection Act

NOAA National Oceanic and Atmospheric Administration

NPFMC North Pacific Fisheries Management Council

NPGOP North Pacific Groundfish Observation Program

NZMOF New Zealand Ministry of Fisheries

PBR Potential Biological Removal

PIRO Pacific Islands Regional Office

RADAR Radio Detection and Ranging

RFMO Regional Fisheries Management Organization

SEFSC POP Southeast Fisheries Science Center, Pelagic Observation Program

SLP Sea Level Pressure

SPC Secretariat of the Pacific Community

SST Sea Surface Temperature

TDR Time Depth Recorder

TEDS Turtle Excluder Device

TRP/TRT Take Reduction Plan/Take Reduction Team

UTC Coordinated Universal Time

VMS Vessel Monitoring System

WCGOP West Coast Groundfish Observer Program

WCPFC Western Central Pacific Commission

Index

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