

Wasted Resources: Bycatch and discards in U. S. Fisheries

by

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National Overview

An Overview of Fishery Discards in the United States

Introduction

The unintentional capture of non-target species of fish, mammals, turtles and birds, and invertebrates is a well-recognized feature of fisheries around the world. Usually termed bycatch, some of the captured organisms may be retained for sale or use, while others are discarded back into the sea due to either low value or regulatory requirements. Survival rates for discarded bycatch is highly variable (Chopin and Arimoto, 1995; reviewed in Alverson et al. 1994; Davis, 2002), as are the impacts of bycatch on marine ecosystems (Hall et al. 2000) but it is widely accepted that the ecological impacts of bycatch are substantial (FAO, 2004a).

Bycatch, and particularly discarded bycatch, is a serious conservation problem because valuable living resources are wasted, populations of endangered and rare species are threatened, stocks that are already heavily exploited are further impacted, and important changes at an ecosystem level such as the overall structure of trophic webs and habitats may result (Morgan and Chuenpagdee, 2003; Alverson and Hughs, 1996; Crowder and Murawski, 1998). Reviewing the status of the stocks included in this report reveals that 25% of stocks are overfished, meaning that their biomass is below a threshold level to maintain a stable population, and 15% of stocks are being fished at a rate above a threshold level, defining overfishing (Figure 1) (NMFS, 2004d). The threshold levels are set individually for each stock by the National Marine Fisheries Service and regional fishery management councils.

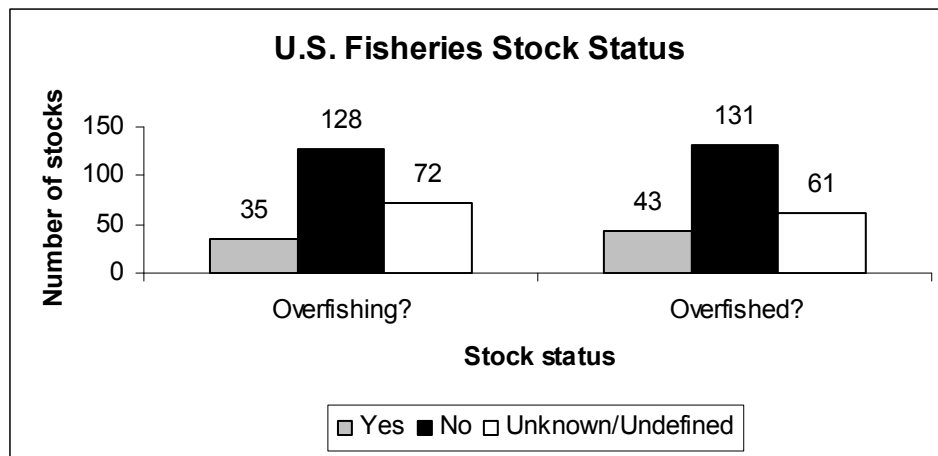


Figure 1: Stock status for 235 federally managed stocks in the United States (NMFS, 2004d).

Discarding also results in substantial waste of potential food resources. As global marine fisheries catches have plateaued (FAO, 2004a) and competition for increasingly depleted stocks has intensified, the moral and economic arguments to decrease bycatch have been received greater emphasis from policy makers, industry, and the general public (Pitcher and Chuenpagdee, 1994; Alverson and Hughs, 1996; FAO, 2004b; UN, 2005).

Internationally and nationally, the conservation problems associated with bycatch have been well recognized in the scientific community (Alverson et al. 1994; Alverson and Hughs, 1996; Hall, 1996; Crowder and Murawski, 1998; ICES, 2005; FAO, 2004a) as well as in policy instruments (UN 1995; NOAA Fisheries, 1996; NMFS, 2004b,c). The U.N. Food and Agriculture Organization Code of Conduct for Responsible Fisheries (FAO, 1995) states that, as a general principle, "States and users of aquatic ecosystems should minimize waste, catch of non-target species, both fish and non-fish species, and

impacts on associated or dependent species” (FAO, 1995). While the Code of Conduct is voluntary, this same principle is carried forward in international treaties such as the U.N. Treaty on Straddling Fish Stocks and Highly Migratory Fish Stocks (UN, 1995).

Domestically, the U.S. Magnuson-Stevens Fisheries Conservation and Management Act of 1996 has, as one of the national standards for management of marine fisheries, the requirement 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” (NOAA Fisheries, 1996).

In response to these requirements, there has been a substantial effort to reduce bycatch internationally and domestically (NMFS, 2004b). A recent draft report from FAO indicated that discards of marine species may be as low as 8% of the total global fisheries catch, although it is important to realize that an additional, and perhaps much larger, amount of non-target species may be caught and landed that are not included in this estimate (FAO, 2004a).

Within the United States, authorities have required implementation of various measures to reduce bycatch. In general, there are three possible means of bycatch reduction: modifying fishing methods including gear, timing or location of fishing or other aspects of the methodology, such as the introduction of bycatch reduction devices in shrimp fisheries in New England, the South Atlantic Bight and the Gulf of Mexico (Nance et al. 1997; Epperly et al. 2002; Morgan and Chuenpagdee, 2003); changing fishing gear or fishing methods entirely, such the change from drift gill net fishing to trolling for tunas or changing from trawls to traps for groundfish such as lingcod (Morgan and Chuenpagdee, 2003); and reducing fishing effort and therefore the amount of fishing gear in use overall, as has occurred in the New England and Alaska groundfish fisheries.

Any one of these methods alone does not necessarily guarantee the reduction of bycatch, but one or more must be a component of any conservation program to reduce the loss of resources due to bycatch. Note that there are other means of converting discarded bycatch to landed catch, such as development of new markets and processing techniques and changing regulatory limits and requirements to land all catch.

In this report we focus on the discarded portion of the bycatch from all U.S. fisheries. Although the U.S. has made extensive efforts to minimize bycatch in domestic and international fisheries an overview of the level of discarding in domestic fisheries has not been available until now. Here, we review all of the federally managed marine fisheries in the United States and compiled the available information on discards for each fishery. We have not, in general, included nearshore fisheries (NMFS, 1999) in the report nor fisheries in the Caribbean region. In this category are some important fisheries that may have significant discarding issues including many state managed fisheries for species such as American lobster, blue crab, Dungeness crab, inshore herring fisheries, bait shrimp fisheries and many others. Because there are scant data publicly available about these fisheries, we judged them beyond the scope of the present study.

Our goal for this report is to provide a comprehensive a picture of U.S. discarded bycatch in federally managed commercial fisheries. We will include some discard estimates for recreational fisheries, but the data on recreational fisheries is limited. In some cases, we have only been able to include information on bycatch, but the proportion of that bycatch that was discarded is not estimable with the available data. We hope this report will serve as a reference point for management and monitoring of this important conservation issue in the future. As new, better, or corrected data become available, we believe the picture we present will be sharpened. More importantly, as greater attention is paid to this problem, we hope the level of bycatch and discarding will continue to be reduced.

Methodology

In this paper, we used estimates of discarded biomass or ratios of discards to landings for each U.S. fishery available in published and unpublished literature. Clarifications and additional insights were provided by many scientists directly involved in bycatch monitoring and fishery stock assessment programs. We attempted to compile as many direct and indirect estimates of bycatch and resulting discards as possible, to arrive at a fair and comprehensive picture. We did not re-estimate discard rates or levels from raw data. In many cases, we extrapolated the available estimates to the entire fishery to get an overall figure of the level of discarded bycatch.

Our goal was to produce estimates of discarded bycatch for each species in each fishery. We defined fisheries by region and target species using similar designations as given in the NOAA Fisheries report, "Our Living Oceans, 1999". Within each fishery we sought to obtain estimates of the discarded bycatch rate for each component of the fishery, where the components were defined by gear type and sub-area as far as possible. We then extrapolated the total amount of discarded fish for each component of the fishery using the ratio of discards to landings and the reported level of landings, and summed the components to estimate the level of discarded bycatch for the fishery as a whole. We obtained our estimates of the rate of discarding for each species, expressed as discarded weight of fish to landed weight of targeted species from published and unpublished reports as indicated above. We did not estimate these rates from the raw data sources because these were unavailable to us or difficult to manage and interpret without more detailed knowledge of the fishery. We, in effect, incorporated that detailed knowledge of each fishery by relying on the available reports from scientists working within each region and fishery.

In some cases we only had estimates in numbers of fish caught and discarded, and we had to infer weights to produce comparable analyses between fisheries. In these cases, we used ancillary data to translate between numbers and weight. We used length composition data for each species when available. In the few cases where length composition data were not available, we used length composition data from similar species in the same fishery. We translated length into weight using data from stock assessment documents, regional research data, or NMFS commercial and recreational fisheries online databases (NMFS, 2004a; NMFS, 2004c). As a last resort, in a few cases, we used general summaries such as FishBase (2004) to obtain species growth parameters for the calculation of length at age and/or length weight relationships for the conversion of numbers of fish discarded to the weight of fish discarded. All data used for this compilation are publicly available. In each case where we had bycatch estimates in numbers instead of weight, we were able to obtain some independent data on the length or weight of the animals discarded, to check if our estimates of the discard ratios were reasonable and appropriate.

In general, we could not quantify uncertainty in the total discard estimates or the ratios of discarded bycatch to fish landings estimates. However, where possible, we indicate cases where we clearly identified factors that are likely to result in discard estimates may be overly conservative (low) or extreme (high). Major sources of uncertainty include sampling issues such as small sample size, biased samples from logbook or observer programs, or heterogeneity in space and time or within a gear type or fishery; lack of length-weight relationships (needed to convert numbers of animals to weight); occasional lack of species-specific discard information; and the use of ratio estimators for most bycatch estimates.

The discard data presented in this report have been extrapolated from the most recent data publicly available for each fishery from around the country, and combined into one estimated biomass of dead discards for each fishery. The discard estimates include data from almost all sectors of the commercial fishery, and some data from the recreational, tribal, and subsistence fisheries. We have attempted to compile data for all major gear types. Generally, our estimates are for 2002, the year for which the most recent landings and effort data were available in the NMFS online database during the course of this

study. For ten fisheries¹, we used information from 2003 because discard estimates were either only available for that year or appeared to be substantially different in 2003 versus 2002. Data for the Atlantic highly migratory species pelagic longline fishery is current only through 2001. Details of the data sources for each fishery are referenced in each chapter.

The compilation presented here gives appropriate scale to the problem of discarded bycatch in the commercial fisheries in the U.S. In many cases, estimates presented here are clearly underestimates of the actual level of discarding because substantial portions of a given fishery are unobserved or reporting is minimal. In addition, many species which are not commercially valuable are not recorded at all. In a few cases, discarding may be overestimated due to poor data quality. While we would expect better, more complete estimates to become available over time, the problem is clearly severe enough to merit increased policy attention immediately.

For almost all of the fisheries we considered, the majority of the bycatch is apparently discarded. We focused on discarded bycatch in this report for this reason, and noted exceptions as appropriate. Also, while bycatch of protected species such as mammals, turtles and birds is a major conservation issue, our focus is on bycatch of fish and fishable invertebrates.

Discarded Bycatch Estimates for the 27 Major Fisheries in the U.S.

Table 1 summarizes the detailed information in the individual fishery chapters. We refer the reader to the detailed discussion for species-specific concerns.

The West Coast salmon, Alaskan salmon, bluefish, tilefish, red crab and red drum fisheries are not included in any of the tables because the discard data were incomplete for these fisheries. For all fisheries except red drum, limited discard data were available from the commercial fishery. For the red drum fishery, the federal fishery is solely recreational, and landings are very small.

¹ Atlantic sea herring, surf clam and ocean quahog, Menhaden, Pacific coastal pelagics, Pacific whiting, west coast salmon, Alaska salmon, Atlantic highly migratory species gillnet and bottom longline fishery, western Pacific bottomfish and seamount groundfish and the western Pacific pelagics

Table 1: Overall landings and discards in 27 U.S. fisheries in 2002

Fishery	Landings (mt)	Discards (mt)	Discard to Landings Ratio ²	Major Discarded Species Groups
Northeast Region				
Northeast groundfish fishery*	54,533	97,688	1.79	Spiny dogfish, skates, butterfish, monkish, hake
Squid, mackerel, butterfish fishery	41,749	51,433	1.23	Spiny dogfish
Monkfish fishery	20,585	17,374	0.84	Spiny dogfish, winter skate, Jonah crab
Summer flounder, scup, black sea bass fishery	18,760	11,474	0.61	Skates, butterfish, groundfish, flatfish
Atlantic scallop fishery*	211,466	55,578	0.26	Skates, monkfish, flatfish, crabs
Spiny dogfish fishery	2,188	184	0.08	Skates, cod
Suf clam, ocean quahog fishery	46,091	3,835	0.08	Unknown
Atlantic herring fishery*	100,676	3,566	0.04	Spiny dogfish
Northeast Region	496,048	241,132	0.49	
Southeast Region				
Gulf of Mexico shrimp fishery*	103,671	472,643	4.56	Snappers, mackerel, Atlantic croaker, crabs, porgies
South Atlantic shrimp fishery*	11,945	35,206	2.95	Crabs, Atlantic croaker, menhaden
Gulf of Mexico reef fish fishery	17,376	7,210	0.41	Skates, toadfish, barracudas, sharks
South Atlantic snapper-grouper fishery	5,579	1,275	0.23	Skates, sharks
Gulf of Mexico coastal migratory pelagics fishery	12,513	1,819	0.15	Unknown
South Atlantic dolphinfish-wahoo fishery	5,588	160	0.03	Swordfish, tunas, sharks
Atlantic and Gulf of Mexico menhaden fishery*	725,458	4,607	0.01	Spanish mackerel, striped bass, rays, bluefish, sharks
Southeast Region	882,130	522,920	0.59	
West Coast Region				
West coast groundfish fishery	24,988	23,297	0.88	Flatfish, skates, halibut, whiting, sharks
Pacific halibut fishery*	26,065	20,929	0.8	Rockfish, spiny dogfish, skates, sharks, sablefish, echinoderms
Pacific coastal pelagics fishery*	123,138	2,560	0.02	Flatfish, skates, halibut, scorpionfish, salmon, sharks
Pacific whiting fishery*	142,020	586	0.004	None
West Coast Region	316,211	47,372	0.15	
Alaskan Region				
BSAI King and Tanner crab fishery	21,646	22,369	1.03	Pacific cod, Pacific halibut, pollock, rockfish, sculpins, skates
Weatherlane scallop fishery	1,788	997	0.56	Sea stars, skates, flatfish
Gulf of Alaska Groundfish fishery*	142,787	47,283	0.33	Halibut crabs, salmon

² Discard to landings ratios were calculated using weight data only. Where possible, weights were estimated for all discards that were in numbers of animals

BSAI Groundfish fishery*	1,793,088	160,119	0.09	Skates, sculpin, halibut, crabs, salmon
Alaskan Region	1,959,309	230,768	0.12	
Western Pacific Region				
Western Pacific bottomfish fishery*	291	64	0.22	Squirrelfishes, sharks, rockfish, goatfish
Western Pacific pelagics fishery	52,594	10,372	0.20	Sharks, marlins, swordfish
Western Pacific Region	52,885	10,436	0.20	
Highly Migratory Species Fisheries				
Atlantic highly migratory species fisheries: pelagic longline	5,716	3,813	0.67	Sharks, swordfish
Atlantic highly migratory species fisheries: bottom longline and drift/set gillnets	4,671	1,548	0.33	Sharks
Highly Migratory Speices Fisheries Total	10,387	5,361	0.52	
National Total	3,716,970	1,058,183	0.28	

* The disposition of a significant portion or all of the bycatch in these fisheries is unknown and may be landed, not discarded.

In addition to Table 1, we also separated total discards by gear type and target species type (Figure 2 and Figure 3). The shrimp trawl and fish trawl fisheries are responsible for 78% of the total discards by gear type (Figure 2), and the crustacean and demersal fisheries are responsible for 87% of the discards by target species type (Figure 3).

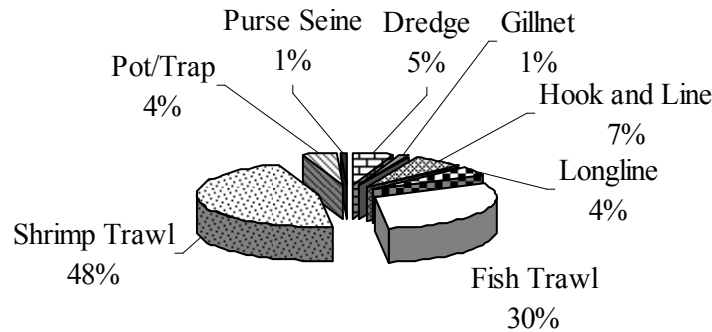


Figure 2: Percent of total U.S. discards (1.06 million mt) by gear type in 2002.

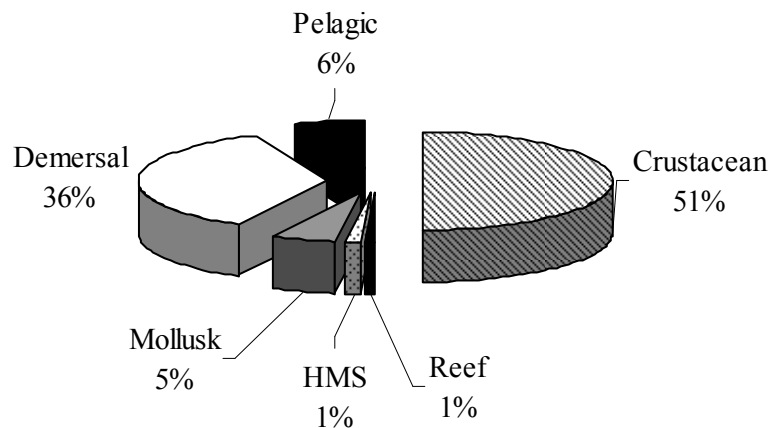


Figure 3: Percent of total U.S. discards (1.06 million mt) by target species type in 2002.

Overall, we estimate 1.06 million metric tons of fish are discarded for 3.7 million metric tons of targeted landings annually. This amounts to a discard amount equal to 28% of the target landings, or 22% of the total nominal catch. This number is higher than FAO's estimate that 8% of the landed catch that is estimated to be discarded globally (FAO, 2004a), but is comparable to the FAO estimate of bycatch for the United States (927,599 metric tons or 21.7% of the total nominal catch). Our estimate may be higher because in many world fisheries, there is a substantial amount of landed bycatch in addition to discards. In addition, according to the FAO draft report on bycatch (2004a), small scale fisheries tend to have lower bycatch rates than industrialized fisheries, particularly trawl fisheries for shrimp and groundfish. As the United States fishery consists of a high number of these higher bycatch fisheries, the United States may have higher discard rates than the rest of the world. According to the FAO, the world's discard rates are decreasing for some fisheries, and we believe this is true in the United States as well.

Regional differences in discarded rates are important because of the regional nature of fisheries management in the U.S. Figure 4 gives the ratio of discards to landings by region for 2002, except for the fisheries where 2003 estimates were used.

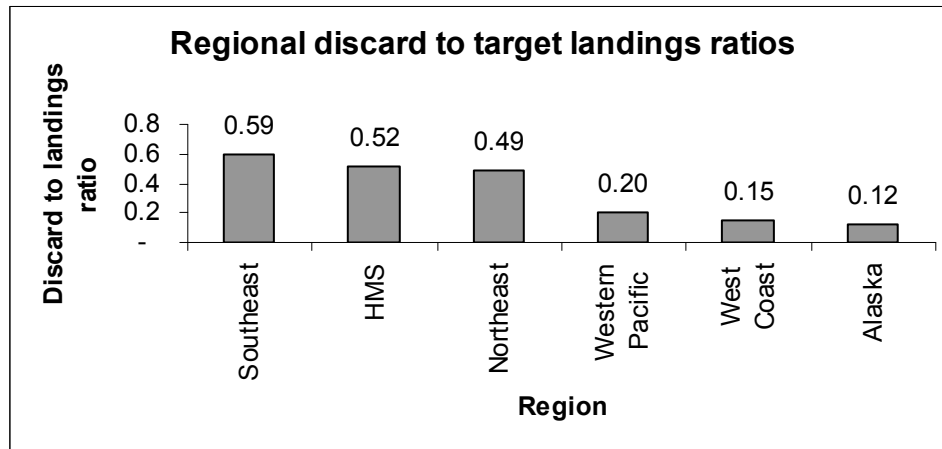


Figure 4: Regional discard to landings ratios.

In terms of the ratio of discards to landings, the highly migratory species, northeast and southeast fisheries discard more than other regions by nearly a factor of two. Of course, there is substantial variation within a region with regard to discarding levels in each fishery.

We then considered the twelve fisheries with the greatest amount of discards (Table 2) and the greatest ratio of discards to landings (Table 3).

Table 2: The twelve fisheries with the highest rankings by discard weight in 2002.

The 12 highest ranking fisheries	
Fishery	Discard Amount (mt)
Gulf Shrimp	472,643
BSAI Groundfish	160,119
NE Groundfish	97,688
Atlantic Scallop	55,578
Squid, Mackerel, Butterfish	51,433
GOA Groundfish	47,478
SA Shrimp	35,206
West Coast Groundfish	23,297
BSAI King and Tanner Crab	22,369
Pacific Halibut	20,929
Monkfish	17,374
Summer Flounder, Scup, Black Sea Bass	11,474

Table 3: The twelve fisheries with the highest rankings by discard to landings ratio in 2002.

The 12 highest ranking fisheries	
Fishery	Discard to Landings Ratio
Gulf Shrimp	4.56
SA Shrimp	2.95
NE Groundfish	1.79
Squid, Mackerel, Butterfish	1.23
BSAI King and Tanner Crab	1.03
West Coast Groundfish	0.93
Monkfish	0.84
Pacific Halibut	0.80
HMS Pelagic Longline	0.67
Summer Flounder, Scup, Black Sea Bass	0.61
Weathervane Scallop	0.56
Gulf Reef Fish	0.41

Most of the fisheries in the top 12 lists of both tables are predominantly trawl fisheries, and most target bottom dwelling species. Clearly, shrimp fisheries still discard some of the largest quantities of fish; despite great efforts to reduce bycatch through gear modification (see chapters on Gulf of Mexico and South Atlantic shrimp in the southeast region). Note that all of these fisheries are under complex regulatory plans and some of this discard is due to management requirements, not just fishery practices.

We compared our results with a recent overview report on bycatch by NMFS (2004b). All of the fisheries we considered to have the worst discard ranking by weight (Table 3) had at least moderate if not high vulnerability ratings according to NMFS (2004b). Three fisheries that NMFS considered to have excessive fish bycatch did not appear on our list, including the South Atlantic and Gulf of Mexico snapper and grouper fisheries and the Atlantic highly migratory species fisheries. This is because these are relatively low volume fisheries when considered nationally and are unlikely to have a high overall weight of discards. Given the major recreational share of the catch in these fisheries, the ratio of discards to landings is either low or very poorly estimated.

While our data correspond to NMFS' vulnerability ratings in most situations, there are some fisheries with very limited data for estimations of bycatch. The analyses we carried out should be updated on a regular basis to maintain an accurate picture of discards in U.S. fisheries.

Recommendations

Efforts to implement bycatch reduction strategies for U.S. fisheries have been substantial and partially successful in many cases (Morgan and Chuenpagdee, 2003). What our analysis shows is that discarding and bycatch are still major problems, likely to have major impacts on several marine ecosystems around the country. While bycatch monitoring and reduction programs are laudatory, much more work is needed immediately. This analysis shows that the discarded tonnage of fish for all federally managed U.S. fisheries combined is over 28% of the landed tonnage, or 1,050,468 metric tons.

In many fisheries, this ratio is far worse than 28%, with resultant greater waste and ecosystem-level impacts (Kaiser and deGroot, 2000; Hall et al. 2000). Unfortunately, high bycatch rates can be found in fisheries that are currently struggling to rebuild, such as New England groundfish and Pacific coast groundfish (Murawski et al. 1997). Bycatch in these fisheries is especially detrimental to stock recovery because juveniles of the target species are often a major component of the discarded bycatch. If juvenile mortality is increased, rebuilding of overfished fisheries will be delayed (Crowder and Murawski, 1998; Diamond et al. 1999). On the other hand, bycatch of non-commercial species can be troubling because populations can be decimated (Baum et al. 2003) or extirpated (Casey and Myers, 1998) with little or no awareness on the part of managers or the public. In addition, destruction of habitat-forming species such as corals and sponges may have significant, long-term ecosystem impacts (NRC, 2002). While we were unable to estimate bycatch rates for such species, this should be a component of future monitoring efforts.

Positive steps to protect seabirds, turtles, and other charismatic animals may not be ensuring that other heavily impacted species are protected. For instance, efforts to reduce catch of seabirds on pelagic longlines (Hall et al. 2000) have not prevented the decimation of shark populations caught as bycatch on longlines in the Pacific (Ward and Myers, 2005). Nor have bycatch prevention devices implemented in the Gulf of Mexico shrimp trawl fishery ameliorated threats to coastal shark species (Shepherd and Myers, 2005, *Submitted*).

The most pressing and important means of addressing problems of bycatch, as well as overfishing and ecosystem impacts, is eliminating overcapitalization and overfishing. Reducing fishing effort and reducing the amount of fishing gear in the water can immediately reduce bycatch. Overcapitalization encourages wasteful fishing practices such as a “race for fish” or the use of regulations specifically designed to reduce vessel efficiency including gear restrictions and trip limits that may encourage bycatch, or at least not provide appropriate incentives for bycatch reduction (Crowder and Murawski, 1998).

Change to more selective fishing gear continues to be an essential element of bycatch reduction programs. More selective gear can mean higher value landings for fishermen at potentially lower costs (Crowder and Murawski, 1998; FAO, 1997). Examples of gear changes that improve catch value and reduce bycatch in certain circumstances are the conversion of trawl fisheries to traps, switching from dragging to groundfish longlining in selected areas (NMFS, 2003), the mandated use of larger mesh throughout the net or in panels for release of certain sizes or species (FAO, 2004a), or the use of sorting grates to improve efficiency while reducing bycatch (Alverson, 1997). The use of more selective gear cannot only be brought about by regulation; there must be specific incentives to continually improve the selectivity of the gear and disincentives for unsustainable levels of bycatch. Enforceability of gear requirements is often very difficult so care must be taken when structuring the regulations to improve compliance.

Continuous efforts at improving fishing methodology as well as regulatory controls are needed particularly for fisheries with relatively high bycatch rates. For example, bycatch reduction devices have been implemented in the Gulf and South Atlantic shrimp fisheries, but discards are still high in weight and in the ratio of discards to landings. Mesh size has increased in the Mid-Atlantic squid fisheries but there is still a substantial bycatch of forage species. Management programs need to be adaptive and make continuous improvements rather than consist of fixed regulations that are not performance based. In addition, when gear modifications are made, efforts must be undertaken to ensure that these methods are, indeed, decreasing bycatch mortality (Crowder and Murawski, 1998).

As stated above, regulations are needed to provide incentives to reduce bycatch and disincentives to continue fishing practices with high bycatch rates. For example, trip limits are often implemented because they are perceived to be more acceptable to the industry compared to alternative regulations. However, trip limits encourage bycatch and discarding of young fish. Closed or protected areas can reduce bycatch and improve the fishermen’s ability to target specific species of fish as well as reduce other ecosystem level impacts (Murawski et al., 2000). Changing incentives such as has occurred with the creation of fishing cooperatives in Alaska operating within clear conservation limits can result in major improvements (FAO, 2004a). This is because the incentive is to reduce excess capital and fishing effort along with the development of fishing practices for cooperative members that reduce the risks of violating the conservation limits with resulting penalties for the cooperative as a whole. Individual quota systems can have similar incentive benefits if they are carefully monitored with observer programs, and checks to ensure there is no discarding and high-grading.

New fisheries need to be strictly controlled to ensure that new bycatch problems do not develop. It is much harder to change fishing practices once fisheries become established than to require best practices from the outset of any new venture. New fisheries are developing particularly in the deep waters on continental slope and on seamounts that have a particularly pernicious form of bycatch, e.g. deepwater corals and sponges, that form critical habitat (Glover and Smith, 2003). Broadly, applicable rules for any newly developing fishery are urgently needed to forestall future bycatch problems. The issue of bycatch must be explicitly incorporated into any future assessments of the potential sustainable prosecution of new fisheries.

This paper provides an overview of bycatch and discarding of fish in U.S. fisheries given the available information to date. Looking across all U.S. fisheries, we show that a large amount of important living marine resources are caught, killed and discarded. The overall magnitude of discarding is surprising as are the details for each fishery when considered in context. This report should serve as a basis for improving the information on bycatch and discarding in the future, focusing efforts on bycatch reduction in those fisheries with the largest problem and consideration of how to make our national policy of minimizing bycatch in fisheries a reality. Overall, bycatch is still a serious conservation problem in U.S. fisheries that needs continuous attention. For the future sustainable fisheries, bycatch reduction is imperative.

Definitions of Key Terms Used in the Report

Bycatch- Anything that is caught that was not targeted. Bycatch may be landed or discarded.

Catch and release- The practice of catching fish and then releasing them alive (typically used in recreational hook gear fisheries)

Discard- Anything that is caught and thrown back. Discards may be of target or non-target species

Discard to landings ratio (d/l ratio)- Discard amount divided by the total target species landings for that fishery. This ratio can be calculated for individual discard species or for all the discarded species combined. Total target species landings typically include landings of all species in that fishery (i.e. in the snapper/grouper fisheries, total landings include the landings of all snapper/grouper target species). Occasionally, in the individual chapters, these ratios may be calculated for individual target species, but the ratios presented in Table 1 include all target species in each fishery.

Bycatch to landings ratio (b/l ratio)- Bycatch amount divided by the total target species landings for that fishery. This ratio can be calculated for individual bycatch species or for all the bycatch species combined. Total target species landings typically include landings of all species in that fishery (i.e. in the snapper/grouper fisheries, total landings include the landings of all snapper/grouper target species). Occasionally, in the individual chapters, these ratios may be calculated for individual target species, but the ratios presented in Table 1 include all target species in each fishery.

Economic discards- fish which are the target of a fishery but which are not retained because they are of an undesirable size, sex, or quality, or for other economic reasons (NOAA Fisheries, 1996)

High-grading- The practice of discarding legal fish of low market value or damaged or poor quality

Landings to landings ratio (l/l)- ratio of the landings of one species or group of species to the landings of another species or group of species.

Non-target species- Any species of fish that is not being targeted during a particular tow, haul or set.

Overfished- A population is considered overfished if it declines to a point that the spawning stock is unable to replace those fish taken by the fishery.

Overfishing- Overfishing is occurring if the fishing mortality is above a threshold rate set for each fishery individually.

Regulatory discards- 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 (NOAA Fisheries, 1996)

Target landings- Landings of the target species for each individual fishery. This value might be different based on type (i.e. commercial or recreational) and gear.

Target species- The group of fish that the fishermen are trying to take.

Total catch- All landings and bycatch (including discards) for a particular fishery.

Acronyms and Abbreviations Used in the Report

AAH- Annual Allowable Harvest
ABC- Allowable Biological Catch
AFA- American Fisheries Act
AFSC- Alaska Fisheries Science Center
AMCC- Alaska Marine Conservation Council
ARO- Alaska Regional Office
AS- American Samoa
ASMFC- Atlantic States Marine Fisheries Commission
BMUS- Bottomfish Management Unit Species
BRD- Bycatch Reduction Device
BSAI- Bering Sea and Aleutian Islands
BSB- Black Seabass
CDQ- Community Development Quota
CFMC- Caribbean Fishery Management Council
CITES- Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNMI- Commonwealth of the Northern Mariana Islands
CPS- Coastal Pelagic Species
CPUE- Catch Per Unit Effort
DAH- Domestic Annual/Allowable Harvest
DAP- Domestic Annual Processing
DAS- Days at Sea
EEZ- Exclusive Economic Zone
EFH- Essential Fish Habitat
ESA- Endangered Species Act
ESU- Evolutionary Significant Unit
FMP- Fishery Management Plan
FY- Fishing Year
GB- Georges Bank
GHL- Guideline Harvest Levels
GMFMC- Gulf of Mexico Fishery Management Council
GN- Gillnet
GOA- Gulf of Alaska
GOM- Gulf of Maine (Northeast Region) or Gulf of Mexico (Southeast Region)
GSMFC- Gulf States Marine Fisheries Commission
HMS- Highly Migratory Species
ICCAT- International Convention for the Conservation of Atlantic Tunas
IOY- Initial Optimum Yield
IPHC- International Halibut Commission
IPHC- International Pacific Halibut Commission
IPOA- International Plan of Action for the Conservation and Management of Sharks
IVR- Interactive Voice Response
JVP- Joint Venture Processing
LCS- Large Coastal Sharks
LLP- License Limitation Program
MA- Mid-Atlantic
MAFMC- Mid-Atlantic Fishery Management Council
MHI- Main Hawaiian Islands
MMA- Marine Mammal Act
MOY- Maximum Optimum Yield
MRFSS- Marine Recreational Fisheries Statistics Survey
MSA- Magnuson-Stevens Fishery Conservation and Management Act
NEFMC- New England Fishery Management Council
NEFSC- New England Fishery Science Center

NE-Northeast
NERO- Northeast Regional Office
NFMA- Northern Fishery Management Unit (Monkfish)
NMFS- National Marine Fisheries Service
NOAA- National Oceanographic and Atmospheric Association
NPFMC- North Pacific Fishery Management Council
NWFSC- Northwest Fisheries Science Center
NWHI- Northwest Hawaiian Islands
NWRO- Northwest Regional Office
OY- Optimum Yield
P/C- Party/Charter
P/R- Private/Rental
PFMC- Pacific Fishery Management Council
PIA- Pacific Insular Areas
PIFSC- Pacific Islands Fisheries Science Center
PIRO- Pacific Islands Regional Office
PMUS- Pelagic Management Unit Species
PS- Pelagic Sharks
PSMFC- Pacific States Marine Fisheries Commission
RAIOMA- Resource Assessment and Investigation of the Mariana Archipelago
RSA- Research Set Aside
SAFE- Stock Assessment and Fishery Evaluation
SAFMC- South Atlantic Fishery Management Council
SARC- Stock Assessment Review Committee
SAW- Stock Assessment Workshop
SCS- Small Coastal Sharks
SEFSC- Southeast Fisheries Science Center
SERO- Southeast Regional Office
SFA- Sustainable Fisheries Act
SFMA- Southern Fishery Management Unit (Monkfish)
SN- Strikenet
SNE- Southern New England
SWFSC- Southwest Fisheries Science Center
SWRO- Southwest Regional Office
TAC- Total Allowable Catch
TAL- Total Allowable Landings
TALFF- Total Allowable Limit for Foreign Fishing
TED- Turtle Excluder Device
VMS- Vessel Monitoring System
VTR- Vessel Trip Report
WPFMC- West Pacific Fishery Management Council

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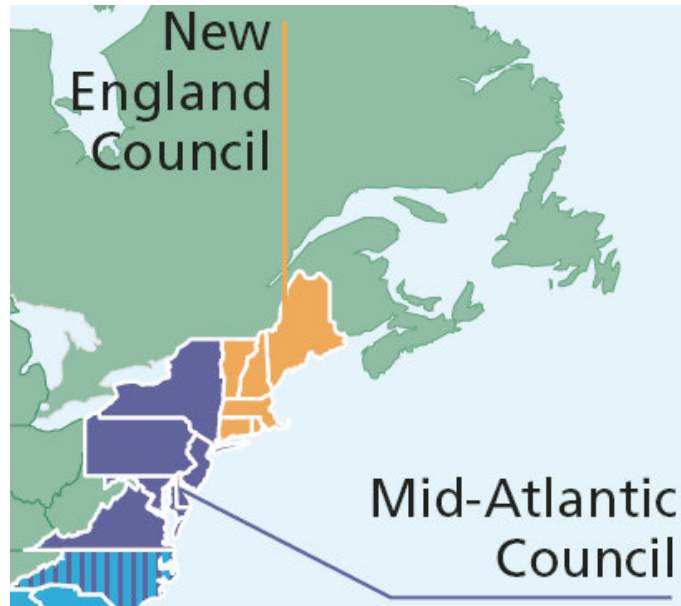
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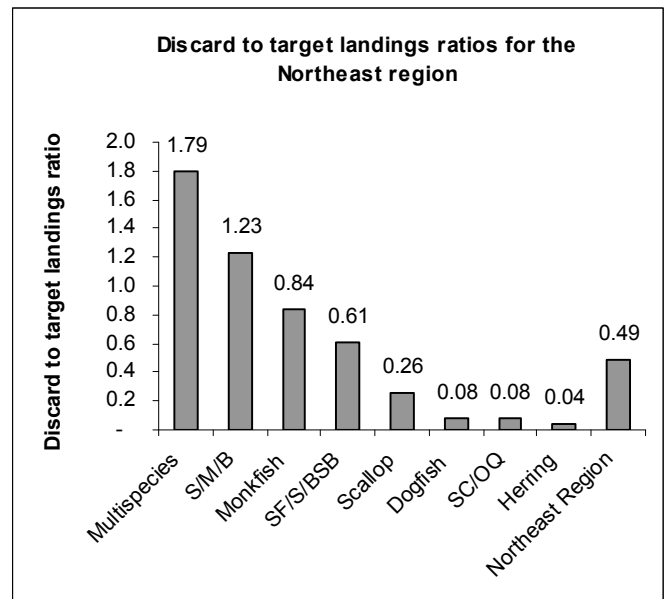
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Northeast



Northeast regional overview of landings, discards and discard to landings ratios by fishery

Fishery	Landings (mt)	Discards (mt)	d/l Ratio
Multispecies	54,533	97,688	1.79
S/M/B	41,749	51,433	1.23
Monkfish	20,585	17,374	0.84
SF/S/BSB	18,890	11,474	0.61
Scallop	211,466	55,578	0.26
Dogfish	2,188	184	0.08
SC/OQ	46,091	3,835	0.08
Herring	100,676	3,566	0.04
Northeast Region	496,178	241,132	0.49



Northeast Groundfish Fishery

Major Target Species:	Cod (<i>Gadus morhua</i>), Haddock (<i>Melanogrammus aeglefinus</i>), American plaice (<i>Hippoglossoides platessoides</i>), Witch flounder (<i>Glyptocephalus cynoglossus</i>), Yellowtail flounder (<i>Limanda ferruginea</i>), White hake (<i>Urophycis tenuis</i>), Redfish (<i>Sebastes fasciatus</i>), Pollock (<i>Pollachius virens</i>), Windowpane flounder (<i>Scophthalmus aquosus</i>), Winter flounder (<i>Pleuronectes americanus</i>), Silver hake (<i>Merluccius bilinearis</i>), Red hake (<i>Urophycis chuss</i>)
Major Discard Species:	Spiny dogfish (<i>Squalus acanthias</i>), Skates, Monkfish (<i>Lophius americanus</i>), Butterfish (<i>Peprilus triacanthus</i>), Hake
Primary Gear Types:	Trawl, Gillnet, Longline
Total Landings (2002):	54,533 mt
Total Discards (2002):	97,688 mt
Total Discards Rank (of 27):	3
Discard to Landings Ratio:	1.79
d/I Rank (of 27):	3
Source of Estimates:	NMFS, Observer data, Authors
Discard Type:	Primarily non-target, regulatory
Notes:	

Under the Northeast Groundfish FMP, 15 species are managed by the NEFMC. Twelve of these species, broken down into 22 stocks, are considered to be major species (NMFS, 2002). Most of these stocks are overexploited (Table 2), having endured high fishing pressure for decades. In the 1960s, foreign fishing of New England groundfish expanded and landings skyrocketed. However, foreign participation in the New England fishery ended with implementation of the 1976 Magnuson-Stevens Fishery Conservation and Management Act and landings shifted to the U.S. fleet. In the mid 1990's, the exploitation of the groundfish stocks was at its highest, and biomass was at record lows due to stock collapse from overfishing (NMFS, 1999). New management measures were enacted in the early 1990s that instituted a moratorium on new entrants into the fishery, reduced DAS by 50%, created 5,000² nmi of closed areas, increased mesh sizes, and implemented target TACs, trip limits and mandatory reporting. Overall, New England groundfish stocks are rebounding, but recruitment and biomass remain low, and some stocks remain overexploited (NMFS, 1999; NMFS, 2004d).

Table 2: Major stocks contained within the northeast groundfish fishery management plan and their current stock status. A status of overfished indicates a biomass below a sustainable threshold; overfishing indicates a fishing rate that is above a sustainable threshold. (NMFS, 2004d).

Stock	Current Stock Status
Cod- GoM	Both overfished and overfishing
Cod- Georges Bank	Both overfished and overfishing
Haddock- GoM	Overfished, but not overfishing
Haddock- Georges Bank	Overfished, but not overfishing
American plaice	Not overfished, but overfishing
Witch flounder	Not overfished, but overfishing
Yellowtail flounder- GB	Neither overfished nor overfishing
Yellowtail flounder- southern New England	Overfished, but not overfishing
Yellowtail flounder- Cape Cod	Both overfished and overfishing
Yellowtail flounder- mid-Atlantic	Both overfished and overfishing
White hake	Both overfished and overfishing
Acadian redfish (ocean perch)	Neither overfished nor overfishing
Pollock	Overfished, but not overfishing
Windowpane flounder- GoM/GB	Neither overfished nor overfishing
Windowpane flounder- southern New England/mid-Atlantic	Overfished, but not overfishing
Winter flounder- GoM	Undefined
Winter flounder Georges Bank	Neither overfished nor overfishing
Winter flounder- southern New England	Neither overfished nor overfishing
Silver hake (whiting)- GoM/northern GB	Not overfished, and unknown if overfishing

Stock	Current Stock Status
Silver hake (whiting)- southern GB/mid-Atlantic	Not overfished (rebuilding), and unknown if overfishing
Red hake- GoM/northern GB	Not overfished, and unknown if overfishing
Red hake- southern GB/mid-Atlantic	Not overfished, and undefined if overfishing

Target landings

There have been increases in biomass and landings for some of the groundfish stocks, but compared to historic figures, most groundfish stocks are still relatively depleted. Recent increases in landings and biomass are small compared to past landings (Figure 5 and Figure 6). Landings values for 2002 by the major gear types used in the fishery are reported in Table 3.

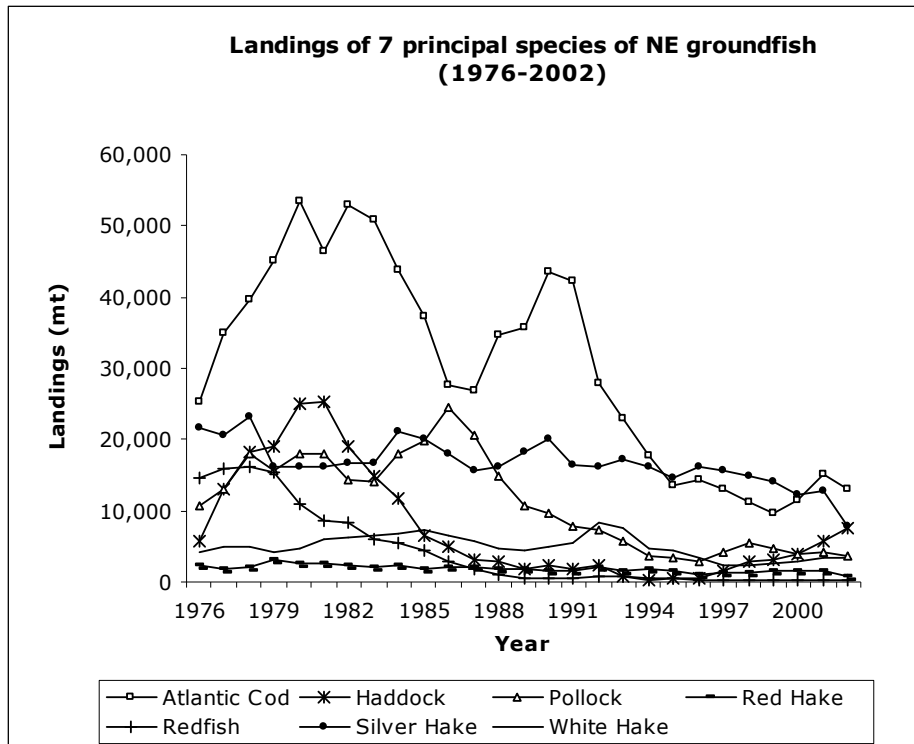


Figure 5: Total commercial landings of 7 principal groundfish species from 1976-2002 (NMFS, 2004a).

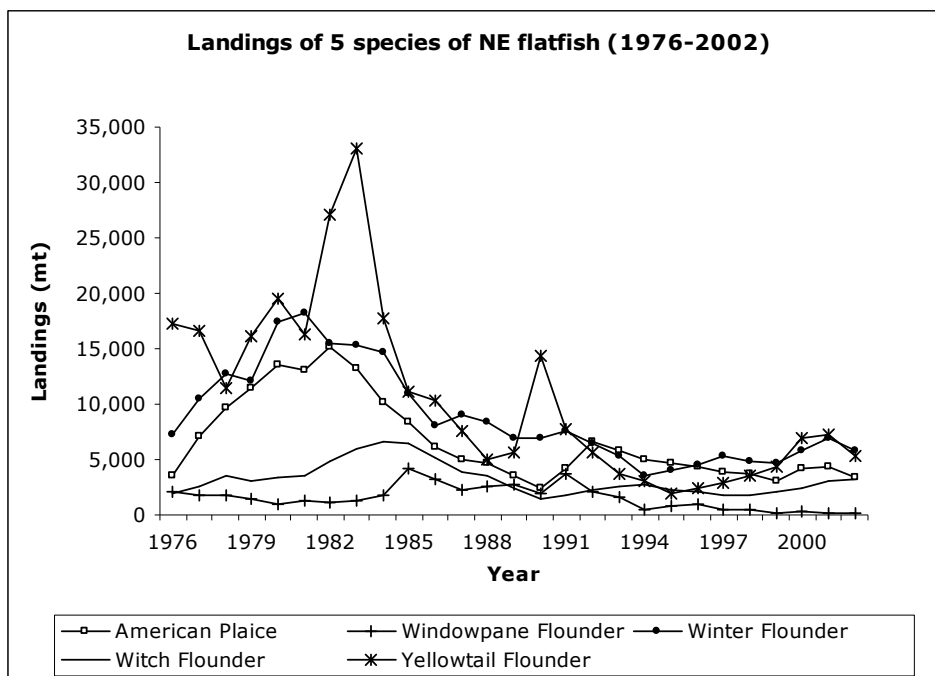


Figure 6: Total commercial landings of 5 flatfish species from 1976-2002 (NMFS, 2004a).

Table 3: Total 2002 commercial landings (mt) for all of the major species for all major gear types.

Species	Trawl	Gillnet	Bottom longline	Other	Total
American Plaice	3,348.2	41.6	0.1	22.4	3,412.3
American Plaice	3,348.2	41.6	0.1	22.4	3,412.3
Atlantic Cod	8,613.4	2,724.9	965.9	782.2	13,086.4
Haddock	6,976.4	447.5	25.3	91.7	7,540.9
Pollock	1,899.8	1,615.1	25.9	38.9	3,579.7
Red Hake	893.7	5.4	0.3	8.0	907.4
Redfish	317.9	48.0	0.6	1.4	367.9
Silver Hake	7,871.3	49.8	0.0	10.6	7,931.7
White Hake	2,445.3	776.1	19.2	25.4	3,266.0
Windowpane Flounder	95.1	0.4	0.0	2.0	97.5
Winter Flounder	5,671.3	144.9	5.7	54.8	5,876.7
Witch Flounder	3,089.6	60.5	0.8	37.3	3,188.2
Yellowtail Flounder	4,989.8	126.9	1.5	160.4	5,278.6
Total	46,211.8	6,041.1	1,045.3	1,235.1	54,533.3

The gear used in these fisheries varies by species, but the two main gear types are the trawl and gillnet. Occasionally, the scallop dredge fishery and the shrimp fishery land a small percentage of groundfish, but these fisheries, along with hook and line gear account for only a small percentage of total catch. The gear use percentages for each of the major stocks are given (Table 4).

Table 4: Gear usage for every NE groundfish stock (NMFS, 2004a).

Stock	Gear Usage (split by % of total catch)	Reference
Cod- Gulf of Maine	Otter trawl 54% Sink gillnet 38%	Mayo et al., 2002b
Cod- Georges Bank	Otter trawl 54% Sink gillnet 38%	O'Brien and Munroe, 2001
Haddock- GoM	Otter trawl >88% Other < 12%	NEFSC, 2001a
Haddock- GB	Mostly otter trawl, exact percentage not defined.	NEFSC, 2002a; NEFSC, 2002c
American plaice	Otter trawl 99% Sink gillnet 1%	NMFS, 2004a

Stock	Gear Usage (split by % of total catch)	Reference
Witch flounder	Otter trawl 98% Other 2%	NEFSC, 2003c
Yellowtail flounder- GoM	Trawl 93% Gillnet 5%	NEFSC, 2003b
Yellowtail flounder- southern New England	Trawl 98% Dredge 2%	NEFSC, 2003b
Yellowtail flounder- Cape Cod	Trawl 90% Dredge 10%	NEFSC, 2003b
Yellowtail flounder- mid-Atlantic	Large-mesh trawl 90% Gillnet 9% Dredge 1%	NEFSC, 2003b
White hake	Otter trawl 64% Gillnet 33% Line trawl 3%	NEFSC, 2003b
Acadian redfish (ocean perch)	Otter trawl 87% Sink gillnet 13%	Mayo et al., 2002a; NMFS 2002
Pollock	Otter trawl 53% Sink gillnet 45%	NMFS, 2004a
Windowpane flounder - GoM/GB	Gear usage is only available for the two stocks combined. Otter trawl 98% Pound net 2%	NMFS, 2004a
Windowpane flounder- southern New England/mid-Atlantic	Gear usage is only available for the two stocks combined. Otter trawl 98% Pound net 2%	NMFS, 2004a
Winter flounder- GoM	Otter trawl 77% Gillnet 22%	NEFSC, 2003b
Winter flounder Georges Bank	Trawl gear (all types) 99% dredging 1%	NEFSC, 2002a
Winter flounder- southern New England	Gear percentages not specified, assumed similar to Georges Bank	
Silver hake (whiting) - GoM/northern GB	SM Otter Trawl 90% LM Otter Trawl 3% Shrimp Fishery 2% Sink Gillnet 5%	Brodziak et al., 2001
Silver hake (whiting)- southern GB/mid-Atlantic	Small Mesh Otter Trawl 67% Large Mesh Otter Trawl 32%	Brodziak et al., 2001
Red hake- GoM/northern GB	Gear usage is only available for the two stocks combined. Otter trawl 99%	NMFS, 2004a
Red hake- southern GB/mid-Atlantic	Gear usage is only available for the two stocks combined. Otter trawl 99%	NMFS, 2004a

Regulations

The regulations for the Northeast Groundfish FMP are complex, involving restrictions on days-at-sea (DAS), minimum fish sizes, possession/landing limits and gear and large closed areas. These regulations have resulted in significant changes in landings and bycatch. All regulations in this section have been taken from the Federal Register (NMFS, 2004b).

Closed areas

There are a set of year-round closed areas on George's Bank and in the Gulf of Maine that prohibit all commercial groundfish and scallop gear. These closures are a major part of the rebuilding program of the groundfish and scallop plans. In addition, there are five temporary area closures in the Gulf of Maine, the first four are closed consecutively for one month each, from March through June. The last closed area is closed for the months of October and November. These rolling closures are created to allow spawning aggregations a safe haven from fishing activity.

DAS restrictions

Allocations of DAS vary depending on the baseline of a particular vessel, defined as the maximum DAS used by that vessel in any single fishing year from qualifying fishing years 1996 through 2001. A vessel's

DAS are broken down into A, B and C DAS. A DAS are used first. At this time, “B” DAS, regular and reserve, can only be fished in special access programs, and one A DAS must be available for every B DAS that is fished. C DAS cannot be fished, but are reserved for future use as stocks recover.

Minimum size restrictions

Of the 12 major species included in this fishery management plan, eight have minimum landing size restrictions (Table 5).

Table 5: Minimum size limits for eight of the major species managed under the northeast groundfish fishery management plan (NMFS, 2004b).

Species	Minimum size (inches)
Cod	22 (55.9 cm)
Haddock	19 (48.3 cm)
Pollock	19 (48.3 cm)
Witch flounder	14 (35.6 cm)
Yellowtail flounder	13 (33.0 cm)
American plaice	14 (35.6 cm)
Winter flounder	12 (30.5 cm)
Redfish	9 (22.9 cm)

Possession/landing limit restrictions

The restrictions on possession and landing limits are complicated because they vary by gear type and the combination of permits and authorization letters on board a given vessel. There are many possible letters of exemption and authorization in this fishery. Only the general possession and landing restrictions for haddock, cod, yellowtail flounder and silver/offshore hake are discussed here.

The fishing year for haddock is divided in two. From May 1st through September 30th a NE groundfish vessel may land up to 3,000 lbs (1,360.8 kg) of haddock per DAS fished, up to 30,000 lbs (13,608 kg) per trip. During the period from October 1st through April 30th, a NE groundfish vessel may land up to 5,000 lbs (2,268 kg) of haddock per DAS fished, up to 50,000 lbs (22,680 kg) per trip.

Cod have similar landing restrictions, but their landings are not restricted by season, rather they are split by area. In the Gulf of Maine, NE groundfish vessels may land up to 500 lbs (227.3 kg) of cod during the first 24-hr period. For each trip longer than 24 hrs, a vessel may land up to 500 additional lbs for each additional 24 hour block of DAS fished, but only up to a maximum of 4,000 lbs (1,818.2 kg) per trip. On Georges Bank, any vessel which is exempt from the landing limit and fishing under a NE groundfish DAS may land up to 2,000 lbs (907.2 kg) of cod during the first 24 hr period. For each trip longer than 24 hrs, a vessel may land up to an additional 2,000 lbs for each additional 24 hour block of DAS fished, to a maximum of 20,000 lbs (9,071.8 kg) per trip.

Yellowtail flounder landings are also regulated using area restrictions. Yellowtail flounder may not be caught south of 40 degrees north latitude. From March through May north of 40 degrees north latitude, vessels may land or possess on-board up to 250 lbs (113.6 kg) of yellowtail flounder per trip. From June through February, vessels may land up to 750 lbs (340.9 kg) of yellowtail flounder per DAS, to a maximum of 3,000 lbs per trip.

Possession and landing limits for silver/offshore hake are dependent on the mesh size used (Table 6).

Table 6: Landing limits for silver/offshore hake based on varying mesh sizes (NMFS, 2004b).

Mesh Size	Possession/Landing Limit
< 2.5 in (6.35 cm) (no LOA)	3,500 lbs (1,588 kg)
> 2.5 in (6.35 cm) (with LOA)	7,500 lbs (3,402 kg)
> 3.0 in (7.62 cm) (with LOA)	30,000 lbs (13,608 kg)
Regular mesh (6.0 in/15.2 cm)	10,000 lbs (4,536 kg)

Gear restrictions

Northeast groundfish fishery management includes area-dependent restrictions on gear type. The four main areas are the Gulf of Maine, Georges Bank, southern New England and the mid-Atlantic (Table 7).

Table 7: Gear Restrictions in the four regulated mesh areas (NMFS, 2004b).

Area	Gear Type	Restrictions
Gulf of Maine regulated mesh area	Trawl (except midwater)	Minimum of 6 inch diamond mesh or 6.5 inch square mesh in the body and 6.5 inch diamond or square mesh in codend
	Seine or midwater trawl	Minimum of 6 inch diamond mesh or 6.5 inch square mesh
	Any large mesh trawl or sink gillnet	8.5 inch minimum square or diamond mesh
	Trip Gillnet	Minimum of 6.5 inch mesh throughout
	Day Gillnet	Roundfish minimum of 6.5 inch mesh. Flatfish minimum of 7 inch mesh.
	Hook Gear	Maximum of 2,000 circle hooks of minimum size 12/0
	De-hookers (crucifiers)	Minimum of 6 inches between fairlead rollers
	Rockhopper/Roller Gear	Diameter of footrope including rollers or rockhoppers may not exceed 12 inches
Georges Bank regulated mesh area	Trawl (except midwater)	Minimum of 6 inch diamond mesh or 6.5 inch square mesh in the body and 6.5 inch diamond or square mesh in codend
	Seine or midwater trawl	Minimum of 6 inch diamond mesh or 6.5 inch square mesh
	Any large mesh trawl or sink gillnet	8.5 inch minimum square or diamond mesh
	Gillnet	Minimum of 6.5 inch mesh throughout for roundfish or flatfish
	Hook Gear	Maximum of 3,600 circle hooks of minimum size 12/0
	De-hookers (crucifiers)	Minimum of 6 inches between fairlead rollers
Southern New England regulated mesh area	Trawl (except midwater)	Minimum of 6 inch diamond mesh or 6.5 inch square mesh in the body and 6.5 inch square or 7 inch diamond mesh in codend
	Seine or midwater trawl	Minimum of 6 inch diamond mesh or 6.5 inch square mesh
	Any large mesh trawl or sink gillnet	8.5 inch minimum square or diamond mesh
	Sink Gillnet	Minimum of 6.5 inch mesh throughout for roundfish or flatfish
	Hook Gear	Maximum of 2,000 circle hooks of minimum size 12/0
	De-hookers (crucifiers)	Minimum of 6 inches between fairlead rollers
Mid-Atlantic regulated mesh area	Trawl (except midwater)	Minimum 6.5 inch diamond or square mesh in codend
	Seine or midwater trawl	Minimum of 6 inch diamond mesh or 6.5 inch square mesh
	Any large mesh trawl or sink gillnet	7.5 inch minimum diamond mesh of 8.0 inch square mesh
	Hook Gear	Maximum of 4,500 hooks
	De-hookers (crucifiers)	Minimum of 6 inches between fairlead rollers

Discards

In the northeast groundfish fishery the discarded bycatch consists of undersized target species and discards of non-target species. The dominant non-target species discarded are monkfish, spiny dogfish, skates, butterfish, summer flounder, porgy, fourspot flounder, jonah crab and loligo squid, and will be reported in greater detail in the next section. In the table below (Table 8) the target landings, discard amount and discard to landings ratio (d/l ratio) are displayed for all of the major species within the northeast groundfish FMP. The discards are of that particular target species only. These discard rates are separated by area and gear.

The reported discards were primarily estimated using the ratio-estimator method (NEFSC, 2003c). This estimate is made by adding all the observed or reported discards and all the landings over a certain time period; and then dividing total discards by total landings to find a d/l ratio. This ratio is then multiplied by the total annual target species landings to determine the total annual discards. Cape Cod yellowtail flounder, GoM yellowtail flounder, American Plaice, Georges Bank winter flounder and GoM winter flounder ratios were all calculated on an annual basis (NEFSC, 2002b; NEFSC, 2002c; NEFSC, 2002a; NEFSC, 2003b). Gulf of Maine cod discard ratios were calculated on a monthly basis (Mayo et al., 2002b), Silver hake discard ratios were calculated on a quarterly basis (Brodziak et al., 2001), and Georges Bank cod, white hake and witch flounder ratios were calculated on a semiannual basis (NEFSC, 2001b; NEFSC, 2003c; Obrien and Munroe, 2001). Southern NE Winter flounder d/l ratios were calculated on a trip basis and averaged semi-annually (NEFSC, 2003b), and discards and discard ratios for SNE yellowtail flounder were obtained from vessel logbook data (NEFSC, 2003b).

Table 8: Target species landings, discards and discard ratios for the major species by gear type within the Northeast Groundfish FMP. If no data were available, the d/l ratio from the most similar species in terms of habitat and behavior was used as an estimate.

Target species	Year	Area/Gear	Landings (mt)	d/l ratio	Discards (mt)	References
Atlantic cod	2000	Gulf of Maine/trawls	2,316	0.48	1,107	(Mayo et al, 2002b)
Atlantic cod	2000	Gulf of Maine/gillnets	1,393	0.74	1,025	(Mayo et al., 2002b)
Atlantic cod	2000	Georges Bank/trawls	4,727	0.02	100.5	(O'Brien and Munroe, 2001)
Atlantic cod	2000	Georges Bank/gillnets	1,635	0.18	299	(O'Brien and Munroe, 2001)
Yellowtail flounder	2001	Cape Cod/trawl	2,100	0.20	414	(NEFSC, 2003a)
Yellowtail flounder	2001	Gulf of Maine/trawl	135	0.23	31	(NEFSC, 2003a)
Yellowtail flounder*	2001	Southern New England/trawl	828	0.1 (0.03)	87 (21)	(NEFSC, 2003a)
Yellowtail flounder	2001	Mid-Atlantic/trawl	234	0.03	6	(NEFSC, 2003a)
Yellowtail flounder	2001	Cape Cod/gillnet	258	0.01	2	(NEFSC, 2003a)
Yellowtail flounder	2001	Gulf of Maine/gillnet	8	0.13	1	(NEFSC, 2003a)
White hake	2000	Otter trawl	1761	0.16	280	(NEFSC, 2001b)
White hake	2000	Sink gillnet	1044	0.04	38	(NEFSC, 2001b)
Winter flounder	2000	Gulf of Maine/trawl	279	0.05	13	(NEFSC, 2003a)
Winter flounder	2000	Gulf of Maine/gillnet	99	0.07	7	(NEFSC, 2003a)
Winter flounder*	2000	Georges Bank/trawl	1,659	0.02 (0.01)	27 (16)	(NEFSC, 2002a)
Winter flounder	2000	SNE/all gear	3783	0.04	148	(NEFSC, 2003a)
Witch Flounder	2002	Georges Bank/Gulf of Maine/LM otter trawl	3088	0.09	278	(NEFSC, 2003b; Wigley et al., 2003)
Silver hake	1999	Northern stock/SM otter trawl	496	0.25	123	(Brodziak et al., 2001)
Silver hake	1999	Northern stock/LM otter trawl	32	0.22	7	(Brodziak et al., 2001)
Silver hake	1999	Northern stock/sink gillnet	14	0.23	3	(Brodziak et al., 2001)
Silver hake	1999	Southern stock/SM otter trawl	838	0.74	619	(Brodziak et al., 2001)
Silver hake	1999	Southern stock/LM otter trawl	44	0.58	25	(Brodziak et al., 2001)

Target species	Year	Area/Gear	Landings (mt)	d/l ratio	Discards (mt)	References
Silver hake	1999	Southern stock/sink gillnet	0.03	0.97	0.03	(Brodziak et al., 2001)
Haddock**	1999	Gulf of Maine/otter trawl	700	0.48	335	
Haddock**	1999	Gulf of Maine/gillnet	<100	0.74	<74	
Haddock**	1999	Georges Bank/otter trawl	2800	0.02	512	
Haddock**	1999	Georges Bank/gillnet	210	0.18	38	
American plaice	2000	GOM, GB, SNE and MA/all gear	4213	0.12	500	(NEFSC, 2002b)
Windowpane flounder***	2001	GOM/GB trawl	49	0.03	0.15	
Windowpane flounder***	2001	SNE/MA trawl	126	0.003	0.50	
Windowpane flounder***	2001	GOM/GB gillnet	0.2	0.07	0.014	
Windowpane flounder***	2001	SNE/MA gillnet	0.5	0.004	0.002	
Acadian redfish+	2000	GOM, GB, SNE and MA/all gear	319	0.39	125	
Red hake++	2001	GOM/GB/all gear	650	0.10	64	
Red hake++	2001	SGB/MA/all gear	1040	0.10	102	
Pollock++	2001	GOM, GB, SNE and MA/all gear	4,111	0.10	403	

* The first number is the observer value, the number in parentheses is the VTR value.

** In the absence of haddock d/l ratios, the corresponding cod d/l ratios were used.

*** In the absence of windowpane flounder d/l ratios, the corresponding winter flounder d/l ratios were used.

+ In the absence of Acadian redfish d/l ratios, a weighted average of silver hake LM trawl and gillnet d/l ratios were used.

++ In the absence of red hake and Pollock d/l ratios, the average white hake d/l ratio was used.

Table 9 uses the d/l ratios from Table 8 to estimate discard data for 2002, the most recent year for which landings data are available. These data are arranged in a slightly different manner, as 2002 landings were available by gear type, not area. Only observer data based ratios were used for the calculations of the 2002 estimated bycatch even if VTR ratios were also available as observer data are typically more accurate.

Table 9: Estimates of 2002 discards for the major target species in the northeast groundfish FMP using actual landings data and the d/l ratios (averaged proportionately according to the distribution of the catch by area) from Table 8.

Species	Gear Type	2002 Target landings (mt)	d/l ratios	Total estimated 2002 discards (mt)
Cod	gillnet	2,724.9	0.44	1,190.8
Yellowtail flounder	gillnet	126.9	0.01	1.5
White hake	gillnet	776.1	0.04	28.3
Winter flounder	gillnet	144.9	0.04	5.9
Witch flounder	gillnet	60.5	0.03	1.6
Silver hake	gillnet	49.8	0.23	11.3
Haddock	gillnet	447.5	0.35	156.2
American plaice	gillnet	41.6	0.12	5
Windowpane flounder	gillnet	0.4	0.02	0.009
Acadian redfish	gillnet	48.0	0.23	10.9
Red hake	gillnet	5.4	0.10	0.53
Pollock	gillnet	1,615.1	0.10	158.3
Total	gillnet	6,041.1	0.14	1,570.3
Cod	trawl	8,613.4	0.17	1,481.5
Yellowtail flounder	trawl	4,989.8	0.16	813.3
White hake	trawl	2,445.3	0.15	371.7
Winter flounder	trawl	5,671.3	0.03	170.1
Witch flounder	trawl	3,089.6	0.09	278.1
Silver hake	trawl	7,871.3	0.55	4,329.2
Haddock	trawl	6,976.4	0.11	781.4
American plaice	trawl	3,348.2	0.12	398.4
Windowpane flounder	trawl	95.1	0.01	1.05

Species	Gear Type	2002 Target landings (mt)	d/l ratios	Total estimated 2002 discards (mt)
Acadian redfish	trawl	317.9	0.43	135.4
Red hake	trawl	893.7	0.10	87.6
Pollock	trawl	1,899.8	0.10	186.2
Total	trawl	46,211.8	0.17	9,034.0

Data from the longline sector are not available in any of the assessment documents. Raw observer data from the Northeast Fisheries Science Center in Woods Hole, MA were obtained to fill this gap. The overall catch by longline gear is much lower than in the other two sectors. However, the discard to landing ratios are quite high (Table 10). Observer data were available for 2002, 2003 and the first quarter of 2004. In 2002, the only year for which landings data are also available, estimates of total bycatch were made. The landed catch for these two years was comprised mainly of cod, haddock and cusk, but there were also landings of winter skate, pollock, and ocean pout (NMFS, 2004c).

Table 10: Observed landings and discards in the longline fishery (NMFS, 2004c).

Year	Target Species	Number of observed trips	Observed target landings (mt)	Observed total discards (mt)	d/l ratio
2002	Cod and Haddock	9	3.08	15.22	4.94
2003	Cod	10	2.34	1.03	0.44
2003	Haddock	7	1.78	0.07	0.04
2004	Cod	3	0.77	0.07	0.09
2004	NK groundfish*	5	2.00	0.12	0.06

* Target landings for the NK groundfish data include landings from any species that are included in the NE groundfish FMP

If the 2002 discards to landings ratio of 4.94 is multiplied by the total longline target landings for 2002 (1,045.3 mt) the resulting discard estimate is 5,163.8 mt. The composition of this discarded bycatch is seen in Figure 7. However, given the high variability in the d/l ratios for the longline fishery, this estimate seems high as the 2003 discard to landings ratio is only 0.44 (Table 10). If the 2003 d/l ratio were applied to 2002 landings, total discards would only be 460 mt. It is possible that there were simply more discards in 2002 than in 2003. However, both estimates are based on very few observed trips (9 and 17 in 2002 and 2003, respectively) and it is more likely that data from one or both years do not present an accurate sample of the longline fishery. These discards are almost entirely spiny dogfish. However, the diversity of species taken in the following year increased (Figure 8). The data for 2003 are grouped to show discards from trips targeting both cod and haddock.

Discarded catch composition in the 2002 longline fishery targeting cod and haddock

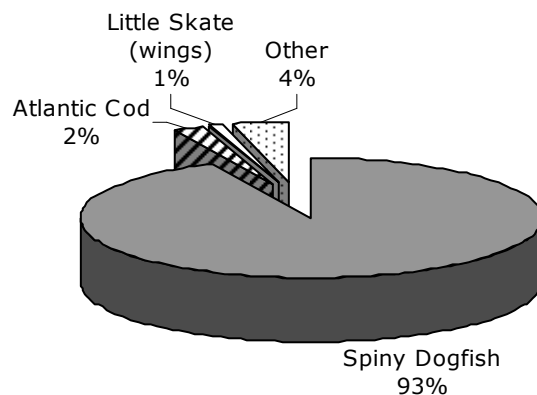


Figure 7: Composition of the discards in the 2002 bottom longline fishery targeting cod or both cod and haddock. This chart is based on 9 observed trips.

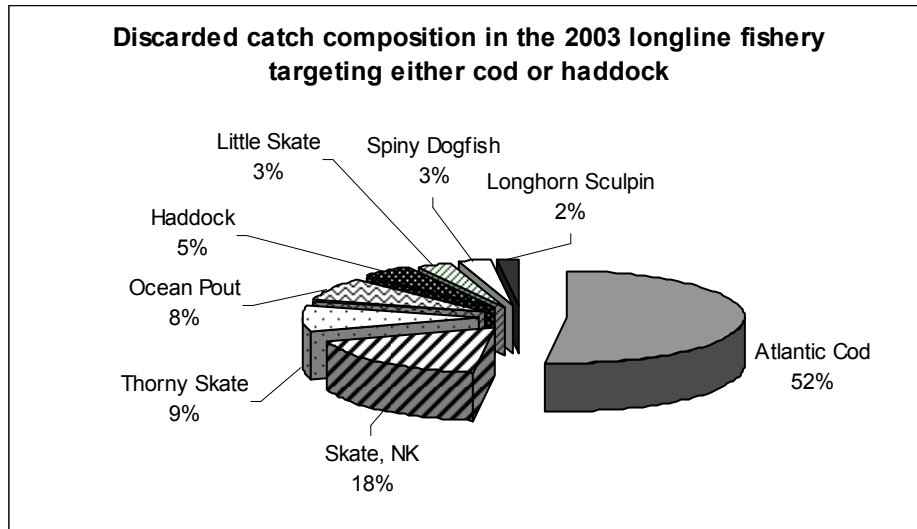


Figure 8: Composition of the discards in the 2003 bottom longline fishery targeting cod or haddock. This chart is based on 17 observed trips.

Seven different skate species are commonly caught in the groundfish fishery: barndoor, clearnose, little, rosette, smooth, thorny and winter. Table 11 shows an expansion of the observer data for the gillnet gillnet fishery. The landings from the groundfish sector account for 25.3% of the total gillnet catch, so the skate numbers have been adjusted accordingly. Discards for this fishery were estimated using seven years of observer data (1994-2000, 7.74% coverage). Table 12 shows the expansion of the observer data for the otter trawl fishery. The combined landings from the large and small mesh groundfish trawl sectors account for 18.3% of the total otter trawl catch, so the skate numbers have been adjusted accordingly. Bycatch and discards for this fishery were also estimated using seven years of observer data (1994-2000, 0.45% coverage). Since the coverage for this fishery was lower than that of the gillnet fishery, these numbers are less accurate.

Table 11: Average annual catch of 7 different species of skates in the groundfish gillnet fishery (mt) (1994-2000) (NEFMC, 2000).

	Barndoor	Clearnose	Little	Rosette	Smooth	Thorny	Winter	Unidentified	All skates
Kept (mt)	0.7	2.4	10.0	0.1	0.9	1.0	81.1	17.3	113.4
Discard (mt)	0.2	2.8	13.2	0.0	0.2	1.9	6.8	3.5	28.6
Total	0.9	5.2	23.2	0.1	1.0	2.9	87.9	20.8	142.0

Table 12: Average annual catch (mt) of 7 different species of skates in the groundfish otter trawl fishery (1994-2000) (NEFMC, 2000).

	Barndoor	Clearnose	Little	Rosette	Smooth	Thorny	Winter	Unidentified	All skates
Kept (mt)	3	38	465	1	6	13	331	399	1,247
Discard (mt)	56	913	3,602	38	20	89	629	886	6,235
Total	59	952	4,059	39	26	102	960	1,285	7,482

Obviously, skates are not the only non-target species that are brought up in groundfish otter trawls and gillnets. Other species such as spiny dogfish, butterfish, summer flounder, scup, fourspot flounder, jonah crab, loligo squid, Atlantic mackerel, sea raven, Atlantic herring, red crab and ocean pout are also common. On average, approximately 10-15 different species were discarded on every observed trawl and gillnet trip (NMFS, 2004c). Two charts (Figure 9 and Figure 10) from the 2002 monkfish SAFE report detail the bycatch percentages from trawl and gillnet trips which caught, but did not target, monkfish.

These charts can be used to approximate the bycatch composition of the groundfish trawl and gillnet fisheries. When compared to the total landings of the groundfish trawl and gillnet fisheries, amounts of bycatch and bycatch/landings ratios can be estimated.

**2001 Catch composition of non-monkfish directed trawls
(% total discards)**

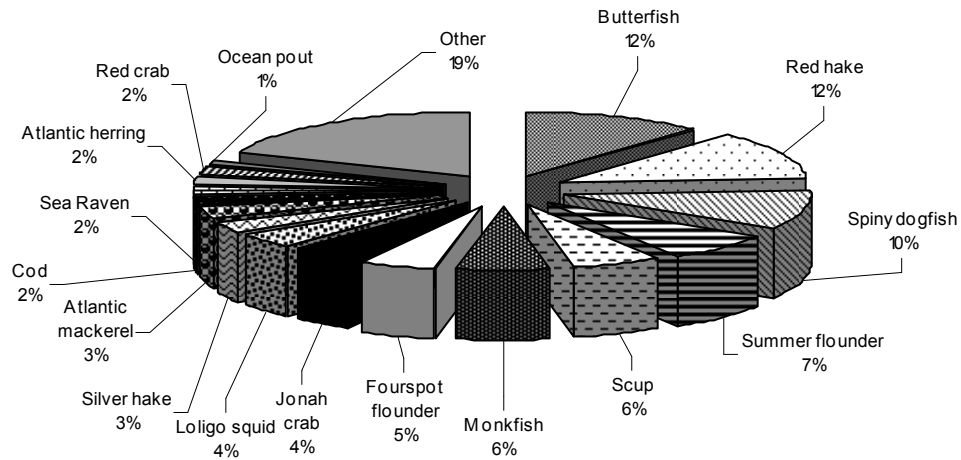


Figure 9: Bycatch in non-monkfish directed trawls for the year 2001. The data are percentages of the total catch. They are representative of bycatch species that might be found in a groundfish trawl (NEFMC and NMFS, 2001).

**Catch composition of non-monkfish directed
gillnets (% total discards)**

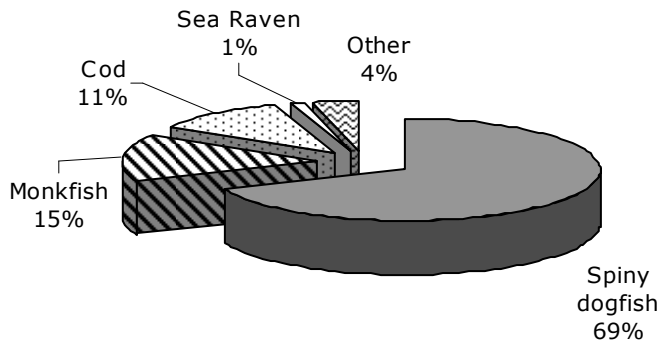


Figure 10: Bycatch in non-monkfish directed gillnets for the year 2001. The data are percentages of the total catch. They are representative of bycatch species that might be found in a groundfish gillnet (NEFMC and NMFS, 2001).

Since the total amount of discarded cod from trawls and gillnets in 2002 is available, the catch composition of discards from the 2001 non-monkfish directed trawl and gillnet fisheries can be used to

extrapolate discard estimates. This extrapolation assumes that the 2002 discarded catch composition was the same as the 2001 discarded catch composition, and it also assumes that all observed non-monkfish trips (both trawl and gillnet) were groundfish trips. Using this assumption, total discards for the 2002 trawl fishery were calculated to be 74,075 mt, and total discards for the 2002 gillnet fishery were calculated to be 10,824.5 mt. The discard amounts of the individual species were then calculated (Table 13 and Table 14).

Table 13: Discarded catch in non-monkfish directed trawls, 2002.

Species	Percent of total discards	Discards (mt)
Butterfish	12	8,889
Red hake	12	8,889
Spiny dogfish	10	7,408
Summer flounder	7	5,185
Scup	6	4,445
Monkfish	6	4,445
Fourspot flounder	5	3,704
Jonah crab	4	2,963
Loligo squid	4	2,963
Silver hake	3	2,222
Atlantic mackerel	3	2,222
Cod	2	1,482
Sea raven	2	1,482
Atlantic herring	2	1,482
Red crab	2	1,482
Ocean pout	1	741
Other	19	14,074
Total	100	74,075

Table 14: Composition and amount of the discarded catch in non-monkfish directed gillnets, 2002.

Species	Percent of total discards	Discards (mt)
Spiny dogfish	69	7,469
Monkfish	15	1,624
Cod	11	1,191
Sea raven	1	108
Other	4	433
Total	100	10,825

In summary, 54,533 mt of groundfish target species were landed in 2002: 46,212 mt from the trawl fishery, 6,041 mt from the gillnet fishery, 1,045 mt from the longline fishery, and 1,235 mt from other gear types. Discards of target species from the trawl and gillnet fisheries were 9,034 mt and 1,570 mt, respectively. Total bycatch (including both target and non-target species) from the trawl and gillnet fisheries was 81,557.3 mt and 10,966.5 mt, respectively; total discards from the longline fishery were 5,164 mt.

The overall 2002 bycatch to landings ratio for the trawl fishery is 1.76, the overall 2002 bycatch to landings ratio for the gillnet fishery is 1.82, and the 2002 bycatch to landings ratio for the longline fishery is 4.94. Overall, there were 97,688 mt of bycatch for 54,533 mt of landings, resulting in an overall groundfish b/l ratio of 1.79.

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Squid, Mackerel and Butterfish Fishery

Major Target Species:	Longfin squid (<i>Loligo pealeii</i>), Shortfin squid (<i>Illex illecebrosus</i>), Atlantic mackerel (<i>Scomber scombrus</i>), Butterfish (<i>Peprilus triacanthus</i>)
Major Discard Species:	Spiny Dogfish (<i>Squalus acanthius</i>)
Primary Gear Types:	Small mesh otter trawl, Mid-water trawl
Total Landings (2002):	41,439 mt
Total Discards (2002):	51,433mt
Total Discards Rank (of 27):	5
Discard to Landings Ratio:	1.2
d/l Ratio Rank (of 27):	4
Source of Estimates:	NMFS, Observer Data, Authors
Discard Type	Primarily non-target, non-regulatory
Notes:	The mackerel fishery reports total bycatch, no distinction was made in the literature between bycatch and discards.

Squid, mackerel and butterfish are managed together in one FMP by the MAFMC. However, unlike the Northeast Groundfish FMP, these species are not targeted in the same seasons. Rather, they are grouped together because many boats fish for all four species in different seasons.

Longfin inshore squid are targeted year around. Typically, they are caught offshore from October to March, and inshore from April to September, and the fishery is dominated by small-mesh otter trawlers. (Cadrin, 2000). *Loligo* can grow to 18 inches in length, although most specimens are closer to 12 inches. They mainly live inshore at depths ranging from surface level to 90 meters and migrate offshore in the winter months to warmer water. The longfin squid ranges from the Bay of Fundy to the West Indies, but is exploited only from Georges Bank to Cape Hatteras. Typically, they are used for bait, but they also are used for human consumption – as calamari. The stock is not overfished, and overfishing is not occurring (NMFS, 2004d).

Northern shortfin squid is a highly migratory species distributed from Labrador to Florida. However, they are only exploited and managed from Newfoundland to Cape Hatteras. *Illex* are targeted primarily from June to September by small-mesh bottom trawlers near the edge of the continental shelf (Hedrickson, 2000). They primarily inhabit the offshore continental shelf and slope waters and range in size from 10 to 14 inches in length. Overfishing is not occurring, but it is unknown whether the fishery is overfished (NMFS, 2004d).

Mackerel is an open sea schooling fish (Collette and Klein-MacPhee, 2002). Commercial fishing patterns for mackerel reflect seasonal distributions of the fish. From January through May, mackerel are found in southern New England and mid-Atlantic coastal waters. However, in the Gulf of Maine, the fishing season is between May and December. United States recreational catches occur mainly between April and October. Mackerel are found throughout the entire North Atlantic, including the Baltic, Black and Mediterranean seas and range from Labrador to Cape Lookout, NC. The American stock occurs over the outer continental shelf. During the fishing season they are most abundant over the inner half of the continental shelf. Typically, they are found around 50 m deep, but they occasionally go down to 180 m. They are not overfished and overfishing is not occurring (NMFS, 2004d).

Butterfish inhabit coastal Atlantic waters off the United States. They range from South Carolina northward to Nova Scotia. North of Cape Hatteras, NC, they tend to migrate inshore and northward in the warmer months. They do not make it to the Gulf of Maine until late June/early July, and disappear by November. They prefer shallower water, 20-50 m in depth, but they overwinter in deeper, 180 m water. Butterfish are not overfished, and overfishing is not occurring (NMFS, 2004d).

Target landings

The Atlantic mackerel fishery has both a commercial and recreational component. Recreational landings have stayed constant while the commercial landings have fluctuated widely. The landings data are given in Figure 11.

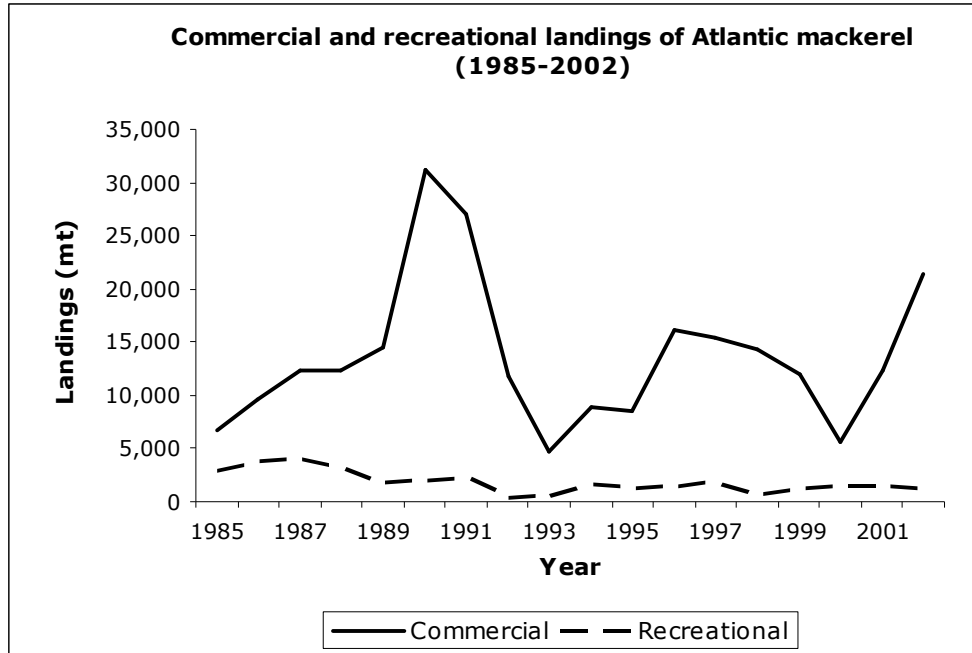


Figure 11: Commercial and recreational landings of Atlantic mackerel from 1985-2002 (NEFSC, 2004).

The landings of both the longfin and northern shortfin squids are erratic as well. Landings of shortfin squid peaked at 24,000 mt per year in 1998, and have been decreasing ever since to 3,000 mt in 2002. Longfin squid landings peaked at 24,000 mt in 1994, and are currently just under 17,000 mt (Hendrickson et al., 2002; NEFSC, 2002; NEFSC, 2003) (Figure 12).

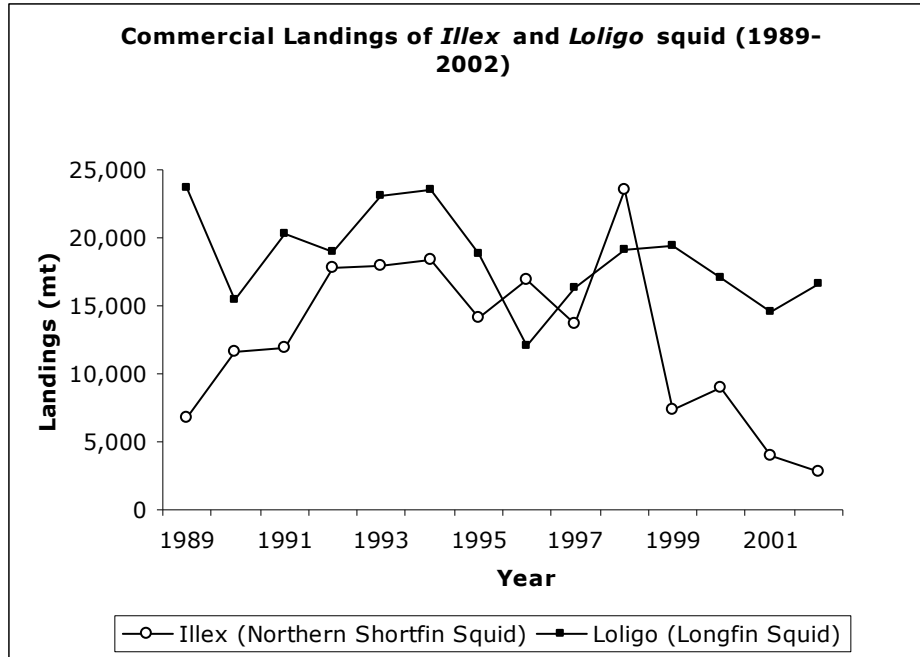


Figure 12: Commercial landings of the longfin (*Loligo*) and northern shortfin (*Illex*) squid from 1989 to 2002 (NEFSC, 2002; NEFSC, 2003).

Butterfish landings have been on a slow but steady decline since 1985. In between these years, there have been many fluctuations with a dramatic spike in 2001 and then a rapid decline (Figure 13).

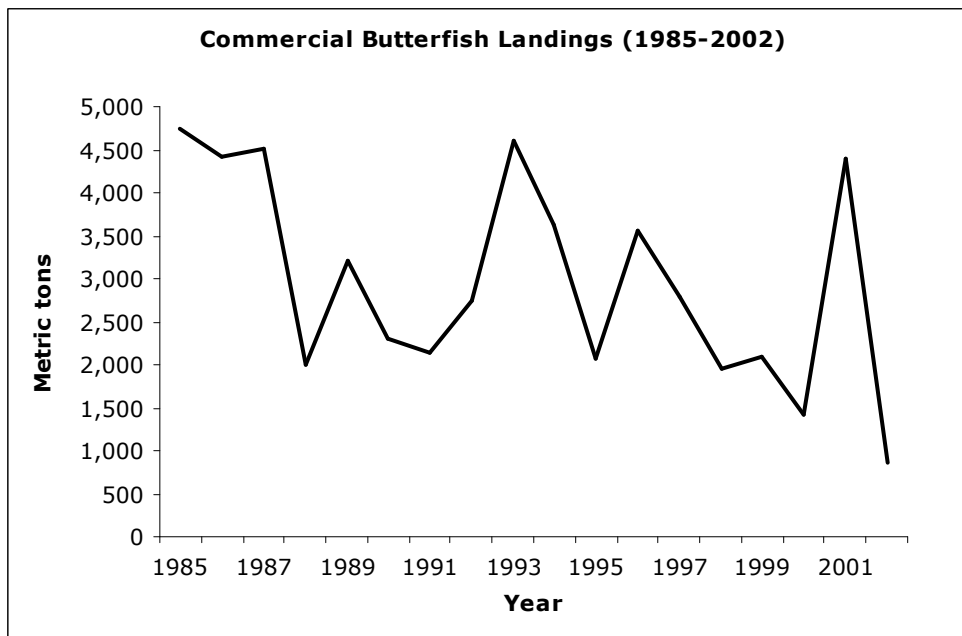


Figure 13: Commercial butterfish landings from 1985-2002 (NEFSC, 2004).

The gear used to fish for all four of the species is limited to small mesh otter trawls and midwater trawls. Both species of squid and the butterfish are fished exclusively with the small mesh bottom otter trawl. The mackerel is mainly fished with midwater and paired midwater trawls (NMFS, 2004b).

Regulations

The regulations for squid, mackerel and butterfish consist mainly of quota limits, closures and gear restrictions. The TAC limits are given in Table 15. For *Loligo* squid, the yearly quota is broken down into four quarters (NMFS, 2004c) (Table 16).

Table 15: Squid, Mackerel and Butterfish quota amounts for 2004 (MAFMC, 2003b).

	<i>Loligo</i>	<i>Illex</i>	Mackerel	Butterfish
Maximum optimal yield	26,000 mt	24,000 mt	-	-
Initial optimum yield	-	-	170,000 mt	5,900 mt
Optimum yield	17,000 mt	24,000 mt	-	-
Allowable biological catch	17,000 mt	24,000 mt	347,000 mt	7,200 mt
Domestic allowable/annual harvest	17,000 mt	24,000 mt	170,000 mt	5,900 mt
Domestic annual processing	-	-	150,000 mt	5,900 mt
Joint venture processing	-	-	5,000 mt	0 mt
Total allowable limit for foreign fishing	-	-	0 mt	0 mt

Table 16: 2004 quota distributions for *Loligo* squid (NMFS, 2004k).

Quarter	Percent
I – January – March	33.2
II – April – June	17.6
III – July - September	17.3
IV – October - December	31.9

The directed mackerel fishery may be closed when 80% of the domestic annual harvest (DAH) is reached in order to prevent the DAH from being exceeded. During the pre-emptive closure incidental catch of mackerel is permitted and the mackerel possession limit is 10% by weight of the total fish on board until the DAH is reached for that year. The directed fisheries for *Illex* and butterfish are closed when 95% of DAH has been harvested. During a closure of the directed squid or butterfish fishery, the possession limit for *Loligo* and butterfish is 1.13 mt (2,500 lbs), and for *Illex* 4.45 mt (10,000 lbs).

Vessels fishing for *Loligo* must have diamond mesh of at least 48 mm applied throughout the codend for at least 150 continuous meshes forward of the terminus of the net. For codends with less than 150 meshes, the minimum mesh size of the codend shall be a minimum of one-third of the net measured from the terminus of the codend to the head rope unless fishing for *Illex*. When fishing for *Illex* from June through September, seaward of specified coordinates, the minimum mesh size is always at least 48 mm (NMFS, 2004c).

There are several other regulatory mechanisms such as research quotas up to three percent of the IOY, minimum sizes, trip limits, possession limits and more stringent gear restrictions used for this fishery (NMFS, 2004c).

Discards

The bycatch and discard data available for the squid, mackerel and butterfish fisheries are varied. The stock assessment data often account only for target species discards. In some cases, the stock assessments give discard data for several species in the FMP. For example, butterfish discards have been estimated in the squid fisheries, *Illex* discards have been estimated in the *Loligo* fishery and *Loligo* discards have been estimated in both the butterfish and mackerel fisheries.

Butterfish Fishery

On average, discards of butterfish account for 18% of the total discards in the butterfish fishery (Table 17) (NEFSC, 2004). *Loligo* squid account for another one percent of the total discards with approximately 17 mt in 2002 (NEFSC, 2002). The remainder of the discards is composed of other species such as silver

hake, red hake, offshore hake and scup. For the years where the butterfish d/l ratio was not given, the average butterfish d/l ratio, 0.47, was used to calculate the discards of butterfish.

Table 17: Landings, estimated discards of butterfish and total discards in the directed butterfish fishery. (NEFSC, 2004).

Year	Butterfish landings (mt)	d/l ratio of butterfish discards	Discards of butterfish (mt)*	d/l ratio of all discards (including butterfish)	Total discards (including butterfish) (mt)
1985	4,739	Not Given	2,227	1.51	7,134
1986	4,418	Not Given	2,076	1.64	7,249
1987	4,508	Not Given	2,119	1.59	7,168
1988	2,001	Not Given	940	1.61	3,224
1989	3,203	Not Given	1,505	1.39	4,442
1990	2,295	Not Given	1,079	1.32	3,020
1991	2,149	0.19	404	1.61	3,451
1992	2,752	Not Given	1,293	2.07	5,698
1993	4,604	0.18	823	1.84	8,478
1994	3,631	0.02	64	1.02	3,701
1995	2,080	Not Given	978	4.13	8,599
1996	3,547	0.68	2,400	1.92	6,823
1997	2,784	0.29	815	1.38	3,852
1998	1,956	Not Given	919	1.67	3,274
1999	2,103	0.53	1,120	1.96	4,115
2000	1,422	Not Given	668	1.71	2,427
2001	4,396	Not Given	2,066	1.65	7,262
2002	867	1.43	1,242	2.09	1,809

* For years where the d/l ratio of butterfish discards to butterfish landings was not given, the average d/l ratio from the other years was used to estimate total annual discards of butterfish.

Squid Fishery

The stock assessment workshop (SAW) documents for squid give data on target species discards and discards of butterfish. Discards of both species of squid have been estimated for the *Loligo* fishery (Table 18), but only target species discards were estimated for the *Illex* fishery (Table 19). Discards of butterfish in the combined squid fishery was also reported (Table 20).

Table 18: Landings and estimated discards of both species of squid in the *Loligo* fishery (NEFSC, 2004).

Year	Landings of <i>Loligo</i> (mt)	d/l of <i>Loligo</i> in <i>Loligo</i> Fishery*	Discards of <i>Loligo</i> (mt)	d/l of <i>Illex</i> in <i>Loligo</i> fishery**	Discards of <i>Illex</i> (mt)
1989	23,733	0.028	657	Not Given	578
1990	15,399	0.028	427	Not Given	375
1991	20,299	0.028	562	Not Given	495
1992	19,018	0.028	527	Not Given	464
1993	23,020	0.028	638	Not Given	561
1994	23,480	0.028	650	Not Given	572
1995	18,880	0.028	523	0.000	0
1996	12,026	0.028	333	0.046	553
1997	16,308	0.028	452	0.033	538
1998	19,151	0.028	530	0.027	517
1999	19,386	0.028	537	0.037	717
2000	17,034	0.028	472	0.008	136
2001	14,603	0.028	405	0.024	350
2002	16,684	0.028	462	0.020	334

* Annual discards for *Loligo* in the *Loligo* fishery were not reported. An average d/l ratio for the years 1997-2000 was reported (0.0277) (NEFSC, 2004), and the weight of discards from 1989-2002 was calculated using that d/l ratio.

** For years where the d/l ratio of *Illex* discards to *Loligo* landings were not given, the average d/l ratio, 0.024, was used to estimate total annual discards of *Illex*.

Table 19: Landings and estimated discards of *Illex* in the *Illex* fishery (NEFSC, 2002a).

Year	Landings of <i>Illex</i>	d/l ratio of <i>Illex</i> discards to <i>Illex</i> landings*	Discards of <i>Illex</i> (mt)
1989	6,801	Not Given	77
1990	11,670	Not Given	132
1991	11,908	Not Given	135
1992	17,827	Not Given	202
1993	18,012	Not Given	204
1994	18,350	Not Given	208
1995	14,058	0.030	422
1996	16,969	0.005	85
1997	13,629	0.006	82
1998	23,597	0.011	260
1999	7,388	0.011	81
2000	9,011	0.005	45
2001	4,009	Not Given	45
2002	2,723	Not Given	31

* For years where the d/l ratio of *Illex* discards to *Illex* landings was not given, the average d/l ratio from the other years was used to estimate total annual discards of *Illex*.

Butterfish discards in the squid fishery are usually over twice the annual landings of both species combined, and in some cases 40 times the landed squid catch (NEFSC, 2004). Butterfish discards in the squid fishery are reported separately (Table 20) because butterfish discards were reported for both squid fisheries together, not separated by target squid species.

Table 20: Estimated butterfish discards in the combined squid fisheries (NEFSC, 2004).

Year	Total squid landings (<i>Loligo</i> and <i>Illex</i>)	d/l of butterfish in squid fishery	Butterfish discards in the squid fishery
1989	30,534	1.8	54,262
1990	27,069	0.4	10,617
1991	32,207	7.0	225,895
1992	36,845	4.4	162,541
1993	41,032	11.8	484,639
1994	41,830	1.8	75,484
1995	32,938	29.4	968,429
1996	28,995	7.2	208,562
1997	29,937	0.9	26,177
1998	42,748	0.9	36,124
1999	26,774	36.7	983,083
2000	26,045	8.8	229,760
2001	18,612	5.2	96,293
2002	19,407	3.5	68,407

Observer data were obtained for the bottom otter trawl fisheries targeting longfin and shortfin squid to determine what non-target species were being discarded from the squid fisheries. Thirty-five trips targeting longfin squid were observed in 2002, and the proportion of total discards for each species group from those observed trips are shown in Figure 14. These 18 species groups encompass 92 different species (NMFS, 2004a).

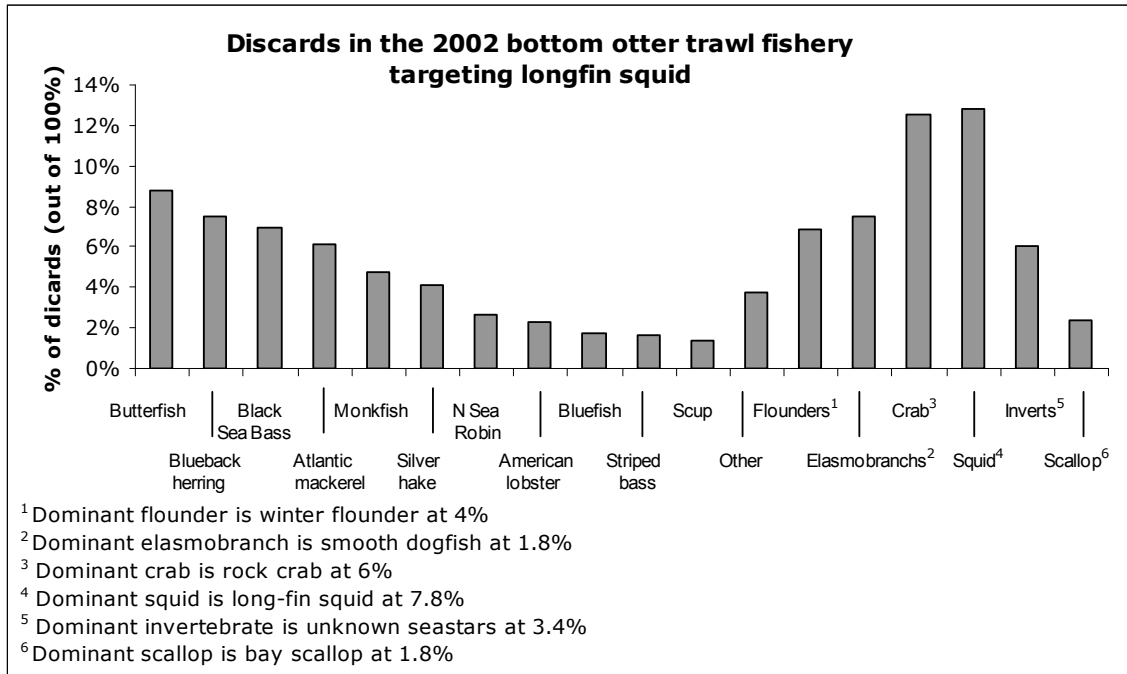


Figure 14: Aggregated discards from the bottom otter trawl fishery targeting longfin squid in 2002 (NMFS, 2004a).

Observers were only present on ten trips targeting shortfin squid, all in 2003, but the discard data for all species caught on these trips is presented (Figure 15).

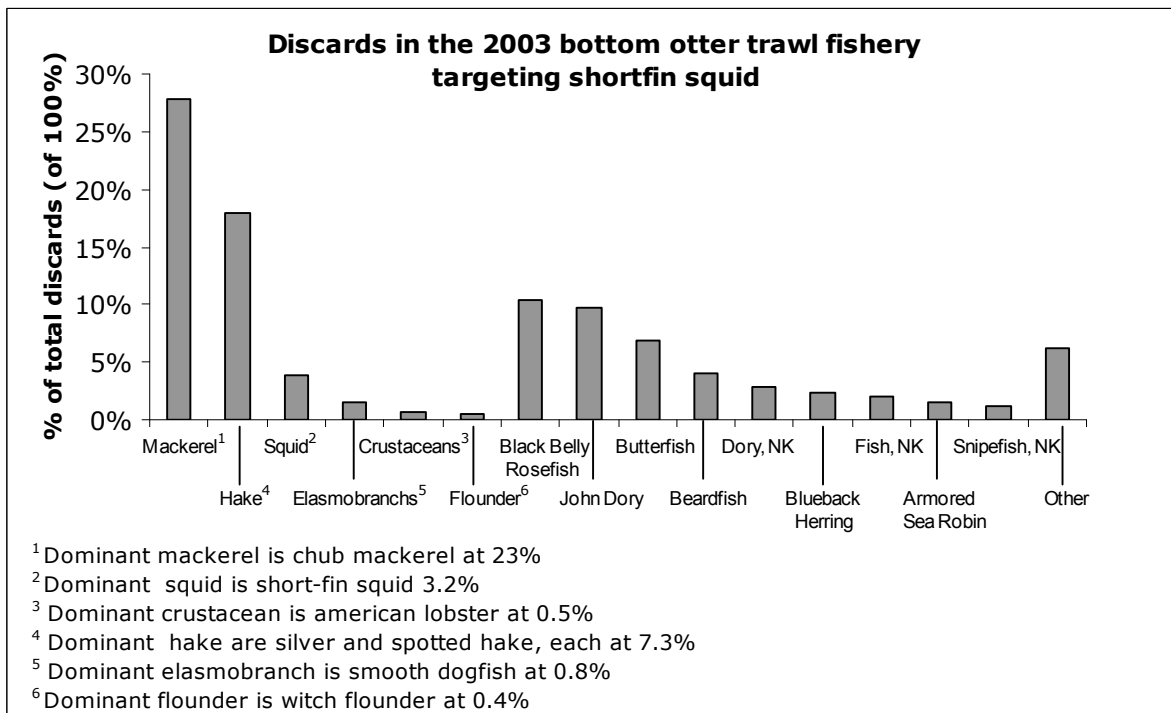


Figure 15: Aggregated discards in the 2003 bottom otter trawl fishery targeting shortfin squid (NMFS, 2004a).

In 2002 there were 16,684 mt of longfin squid landings, and according to the 2002 observer data, the average discard to landings ratio was 1.02 (observed discards divided by observed longfin squid landings, giving an estimate of 17,018 mt total discards. For the shortfin squid, a discard to landings ratio of 4.198 was calculated from the 2003 observer data. If this ratio is applied to 2002 shortfin squid landings (2,723 mt), the most recent year for which total landings are available, total discards are estimated at 11,431 mt.

Mackerel Fishery

The mackerel fishery is very different from the squid and butterfish fisheries. Mackerel are typically caught with trawl gear; both bottom and midwater (single or paired) are used frequently. Occasionally, gillnets are used. The catch composition of a midwater trawl targeting mackerel is very similar to that of a midwater trawl targeting herring. Consequently, herring comprise the largest amount of bycatch in the mackerel midwater trawl fishery (Figure 16). However, the majority of the herring catch in the mackerel fishery is landed, and counts against the herring quota. Since the mackerel and herring fisheries overlap, some mackerel data can be found in herring assessment documents. In the First Amendment to the Herring FMP, catch and discards were reported for all species on four observed midwater pair trawl trips which targeted herring and/or mackerel (NEFMC, 2004). Mackerel and herring (blueback and Atlantic) comprise the majority of the catch, but spiny dogfish, alewife and shad were listed as bycatch species (Figure 14). Target species discard estimates for the entire fishery were not given as the entire observed mackerel and herring catch was landed. The *Loligo* stock assessment in the 34th SAW also lists a small amount of *Loligo* bycatch in the mackerel fishery, ranging from a low of 1.87 mt in 1993 to a high of 12.50 mt in 1990. In 2002, *Loligo* bycatch in the mackerel fishery was 9 mt (NEFSC, 2002).

Average catch composition from four midwater pair trawl traps targeting mackerel and/or herring (1994-2002)

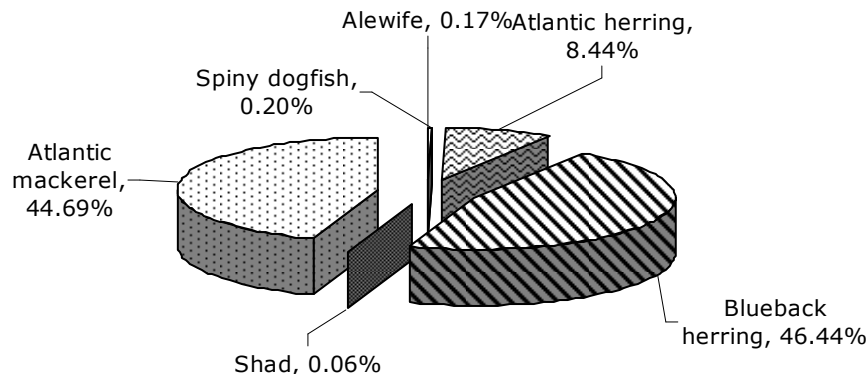


Figure 16: Catch composition of midwater pair trawls targeting mackerel and/or herring (NEFMC, 2004).

In Figure 16, all mackerel were landed, and these percentages were used to determine bycatch to landing (b/l) ratios as the catch disposition was not given for the rest of the species. The b/l ratios were multiplied by the total mackerel commercial landings for midwater and pair trawls in 2002 (17,090.6 mt) to arrive at a rough estimate of bycatch for these five species in the 2002 midwater and pair trawl mackerel fishery (Table 21). These are estimates of the total bycatch of these species, no distinction is made between landed and discarded catch.

Table 21: 2002 bycatch estimates for the Atlantic mackerel midwater trawl and pair trawl fisheries using the bycatch to landings ratio from the midwater pair trawl fishery.

Species	b/l ratio	Bycatch in 2002 mackerel fishery (mt)
Alewife	0.004	65
Spiny dogfish	0.004	75
Atlantic herring	0.189	3,230
Blueback herring	1.039	17,757
Shad	0.001	22
Total		21,150

Along with the mid-water pair trawl data, five anchored sink gill net trips and six otter trawl trips targeting mackerel were observed in 2001. The observer data gives an estimate of discards by these gears in the mackerel fishery (Figure 17 and Figure 18). The composition of the discarded catch is very different for the two gear types.

Discarded catch in the 2001 anchored sink gillnet fishery targeting Atlantic mackerel

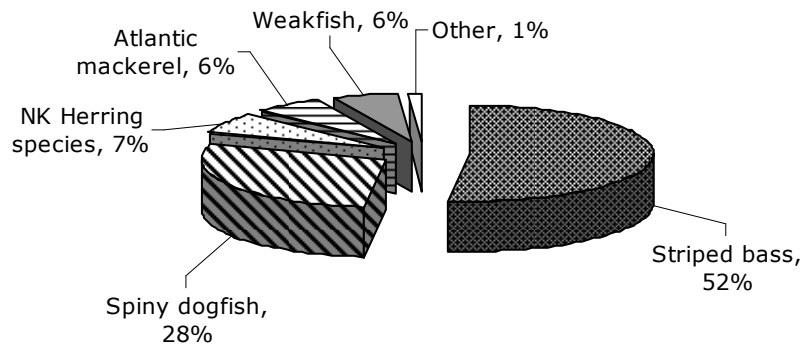


Figure 17: Discarded catch composition from six observed trips in the 2001 Atlantic mackerel fishery using anchored sink gillnets.

Discarded catch in the 2001 bottom otter trawl fishery targeting Atlantic mackerel

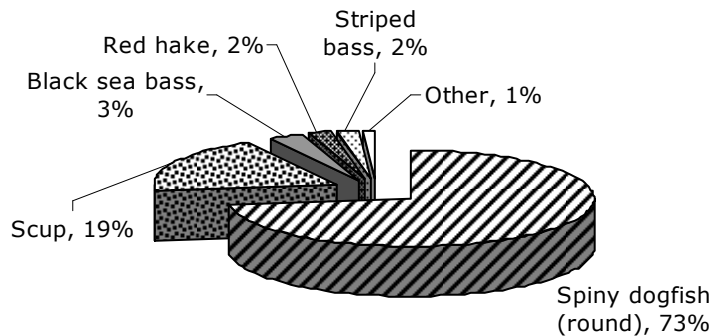


Figure 18: Discarded catch composition from five observed trips in the 2001 Atlantic mackerel fishery using otter trawls.

The observed discards for each species were divided by the observed landings of Atlantic mackerel to determine individual d/l ratios for 2001 (Table 22). These ratios were then multiplied by the total 2002 landings of Atlantic mackerel to get total discards for each species in 2002 (Table 22). In 2002, the sink gillnet and otter trawl fisheries caught 66.8 and 4,008.4 mt respectively.

Table 22: Estimated discards in the sink gillnet and otter trawl fisheries targeting Atlantic mackerel for 2002 based on 2001 observer data.

Sink gillnet estimated discards			Otter trawl estimated discards		
Species	2001 d/l ratio	2002	Species	2001 d/l ratio	2002
Striped bass	0.055	3.67	Spiny dogfish	0.0016	6.41
Spiny dogfish	0.031	2.07	Scup	0.0004	1.60
Herring, NK	0.008	0.53	Black sea bass	0.00006	0.24
Atlantic mackerel	0.007	0.47	Red hake	0.00004	0.16
Weakfish	0.006	0.40	Striped bass	0.00004	0.16
Other	0.0008	0.05	Other	0.00002	0.08
Total		7.15	Total		8.65

In summary, the total 2002 landings of butterfish were 867 mt. There were 1,809 mt of discards for a d/l ratio of 2.09.

In the 2002 Loligo squid fishery, there were 16,684 mt of longfin squid landings, and according to the 2002 observer data, the average discard to landings ratio was 1.02 giving an estimate of 17,018 mt total discards. For the shortfin squid, a discard to landings ratio of 4.198 was calculated from the 2003 observer data. If this ratio is applied to 2002 shortfin squid landings (2,723 mt), the most recent year for which landings are available, total discards are estimated at 11,431 mt. While butterfish discards are included in these estimates, it is worth mentioning that a much larger amount of butterfish discards (68,407 mt) were reported by a different source (NEFSC, 2004). These discards were left out of the total because the first estimate was more complete, and the large amount of butterfish discards were expanded greatly, thus increasing the error in the estimate.

In 2002, the total landings of Atlantic mackerel amounted to 21,165 mt; total bycatch was almost exactly the same, 21,166 mt. The majority of the bycatch (96%) was landed Atlantic and blueback herring. The estimated discards from the 2002 sink gillnet and otter trawl fisheries targeting herring only amounted to 16 mt (included in the 21,166 mt estimate). There was also an additional estimate of 9 mt of discarded loligo squid, for an overall bycatch amount of 21,175 mt, and an overall b/l ratio of 1.00. It is obvious that the majority of the landings as well as the majority of the discards in the mackerel fishery were from midwater trawls.

Overall, 41,439 mt of squid, mackerel and butterfish and 51,433 mt of bycatch were caught in 2002, for a b/l ratio of 1.24.

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Monkfish Fishery

Major Target Species:	Monkfish (<i>Lophius americanus</i>)
Major Discard Species:	Spiny Dogfish (<i>Squalus acanthius</i>), Winter skate (<i>Leucoraja ocellata</i>), Jonah crab (<i>Cancer borealis</i>)
Primary Gear Types:	Trawl, Gillnet
Total Landings (2002):	20,585 mt
Total Discards (2002):	17,374 mt
Total Discards Rank (of 27):	11
Discard to Landings Ratio:	0.84
d/l Rank (of 27):	7
Source of Estimates:	NMFS, Authors
Discard Type:	Primarily non-target, non-regulatory
Notes:	

The monkfish, also known as goosefish, is a demersal groundfish which is often associated with New England multispecies though it has its own FMP and is managed as two separate stocks, north and south. Monkfish are found along the entire Atlantic coast (to about 29 degrees north latitude). They are fished mainly with trawl, gillnet and dredge. The monkfish is a relatively new delicacy to the people of America. Until the 1970's it was used as a lobster substitute, and usually only the tails were landed because the appearance of the fish deterred potential consumers. However, monkfish is now a very popular restaurant food fish. Its livers are also exported (NMFS, 1999). Both stocks of monkfish are experiencing overfishing, and the southern stock is overfished (NMFS, 2004c)

Target landings

In the 1970's and 1980's monkfish landings in the U.S. more than doubled. Landings from the northern stock declined beginning in 1995, followed by the southern stock in 1998. (Figure 19) (NMFS, 2004a). Overall landings from 2001 and 2002 show another small increase. However, the biomass is severely depleted, and landings of this magnitude can not be sustained for an extended period of time (NMFS, 1999).

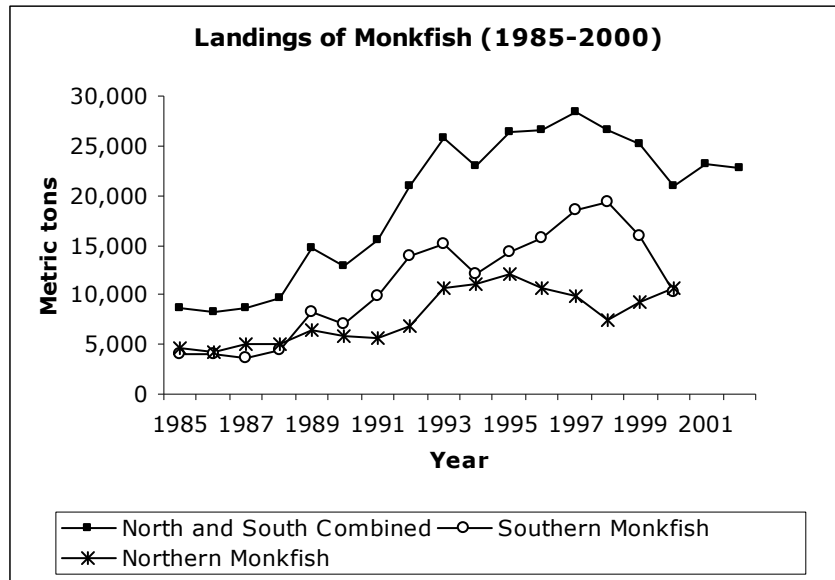


Figure 19: Landings of monkfish from 1985-2000 (NMFS, 2004e).

The majority of monkfish landings in both the northern and southern stocks is from trawls; gillnets and dredges account for the rest of the landings. It is illegal to target monkfish with dredges, but many monkfish are landed as bycatch in the scallop fishery. These monkfish landed as bycatch must still meet the same size limits as targeted landings (Figure 20 and Figure 21) (NMFS, 2004a).

Average Gear Usage for Northern Monkfish, 1996-2000

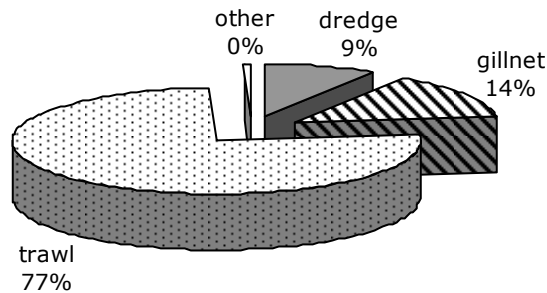


Figure 20: Gear usage percentages in the northern monkfish stock (NMFS, 2004e).

Average Gear Usage for Southern Monkfish, 1996-2000

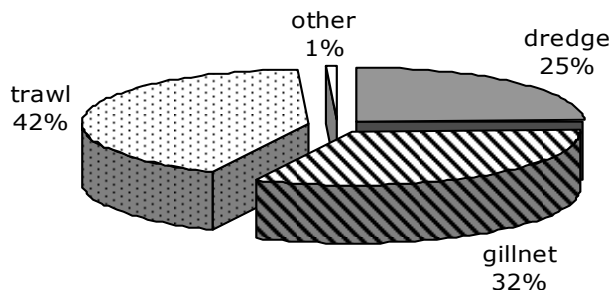


Figure 21: Gear usage percentages in the southern monkfish stock (NMFS, 2004e).

Regulations

The main regulations for monkfish are limitations on DAS, area closures, gear restrictions, landing limits and minimum fish sizes.

Limited access monkfish vessels are allocated 40 DAS per year. However, for the 2004 FY, fishermen were further restricted to 28 days in an effort to rebuild the monkfish stock. Monkfish DAS must be used in combination with multispecies and scallop DAS if a fisherman holds these permits.

All monkfish vessels are assumed to be fishing in the southern monkfish area unless they have an authorization letter from the NMFS Regional Administrator. Gear is restricted by minimum mesh sizes, number of nets, and type of gear allowed. Trawl nets used while on Monkfish DAS must have a minimum

mesh size of 10 inches square mesh or 12 inches diamond mesh. All gillnets used while on Monkfish DAS must have a minimum square mesh size of 10 inches. A monkfish vessel may not have more than 160 gillnets set at any one time, and dredges are not allowed for targeting monkfish.

There are landing limits and minimum fish sizes in place. In the northern fishery management area (NFMA) there is no trip limit for vessels with a limited access permit fishing under a monkfish DAS. In the southern fishery management area (SFMA), category A and C monkfish vessels fishing under a monkfish DAS may land a quarter ton of tails or 0.83 tons of whole monkfish and category B and D monkfish vessels may land 0.2 tons of tail or 0.68 tons of whole fish. All vessels holding a valid NFMA monkfish permit must adhere to the following minimum fish size requirements: total length 17 inches (43.2 cm), tail length 11 inches (27.9 cm). In the SFMA, the minimum length is 21 inches (53.3 cm) total length and 14 inches (35.6 cm) tail length (NMFS, 2004b).

Discards

The 34th SAW and the 2002 monkfish SAFE report have detailed bycatch information for both monkfish discards and non-target discards. When calculating target species discard ratios in the 34th SAW, both fishery observer data and VTR data were used. The annual amount of monkfish discarded was calculated using discard ratios from the observer program on a management region, gear type and half-year basis. Then the discard ratios were multiplied by the reported landings (live weight, by stock, gear type and half-year cells) to derive metric tons of discards. If no sampling data were available for a cell, the assessment used the overall mean discard to landings ratio for all gears and years (NEFSC, 2002). Discard ratios from the two data sources were consistent, but only observer data were used in the calculation of total discards (Table 23 and Table 24).

Table 23: Monkfish landings, monkfish discards and discard to landing ratios of the northern monkfish stock using observer data (NEFSC, 2002).

Year and Gear Type	Landings (mt)	Discards (mt)	d/l ratio
1996			
Trawl	8,437	1,611	0.19
Gillnet	1,391	189	0.14
1997			
Trawl	7,400	688	0.09
Gillnet	1,004	108	0.11
1998			
Trawl	5,444	626	0.12
Gillnet	906	37	0.04
1999			
Trawl	7,002	490	0.07
Gillnet	1,492	33	0.02
2000			
Trawl	8,172	654	0.08
Gillnet	2,092	149	0.07

Table 24: Monkfish landings, monkfish discards and discard to landing ratios of the southern monkfish stock using observer data (NEFSC, 2002).

Year and Gear Type	Landings (mt)	Discards (mt)	d/l ratio
1996			
Trawl	7,173	911	0.13
Gillnet	4,220	287	0.07
1997			
Trawl	8,234	362	0.04
Gillnet	5,202	297	0.06
1998			
Trawl	7,832	603	0.08
Gillnet	6,196	489	0.08
1999			
Trawl	6,399	601	0.09
Gillnet	6,164	327	0.05

Year and Gear Type	Landings (mt)	Discards (mt)	d/l ratio
2000			
Trawl	4,069	1,062	0.26
Gillnet	4,015	325	0.08

In 2002, the only data available were total landings. In order to determine an estimate of discards in 2002, the 2000 discard to landings ratios for the north and south were averaged proportionately for each gear type, and then multiplied by total landings of monkfish for 2002 (Table 25).

Table 25: Combined north and south monkfish landings and estimated monkfish discards for 2002 using 2000 observed discard to landings ratios (NEFSC, 2002a).

Gear Type	Landings (mt)	Discards (mt)	d/l ratio
Trawl	12,339	1,728	0.140
Gillnet	8,246	643	0.078
Total	20,585	2,371	0.115

Discards of monkfish as well as discards of non-target species were evaluated in a different manner in the 2002 Monkfish SAFE report. The SAFE report gave total study landings of monkfish from each gear type, and listed every species discarded by each of the gear types as well as their percentage of the total observed discards (NEFMC and NMFS, 2001). The SAFE report also gave, for each gear type, the number of observed trips in the study as well as the weight of total discards from those trips. The discarded weight of each species was then extrapolated by multiplying its percentage by the total discards. This method found a higher overall discard amount of monkfish than the 34th SAW. The discards are reported in Table 26 and Table 27, separated by gear type.

Table 26: Weight of discards in the monkfish trawl fishery. Discard amounts are extrapolated based on the catch from 13 observed trawl trips which targeted monkfish (NEFMC and NMFS, 2001).

Species	2001 est. discards (mt)	2002 est. discards (mt)
Monkfish (landings)	13,000	12,339
Monkfish (discards)	3,204	3,040
Jonah Crab	3,458	3,282
Winter Skate	2,017	1,914
Spiny Dogfish	1,855	1,760
American Plaice	1,282	1,216
American Lobster	1,121	1,064
Witch Flounder	961	912
Longhorn Sculpin	481	456
Silver Hake	481	456
Yellowtail Flounder	481	456
Little Skate	320	304
White Hake	320	304
Total discards	15,981	15,166

Table 27: Weight of discards in the monkfish gillnet fishery. Discard amounts are extrapolated based on the catch from 42 observed gillnet trips which targeted monkfish.

Species	2001 est. discards (mt)	2002 est. discards (mt)
Monkfish (landings)	7,973	8,246
Monkfish (discards)	491	508
Winter Skate	585	605
Spiny Dogfish	356	368
Little Skate	128	132
American Lobster	84	86
Bluefish	64	66
Rock Crab	64	66
Thorny Skate	64	66
Atlantic Mackerel	44	46

Species	2001 est. discards (mt)	2002 est. discards (mt)
Jonah Crab	44	46
Others	211	218
Total discards	2,135	2,208

In summary, monkfish discards are estimated by scientists at the NEFSC (SAW) and the NEFMC (SAFE). The 34th SAW's estimate of monkfish discards is somewhat lower than the 2002 SAFE report's estimates. The SAW reported that 2,370.71 mt of monkfish were discarded and 20,585 mt of monkfish were landed in 2002 for a d/l ratio of 0.115. In contrast, the SAFE report estimated that 3,548 mt of monkfish were discarded from the trawl and gillnet fisheries combined, for a target species d/l ratio of 0.172. Here, we use the SAFE report's estimate of discards because it is more current, and includes non-target species discards. Overall, 17,374 mt were discarded in the monkfish fishery for an overall d/l ratio of 0.84.

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Summer Flounder, Scup, and Black Sea Bass Fishery

Major Target Species:	Summer flounder (<i>Paralichthys dentatus</i>), Scup (<i>Stenotomus chrysops</i>), Black sea bass (<i>Centropristis striata</i>)
Major Discard Species:	Skates, Butterfish (<i>Peprilus triacanthus</i>), Groundfish, Flatfish
Primary Gear Types:	Otter trawl, Handline (Scup and BSB), Pot and trap (BSB)
Total Landings (2002):	18,890 mt
Total Discards (2002):	11,474 mt
Total Discards Rank (of 27):	12
Discard to Landings Ratio:	0.61
d/l Rank (of 27):	10
Source of Estimates:	NMFS, Authors
Discard Type:	Unknown if primarily target or non-target, Primarily regulatory.
Notes:	Only target species discards are known.

The FMP for Summer Flounder, Scup and Black Sea Bass was initially approved by the MAFMC in September of 1988, and has been amended 12 times since. All three species are found between Cape Cod, Massachusetts and Cape Hatteras, North Carolina. The range of summer flounder extends southward to South Carolina and possibly Florida. Black sea bass are found as far south as Cape Canaveral, Florida. There are a few incidences of all species being found in the Gulf of Maine, but these occurrences are rare (Collette and Klein-MacPhee, 2002). Overfishing is occurring in all three fisheries. The black sea bass and summer flounder fisheries also are categorized as overfished. (NMFS, 2004a). The scup fishery is in the process of rebuilding (MAFMC, 2003)

Target landings

Over the past three decades, summer flounder and scup have similar patterns of landings, (Figure 22). A landings peak in both the summer flounder and scup fisheries was seen in the early 1980's before the FMP was put into effect, followed by a dramatic decline in landings in 1988, the year that the FMP and its total allowable catch limits were first enforced. Black sea bass landings did not experience any observable change after the FMP was implemented. However, the black sea bass resource is still considered overfished.

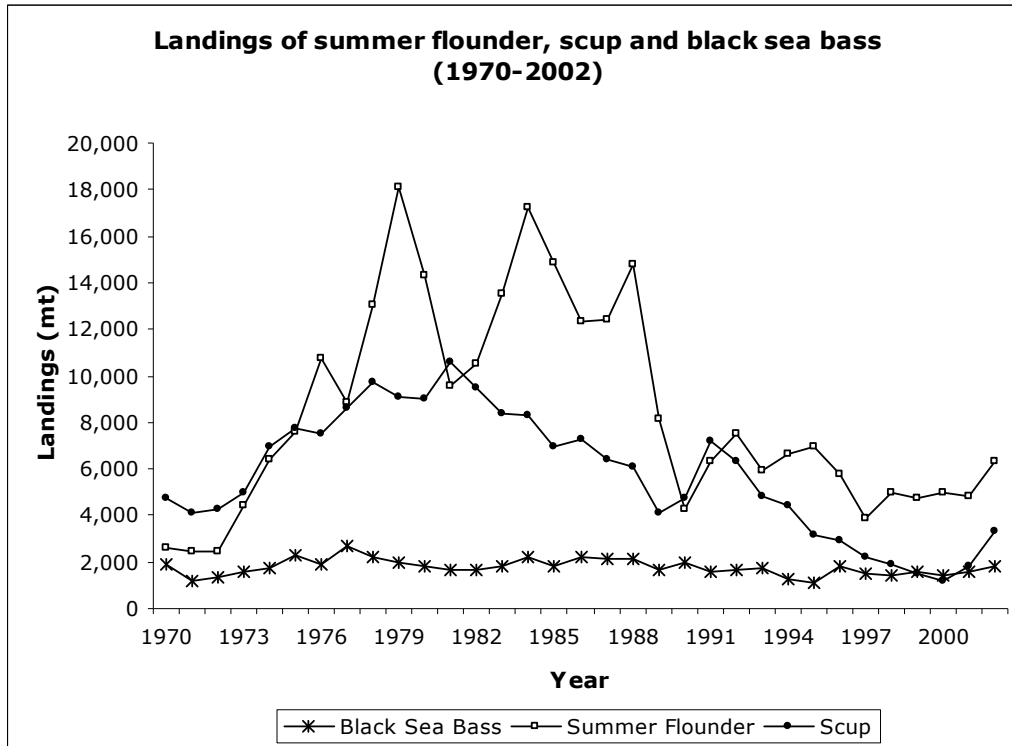


Figure 22: Commercial landings of summer flounder, scup and black sea bass over the past 30 years. The year that the fishery management plan went into effect (1988) is visible in the landings (NMFS, 2004b).

The gear types used to fish for these species are varied. Summer flounder is the only fishery in which there is a strong preference for the otter trawl. The otter trawl is the most commonly used gear in the scup fishery as well, but it is responsible for only 66% of the total catch as opposed to 92% in the summer flounder fishery. The gear types used to fish for all of these species are given in Table 28, split by percent usage.

Table 28: Percentages of landings split by gear type in the summer flounder, scup and black sea bass fisheries for 2002 (NMFS, 2004b).

	Otter Trawl	Hand Line	Gill Net	Pound Net	Pots and Traps	Floating Traps
Summer flounder	92.2%	3.1%	1.5%	1.6%	0.2%	0.2%
Scup	66.1%	13.8%	0.6%	2.9%	7.5%	6.7%
Black sea bass	36.6%	12.2%	0.4%	0.6%	46.2%	0.4%

Regulations

The 2004 summer flounder allowable landings are 28.2 million pounds. After deducting a research set-aside (RSA), the commercial quota is 16.82 million pounds and the recreational harvest limit is 11.21 million pounds. The annual commercial quota for summer flounder is distributed among several states, with Virginia, North Carolina, New Jersey and Rhode Island holding the largest landing shares. For scup, the annual commercial quota is divided into three periods, based on the following percentages (Winter I: January through April - 45.11%, Summer: May through October - 38.95%, Winter II: November through December - 15.94%). For 2004, after deducting the RSA, the TAL is divided into a commercial quota of 5,600 mt and a recreational harvest limit of 1,812 mt. Allowable landings for Black sea bass are 3,629 mt. After being adjusted to reflect the 2004 RSA, the allowable black sea bass landings are divided into

a commercial quota of 1,751 mt and a recreational harvest limit of 1,819 mt. The minimum sizes for each of these species are given in Table 29.

Table 29: Minimum legal size for each species. The minimum length for party/charter boats only applies if the boat is carrying more than 5 crew members (party) or more than three crew members (charter) (NMFS, 2004c).

	Minimum length for vessels with moratorium permit	Minimum length for vessels without a moratorium permit or party/charter boats
Summer flounder	14 inches	17 inches
Scup	9 inches	10 inches
Black sea bass	11 inches	12 inches

Summer flounder nets must have a minimum mesh size of 5.5 inches diamond mesh or 6 inch square mesh. Scup and black sea bass boats must fish with nets that have a minimum mesh size of 4.5 inches diamond mesh. In addition, scup and black sea bass pot and trap gear must have biodegradable hinges or fasteners, escape vents and ID codes. Rollers used in a roller rig or rock hopper trawl gear shall be no greater than 18 inches (45.7 cm) in diameter when fishing for any of these species.

Unless otherwise noted, no person is allowed to possess more than four summer flounder, 50 scup or 25 black sea bass in, or harvested from, the EEZ, unless that person is the owner or operator of a fishing vessel issued a moratorium permit, or holds a flounder dealer permit for the species in possession. (NMFS, 2004c).

Discards

As in the New England multispecies fishery, the most detailed bycatch information available for the summer flounder, scup and black sea bass fishery pertains to target species discards, not discards of other species. These three fisheries also have large recreational components. In some years, the recreational landings exceed the commercial landings. For that reason, recreational discard data are included here. It appears that bycatch is lower in recreational fisheries than in the commercial fisheries. The most recent data for these fisheries is from 2001.

Target Species Discards

Summer flounder

The summer flounder fishery theoretically extends to northern Florida. However, there are no reported commercial landings in Georgia or Florida (NMFS, 2004b). Stock assessment documents only cover the region from Maine to North Carolina.

Target species discards were estimated in the commercial summer flounder trawl fishery using observer and VTR data. Observer data typically are more accurate than VTR data, but the volume of VTR data available are much greater. It is interesting to note that for many of the years, VTR data reported higher estimates of discards than observer data. This is most likely due to the fact that only a few observer trips were used to make these estimates. However, there was an increase in observer coverage in 2004, and the discard estimates increased. Due to this increase in observer coverage, and the greater inherent accuracy of observer data, only observer data are used here (Table 30). Observed landings and discards, discard to landings ratios and total discard estimates for 1994-2001 are shown for observer data from the trawl fishery (Table 30) (NEFSC, 2002). The 2002 discard amounts are calculated using the d/l ratio from 2001.

Table 30: Commercial discards and discard to landings ratios of summer flounder in the trawl fishery estimated using observer data (1994-2002) (NEFSC, 2002).

Year	Observed trawl landings (mt)	Observed trawl discards (mt)	d/l ratio	Total trawl landings (mt)	Estimated total trawl discards using observer d/l ratio (mt)
1994	74.3	4.8	0.07	5,768	374
1995	106.6	3.5	0.03	6,484	215
1996	41.2	4.8	0.12	5,516	644
1997	12.0	2.4	0.20	3,599	711
1998	29.7	3.1	0.11	4,585	482
1999	20.9	6.7	0.32	4,376	1,403
2000	65.7	7.8	0.12	4,582	546
2001	27.9	21.7	0.78	4,430	3,443
2002*			0.78*	5,911	4,593*

* 2002 discards are estimated using the d/l ratio from 2001

The discards estimated in Table 30 are from the trawl fishery only, but since trawl landings account for over 92% of the total summer flounder landings, these estimates of discard are only slightly lower than the total discard in the entire commercial fishery.

Recreational landings make up a large portion of total landings, so discards from the recreational summer flounder fishery are also reported (Table 31).

Table 31: Recreational landings and discards of summer flounder (1995-2002) (MAFMC and NMFS, 2004; NEFSC, 2002).

Year	Recreational Landings, ME-NC (all gear) (mt)	Recreational d/l ratio	Est. Recreational Discards, ME-NC (mt)
1995	2,496	0.29	714
1996	4,704	0.13	615
1997	5,378	0.12	627
1998	5,659	0.09	517
1999	3,795	0.18	688
2000	7,090	0.12	855
2001	5,250	0.23	1,184
2002*	3,633	0.23*	821

* 2002 discards are estimated using the d/l ratio from 2001

In order to estimate discards from the other eight percent of landings in the commercial summer flounder fishery, the d/l ratios from the recreational fishery were used because this small part of the commercial fishery is fished predominately with handlines (Table 32).

Table 32: Estimated discards in the non-trawl commercial summer flounder fishery using the recreational d/l ratio (1994-2002).

Year	Total non-trawl landings of summer flounder	Recreational d/l ratio	Estimated non-trawl discards using recreational d/l ratio (mt)
1994	834.1	0.29	239
1995	506.5	0.13	66
1996	225.1	0.12	26
1997	297.7	0.09	27
1998	397.3	0.18	72
1999	382.2	0.12	46
2000	416.6	0.23	94
2001	430.9	0.23	97
2002*	538.4	0.23*	122

* 2002 discards are estimated using the d/l ratio from 2001

Scup

The data from the scup fishery includes only the region from Maine to North Carolina. Florida accounts for an additional 4 mt of hook gear landings, but has been left out of the analysis.

Scup commercial fishery discards are much higher than in the summer flounder fishery. However, the scup recreational fishery is much smaller than its summer flounder counterpart, and the bycatch in the recreational sector is minimal (NEFSC, 2002) (Table 33).

Actual landings and estimated discards for the commercial and recreational scup fisheries from 1995-2001 (NEFSC, 2002) are reported in Table 33. Commercial catch data for 2002 were obtained from NMFS (2004) and the 2002 recreational catch was reported in a recreational specifications document (MEFMC and NMFS, 2004). Discard estimates are published values (NEFSC, 2002), and discard to landing ratios were calculated using the landings and discard data. The 2002 discards (both commercial and recreational) were estimated using the 2001 d/l ratios. The commercial d/l ratios are high, but in recent years are decreasing slightly

Table 33: Commercial and recreational landings and discards of scup (1995-2002) (MAFMC and NMFS, 2004; NEFSC, 2002).

Year	Commercial Landings, ME-NC (mt)	Commercial Discards, ME-NC (mt)	Commercial d/l ratio	Recreational Landings, ME-NC (mt)	Recreational Discards, ME-NC (mt)	Recreational d/l ratio
1995	3,073	2,046	0.67	596	33	0.06
1996	2,945	1,522	0.52	1,016	47	0.05
1997	2,188	1,843	0.84	543	25	0.05
1998	1,896	3,830	2.02	395	8	0.02
1999	1,505	4,819	3.20	855	17	0.02
2000	1,207	2,352	1.95	2,365	50	0.02
2001	1,729	1,499	0.87	1,933	85	0.04
2002*	3,397	2,945*	0.87	1,642	72*	0.04

* 2002 discards are estimated using the d/l ratio from 2001

Black sea bass

The black sea bass fishery extends to southern Florida. However, it is separated into two separate stocks: north of Cape Hatteras and south of Cape Hatteras. Discard data are only available for the northern recreational sector. Total recreational landings from Maine to North Carolina for the black sea bass fishery from 1996-2001 (MAFMC and NMFS, 2004) are reported in Table 34. The recreational catch is then broken into three sectors, party/charter, private/rental and shore. The only discard data available for black sea bass are from the party/charter sector which constitutes the largest segment of the fishery. This data comes from the unpublished NMFS VTR data (MAFMC and NMFS, 2004). The data are presented in numbers of fish and was used solely to calculate the d/l ratio for the party/charter fishery. MAFMC and NMFS (2004) give the average percentage of the total recreational catch by sector. For black sea bass, party/charter vessels land 64% of the total catch, private/rental vessels land 32% of the total catch and shore landings account for 4% of the total catch. Using these percentages, landings were extrapolated from the total recreational catch to all sectors and are reported in Table 34. The discards for the private/rental fishery were calculated using the party/charter d/l ratio. Discards from the very small shore sector were not estimated. Recreational discards of black sea bass have been increasing in recent years, most likely due to increasing minimum size limits.

Table 34: Landings, discards and d/l ratios of the black sea bass recreational fishery (ME-NC) from 1996-2002 (MAFMC and NMFS, 2004; SAFMC, 2003).

Year	Total recreational landings, ME-NC (mt)	Estimated Party/charter landings, ME-NC (mt)	Party/charter d/l ratio, ME-NC	Estimated Party/charter discards, ME-NC (mt)	Estimated private/rental landings, ME-NC (mt)	Estimated private/rental discards, ME-NC (mt)	Estimated shore landings, ME-NC (mt)
1996	1,815	1,161.6	0.167	193.99	580.80	96.99	72.60
1997	1,937	1,239.68	0.161	199.59	619.84	99.79	77.48
1998	522	334.08	0.591	197.44	167.04	98.72	20.88
1999	771	493.44	0.603	297.54	246.72	148.77	30.84
2000	1,819	1,164.16	0.683	795.12	582.08	397.56	72.76
2001	1,552	993.28	0.803	797.60	496.64	398.80	62.08
2002	1,974	1,263.00*	0.803	1,014.19**	632.00*	507.50**	79.00*

* 2002 Landings are calculated using the 2002 total recreational landings for black sea bass (1974 mt) (MAFMC and NMFS, 2004) and splitting the catch by sectors according to the percentages above.

** 2002 discards are estimated using the 2001 party/charter d/l ratio.

The commercial catch of black sea bass has hovered between 1,500 and 2,000 mt per year for decades (NMFS, 2004b) (Figure 22). Trawling has been banned from the commercial black sea bass fishery since 1989. Even though 37% of total black sea bass landings were from trawl gear in 2002, these are actually landings of black sea bass as bycatch in other fisheries. The main gear types used to fish for black sea bass commercially are pots, traps and handlines, which typically produce less discard than trawling (Table 28). No commercial discards in the black sea bass fishery were estimated by NMFS. However, we were able to estimate target species discards from the commercial hook gear fishery. The gear used in the commercial hook gear fishery is similar to the gear used in the recreational hook gear fishery, so the 2002 d/l ratio of 0.803 was multiplied by the 2002 commercial hook gear landings (226.8 mt) to obtain commercial discards in the hook gear fishery (182.1 mt). The landings from this fishery equal 12.6% of the total black sea bass commercial landings, a small amount of the discards from the entire commercial black sea bass fishery. (SAFMC, 2003). A summary of the target species discard data for the three fisheries is given in Table 35. The observer data estimate of discards is used for the summer flounder fishery.

Table 35: Summary of estimated 2002 target species discards in all three fisheries from Maine to North Carolina

	Recreational discards (mt)	Commercial discards (mt)	Total (mt)
Summer flounder	821	4,715	5,536
Scup	72	2,945	3,017
Black sea bass	1,521	>182	>1,703
Total	2,414	>7,842	>10,256

Non-Target Species Discards

Discards of non-target species in the trawl and gillnet sectors of the groundfish fishery are not frequently reported, and most of the data reported here are extrapolated from data on similar fisheries. There is some skate bycatch data available from the Skate FMP. However, since these numbers are reported by gear type rather than fishery, the discard data must be altered proportionately to the ratio of summer flounder landings by that gear to all landings by that gear. For example, if summer flounder landings accounted for 5% of all otter trawl landings, then the reported bycatch of skate in the otter trawl fishery would be multiplied by 0.05 to attain an estimate of skate bycatch in the summer flounder fishery alone.

Seven different skate species are commonly caught in the summer flounder fishery: barndoor, clearnose, little, rosette, smooth, thorny and winter. Table 36 shows an expansion of the observer data for the otter trawl fishery (NEFMC, 2000). The combined landings from the summer flounder sector account for 2.98% of the total otter trawl catch, so the skate numbers have been adjusted accordingly. Bycatch for this fishery was estimated using seven years of observer data (1994-2000, 0.45% coverage) (NEFMC, 2000).

Table 36: Average annual catch (mt) and discard (mt) of 7 different species of skates in the summer flounder trawl (1994-2000) (NEFMC, 2000).

	Barndoor	Clearnose	Little	Rosette	Smooth	Thorny	Winter	Unidentified	All skates
Kept	0	6	76	0	1	2	54	65	203
Discard	9	149	587	6	3	15	102	144	1,015
Total	10	155	661	6	4	17	156	209	1,218

Other Species

As in the New England multispecies fishery, the catch composition of non-monkfish directed trawl trips also can be a good approximation of the catch composition of summer flounder and scup trawls. The Monkfish SAFE report (NEFMC and NMFS, 2001) details the catch composition of non-monkfish trawl trips (Figure 23). The catch percentages of each species are indicative of catch and bycatch in summer flounder and scup trawls where these species co-occur. It is important to note that these are not the actual percentages of catch in summer flounder or scup trawls. For example, this chart lists dogfish as accounting for 10% of the catch, but the dogfish SAW report listed no bycatch of dogfish in the summer flounder or scup fisheries (NEFSC, 2003c). In addition, butterfish is listed as 12% of the catch, even though the bycatch of butterfish in summer flounder and scup trawls has been observed to be low (NEFSC, 2004).

2001 Catch composition of non-monkfish directed trawls (% total discards)

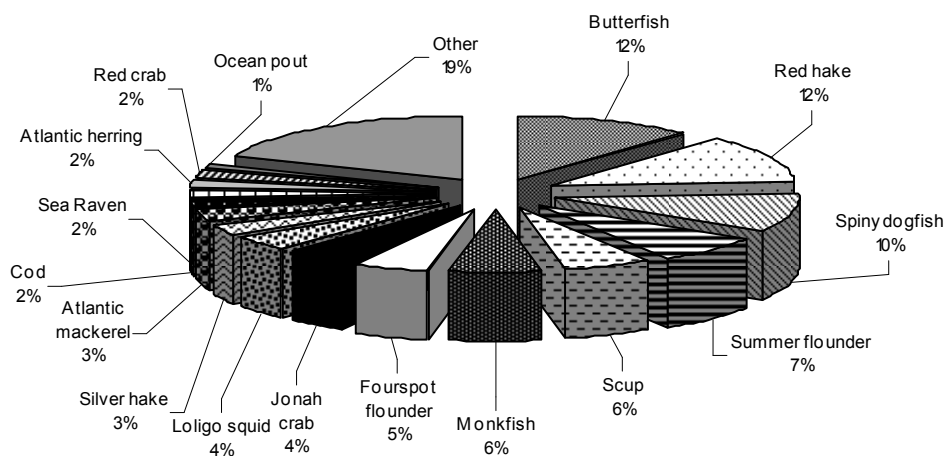


Figure 23: Bycatch in non-monkfish directed trawls for the year 2001. The data are percentages of the total amount of bycatch. They provide a list of possible bycatch species that would be found in a summer flounder or scup trawl (NEFMC and NMFS, 2001).

The data are representative of species that might be found in summer flounder and scup trawls, but not the level of bycatch or discards.

In summary, the main bycatch data that are available are for target species discards. Only non-target species bycatch of skates and butterfish can be estimated. Overall, the summer flounder fishery appears to have the largest amount of discards

In the 2002 summer flounder fishery, 6,449.4 mt of summer flounder were landed commercially, while 4,715 mt were discarded. In the recreational summer flounder fishery, 3,633 mt were landed recreationally and 821 mt were discarded. In addition, on average, 1,218 mt of skate are caught annually as bycatch in the summer flounder trawl fishery, 83% of which was discarded. Overall, this gives a d/l ratio of 0.669 for the commercial and recreational summer flounder fisheries combined. In the 2002 scup fishery, 3,397 mt of scup were landed commercially, while 2,945 mt were discarded. In the recreational fishery, 1,642 mt of scup were landed, and 72 mt were discarded. Overall, this gives a d/l ratio of 0.599 for the commercial and recreational fisheries scup fisheries. For the black sea bass fishery, 1,974 mt of black sea bass were caught recreationally, and 1,521 mt were discarded. Commercially, 1,794.4 mt of black sea bass were landed in 2002. The recreational party/charter d/l ratio of 0.803 was used to calculate discards in the hook gear sector, and they amounted to 182.1 mt. The overall d/l ratio for the black sea bass fishery is 0.452, but this ratio is low, as the commercial discards that are reported account only for the hook gear fishery, a small sector of the commercial fishery.

Overall, landings for the three fisheries combined were 18,889.8 mt in 2002, and discards were 11,474.1 mt for an overall d/l ratio of 0.607.

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Spiny Dogfish Fishery

Major Target Species:	Spiny dogfish (<i>Squalus acanthius</i>)
Major Discard Species:	Skates, Cod (<i>Gadus morhua</i>)
Primary Gear Types:	Bottom longline, Sink gillnet
Total Landings (2002):	2,188 mt
Total Discards (2002):	184 mt
Total Discards Rank (of 27):	25
Discard to Landings Ratio:	0.084
d/I Rank (of 27):	21
Source of Estimates:	Massachusetts Division of Marine Fisheries, NMFS, Observer data, Authors
Discard Type:	Primarily target, regulatory
Notes:	Total discards are low because there are no data from the longline fishery. As of 2003, there is no longer a directed fishery for this species.

The Spiny Dogfish FMP was implemented in 2002 MAFMC and NEFMC. Dogfish are a widely distributed migratory species. The western Atlantic stock ranges from Greenland to northern Florida (Collette and Klein-MacPhee, 2002). The official status of the dogfish fishery is that overfishing is occurring, and it is undefined whether it is overfished (NFMS, 2004d). Of concern are the large numbers of mature females in the landings. The biased harvest of larger, female dogfish impairs the population's long-term viability. Females do not mature until 12 years of age and have a long gestation period with low fecundity. Recently, the dogfish fishery became a bycatch-only fishery in federal and state waters and is no longer a targeted fishery (Correia, 2004. Personal communication to Harrington, J.). It is still included in this report because as recently as April of 2003, it was still legal to target spiny dogfish.

Target landings

Landings of the spiny dogfish have been extremely variable over the course of the fishery's history. Figure 24 shows landings data from the most recent 14 years, as those are the only years for which landings data were available (NEFSC, 2003). However, landing trends are known for the previous three decades. In 1974, total landings peaked at just less than 25,000 mt, and then dropped sharply to approximately 5,000 mt per year until 1989, when they started increasing. Landings spiked again in 1995 at 23,000 mt and then declined to 3,000 mt in 2002 (Collette and Klein-MacPhee, 2002) (Figure 24). This last decrease is due to the creation of a federal bycatch-only fishery for dogfish in 2000. The state fisheries were still commercially targeting dogfish until 2003. As of 2000, trip limits of 600 lb (May-October) and 300 lb (November-April) were enforced (Steve Correia, MA DMF, Personal Communication, October, 20, 2004)

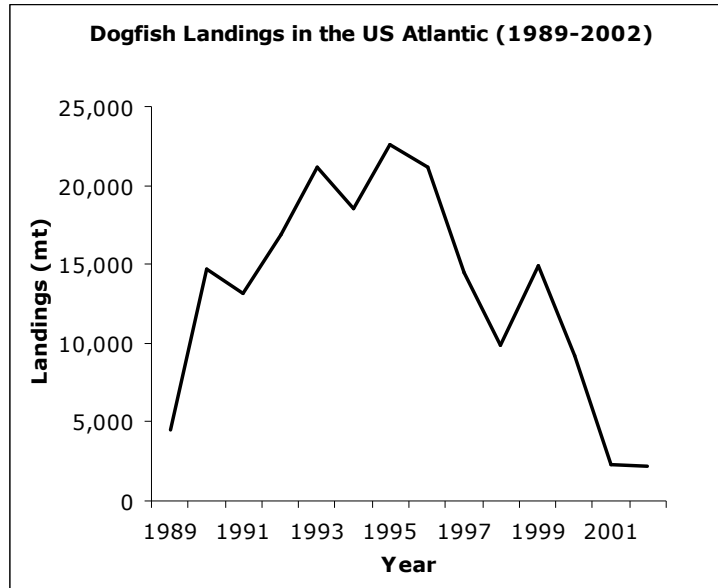


Figure 24: Landings of spiny dogfish in the northwest Atlantic from 1989 to 2002 (NEFSC, 2003).

Four gear types commonly catch spiny dogfish with the bottom longline responsible for the most landings (47%), followed by the sink gillnet (41%), otter trawls (11%) and drift gillnets (1%). Landings of dogfish from the otter trawl and drift gillnet are most likely as bycatch from other fisheries. Landings from otter trawls and sink gillnets have decreased over the past decade, and landings from drift gillnets have stayed low, except for a brief five year period from 1995-1999 when landings rose to 13.3% (NEFSC, 2003c).

Regulations

Currently, the only regulation that exists for the spiny dogfish fishery is a 4 million pound bycatch quota . Fifty-eight percent of the quota is allocated to the period May 1 – October 31. During this period, vessels may possess up to 600 lbs (272 kg) of dogfish per trip, and take only one trip per calendar day. The remainder of the quota is allocated to the period from November 1 - April 30. During this period, vessels may only possess up to 300 lbs (136 kg) of dogfish per trip and take one trip per calendar day (NMFS, 2004c). All landed dogfish apply against the quota. Once the quota has been met, the regional administrator may close the fishery until the end of that quota period (NMFS, 2004c).

Discards

Target species discard data are readily available for the spiny dogfish fishery for 1989 to 2002 for the gillnet (sink and drift), hook and line, and trawl sectors (Table 37).

Table 37: Dogfish landings, dogfish discards, and the discard to landing ratios for gillnets, hook gear and trawls, 1989-2002. Entries of N/A in the discard column indicate that no trips utilizing that gear type were observed for that year. (NEFSC, 2003).

Year	Gillnet				Hook				Trawl			
	Number of observed trips	Total landings (mt)	Observed d/l ratio	Total discards (mt)	Number of observed trips	Total landings (mt)	Observed d/l ratio	Total discards (mt)	Number of observed trips	Total landings (mt)	Observed d/l ratio	Total discards (mt)
1989	5	3,847	0.22	855	0	138	N/A	N/A	6	487	0.48	234
1990	10	7,700	0.18	1,344	0	17	N/A	N/A	3	7,011	1.28	8,977
1991	163	7,913	0.20	1,589	0	31	N/A	N/A	7	5,209	2.76	14,367
1992	162	11,811	0.30	3,492	0	10	N/A	N/A	2	4,786	0.39	1,857
1993	118	15,842	0.12	1,962	0	251	N/A	N/A	4	5,100	0.08	383
1994	317	14,825	0.05	754	0	482	N/A	N/A	5	3,056	0.66	2,010
1995	344	17,998	0.08	1,366	1	1,494	0.43	646	10	2,818	1.02	2,879
1996	276	16,337	0.06	1,024	0	1,313	N/A	N/A	8	3,408	0.40	1,372
1997	319	11,489	0.03	296	0	1,085	N/A	N/A	0	1,801	N/A	N/A
1998	405	5,613	0.04	222	0	1,410	N/A	N/A	7	2,709	0.51	1,393
1999	258	10,788	0.01	103	0	1,611	N/A	N/A	45	2,213	0.00	0
2000	79	4,314	0.01	42	4	1,776	0.1	171	1	3,147	0.00	0
2001	52	750	0.03	22	0	1,276	N/A	N/A	0	254	N/A	N/A
2002	24	897	0.03	30	0	1,044	N/A	N/A	0	248	N/A	N/A

Whereas gillnets produce less discard overall, the discard mortality is much higher in gillnets than in trawls. It should also be noted that the estimates of discards in the hook and trawl fisheries are based on very few observed trips. The method used to calculate these discards is explained below.

“The [observed] ratio of dogfish discards to [dogfish landings] was multiplied by the total landings of the dogfish within each gear group. In order for this estimator to be reliable, it is important to consider the relationship between the observed landings and the total landings reported in the dealer records. The ratio of these two quantities can be considered the sampling ratio. The inverse of this quantity is the expansion factor that will be applied to the total observed dogfish discards. For example, a sampling rate of 0.001 would imply an expansion factor of 1000 and a concomitant increase in the sampling variability. Plots of the sampling rates for dogfish landings versus year suggest an overall sampling rate of about 0.01 since 1990. For trawl gear, the sampling rate is about 0.05, but for gillnets, the sampling rate seems to be clustered around 0.03 to 0.05. As for the association between the total landings of the dogfish from the dealer records and the total landings observed during sea-sampling trips, the relationship appears stronger for the gillnet gear than for trawls, but both groups' relationships seem acceptable. Collectively, the results were considered sufficient to proceed with the computation of discard rates based on landings within the trawl and gillnet gear groups” (NEFSC, 2003).

In 2002, the Massachusetts Division of Marine Fisheries published a corresponding estimate of spiny dogfish bycatch off the coast of Massachusetts in their Newsletter. They estimated that discards of dogfish by weight were approximately two to three percent of total landings. This estimate was made from nine observed trips, three gillnet and six longline. The data were grouped because the gillnet and longline trips occurred at the same time and in the same general area, even though the discard rate was much higher in the gillnet fishery than in the longline fishery (ASMFC, 2003). In 2002, the combined total landings of dogfish from the gillnet and hook fishery were 1,940.6 mt and total discards of spiny dogfish were estimated to be between 39 and 58 mt.

Data on non-target species discards are also available for the anchored sink gillnet fishery targeting dogfish. Observer data from 2001-2003 were obtained from the NEFSC in Woods Hole, Massachusetts and analyzed to determine the species composition of the discarded bycatch (NMFS, 2004a). In 2001 (Figure 25) and 2002 (Figure 26), only four trips were observed each year. In 2003 (Figure 27), 19 trips were observed. Many of the species recorded individually in 2001 and 2002 fall into the “other” category in 2003. Nevertheless, the same four species make up the majority of the bycatch in every year: spiny dogfish, little skate, Atlantic cod and smooth dogfish (NMFS, 2004a).

Discard composition of the 2001 anchored sink gillnet fishery targeting spiny dogfish

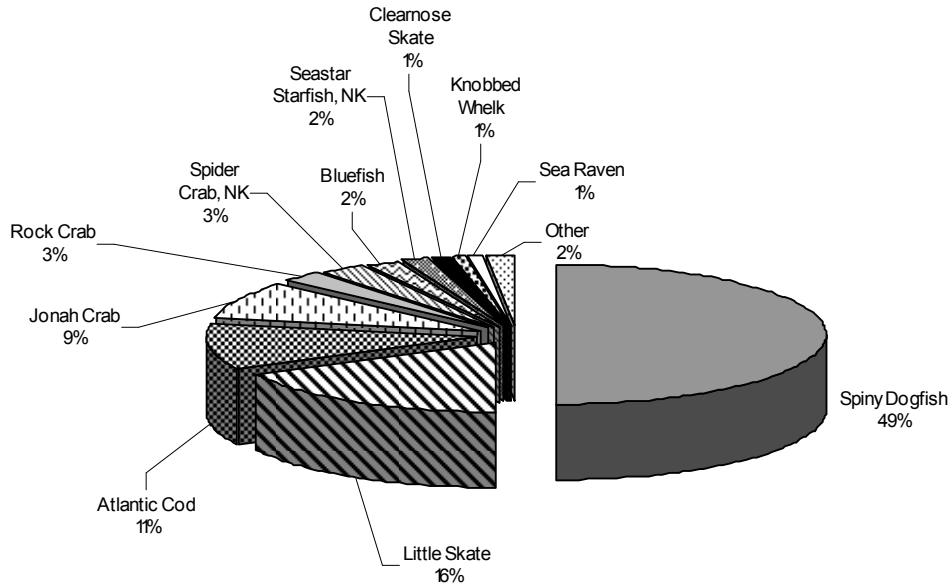


Figure 25: Discard composition of the 2001 anchored sink gillnet fishery (NMFS, 2004a).

Discard composition of the 2002 anchored sink gillnet fishery targeting spiny dogfish

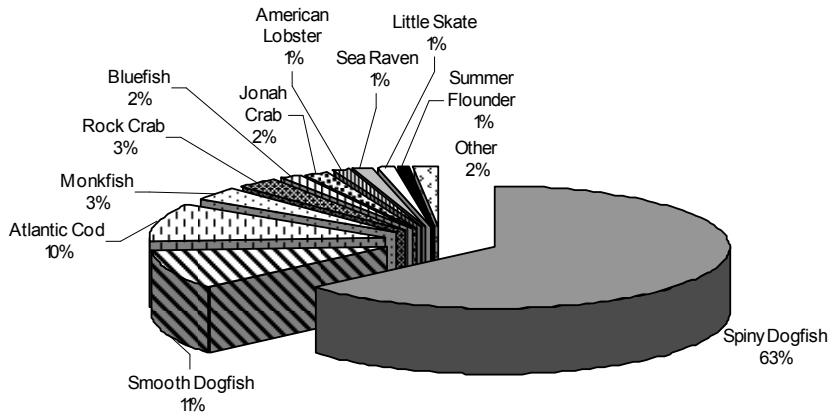


Figure 26: Discard composition of the 2002 anchored sink gillnet fishery (NMFS, 2004a).

Discarded catch in the 2003 Anchored sink gillnet fishery targeting spiny dogfish

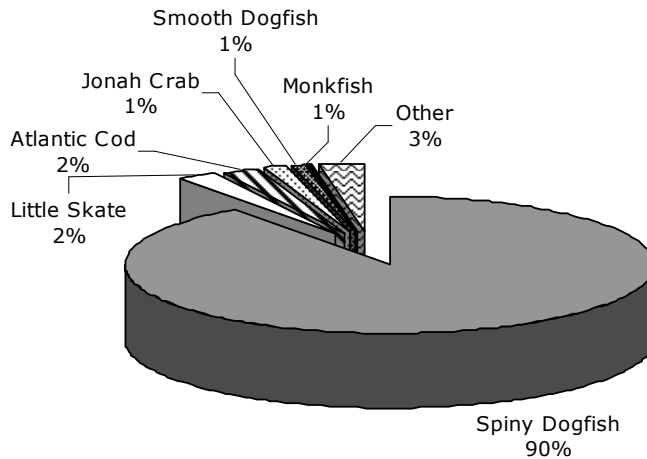


Figure 27: Discard composition of the 2003 anchored sink gillnet fishery (NMFS, 2004a).

The total observed discards from 2001 (0.262 mt), 2002 (2.21 mt) and 2003 (10.599 mt) (NMFS, 2004a) can be divided by the total number of observed spiny dogfish landings from 2001 (4.71 mt), 2002 (9.71 mt) and 2003 (45.73 mt) (NMFS, 2004a), and then multiplied by the total anchored sink gillnet spiny dogfish landings for each year (693.6, 808 and 303, respectively) (NMFS, 2004b) to obtain the total amount of discards in the gillnet fishery (Table 38). These discards can then be multiplied by the percentages in Figure 25 through Figure 27, and the individual discard amount of each species for each year can be obtained (Table 38). There are data for a few species in Table 38 which appear in the “other” category in Figure 25 through Figure 27.

Table 38: Total 2001-2003 discards of 12 species commonly caught in anchored sink gillnets in the spiny dogfish fishery

Species	Amount discarded in 2001 (mt)	Amount discarded in 2002 (mt)	Amount discarded in 2003 (mt)
Spiny dogfish	18.90	115.88	63.21
Little skate	6.17	1.84	1.40
Atlantic cod	4.24	18.39	1.40
Jonah crab	3.47	3.68	0.70
Rock crab	1.16	5.52	0.16
Spider crab	1.16	Unknown	Unknown
Bluefish	0.77	3.68	0.27
Seastar, NK	0.77	0.57	0.02
Clearnose skate	0.39	Unknown	Unknown
Knobbed whelk	0.39	Unknown	Unknown
Sea raven	0.39	1.84	0.32
Smooth dogfish	0.00	20.23	0.70
Monkfish	0.00	5.52	0.70
American lobster	Unknown	1.84	0.33
Summer flounder	Unknown	1.84	0.00
Other	0.77	3.11	1.00
Total	38.57	183.94	70.23
Total non-dogfish discards	19.67	68.06	7.02

In summary, only one source, the observer data (Table 38), gave estimates of both target species and non-target species discards in the spiny dogfish fishery. The total dogfish landings from all three gear types in 2002 were 2,188.3 mt, and the total discards were 183.94 mt, for a d/l ratio of 0.084. The 2002 data are reported in the summary instead of 2003 data because that is the last year in which dogfish were targeted by both the federal and state fisheries. It should also be noted that since the dogfish fishery is no longer a target fishery, there will be no discards from a directed fishery in the future, and all discards of dogfish will be from other fisheries.

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Atlantic Surf Clam and Ocean Quahog Fishery

Major Target Species:	Surf clam (<i>Spisula solidissima</i>), Ocean quahog (<i>Artica islandica</i>)
Major Discard Species:	Unknown
Primary Gear Types:	Hydraulic clam dredge
Total Landings (2003):	46,091 mt
Total Discards (2003):	3,835
Total Discards Rank (of 27):	16
Discard to Landings Ratio:	0.083
d/l Rank (of 27):	22
Source of Estimates:	Logbook data, NMFS
Discard Type:	Unknown
Notes:	Total discards do not include non-target species.

Atlantic surf clams and ocean quahogs are found along the coastlines of New Jersey, Long Island and Southern New England and are managed by the MAFMC. Surf clams tend to have a more southern range than ocean quahogs, and can be found as far south as Cape Hatteras. Both species' ranges are shifting northward with rising water temperatures (NMFS, 1999). Surf clams are the larger of the two species, often attaining sizes of eight inches in diameter, while ocean quahogs rarely grow to more than three inches. However, the ocean quahog can live over 100 years, much longer than the 35-year life span of the surf clam (NMFS, 2000b). They are both fished mainly with the hydraulic clam dredge, a device that sprays a high-pressure stream of water just in front of the dredge to stir up clams which might be buried below the surface of the substrate. For the most part, the clams are sold to processors for canning or chowder.

Target landings

Both the Atlantic surf clam and the ocean quahog fisheries have high catch rates, and neither is experiencing overfishing, although it is undefined whether surf clams are overfished (NMFS, 2004b). However, these resources may be fully exploited in some localized areas. In 2003, 29,868 metric tons of surf clam and 16,223 metric tons of ocean quahog were landed. The 2003 surf clam landings were almost identical to the 2002 landings of surf clam (29,624 mt) but ocean quahog landings almost doubled from 2002 (9,818 mt) to 2003. Landings for the past three decades are given below (Figure 28).

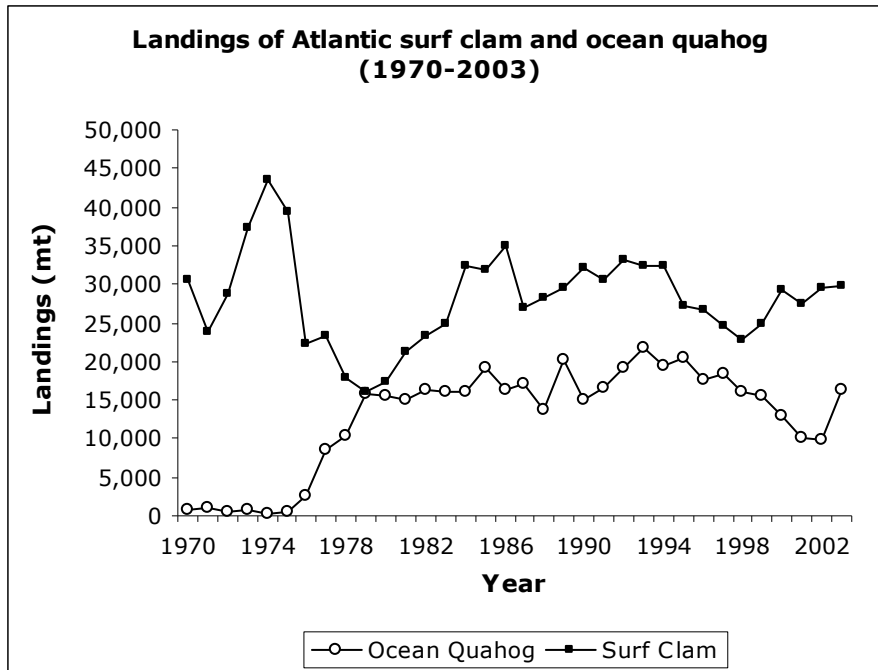


Figure 28: Landings of the Atlantic surf clam and the ocean quahog over the past three decades (NMFS, 2004).

Regulations

The Atlantic surf clam and ocean quahog fisheries are regulated using ITQs. The total 2003 quota for surf clam was 3,250,000 bushels (approximately 25,060 metric tons), and the quota for ocean quahog was 4,500,000 bushels (approximately 20,411 metric tons) (EPA, 2002). The conversion was made assuming an average weight of 17 pounds of meats per bushel of surf clam and 10 pounds per bushel of ocean quahog (NMFS, 2000b). There is also a minimum size regulation for the Atlantic surf clam of 4.75 inches. However, this minimum size is often suspended on a yearly basis due to the low percentage of undersized clams in the total catch. In addition to these regulations, there are also a few closed areas. In particular, George’s Bank has been closed to the surf clam and ocean quahog fisheries since late 1989 due to paralytic shellfish poisoning.

Discards

NMFS currently has no direct measures to counteract discards and bycatch in the Atlantic surf clam/ocean quahog fishery, a distinction shared in the northeast only by the Atlantic herring fishery (NMFS, 2003). In 2003, logbook data for the surf clam fishery reported the average discard of surfclams to be 2.42% of total landings, and logbook data for the ocean quahog fishery reported 0.77% discards of ocean quahog (Heaton, 2004). If these discard percentages are applied to 2003 landings data, surfclam discards amount to 723 mt of meat, and ocean quahog discards amount to 125 mt of meat. Surf clam trawls occurring in shallow waters 30 meters deep or less tend to bring up more bycatch than deeper trawls (Nuckols III, 1998).

Surf clams also have a higher mortality rate (50%) when discarded than ocean quahog (10%), because surf clams cannot re-burrow as quickly, making them prey to crabs, sea star, snails, fish and skates (NMFS, 2000a). In addition to the discard and mortality reported, unobserved mortality of clams killed by the dredge passing over them is approximately 10% of the total landings, or 2,987 mt of surf clam meat in 2003 (NMFS, 2000a). It was not clear in the literature how this percentage was estimated. Surf clams are more susceptible to this type of gear damage than ocean quahogs because they cannot close their shells completely which renders them vulnerable to internal damage from the hydraulic jet and sand in their gills and mantle. Inefficient dredges may injure or kill up to 92% of clams they pass over but do not

catch, whereas efficient dredges may injure or kill only 7-30% (NMFS, 2000a). In addition, there is also significant habitat destruction resulting from furrows cut by the dredges (Gilkinson et al., 2003). Discard mortality because of this habitat destruction is not represented in these numbers, and may be an important factor that should be investigated more fully in the future.

Non-target species bycatch is not recorded, but is thought to be extremely low (Malchoff, 1999; NMFS, 2000a). In the proceedings of the Sea Grant Bycatch Workshop (Malchoff, 1999), flatfish were mentioned as possible bycatch in clam dredges. Many other species managed by the Northeast and Mid-Atlantic Fishery Management Councils also share portions of their essential fish habitat (EFH) with the EFH of surf clams and ocean quahogs, thus becoming potential bycatch candidates. In the mid-Atlantic, summer flounder, scup, black sea bass, squid, mackerel, butterfish, bluefish and dogfish share bottom habitat with the surf clams and ocean quahogs. In the Northeast, Atlantic cod, haddock, monkfish, ocean pout, American plaice, pollock, redfish, white hake, windowpane flounder, winter flounder, witch flounder, yellowtail flounder, Atlantic halibut and Atlantic sea scallops share bottom habitat with them. Many species included in the highly migratory species FMP and many marine mammals and turtles also have overlapping ranges and habitat with surf clams and ocean quahogs (NMFS, 2000a). However, due to the slow speed at which the gear travels along the ocean floor, healthy animals should be able to escape the dredge (Malchoff, 1999; NMFS, 2000a).

In summary, the 2003 combined landings of surf clams and ocean quahogs were 46,091 mt meat weight and the overall annual discards of surf clams and ocean quahogs for 2003 was 848 mt meat weight not including unobserved mortality from the dredge. If unobserved dredge mortality of surf clams is included, the number increases to 3,835 mt meat weight, for a d/l ratio of 0.083. This is an underestimation of total discards because the discard of finfish and other non-target species is not included.

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Atlantic Sea Scallop Fishery

Major Target Species:	Atlantic sea scallop (<i>Placopecten magellanicus</i>)
Major Discard Species:	Skates, Monkfish (<i>Lophius americanus</i>), Flatfish, Crabs
Primary Gear Types:	Scallop dredge
Total Landings (2003):	211,466
Total Discards (2003):	55,578
Total Discards Rank (of 27):	4
Discard to Landings Ratio:	0.26
d/l Rank (of 27):	15
Source of Estimates:	NMFS, Authors
Discard Type:	Almost equal target and non-target, regulatory and non-regulatory
Notes:	Total discards include 7,996.6 mt of landed bycatch. All scallop landings and discards are reported in whole weight (including shell).

The Atlantic sea scallop ranges from North Carolina into Canada. Scallops are primarily harvested on Georges Bank, in the Gulf of Maine, and in the Mid-Atlantic Bight. Typically, they are harvested with epibenthic scallop dredges, but approximately 10% of the total catch is landed using otter trawls (NEFMC, 2003). Atlantic sea scallops are divided into the Georges Bank stock and the mid-Atlantic stock. Approximately one-third of the Georges Bank stock extends into Canada. However, the Georges Bank stock data which are reported in this chapter refer only to the American portion of the stock, and do not include Canadian landings or other data. Neither stock is overfished, but overfishing is believed to be occurring on the mid-Atlantic stock (NMFS, 2004c).

Target landings

In recent years, the catch of the Atlantic sea scallop has increased due to substantial stock recovery under management and the limited reopening of extensive closed areas for scallop fishing. Scallop biomass more than tripled in the Georges Bank Hudson Canyon and VA/NC areas after a few years of closure. It was determined that a certain amount of scallops could be harvested from these areas without being detrimental to either the scallop or groundfish stocks. Figure 29 shows the total landings of Atlantic sea scallop from 1970 to 2002.

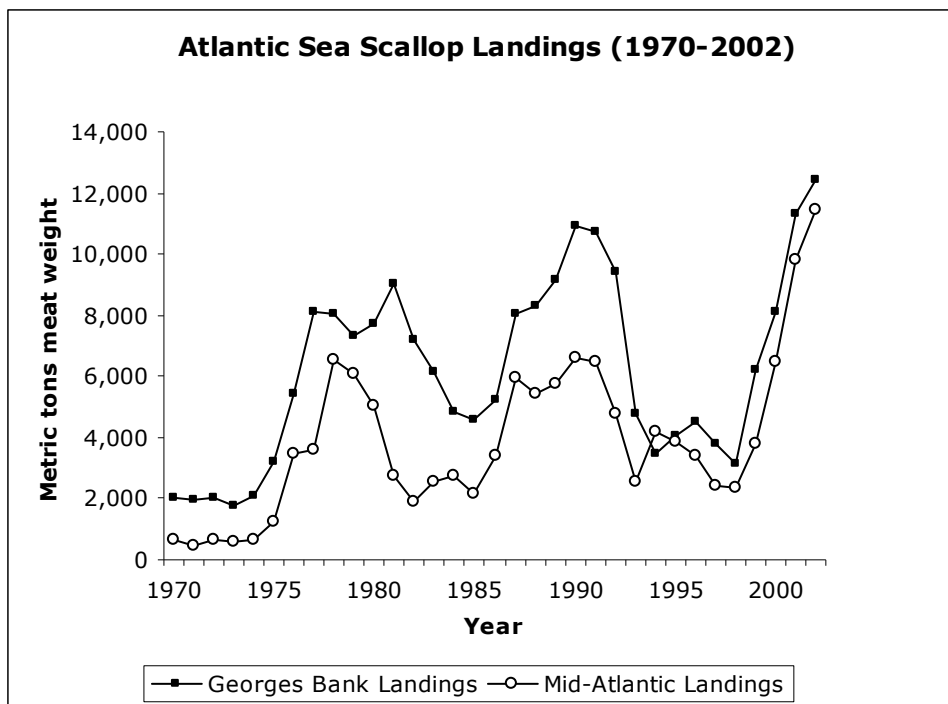


Figure 29: Atlantic sea scallop landings from 1970-2002. Landings are in metric tons of meat weight. (NMFS, 2004a).

Regulations

There are two fisheries for Atlantic sea scallop: smaller vessels fishing under daily trip limits in an open access fishery and larger vessels in a limited access fishery with restrictions on DAS. Both fisheries are subject to gear restrictions and closed areas (NEFMC, 2003).

The limited access fishery is comprised of three different categories: full-time, part-time, and occasional, and each category is assigned a different annual DAS allocation tracked using a VMS system (Table 39). Most of these vessels use two dredges with a combined width of 30 feet or less. The ring size on these dredges must be at least 3.5 inches. The dredge twine top is an eight inch mesh size to allow for escapement of finfish. Currently, vessels with a limited access permit are authorized up to three trips to the closed areas with an 18,000 pound (meat weight) possession limit. Vessels fishing in these closed areas must have a 10 inch mesh twine top on their dredges to improve the escapement of finfish (NEFMC, 2003a).

Table 39: Day-at-sea allocations for 2002 through 2008 (Source: (NEFMC, 2003; NMFS, 2003b).

	Fishing Year						
	2002	2003	2004	2005	2006	2007	2008 or rebuilt
Full-time allocation	120	120	42	35	38	36	60
Part-time allocation	48	48	17	14	15	17	24
Occasional allocation	10	10	4	3	3	4	5

The open access fishery was created to allow those fishermen who opportunistically fished for scallops a few times per year to still participate in the fishery. Vessels with this permit may land up to 50 bushels (400 lbs meat wt) of scallop meat per trip. Vessels may fish in state waters without trip or effort limits (NEFMC, 2003).

Discards

Monkfish, yellowtail and summer flounder bycatch were estimated in the scallop fishery using the discard ratio method (NEFMC, 2003) (Table 40). All estimates were made from observer, logbook and dealer records. “[The discard ratio method] computes total catch by expanding reported landings by the ratio R of discards to landings on observed trips. That is, Total Catch = (1 + R) landings. For other species, a rough estimate of bycatch can be obtained by comparing the bycatch of the species in observed trips with that of monkfish, and using the discard ratio estimate for monkfish as above. Monkfish is the best choice for this estimate because it is relatively ubiquitous. Moreover, its discard ratio estimate should be reliable because the majority of the monkfish are landed, so the monkfish R is fairly small. Estimates for other species were obtained by comparing the bycatch of the species in observed trips with that of monkfish and using the discard ratio for monkfish.” (NEFMC, 2003). There are several species of fish which are common bycatch in the Atlantic sea scallop fishery: skates, monkfish, yellowtail flounder, summer flounder, winter flounder, Atlantic halibut, cod and haddock (Table 40) (NEFMC, 2003). Estimating discards of other species based on the discard to landings ratio for monkfish is appropriate and conservative because monkfish are broadly distributed and most monkfish are landed not discarded.

Table 40: Total bycatch in the entire Atlantic scallop fishery for the 2000 fishing year (NEFMC, 2003).

Species	Disposition	Total Weight (mt)
Monkfish	Landed	2,433.0
Yellowtail flounder		301.0
Summer flounder		23.0
Winter flounder		150.0
Atlantic halibut		0.1 in closed area 1
Gadids		1.3 of cod and haddock in closed area fishery
Monkfish	Discarded	567.8
Summer flounder		167.0
Little skate		6,560.0
Winter skate		720.0
Clearnose skate		240.0
Smooth skate		240.0
Thorny skate		160.0
Barndoor skate		80.0
Total		Combined

The discard estimates for the 2003 fishing year are higher than for 2000 because the landings of sea scallops increased almost twofold (Table 41). This adjustment is made by multiplying all the discard numbers in Table 40 by 1.74, the ratio of the 2003 to 2000 landings of Atlantic sea scallop.

Table 41: Estimated total discards and bycatch in the entire Atlantic scallop fishery for the 2003 fishing year.

Species	Disposition	Total Weight (mt)
Monkfish	Landed	4,233.4
Yellowtail flounder		523.7
Summer flounder		40.0
Winter flounder		261.0
Atlantic halibut		0.2 in closed area 1
Gadids		2.3 cod and haddock in closed area fishery
Total		5,060.6
Monkfish	Discarded	988.0
Summer flounder		290.6
Little skate		11,414.4
Winter skate		1,252.8
Clearnose skate		417.6
Smooth skate		417.6
Thorny skate		278.4
Barndoor skate		139.2
Total		
Total	Combined	20,259.2

Bycatch data are also available from the Georges Bank closed areas (Closed Area I, Closed Area II, and the Nantucket Light Ship closed area) (Table 42) and the mid-Atlantic closed areas (Hudson Canyon and Virginia Beach) (Table 43) These amounts are small compared to overall catch and bycatch, but they do illustrate a diverse group of species affected by the scallop fishery.

Table 42: Total catch in the 2000-2001 Georges Bank closed areas (CL1, CL2, NLS) scallop fishery (NEFMC, 2003).

Species	Total Catch (mt)
Target	
Sea scallops (whole wt)	23,768.48
Sea scallops (meat wt)	2,853.34
Bycatch	
Skates (not including barndoor or thorny skates)	783.73
Monkfish	363.37
Yellowtail flounder	242.54
Winter flounder	69.98
Barndoor skate	30.94
Witch flounder	15.64
Windowpane flounder	12.68
American plaice	12.52
Thorny skate	5.58
Silver hake	5.33
Red hake	5.23
Summer flounder	3.14
Atlantic cod	1.22
Atlantic halibut	0.13
Haddock	0.07
Total Bycatch	1,552.10

Table 43: Total catch in the 2000-2001 mid-Atlantic closed areas (Hudson Canyon and VA Beach) scallop fishery (NEFMC, 2003).

Species	Total catch (mt)	Species	Total catch (mt)
Target		Bycatch cont.	
Sea scallop (whole weight)	60,315.00	Atlantic silverside	0.51
Bycatch		Northern stone crab	0.49
Little skate	843.46	Scup	0.41
Monkfish	515.92	Sponge, unknown	0.40
Skate, unknown	297.61	Speckled crab, unknown	0.35
Sand dollar	218.52	Yellowtail flounder	0.24
Winter skate	42.10	Stony coral, unknown	0.18
Summer flounder	37.78	Winter flounder	0.17
Fourspot flounder	33.81	Barndoor skate	0.17
Northern sea robin	21.32	Chain dogfish	0.12
Rock crab	20.29	Sand lance eel, unknown	0.11
Clearnose skate	16.40	Hake, unknown	0.11
Jonah Crab	8.29	Butterfish	0.10
Spiny dogfish	8.15	Shortfin squid	0.08
Spotted hake	7.98	Octopus, unknown	0.07
Red hake	5.70	Ocean pout	0.05
Seastar sea star	4.74	Weakfish	0.05
Striped searobin	4.06	Porgy, unknown	0.04
Cancer crab, unknown	3.49	American eel	0.04
Witch flounder	2.74	American plaice	0.03
Black sea bass	2.38	Eel, unknown	0.01
True crab, unknown	2.28	Atlantic cod	0.01
Silver hake	2.14	Conger eel	0.01
Horseshoe crab	1.56	Sea bass, unknown	0.01
Longfin squid	1.52	Spot	0.01
American lobster	1.16	Cunner	0.01
Sea robin	1.13	Filefish, unknown	0.01
Windowpane flounder	0.92	Smooth skate	0.01
White hake	0.80	Spider crab	0.01

Species	Total catch (mt)	Species	Total catch (mt)
Rosette skate	0.79	Triggerfish, unknown	0.01
Squid, unknown	0.75	Dogfish, unknown	0.004
Hermit crab, unknown	0.66		
Snapper, unknown	0.59	Total Bycatch	2,112.88

Finally, a separate analysis of scallop bycatch in the dredge fishery was published which averaged bycatch and discards from 1991 to 2000 using Sea Sampling Observer Program data (Table 44) (NEFMC, 2003). "The estimated bycatch rates for each species were adjusted for annual changes in that species' biomass indices on the NMFS fall finfish survey, then classified into rotation management areas and calendar quarter." However, due to low sample sizes, these estimates are not very precise (NEFMC, 2003). The discard to landings and bycatch to landings ratios for 15 species, including scallop, are given, as well as the extrapolated 2003 discard and bycatch amounts for each of these species (Table 44).

Table 44: Scallop and finfish bycatch estimates for the 2003 scallop dredge fishery using 1991-2000 observed discard and bycatch rates (NEFMC, 2003).

	Average 91-00 d/l ratio	Average 91-00 b/l ratio	2003 Discards (mt)	2003 Landings (bycatch) (mt)
Scallop (whole weight)	0.11	1	23,261	211,466.21*
Monkfish	0.02	0.09	508	2,285
Cod	0.00	0.03	0	635
Fourspot flounder	0.01	0.00	254	0
Sanddab flounder	0.01	0.00	254	0
Summer flounder	0.02	0.01	508	254
Winter flounder	0.01	0.01	254	254
Yellowtail flounder	0.02	0.01	508	254
Unclassified skate	0.28	0.06	7,108	1,523
Barndoor skate	0.00	0.00	0	0
Clearnose skate	0.07	0.00	1,726	0
Little Skate	0.25	0.04	6,347	1,015
Smooth skate	0.13	0.06	3,300	1,523
Thorny skate	0.08	0.00	2,031	0
Winter skate	0.06	0.01	1,523	254
Total			47,581**	7,997***

* From the NMFS commercial landings database (NMFS, 2004a).

** Includes scallop discards

*** Does not include scallop landings

In summary, Table 41 and Table 44 both give estimates of discards for the entire scallop fishery. The estimates are arrived at in two different ways, the first (Table 41) expands known discards for 2000 based on the 2003:2000 scallop landings ratio and the second (Table 44) applies known d/l and b/l ratios to 2003 landings data. The two methods obtained similar bycatch and discard estimates for non-target species, but Table 44 also includes a large amount of target species discards, so we used these data in the final estimate. Overall, 211,466.2 mt of scallop (whole weight) were landed in 2003 (calculated using the whole weight to meat weight ratio of 8.33 in Table 42), and 47,581.2 mt were discarded, almost half of which was scallops (whole weight). This gives a d/l ratio of 0.225. There were also 7,996.6 mt of landed bycatch in addition to these discards.

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NMFS (2004a). Annual Commercial Landing Statistics. NOAA Fisheries, Office of Science and Technology, Fisheries Statistics and Economics. [Online]
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NMFS (2004b). Fisheries of the northeastern United States; Atlantic sea scallop fishery; proposed emergency rule to maintain an area access program for the Atlantic sea scallop fishery in Hudson Canyon, FR Doc. 04-2411 (February 2, 2004).

NMFS (2004c). 2003 Report to congress: The status of U.S. Fisheries. NOAA Fisheries. Silver Spring, MD. [Online] <http://www.nmfs.noaa.gov/sfa/reports.htm#sos>.

Atlantic Sea Herring Fishery

Major Target Species:	Atlantic sea herring (<i>Clupea harengus</i>)
Major Discard Species:	Spiny dogfish (<i>Squalus acanthius</i>)
Primary Gear Types:	Pair trawl, Mid-water trawl, Purse seine
Total Landings (2003):	100,676
Total Discards (2003):	3,566 mt
Total Discards Rank (of 27):	18
Discard to Landings Ratio:	0.035
d/I Rank (of 27):	23
Source of Estimates:	NMFS, Authors
Discard Type:	Primarily target, non-regulatory
Notes:	Total discards include 1,663 mt of landed bycatch.

The Atlantic sea herring is primarily found in the Northeastern United States, and is managed by the Atlantic States Marine Fisheries Commission. It occurs in groups of hundreds or even thousands; rarely are herring seen singly or in small assemblages (Collette and Klein-MacPhee, 2002). In the western Atlantic they range from Southern Greenland to Cape Cod and Block Island. In the winter they can occasionally be found as far south as Cape Hatteras (Collette and Klein-MacPhee, 2002). Currently, sea herring landings (although this number includes both Atlantic and Pacific herring) rank as number nine in the U.S. for landed poundage, but are only valued at approximately 20 million dollars (NMFS, 2002a). Herring is used primarily as bait for commercial lobster, blue crab, and tuna fisheries in New England, and is also canned. Overseas, they are sold frozen and salted and are considered a valuable commodity (ASMFC, 2003).

Target landings

Recently, the herring population has been growing (NMFS, 2002b). The herring stocks in the Gulf of Maine and Georges Bank collapsed during the late 1960's and early 1970's due to heavy fishing from foreign fleets. Stocks have been recovering since the Magnuson-Stevens Fisheries Conservation Act was implemented in 1976. The two stocks are managed together, and herring fishery as a whole is not considered to be overfished, nor is it experiencing overfishing (NMFS, 2004c).

In 2003, 100,676 metric tons of Atlantic herring were landed, an increase in landings from 2002. In the last two decades, there has been an overall increase in landings with an apparent leveling off in the last five to seven years (NEFMC, 2004a; NMFS, 2004a) (Figure 30).

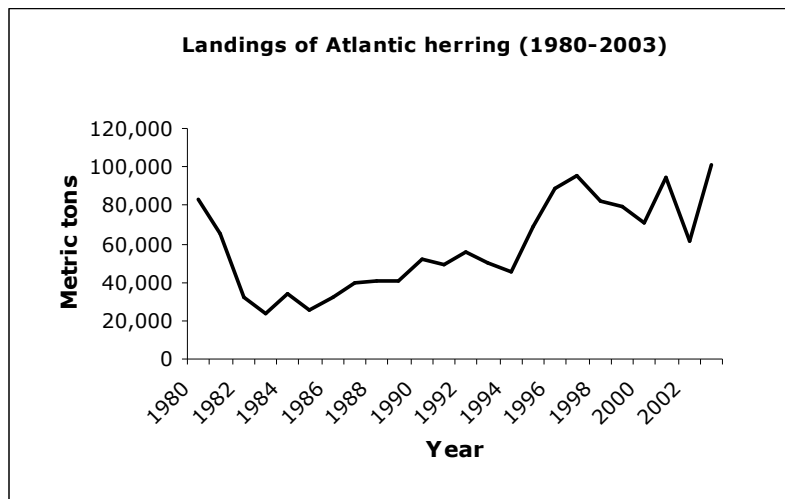


Figure 30: Atlantic herring landings and abundance (NEFMC, 2004a; NMFS, 2004a).

Herring is mainly fished with the pair trawl. The 2003 landings by gear type are shown in Figure 31.

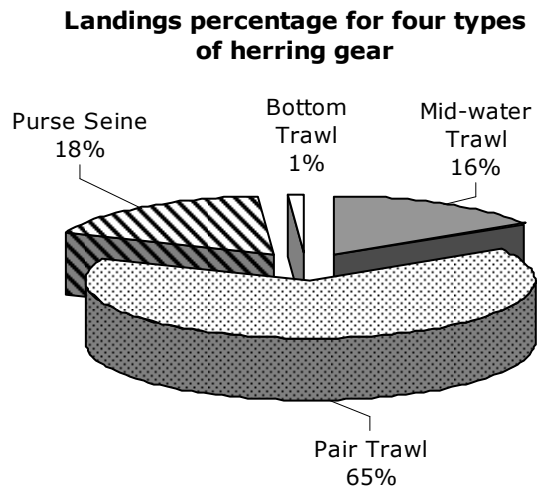


Figure 31: Herring landings in 2003 by gear type (NEFMC, 2004a).

Regulations

The main regulations in place for Atlantic herring are vessel permitting, management areas, total allowable catch (TAC) limits, and some effort controls. Currently, while licenses are required, the Atlantic herring fishery is open access. There are four different management areas in the Northeast for Atlantic herring, and each has its own TAC (Figure 32). Area 1A, the inshore Gulf of Maine, is experiencing higher fishing pressure and may possibly constitute a separate stock. In area 1A, the TAC between June and December (when herring are abundant) is 6,000 mt. During the period between January and May (when most herring are farther south) the TAC is increased to 54,000 mt. Area 1B, offshore Gulf of Maine, has a TAC of 10,000 mt. Area 2, the south coastal area, and Area 3, Georges Bank, both have TACs of 50,000 mt (NEFMC et al., 2002). If the landings in any one area approach 90% of the TAC for that area, vessels are required to take Friday, Saturday, Sunday, and Monday out of the fishery (in that area or sub-area) (NEFMC et al., 2002).

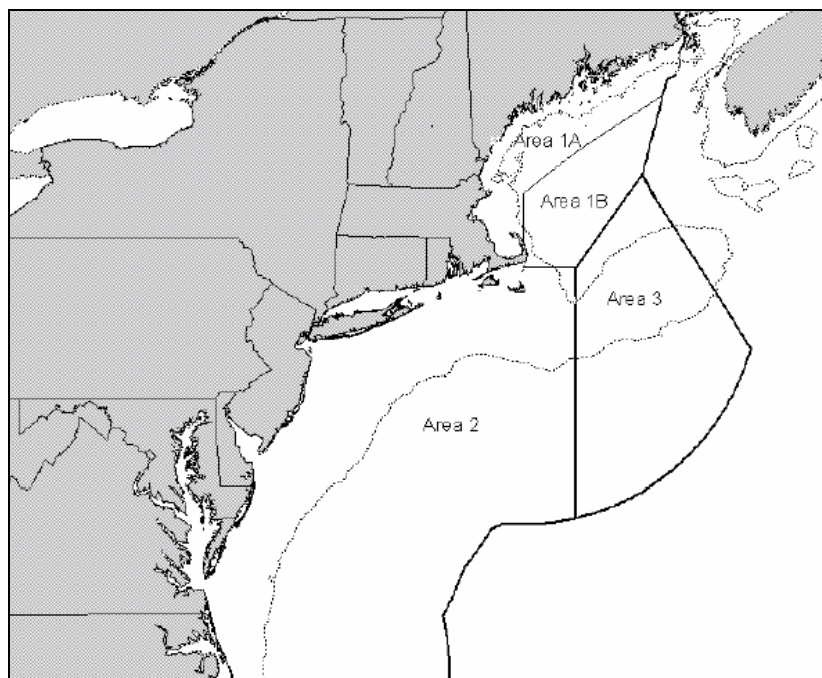


Figure 32: Herring management areas (NEFMC, 2004b)

Discards

Only a few studies have considered bycatch and discarding in the Atlantic herring fishery, estimated from observer data or self-reporting by fishermen and then extrapolated bycatch rates for the entire fishery.

Less than two percent of the total catch is recorded as bycatch. One study (Stevenson and Scully, 1999) found only dogfish and mackerel caught in large quantities as bycatch in herring trawls, but exact numbers were not reported. The study did not rule out other species in the bycatch. Even though only 0.05% of the trawl catch and 0.0001% of the purse seine catch consisted of groundfish, only 3.5% of the total trawl trips were observed, and the sample might not be an accurate representation of the total catch (Stevenson and Scully, 1999). NEFMC et al. (2001) reported weights of all species caught in herring mid-water trawls and purse seines as well as the disposition of the catch (Table 45) and gives a more complete picture of discarded bycatch in this fishery.

We used these data (NEFMC et al., 2001) to estimate the total weight of discarded bycatch for each gear type in 2000. We raised the weight of the observed bycatch in the study for each species by the ratio of the study landings of herring to the total fishery landings of herring in 2000 for each gear type. For further extrapolation, we then calculated the bycatch in 2003 by multiplying the 2000 bycatch of each species by the ratio of 2000 herring landings to 2003 herring landings.

Table 45: Total weight of landed and discarded species by mid-water trawl and purse seine trips targeting herring in 2000 and 2003 (NEFMC et al., 2001).

Gear	Species	Disposition	Total study weight (mt)	Estimated total weight for 2000 (mt)	Estimated total weight for 2003 (mt)	
Mid-water Trawl (12 Trips)	Atlantic herring	<i>Discarded</i>	37.422	660.503	450.463	
	Atlantic cod		0.003	0.052	0.035	
	Spiny dogfish		3.805	67.163	45.805	
	Sand dab flounder		0.001	0.016	0.011	
	Winter flounder		0.004	0.064	0.044	
	Yellowtail flounder		0.000	0.008	0.005	
	Haddock		0.000	0.004	0.003	
	Silver hake		0.003	0.052	0.035	
	Alewife		0.000	0.004	0.003	
	Herring, unid		0.318	5.604	3.822	
	Longhorn sculpin		0.001	0.024	0.016	
	Squid, unid		0.000	0.008	0.005	
	Total			41.558	733.503	500.249
	Atlantic herring	<i>Landed</i>	1,337.570	23,608.300	16,108.160	
	Atlantic cod		0.005	0.088	0.060	
	Winter flounder		0.001	0.016	0.011	
	Yellowtail flounder		0.000	0.008	0.005	
	Alewife		30.000	529.508	361.124	
	Blueback herring		1.633	28.822	19.657	
	Herring, unid		4.854	85.665	58.424	
Atlantic mackerel		50.722	895.258	610.566		
Monkfish		0.004	0.072	0.049		
Pollock		0.002	0.032	0.022		
Total		1,424.792	25,147.769	17,158.078		
Purse Seine (3 Trips)	Atlantic herring	<i>Discarded</i>	2.268	197.652	166.226	
	Spiny dogfish		0.318	27.671	23.272	
	Total		2.586	225.324	189.497	
	Atlantic herring	<i>Landed</i>	247.212	21,544.100	18,121.680	
	Total		247.212	21,544.100	18,121.680	

*It should be noted that an additional 150 mt of silver hake were caught in the joint venture and foreign fisheries during the course of the study (NEFMC et al., 2002).

There was considerable mackerel and alewife landed bycatch. Bycatch of dogfish, unclassified herring, and blueback herring was reported (NEFMC et al., 2001). The size composition of the bycatch is not known.

Mid-water trawls produced 0.0311 mt of discarded bycatch for each metric ton of landed Atlantic Herring in 2000, while purse seines produced 0.0105 mt of discarded bycatch for each metric ton of landed Atlantic herring in 2000 (NEFMC et al., 2001). In 2003, the total herring landings were 100,676 mt (NEFMC, 2004c). The total catch by gear type (NMFS, 2004a) along with the estimated bycatch for each of these gear types (calculated using the method above) is given in Table 46. Bycatch data were unavailable for the pair trawl and bottom trawl due to confidentiality issues. However, it was reported that total bycatch for each of these types of trawls was less than one percent (NEFMC et al., 2001). Total estimated bycatch in the herring fishery for 2003 is approximately 2,000 mt.

Table 46: Herring landings and estimated discards for the 2003 fishing year.

Gear	Herring landed in 2003 (mt) (NEFMC, 2004c)	Discard/landings ratio (NEFMC et al., 2001)	Estimated discarded bycatch (mt)	Total bycatch/landings ratio (NEFMC et al., 2001)	Estimated total bycatch in 2003 (mt)
Purse Seine	18,121	0.011	190	0.011	190
Mid-water Trawl	16,108	0.031	501	0.096	1,551
Pair trawl*	65,439	Unknown	Unknown	<0.010	<654
Bottom Trawl*	1,007	Unknown	Unknown	<0.010	<10
Total	100,676		>691		Between 1,741 and 2,405

*Bycatch from these gear types was less than one percent. The total bycatch number is one percent of the total herring landings from that gear.

New observer data were released in the beginning of 2004 summarizing catch and discards from purse seines, pair trawls and mid-water trawls in 2003. Unfortunately, observations were only made on two trips for the purse seine and mid-water trawl fisheries, and can not be reasonably extrapolated to the entire fishery.

Twenty-five trips were observed in the 2003 pair trawl fishery (NEFMC, 2004a). To expand this data to the entire 2003 pair trawl fishery, the total 2003 pair trawl landings of Atlantic herring (65,439 mt) were divided by the 2003 observed pair trawl landings of Atlantic herring (2,732 mt) to obtain a total to observed landings ratio for 2003 (24:1). This ratio was then applied to the landings and discard data for all species observed in pair trawls to obtain an expanded estimate of bycatch in the 2003 Atlantic herring pair trawl fishery. Overall, we estimate 1,812 mt of fish are caught as bycatch each year in the pair trawl fishery, and 1,050 mt, over half the total bycatch, is discarded (Table 47). This estimate of 1,812 mt of bycatch is almost three times the estimate of 654 mt calculated in Table 46. Since the estimate in Table 47 was calculated from direct observation, and the estimate in Table 46 is simply an expansion from previous years, the estimate in Table 47 is more reliable, and it will be the estimate used in the final estimate.

Table 47: Observed landings and discards from 25 Atlantic herring pair trawl trips in 2003 and the expansion for the entire 2003 pair trawl fishery using the total to observed herring landings ratio of 24:1 (NEFMC, 2004a).

Species	Landed weight (mt)	Discarded weight (mt)	Total to observed landings ratio	Estimated pair trawl landings for 2003 (mt)*	2003 total pair trawl discards (mt)
Atlantic herring	2,731.85	41.70	23.95	65,439	998.72
Alewife	6.58	0.04	23.95	157.59	0.86
American Plaice	0.00	0.00	23.95	0.00	0.06
Atlantic mackerel	22.32	0.03	23.95	534.56	0.81
Atlantic cod	0.00	0.02	23.95	0.00	0.43
Haddock	0.02	0.01	23.95	0.48	0.13
Illex squid	0.50	0.00	23.95	11.98	0.03
Monkfish	0.00	0.00	23.95	0.00	0.08
Porbeagle shark	0.00	0.02	23.95	0.00	0.57
Red hake	0.00	0.00	23.95	0.00	0.02
Redfish	0.00	0.00	23.95	0.00	0.01
Silver hake	1.39	0.00	23.95	33.29	0.02
Spiny dogfish	0.27	1.83	23.95	6.47	43.83
Striped bass	0.00	0.01	23.95	0.00	0.26
White hake	0.00	0.00	23.95	0.00	0.03
Witch flounder	0.00	0.00	23.95	0.00	0.02
Shrimp	0.00	0.18	23.95	0.00	4.34
Squid, unid	0.73	0.00	23.95	17.48	0.00
Total (including herring)	2,763.66	43.85	23.95	66,200.85	1,050.29
Total (w/o herring)	31.81	2.15	23.95	761.85	51.57

* The landings in column 5 are assumed to be bycatch except for the herring landings which were targeted. This number does NOT include the discards from the last column. Total pair trawl bycatch for 2003 is calculated by summing the total landings (w/o herring) and the total discards (including herring) cells.

In summary, the mid-water trawl fishery, and to a lesser extent the pair trawl and purse seine fisheries are estimated to generate a small amount of bycatch though we note there are significant gaps in the data, particularly for otter and pair trawls. In 2003, 100,676 metric tons of herring were landed with approximately 3,563 mt of bycatch, 1,741 mt of which was discarded. This results in a bycatch to landings ratio of 0.035 and a discard to landings ratio of 0.017. For the pair trawl part of the expanded bycatch and discard data, the estimate obtained from the 25 observed pair trawl trips (Table 47) were used rather than the approximate number in Table 46 as the observer data in Table 47 are more reliable. Pair trawls are responsible for 50.9% of all bycatch in the herring fishery followed by mid-water trawls at 43.5% and purse seines at 5.3%. The bottom trawl fishery is responsible for 0.3% percent of the total bycatch.

This fishery is still very limited. Bycatch monitoring is classified by NMFS (2004b) as developing. There clearly is potential for substantial bycatch of groundfish particularly in the trawl fishery. Even though the discard to landings ratio is low, a high volume fishery such as this can generate considerable bycatch of recovering species.

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Northern Golden Tilefish Fishery

Major Target Species:	Tilefish (<i>Lopholatilus chamaeleonticeps</i>)
Major Discard Species:	Unknown
Primary Gear Types:	Bottom longline
Total Landings (2002):	1,040 mt
Total Discards (2002):	9 mt
Total Discards Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Discard to Landings Ratio:	0.0087
d/I Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Source of Estimates:	Independent research study, Authors
Discard Type:	Unknown
Notes:	This is an estimate of bycatch, not discards, and it is an underestimate, making the discard to landings ratio low.

The golden tilefish range extends from Nova Scotia to Florida (both coasts) and southward to the Caribbean and northern coast of South America. The FMP was put into effect on November 1, 2001 splitting the species into two separate stocks. This chapter focuses solely on the northern stock, managed by the MAFMC; the southern stock is included in the southeast snapper-grouper complex chapter. The northern stock extends from Nova Scotia to Cape Hatteras, NC (Collette and Klein-MacPhee, 2002). The stock is considered overfished and overfishing is occurring (NMFS, 2004c).

Target landings

The landings of tilefish from Maine to North Carolina are graphed below (Figure 33).

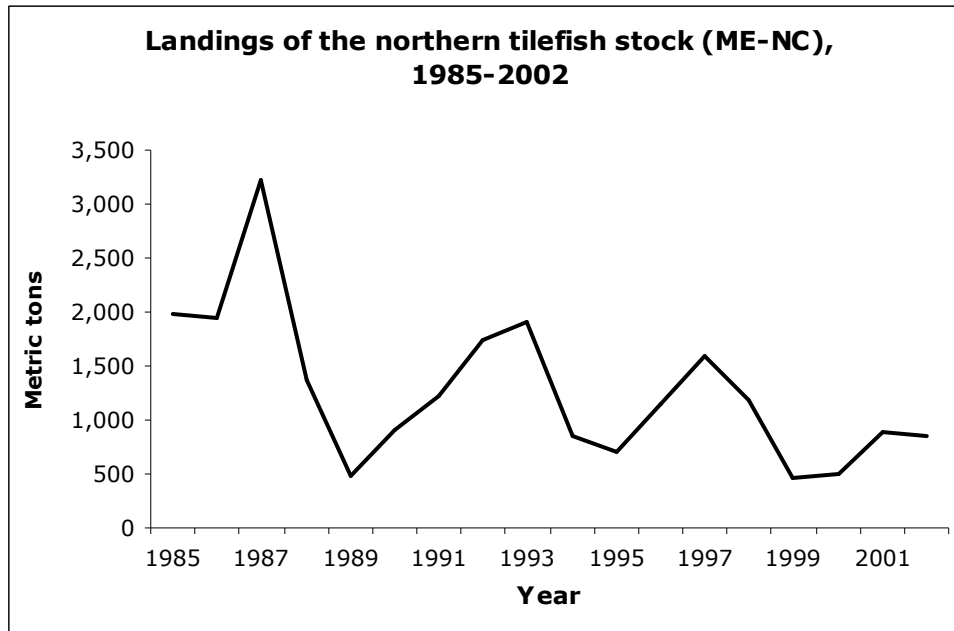


Figure 33: Landings of the northern tilefish stock from 1985 to 2002. For the last five years, the landings have been below 1,000 mt after reaching a high of 3,200 mt in 1987 (NMFS, 2004a).

Tilefish are caught exclusively by longlines in the directed fishery. However, otter trawls are responsible for approximately five percent of the annual landings, and handlines are responsible for another one or two percent.

Regulations

Currently, the northern golden tilefish fishery is managed by a total allowable landings limit (TAL), an incidental catch limit, limited entry, and a longline gear restriction. For the 2004 fishing year, the TAL is 905 mt. Three percent of the total quota is set aside for research, and five percent is set aside to account for incidental catch of tilefish in other fisheries. The incidental trip limit is 300 lbs (136 kg). As soon as the TAL is met, the fishery is closed for the remainder of the year. After the research quota and incidental catch are subtracted, the allocation is split in the following manner: full-time (tier 1) – 66%, full-time (tier 2) – 15%, part-time – 19% (NMFS, 2004b).

Discards

For this fishery, total discards are not known, as the disposition of the catch is not reported. The data refer to total bycatch throughout this section. The northern tilefish bottom longline fishery appears to be relatively selective, with minimal bycatch. The landed catch from 1995-1997 for trips that targeted tilefish contained the following other fish: Eel (species not specified), hake (species not specified), silver hake, kingfish and shark (mako, porbeagle, blue and sandbar). These bycatch species constitute only a small fraction of the total catch (Table 48) (Nitschke et al., 1998).

The data are from the VTR database, with six total vessels reporting between 1995 and 1997. In 1995 and 1997, the data were from 4 vessels, and in 1996 the data were from 5 vessels. During the three years, landings from these vessels accounted for the majority of the catch (Nitschke et al., 1998).

In order to expand the data to the entire fishery, the catch of tilefish from 1995-1997 (NMFS, 2004a) was divided by the VTR reported catch of tilefish in each year. This proportion was multiplied by the reported catch for each of the other species in each year to obtain total bycatch for each species. The total catch of tilefish from 2002 (NMFS, 2004a) was then divided by the average 1995-1997 catch of tilefish to create another ratio. This ratio was multiplied by the 1995-1997 average catch for all the other species to obtain an estimate of 2002 bycatch (Table 48).

Table 48: Overall catch in landed metric tons from the tilefish target fishery for 1995-1997 and estimated total catch for 2002 (Nitschke et al., 1998).

Species	1995	1996	1997	1995-1997 Average	2002 Total catch (bycatch of all non-tilefish species)
Eel (ns)	0.00	6.07	0.33	2.13	1.93
Hake (ns)	1.26	0.00	0.00	0.42	0.38
Silver hake	3.89	4.16	3.99	4.01	3.63
Kingfish	0.00	1.64	0.00	0.55	0.50
Shark	0.98	3.30	1.09	1.79	1.62
Tilefish*	709.26	1,144.95	1,594.68	1,149.63	1,040.50
Other	0.40	2.95	0.52	1.29	1.17
Total	715.78	1,163.07	1,600.62	1,159.82	1,049.64
Total (w/o tilefish)	6.52	18.12	5.94	10.19	9.14

* Actual catch of tilefish (NMFS, 2004a)

In summary, in 2002, there were 1,040 mt of tilefish landed, and just over nine metric tons of bycatch, for a b/l ratio of 0.0087. However, this number is an underestimate, as it does not account for every species that is caught as bycatch in the tilefish fishery. Bycatch in the South Atlantic and Gulf of Mexico tilefish fisheries is discussed elsewhere.

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Atlantic Bluefish Fishery

Major Target Species:	Atlantic bluefish (<i>Pomatomus saltatrix</i>)
Major Discard Species:	Unknown
Primary Gear Types:	Gillnet, Trawl
Total Landings (2002):	8,267 mt
Total Discards (2002):	5 mt
Total Discards Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Discard to Landings Ratio:	0.0010
d/I Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Source of Estimates:	MRFSS, Authors
Discard Type:	Unknown
Notes:	Total discards include only recreational target species discards. Total landings include both commercial and recreational fisheries, thus the d/I ratio is underestimated.

Bluefish are a migratory species found anywhere from the northern Gulf of Maine to the Caribbean Ocean. Bluefish migrate northward in the summer, and south in the winter (Collette and Klein-MacPhee, 2002). The fishery for this species is largely recreational. There is a small commercial catch, amounting to approximately 3,000 mt annually. Currently, the Atlantic bluefish resource is overfished, overfishing is not believed to be occurring (NMFS, 2004d).

Target landings

In recent years, the recreational catch has accounted for two-thirds of the total bluefish landings in the eastern United States. In 2001 and 2002 the recreational landings were 6,001 mt and 5,158 mt respectively (NMFS, 2004c), while the commercial fishery amounted to only 3,945 mt and 3,109.3 mt (NMFS, 2004a) in landings, respectively. Figure 34 shows both the commercial and recreational landings of bluefish for the last two decades.

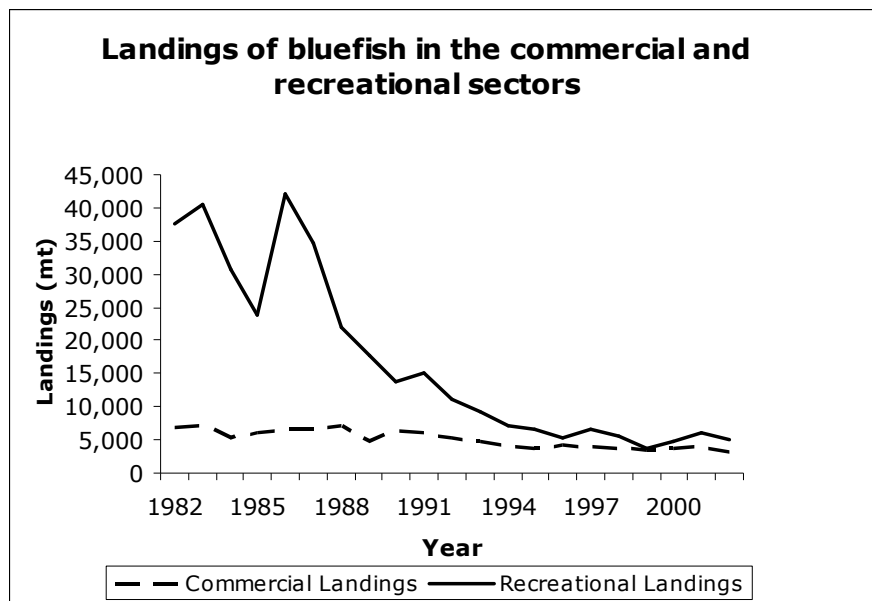


Figure 34: Landings of bluefish in the commercial and recreational fisheries for the past two decades (NMFS, 2004a; NMFS, 2004c).

The gear used in the recreational fishery is largely hook and line. However, some pots and traps are used. In the commercial fishery, the gear types used are slightly more diverse. The commercial landings grouped by gear type are given in Table 49.

Table 49: Percentage of the commercial catch landed by gear type.

Gear Type	Percentage of commercial catch
Otter trawl	17.6
Pound net	8.3
Floating trap	2.4
Sink gillnet	54.0
Drift gillnet	12.5
Handline	5.1

Regulations

The FMP for Atlantic bluefish was implemented in early 1990 (MAFMC, 2003). Currently, the only regulations in place for bluefish are a commercial landings quota and a recreational possession limit. The fishery is reviewed annually by the Bluefish Monitoring Committee. The TAL is split so that the recreational harvest limit is 83% of the TAL and the commercial harvest limit is 17%. If 17% is less than 10.5 million pounds (4,762.8 mt) and the recreational fishery is not projected to land its full harvest limit, the commercial fishery may be allocated up to 4,762.8 mt provided the aggregate commercial and recreational landings do not exceed the TAL (NMFS, 2004b). For the 2004 fishing year, 31.85 million pounds (14,447.0 mt) were allocated to the recreational fishery, and 10.5 million pounds (4,762.8 mt) were allocated to the commercial fishery (MAFMC, 2003a).

The final quota is distributed among the states. The largest quotas are allocated to New Jersey and North Carolina (10.4% and 32% respectively), and are then split between the recreational and commercial fisheries. With permission from the Regional Administrator, state allocations may be transferred to other states or combined with other states' quotas in order to create an overall regional quota (NMFS, 2004b).

Discards

The only data on discarding in this fishery are recreational discards of bluefish. There are no data available for non-target species discards. The Atlantic States Marine Fisheries Commission (ASMFC) reviewed the fishery within the last two years. However, no discard data were included in their publications.

Discard data for the recreational fishery are available online at the Marine Recreational Fisheries Statistics Survey website (NMFS, 2004c). However, these data are only available in numbers of fish, and are from fishermen's reports. The discard data for the most recent five years are reported in Table 50. We estimated the weight of the discard, using an estimate of 0.54 kg per fish (Collette and Klein-MacPhee, 2002). This estimate was calculated by taking a weighted average of the weights-at-age of bluefish that are under the Gulf of Mexico minimum size limit. This estimate may be high, as the South Atlantic does not have a minimum size limit. The discards and landings of bluefish were then used to find a target species discard to landed weight (d/l) ratio.

Table 50: Recreational discards of bluefish in the bluefish fishery and the estimated weight of these discards (1998-2002).

Year	Discards (number of fish)	Estimated weight of discards (mt)	Landings (mt)	d/l ratio
1998	5,002,000	2.70	5,594.7	0.00048
1999	7,805,000	4.21	3,743.6	0.0011
2000	11,363,000	6.14	4,810.7	0.0013
2001	13,748,000	7.42	6,001.0	0.0012
2002	9,917,000	5.40	5,158.1	0.0010

In summary, recreational discards of bluefish are the only discard data available for the bluefish fishery. In 2002, the recreational bluefish fishery discarded 5.4 metric tons of bluefish and landed 5,158.1 metric tons for a d/l ratio of 0.001.

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Deep Sea Red Crab Fishery

Major Target Species:	Red crab (<i>Chaceon quinquegens</i>)
Major Discard Species:	Unknown
Primary Gear Types:	Trap, Pot
Total Landings (2002):	516 mt
Total Discards (2002):	Unknown
Total Discards Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Discard to Landings Ratio:	Unknown
d/I Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Source of Estimates:	None
Discard Type:	Unknown
Notes:	

The deep sea red crab fishery has only been in existence for a few decades. The fishing zone for red crab is in deep water between 400-800 meters and extends from Cape Hatteras, NC, to the Hague line (NEFMC, 2003). The fishery management plan (FMP) was not instituted until October 21, 2002, so there are very little data available pertaining to the red crab fishery. Beginning in 2003, the status of the stock will be evaluated yearly, and a stock assessment and fishery evaluation report will be prepared biennially. Before the 1970's, red crab was considered an underutilized resource. According to a recent summary of stock status report, the deep sea red crab fishery is classified as unknown for both overfished and overfishing conditions (NMFS, 2004b).

Target landings

The catch data available for this fishery are limited. The NMFS commercial landings database information on red crab are erratic (NMFS, 2004a). In 2000, the logbook landings of red crab from Maine to North Carolina totaled only 297 mt, but the weigh-out data for the same region in 2000 totaled 3,131 mt. The same discrepancy existed in 2001, with preliminary logbook landings accounting for 877 mt and weight-out data accounting for 3,296 mt of red crab. With the implementation of the FMP for deep sea red crab and mandatory reporting, the landings data have become more reliable in the past two years. In 2002, 516 mt of red crab were landed according to the IVR database, and 792 mt were landed in the first half of 2003 (March 1, 2003 - September 1, 2003) (NEFMC, 2003). This number will increase as landings data become available for the rest of 2003.

Regulations

Currently there are only five vessels in the red crab fishery. It is a limited access fishery with two types of permit available. A category B permit allows a daily trip limit of up to 75,000 lbs. A category C permit is allocated to vessels that have historical evidence of landing more than 75,000 lbs in a single trip. With this permit, the vessel is allowed to land up to the highest amount landed by that vessel historically, rounded to the nearest 5,000 lbs. However, there is a total allowable catch (TAC) limit for the fishery that is set each year. Once the TAC is used up, all fishing activities must cease until the beginning of the new fishing year. So far, the TAC has not been reached. Both VTR and IVR reporting is mandatory. The fishery is strictly a trap/pot fishery, with a 600 trap/pot limit. Traps must not exceed 18 cubic feet, and parlor traps are prohibited. The take of female crabs is also illegal. Even though there is no enforced minimum size, four inches is the operational minimum size. If many crabs less than four inches start being landed, the council will consider imposing an enforceable minimum size (NMFS, 2002).

An open access permit is also attainable, but it is only for the incidental catch of red crab in other fisheries. With an open access permit, vessels are allowed to land up to 500 lbs of whole red crab daily, and all catch must be reported through the VTR system (NMFS, 2002).

Discards

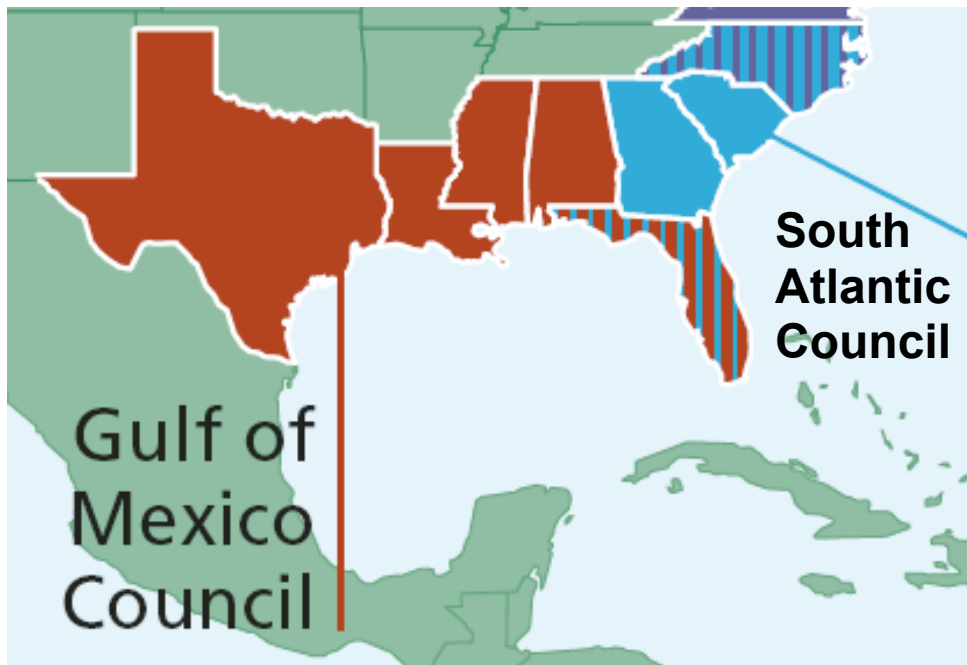
Since the adoption of the FMP is recent, there is very little documentation of target species and non-target species bycatch in the red crab fishery. What little data there are suggest a lack of bycatch in the red crab fishery, which the authors consider unlikely as no study has ever been conducted with the sole purpose of assessing bycatch in the red crab fishery. Of more concern is the bycatch of red crab in other fisheries (NEFMC, 2002). However, the EFH source document for red crab lists nine species that are possibly in competition with the red crab for food and habitat resources, and therefore potential bycatch candidates. They are the Jonah crab, American lobster, hagfish, cusk, eelfish, rattail, white hake, galatheid crab and golden crab (NMFS, 2001). Also occurring alongside the red crab: longfin hake, witch flounder, and blue hake (Haedrich et al., 1980), as well as snow crabs (Williams and Wigley, 1977).

However, these are only potential bycatch species. There are currently no data reporting bycatch in the red crab fishery of any of these species. The traps and pots that are used are considered selective, although studies are underway to determine an appropriate escape vent size, and the preferred depth of the red crab makes for little overlap with the fishing grounds of other commercially targeted species such as groundfish or scallop. Currently, one of the only real bycatch concerns may be discards of red crabs that are either female or considered too small. Crabs that are tossed back because they are too small or female may experience mortality as a result of sea bird predation or settling on an uninhabitable bottom type (NEFMC, 2002). However, small crabs constitute a very small percentage of the catch due to the required two-inch gap between slats on the side of the pots.

References:

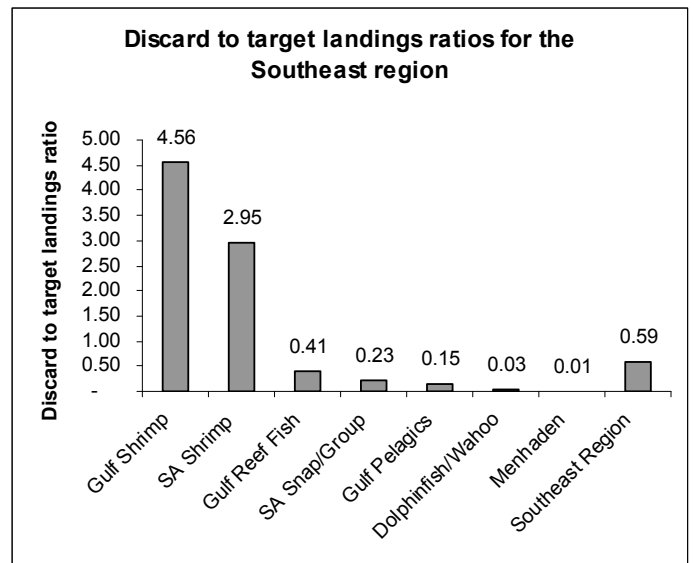
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Southeast



Southeast regional overview of landings, discards and discard to landings ratios by fishery

Fishery	Landings (mt)	Discards (mt)	d/l ratio
Gulf Shrimp	103,671	472,643	4.56
SA Shrimp	11,945	35,206	2.95
Gulf Reef Fish	17,376	7,210	0.41
SA Snapper/Grouper	5,579	1,275	0.23
Gulf Pelagics	12,513	1,819	0.15
Dolphinfish/Wahoo	5,588	160	0.03
Menhaden	725,458	4,607	0.01
Southeast Region	882,130	522,920	0.59



Shrimp Fishery of the South Atlantic

Major Target Species:	Brown shrimp (<i>Penaeus aztecus</i>), Pink shrimp (<i>Penaeus duorarum</i>), White shrimp (<i>Penaeus vannamei</i>), Rock shrimp (<i>Sicyonia brevirostris</i>)
Major Discard Species:	Crabs, Atlantic croaker (<i>Micropogonias undulatus</i>), Menhaden
Primary Gear Types:	Bottom otter trawl
Total Landings (2002):	11,945 mt
Total Discards (2002):	35,206
Total Discards Rank (of 27):	7
Discard to Landings Ratio:	2.95
d/I Rank (of 27):	2
Source of Estimates:	Independent research studies, NMFS, Authors
Discard Type:	Primarily non-target, regulatory
Notes:	This is an estimate of bycatch, not discards.

The FMP for Shrimp in the South Atlantic includes pink, white, brown and rock shrimp and is managed by the SAFMC. The management area extends from North Carolina through the east coast of Florida. When the FMP was first written in 1993, it only included white shrimp. The first amendment added rock shrimp, and Amendment 2 added pink and brown shrimp (NMFS, 2002). None of the four species of shrimp in this FMP are overfished, and overfishing is not occurring (NMFS, 2004a), though bycatch in this fishery is an issue of great importance.

Target landings

The landings of shrimp in the South Atlantic are much lower than shrimp landings in the Gulf of Mexico (NMFS, 2004b) (Figure 35). Rock shrimp is the only exception. Its landings are approximately the same in both regions. For white, pink and brown shrimp, landings in the South Atlantic average five, 10 and 15 times lower, respectively, than landings of their Gulf counterparts (NMFS, 2004b).

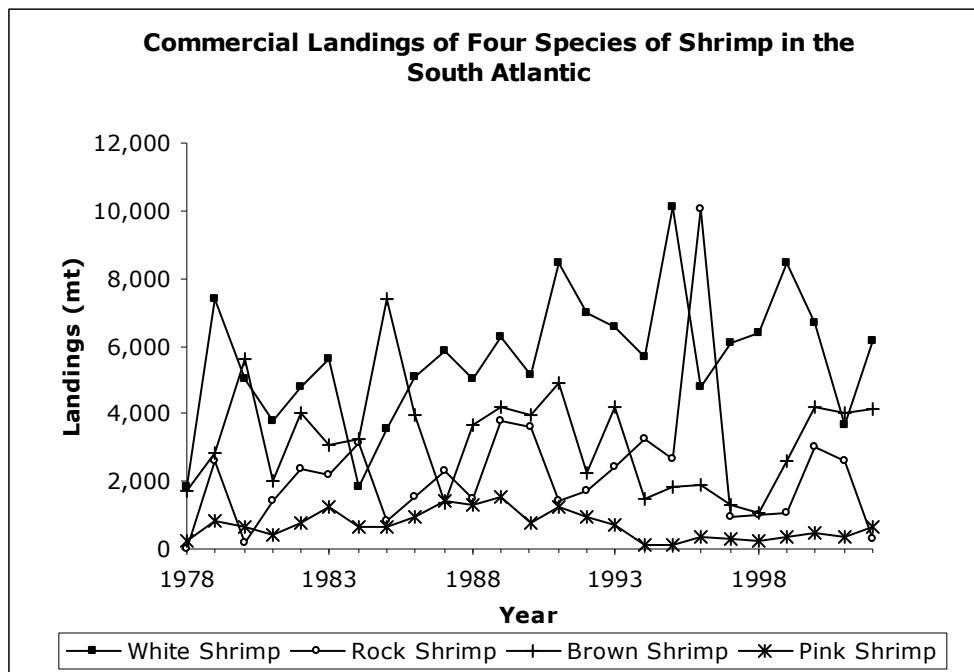


Figure 35: Landings of shrimp in the South Atlantic from 1978-2002.

The gear used to fish for shrimp in the South Atlantic is almost exclusively bottom otter trawls (Figure 36). A small percentage of the total shrimp landings are from beam trawls, and there is a recreational fishery

that uses bait and cast nets (NMFS, 2004b). However, landings from these gear types are more likely accounted for as bycatch in other fisheries.

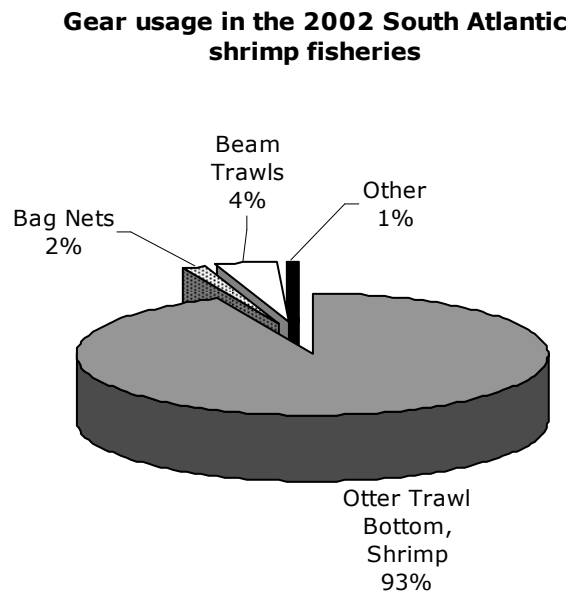


Figure 36: Gear usage in the 2002 South Atlantic shrimp fishery. Landings for all species of shrimp were totaled by gear type.

Regulations

Regulations for the South Atlantic shrimp fishery are much more stringent than regulations for the Gulf of Mexico shrimp fishery. In the South Atlantic, limited access permits are required for rock shrimp vessels, and these vessels must also have VMS systems on board. All shrimp trawlers are required to have bycatch reduction devices (BRDs), a regulation that went into effect in 1997 (CCAF, 2005), with the exception of royal red trawlers, but only if over 90% of the catch on board is royal red shrimp. In federal waters, turtle excluder devices (TEDs) are required on every vessel (since 1991) and they must be able to exclude 97% of turtles from the trawls (SCDNR, 2005). In the South Atlantic, the general minimum size requirement for a TED opening is 35" wide x 20" high, which was implemented in April of 2003 to allow for the exclusion of leatherback turtles from shrimp trawls. However, this minimum size can vary with the type of TED. Some TED variations must have escape openings larger than the minimum size.

State regulations also are reported here, because most of the shrimp fishery takes place in inshore waters, within three miles of land. All states in the South Atlantic are required to use federally approved TEDs and BRDs. They can have more stringent TED regulations if they wish, and Georgia and South Carolina have done this in the past. Individual states are also allowed to close their entire fishery if the winter has been extremely cold. In this situation, when the state fishery closes, the federal fishery off that state's coast and out to 25 nautical miles from shore also closes.

In Georgia, federally approved TEDs and BRDs are only required for nets with a foot rope longer than 16 feet. There are also time and area closures, size limits, and catch limits. In Florida, nets must be smaller than 500 square feet. With the exception of seabob shrimp, a size limit is strictly enforced and mesh size regulations are variable by region. In some areas of Florida, the minimum mesh size of the codend is 5/8". In North Carolina, various area and seasonal closures are in effect, and weekend shrimping is not allowed. The minimum mesh size is 1.5 inches. South Carolina has been known to have especially strict TED regulations. They enforced the 35 x 20 inch minimum opening before it was a federal regulation (NMFS, 2003).

Discards

Bycatch estimates before BRD requirements

Nance et al. (1997) investigated shrimp trawl catch composition in the South Atlantic. The study divided the South Atlantic region into three areas: above 34 degrees North latitude (NC and north), between 30 and 34 degrees North latitude (SC and GA), and below 30 degrees North latitude (FL). Catch composition is reported as percent of total catch weight for a one hour trawl, based on over 1,000 trawls (Table 51) (Nance et al., 1997). The study also reported that on average, 8 kg of finfish were caught for every 1 kg of shrimp in the northernmost area, but only 2.5-3 kg of finfish were caught for every 1 kg of shrimp in the two southern areas (Nance et al., 1997).

We calculated 2002 bycatch weights from catch composition data using simple proportions to extrapolate bycatch amounts of the finfish. For example, the 2002 commercial landings of shrimp (pink and brown) from the >34°N area (3,133.9 mt) made up 26% of the catch (Nance et al., 1997). The ratio of shrimp landings to the proportional shrimp catch (3,133.9/0.26) multiplied by the proportional bycatch of each of the other species (e.g., 0.19 for blue crab) gives the bycatch weight of that particular species prior to full implementation of BRD regulations (e.g. 2,290 mt of bluecrab) (Table 51).

Table 51: Average catch compositions by weight for a one hour tow by area in the South Atlantic from February 1992 through December 1996 and expanded catch composition by weight for 2002 prior to full BRD regulations (Nance et al., 1997).

Area	Average percent catch composition by weight.	Average estimated catch composition by weight, 2002.
South Atlantic, >34°N	Blue crab – 19% Pink shrimp – 16% Spot – 12% Brown shrimp – 10% Atlantic croaker – 8% Pinfish – 7% Pigfish – 4% Atlantic thread herring – 2% Summer flounder – 2% Southern hake – 1% Other – 19%	Pink and brown shrimp – 3,134* Blue crab – 2,290 Spot – 1,446 Atlantic croaker – 964 Pinfish – 844 Pigfish – 482 Atlantic thread herring – 241 Summer flounder – 241 Southern hake – 121 Other – 2,290 Total (without shrimp) – 8,620
South Atlantic, 30°-34°N	Cannonball jellyfish – 11% Atlantic menhaden – 10% White shrimp – 10% Spot – 8% Star drum – 7% Jellyfish – 7% Brown shrimp – 6% Atlantic croaker – 6% Southern kingfish – 5% Cutlassfish – 2% Other – 28%	White and brown shrimp – 4,557* Cannonball jellyfish – 3,133 Atlantic menhaden – 2,848 Spot – 2,278 Star drum – 1,993 Jellyfish – 1,993 Atlantic croaker – 1,709 Southern kingfish – 1,424 Cutlassfish – 570 Other – 7,974 Total (without shrimp) – 23,922
South Atlantic, <30°N	Brown shrimp – 16% Star drum – 14% Southern kingfish – 9% Spot – 7% Lady crab – 5% Lesser blue crab – 5% White shrimp – 4% Spanish mackerel – 3% Northern searobin – 3% Striped searobin – 3% Other – 31%	Brown and white shrimp – 1,917* Star drum – 1,342 Southern kingfish – 863 Spot – 671 Lady crab – 479 Lesser blue crab – 479 Spanish mackerel – 288 Northern searobin – 288 Striped searobin – 288 Other – 2,971 Total (without shrimp) – 7,667
Bycatch Total (shrimp not included)		40,208

* Actual landings from the NMFS commercial landings database (NMFS, 2004b).

Another study completed before TEDs were mandatory on all shrimp trawls reported a ratio of 2.3:1 for finfish weight to shrimp weight (Schmied and Nance, 1995), similar to the ratio reported by Nance et al (1997) for the two southern areas. The Schmied and Nance report (1995) reported the top ten species by

weight per hour tow (Table 52). The same proportional method from Table 51 was used to estimate bycatch weight for each individual species in Table 52 based on the catch percentage (Table 53). This is an estimate based on data collected before current TED and BRD regulations were implemented.

Table 52: Top ten species by weight in a one-hour shrimp tow in the South Atlantic from February 1992 through September 1994 (Schmied and Nance, 1995).

Species	Percent of Catch ³
Cannonball jellyfish	14
White shrimp	9
Spot	9
Atlantic menhaden	9
Brown shrimp	8
Other jellyfish	8
Atlantic croaker	6
Southern kingfish	4
Blue crab	4
Star drum	3

Table 53: Estimated weight of selected finfish species caught as bycatch in South Atlantic shrimp trawls, 2002.

Species	Total estimated weight (mt) in shrimp trawls, 2002
Shrimp (brown, white)	10,349 (NMFS, 2004b)
Cannonball jellyfish	8,522
Spot	5,479
Atlantic menhaden	5,479
Other jellyfish	4,870
Atlantic croaker	3,652
Southern kingfish	2,435
Blue crab	2,435
Star drum	1,826
Total bycatch (does not include shrimp)	34,698

We found only one report that characterized bycatch in rock shrimp trawls (GSAFDF, 1995). The data only represent a single trip, however, making extrapolation to an entire year problematic, unless one assumes that the trip was typical in scope and duration. This is highly unlikely because many factors such as where and when the trip was conducted could have influenced the catch composition. Rock shrimp and the fish species commonly associated with them fluctuate in abundance depending on season, depth, temperature and location, making it impossible for one trip to be representative of all commercial rock shrimp trips. However, a list of bycatch species from this study is presented without amounts (Table 54).

³ The catch ratios (to one another) for the four species of shrimp in this table do not equal their actual catch ratios as reported by NMFS. Landings of brown shrimp were not three times that of pink shrimp; white shrimp and rock shrimp did not have comparable landings.

Table 54: Species characterization from a rock shrimp research trip (GSAFDF, 1995).

Shrimp	Flatfishes	Other fishes
Rock shrimp (<i>S. brevirostris</i>)	Southern Flounder (<i>P. lethostigma</i>)	Eel (<i>Lepophidium sp.</i>)
Penaeids	Gulf of Mexico ocellated flounder (<i>A. quadrocellata</i>)	Jenny (<i>Eucinostomus sp.</i>)
	Shoal flounder (<i>S. gunteri</i>)	Goatfish (<i>Mullus sp.</i>)
Other invertebrates	Twospot flounder (<i>B. robinsi</i>)	Sand perch (<i>Diplectrum sp.</i>)
Swimming crabs	<i>Etropus sp.</i>	Sea bass (<i>Centropristis sp.</i>)
Mantis shrimp (<i>O. scyllarus</i>)	Fringed flounder (<i>E. crossotus</i>)	Grunt (<i>Haemulon sp.</i>)
Squid	<i>Cyclopsetta sp.</i>	Pinfish (<i>Lagodon sp.</i>)
	Spotted whiff (<i>Citharichthys macrops</i>)	Searobin (<i>P. ophryas</i>)
	Blackcheek tonguefish (<i>Symphurus plagiusa</i>)	Searobin (<i>P. longirostris</i>)
		Searobin (<i>Bellator sp.</i>)
	Drums	Scorpionfish (<i>S. calcarutta</i>)
	Croaker (<i>M. undulatus</i>)	Filefish (<i>Monocanthus sp.</i>)
	Spot (<i>L. xanthurus</i>)	Puffer (<i>Sphoeroides sp.</i>)
		Other

The estimates of bycatch from the Nance et al. (1997) report is the most recent and comprehensive. Therefore, the bycatch numbers in Table 51 were used as the best estimates of pre-BRD conditions.

Bycatch estimates adjusted for BRD reduction rates

Since 1997, many TED and BRD regulations have been enacted changing the size, shape and location of TED openings, and introducing new and improved TED and BRD designs (SCDNR, 2005). One study investigating the effectiveness of BRDs gave an average finfish bycatch reduction rate of 42% (NMFS, 1998). However, a more recent report incorporating additional research (NOAA, 2004) reveals that the actual bycatch reduction rate is much lower. The Gulf Fisheye BRD is the main BRD used by the fleet, due to its small reduction in shrimp catch. Other certified BRDs (such as the Jones-Davis BRD or the Extended Funnel BRD) are not widely used by the shrimp fleets because of the larger reduction in shrimp catch that they produce. According to the report, the Gulf Fisheye BRD produces only a 16.5% reduction in finfish bycatch (NOAA, 2004), an amount much smaller than the 42% reduction indicated in 1998.

If this reduction rate of 16.5% is applied to the bycatch estimates for finfish (not crabs and jellyfish) prior to implementation of BRDs, estimated bycatch is reduced from 40,208 mt to 35,206 mt. Therefore, total 2002 landings in the South Atlantic shrimp fishery were 11,945 mt and total bycatch was 35,206 mt for a b/l ratio of 2.95.

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Snapper and Grouper of the South Atlantic

Major Target Species:	Red snapper (<i>Lutjanus campechanus</i>), Snowy grouper (<i>Epinephelus niveatus</i>), Golden tilefish (<i>Lopholatilus chamaeleonticeps</i>), Red grouper (<i>Epinephelus morio</i>), Black sea bass (<i>Centropristis striata</i>), Vermilion snapper (<i>Rhomboplites aurorubeus</i>), Gag grouper (<i>Mycteroperca microlepis</i>), Yellowtail snapper (<i>Ocyurus chrysurus</i>), Mutton snapper (<i>Lutjanus analis</i>), Greater amberjack (<i>Seriola dumerili</i>), Scamp (<i>Mycteroperca phenax</i>), White grunt (<i>Haemulon plumieri</i>), Gray snapper (<i>Lutjanus griseus</i>), Blue runner (<i>Caranx crysos</i>), Crevalle jack (<i>Caranx hippos</i>), Spadefish (<i>Chaetodipterus faber</i>), Sheepshead (<i>Archosargus probatocephalus</i>)
Major Discard Species:	Skates, Sharks
Primary Gear Types:	Hook and line, Divers, Longline
Total Landings (2002):	5,579 mt
Total Discards (2002):	1,275 mt
Total Discards Rank (of 27):	22
Discard to Landings Ratio:	0.23
d/I Rank (of 27):	16
Source of Estimates:	NMFS, MRFSS, Authors
Discard Type:	Primarily target, regulatory
Notes:	Total discards does not include recreational non-target species discards or commercial trap discards.

The FMP for Snapper and Grouper of the South Atlantic is managed by the SAFMC. It contains 17 major species: 10 species of snappers and groupers, plus golden tilefish, black sea bass, white grunt, blue runner, crevalle jack, sheepshead and spadefish. Of these, eight stocks are subject to overfishing and seven stocks are overfished (NMFS, 2004c) (Table 55). There are several other stocks managed under this FMP that are considered to be minor stocks and are either overfished or overfishing is occurring. They are the speckled hind, Warsaw grouper, black grouper, red porgy, goliath grouper (protected species) and Nassau grouper (protected species) (NMFS et al., 2004). However, due to their minor status, they will not be mentioned further in this chapter. Recreational fisheries exist for 12 of the 17 major species within this FMP, and the recreational landings of these species are often as much, if not higher than, the commercial landings.

Table 55: Major stocks in the South Atlantic snapper/grouper FMP and their stock status (NMFS, 2004c)

Species	Stock Status
Red Snapper*	Both overfished and overfishing
Snowy Grouper	Both overfished and overfishing
Golden Tilefish	Both overfished and overfishing
Red Grouper*	Both overfished and overfishing
Black Sea Bass*	Both overfished and overfishing
Vermilion Snapper*	Both overfished and overfishing
Gag*	Overfishing, but not overfished
Yellowtail Snapper*	Both overfished and overfishing
Mutton Snapper*	Neither overfished or overfishing
Greater Amberjack*	Neither overfished or overfishing
Scamp	Neither overfished or overfishing
White Grunt*	Neither overfished or overfishing
Gray (Mangrove) Snapper*	Neither overfished or overfishing
Blue Runner	Unknown
Crevalle Jack*	Unknown
Spadefish	Unknown
Sheepshead*	Unknown

* Species which have a recreational component to the fishery

Target landings

Commercial landings for each of the major species within the FMP, and recreational landings for each of the snappers and groupers are under 700 mt with the exception of recreationally landed sheepshead (NMFS, 2004a; NMFS, 2004b) (Figure 37-Figure 40). The recreational landings of all other species (sheepshead, crevalle jack, white grunt and greater amberjack) are quite a bit higher, especially those of sheepshead and greater amberjack (Figure 40). Commercially, vermilion snapper, gag grouper, black sea bass, golden tilefish and greater amberjack have the highest landings (Figure 37 and Figure 38). Recreationally, sheepshead, greater amberjack and black sea bass have the highest historical landings (Figure 40).

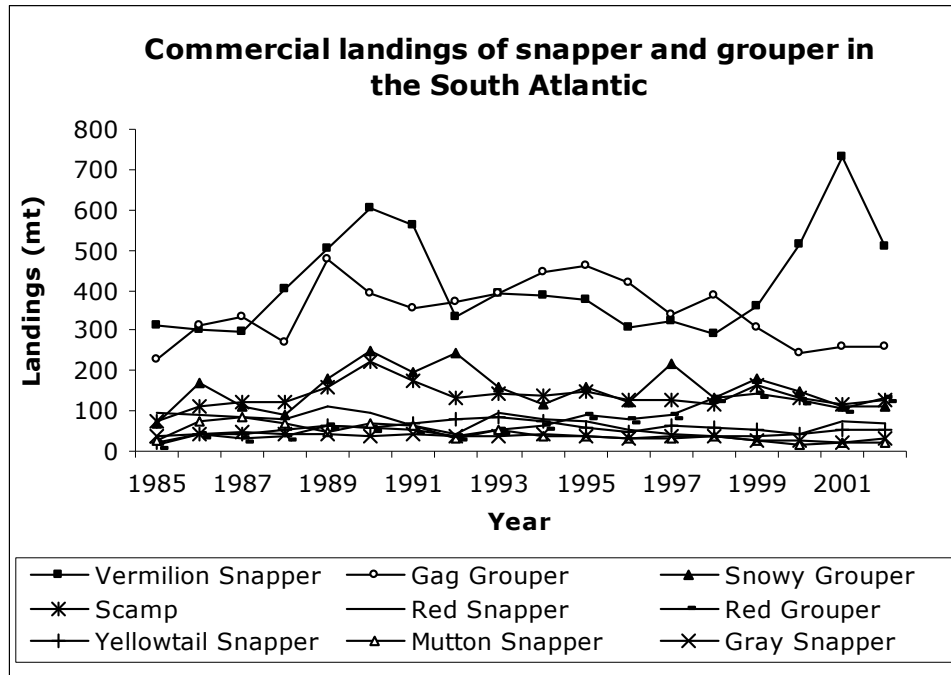


Figure 37: Commercial landings of snapper and grouper in the South Atlantic, 1985-2002.

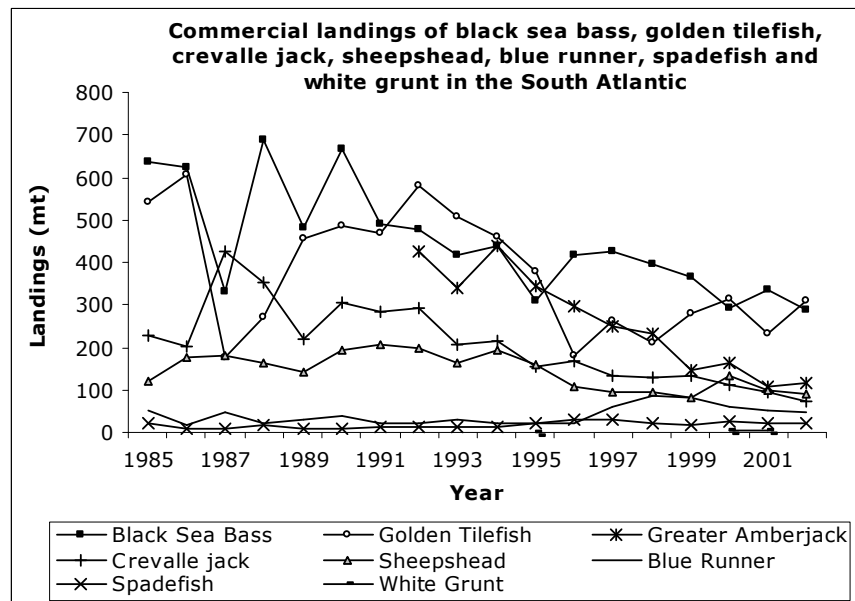


Figure 38: Commercial landings of black sea bass, golden tilefish, crevalle jack, sheepshead, blue runner, spadefish and white grunt in the South Atlantic, 1985-2002.

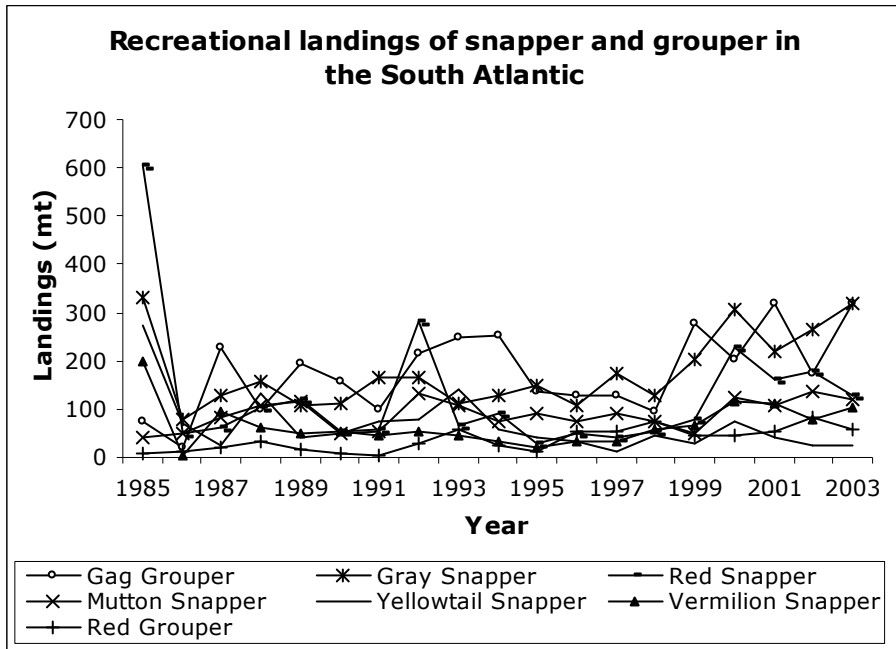


Figure 39: Recreational landings of snapper and grouper in the South Atlantic, 1985-2003.

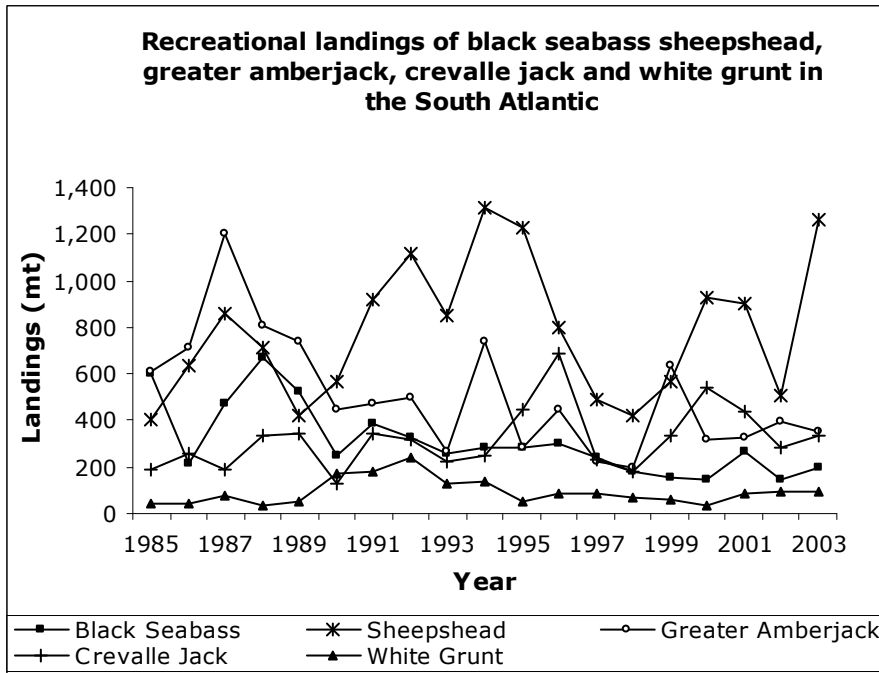


Figure 40: Recreational landings of black seabass, sheephead, greater amberjack, crevalle jack and white grunt in the South Atlantic, 1985-2003.

The gear used to fish for these species is predominately hook and line (vertical and bandit gear) (71% of landings) and longline (27% of landings). Black seabass are targeted with pot gear (2% of landings). Spearfishing is allowed without the use of rebreathers, devices that allow divers to dive deeper and for longer periods of time than traditional SCUBA gear. Longlines are allowed north of St. Lucie Inlet, FL and in waters deeper than 50 fm.

Regulations

Presently, the FMP utilizes permit restrictions, seasonal/area closures, minimum fish length requirements, trip/possession limits, quotas, and gear restrictions to regulate the snapper-grouper fishery.

Permit restrictions

In 1998, the snapper-grouper fishery became limited entry. Transferable and non-transferable permits were issued depending on the fishing vessel's landing history. New entrants into the snapper-grouper fishery are required to obtain two transferable permits which they can trade in for one transferable permit (SAFMC, 2004b).

Seasonal and area closures

Seasonal closures exist for several commercial fisheries in the snapper-grouper FMP (Table 56). During these seasonal closures, additional restrictions may be in place.

Table 56: Seasonal closures and restrictions on gag, mutton snapper, greater amberjack, black grouper, and red porgy (SAFMC, 2004e).

Species	Closed Season	Additional Restrictions
Gag	April-March	Recreational bag limit takes effect. Sale/purchase is prohibited.
Mutton Snapper	May-June	Possession limits are 10/person or 10/day, whichever is more restrictive.
Greater Amberjack	April 1-30	Recreational bag limit takes effect.
Black Grouper	April-March	Sale/purchase is prohibited.
Red Porgy	January-April	Recreational bag limit takes effect. Sale/purchase is prohibited.

The primary area closure is the Oculina Bank Habitat Area of Particular Concern (HAPC) which protects Oculina coral and the associated community. The Oculina HAPC consists of approximately 300 sq mi. off the coast of Florida from Ft. Pierce to Cape Canaveral (Pugliese, 2003). A smaller area, the 92 square mile Experimental Closed Area (ECA), is located inside the HAPC (SAFMC, 2004c). Throughout the entire HAPC, the use of bottom gear is prohibited. Anchors, bottom chains, and grapple hooks also are prohibited and the possession of rock shrimp and Oculina coral is illegal. Within the ECA, all snapper-grouper fishing is prohibited. Other hook and line fisheries that catch any fish in the snapper-grouper FMP must cut the line and release the fish without removing it from the water.

Minimum fish length requirements and recreational bag/possession limits

There are minimum fish length requirements and recreational bag limits in effect for numerous species (Table 57). In addition to the minimum size requirements, most fish species in the snapper-grouper management complex fall into one of three "bag limit" categories. The grouper aggregate bag limit is five fish per person⁴; the snapper aggregate bag limit is 10 fish per person⁵; and the 20 fish/person aggregate bag limit includes all species of fish within the complex that do not have a species specific limit and are not included in one of the other two aggregate limits (Table 56). Goliath grouper and Nassau grouper, are illegal to harvest or possess (SAFMC, 2004d; SAFMC, 2004e).

Commercial trip limits/quotas

Commercial trip limits and quotas are used only for snowy grouper, greater amberjack and wreckfish. Wreckfish is a minor species within the FMP, regulated using an individual transferable quota (ITQ) system. Snowy grouper have a 2,500 lb trip limit until the quota of 344,508 lb is reached, thereafter the trip limit drops to 300 lb. For greater amberjack, the trip limit is 1,000 lb and the fishery closes once the quota of 1,169,931 lbs is reached (SAFMC, 2004d; SAFMC, 2004e).

⁴ The grouper aggregate bag limit includes: black grouper, gag grouper, misty grouper, red grouper, scamp, snowy grouper, speckled hind, tiger grouper, Warsaw grouper, yellowedge grouper, yellowfin grouper, yellowmouth grouper, blueline tilefish, golden tilefish, sand tilefish, coney, graysby, red hind and rock hind.

⁵ The snapper aggregate bag limit includes all snappers.

Table 57: The minimum size limits (given as total length, TL, or fork length, FL) for recreational and commercial fisheries, and recreational bag limits for selected species.

Species	Minimum Total Length (inches)		Recreational Bag Limits
	Recreational	Commercial	
Vermilion Snapper	11	12	Snapper aggregate limit + 10/person additional.
Red Snapper	20	20	2/person, included in the snapper aggregate limit.
Snowy Grouper	None	None	Grouper aggregate limit.
Golden Tilefish	None	None	Grouper aggregate limit.
Red Grouper	20	20	Grouper aggregate limit.
Black Sea Bass	10	10	20/person
Gag	24	24	2/person Gag or Black Grouper combined, included in the grouper aggregate limit.
Mutton Snapper	16	16	Snapper aggregate limit.
Greater Amberjack	28 FL (Florida only)	36	1/person
Scamp	20	20	Grouper aggregate limit.
Gray Snapper	12	12	Snapper aggregate limit.
White Grunt	None	None	Other fish aggregate limit.
Blue Runner	None	None	Other fish aggregate limit.
Crevaille Jack	None	None	Other fish aggregate limit.
Spadefish	None	None	Other fish aggregate limit.
Sheepshead	None	None	Other fish aggregate limit.
Goliath Grouper			Illegal to harvest/possess
Nassau Grouper			Illegal to harvest/possess
Jewfish			Illegal to harvest/possess
Wreckfish			Must have specific permit to possess

Discards

There are no discard data available for the commercial fishery of snapper and grouper in the South Atlantic. However, discard to landings ratios from an observer study in the Gulf of Mexico were applied to landings data from the South Atlantic for the longline (NMFS, 1995; NMFS, 1996; Scott-Denton, 2004) and handline (McCarthy, 2004) fisheries (Table 58 and Table 59). The observer data were in numbers, but additional weight data obtained for the calculations of discards in the longline fishery (Scott-Denton, 2004), and the handline observer data was expanded using logbook effort (McCarthy, 2004). Data from the Gulf of Mexico were used as an approximation of discards since the South Atlantic and Gulf of Mexico fish stocks are not isolated from one another, and fishing strategies are similar between the two regions. It was not possible to apply discard ratios from the Gulf of Mexico trap fishery to the South Atlantic trap fishery because the target species were different (red grouper in the Gulf, black seabass in the South Atlantic).

Table 58: Estimated discards from the South Atlantic snapper-grouper longline fishery, 2001-2003.

Species	2001	2002	2003
Red grouper	1.372	0.896	0.553
Cleannose skate	0.041	0.026	0.016
Leopard toadfish	0.025	0.017	0.010
Great barracuda	0.025	0.016	0.010
Blacknose shark	0.014	0.009	0.006
Reticulate moray	0.010	0.006	0.004
Scamp	0.006	0.004	0.002
Nurse shark	0.004	0.003	0.002
Sharksucker	0.004	0.003	0.002
Spotted moray	0.003	0.002	0.001
Spinycheek scorpionfish	0.003	0.002	0.001
Yellowedge grouper	0.002	0.001	0.001
Longspine squirrelfish	0.002	0.001	0.001
Speckled hind	0.001	0.001	0.001
Florida smoothhound shark	0.001	0.001	0.000
Inshore lizardfish	0.000	0.000	0.000
Chain dogfish	0.000	0.000	0.000
Bank seabass	0.000	0.000	0.000
Sand perch	0.000	0.000	0.000
Pale spotted eel	0.000	0.000	0.000

Species	2001	2002	2003
Margintail conger	0.000	0.000	0.000
Total	1.513	0.988	0.610

Table 59: Estimated discards in the South Atlantic snapper-grouper handline fishery, 2002-2004.

Species	2002	2003	2004*
Red grouper	23.10	21.71	9.03
Red snapper	3.19	3.00	1.25
Gag	0.90	0.85	0.35
Jewfish	0.44	0.41	0.17
Little tunny	0.22	0.21	0.09
Tiger shark	0.20	0.18	0.08
Clearnose skate	0.19	0.18	0.08
Leopard toadfish	0.12	0.11	0.05
Silver seatrout	0.07	0.07	0.03
Scamp	0.06	0.06	0.02
Reticulated moray	0.05	0.05	0.02
Sand tilefish	0.05	0.05	0.02
Spotted moray	0.04	0.04	0.02
Guaguanche barracuda	0.04	0.03	0.01
Gray snapper	0.03	0.03	0.01
Vermilion snapper	0.03	0.03	0.01
Sand diver	0.02	0.02	0.01
Gray triggerfish	0.02	0.02	0.01
Lane snapper	0.02	0.02	0.01
Blue runner	0.01	0.01	0.00
Pinfish	0.01	0.01	0.00
Tomtate	0.00	0.00	0.00
Total	23.10	21.71	9.03

* 2004 values are current only through September

There are also recreational target species discard data available for the South Atlantic from the Marine Recreational Fisheries Statistics Survey (MRFSS) database. These data are given in numbers of fish only; therefore the weight of the discards had to be estimated. The methodology for this estimation technique is described in the National Overview but in general, weight-at-age data were used to arrive at an average weight per discarded fish (See Size References at end of chapter). These calculations only considered sub-legal fish, as it is assumed that legal sized fish are retained. Multiplying the average weight per fish by the number of discarded fish of each species (NMFS, 2004c) gives an estimated weight of discards (Table 60 and Table 61).

Table 60: Estimated yearly discards of red snapper, vermilion snapper, mutton snapper, gray snapper, yellowtail snapper and black sea bass in the South Atlantic recreational snapper-grouper fishery, 1985-2003 (NMFS, 2004c).

Year	Red Snapper Discards (mt)	Vermilion Snapper Discards (mt)	Mutton Snapper Discards (mt)	Gray Snapper Discards (mt)	Yellowtail Snapper Discards (mt)	Black Sea Bass Discards (mt)
1985	43.8	0.4	4.8	38.9	7.7	59.1
1986	0.0	0.6	3.0	35.1	24.1	49.9
1987	51.8	0.2	19.3	42.7	24.0	71.0
1988	48.8	2.0	1.8	25.6	1.9	74.8
1989	13.0	4.7	2.4	48.1	9.8	54.4
1990	1.2	5.6	0.4	55.5	24.0	33.1
1991	21.6	3.3	2.7	85.3	28.3	49.0
1992	16.8	4.4	11.8	98.4	64.7	49.6
1993	34.2	3.6	12.2	62.2	40.2	43.2
1994	32.6	4.7	10.3	117.0	25.2	79.6
1995	26.6	8.6	5.9	123.3	38.9	57.4
1996	9.7	2.5	5.9	106.1	27.4	42.5
1997	7.3	2.5	9.9	147.1	18.4	65.6
1998	14.0	4.4	14.1	163.4	20.7	57.7
1999	88.5	17.7	7.3	194.8	30.7	77.2
2000	130.8	17.2	13.2	197.7	31.7	99.4

Year	Red Snapper Discards (mt)	Vermilion Snapper Discards (mt)	Mutton Snapper Discards (mt)	Gray Snapper Discards (mt)	Yellowtail Snapper Discards (mt)	Black Sea Bass Discards (mt)
2001	102.3	10.2	8.6	155.3	21.7	109.0
2002	63.7	8.2	14.9	171.5	20.9	79.4
2003	80.2	13.1	8.9	198.5	24.1	76.9

Table 61: Estimated yearly discards of red grouper, gag, greater amberjack, white grunt, crevalle jack and sheepshead in the South Atlantic recreational snapper-grouper fishery, 1985-2003 (NMFS, 2004c).

Year	Red Grouper Discards (mt)	Gag Discards (mt)	Greater Amberjack Discards (mt)	White Grunt Discards (mt)	Crevalle Jack Discards (mt)	Sheepshead Discards (mt)
1985	0.0	17.9	191.7	29.9	96.4	25.6
1986	0.2	26.7	175.7	53.3	301.0	16.1
1987	7.2	24.1	135.9	25.1	138.8	17.5
1988	1.5	13.9	91.4	3.7	163.0	32.9
1989	3.2	70.8	81.6	5.2	107.0	76.4
1990	7.5	23.1	76.7	10.3	134.8	28.3
1991	29.0	30.8	156.8	29.6	190.2	57.7
1992	9.6	34.4	146.0	52.7	196.9	67.8
1993	2.4	37.1	92.8	27.0	184.0	53.4
1994	4.8	86.2	61.0	26.3	279.4	98.4
1995	36.0	94.2	23.1	10.1	320.4	116.5
1996	31.0	67.4	126.4	16.7	318.7	97.6
1997	10.9	69.7	67.0	24.0	330.8	108.4
1998	20.5	35.7	42.2	34.0	367.3	131.7
1999	16.0	56.8	111.2	28.1	316.0	140.7
2000	32.2	137.3	128.2	17.1	361.1	141.1
2001	63.3	84.0	67.7	10.4	280.3	195.6
2002	16.4	136.6	154.2	10.3	241.4	146.8
2003	26.6	164.0	127.9	14.1	314.2	202.6

In summary, total commercial discards appear to be far less than the recreational discards. Commercial discards may be an slight underestimate because they do not include the black seabass pot fishery. In 2002, the most recent year for which commercial landings data were available, the total known discards from the commercial snapper-grouper fisheries were only 24.1 metric tons and total landings were 2,262 mt for a d/l ratio of only 0.011. However, recreational discards for 2003 amounted to 1,251 mt and 2003 recreational landings were 3,317 mt, giving a d/l ratio of 0.377. Overall, landings were 5,579 mt, and discards were 1,275 mt for a d/l ratio of 0.23.

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Dolphinfish and Wahoo Fishery of the South Atlantic

Major Target Species:	Dolphinfish (<i>Coryphaena hippurus</i> and <i>Coryphaena equiselis</i>), Wahoo (<i>Acanthocybium solandri</i>)
Major Discard Species:	Swordfish, Tunas, Sharks
Primary Gear Types:	Hook and line, Longline, Spear
Total Landings (2002):	5,588 mt
Total Discards (2002):	160 mt
Total Discards Rank (of 27):	26
Discard to Landings Ratio:	0.029
d/l Rank (of 27):	24
Source of Estimates:	NMFS, MRFSS, Authors
Discard Type:	Primarily non-target, regulatory
Notes:	Recreational discards do not include non-target species.

The FMP for the Dolphinfish and Wahoo Fishery of the Atlantic, developed by the South Atlantic Fishery Management Council, was enacted in January, 2003. It regulates the recreational and commercial sectors of the dolphinfish (common dolphinfish and pompano dolphinfish) and wahoo fisheries in the EEZ along the entire U.S. Atlantic coast. The management plan does not extend to dolphinfish or wahoo in the Gulf of Mexico. Currently, the status of the stocks is unknown (NMFS, 2004c). This fishery is almost entirely recreational.

Target landings

Landings of dolphinfish are close to 10 times those of wahoo (NMFS, 2004b) (Figure 41 and Figure 42). Landings of both species of dolphinfish are combined in most reports as the two species are almost indistinguishable. Recreational landings of both species have been increasing steadily over the past two decades, and while neither stock is overfished, they should be watched carefully. The commercial landings for both species are typically from longlines set with hooks, handlines or troll lines, while the recreational landings are typically from handlines.

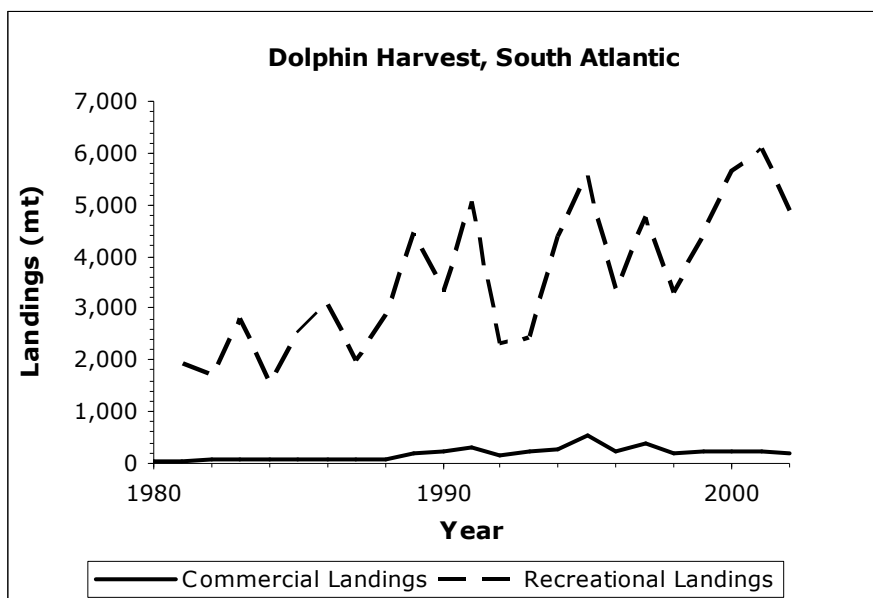


Figure 41: Commercial and recreational landings of dolphinfish in the South Atlantic (NMFS, 2004a; NMFS, 2004b).

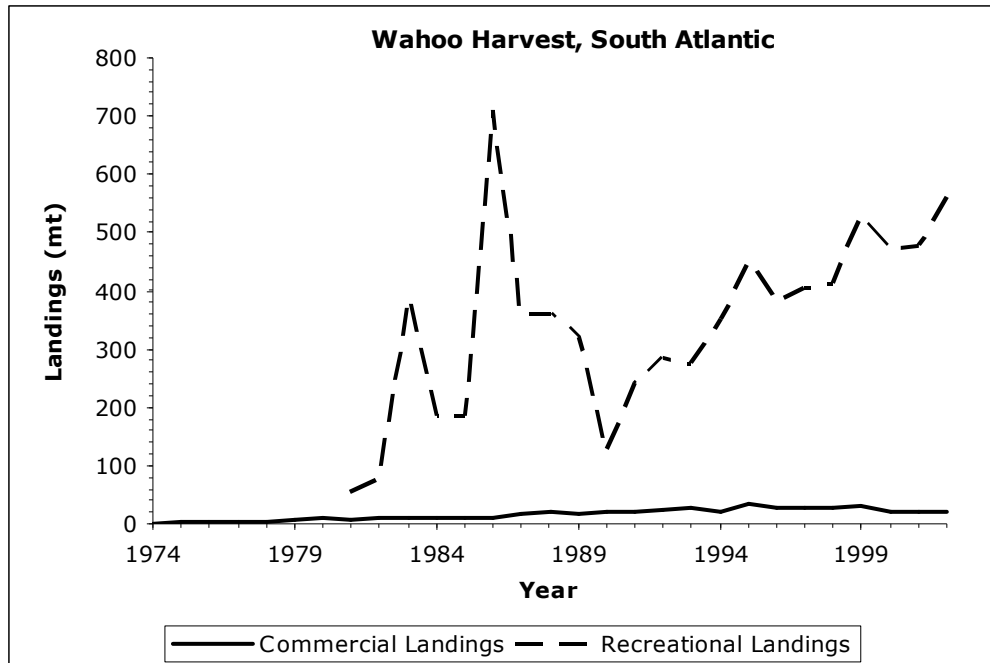


Figure 42: Commercial and recreational landings of wahoo in the South Atlantic (NMFS, 2004a; NMFS, 2004b).

Regulations

The FMP for dolphinfish and wahoo utilizes multiple management strategies including area closures, minimum fish size requirements, quotas, possession and landing limits and gear restrictions (NMFS, 2003j). It did not establish any new closures, but extended the time and area closures for the highly migratory species (HMS) pelagic longline fishery to include dolphinfish and wahoo.

The only minimum size requirement in this fishery exists for dolphinfish caught off of the coasts of Florida and Georgia. These fish must be at least 20 inches (51 cm) in fork length (FL). The fishing season for both dolphinfish and wahoo starts on January 1st each year. A quota of 1.5 million pounds (680 mt) was placed on dolphinfish. There is no quota established for wahoo. However, there are daily possession and landing limits for both dolphinfish and wahoo. The commercial landing limits for dolphinfish are lower north of the Florida/Georgia state line (1,000 pounds/day, 454 kg/day) than they are for dolphinfish south of the Florida/Georgia state line (3,000 pounds/day, 1.36 mt/day). These limits are listed in Table 62.

Table 62: Recreational and commercial possession/trip limits for dolphinfish and wahoo in the Atlantic.

Species (location)	Daily possession/trip limits	
	Recreational	Commercial
Dolphinfish (Atlantic)	10/person or 60/boat (excluding headboat)	3,000 pounds north of 31° N lat. (approximately the Florida-Georgia state line), 1,000 pounds south of 31° N lat.
Wahoo (Atlantic)	2/person	500 lbs (227 kg)

The allowable gears for the dolphinfish and wahoo fishery in the Atlantic are hook-and-line gear (including manual, electric, and hydraulic), handlines, longlines (except areas where longlines are prohibited to protect highly migratory pelagic species), and spearfishing.

Discards

The majority of the available discard data for dolphinfish and wahoo in the South Atlantic are regulatory target species discards from the recreational fishery. Limited information from the commercial pelagic longline fishery is also available. For the recreational fishery, the target species discard data are in numbers of fish: therefore the weight of the discards had to be estimated. The methodology for this estimation technique is described in the National Overview, but in general, species-specific mortality and weight-at-age data were used to arrive at an average weight per discarded fish (Castro et al., 1999; Oxenford, 1999). The result of these calculations estimates that the average weight of recreationally discarded dolphinfish is 0.198 kg, and the average weight of recreationally discarded wahoo is 0.528 kg. These calculations only considered sub-legal fish, as it is assumed that legal sized fish are retained. Multiplying these weights by the numbers of fish that were known to be discarded (NMFS, 2004b) gives an estimated weight of discards (Table 63).

Table 63: Recreational discards of dolphinfish and wahoo in the South Atlantic, 1981-2002.

Year	Number of Discarded Dolphinfish	Weight of Discarded Dolphinfish (mt)	Number of Discarded Wahoo	Weight of Discarded Wahoo (mt)
1981	28,587	5.7	0	0.0
1982	23,858	4.7	0	0.0
1983	0	0.0	428	0.2
1984	38,562	7.6	0	0.0
1985	1,688	0.3	0	0.0
1986	22,100	4.4	809	0.4
1987	27,928	5.5	2,422	1.3
1988	22,876	4.5	376	0.2
1989	159,559	31.6	0	0.0
1990	54,081	10.7	0	0.0
1991	149,001	29.5	40	0.0
1992	102,561	20.3	4,510	2.4
1993	60,892	12.1	0	0.0
1994	95,763	19.0	2,422	1.3
1995	73,778	14.6	2,456	1.3
1996	103,586	20.5	2,903	1.5
1997	96,042	19.0	970	0.5
1998	78,284	15.5	1,444	0.8
1999	152,687	30.2	2,904	1.5
2000	239,233	47.4	531	0.3
2001	233,841	46.3	636	0.3
2002	80,886	16.0	1,263	0.7

In Table 63, some years have zero for the number of fish discarded, which is highly improbable. However, as the data become more recent, they also become more reliable. In 2000, NMFS redesigned their survey methods for assessing and estimating recreational catch and discards.

Commercially, dolphinfish and wahoo are targeted primarily with pelagic longlines, handlines and troll-lines, but discard data are only available from pelagic longlines. In 2001, 166.34 mt of dolphinfish was caught on pelagic longlines. This represents three percent of the total pelagic longline catch, which was 5,715.68 mt. Only 43.19 mt of wahoo was caught in 2001, and it was estimated to comprise just 0.8 percent of the total catch (NMFS, 2002; NMFS, 2003a; NMFS, 2003b) (Table 64). These percentages are small, but they are the fourth and seventh most commonly caught species in the pelagic longline fishery, respectively. Therefore, any species discarded in the pelagic longline fishery could potentially be counted as discards in the dolphin/wahoo fishery of the South Atlantic. Table 64 gives discard amounts for the entire pelagic longline fishery. Table 65 gives discards amounts which have been calculated for just the dolphinfish and wahoo pelagic longline fishery. This was done by multiplying the discard amounts by 0.038, the proportion of dolphinfish and wahoo pelagic longline landings to total pelagic longline landings.

Table 64: Predicted weights of landings and discards in the entire 2001 South Atlantic pelagic longline fishery. These estimates are based on observer data from 1992-2000 (NMFS, 2002; NMFS, 2003a; NMFS, 2003b).

Species	2001 Predicted mt Landed	2001 Predicted mt Discarded	2001 Predicted mt Discarded Dead
Swordfish	2606.4	582.3	435.0
Yellowfin tuna	1700.2	110.2	45.9
Bigeye tuna	701.3	57.2	24.6
Dolphinfish spp.	166.3	6.5	1.4
Albacore tuna	147.6	23.3	17.6
Shortfin mako	100.9	44.1	13.4
Wahoo	43.2	5.8	4.7
Mako spp.	39.0	17.1	4.9
Escolar	84.4	53.6	26.7
Silky shark	33.5	162.5	101.0
Bluefin tuna	28.9	131.8	79.2
Sandbar shark	8.4	40.5	6.9
Oilfish	15.3	9.7	3.6
Scalloped hammerhead	6.6	32.1	18.2
Hammerhead spp.	5.9	28.8	12.4
Whitetip oceanic	6.6	30.8	9.3
Blackfin tuna	5.0	13.6	8.9
Skates/rays	2.4	115.6	0.9
Skipjack tuna	2.6	7.1	6.6
Blacktip shark	1.4	6.7	4.5
Common thresher	1.7	8.1	2.4
Great hammerhead	1.0	4.9	2.9
Little tunny	1.3	3.7	2.8
Bull shark	0.4	2.1	0.7
Thresher shark	0.6	3.0	1.1
Porbeagle shark	0.6	2.8	1.2
Spinner shark	0.3	1.2	0.4
Atlantic sharpnose shark	0.2	1.9	1.0
Bonito	0.3	0.7	0.6
Smooth hammerhead	0.1	0.3	0.2
Lemon shark	0.0	0.1	0.0
Nurse shark	0.0	0.1	0.0
Atlantic sailfish	0.0	71.7	42.5
Blue marlin	0.0	124.0	43.8
White marlin	0.0	205.2	95.5
Longnose spearfish	0.0	6.2	3.9
Roundscale spearfish	0.0	1.1	0.9
Spearfish spp.	0.0	5.6	2.7
Lancetfish spp.	0.0	25.7	18.5
Blue shark	0.0	1574.9	249.8
Dusky shark	0.0	112.6	45.5
Night shark	0.0	31.8	24.6
Bigeye thresher shark	0.0	38.9	16.2

Since dolphinfish and wahoo contribute 3.8% of the pelagic longline landings, we assumed that they also contribute 3.8% of the discards in order to make an estimate. Table 65 displays the discards for just the dolphinfish and wahoo fishery. The discard estimates for certain species may be over or under the actual amount discarded because there is no information on targeting. It could be very different from what swordfish fishermen are catching. It does appear that swordfish constitutes the highest bycatch of a non-target species.

Table 65: Predicted weights of discards in the 2001 South Atlantic pelagic longline fishery targeting dolphinfish and wahoo. These estimates are based on observer data from 1992-2000 (NMFS, 2002; NMFS, 2003a; NMFS, 2003b).

Species	2001 Predicted mt discarded	2001 Predicted mt discarded dead
Swordfish	22.13	16.53
Yellowfin tuna	4.19	1.75
Bigeye tuna	2.17	0.93
Dolphinfish spp.	0.25	0.05
Albacore tuna	0.89	0.67
Shortfin mako	1.68	0.51
Wahoo	0.22	0.18
Mako spp.	0.65	0.19
Escolar	3.85	1.92
Silky shark	6.18	3.84
Bluefin tuna	5.01	3.01
Sandbar shark	1.54	0.26
Oilfish	0.70	0.26
Scalloped hammerhead	1.22	0.69
Hammerhead spp.	1.10	0.47
Whitetip oceanic	1.26	0.38
Blackfin tuna	0.58	0.38
Skates/rays	4.39	0.04
Skipjack tuna	0.31	0.28
Blacktip shark	0.25	0.17
Common thresher	0.33	0.10
Great hammerhead	0.18	0.11
Little tunny	0.16	0.12
Bull shark	0.08	0.03
Thresher shark	0.12	0.05
Porbeagle shark	0.12	0.05
Spinner shark	0.05	0.02
Atlantic sharpnose shark	0.07	0.04
Bonito	0.03	0.03
Smooth hammerhead	0.01	0.01
Lemon shark	0.00	0.00
Nurse shark	0.00	0.00
Atlantic sailfish	2.73	1.62
Blue marlin	4.71	1.66
White marlin	7.80	3.63
Longnose spearfish	0.23	0.15
Roundscale spearfish	0.04	0.03
Spearfish spp.	0.21	0.10
Lancetfish spp.	0.98	0.70
Blue shark	59.85	9.49
Dusky shark	4.28	1.73
Night shark	1.21	0.94
Bigeye thresher shark	1.48	0.62
Total	143.20	53.71

In summary, in 2002, there were approximately 4,816 mt of dolphinfish and 562 mt of wahoo landed in the recreational fishery. There were 16.02 and 0.67 mt of dolphinfish and wahoo discarded in that fishery, respectively. In addition, in the commercial longline fishery targeting dolphinfish and wahoo in 2001, only approximately 210 mt of dolphinfish and wahoo (combined) were landed and there were at least 143 mt of total discards (more than half of which were night sharks and swordfish), 36% of which was discarded dead. Overall, for the recreational and commercial fisheries combined, there were 5,588 mt of dolphinfish and wahoo landed, and 160 mt of discards, for a d/l ratio of 0.029. This is a low estimate of discards, however, as only target species discards are known for the commercial fishery.

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Shrimp Fishery of the Gulf of Mexico

Major Target Species:	Brown shrimp (<i>Penaeus aztecus</i>), Pink shrimp (<i>Penaeus duorarum</i>), White shrimp (<i>Penaeus vannamei</i>), Royal red shrimp (<i>Pleoticus robustus</i> or <i>Hymenopenaeus robustus</i>), Rock shrimp (<i>Sicyonia brevirostris</i>), Seabob shrimp (<i>Xiphopenaeus kroyeri</i>)
Major Discard Species:	Snappers, Mackerel, Atlantic croaker (<i>Micropogonias undulatus</i>), Crabs, Porgies
Primary Gear Types:	Bottom otter trawl
Total Landings (2002):	103,671 mt
Total Discards (2002):	472,643 mt
Total Discards Rank (of 27):	1
Discard to Landings Ratio:	4.56
d/I Rank (of 27):	1
Source of Estimates:	NMFS, Independent research studies, Authors
Discard Type:	Primarily non-target, regulatory
Notes:	This is an estimate of bycatch, not discards.

The FMP for the Gulf of Mexico Shrimp Fishery includes brown, pink, white, royal red, rock and seabob shrimp, and is managed by the GMFMC. The FMP was first created in May of 1981, but this extensive and valuable fishery has been active since the late 1800's (NMFS, 1999). According to the stock status report, brown, pink, and white shrimp are not overfished, and overfishing is not occurring for those species. Overfishing is also not occurring in the royal red shrimp fishery. However, it has not been determined whether royal red, rock or sheabob shrimp are overfished or if overfishing is occurring in the rock and seabob shrimp fisheries (NMFS, 2004a).

Target landings

Total landings of shrimp in the Gulf are almost ten times the total landings of shrimp in the South Atlantic. However, the landings in the Gulf are not evenly distributed among species. Brown, pink and white shrimp account for close to 90% of the total landings, while rock shrimp, seabob shrimp and royal red shrimp account for the other ten percent (NMFS, 2004b) (Figure 43).

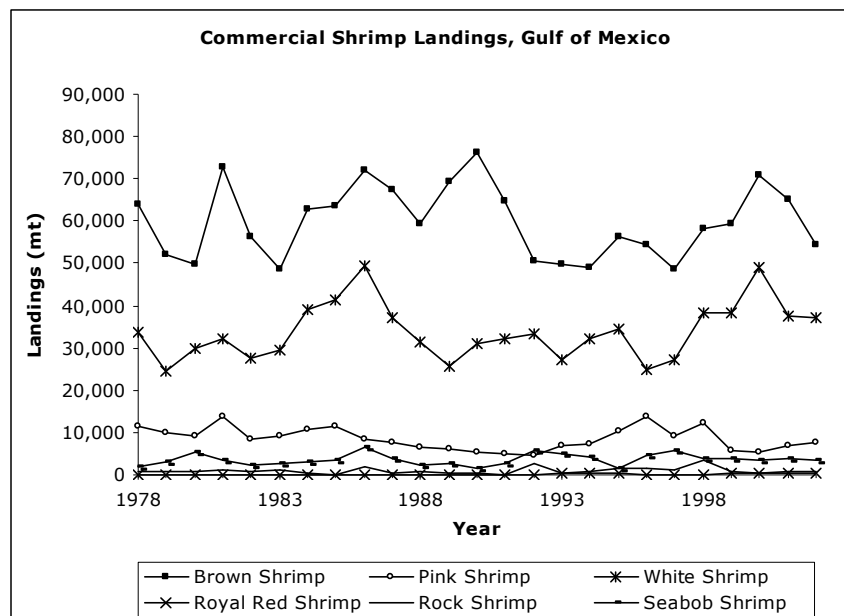


Figure 43: Commercial landings of six species of shrimp in the Gulf of Mexico.

The bottom otter trawl is used almost exclusively to fish for shrimp in the Gulf of Mexico (Figure 44) (NMFS, 2004b). Occasionally, shrimp landings are reported from unspecified trawls (possibly beam trawls) and butterfly nets, and some of these landings are likely the result of bycatch from other fisheries.

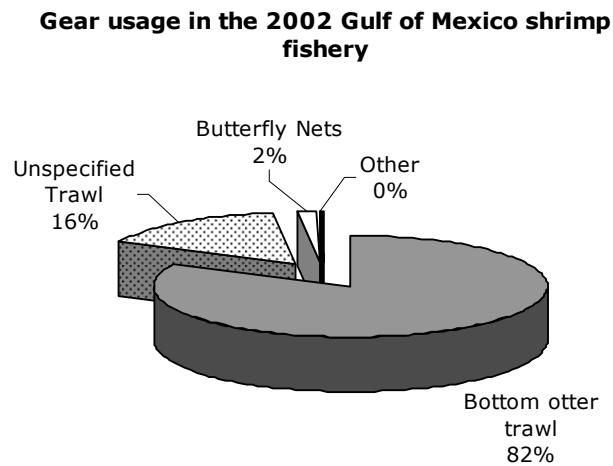


Figure 44: Gear usage in the 2002 Gulf of Mexico shrimp fishery. Otter trawls account for a large percentage of the catch.

Regulations

In the Gulf of Mexico, the shrimp fishery is regulated using numerous area and seasonal closures, quotas, and gear regulations such as the use of turtle excluder devices (TEDs) and bycatch reduction devices (BRDs). In the Gulf of Mexico, TED regulations went into effect year-round in 1991, and BRD regulations in 1999 (CCAF, 2005; SCDNR, 2005). The only size limitation is that white shrimp taken in the EEZ and transported to Louisiana must comply with the state's minimum size limit (NMFS, 2003). The area and seasonal closures are intended to protect small shrimp and limit conflict with the crab trap fishery. Federal and state waters are closed off the coast of Florida from May 1 through July 15, the Tortugas Shrimp Sanctuary which was established under the original FMP to protect young pink shrimp, and there is a seasonal closure off Texas for brown shrimp. Only royal red shrimp has a quota, set in 2004 at 177.8 mt tail weight. Once that quota is reached, the season closes and possession of royal red shrimp is prohibited. Royal red shrimp also are not allowed to be caught in traps, and cannot be transferred-at-sea. Allowable gears in the commercial fishery are trawl nets, butterfly nets, skimmers and cast nets. TEDs and BRDs are required on all shrimp trawls. In federal waters, TEDs are required on every vessel and they must be able to exclude 97% of turtles from the trawls. In the Gulf of Mexico, the minimum size requirement for the TED opening is 35 x 20 inches to allow for the escape of leatherback turtles (NMFS, 2003).

Discards

Bycatch estimates before BRD requirements

In the shrimp fisheries, generally total bycatch of finfish is reported, but not the disposition (landed or discarded) of that bycatch the numbers reported here therefore refer to total bycatch. The shrimp fisheries in the Gulf of Mexico and the South Atlantic have been a focal point for bycatch management because of controversial issues surrounding turtle and red snapper discards and bycatch from shrimp trawls. Substantial finfish bycatch is discarded with the potential to affect stock status or reduce directed fishery yields. The most recent publication on shrimp bycatch reported total finfish bycatch in weight, and individual species bycatch in numbers of fish (Table 66) (NMFS, 1998).

Table 66: Total finfish bycatch (mt) and bycatch of several key species (millions of fish) in the Gulf of Mexico shrimp trawl fishery prior to full implementation of BRD regulations (NMFS, 1998).

Year	Total shrimp landings (mt)	Total finfish bycatch (mt)	Atlantic croaker bycatch	Longspine porgy bycatch	Cobia bycatch	Red snapper bycatch	King mackerel bycatch	Spanish mackerel bycatch	Red drum bycatch
1972	NA	668,784	17,277	4,296	0.080	64.6	0.816	2.45	0.075
1973	NA	539,474	28,679	1,123	0.022	23.1	0.309	2.07	0.079
1974	NA	421,960	20,003	906	0.148	17.2	0.374	1.63	0.091
1975	NA	541,289	44,834	1,042	0.093	15.3	0.288	1.53	0.100
1976	NA	601,180	31,484	1,740	0.093	23.4	0.325	2.31	0.196
1977	NA	375,681	12,285	3,822	0.057	24.5	0.303	2.77	0.147
1978	111,764	554,446	19,609	3,955	0.092	22.2	0.552	3.40	0.086
1979	90,583	464,610	18,426	2,839	0.191	22.4	0.631	3.44	0.251
1980	95,309	465,971	23,978	960	0.138	34.2	0.378	4.22	0.106
1981	123,206	410,163	10,153	2,985	0.070	34.3	0.372	2.55	0.095
1982	95,084	457,350	11,703	3,161	0.113	33.9	0.369	2.84	0.120
1983	91,001	351,180	15,488	2,518	0.214	21.3	0.342	2.57	0.316
1984	116,248	540,835	21,911	3,269	0.116	16.5	0.521	2.78	0.104
1985	119,896	434,664	24,349	2,492	0.231	20.3	0.443	2.78	0.061
1986	138,639	269,964	7,099	5,869	0.064	19.1	0.375	2.89	0.142
1987	116,516	293,557	7,409	4,670	0.128	24.2	0.858	3.37	0.200
1988	100,760	259,982	8,121	4,168	0.055	23.0	0.648	3.87	0.218
1989	104,060	264,519	9,702	2,355	0.116	27.8	1.314	4.13	0.198
1990	114,829	334,392	9,875	1,936	0.129	53.8	0.879	3.72	0.146
1991	104,281	338,022	19,381	2,137	0.202	47.5	1.102	4.13	0.125
1992	97,250	322,595	24,981	7,722	0.226	30.7	0.586	5.07	0.221
1993	89,765	264,065	10,795	3,559	0.292	34.9	1.055	4.75	0.171
1994	93,679	298,094	10,512	4,923	0.287	43.1	0.989	3.03	0.193
1995	104,299	303,993	8,244	4,350	0.207	45.2	1.105	2.73	0.233
1996	99,582	284,029	6,747	7,738	0.310	36.8	0.617	2.76	0.184
1997	91,963	347,550	8,200	7,196	0.374	41.7	0.742	2.59	0.320

The average bycatch to shrimp landings ratio from 1991-1997 (3.2) and the 2002 commercial shrimp landings (103,671 mt) were then used to find the 2002 total finfish bycatch. This method produces an estimate of 331,747 mt of finfish bycatch in 2002. This estimate uses data collected prior to the full implementation of BRDs. Only data from 1991-1997 were used to calculate the b/l ratio because 1991 was the first year in which TEDs were required year-round (SCDNR, 2005).

Nance et al. (1997) reported that on average, 28 kg (0.028 mt) of organisms were caught during a one-hour tow in the Gulf of Mexico. This estimate is based on data from over 4,000 observed tows (Nance et al., 1997; NMFS, 1998). The average composition of this catch was 67% finfish, 16% commercial shrimp, 13% non-commercial shrimp and 4% non-crustacean invertebrates (NMFS, 1998) (Table 67). Thus, 84% of the catch by weight is non-targeted bycatch, and on average, four kg of finfish were caught for every one kg of commercial shrimp prior to full implementation of BRD regulations (NMFS, 1998). The bycatch of each of the species groups was calculated using the total commercial shrimp catch in 2002 and the percent of total catch (Table 67).

Table 67: Catch composition of the 2002 Gulf of Mexico shrimp fishery, estimated with data collected prior to full implementation of BRDs (NMFS, 1998).

	Commercial shrimp	Finfish	Non-commercial shrimp	Non-crustacean invertebrates	Total bycatch
Percent of Total Catch (%)	16%	67%	13%	4%	84%
2002 Total Catch (mt)	103,671*	434,122	84,233	25,918	544,273

* Actual landings of commercial shrimp (NMFS, 2004b).

In addition to the bycatch of finfish species in Table 66 and total bycatch in Table 67, Nance et al. (1997) found a wide range of other species in bycatch of the shrimp trawl fishery (Table 68). However, we are unable to quantitatively estimated total bycatch weights of these additional species.

Table 68: Average percent catch compositions by weight for a one hour tow by state and area in the Gulf of Mexico from February 1992 through December 1996 (Nance et al., 1997).

State	Nearshore (<10 fms) percent catch composition by weight	Offshore (>10 fms) catch composition by weight
Florida, west coast	Pink shrimp – 18% Iridescent swimming crab – 9% Leopard sea robin – 6% Sand perch – 6% Brown rock shrimp – 4% Orange filefish – 3% Bigeye mojarra – 3% Mantis shrimp – 3% Blotched swimming crab – 2% Pinfish – 2% Other 42%	Pink shrimp – 19% Blotched swimming crab – 8% Shoal flounder – 7% Inshore lizardfish – 5% Dusky flounder – 5% Clearnose skate – 3% Scrawled cowfish – 3% Sand perch – 3% Bandtail pufferfish – 2% Smoothhead scorpionfish – 2% Other – 42%
Alabama and Mississippi	Atlantic croaker – 34% Brown Shrimp – 11% Sand seatrout – 7% Lesser blue crab – 7% Spot – 6% Hardhead catfish – 4% Mantis shrimp – 3% Fringed flounder – 3% Southern kingfish – 3% White shrimp – 2% Other – 21%	Longspine porgy – 16% Inshore lizardfish – 5% Atlantic croaker – 5% Bigeye searobin – 5% Mantis shrimp – 4% Longspine swimming crab – 4% Lesser blue crab – 4% Rock seabass – 4% Brown shrimp – 4% Sand seatrout – 4% Other 47%
Louisiana	Atlantic croaker – 19% White shrimp – 12% Gulf menhaden – 9% Longspine porgy – 8% Brown shrimp – 8% Hardhead catfish – 7% Blue crab – 3% Cutlassfish – 3% Gulf butterfish – 2% Sand seatrout – 2% Other – 27%	Longspine porgy – 15% Inshore lizardfish – 10% Brown shrimp 9% Atlantic croaker – 8% Sand seatrout – 4% Rock seabass – 3% Bigeye searobin – 3% Lesser blue crab – 3% Longspine swimming crab – 3% Gulf butterfish – 3% Other - 39%
Texas	Atlantic croaker – 14% Gulf butterfish – 13% Brown shrimp – 7% Longspine porgy – 6% White shrimp – 6% Cutlassfish – 6% Atlantic bumper – 4% Spot – 4% Sugar/Blood shrimp – 3% Southern kingfish – 2% Other - 35%	Longspine porgy – 16% Brown shrimp – 16% Atlantic croaker – 9% Inshore lizardfish – 7% Lesser blue crab – 6% Gulf butterfish – 3% Sugar/Blood shrimp – 3% Brown rock shrimp – 2% Spot – 2% Shoal flounder – 2% Other – 32%

The bycatch estimates in Table 67 are the most comprehensive for finfish and non-fish bycatch prior to the implementation of BRDs.

Bycatch estimates adjusted for BRD reduction rates

Since 1997, many TED and BRD regulations have been enacted changing the size, shape and location of TED openings, and introducing new and improved TED and BRD designs (SCDNR, 2005). Two studies of the effectiveness of BRDs have reported average finfish bycatch reduction rates of 43% (Fuls and McEachron, 1998) and 45% (NMFS, 1998). These rates are the average of the reductions by the Jones/Davis (58%), Fisheye (37% or 44%) and Extended Funnel (35% or 32%) BRDs. However, a more recent report incorporating additional research (NOAA, 2004) reveals that the actual bycatch reduction rate is much lower. The Gulf Fisheye BRD is the main BRD used by the fleet, due to its small reduction in shrimp catch. Other certified BRDs are not widely used by the shrimp fleets because of the larger reduction in shrimp catch that they produce. According to the report, the Gulf Fisheye BRD produces only a 16.5% reduction in finfish bycatch (NOAA, 2004), an amount much smaller than the 37% reduction by the Gulf Fisheye BRD that was indicated in 1998 (NMFS, 1998).

If the reduction of 16.5% is applied to our finfish bycatch estimates, the total finfish bycatch estimate from Table 67 (544,273 mt) is reduced to 472,643 mt. The 16.5% reduction was only applied to the finfish portion of the bycatch in Table 67 as we have no estimates for the reduction rates for non-commercial shrimp and non-crustacean invertebrates. The resulting estimate of total bycatch after BRDs were required is 472,643 mt (362,492 mt finfish, 25,918 mt non-crustacean invertebrates, 84,233 mt non-commercial shrimp) with the total 2002 commercial shrimp landings are 103,671 mt to give an overall b/l ratio of 4.56.

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Reef Fish Resources of the Gulf of Mexico

Major Target Species:	Red snapper (<i>Lutjanus campechanus</i>), Red grouper (<i>Epinephelus morio</i>), Greater amberjack (<i>Seriola dumerili</i>), Vermilion snapper (<i>Rhomboplites aurorubens</i>), Gag grouper (<i>Mycteroperca microlepis</i>), Gray triggerfish (<i>Balistes capricus</i>), Mutton snapper (<i>Lutjanus analis</i>), Gray snapper (<i>Lutjanus griseus</i>), Lane snapper (<i>Lutjanus synagris</i>), Yellowtail snapper (<i>Ocyurus chrysurus</i>), Yellowedge grouper (<i>Epinephelus flavolimbatus</i>), Snowy grouper (<i>Epinephelus niveatus</i>), Black grouper (<i>Mycteroperca bonaci</i>), Scamp (<i>Mycteroperca phenax</i>)
Major Discard Species:	Skates, Toadfish, Barracudas, Sharks
Primary Gear Types:	Hook and line, Longline, Pot, Trap
Total Landings (2002):	17,376 mt
Total Discards (2002):	7,210 mt
Total Discards Rank (of 27):	14
Discard to Landings Ratio:	0.41
d/I Rank (of 27):	12
Source of Estimates:	NMFS, Observer data, Logbook data, MRFSS, Authors
Discard Type:	Primarily target, regulatory
Notes:	Recreational non-target species discards are unknown

The FMP for the Reef Fish resources of the Gulf of Mexico includes 14 major species and 28 minor species. Stock assessment data are limited for this fishery, and stock status is available for only five of the 14 major species: red snapper, red grouper, greater amberjack, vermilion snapper and gag (Table 69) (NMFS, 2002; NMFS, 2004a). Two minor species, Nassau grouper and goliath grouper (Jewfish), were once common, but are now overfished.

Table 69: Major stocks contained within the Gulf of Mexico reef fish resources fishery management plan and their current stock status. (NMFS, 2004a)

Stock	Current Stock Status	
	Overfishing?	Overfished?
Red snapper*	Yes	Yes
Red grouper*	Yes	Yes
Greater amberjack*	No	Yes
Vermilion snapper*	Yes	Unknown
Gag grouper*	No	No
Gray triggerfish*	Unknown	Unknown
Mutton snapper*	Unknown	Unknown
Gray (mangrove) snapper*	Unknown	Unknown
Lane snapper	Unknown	Unknown
Yellowtail snapper*	Unknown	Unknown
Yellowedge grouper	Unknown	Unknown
Snowy grouper	Unknown	Unknown
Black grouper	Unknown	Unknown
Scamp	Unknown	Unknown

* Fisheries which have a recreational component.

Target landings

All 14 major species are targeted commercially and recreationally, but recreational landings are recorded for only nine of these species by the Marine Recreational Fisheries and Statistics Survey (MRFSS) (NMFS, 2004b; NMFS, 2004c). Recreational landings are larger than the commercial landings for some species (Figure 45-Figure 48) (NMFS, 2004b; NMFS, 2004c). The primary gear type used is hook and line (NMFS, 2004b).

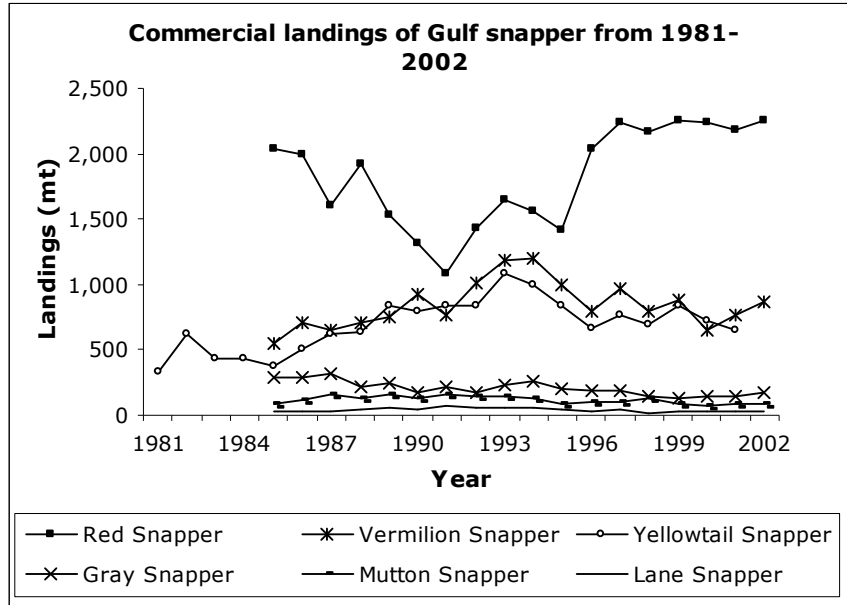


Figure 45: Commercial landings of snapper and from the Gulf of Mexico, 1981-2002.

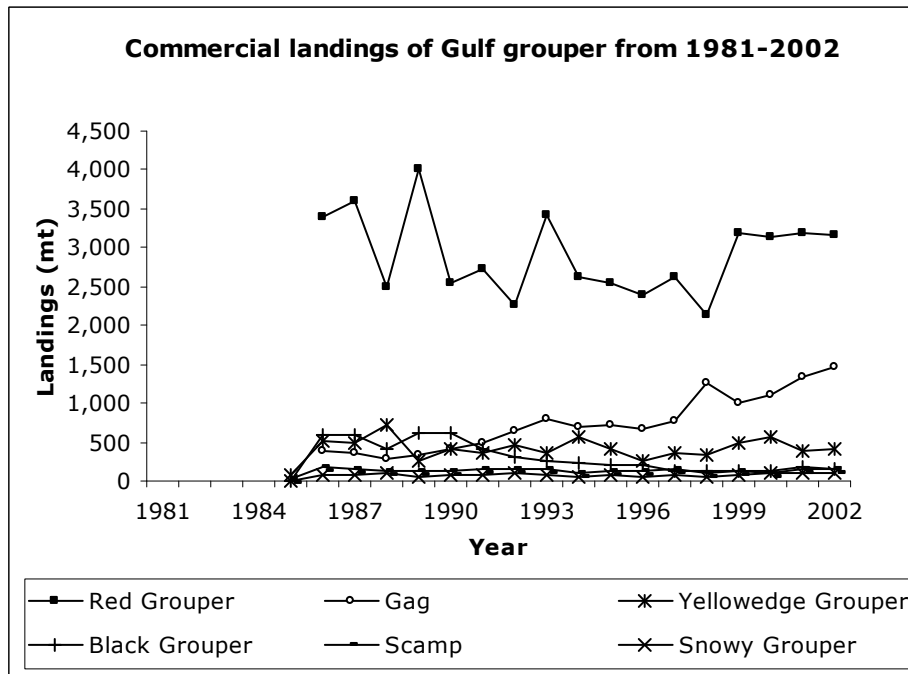


Figure 46: Commercial landings of grouper from the Gulf of Mexico, 1981-2002.

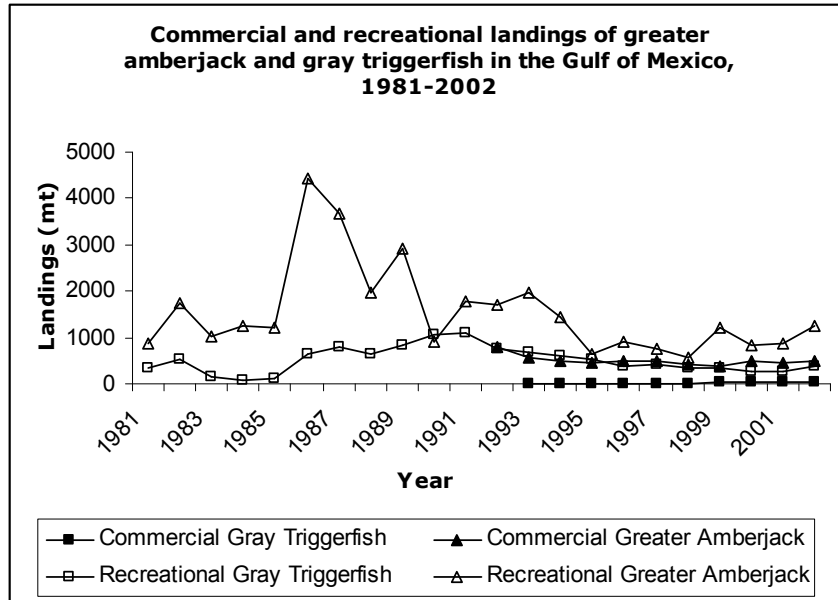


Figure 47: Commercial and recreational landings of gray triggerfish and greater amberjack from the Gulf of Mexico, 1981-2002.

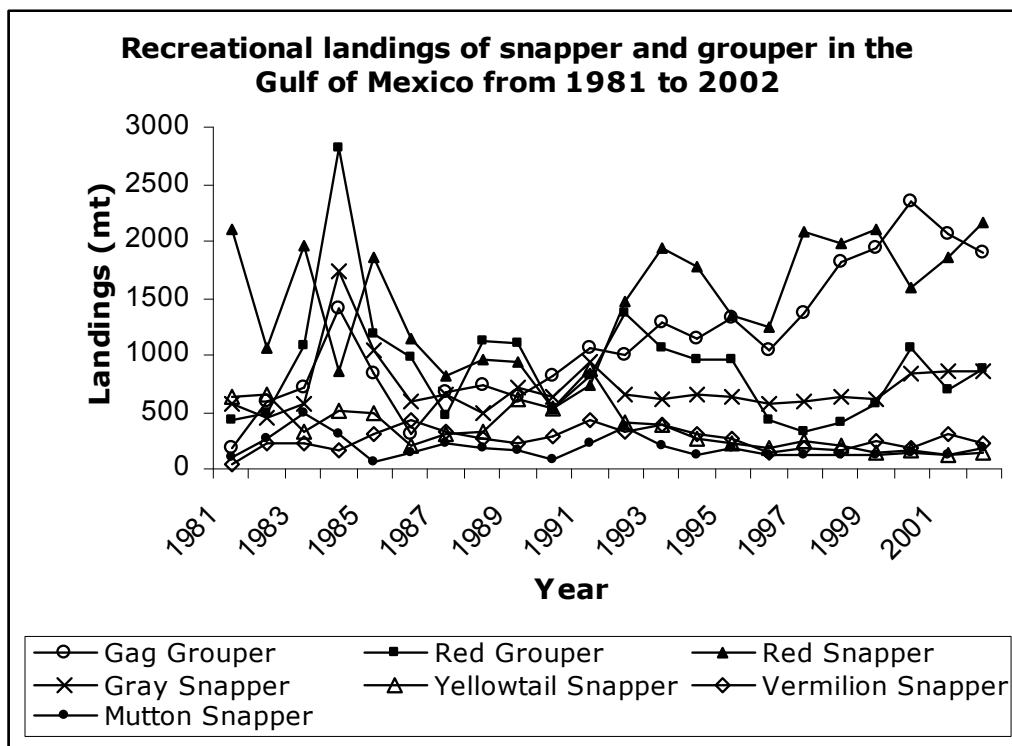


Figure 48: Recreational landings of snapper and grouper from the Gulf of Mexico, 1981-2002.

Yellowtail snapper, vermilion snapper and red grouper were the only fisheries to have higher commercial landings than recreational landings. All of the other species had equal if not higher landings in the recreational sector. Of the commercial fisheries, red snapper and red grouper are the most sought after

species (Figure 45 and Figure 46), and recreationally, red snapper is the most sought after species (Figure 48), followed by greater amberjack (Figure 47).

According to 2002 Gulf of Mexico logbook data, hook and line gear is responsible for 61% of all commercial snapper and grouper landings, longline is responsible for 34%, and trap gear only lands 5% of total commercial landings.

Regulations

Of all the species in this FMP, red snapper are managed with the most regulations. Commercially, regulations include minimum fish sizes (Table 70), trip limits (Class I - 2,000 lbs/trip, Class II - 200 lbs/trip) and quotas (4.65 million lbs total). The red snapper fishery is closed from November 1st at 12:01 AM until April 21st at 12:01 AM (GMFMC, 2003b). For the rest of the snappers: vermilion, lane, gray, mutton and yellowtail, the only commercial regulation is a minimum size limit (Table 70).

Table 70: Minimum fish sizes for the commercial reef fish resources of the Gulf of Mexico (GMFMC, 2003a).

Species	Minimum Total Length (inches)
Red snapper	15
Vermilion snapper	10
Lane snapper	8
Gray snapper	12
Mutton snapper	16
Yellowtail snapper	12
Black grouper	24
Gag	24
Red grouper	20
Scamp	16
Gray triggerfish	12
Greater amberjack	36 (fork length)

Red grouper also has a separate quota (5.31 million pounds gutted weight), and landings of red grouper count toward the shallow-water grouper quota as well. The shallow-water groupers include black grouper, gag grouper, red grouper and scamp. Shallow-water groupers are regulated with minimum sizes (Table 70), a quota (8.8 million pounds gutted weight) and a seasonal closure from February 15th to March 15th. For the deep-water grouper in the management plan, snowy and yellowedge, there is a 1.02 million pound gutted weight quota and no minimum size. Scamp is included in the deep-water designation after the shallow-water grouper quota is filled. Gray triggerfish and greater amberjack have minimum size limits (Table 70) and greater amberjack has an additional closed season during the months of March, April and May (GMFMC, 2003a). Tilefish, a minor species in the FMP, has a quota of 0.44 million pounds gutted weight. All of the quotas given are for the 2003 fishing year. The recreational regulations consist of minimum size limits for 12 of the 14 species (Table 71) and daily bag limits for all 14 (Table 72).

Table 71: Minimum fish sizes for the recreational reef fish resources of the Gulf of Mexico (GMFMC, 2003b).

Species	Minimum Total Length (inches)
Red snapper	16
Vermilion snapper	10
Lane snapper	8
Gray snapper	12
Mutton snapper	16
Yellowtail snapper	12
Black grouper	22
Gag grouper	22
Red grouper	20
Scamp	16
Gray triggerfish	12
Greater amberjack	28 (fork length)

Table 72: Daily bag limits for the recreational reef fish reef resources of the Gulf of Mexico (GMFMC, 2003b).

Species	Daily Bag Limit
Red snapper	4 per person
Vermilion snapper	Included in 20 reef fish aggregate limit ¹
Lane snapper	Included in 20 reef fish aggregate limit
Gray snapper	Included in 10 per person aggregate snapper limit ²
Mutton snapper	Included in 10 per person aggregate snapper limit
Yellowtail snapper	Included in 10 per person aggregate snapper limit
Yellowedge grouper	5 per person in aggregate of all groupers ³
Snowy grouper	5 per person in aggregate of all groupers
Black grouper	5 per person in aggregate of all groupers
Gag grouper	5 per person in aggregate of all groupers
Red grouper	2 per person within the 5 fish aggregate grouper bag limit
Scamp	5 per person in aggregate of all groupers
Gray triggerfish	Included in 20 reef fish aggregate limit
Greater amberjack	1 per person

1. The reef fish aggregate includes vermilion and lane snappers, gray triggerfish, goldface tilefish, almaco jack, tilefish, and anchor, blackline and blueline tilefish. (GMFMC, 2003b)

2. The snapper aggregate includes all snapper except red snapper, vermilion snapper and lane snapper, (GMFMC, 2003b).

3. The grouper aggregate include all groupers except jewfish and Nassau grouper, (GMFMC, 2003b).

Discards

Commercial fishery

There is a large amount of discard data for the commercial longline, handline and fish trap fisheries from the early 1990s (NMFS, 1995; NMFS, 1996). However, the catch and discard data are presented in numbers of fish. Additional weight data were obtained to complete the conversion of the longline and trap data (Table 73 and Table 75) from numbers to weights and the expansion of the data from the study to the entire longline and trap fisheries (Scott-Denton, 2004). The handline observer data were expanded to the entire fishery (Table 74) using logbook effort (McCarthy, 2004).

Table 73: Discards from the snapper-grouper longline fishery in the Gulf of Mexico (2001-2003). Discards are in metric tons.

Species	2001	2002	2003
Red grouper	415.2	381.1	379.6
Clearnose skate	12.3	11.2	11.2
Leopard toadfish	7.7	7.1	7.0
Great barracuda	7.5	6.9	6.8
Blacknose shark	4.2	3.9	3.8
Reticulate moray	3.0	2.7	2.7
Scamp	1.7	1.6	1.6
Nurse shark	1.2	1.1	1.1
Sharksucker	1.2	1.1	1.1
Spotted moray	0.8	0.7	0.7
Spinycheek scorpionfish	0.8	0.7	0.7
Yellowedge grouper	0.6	0.6	0.6
Longspine squirrelfish	0.5	0.5	0.5
Speckled hind	0.5	0.4	0.4
Florida smoothhound shark	0.4	0.3	0.3
Inshore lizardfish	0.1	0.1	0.1
Chain dogfish	0.1	0.1	0.1
Bank seabass	0.1	0.1	0.1
Sand perch	0.0	0.0	0.0
Pale spotted eel	0.0	0.0	0.0
Margintail conger	0.0	0.0	0.0
Total	457.8	420.3	418.6

**Table 74: Discards from the snapper-grouper handline fishery in the Gulf of Mexico (2002-2004).
Discards are in metric tons.**

Species	2002 Discards (mt)	2003 Discards (mt)	2004 Discards* (mt)
Red grouper	216.6	219.9	117.0
Red snapper	29.9	30.4	16.2
Gag	8.5	8.6	4.6
Jewfish	4.1	4.1	2.2
Little tunny	2.0	2.1	1.1
Tiger shark	1.8	1.9	1.0
Clearnose skate	1.8	1.8	1.0
Leopard toadfish	1.1	1.1	0.6
Silver seatrout	0.7	0.7	0.4
Scamp	0.6	0.6	0.3
Reticulated moray	0.5	0.5	0.3
Sand tilefish	0.5	0.5	0.3
Spotted moray	0.4	0.4	0.2
Guaguanche barracuda	0.3	0.3	0.2
Gray snapper	0.3	0.3	0.2
Vermilion snapper	0.3	0.3	0.2
Sand diver	0.2	0.2	0.1
Gray triggerfish	0.2	0.2	0.1
Lane snapper	0.2	0.2	0.1
Blue runner	0.1	0.1	0.0
Pinfish	0.1	0.1	0.0
Tomtate	0.0	0.0	0.0
Total	270.2	274.3	145.9

*2004 discard values are only current through September 2004.

**Table 75: Discards from the snapper-grouper trap fishery in the Gulf of Mexico (2001-2003).
Discards are in metric tons.**

Species	2001	2002	2003
Red grouper	123.15	74.14	100.15
White grunt	7.08	4.26	5.76
Sand perch	6.77	4.08	5.51
Lane snapper	5.63	3.39	4.58
Nurse shark	5.36	3.23	4.36
Tomtate	4.34	2.61	3.53
Pinfish	3.43	2.07	2.79
Littlehead porgy	2.21	1.33	1.80
Gray triggerfish	2.09	1.26	1.70
Southern puffer	1.61	0.97	1.31
Spotted moray	1.60	0.96	1.30
Knobbed porgy	1.35	0.81	1.10
Gag	1.12	0.68	0.91
Planehead filefish	0.77	0.47	0.63
Black seabass	0.53	0.32	0.43
Gray snapper	0.52	0.31	0.42
Jackknife-fish	0.45	0.27	0.37
Whitebone porgy	0.36	0.21	0.29
Vermilion snapper	0.26	0.15	0.21
Blue angelfish	0.25	0.15	0.21
Fringed filefish	0.23	0.14	0.19
Orange filefish	0.22	0.13	0.18
Sand diver	0.22	0.13	0.18
Pigfish	0.21	0.13	0.17
Bandtail puffer	0.21	0.13	0.17
Sharksucker	0.18	0.11	0.15
Gray angelfish	0.12	0.07	0.10
Spottail pinfish	0.12	0.07	0.10
Tiger shark	0.12	0.07	0.10
Greater amberjack	0.12	0.07	0.09
Yellowtail snapper	0.10	0.06	0.08
Bank seabass	0.09	0.06	0.08
Spotfin butterflyfish	0.09	0.05	0.07

Species	2001	2002	2003
Black grouper	0.09	0.05	0.07
Margate	0.08	0.05	0.06
Triggerfish/filefish	0.07	0.04	0.06
Cubbyu	0.07	0.04	0.05
Remora	0.06	0.04	0.05
Leopard toadfish	0.06	0.03	0.05
Inshore lizardfish	0.05	0.03	0.04
Gulf toadfish	0.04	0.02	0.03
Hardhead catfish	0.04	0.02	0.03
Bucktooth parrotfish	0.03	0.02	0.03
Jolthead porgy	0.02	0.01	0.02
Ocellated frogfish	0.02	0.01	0.02
Red hogfish	0.02	0.01	0.02
Least puffer	0.02	0.01	0.02
Southern flounder	0.01	0.01	0.01
Cottonwick	0.01	0.01	0.01
Atlantic spadefish	0.01	0.01	0.01
Lesser amberjack	0.01	0.01	0.01
Sheepshead porgy	0.01	0.01	0.01
Scrawled cowfish	0.01	0.01	0.01
Grass porgy	0.01	0.01	0.01
Red goatfish	0.01	0.01	0.01
Ocean triggerfish	0.01	0.01	0.01
Reef butterflyfish	0.01	0.00	0.00
Blue runner	0.00	0.00	0.00
Total	171.67	103.34	139.60

Table 73-Table 75 were combined to give total discards in the 2002 Gulf of Mexico snapper and grouper fishery by species (Table 76). Red grouper constitutes 85% of the total discards.

Table 76: Total 2002 discards in the Gulf of Mexico snapper grouper fishery.

Red grouper	671.84	Spinycheek scorpionfish	0.70	Spottail pinfish	0.07
Red snapper	29.90	Gray snapper	0.61	Yellowtail snapper	0.06
Clearnose skate	13.00	Yellowedge grouper	0.60	Black grouper	0.05
Gag	9.18	Longspine squirrelfish	0.50	Margate	0.05
Leopard toadfish	8.23	Sand tilefish	0.50	Spotfin butterflyfish	0.05
Great barracuda	6.90	Planehead filefish	0.47	Cubbyu	0.04
Nurse shark	4.33	Vermilion snapper	0.45	Remora	0.04
White grunt	4.26	Speckled hind	0.40	Triggerfish/filefish	0.04
Jewfish	4.10	Sand diver	0.33	Bucktooth parrotfish	0.02
Sand perch	4.08	Black seabass	0.32	Gulf toadfish	0.02
Blacknose shark	3.90	Florida smoothhound shark	0.30	Hardhead catfish	0.02
Lane snapper	3.59	Guaguanche barracuda	0.30	Atlantic spadefish	0.01
Reticulate moray	3.20	Jackknife-fish	0.27	Cottonwick	0.01
Tomtate	2.61	Whitebone porgy	0.21	Grass porgy	0.01
Scamp	2.20	Bank seabass	0.16	Jolthead porgy	0.01
Pinfish	2.17	Blue angelfish	0.15	Least puffer	0.01
Spotted moray	2.06	Fringed filefish	0.14	Lesser amberjack	0.01
Little tunny	2.00	Bandtail puffer	0.13	Ocean triggerfish	0.01
Tiger shark	1.87	Inshore lizardfish	0.13	Ocellated frogfish	0.01
Gray triggerfish	1.46	Orange filefish	0.13	Red goatfish	0.01
Littlehead porgy	1.33	Pigfish	0.13	Red hogfish	0.01
Sharksucker	1.21	Blue runner	0.10	Scrawled cowfish	0.01
Southern puffer	0.97	Chain dogfish	0.10	Sheepshead porgy	0.01
Knobbed porgy	0.81	Gray angelfish	0.07	Southern flounder	0.01
Silver seatrout	0.70	Greater amberjack	0.07	Total	793.76

Recreational fishery

Recreational discard estimates for all species of snapper and grouper for which landings are available can be made from the Marine Recreational Fisheries Statistics Survey (MRFSS) online database; however recreational discards in the MRFSS database are given in numbers of fish only, therefore the

weight of the discards had to be estimated. The methodology for this estimation technique is described in the National Overview, but in general, weight-at-age data were used to arrive at an average weight per discarded fish (See Size References at end of chapter). These calculations only considered sub-legal fish, as it is assumed that legal sized fish are retained. Multiplying the average weight per fish by the number of discarded fish of each species (NMFS, 2004c) gives an estimated weight of discards (Table 77 and Table 78).

In addition to the authors' calculation of discards, published recreational discard values were also available for red and gag grouper. For red grouper, recreational discards were available by year class, averaged over an eight-year time span. The average discards from each year class were added together for a total average discard amount (Schirripa et al., 1999). For gag grouper, discard amounts were available from 1986 to 1999 (Turner et al., 2001). Both sets of numbers (authors' estimate and literature estimate) are reported, the literature values are reported first (Table 77).

Table 77: Estimated yearly discards of red grouper, gag grouper, gray triggerfish, and greater amberjack in the Gulf of Mexico recreational fishery, 1981-2002.

Year	Red Grouper Discards (mt)	Gag Grouper Discards (mt)	Gray Triggerfish Discards (mt)	Greater Amberjack Discards (mt)
1981	33.1	106.0	4.6	227.3
1982	32.3	111.2	6.1	502.3
1983	111.5	517.9	2.4	568.9
1984	238.1	52.5	12.1	229.7
1985	434.0	64.9	10.2	368.1
1986*	300.8	127.9 (84.1)	14.4	1032.6
1987*	263.3	89.4 (154.5)	10.9	257.6
1988*	480.3	82.6 (111.6)	13.7	133.9
1989*	1,093.8	145.2 (375.0)	30.5	588.2
1990*	237.2 (908.5)	127.0 (458.3)	20.3	367.9
1991*	237.2 (1,619.5)	277.2 (950.4)	36.4	1508.6
1992*	237.2 (1,4723.0)	245.0 (826.8)	22.6	1540.8
1993*	237.2 (918.2)	390.2 (1,399.0)	15.0	1358.5
1994*	237.2 (917.9)	542.6 (1,993.5)	11.4	368.4
1995*	237.2 (920.5)	604.4 (2,222.6)	13.9	278.1
1996*	237.2 (590.8)	380.7 (1,326.8)	18.0	476.9
1997*	237.2 (606.9)	527.2 (1,886.1)	14.8	217.8
1998*	793.1	632.0 (2,253.3)	16.1	353.1
1999*	1,072.2	463.2 (1,679.7)	14.7	565.1
2000	1,194.9	1,649.9	11.1	752.8
2001	895.4	2,102.5	17.7	2542.0
2002	1,047.8	2,749.6	23.4	1480.8

* Years with more than one estimate of discards for at least one of the species. The first value reported is from the literature (Schirripa et al., 1999; Turner et al., 2001). The second was calculated using von Bertalanffy calculations.

Table 78: Estimated yearly discards of gray snapper, mutton snapper, red snapper, vermilion snapper and yellowtail snapper in the Gulf of Mexico recreational fishery, 1981-2002.

Year	Gray Snapper Discards (mt)	Mutton Snapper Discards (mt)	Red Snapper Discards (mt)	Vermilion Snapper Discards (mt)	Yellowtail Snapper Discards (mt)
1981	37.1	0.3	12.7	0.0	29.5
1982	80.2	0.3	5.0	3.2	51.0
1983	242.7	3.1	9.4	1.5	38.8
1984	57.0	14.6	33.3	2.2	154.2
1985	112.5	5.0	60.1	1.7	22.2
1986	96.2	4.1	10.6	6.0	44.0
1987	63.3	22.2	40.6	1.7	118.1
1988	82.1	10.7	66.3	13.3	68.6
1989	149.7	2.7	72.2	9.4	115.7
1990	175.0	2.6	120.7	9.0	91.7
1991	644.7	20.3	203.9	15.5	507.7
1992	485.5	20.0	216.5	16.8	178.0
1993	456.2	28.0	230.7	30.5	222.3

Year	Gray Snapper Discards (mt)	Mutton Snapper Discards (mt)	Red Snapper Discards (mt)	Vermilion Snapper Discards (mt)	Yellowtail Snapper Discards (mt)
1994	426.0	18.1	217.0	12.7	123.3
1995	421.6	11.9	180.3	30.1	146.2
1996	428.5	12.8	228.6	9.1	121.5
1997	532.8	24.8	417.7	5.5	175.3
1998	556.0	28.4	309.7	6.8	106.4
1999	464.9	9.9	486.2	22.9	82.3
2000	601.0	14.9	378.4	19.3	68.9
2001	467.3	9.3	449.9	14.1	58.2
2002	534.3	16.2	495.7	14.5	53.9

In summary, landings for the commercial and recreational fisheries are very similar, but discards are much higher in the recreational fishery. In 2002, the total discards from the commercial snapper-grouper fisheries were 793.84 metric tons and total landings were 9,392.4 mt for a d/l ratio of 0.085. Recreational discards for 2002 amounted to 6,416.19 mt and 2002 recreational landings were 7,983.33 mt for a d/l ratio of 0.80. Overall, total landings from the commercial and recreational fisheries combined were 17,376 mt, and total discards were 7,210 mt for an overall d/l ratio of 0.41.

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Coastal Migratory Pelagics of the Gulf of Mexico and South Atlantic

Major Target Species:	King mackerel (<i>Scomberomorus cavalla</i>), Spanish mackerel (<i>Scomberomorus maculatus</i>), Little tunny (<i>Euthynnus alletteratus</i>), Cobia (<i>Rachycentron canadum</i>), Dolphinfinch (<i>Coryphaena hippurus</i> and <i>Coryphaena equiselis</i>), Bluefish (<i>Pomatomus saltatrix</i>)
Major Discard Species:	Unknown
Primary Gear Types:	Hook and line, Gillnet, Purse Seine
Total Landings (2002):	12,513 mt
Total Discards (2002):	1,819 mt
Total Discards Rank (of 27):	20
Discard to Landings Ratio:	0.15
d/I Rank (of 27):	19
Source of Estimates:	MRFSS, Authors
Discard Type:	Unknown if primarily target or non-target, Primarily regulatory
Notes:	Total discards include the recreational fishery but not non-target species discards, d/I ratio will be low.

The FMP for Coastal Migratory Pelagics in the Gulf of Mexico and the South Atlantic is jointly managed by the GMFMC and the SAFMC with the GMFMC having administrative lead. Included in this plan are king and Spanish mackerel, cero mackerel (minor species), little tunny, cobia, dolphinfinch and bluefish. Cero mackerel is included in this chapter even though it is a minor species as it is very difficult to distinguish from king mackerel and landings of the two species are often reported together. While this FMP regulates some stocks in both the Gulf of Mexico and the South Atlantic, it regulates dolphin and bluefish in the Gulf of Mexico only. The South Atlantic stocks of these species are managed under separate FMPs. There are no stocks in this FMP where overfishing is occurring. Only the king mackerel stock in the Gulf of Mexico is overfished (NMFS et al., 2004). However, Mexican landings of these species, most likely belonging to the same stocks as fish landed in the US, are not regulated, and are thought to be quite large (NMFS, 1999).

Target landings

Landings of the coastal migratory pelagic species for 2002 are reported in Table 79. Commercial landings data group king and cero mackerel together (Figure 49 and Figure 50), but recreational data only report landings of king mackerel (Figure 51 and Figure 52). Landings of cero mackerel are not reported in the marine recreational fisheries statistics survey database.

Table 79: Landings of coastal migratory pelagic species in the Gulf of Mexico and South Atlantic for the 2002 fishing year (NMFS, 2004b).

Species	Recreational Landings (mt)	Commercial Landings (mt)
King mackerel – Gulf	1,417	989
King mackerel – South Atlantic	1,690	1,116
Spanish mackerel – Gulf	1,453	447
Spanish mackerel – South Atlantic	909	1,222
Little tunny – Gulf	396	208
Little tunny – South Atlantic	472	96
Cobia – Gulf	359	56
Cobia – South Atlantic	272	40
Dolphinfinch	1,011	132
Bluefish	173	59
Total	8,150	4,363

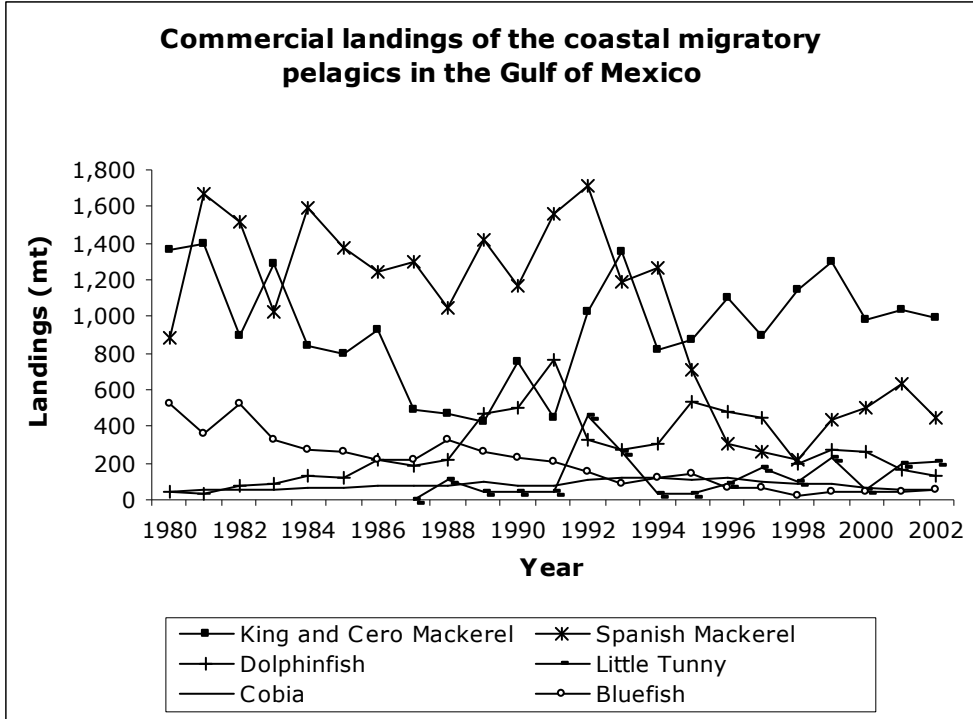


Figure 49: Commercial landings of coastal migratory pelagics in the Gulf of Mexico, 1980-2002 (NMFS, 2004b).

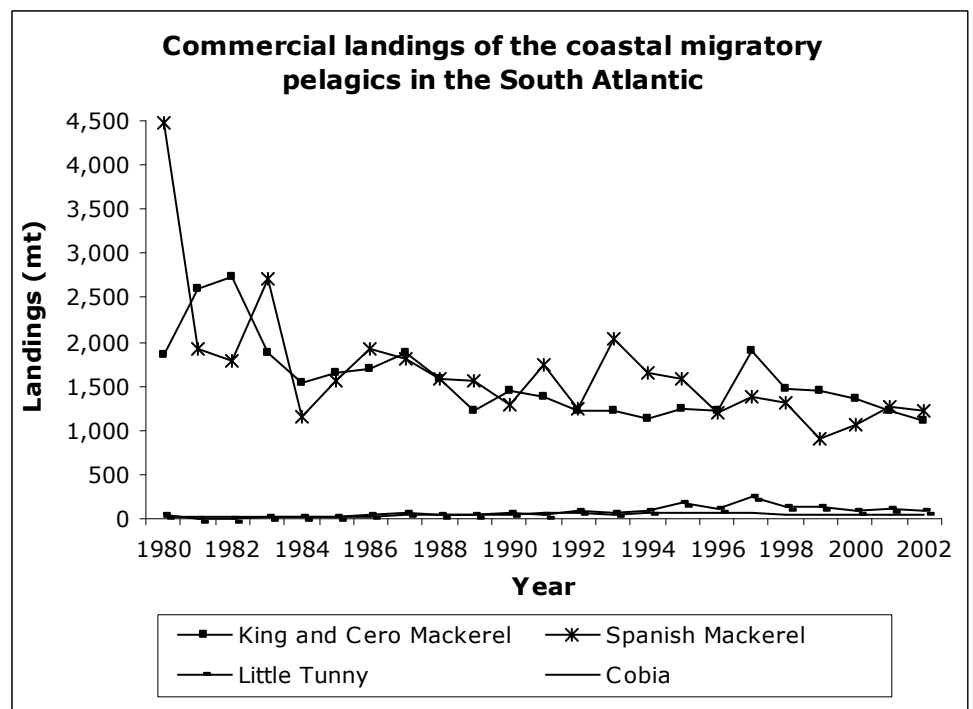


Figure 50: Commercial landings of coastal migratory pelagics in the South Atlantic, 1980-2002. Dolphin and bluefish are not included in graph as they are regulated separately (NMFS, 2004b).

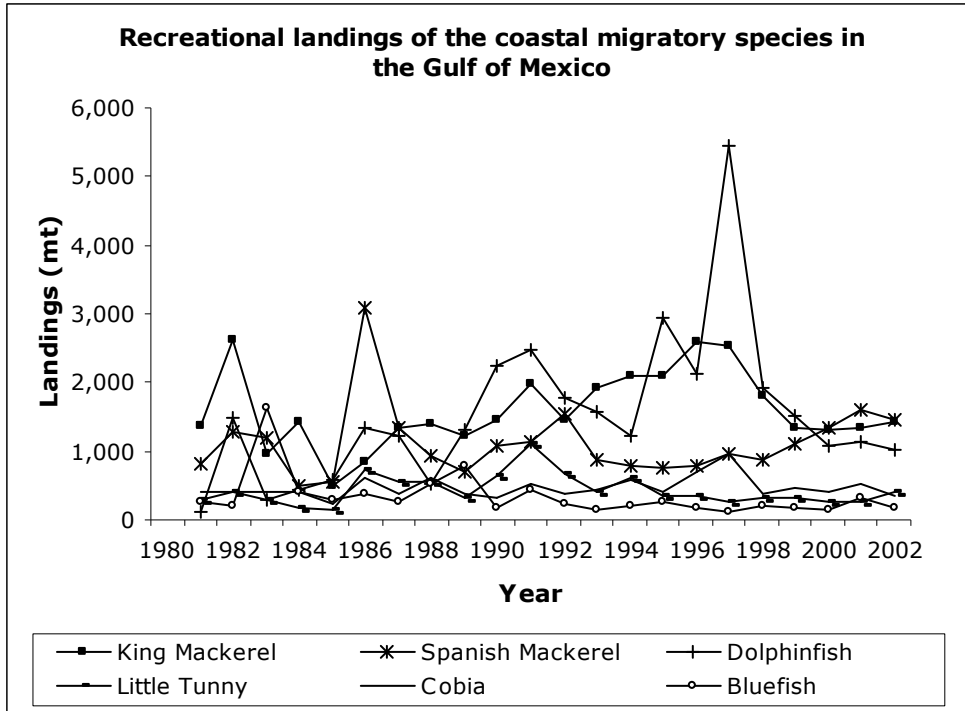


Figure 51: Recreational landings of coastal migratory pelagics in the Gulf of Mexico, 1981-2002 (NMFS, 2004c).

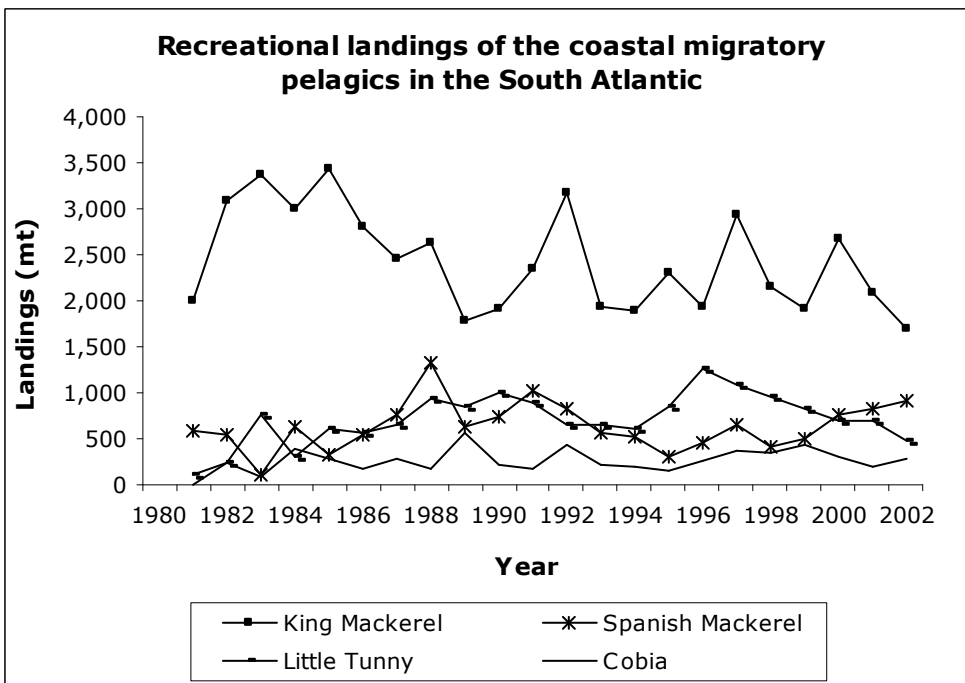


Figure 52: Recreational landings of coastal migratory pelagics in the South Atlantic, 1981-2002.

In the Gulf of Mexico, king mackerel, cero mackerel and Spanish mackerel produce the highest landings in the commercial fisheries. The commercial and recreational landings of king mackerel are currently about the same, but historically, recreational landings have been almost twice the commercial landings. Commercial landings of Spanish mackerel fell in the early 1990s from approximately 1,700 mt annually to

just 400 mt in the Gulf of Mexico. The annual recreational landings of Spanish mackerel hovered around 1,000 mt during this same time period, but are currently closer to 1,500 mt. In the Gulf of Mexico, recreational landings of dolphinfish have always been higher than commercial landings.

In the South Atlantic, king, cero and Spanish mackerel are the majority of the commercial landings. King mackerel is landed in larger quantities recreationally. There are also landings of cobia and little tunny in the recreational fisheries, but landings of cobia and little tunny are virtually non-existent in the commercial fisheries.

The most common gear used to fish for these species is the handline. However, gillnets, purse seines, trolls, electric reels and castnets are also frequently used, depending on the species (NMFS, 2004b; NMFS, 2004c).

Regulations

The FMP for Coastal Migratory Pelagics of the Gulf of Mexico and the South Atlantic utilizes multiple management strategies including area closures, minimum fish size requirements, quotas, bag limits, and gear restrictions. Minimum size restrictions, quotas, landing limits and possession limits for king mackerel, Spanish mackerel and cobia are listed in Table 80. King and Spanish mackerel are separated into Gulf of Mexico and South Atlantic stocks.

Table 80: Minimum size, quota and recreational and commercial landing limits for king mackerel, Spanish mackerel and cobia (NMFS, 2003).

Species	Minimum Fork Length (inches)	Quota	Landing/Possession Limits	
			Recreational	Commercial
King mackerel (Gulf)	24	1,480	2/person	Variable depending on time, location, and gear. 50 fish – 25,000 pounds (11.3 mt)
King mackerel (South Atlantic)	24	1,680	2/person off the coast of Florida, 3/person elsewhere	Variable depending on time, location and gear. 75 fish – 3,500 pounds (1590 kg)
Spanish Mackerel (Gulf)	12	2,353	15/person	No limit
Spanish Mackerel (South Atlantic)	12	1,755	15/person	From Georgia north, 3,500 pounds (1.6 mt)/vessel/day
Cobia	33	None	2/person	2/person

There are no minimum size restrictions on bluefish, little tunny, dolphinfish and cero mackerel. However, gear restrictions apply to all of the coastal migratory pelagics. Table 81 describes the allowable gears for all of the coastal migratory pelagics of the Gulf of Mexico and the South Atlantic.

Table 81: Prohibited gears, authorized gears, and specifications for the seven coastal migratory species under the FMP (NMFS, 2003).

Species, stock (location)	Prohibited gears	Authorized gears	Specifications
King mackerel, Gulf of Mexico	All others	Handline, rod and reel, hook and line, gillnet.	4.75 inch (12 cm) minimum mesh stretch
King mackerel, South Atlantic	All others	Automatic reel, bandit gear, handline, rod and reel, pelagic longline, purse seine, runaround gill net	4.75 inch (12 cm) minimum mesh stretch
Spanish mackerel, Gulf of Mexico	Drift gillnet, long gillnet, purse seine	All others	3.5 inch (8.9 cm) minimum mesh stretch
Spanish mackerel, South Atlantic	Drift gillnet, purse seine	Automatic reel, bandit gear, rod and reel, cast net, run-around gillnet, stab net	3.5 inch (8.9 cm) minimum mesh stretch
Little tunny (South Atlantic)	Drift gillnet	Automatic reel, bandit gear, hand line, rod and reel, pelagic long-line.	-----
Little tunny (Gulf of Mexico)	Purse seine south of 34°37.3' N. lat.	Purse Seine allowed north of 34°37.3' N lat. (approximately the South Carolina-North Carolina state line)	-----
Dolphinfish (Gulf of Mexico)	Drift gillnet, long gillnet	-----	-----
Cobia (South Atlantic)	Drift gillnet, long gillnet	All others	-----

Species, stock (location)	Prohibited gears	Authorized gears	Specifications
Cobia (Gulf of Mexico)	All others	All others	-----
Cero	Drift gillnet, long gillnet	Automatic reel, bandit gear, hand line, rod and reel, pelagic long-line	-----
Bluefish (Gulf of Mexico)	Drift gillnet, long gillnet	All others	-----

Discards

There have been few studies investigating discards in the commercial coastal migratory pelagics fishery of the Gulf of Mexico and South Atlantic. The only discard data available are from the recreational fishery and are found on the Marine Recreational Fisheries Statistics Survey (MRFSS) database. These discard data are kept in numbers of fish; therefore the weight of the discards had to be estimated. The methodology for this estimation technique is described in the Acknowledgements

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National Overview, but in general, weight-at-age data were used to arrive at an average weight per discarded fish (See Size References at end of chapter). These calculations only considered sub-legal fish, as it is assumed that legal sized fish are retained. Multiplying the average weight per fish by the number of discarded fish of each species (NMFS, 2004c) gives an estimated weight of discards (Table 82-Table 83).

Table 82: Estimated yearly discards of little tunny, Spanish mackerel, king mackerel and cobia in the South Atlantic recreational fishery, 1981-2002.

Year	Little Tunny Discards (mt)	Spanish Mackerel Discards (mt)	King Mackerel Discards (mt)	Cobia Discards (mt)	Total Discards (mt)
1981	24.7	4.5	1.7	0.0	30.9
1982	1.6	0.5	1.9	9.7	13.7
1983	19.8	0.4	0.2	5.6	26
1984	16.4	1.9	0.9	144.9	164.1
1985	11.3	4.0	14.7	17.4	47.4
1986	64.5	22.5	13.8	33.4	134.2
1987	45.1	3.2	34.4	8.7	91.4
1988	52.5	4.7	33.7	23.6	114.5
1989	68.4	16.2	21.3	12.4	118.3
1990	50.4	10.1	13.9	23.6	98
1991	77.9	25.0	47.2	58.6	208.7
1992	51.7	22.8	41.9	96.3	212.7
1993	40.5	12.5	38.0	50.0	141
1994	53.6	42.5	21.9	35.5	153.5
1995	54.1	21.3	57.4	35.3	168.1
1996	36.4	25.8	47.2	70.5	179.9
1997	65.4	27.1	69.3	84.9	246.7
1998	81.8	15.1	77.3	88.8	263
1999	102.4	31.9	85.5	105.5	325.3
2000	77.4	52.2	78.5	30.3	238.4
2001	79.7	33.4	78.8	105.4	297.3
2002	113.4	56.0	78.2	63.2	310.8

Table 83: Estimated yearly discards of dolphinfish, little tunny, bluefish, Spanish mackerel, king mackerel and cobia in the Gulf of Mexico recreational fishery, 1981-2002.

Year	Dolphin Discards (mt)	Little Tunny Discards (mt)	Bluefish Discards (mt)	Spanish Mackerel Discards (mt)	King Mackerel Discards (mt)	Cobia Discards (mt)	Total Discards (mt)
1981	1.0	11.9	63.9	5.8	6.8	44.5	133.9
1982	3.1	11.5	125.0	37.9	12.8	64.8	255.1
1983	10.5	14.2	89.2	85.8	0.1	0.6	200.4
1984	19.3	8.6	54.1	4.1	0.7	33.5	120.3
1985	0.3	1.5	55.8	10.2	6.9	4.4	79.1
1986	10.1	27.6	96.2	292.3	12	170.2	608.4
1987	17.7	29.9	233.4	29.7	25.4	90.2	426.3
1988	16.3	63.4	160.0	51.4	26.2	296.4	613.7
1989	14.7	40.2	205.4	35.2	121.4	286.1	703
1990	4.6	31.3	122.5	155.8	90.9	339.1	744.2
1991	68.9	49.5	262.4	89.6	122.5	903.2	1,496.1
1992	10.1	42.5	146.2	120.1	107.4	432.8	859.1
1993	20.3	72.3	100.2	73.8	42	258.6	567.2
1994	25.2	48.6	106.9	47.1	114.2	459.9	801.9
1995	47.4	15.6	123.0	41.2	102.6	309.1	638.9
1996	2.9	14.4	149.6	50.2	138.6	332.7	688.4
1997	24.9	38.1	244.2	62.3	101.7	458.7	929.9
1998	19.2	23.3	184.2	52.0	65.1	385.3	729.1
1999	12.7	39.8	117.6	90.5	68.7	372.9	702.2
2000	12.8	31.6	125.8	109.0	98.7	479.0	856.9
2001	9.0	36.7	213.9	134.3	224.7	500.5	1,119.1
2002	7.0	59.5	193.6	139.8	130.1	508.3	1,038.3

In the South Atlantic, the 2002 discards are fairly evenly distributed, with the exception of little tunny, which is discarded more frequently than the other species. In the Gulf of Mexico, cobia are discarded in much larger quantities than the other species, and dolphinfish is rarely discarded.

No commercial discard data are available for the coastal migratory pelagics of the South Atlantic and Gulf of Mexico, but since most of the commercial catch is made with hook and line, the d/l ratios from the recreational fishery would most likely be similar to the d/l ratios for the commercial fishery. In Table 84, the recreational d/l ratios for each species are multiplied by the 2002 commercial landings for that species to obtain an estimate of target species discards. For king and Spanish mackerel, these estimates of discards are most likely low because of the higher frequency of gillnetting in those fisheries.

Table 84: Estimates of 2002 commercial discards using recreational d/l ratios

Species/Region	Commercial Discard Estimates (mt)
King mackerel, Gulf of Mexico	90.8
Spanish mackerel, Gulf of Mexico	43.0
Cobia, Gulf of Mexico	78.5
Little tunny, Gulf of Mexico	31.1
Bluefish, Gulf of Mexico	66.5
Dolphinfish, Gulf of Mexico	0.9
King mackerel, South Atlantic	51.6
Spanish mackerel, South Atlantic	75.3
Cobia, South Atlantic	9.4
Little tunny, South Atlantic	22.9
Total	470.0

In summary, only target species discards (mainly regulatory catch and release discards) are available for both the recreational and commercial fishery. Landings of coastal migratory pelagics were 4,363 mt in the commercial fishery, and there were 470 mt of CMP discards for a commercial discard to landings ratio of 0.11. Landings in the recreational fishery were 8,150 mt, and discards were 1,349 mt. This gives a recreational discard to landings ratio of 0.17. Overall, there were 12,513 mt landed, and 1,819 mt discarded for a d/l ratio of 0.15.

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Red Drum Fishery of the South Atlantic and Gulf of Mexico

Major Target Species:	Red drum (<i>Sciaenops ocellatus</i>)
Major Discard Species:	Unknown
Primary Gear Types:	Hook and line
Total Landings (2002):	5,786 mt
Total Discards (2002):	14,963 mt
Total Discards Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Discard to Landings Ratio:	2.6
d/I Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Source of Estimates:	MRFSS, Authors
Discard Type:	Unknown if primarily target or non-target, Primarily regulatory
Notes:	This is a recreational only fishery, non-target species discards are unknown

The red drum is a popular game fish in the South Atlantic and the Gulf of Mexico. In the Atlantic, red drum is occasionally found as far north as Massachusetts, but mostly inhabit waters south of Virginia, off the coasts of North and South Carolina, Georgia and Florida. In the Gulf of Mexico, red drum is found off the coast of every state. They settle inshore for the first 3-4 years of life, and then move to deeper waters as they mature (FFWCC and FMRI, 2003; NCDMF, 2004). Currently, there are no commercial or recreational red drum fisheries operating in federal waters (GMFMC, 2003a; GMFMC, 2003b). The only red drum fisheries are state fisheries. Mississippi and Virginia are the only two states with commercial fisheries for red drum, the other states have only recreational fisheries. The gear used to target red drum is almost exclusively hook and line. The stock is considered overfished, and overfishing is considered to be occurring (NMFS, 2004c).

Target catch data

The commercial landings of red drum in the United States have never been large with a peak catch of 6,566 mt in 1987, followed by a dramatic decline to just a few hundred metric tons in 1989 when the federal fishery was banned to allow for the recovery of the stock (Figure 53) (NMFS, 2004a). Since the federal prohibition, the individual state fisheries have expanded. Most recently, the recreational landings reached just over 7,000 mt in 2000 (Figure 53) (NMFS, 2004b) despite bag and size limits.

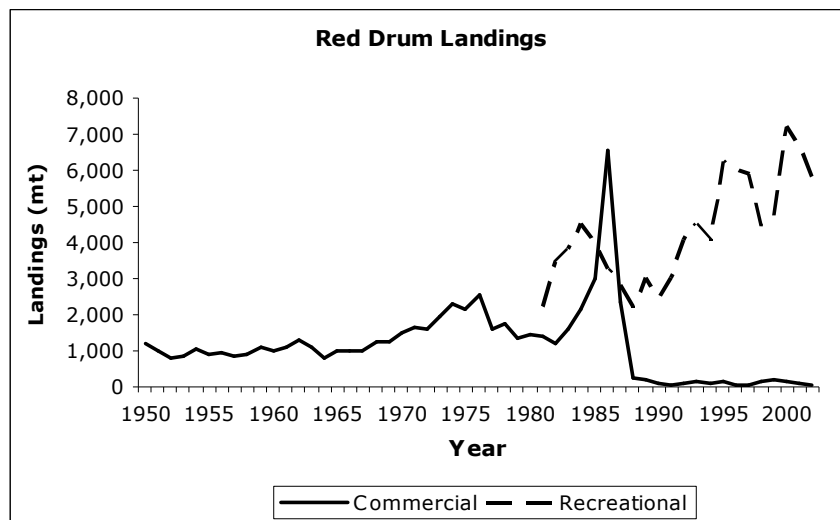


Figure 53: Historical commercial and recreational landings of red drum from 1950-2002. Commercial landings after 1990 are mainly bycatch of red drum in other commercial fisheries (NMFS, 2004a; NMFS, 2004b).

While the gear used to target red drum is almost exclusively hook and line, the major gear type that catches red drum as bycatch are gillnets. Figure 54 gives the percentages for all gear types in commercial red drum fisheries in 2002 (NMFS, 2004a).

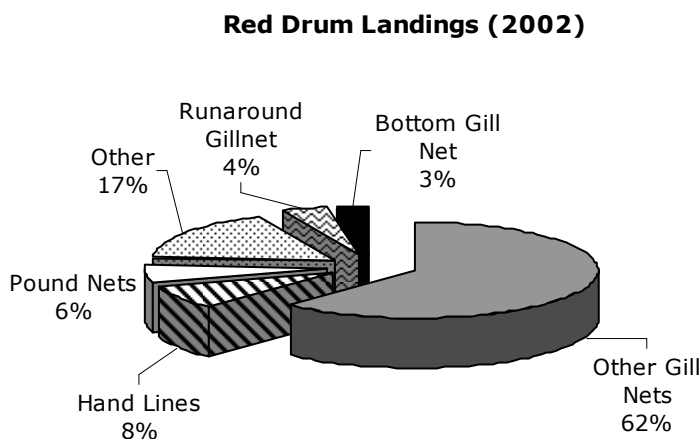


Figure 54: Gear that caught red drum as bycatch in commercial fisheries in 2002 (NMFS, 2004a).

Regulations

In federal waters, all catch of red drum is prohibited, commercial and recreational. In state waters, recreational fishing is permitted, but the commercial catch of red drum is only allowed in Mississippi and Virginia. Mississippi has a quota for red drum, and Virginia has a three fish daily allowance with sale allowed. In the states where commercial red drum catch is prohibited, laws govern the bycatch of red drum in other commercial fisheries. There are recreational and daily bag limits and size ranges for the Atlantic and Gulf states (Table 85).

Table 85: Recreational regulations for Red Drum in the South Atlantic and Gulf of Mexico (ASMFC, 2002).

State	Daily Bag Limit (# of fish)	Legal Size Range	Size Limit Exemptions
Texas	3	20-28"	2 per year can be over 28"
Louisiana	5	16-27"	1 in 5 can be over 27"
Mississippi	3	18-30"	1 in 3 can be over 30"
Alabama	3	16-26"	1 in 3 can be over 30"
Florida (both coasts)	1	18-27"	None
Georgia	5	14" min., no max.	None
South Carolina	2	15-24"	None
North Carolina	1	18-27"	None
Virginia	3	18-26"	None

Discards

As there are no federal fisheries for red drum, and only two small state commercial fisheries, the discards data from the red drum fishery is only from the recreational sector. Currently, the only data that are available are on target species discards (released fish from the recreational sector). The data are in numbers of fish, and the average weight of landed red drum was used to calculate the weight of the discards. It is difficult to determine whether the weight of the discards is over or under estimated for this fishery. Normally, when there is a minimum size regulation, the majority of the discards are smaller than

the landed catch. However, red drum are managed with a slot limit (minimum and maximum size limit) so some of the discards could be larger than the average landed fish. Recently, the catch composition of red drum has been heavily skewed towards discards (Figure 55) (NMFS, 2004b). Approximately two-thirds of the total catch is released back into the ocean, while only one-third is retained. A discard mortality rate of five percent was assumed by the Florida Fish and Wildlife Conservation Commission (FFWCC, 2002; Murphy, 2002).

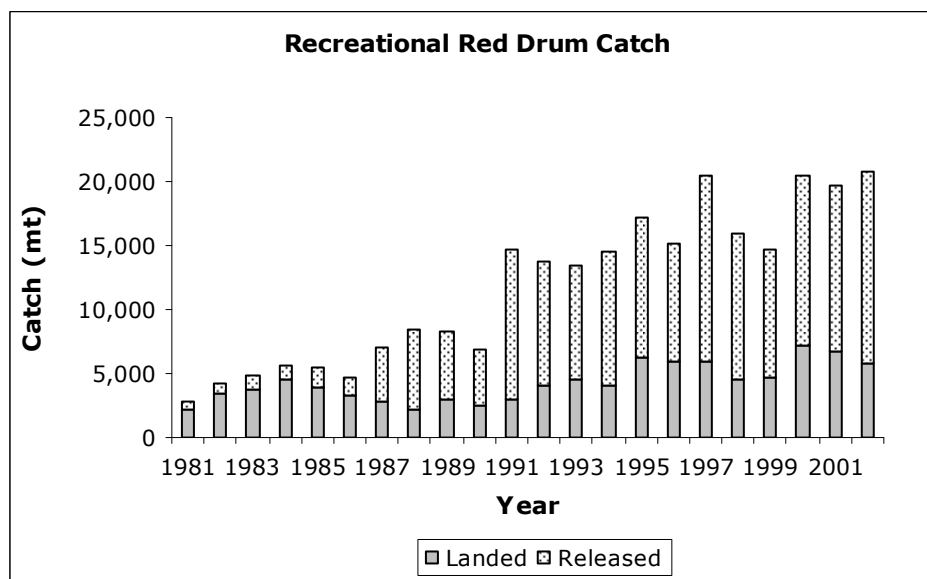


Figure 55: Recreational catch of red drum in the United States. The catch is separated into landed and released.

In summary, in 2002, the most recent year for which data are available, 5,786 mt of red drum were landed and 14,963 mt of red drum were released for a recreational d/l ratio of 2.59. Using the five percent mortality estimate from above, approximately 750 mt of discarded red drum died in 2002 when released. Little is known about the bycatch of other species in the recreational red drum fishery.

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Atlantic and Gulf of Mexico Menhaden Fisheries

Major Target Species:	Atlantic menhaden (<i>Brevoortia tyrannus</i>), Gulf of Mexico menhaden (<i>Brevoortia patronus</i>)
Major Discard Species:	Spanish mackerel (<i>Scomberomorus maculatus</i>), Striped bass (<i>Morone saxatilis</i>), Cownose rays (<i>Rhinoptera bonasus</i>), Bluefish (<i>Pomatomus saltatrix</i>), Blacktip sharks (<i>Carcharhinus limbatus</i>)
Primary Gear Types:	Purse seine, Pound net
Total Landings (2003):	725,458 mt
Total Discards (2003):	4606.6 mt
Total Discards Rank (of 27):	15
Discard to Landings Ratio:	0.0064
d/I Rank (of 27):	26
Source of Estimates:	Independent research study, Authors
Discard Type:	Primarily non-target, regulatory
Notes:	This is an estimate of bycatch, not discards.

Menhaden are a herring-like fish used for fishmeal, fish oil and bait. It is currently ranked second in the U.S. for quantity of fish landed at close to two billion pounds valued at \$105 million USD (NMFS, 2002). The menhaden fisheries are based in the southeastern United States. There are two species of menhaden, but they are very similar in their biology and ecology. The Atlantic menhaden inhabits waters off of the entire Atlantic coast of the United States from Maine to Florida, with harvest focused between North Carolina and Florida. Gulf menhaden are found between Mexico's Yucatan Peninsula and Tampa Bay in Florida. Both species are harvested with purse seines and pound nets. Currently, neither stock of menhaden is overfished, and overfishing is not occurring (NMFS, 2004b).

Target landings

Target landings for both species of menhaden have been high for the past decade (Figure 56). Gulf menhaden landings have fluctuated between 400,000 and 800,000 mt but were 522,195 mt in 2002, while Atlantic menhaden landings have fluctuated between 200,000 and 400,000 mt but were 203,263 mt in 2002 (NMFS, 1995; NMFS, 1997; NMFS, 1999a; NMFS, 2001; NMFS, 2002).

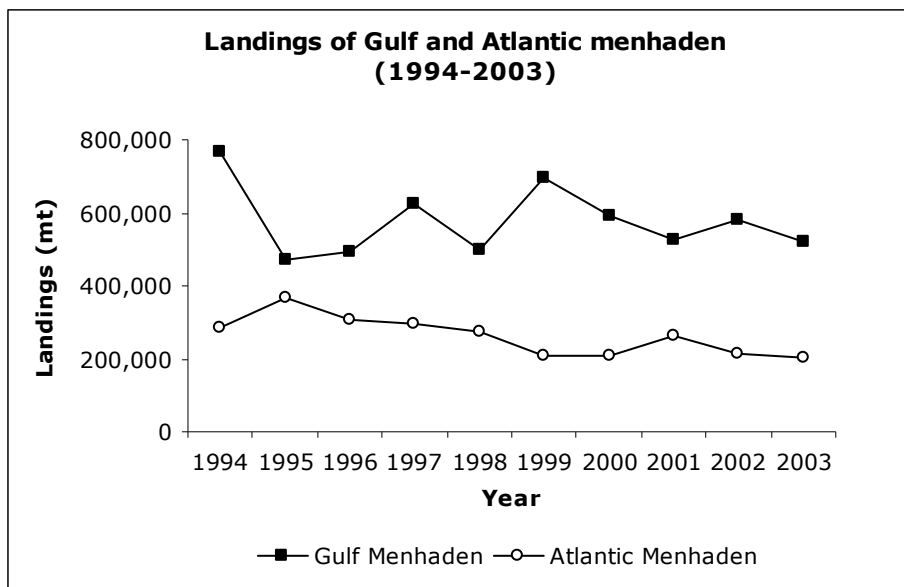


Figure 56: Landings of Atlantic and Gulf menhaden over the last decade (NMFS, 2004a).

Regulations

Atlantic Menhaden

An FMP was implemented in 1992 by the ASMFC identifying six variables to be reviewed annually to guide management: landings in weight, percentage of age 0 and adults in the landings, new recruits aged 1 year old, spawning stock biomass (SSB), and maximum spawning potential. Management of the Atlantic menhaden falls to the individual states under the overall ASMFC plan (Desfosse et al., 2000).

Gulf Menhaden

Regulations in the Gulf include a fishing season which runs from the third Monday in April through November 1st and a closure of inside waters across the northern Gulf of Mexico to protect juvenile menhaden (NMFS, 199b). However, there is a special bait fishery provision in Louisiana state waters that allows the fishing season to be extended from April 1st through December 1st. The closed areas and seasonal closures are continually re-evaluated by the individual states and changes are made when necessary (NMFS, 1999b)

Discards

Three studies examined bycatch and discards in the menhaden fisheries in 1992 (Austin et al., 1994; Condrey, 1994; Kirkley, 1995), and a more recent study examined discards in the Gulf of Mexico menhaden fishery in 2001 (deSilva et al., 2001). Since fishery regulations have not changed, some bycatch and discard data for 2003 was extrapolated using 1992 data.

Atlantic menhaden

Both of the menhaden fisheries are considered to be extremely clean (Austin et al., 1994), suggesting that there is little bycatch or discard. Bycatch in the menhaden fishery accounts for less than one percent of the total catch by numbers of fish, and common bycatch species in 43 sampled Atlantic menhaden purse seines were Spanish mackerel, striped bass, cownose rays and bluefish (Austin et al., 1994). A second paper by one of the authors of the 1994 study utilized published length-weight relationships to convert the bycatch from numbers of fish to weights (Table 86) (Kirkley, 1995). We expanded the 1992 study catch to 2003 the proportion of 2003 total Atlantic menhaden landings (NMFS, 2003) to 1992 Atlantic menhaden study landings. This proportion (266.2) was multiplied by the study bycatch for each species to obtain total bycatch in the 2003 Atlantic menhaden fishery. The total bycatch was estimated to be 1,188.63 mt, and the overall Atlantic b/l ratio as 0.00585 (Table 86).

Table 86: Bycatch in the 2003 Atlantic menhaden fishery expanded from a 1992 study (Kirkley, 1995).

Species	Total 1992 study weight (mt)	Total 2003 Atlantic weight (mt)
Blue crabs	0.02	4.8
Bluefish	0.60	158.9
Butterfish	0.02	5.8
Croaker	0.06	16.9
Cownose rays	0.82	218.6
Summer flounder	0.02	5.3
Harvest fish	0.06	15.0
Hog choaker	0.03	9.0
Lady crab	0.01	2.7
Oyster toad	0.00	0.4
Sandbar shark	0.16	41.3
Silver perch	0.00	0.7
Spanish mackerel	1.64	437.3
Spider crab	0.01	3.0
Spot	0.01	1.5
Squid	0.00	0.6
Striped bass	0.91	242.7
Thread herring	0.04	11.5
Sea trout	0.03	7.4
Witch flounder	0.02	5.3
Total bycatch	4.47	1,188.6
Menhaden	763.59	203,263.0*

* Actual 2003 landings of Atlantic menhaden (NMFS, 2003).

Gulf menhaden

In the Gulf of Mexico, Condrey (1994) found that Atlantic croaker was the most common species of bycatch, found in 30% of the sets. Atlantic bumper, silver seatrout and gafftopsail catfish were also common. The same study found that in samples from 49 sets, the weight of the menhaden catch ranged from 10 to 42 pounds, with a mode of 16 pounds and the weight of bycatch ranged from 0 to 4 pounds with a mode of 0 pounds. If 16 pounds is assumed to be the average menhaden catch, then total bycatch could range from 0 to 145,624 mt. However, if the Atlantic d/l ratio of 0.00585 is applied to the 2003 Gulf of Mexico menhaden catch (522,195 mt), total discards would equal 3,055 mt.

Blacktip sharks also contribute to the overall weight of bycatch in the Gulf of Mexico menhaden fishery. DeSilva et al (2001) showed that blacktip sharks appeared in 30% of all menhaden sets (in 1995). Most of the time, this bycatch was limited to one or two sharks. However, in one set, 148 adolescent blacktip sharks were observed. The study estimated that menhaden purse seines contribute to the entanglement or killing of 33,000 blacktip sharks each year (de Silva et al., 2001). This number is approximately equal to 17% of the directed blacktip shark landings, a large amount. The total Gulf of Mexico menhaden catch for 1995 was 472,039 mt; in 2003, 522,195 mt of menhaden were caught. By using the ratio of 2003 to 1995 menhaden landings (1.1), we project that approximately 36,300 blacktip sharks were taken in Gulf of Mexico menhaden nets in 2002.

In summary, 203,263 mt of menhaden and 1,188.6 mt of bycatch were caught in the Atlantic fishery, and 522,195 mt of menhaden and 3,055 mt of bycatch were caught in the Gulf of Mexico fishery in 2003. In addition, approximately 36,300 blacktip sharks were caught in the Gulf of Menhaden fishery in 2003. If these sharks weigh approximately 10 kg each - based on length-weight equations (PSRC, 2004) and the average length of the entangled sharks (de Silva et al., 2001) - total bycatch of black tip sharks would weigh 363 mt, raising the total Gulf of Mexico bycatch to 3,418 mt. Overall, total landings for both menhaden fisheries total 725,458 mt, and total bycatch is 4,607 mt, for an overall d/l ratio of 0.00635.

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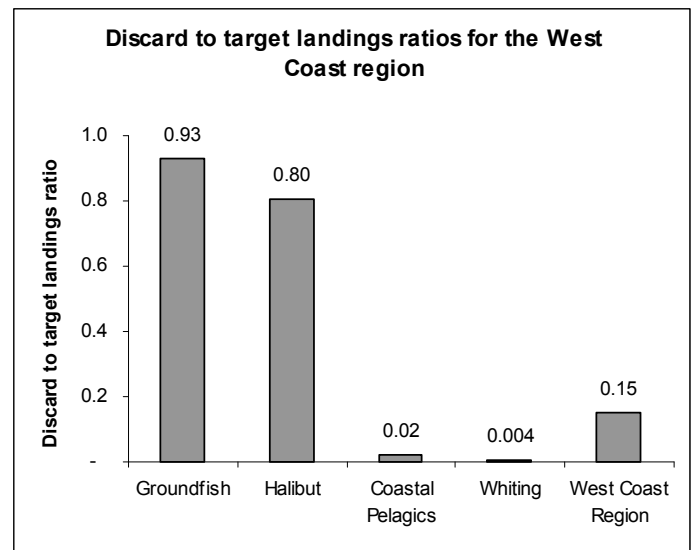
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West Coast



Pacific regional overview of landings, discards and discard to landings ratios by fishery

Fishery	Landings (mt)	Discards (mt)	d/l ratio
Groundfish	24,988	23,297	0.93
Halibut	26,065	20,929	0.80
Coastal Pelagics	123,138	2,560	0.02
Whiting	142,020	586	0.004
West Coast Region	316,211	47,372	0.15



Pacific Coast Groundfish Fishery

PACIFIC COAST GROUND FISH FISHERY

Major Target Species:	Lingcod (<i>Ophiodon elongatus</i>), Bocaccio (<i>Sebastes paucispinis</i>), Pacific Ocean perch (<i>Sebastes alutus</i>), Spiny dogfish (<i>Squalus acanthius</i>), Sablefish (<i>Anoplopoma fimbria</i>), Pacific cod (<i>Gadus macrocephalus</i>), Dover sole (<i>Microstomus pacificus</i>), Widow rockfish (<i>Sebastes entomelas</i>), Black rockfish (<i>Sebastes melanops</i>), Blackgill rockfish (<i>Sebastes melanostomus</i>), Brown rockfish (<i>Sebastes auriculatus</i>), Gopher rockfish (<i>Sebastes carnatus</i>), Splitnose rockfish (<i>Sebastes diploproa</i>), Vermilion rockfish (<i>Sebastes miniatus</i>), Cabezon (<i>Scorpaenichthys marmoratus</i>), Canary rockfish (<i>Sebastes pinniger</i>), Darkblotched rockfish (<i>Sebastes crameri</i>), Bank rockfish (<i>Sebastes rufus</i>), Blue rockfish (<i>Sebastes mystinus</i>), California scorpionfish (<i>Scorpaena guttata</i>), Yellowtail rockfish (<i>Sebastes flavidus</i>), Chilipepper rockfish (<i>Sebastes goodei</i>), Shortspine thornyhead (<i>Sebastolobus alascanus</i>), Longspine thornyhead (<i>Sebastolobus altivelis</i>), English sole (<i>Pleuronectes vetulus</i>), Arrowtooth flounder (<i>Atheresthes stomias</i>), Sand sole (<i>Psettichthys melanostictus</i>), Petrale sole (<i>Eopsetta jordani</i>), Rex sole (<i>Glyptocephalus zachirus</i>), Starry flounder (<i>Platichthys stellatus</i>)
Major Discard Species:	Groundfish, Sharks, Skates, Halibut (<i>Hippoglossus stenolepis</i>), Whiting (<i>Merluccius productus</i>)
Primary Gear Types:	Trawl, Hand line
Total Landings (2002):	24,988.2 mt
Total Discards (2002):	23,297 mt
Total Discards Rank (of 27):	8
Discard to Landings Ratio:	0.93
d/l Rank (of 27):	6
Source of Estimates:	NMFS, MRFSS, Independent research studies, Authors
Discard Type:	Primarily target, regulatory
Notes:	Recreational discards do not include non-target species.

PACIFIC WHITING FISHERY

Major Target Species:	Pacific whiting (<i>Merluccius productus</i>)
Major Discard Species:	No major discards
Primary Gear Types:	Trawl
Total Landings (2003):	142,020 mt
Total Discards (2003):	586 mt
Total Discards Rank (of 27):	24
Discard to Landings Ratio:	0.0041
d/l Rank (of 27):	27
Source of Estimates:	NFMS, Authors
Discard Type:	Unknown if primarily target or non-target, primarily regulatory
Notes:	The discard amount for this fishery includes 10,695 salmon assumed to weigh 5 kg each, and 199 halibut assumed to weigh 16.7 kg each. This is an estimate of bycatch, not discards.

The Pacific Coast Groundfish FMP, developed by the Pacific Fishery Management Council and implemented in October, 1982, manages the fisheries for approximately 90 species of roundfish, rockfish, flatfish, shark and skates. The management area extends off the coasts of Washington, Oregon and California, and covers an array of habitat types using several types of fishing gears (NMFS, 1999). Only 31 of these species are considered to be major within the FMP and will be addressed in this chapter. The Pacific whiting fishery is the only fishery in which overfishing is occurring, but seven of the 31 species are overfished: Pacific whiting, lingcod, Pacific ocean perch, bocaccio, canary rockfish, darkblotched rockfish and widow rockfish (NMFS et al., 2004).

Target landings

The catch rates and landings for all 31 species have varied widely by species and fishery over the past two decades. Since at least 1980, with the exception of Pacific Whiting, there have been decreasing landings throughout the commercial fishery (Figure 57-Figure 62, Table 87). Pacific whiting is considered a distinct fishery from the other Pacific groundfish, and continues to maintain landings up to five times that historically found in any other stock of the Pacific groundfish complex.

Figure 57-Figure 62 show landings of commercially harvested groundfish from 1980-2002, and Table 87 gives the 2002 landings (NMFS, 2004b). They are grouped by similarity and landings amounts. The trend of decreasing landings is not seen in the recreational fisheries. Figure 63 and Figure 64 show recreational landings for ten of the groundfish species for 1993-2002, and Table 88 gives the recreational landings for 2002 (NMFS, 2004e). Landings of California scorpionfish are included only in the recreational landings. Commercially, scorpionfish are landed only in California, and landings are under 50 mt per year.

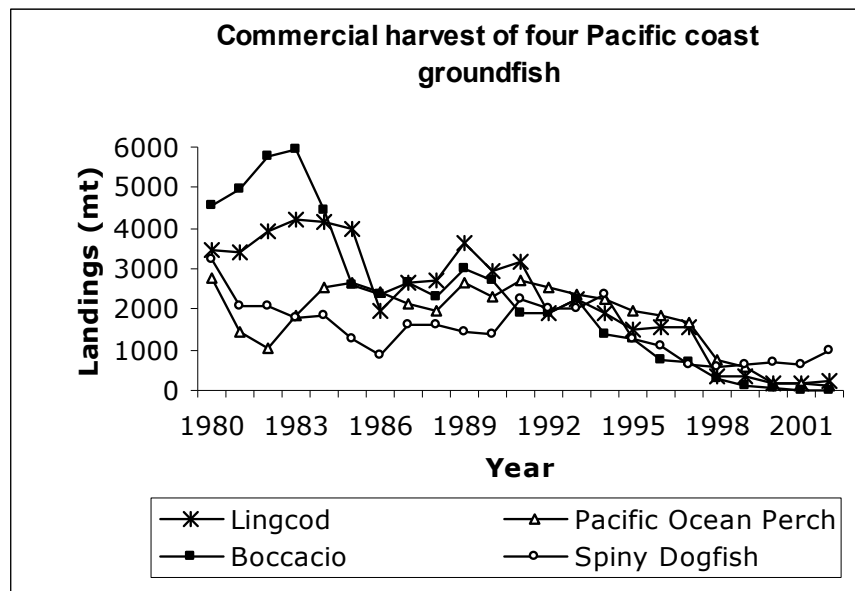


Figure 57: Commercial landings of three species of round groundfish, and spiny dogfish from 1980-2002.

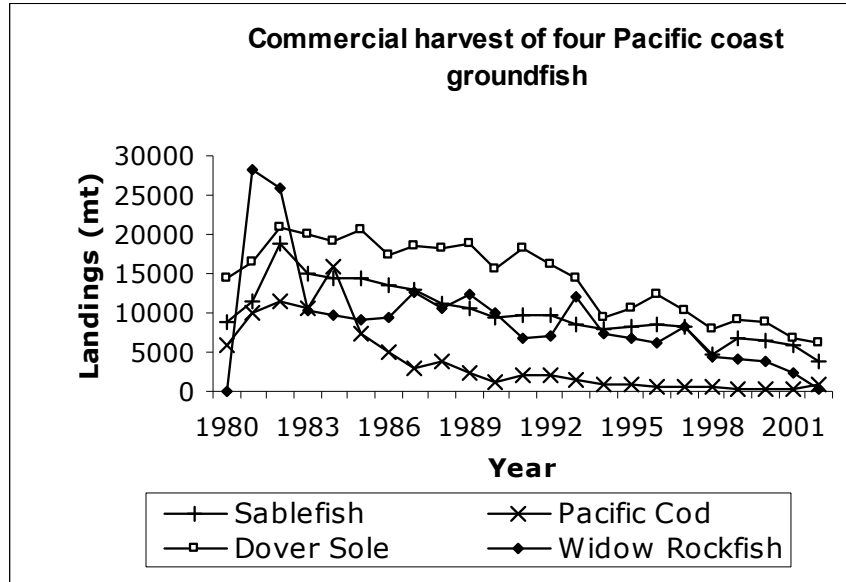


Figure 58: Commercial landings of four species of groundfish from 1980-2002. These species have the highest landings of all groundfish with the exception of Pacific whiting.

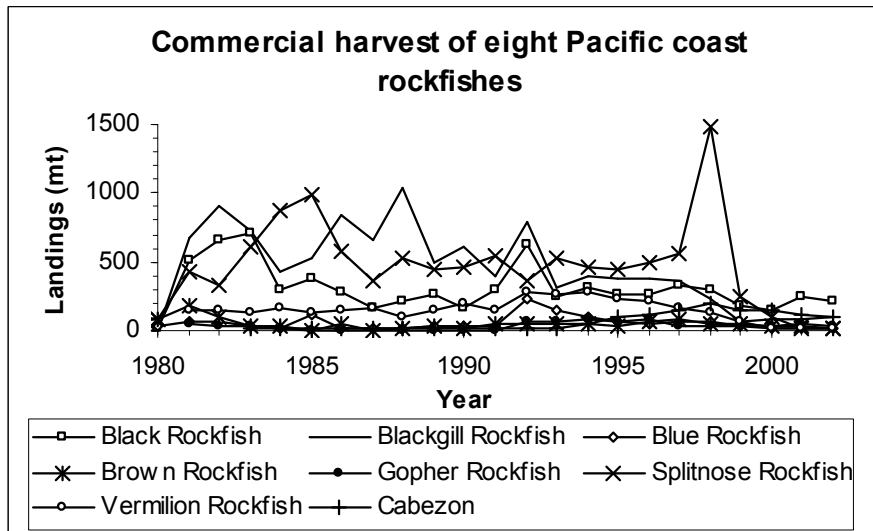


Figure 59: Commercial landings of eight species of rockfish with high landings from 1980-2002.

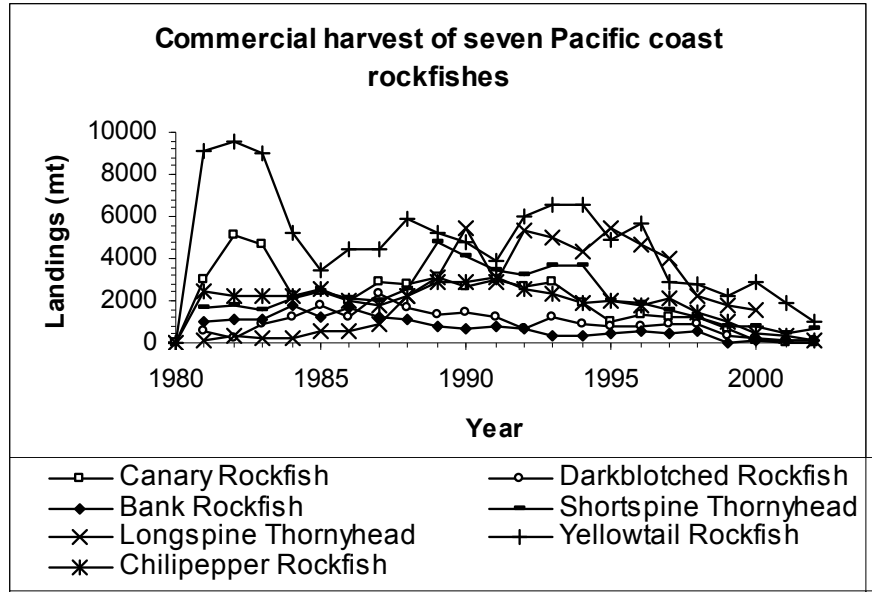


Figure 60: Commercial landings of seven species of rockfish with low landing amounts from 1980-2002.

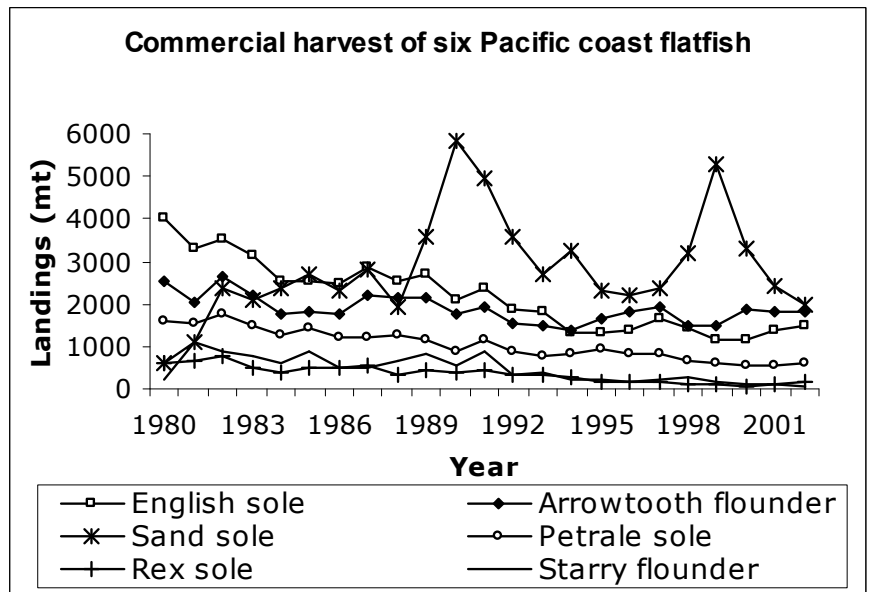


Figure 61: Commercial landings of flatfish in the Pacific coast groundfish complex from 1980-2002.

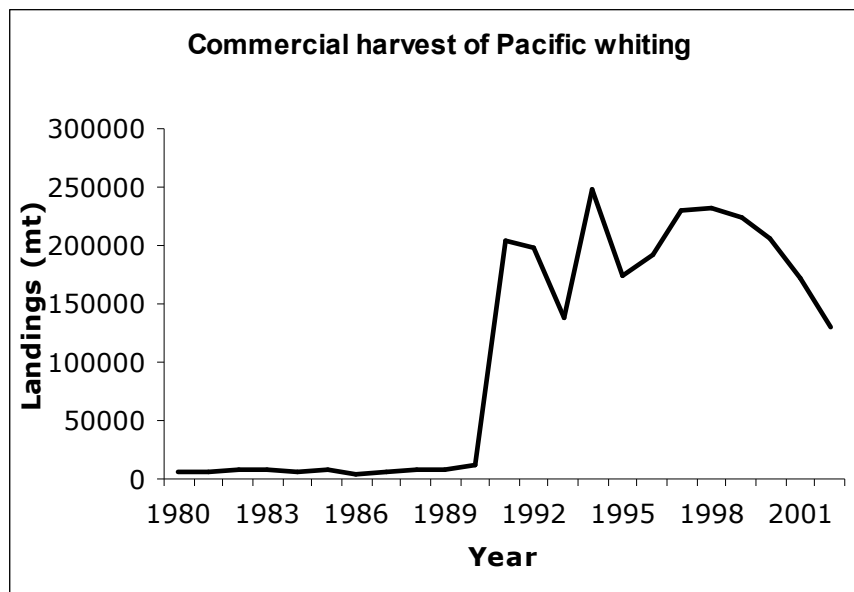


Figure 62: Commercial landings of Pacific whiting from 1980-2002.

Table 87: Commercial landings of 29 species of groundfish in the North Pacific for the 2002 fishing year (NMFS, 2004b). This table excludes longspine thornyhead and California scorpionfish; both are considered major species, but longspine thornyhead has not been landed commercially since 2000 and California scorpionfish is only landed recreationally.

Species	2002 Landings (mt)	Species	2002 Landings (mt)
Lingcod	207.9	Blue rockfish	20.0
Pacific Ocean perch	106.9	Brown rockfish	21.5
Bocaccio	20.9	Gopher rockfish	33.7
Sablefish	3,935.9	Splitnose rockfish	18.3
Pacific cod	937.9	Vermilion rockfish	8.4
Spiny dogfish	1,006.1	Cabezon	96.3
Dover sole	6,301.1	Canary rockfish	46.8
English sole	1,476.5	Darkblotched rockfish	77.1
Petrale sole	1,793.1	Widow rockfish	362.5
Arrowtooth flounder	2,000.7	Bank rockfish	163
Rex sole	597.7	Shortspine thornyhead	683.5
Sand sole	186.8	Yellowtail rockfish	1,027.2
Starry flounder	62.4	Chilipepper rockfish	156.8
Black rockfish	219.5	Pacific whiting	129,598.5
Blackgill rockfish	93.7		
Total commercial landings (all species)		152,776 mt	

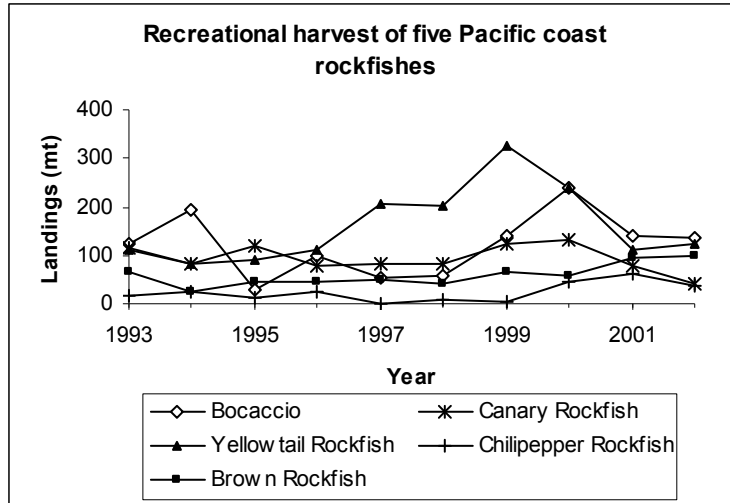


Figure 63: Recreational landings of rockfish from 1993-2002. Landings fluctuate, but do not show any overall trends.

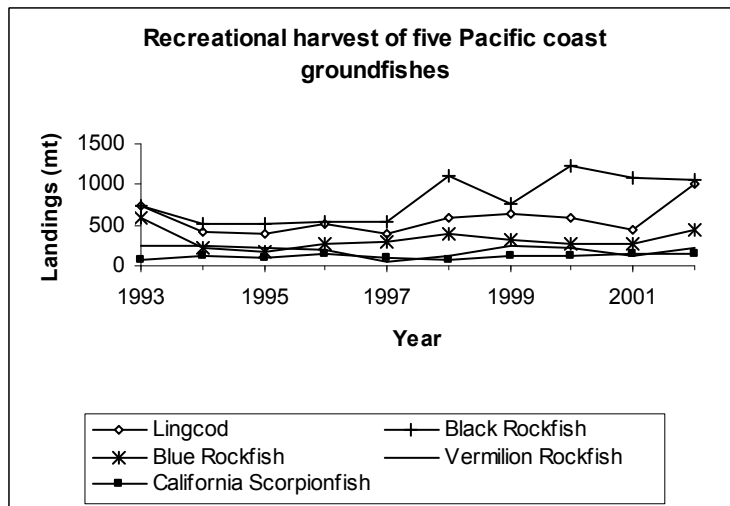


Figure 64: Recreational harvest of five Pacific coast groundfish from 1993-2002. Landings appear to be increasing minimally.

Table 88: Total recreational landings for ten species of North Pacific groundfish for the 2002 fishing year (NMFS, 2004e).

Species	2002 Recreational landings (mt)
Bocaccio	134.2
Canary rockfish	40.5
Yellowtail rockfish	123.8
Chilipepper rockfish	38.6
Brown rockfish	100.4
Lingcod	1,007.7
Black rockfish	1,063.5
Blue rockfish	447.0
Vermilion rockfish	229.6
California scorpionfish	140.6
Total recreational landings (mt)	3,325.9

Gear usage in the Pacific coast groundfish fisheries is described in Table 89 based on catch data. Overall, trawls are responsible for almost 98% of the total groundfish catch along the Pacific coast. However, three distinct species groupings emerge with distinct gear usage patterns. The first, consisting of the fisheries for lingcod, bocaccio, canary rockfish, sablefish, blackgill rockfish and spiny dogfish, has large portions of the catch from both trawls and hand lines. In the second grouping, black rockfish, blue rockfish, brown rockfish, gopher rockfish, vermilion rockfish and cabezon, handlines are responsible for the majority of the catch. In the last grouping, which includes all other species (18 total), almost the entire catch is from trawl gear (NMFS, 2004b).

Table 89: Gear usage (%) in the Pacific coast groundfish fishery. The main gears used are trawls and hand lines.

Species	Gear Type						
	Trawls, Unspecified	Lines Hand, Other	Otter Trawl Bottom, Shrimp	Lines Troll, Other	Nets, excluding trawls	Pots And Traps, Other	Unspecified Gear
Lingcod	41.6	38.2	10.3	6.7	2.3	0.9	
Ocean Perch	99.5	0.4	0.1				
Bocaccio	74.2	21.4	0.7	1.3	2.3		
Canary Rockfish	56.6	21.3	18.9	3.3			
Darkblotched Rockfish	99.2	0.8					
Widow Rockfish	99.4	0.4	0.1		0.2		
Pacific Whiting	100						
Bank Rockfish	91.4	5.8	0.2	0.2	2.4		
Shortspine Thornyhead	91.4	7.6	0.2			0.7	
Longspine Thornyhead	95.8	3.6	0.3			0.2	
Yellowtail Rockfish	96.3	0.4	3.1	0.2			
Sablefish	41.2	44.7	1.0			13.1	
Dover Sole	99.4		0.5				
English Sole	99.8		0.2				
Petrale Sole	99.6		0.4				
Chilipepper Rockfish	86.7	10.6	1.0	0.4	1.3		
Arrowtooth Flounder	99.5		0.4				
Black Rockfish	1.2	96.3		1.7		0.7	0.1
Blackgill Rockfish	66.4	32.9		0.1	0.2	0.3	
Pacific Cod	99	0.7	0.3				
Rex Sole	99.6		0.4				
Sand Sole	98.8	0.4		0.2	0.6		
Starry Flounder	98.8	0.2	0.1	0.2	0.7		
Blue Rockfish		97.9		0.5		1.5	
Brown Rockfish	1.2	95.5				3.3	
Gopher Rockfish		89.4				10.1	0.6
Splitnose Rockfish	95.6	4.3				0.1	
Vermilion Rockfish	2.5	92.5		1.3	0.6	2.5	0.6
Spiny Dogfish	48.6	48.2			3.2		
Cabezon	0.3	72.2		0.1	0.2	27.2	0.1
Percent landings by gear, all groundfish (%)	97.877	1.606	0.114	0.012	0.018	0.373	0.001

Regulations

The Pacific coast groundfish FMP mandates several types of fishing regulations including permit requirements, landing limits, gear restrictions, size restrictions, area/time closures, and quotas. The Pacific Fishery Management Council is also currently considering the use of individual fishing quotas as an additional management strategy for the Pacific Coast groundfish stocks (NMFS, 2003a; NMFS, 2004d; NMFS, 2004f). Below is a summation of the current regulations for the fisheries.

Permit requirements

Commercial fishing permits for Pacific coast groundfish are divided into two categories: Limited entry and open access. Open access permit holders are not allowed to use trawl gear. Federal limited entry permit holders are allowed to fish using trawl, longline, or trap under the limited entry quotas and trip limits.

Under the FMP, native Indian tribes are allowed to continue fishing their historical fishing grounds without a federal limited entry permit. Washington coast's Treaty Indian Tribal fisheries are regulated under a separate set of requirements and carry different regulations.

Landing/trip limits

The PFMCM actively maintains and updates landing limits, generally in pounds of fish per two month interval. The landing limits are complex and vary according to multiple factors such as target species, fishing permit, time of year, area, and gear used. For example, a vessel targeting lingcod under a limited access fishing permit, May-November, North of 40° North Latitude using fixed gear can only land up to 400 lb/month. In addition, a vessel targeting lingcod under a limited access fishing permit, July-December, south of 40° N. Lat. using a large footrope bottom trawl (i.e., equipped with rollers or discs) or midwater trawl can land up to 500 lb/2 months.

Gear restrictions

Authorized commercial gears in Pacific Coast groundfish fishery are trawl nets, traps, longlines, hook and line, and spear. Setnets (anchored gill/trammel nets) are authorized for use only south of 38° N. Lat. in an effort to reduce incidental take of Salmonids. In general, trawl nets must have a minimum mesh size of 3.0 or 4.5 inches, depending on the type of trawl net and the location in which it is fished. Traps are required to have biodegradable escape openings of equal to or greater than eight inches in diameter.

The only gears that are allowed in the recreational fishery are hook and line and spear. Further specifications on the number of hooks/lines per fisherman and the sizes of hooks are dictated by state and vary depending on target species, area, and season.

Size restrictions

The only size restrictions used to manage Pacific Coast groundfish apply to just a few species in the recreational fishery which are determined by the state.

Area/time closures

Multiple conservation areas run along the entire Pacific Coast. The location of conservation areas (an area of the ocean awarded protected status in order to ensure that the species and habitat within are safeguarded) usually follow depth contours. For instance, the rockfish conservation area for the limited entry fixed gear fishery north of 46°16' N. Lat. extends from the shore to 100 fathoms (year round). Further south, the rockfish conservation area for this fishery follows a deeper depth contour. The regulations in conservation areas can range from modified trip limits and gear restrictions to complete closures. In addition to conservation areas, the Pacific Fishery Management Council may also close certain area fisheries based on recent harvest and bycatch trends or the attainment of a quota or harvest guideline.

Quotas

For the 2004 fishing year, five fish species in the groundfish management complex were regulated using quotas: sablefish, Pacific ocean perch, widow rockfish, Pacific whiting, and shortbelly rockfish. Harvest guidelines (similar to a quota, but the attainment of which does not necessitate the closure of the fishery) are also used north of Coos Bay, Oregon to manage yellowtail rockfish and the fishes of the Sebastes complex (all rockfish except widow and shortbelly rockfishes, Pacific ocean perch, and thornyheads).

Discards

Commercial discards

Recent commercial discard data are available from the groundfish trawl and the sablefish fixed gear fisheries only. Discards in the groundfish trawl fishery as a whole (including sablefish) are reported in

Table 90. The observer data for this fishery are categorized by depth (0-100, 100-200, >200fm), target species and area (two latitude ranges). However, the landings data only included the area stratum, and the resulting discard estimates could not be made by depth stratum or target species. The uncertainty in the estimates of discards is increased because of the inability to stratify the data within areas by target species and depth. Bycatch of halibut in the groundfish trawl fishery off Washington and Oregon is reported separately (Table 91). Bycatch in the sablefish fixed gear fisheries is reported in Table 92 (longline fishery) and Table 93 (pot fishery).

Table 90: Discards in the Pacific coast groundfish trawl fishery, 2002-2003. Discards are reported in metric tons (NMFS, 2003b).

Species	2002			2003		
	North of 40°10'	South of 40°10'	Total	North of 40°10'	South of 40°10'	Total
Whiting	4,350.5	344.3	4,694.8	4,886.7	231.1	5,117.9
Arrowtooth flounder	2,339.6	7.3	2,346.9	2,604.2	6.4	2,610.6
Petrale sole	584.9	7.2	592.2	684.8	6.8	691.7
Dover sole	1,055.6	413.1	1,468.7	1,240.5	379.4	1,619.9
Longspine thornyhead	220.5	144.0	364.5	274.9	132.2	407.1
Shortspine thornyhead	158.9	70.5	229.4	192.5	66.6	259.1
Thornyheads	193.7	77.1	270.7	241.1	71.2	312.3
Sablefish	4,321.4	509.3	4,830.7	5,097.7	373.7	5,471.3
Bocaccio	51.5	52.7	104.2	61.2	31.1	92.3
Chilipepper	17.4	171.7	189.1	17.4	79.3	96.8
Canary	220.5	0.7	221.2	253.8	0.7	254.4
Cowcod	0.0	3.2	3.2	0.0	1.5	1.5
Widow	2.1	0.7	2.8	1.9	0.7	2.6
Yellowtail	507.7	0.0	507.7	489.8	0.0	489.8
Yelloweye	0.6	0.2	0.8	0.7	0.2	0.9
Darkblotched	118.0	2.1	120.0	129.6	2.1	131.7
POP	37.1	0.1	37.2	39.0	0.2	39.2
Splitnose	135.5	52.4	187.9	145.4	64.8	210.2
Black rockfish	2.5	0.0	2.5	2.9	0.0	2.9
Lingcod	555.4	63.4	618.8	641.6	64.7	706.3
Pacific halibut	101.5	0.2	101.7	117.3	0.2	117.5
Salmon	97.0	1.4	98.4	113.8	1.2	115.0
Shark/skates	3,528.3	846.1	4,374.4	4,100.4	727.4	4,827.7
Total	18,600.2	2,767.5	21,367.7	21,337.1	2,241.6	23,578.7

Wallace and Hastie (2004) calculated bycatch of halibut in the groundfish trawl fishery off Washington and Oregon based on 2,812 observed bottom trawl tows. The strata used to estimate 2002 halibut bycatch were season (Jan-Aug and Sept-Dec), depth (0-100, 100-300, 300-700 fm), area (four latitude ranges) and catch of arrowtooth flounder (0-20 lbs per hour and >20 lbs). Wallace and Hastie (2004) applied bycatch rates for these strata to trawl effort summarized from logbooks by stratum, and the resulting bycatch amounts were expanded to account for landings not captured in logbooks. Halibut bycatch by the bottom trawl fleet was estimated by summing across strata (Table 91). If there was effort within a strata, but no observed tows, the researchers used the coast wide average bycatch rate: 15.083 kg per hour. These bycatch values are calculated as the unweighted averages of the stratum means.

Table 91: Bycatch of halibut in the Washington and Oregon groundfish trawl fishery, 1998-2003. Bycatch is given in metric tons round weight (Wallace and Hastie, 2004).

Year	Estimated halibut bycatch
1998	1,259
1999	1,144
2000	944
2001	962
2002	619
2003	559

Bycatch and discards in the sablefish fixed gear fishery were estimated from observer data (NMFS, 2004c). Observer data were expanded to give bycatch and discard estimates for the sablefish longline

and pot fisheries by multiplying the observed bycatch or discards by the reported sablefish landings/observed retained sablefish ratio by year and gear type (Table 92 and Table 93).

Table 92: Estimated bycatch and discards in the sablefish longline fishery off California, Oregon and Washington, 2001-2003. Discards are reported in metric tons (NMFS, 2004c).

Species	2001			2002			2003		
	Landings, mt	Discards, mt	Total Catch, mt	Landings, mt	Discards, mt	Total Catch, mt	Landings, mt	Discards, mt	Total Catch, mt
Bocaccio rockfish	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.4
Canary rockfish	0.0	0.0	0.0	0.2	4.4	4.7	0.6	0.8	1.4
Widow rockfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Yelloweye rockfish	0.2	0.0	0.2	0.3	4.4	4.7	0.4	3.3	3.7
Darkblotched rockfish	0.1	0.0	0.1	0.3	0.2	0.5	1.2	0.2	1.4
Pacific Ocean perch	0.0	0.0	0.0	0.7	0.0	0.7	0.1	0.0	0.1
Lingcod	0.7	0.8	1.5	7.4	3.1	10.5	13.3	5.5	18.8
Sablefish	2,354.6	190.7	2545.3	1744.5	366.4	2110.9	2319.1	346.7	2665.8
Pacific whiting	0.0	1.3	1.3	0.1	0.6	0.7	0.0	0.4	0.4
Roundfish, other	0.0	7.3	7.3	1.3	3.8	5.2	6.7	3.4	10.1
Dover sole	0.0	0.2	0.2	0.3	11.5	11.8	0.3	4.0	4.3
Arrowtooth flounder	0.1	55.6	55.8	24.4	44.1	68.5	28.8	52.3	81.0
Petrale sole	0.0	0.0	0.0	4.0	0.2	4.2	0.9	0.1	1.1
Other flatfish	0.0	0.0	0.0	1.8	0.0	1.8	0.0	0.0	0.0
Longspine thornyhead	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0
Shortspine thornyhead	31.7	12.4	44.2	6.8	0.3	7.2	8.2	0.6	8.8
Mixed thornyheads	6.0	2.4	8.4	0.7	0.0	0.7	0.3	0.0	0.3
Yellowtail rockfish	0.0	0.0	0.0	0.8	0.4	1.2	1.6	0.2	1.9
Shelf rockfish, other	0.2	0.2	0.5	4.1	5.2	9.3	8.0	3.7	11.7
Slope rockfish, other	15.0	0.4	15.4	28.3	5.2	33.5	70.5	9.4	79.9
Black rockfish	0.0	0.0	0.0	0.8	0.0	0.8	0.0	0.0	0.0
Nearshore rockfish, other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cabezon	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0
Pacific halibut	19.5	193.7	213.2	73.1	311.2	384.3	98.7	518.6	617.3
Salmon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (with sablefish)	2,428.3	465.1	2893.4	1900.7	761.1	2661.8	2559.0	949.4	3508.4
Total (without sablefish)	73.7	274.4	348.1	156.2	394.7	550.9	239.9	602.7	842.7

Table 93: Landings and discards in the sablefish pot fishery off California, Oregon and Washington, 2001-2003. Discards are reported in metric tons (NMFS, 2004c).

Species	2001			2002			2003		
	Landings, mt	Discards, mt	Total Catch, mt	Landings, mt	Discards, mt	Total Catch, mt	Landings, mt	Discards, mt	Total Catch, mt
Bocaccio rockfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Canary rockfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Widow rockfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yelloweye rockfish	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0
Darkblotched rockfish	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Pacific Ocean perch	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lingcod	0.8	34.8	35.6	1.7	0.0	1.7	0.1	0.4	0.4
sablefish	674.4	35.5	709.9	472.0	215.0	687.0	809.5	98.9	908.4
Pacific whiting	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Roundfish, other	0.0	0.0	0.0	0.0	0.0	0.1	1.8	6.0	7.7
Dover sole	0.1	0.8	1.0	0.8	1.3	2.0	1.4	0.5	2.0
Arrowtooth flounder	0.0	0.7	0.7	0.4	0.4	0.8	0.3	2.2	2.4
Petrale sole	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other flatfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Longspine thornyhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Species	2001			2002			2003		
	Landings, mt	Discards, mt	Total Catch, mt	Landings, mt	Discards, mt	Total Catch, mt	Landings, mt	Discards, mt	Total Catch, mt
Shortspine thornyhead	0.0	0.1	0.1	0.1	0.0	0.1	1.3	0.1	1.4
Mixed thornyheads	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellowtail rockfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shelf rockfish, other	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.1
Slope rockfish, other	0.3	0.7	1.0	1.6	0.0	1.6	2.4	0.0	2.4
Black rockfish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nearshore rockfish, other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cabezon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pacific halibut	0.0	30.0	30.0	0.0	5.7	5.7	0.0	0.4	0.4
Salmon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	675.6	102.9	778.6	477.0	222.4	699.4	817.0	108.4	925.4

The whiting fishery, while included in the FMP for Pacific groundfish, is separate from the fisheries for the other groundfish species. Total catch from the whiting fishery for 2002 is given in Table 94. Forty-seven percent of the catch is from non-tribal at-sea processor vessels, 17% of the catch is from tribal at-sea processor vessels, and 36% of the catch is from shore-based processors (NMFS, 2004a).

Table 94: Overall catch in the entire Pacific whiting fishery for 2003. Catch is in mt except where specified for the prohibited species (salmon and halibut) (NMFS, 2004a).

Species	Catch
Whiting	142,020
Yellowtail rockfish	87
Widow rockfish	23
POP	7
Darkblotched rockfish	5
Canary rockfish	1
Lingcod	1
All other groundfish	405
Total bycatch (excluding whiting)	529
Chinook salmon (#)	6,512
Non-chinook salmon (#)	4,183
Pacific halibut (#)	199

The non-tribal at-sea processors have the most observer data available of all the whiting fisheries, and the catch from that sector is broken down by species (Table 95).

Table 95: Total catch and some discard in the non-tribal at-sea processing sector, 2003. Catch and discards are in mt except where specified for the prohibited species (salmon and halibut) (NMFS, 2004a).

Species	2003 total catch (mt)	2003 discards if known (mt)
Whiting	67235.8	490.0
Pacific cod	0.3	NA
Lingcod	0.5	NA
Sablefish	17.0	NA
Arrowtooth	2.9	NA
Dover sole	0.9	NA
English sole	0.0	NA
Petrable sole	0.0	NA
Rex sole	6.7	NA
Rock sole	0.0	NA
Starry flounder	0.0	NA
All other flatfish	0.2	NA
Bocaccio	0.1	0.0
Canary rockfish	0.3	0.1
Chilipepper	1.3	0.8
POP	5.2	4.4
shortbelly rockfish	0.5	0.1

Species	2003 total catch (mt)	2003 discards if known (mt)
Thornyheads	15.7	1.3
Widow rockfish	12.3	1.6
Yellowtail rockfish	2.3	0.6
Other rockfish	29.1	NA
Pacific mackerel	0.0	NA
Jack mackerel	12.4	NA
Pacific sardine	0.0	NA
Total weight (excluding whiting)	107.2	15.1
Chinook (#)	2648.0	2648.0
non-chinook (#)	224.0	224.0
Pacific halibut (#)	199.0	199.0

Recreational discards

Recreational discard estimates for the all species of Pacific groundfish for which landings are available can be made from the MRFSS online database; however the data are in numbers of fish only. The weight of the discards had to be estimated. Species-specific mortality and weight-at-age data were used to arrive at an average weight per discarded fish (Love et al., 1987; Love et al., 2000; Lowe et al., 1998; Miller and Geibel, 1973; Shaw and Hassler, 1989; Smith and McFarlane, 1990; Wilkins, 1980). These calculations only considered sub-legal fish, as it is assumed that legal sized fish are retained.

Applying the average weight per fish to the numbers of discarded fish of each species (NMFS, 2004e) gives an estimated weight of discards (Table 96). Of particular interest is the major increase in lingcod discards over the past three years.

Table 96: Estimated recreational discards of target species within the North Pacific groundfish complex, 1993-2002. Discards are reported in metric tons.

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Lingcod	87.8	62.3	85.1	151.3	135.2	177.9	186.9	385.3	406.3	850.2
Bocaccio	0.9	0.2	0.1	0.0	0.1	0.1	2.3	1.1	0.3	1.3
Canary rockfish	1.2	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.9	1.3
Yellowtail rockfish	5.0	0.3	0.1	0.2	0.4	0.1	0.1	0.2	1.4	1.3
Chilipepper rockfish	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Black rockfish	17.8	4.7	8.8	0.7	0.6	1.7	5.1	2.2	31.8	22.4
Blue rockfish	36.1	2.7	4.9	3.4	6.0	5.3	4.0	0.9	4.2	9.2
Brown rockfish	1.1	0.2	0.1	0.3	0.1	0.1	0.2	0.5	0.3	0.8
Vermilion rockfish	2.0	0.7	0.1	0.6	0.1	0.1	0.1	0.2	1.8	2.2
California scorpionfish	10.2	17.9	19.7	33.2	18.7	9.3	15.0	33.7	41.0	56.9
Total	162.1	89.6	118.9	189.8	161.3	194.7	213.6	424.5	488.1	945.6

In summary, the 2002 commercial groundfish fishery (excluding whiting) landed 21,662 mt of target species (NMFS, 2004b). In 2002, there were 21,368 mt of discards in the groundfish fishery and 983 mt in the sablefish fixed gear fishery. This gives an overall commercial d/l ratio of 1.03. Even though 2003 discards were available (Table 90), 2003 landings were not yet published on the NMFS commercial landings database, so 2002 data are presented here. Discards for 2003 increased by over 2,000 mt, but without the landings data, there is no way to determine whether that increased or decreased the discard to landings ratio. Other estimates of halibut bycatch and discards in the Washington and Oregon groundfish trawl fisheries were considerably higher (quadruple) than in the overall Pacific coast groundfish trawl surveys (Wallace and Hastie, 2004). The reason for this discrepancy is unknown. Recreationally, 3,326 mt of groundfish were landed and 946 mt of fish were discarded, resulting in a recreational d/l ratio of 0.28.

In the commercial whiting fishery, the total catch of whiting was 142,020 mt (NMFS, 2004a) and the total bycatch was 585.52 mt for a b/l ratio of 0.004. In order to obtain this total bycatch weight, we assumed an average salmon weight of 5 kg in the absence of weight data. Halibut were assumed to weigh on average 16.7 kg each (IPHC, 2004). The primary bycatch species were groundfish (405.18 mt), yellowtail rockfish (86.89 mt) and salmon (53.48 mt).

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Pacific Halibut Fishery

Major Target Species:	Pacific Halibut (<i>Hippoglossus stenolepis</i>)
Major Discard Species:	Rockfish, Spiny dogfish (<i>Squalus acanthius</i>), Skates, Sharks, Sablefish (<i>Anoplopoma fimbria</i>), Echinoderms
Primary Gear Types:	Longline
Total Landings (2002):	26,065 mt
Total Discards (2002):	20,929 mt
Total Discards Rank (of 27):	10
Discard to Landings Ratio:	0.80
d/I Rank (of 27):	8
Source of Estimates:	DFO, Independent research studies, IPHC, Authors
Discard Type:	Primarily non-target, regulatory
Notes:	

The Pacific halibut ranges from California to the Bering Sea, and it is most abundant in the Gulf of Alaska. Halibut are managed jointly under a bilateral treaty between the U.S. and Canada. Research, data and quota recommendations by the IPHC, formed in 1923, are used in determining management strategies for halibut. The Pacific halibut fishery has a long tradition dating back to the 1880's. However, the nature of the fishery has changed. In 1979 and 1995, respectively, Canada and Alaska moved from a derby-style fishery to an individual fishing quota (IFQ) system. Derby-style fishing is still in effect in Washington, Oregon and California (WA/OR/CA), but if fishermen from these three states also have an Alaskan halibut permit, they must abide by the IFQ laws when fishing in Alaskan waters or landing Alaskan halibut. Overfishing is not occurring in this fishery, but it is undefined whether the fishery is overfished (NMFS, 2004b).

Target landings

Catch data for Pacific halibut are available from two different sources, NMFS and IPHC. Here, the IPHC data will be used instead of NMFS data. The IPHC documents halibut harvest based on where the fish were caught, and NMFS documents halibut harvest based on where the fish were landed. The former provides a better basis for estimating total bycatch. The IPHC catch data from Alaska and WA/OR/CA for the past three decades (Figure 65 and Figure 66), shows that prior to 1992, the total catch almost always exceeds the quota. In 2002, the total catch (commercial and recreational) of Alaskan halibut was 41,612.6 mt and the total catch (commercial and recreational) of WA/OR/CA halibut was only 756.0 mt.

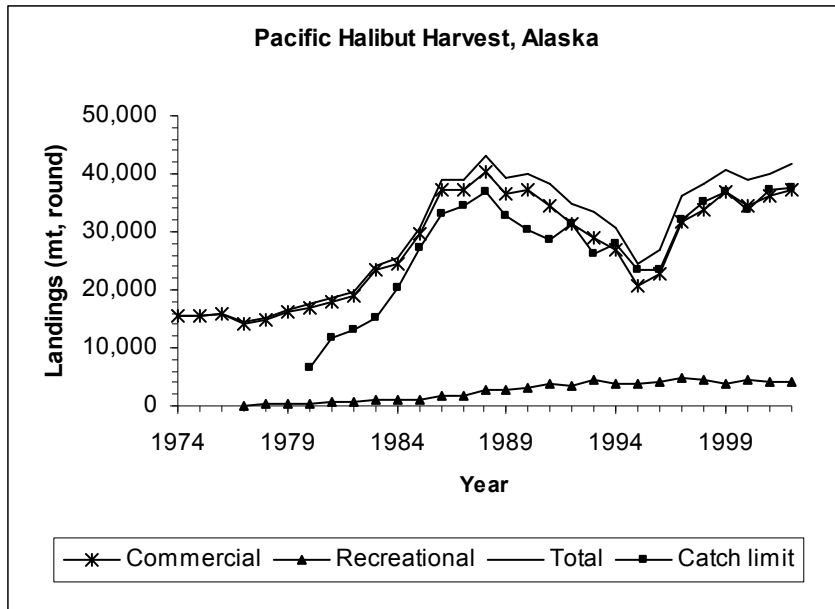


Figure 65: Pacific halibut harvest in Alaska, both commercial and recreational, shown with annual quota (1974-2002).

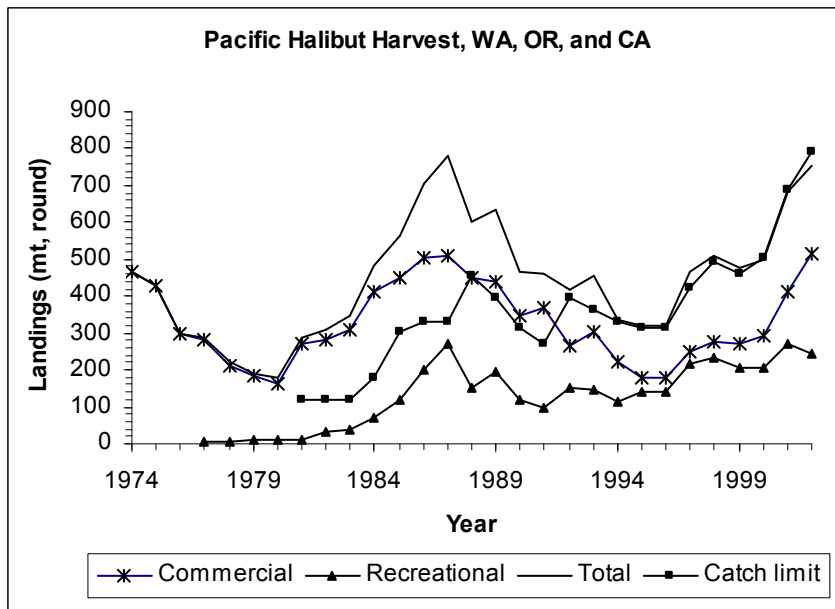


Figure 66: Pacific halibut harvest in WA, OR, and CA, both commercial and recreational, shown with annual quota (1974-2002).

The gear usage for the Pacific halibut fishery is almost entirely longline. Off the coasts of WA, OR and CA, landings are 95% from setlines (longlines), and five percent from trolling. Gear percentages for Alaska are not known.

Regulations

Pacific halibut in the northeastern Pacific Ocean are managed by the IPHC, a joint commission between the U.S. and Canada. The IPHC meets annually to set a total allowable catch (TAC) for Pacific halibut divided between Alaska (Areas 2C, 3A, 3B 4A, 4B, 4C, 4D and 4E), British Columbia (Area 2B), and Washington/Oregon/California (Area 2A) (Figure 67). The Pacific States Fisheries Management Council

(PSFMC) and the Alaska Fisheries Management Council (AFMC) are responsible for further allocating allowable catch levels and setting regulations, for approval by the IPHC.

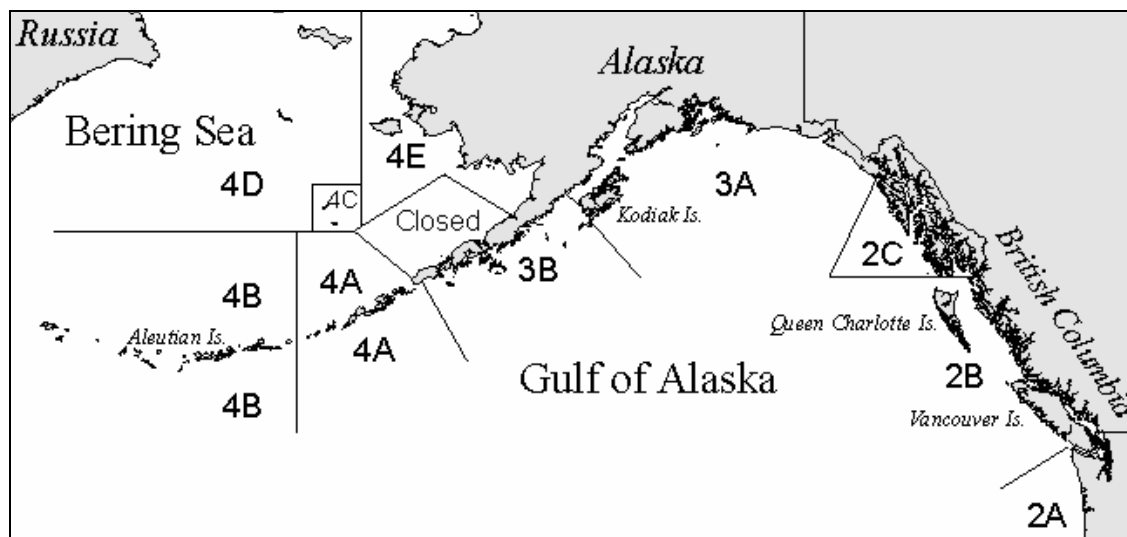


Figure 67: Pacific halibut management areas (IPHC, 2005).

The IPHC set the 2004 Pacific halibut TAC at 34,700 mt, based on information from the 2003 Pacific halibut stock assessment. Of that, 27,766 mt was allocated to Alaska, 6,259 mt to British Columbia, and 673 mt to WA/OR/CA (Table 97). The allowable catch in Alaska is divided among eight subregions and allocated using an IFQ and community development quota (CDQ) system for the commercial and tribal fisheries. The PSFMC subdivides the allowable catch for area 2A (WA/OR/CA) between the treaty-tribal and non-treaty fisheries. Additionally, there are further subdivisions of the allowable catch between user groups, area, and season. The allowable catch allocated to the directed non-treaty commercial halibut fishery in the EEZ off WA, OR, and CA for 2004 is 115 mt.

Table 97: Breakdown of the 2004 IPHC TAC by user group and area. Values are approximate.

User Group	Allowable catch, 2004 (mt)
Alaska	27,766
British Columbia	6,259
Area 2A (WA,OR,CA) Total	673
Treaty-Tribal	247
Commercial	238
Ceremonial/Subsistence	9
Non-Treaty	426
Commercial	167
Directed Halibut	115
Salmon Troll Incidental	20
Sablefish Incidental	32
Recreational	259
WA Sport	124
CA/OR sport	135
Total Pacific Halibut Fishery	34,698

Although quotas are the primary method of regulation for the Pacific halibut fishery, both the AFMC and the PSFMC also use area/seasonal closures, gear regulations, possession limits, trip limits, and size requirements (32" TL with head on, set by IPHC) for the commercial and recreational fisheries. The non-tribal commercial fishery is open for 10 hours on each of seven days spread out between June and

September. If the projected catch for any of the fishing days exceeds the allowable catch, then the fishery is closed (IPHC, 2004; NMFS, 2004a; PFMC, 2004a; PFMC, 2004b).

Discards

Target species discards in the halibut fishery are well documented. Discards are split by management area and by size. Sub-legal halibut mortality (< 32") in Table 98, legal sized halibut mortality (\geq 32") as a result of discarding is reported in Table 99, and legal sized halibut mortality from abandoned or lost gear is estimated in Table 100. Discards from British Columbia are included in these tables.

Table 98: Discard mortality (mt, round weight) of sub-legal halibut in the halibut fishery by area, 1987-2003 (Gilroy, 2004).

Year	Area 2A	Area 2B	Area 2C	Area 3A	Area 3B	Area 4	Total
1987	1.8	104.6	222.6	955.6	206.2	155.4	1646.2
1988	0.6	29.6	124.6	910.8	73.8	41.7	1181.2
1989	4.2	27.8	116.7	881.8	117.3	78.6	1226.5
1990	9.1	70.8	197.8	671.3	130.6	143.9	1223.5
1991	1.2	43.5	209.9	691.3	252.8	148.2	1346.9
1992	4.2	32.1	148.2	388.9	109.5	76.2	759.0
1993	5.4	58.1	116.1	206.2	38.1	68.3	492.3
1994	0.6	41.7	137.9	511.1	23.6	64.7	779.6
1995	1.8	23.6	32.7	77.4	5.4	14.5	155.4
1996	0.6	17.5	26.6	107.1	13.3	44.8	209.9
1997	3.6	22.4	24.2	44.8	32.7	47.8	175.4
1998	0.6	32.1	24.8	93.1	33.9	32.7	217.1
1999	4.2	24.2	40.5	70.8	42.9	56.3	238.9
2000	4.2	16.9	23.0	12.7	35.1	41.7	133.7
2001	1.8	27.8	22.4	19.4	19.4	53.2	143.9
2002	3.0	21.8	15.7	13.9	20.6	30.8	105.8
2003 (prelim. estimate)	3.0	13.9	17.5	55.0	21.2	25.4	136.1

Discard mortality has decreased significantly over the past 17 years (Table 98). However, this does not imply that the catch of sub-legal halibut is decreasing. New methods for increasing the survival of released halibut have been implemented. Prior to 1999, estimates of sub-legal halibut mortalities were made using sub-legal to legal size ratios from IPHC grid surveys. Starting in 1999, estimates were based on ratios from commercial setline surveys using data from one-third of the survey trips, incorporating the trips that caught the most legal-sized halibut, as they are most similar to the catch from a commercial halibut trip (Gilroy, 2004).

Table 99 gives discard mortality of legal-sized halibut in all areas (Clark and Hare, 2004). The overall discard mortality is decreasing, but it is much higher than that of the sub-legal sized halibut, a fact that is surprising. One possible explanation for the higher discard mortality of legal sized halibut is that halibut fishermen are high-grading their catch and discarding many legal sized halibut which have been on deck too long to survive when returned to the water.

Table 99: Bycatch mortality (mt, round weight) of legal sized halibut, 1990-2004 (Clark and Hare, 2004).

Year	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
1990	153.0	622.3	407.6	1592.4	734.8	378.0	202.6	1442.4	5533.3
1991	153.0	738.5	330.2	1890.6	626.0	442.1	142.7	1352.9	5676.0
1992	166.9	615.1	347.2	1599.1	675.0	437.9	396.1	1171.5	5408.7
1993	166.9	393.7	201.4	1160.6	281.8	84.7	289.7	850.9	3429.8
1994	166.9	345.3	239.5	1422.5	512.9	723.9	324.2	1100.7	4835.9
1995	230.4	426.4	132.5	883.0	499.0	657.4	90.1	1279.7	4198.5
1996	286.1	100.4	140.9	848.5	580.6	359.2	277.6	1808.9	4402.3
1997	286.1	65.9	145.2	936.8	440.9	510.4	119.8	1792.6	4297.7
1998	504.4	70.8	143.9	889.7	442.1	721.5	197.8	1648.1	4618.2
1999	460.3	64.7	139.1	776.0	449.4	549.8	203.2	1597.9	4240.2
2000	383.4	77.4	153.6	777.8	390.7	488.7	350.8	1378.3	4000.7
2001	390.1	90.1	111.3	978.0	382.2	347.2	234.1	1753.9	4286.8
2002	173.0	91.9	100.4	648.9	434.8	323.0	118.5	1654.1	3544.7

Year	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
2003	214.7	80.4	87.1	711.8	302.4	311.5	132.5	1273.1	3113.5
2004	222.0	84.7	90.1	919.3	237.7	312.1	177.8	1158.2	3201.8

Gilroy (2004) estimated legal-sized halibut mortality from lost or abandoned gear based on logbook data and interviews (Table 100)

Table 100: Amount (mt, round weight) of legal sized halibut mortalities from lost or abandoned gear, 1987-2003 (Gilroy, 2004).

Year	Area 2A	Area 2B	Area 2C	Area 3A	Area 3B	Area 4	Total
1987	7.3	217.1	96.8	332.6	148.8	83.5	886.0
1988	6.1	228.0	103.4	402.2	136.1	56.9	932.6
1989	5.4	179.0	92.5	365.3	114.9	59.9	817.1
1990	2.4	150.6	88.9	307.2	155.4	65.9	770.5
1991	6.1	97.4	78.6	449.4	180.2	45.4	857.0
1992	7.3	103.4	88.9	526.2	130.6	50.2	906.6
1993	9.7	143.9	102.2	446.9	118.5	47.2	868.5
1994	4.8	134.3	94.4	488.1	58.7	40.5	820.7
1995	1.8	102.2	45.4	248.6	30.2	23.0	451.2
1996	1.8	129.4	85.9	248.0	53.2	25.4	543.7
1997	2.4	204.4	86.5	405.2	157.9	101.6	958.0
1998	2.4	229.2	108.3	348.4	173.0	105.2	966.5
1999	1.2	207.4	99.8	264.9	159.7	95.6	828.6
2000	0.6	109.5	80.4	254.0	189.9	80.4	714.9
2001	1.8	149.4	93.7	235.9	271.0	111.3	863.0
2002	2.4	110.1	66.5	292.7	292.7	79.8	844.3
2003 (prelim. estimate)	5.4	192.3	61.1	371.3	367.7	80.4	1078.3

No non-target species bycatch or discard data were available for the U.S. halibut fisheries. However, the Department of Fisheries and Oceans Canada reports some non-target species bycatch data from their halibut longline fishery. We applied these data to the U.S. halibut fishery to approximate non-target species bycatch in the U.S. fishery.

In 2002, the bycatch to landings ratios for 14 species of rockfish were determined for the Canadian fishery and then applied to the U.S. fishery (Table 101). The 2003 Discard to landings ratios for each species of rockfish were calculated by dividing the amount of rockfish caught in the Canadian halibut fishery by the total Canadian halibut landings. These ratios were then multiplied by the total 2002 U.S. landings of halibut (37,851.4 mt) to obtain the total U.S. bycatch of rockfish. Total rockfish bycatch is estimated at 3,443.73 mt. Based on the Canadian estimate of rockfish catch dispositions, the majority of this catch is landed and not discarded.

Table 101: Bycatch of rockfish in the United States halibut fishery based on bycatch to landings ratios from the Canadian halibut fishery (DFO, 2003).

Species	2003 Canadian b/l ratio	Rockfish bycatch (mt) in 2002 U.S. halibut fishery
Yelloweye rockfish	0.031	1168.8
Quillback rockfish	0.003	108.4
Copper rockfish	≤0.001	2.9
China rockfish	≤0.001	3.0
Tiger rockfish	≤0.001	2.8
Silvergray rockfish	0.004	159.2
Canary rockfish	0.002	87.9
Red banded rockfish	0.019	731.0
Rougheye rockfish	0.016	600.4
Shortspine thornyhead	0.007	249.6
Thornyheads	≤0.001	0.2
Shortraker rockfish	0.006	211.5
Bocaccio rockfish	0.002	62.0
Yellowmouth rockfish	0.001	39.0
Additional rockfish	≤0.001	17.3
Total	0.091	3443.7

Bycatch data for the U.S. halibut fishery also was expanded from a 2002 Canadian observer study (Table 102) (McElderry et al., 2003). The data were originally in numbers of fish, but average weights for all the animals on the list were obtained and the weight of bycatch was estimated (Bodenmiller, 2001; Conservation Science Institute, 2004; FLMNH, 2004a; FLMNH, 2004b; IPHC, 2004; Janusz et al., 1999; Leask and Beamish, 1999 Sharks.com, 2004a, Sharks.com 2004b; Thompson and Dorn, 2003; Wallace, 2002). The landed weights reported in Table 102 may be underestimates as the average weights used to calculate landings and discards were the average discarded weight per fish from several other Pacific Ocean fisheries. This mainly effects the rockfish and sablefish landings, as the majority of the catch of these species were landed, and the average weight of landed rockfish is larger than the average weight of discarded rockfish. This accounts for the difference in bycatch amounts of rockfish between Table 101 and Table 102 (3,443.73 mt as opposed to 2,014.9 mt). In addition, the bycatch of halibut reported below (Table 102) is considerably higher than the amounts reported for halibut discard mortality (Table 98-Table 100), because live releases are included.

Table 102: Expanded U.S. longline bycatch data from a 2002 Canadian study.

Species	Total # caught	Average wt/animal (mt)	Total catch (mt)	Total landings (mt)	Total discards (mt)
Rockfish					
Rougheye rockfish	731,455	0.0012	877.8	873.4	3.5
Red banded rockfish	446,699	0.0009	416.8	395.2	13.3
Shortraker rockfish	269,231	0.0009	231.5	231.5	0.0
Shortspine rockfish	206,390	0.0010	206.4	184.5	16.7
Yelloweye rockfish	153,755	0.0008	125.8	116.3	8.3
Silvergray rockfish	110,904	0.0007	78.7	61.7	16.8
Quillback rockfish	57,100	0.0005	26.0	24.2	1.6
Yellowmouth rockfish	27,221	0.0010	27.2	27.2	0.0
Canary rockfish	25,094	0.0004	10.2	9.9	0.3
Bocaccio rockfish	8,613	0.0010	9.0	7.8	1.2
Rosethorn rockfish	7,018	0.0002	1.3	1.3	0.0
Pacific Ocean perch	3,828	0.0003	1.0		
Greenstripe rockfish	2,233	0.0002	0.5	0.4	0.1
Yellowtail rockfish	1,489	0.0004	0.6	0.6	0.0
Redstripe rockfish	1,170	0.0002	0.2		
Copper rockfish	638	0.0006	0.4		
Darkblotch rockfish	638	0.0006	0.4		
Tiger rockfish	532	0.0005	0.3	0.3	0.0
Dusky rockfish	425	0.0018	0.8		
Sharpchin rockfish	106	0.0004	0.0		
Widow rockfish	106	0.0004	0.1		
Harlequin rockfish	106	0.0006	0.1		
Unidentified rockfishes	106	0.0006	0.1		
Elasmobranchs					
Spiny dogfish	476,046	0.0018	833.5	0.8	825.2
Longnose skate	212,769	0.0020	425.5	81.7	336.6
Ratfish	40,831	0.0006	25.9	0.4	25.6
Big skate	38,705	0.0020	77.4	14.2	63.2
Sandpaper skate	11,271	0.0020	22.5	0.0	22.5
Unidentified skates	6,805	0.0020	13.6		
Sleeper shark	1,595	0.3400	542.3	0.0	542.3
Black/rougthead skate	1,489	0.0020	3.0		
Blue shark	1,276	0.1810	231.0	0.0	231.0
Soupin shark	319	0.0318	10.1		
Six gill shark	213	0.2720	57.8		
Starry skate	213	0.002	0.4		
Deep sea skate	106	0.0020	0.2		
Flatfish					
Pacific Halibut	2,546,109	0.0167	42,520.0	26,064.8	16,285.2
Arrowtooth flounder	432,557	0.0008	338.5	63.0	275.2
Petrale sole	6,593	0.0010	6.6	3.8	2.8
Dover sole	2,233	0.0041	9.2	1.5	7.6
Rock sole	1,170	0.0003	0.3	0.0	0.0
Other fish					
Sablefish	1,785,732	0.0020	3,609.4	2,306.4	1,256.1

Species	Total # caught	Average wt/animal (mt)	Total catch (mt)	Total landings (mt)	Total discards (mt)
Lingcod	174,703	0.0016	284.0	143.7	140.3
Pacific cod	11,271	0.0038	42.8	41.6	1.2
Grenadiers	8,613	0.0008	6.9	0.0	5.7
Pollock	638	0.0045	2.9	0.0	2.9
Hagfish	532	0.0001	0.1		
Sculpin	425	0.0003	0.2		
Eelpout	319	0.0041	1.3		
Pacific flatnose	106	0.0008	0.1		
Unidentified fish	851				
Invertebrates					
Echinoderms	60,077				
Gastropods	12,015				
Anthozoans	7,443				
Sponges	1,914				
Octopus	744				
Scallops	106				
Tanner crab	106				
Unidentified invertebrates	319				
Seabirds					
Black-footed albatross	106				
TOTAL (invertebrates and birds)	82,832				
TOTAL (w/ halibut)			51,080.4*	30,655.8	20,085.2
TOTAL (w/o halibut)			8,560.4*	4,591.0	3,800.0

* The sum of the total catch column is more than the sum of the total landings and total discards because the disposition of the catch is not known for every species.

In summary, 26,064.77 mt of halibut were landed in 2002, and 16,285 mt of halibut were discarded. In addition, 844 mt of halibut were estimated to die in 2002 because of entanglement in lost or abandoned gear. There were 9,989 mt of non-target species bycatch, at least 3,800 mt of which was discarded. The rockfish bycatch estimates from Table 101 were used in the final estimate rather than the rockfish bycatch estimates from Table 102 to account for the weight of landed rockfish. Overall, there were 27,119 mt of bycatch, at least 20,929 mt of which was discarded. This gives a b/l ratio of 1.04 and a d/l ratio of 0.80. It should be noted that this d/l ratio underestimate because the bycatch disposition was unknown for many of the species in Table 102.

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West Coast Salmon Fishery

Major Target Species:	Chinook salmon (<i>Oncorhynchus tshawytscha</i>), Coho salmon (<i>Oncorhynchus kisutch</i>), Pink salmon (<i>Oncorhynchus gorbuscha</i>)
Major Discard Species:	Salmon
Primary Gear Types:	Ocean troll, gillnet, hook and line
Total Landings (2003):	10,649 mt
Total Discards (2003):	3,543 mt
Total Discards Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Discard to Landings Ratio:	0.33
d/I Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Source of Estimates:	NFMS, Authors
Discard Type:	Primarily target, regulatory
Notes:	This estimate of discards includes recreational data. Average weights of 14 kg for Chinook salmon, 1.875 kg for pink salmon, and 4.05 kg for coho salmon were used to convert landings and discards from numbers of fish to weights (Great Canadian Rivers.com, 2005). Non-target species discard data are not available.

Pacific salmon support important commercial, recreational and tribal fisheries in the states of Washington, Oregon, California and Idaho. Salmon are harvested from the Pacific Ocean, Puget Sound, estuaries and rivers along spawning migration routes. The west coast salmon fishery is managed by the PFMC and focuses on chinook and coho salmon. Small numbers of pink salmon are also harvested, especially in odd-numbered years during spawning runs. Sockeye, chum and steelhead are rarely caught in the Council's ocean fisheries and there are no directed fisheries for these species in council-managed waters. Although several specific populations of salmon have declined over the last century due mostly to freshwater habitat degradation, excessive harvests and hydropower activities, there have been recent increases in overall abundance of harvestable salmon due to more favorable environmental conditions and hatchery production (NMFS, 2003).

Chinook salmon are the largest of the Pacific salmon and range from Kotzebue Sound, Alaska, to Santa Barbara, California. Spawning and rearing chinook are found in most of the rivers in this region, with significant runs in the Columbia River, Rogue River, and Puget Sound. Coho salmon are found in streams and rivers throughout much of the Pacific Rim, from central California to Korea and northern Japan. Unlike chinook, which use mainstream spawning areas, coho use smaller streams and tributaries as spawning grounds. North American coho spawn in tributaries from the San Lorenzo River in Monterey Bay, California to Point Hope, Alaska, and throughout the Aleutian Islands. They are most abundant in coastal areas from central Oregon to southeast Alaska (PFMC, 2004a).

Commercial fisheries for salmon include treaty Indian and non-Indian ocean troll fisheries, the Puget Sound seine and gillnet fisheries, Washington coastal bays gillnet fisheries, lower Columbia non-Indian gillnet fisheries, and the mid-Columbia treaty Indian gillnet fishery. In addition, there are tribal, ceremonial and subsistence fisheries (gillnet, dip net and hook and line) in Puget Sound, Washington coastal bays, Columbia River and other Washington rivers and the Klamath River. Recreational fisheries operate in the ocean, in the inland marine environment (Puget Sound, Strait of Juan de Fuca, coastal bays) and in freshwater (including waters around the Columbia River Buoy 10) (PFMC, 2004b).

In 1990, NMFS began a review of the status of all west coast salmon. It identified 52 environmentally significant units (ESUs) of salmon in Oregon, Washington, Idaho and California. Of those, 26 have been listed as threatened or endangered under the Endangered Species Act (ESA) and 22 are managed under the Pacific Coast Salmon Plan. The managed ESUs that contain stocks which are considered major under the FMP are listed in Table 103 (PFMC, 2003b).

Table 103: Salmon ESUs and their ESA status for major stocks managed under the FMP. This listing does not include hatchery stocks (PFMC, 2003b).

ESU	ESA Status and Date of Initial Listing	Stock Representation in FMP
CHINOOK		
Central Valley fall	Candidate species Sept. 1999	Sacramento River fall
Southern Oregon/Northern California coast	Not warranted Sept. 1999	Southern Oregon Klamath River fall
Upper Klamath and Trinity Rivers	Not warranted	Klamath River fall
Oregon Coast	Not warranted	Central and Northern Oregon
Lower Columbia River	Listed threatened May 1999	North Lewis River fall
Snake River fall	Listed threatened May 1992	Snake River fall
COHO		
Southern Oregon/Northern California Coasts	Listed Threatened May 1997	Southern Oregon Coastal Natural
Oregon Coast	Listed Threatened Oct. 1998	South Central Oregon Coast North Central Oregon Coast Northern Oregon Coastal
Lower Columbia River/Southwestern Washington Coast	Candidate species July 1995	Grays Harbor
Olympic Peninsula	Not warranted	Queets Hoh Quillayute fall Strait of Juan de Fuca (Western)
Puget Sound/Strait of Georgia	Candidate species	Strait of Juan de Fuca (Eastern) Hood Canal Skagit Stillaguamish Snohomish

In addition, there are eight hatchery stocks which are considered major under the West Coast Salmon FMP. They are the Columbia River Basin chinook/Lower River Hatchery Fall, Columbia River Basin chinook/Lower River Hatchery Spring, Columbia River Basin chinook/Spring Creek Hatchery (Fall), Oregon Production Index Area Coho/Columbia River Late (Hatchery), Oregon Production Index Area Coho/Columbia River Early (Hatchery), Washington Coastal Coho/Willapa Bay (Hatchery), Washington Coastal Coho/Quinault (Hatchery) and Washington Coastal Coho/Quillayute Summer (Hatchery) (NMFS, 2004a).

Target landings

The federally managed ocean salmon fisheries are divided into commercial troll and recreational fisheries. Both groups use hook-and-line gear. Inside-water commercial fisheries, managed by the states and treaty tribes, use gillnets and purse seines (NMFS, 2003l). Overall, since 1975, the commercial landings of coho and pink salmon have declined drastically. Landings of chinook salmon declined until 1984 when a six-year increase began. Since then, chinook landings have fluctuated but maintained an overall increasing trend (Figure 68) (PFMC, 2003b; PFMC, 2004b). Total 2003 salmon landings for chinook, coho and pink salmon were 5,169.6 mt (PFMC, 2003b; PFMC, 2004b).

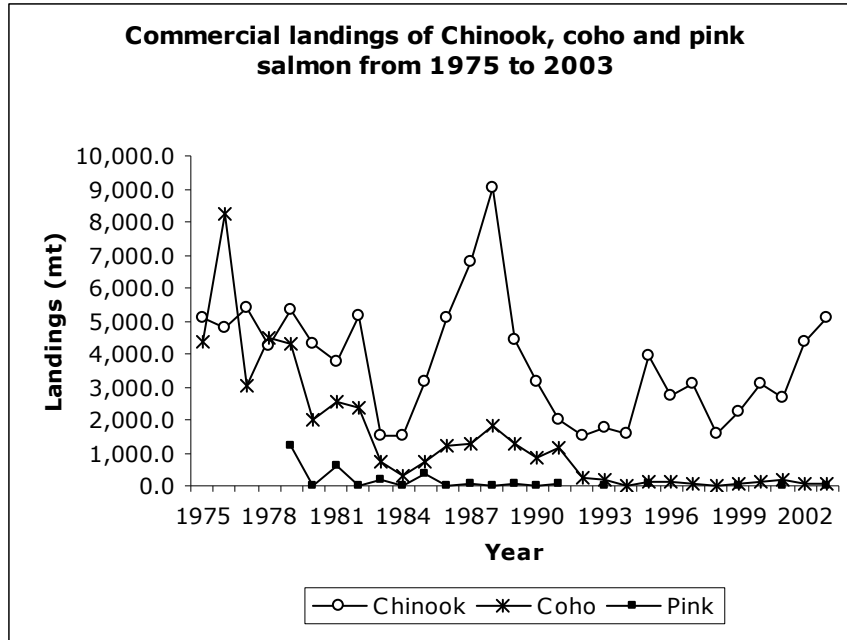


Figure 68: Commercial landings (mt) of chinook, coho and pink salmon (1975 to 2003) (PFMC, 2003b; PFMC, 2004b).

Preliminary landings data for 2004 are available by gear type, but are not separated by species (Table 104). Total landings have risen since 2003 (NMFS, 2004s). The 2004 landings may include some catch from Puget Sound, Alaska and possibly Canadian waters (PFMC, 2003b; PFMC, 2004b). Recent recreational landings (1997-2003) are reported (Table 105).

Table 104: Preliminary 2004 landings (mt) of salmon (all species) by gear type (NMFS, 2004s).

Gear type	2004 Landings (mt)
Mid-water Trawl	12.5
Troll	5,492.5
Pot C&L Pot	.7
Dip Net	40.0
Gillnet	1,413.0
Other nets	72.8
Seine	316.6
Set net	903.0
Longline	.3
HKL, Pole (Roe)	13.3

Table 105: Total recreational landings for all management areas, 1997-2003 (number of salmon) (PFMC, 2004c).

Year	Chinook	Coho	Pink	Total
1997	240,607	31,726	1,410	273,743
1998	128,174	14,418	13	142,605
1999	105,452	54,363	2,194	162,009
2000	219,781	97,396	18	317,195
2001	148,957	263,737	3,921	416,615
2002	287,325	111,470	0	398,795
2003*	167,924	253,327	13,400	434,651

*2003 data are preliminary

Regulations

Management of salmon stocks is exceedingly complex. Sixteen stocks have been classified as endangered under the ESA and therefore require incidental take statements under Section 9 of the ESA (PFMC, 2003a). The Council's Salmon Fishery Management Plan (FMP) includes season length, minimum size, quotas, and bag limits which vary by year (Table 106). The FMP is based on an annual goal for the number of spawners in each of the major salmon stocks (spawner escapement goals), and an allocation of the harvest among different groups of fishers (commercial, recreational, tribal, various ports, ocean, and inland) (NMFS, 2004b).

Table 106: Summary of 2003 fishing seasons and minimum sizes for the treaty Indian commercial ocean and Area 4B (Aleutian Islands) troll salmon fisheries (PFMC, 2004c).

Tribe and Area	Species	Dates	Minimum Size (inches)	
			Chinook	Coho
Quinault				
Areas 2 and 3	Chinook	May 1-June 30	24	-
	All	July 1-Sept. 15	24	16
Hoh				
Area 2-3	Chinook	May 1-June 30	24	-
	All	July 1-Sept. 15, Sept. 16-Oct. 15	24	16
Quileute				
Area 3	Chinook	May 1-June 30	24	-
	All	July 1-Sept. 15	24	16
Makah				
Areas 3N, 4 and 4A	Chinook	Jan. 1-Apr. 15, May 1-June 30, Sept. 16-Dec. 31	24*	-
Area 4B	All	July 1-Sept. 15	24	16
S'Klallam				
Area 4B	Chinook	May 1-June 30	24	-
	All**	Jan. 1-Apr. 15, July 1-Dec. 31	24*	16

* Minimum length limit 22 inches prior to May 1 and after October 31

** Commercially, the retention of steelhead is prohibited year round and the retention of coho is prohibited prior to September 30th each year

The overall commercial quotas for these fisheries are reported in Table 107. Half of the chinook quota may be caught during the May 1-June 30 season and the other half may be caught during the July 1-Sept. 15 season. Unused quota may not be transferred from season to season. Barbless hooks are required in all ocean fisheries (PFMC, 2004b).

Table 107: Commercial and recreational chinook and coho harvest quotas for 2003. Quotas are in numbers of fish (PFMC, 2004c).

Fishery Governed by quota	Chinook Quota	Coho Quota
North of Cape Falcon		
Treaty Indian commercial troll	60,000	90,000
Non-Indian commercial troll		
Canada to Cape Falcon, OR (May-June)	40,000	-
Canada to Cape Falcon, OR (July-Sept.)	29,400	75,000
Recreational		
US/Canada border to Cape Alava, WA	3,900	23,400
Cape Alava, WA to Queets River, WA	2,300	5,700
Queets River, WA to Leadbetter Point, WA	40,600	83,300
Leadbetter Point, WA to Cape Falcon, OR	12,700	112,500
Total north of Cape Falcon, OR	188,900	389,900
South of Cape Falcon		
Commercial troll (except coho)		
Humbog Mt., OR To OR/CA border (June-Sept.)	9,200	
OR/CA border to Humboldt S. Jetty, CA (Sept.)	10,000	
Recreational		
Cape Falcon, OR to Humbog Mt., OR	-	88,000
Total south of Cape Falcon, OR	19,200	88,000

There are no quotas south of Humboldt south jetty, CA, so the southern commercial catch of chinook salmon is much higher than the sum of all the quotas. Many Washington and Oregon vessels also have permits to fish in Alaska and these “over-quota” fish are actually Alaskan salmon landed in Washington and Oregon ports, but are counted against Alaska’s quota. The daily bag limit for salmon is typically two salmon, only one of which can be a chinook plus one additional pink salmon (PFMC, 2004b).

Discards

Discards in the ocean commercial troll and recreational salmon fisheries have three major components; the catch and discard of salmon species which are below the legal size limit (≥ 24 ”, chinook; ≥ 16 ”, coho), the catch and discard of salmon species where the retention of some, but not all, species of salmon is allowed, and in mark selective fisheries, where only hatchery raised salmon identified by an external mark can be retained and all other salmon of the same species must be released. According to the Salmon FMP, the primary discarding that occurs in salmon fisheries is of salmon species. Currently, discards of coho and chinook salmon from 12 of the ESUs listed under the ESA are considered the largest concern in ocean salmon fisheries. Impacts to the 14 remaining listed ESUs for chinook and coho are very small. There are no pink salmon stocks listed under the ESA (NMFS, 2003).

Target species discards

Estimated incidental chinook and coho mortalities are reported in Table 108. Unless otherwise noted, chinook mortality estimates from north of Cape Falcon and coho mortality estimates coast-wide are based on expanded observer data; chinook mortality estimates south of Cape Falcon are based on expansion of dockside sampling data.

Table 108: Estimated incidental mortality of chinook and coho salmon in 2003 ocean troll fisheries (PFMC, 2004b).

Area & Fishery *	2003 Catch (number of fish)	Discard Mortality** (number of fish)	Mortality to Catch Ratio
CHINOOK			
North of Cape Falcon			
Treaty Commercial Troll	34,674	5,100	0.15
Non-Indian Commercial Troll	69,775	26,600	0.38
Recreational	36,536	6,500	0.18
Cape Falcon to Humbug Mt.			
Commercial Troll	312,408	38,000	0.12
Recreational	32,858	3,300	0.10
Humbug Mt. to Horse Mt.			
Commercial Troll	9,289	800	0.09
Recreational	14,203	1,600	0.11
South of Horse Mt.			
Commercial	484,615	43,600	0.09
Recreational	84,327	9,300	0.11
Total Oceanic Fisheries			
Commercial Troll	910,761	114,100	0.13
Recreational	167,924	20,700	0.12
COHO			
North of Cape Falcon			
Treaty Commercial Troll	10,912	600	0.05
Non-Indian Commercial Troll***	15,668	5,600	0.36
Recreational***	168,846	23,600	0.13
South of Cape Falcon			
Commercial Troll	0	43,200	All discards
Recreational***	84,481	21,600	0.26
Total Oceanic Fisheries			
Commercial Troll	26,580	49,400	1.85
Recreational***	253,327	45,200	0.17

* Includes Oregon territorial water, late season chinook fisheries.

** The discard mortality in this table consists of drop-off mortality (includes predation on hooked fish) plus hook-and-release mortality of chinook and coho salmon in Council-area fisheries. Drop-off mortality for both chinook and coho is assumed to be equal to 5% of total encounters. The hook-and-release mortality (HRM) rates used for both chinook and coho are: Comm. - 26%, Rec. north of Pt. Arena - 14%, Rec. south of Pt. Arena - 23%

*** Coho retention limited to fish with a healed adipose fin clip.

Table 108 does not account for mortality due to the third type of discard: discards from mark selective (hatchery) fisheries. Recreational fisheries selective for marked coho exist in the area between Cape Falcon and Humbug Mt., the four ocean sub-areas north of Cape Falcon, the inside fisheries at Buoy 10 and in the Strait of Juan de Fuca (Areas 5 and 6). These fisheries were sampled by on-water observers and dockside interviews. These recreational fisheries have over 14 times the discard rate of unmarked coho than the commercial fisheries (Table 109).

Table 109: Summary of 2003 recreational and commercial fisheries selective for marked hatchery coho (preliminary data) (PFMC, 2004b).

Area	Observed mark rate	Preseason quota	Landed coho catch			Unmarked coho released*	Estimated non-retention mortality**	Non-retention mortality to total landings ratio
			Total	Marked	Unmarked			
Recreational								
Ocean Fisheries								
Neah Bay	39%	23,400	19,749	19,258	491	9,630	6,686	0.35
La Push	31%	5,750	3,407	372	35	470	1,590	4.27
Westport	53%	83,250	39,267	8,948	319	4,220	8,465	0.95
Columbia River	57%	112,500	106,423	5,743	680	9,091	20,348	3.54
Cape Falcon to Humbug Mt.	44%	88,000	83,831	83,255	576	16,460	26,319	0.32
Inside Fisheries								
Strait of Juan de Fuca	27%	36793***	38,673	37,745	928	1,706	12,205	0.32
Buoy 10	61%	35000***	54,301	53,736	565	3,791	9,135	0.17
Recreational total	45%	384,693	345,651	209,057	3,594	45,368	84,748	0.41
Commercial								
Neah Bay	na	-	NA	A	NA	NA	NA	NA
La Push	na	-	NA	A	NA	NA	NA	NA
Westport	na	-	NA	A	NA	NA	NA	NA
Columbia River	na	-	NA	A	NA	NA	NA	NA
Commercial total	48%	75,000	15,668	15,668	0	16,974	6,045	0.39

* Calculated from observed mark rates, Buoy 10 based on dockside sampling.

** Hook-and-release plus drop-off mortality of unmarked fish.

*** Expected catch, not a quota.

In 2003, recreational fisheries in the Strait of Juan de Fuca (Areas 5 and 6) operated under mark-selective retention restrictions for both coho and chinook salmon. The coho mark selective fishery occurred in both Area 5 and Area 6 from July 1 through September 30, but catch data are only available from Area 5 (Table 110). The chinook mark selective fishery operated in Area 5 and a portion of Area 6 from July 5 through August 3 (Table 111). Catch and release estimates are derived from creel censuses (PFMC, 2004c). Even though Areas 5 and 6 are very small, a large portion of the catch comes from these areas. The coho values in Table 110 and Table 111 are a breakdown of the Inside Fisheries section in Table 109.

Table 110: Area 5 preliminary recreational salmon catch estimates (numbers of fish) during the coho mark selective fishery (numbers of fish) (PFMC, 2004c).

Fishery	Landings				Discards			d/l ratios		
	Chinook	Coho	Pink	Total*	Chinook	Coho	Pink	Chinook	Coho	Pink
Area 5: July 1-Sept. 30	3,052	38,673	46,779	145,610	18,461	101,706	24,235	0.127	0.698	0.166

* The total does not equal the sum of the chinook, coho and pink salmon. It is assumed that total landings include chum and sockeye salmon landings as well, although no clarification was given by the PFMC.

Table 111: Areas 5 and 6 preliminary salmon catch estimate during the chinook mark selective fishery, July 5 - August 3, 2003 (numbers of fish) (PFMC, 2004c).

Fishery	Landings				Discards			d/l ratios		
	Chinook	Coho	Pink	Total*	Chinook	Coho	Pink	Chinook	Coho	Pink
Area 5: July 5-Aug. 3	2,623	5,230	5,210	39,729	13,466	22,310	3,209	0.339	0.562	0.081
Area 6: July 5-Aug. 3	962	105	440	2,383	1,707	455	183	0.721	0.191	0.077
Total	3,585	5,335	5,650	42,112	15,173	22,765	3,392	0.360	0.541	0.081

* The total does not equal the sum of the chinook, coho and pink salmon. It is assumed that total landings include chum and sockeye salmon landings as well, although no clarification was given by the PFMC.

Non-target species discards

Bycatch of fish other than salmon in salmon fisheries is generally very limited. However, some fish species are taken incidentally, including groundfish species such as Pacific halibut. Only hook-and-line gear is allowed in ocean salmon fisheries and regulations allow for the retention of most groundfish. Pacific halibut may be caught incidentally in WA/OR/CA during authorized fishing periods, while trolling for salmon. In this case, licensed holders may land no more than one halibut per three chinook and no more than 35 halibut may be landed per trip. If no chinook are landed, then one halibut per fishing trip may be retained. Landed halibut must meet minimum size limits (≥ 32) (NMFS, 2004b).

Other species accidentally taken in salmon fisheries are steelhead trout, marine mammals such as sea lions and harbor seals, sea turtles and seabirds. Steelhead catches in salmon fisheries are not believed to pose a threat to the continued existence of threatened steelhead, as steelhead retention is prohibited in the non-treaty fisheries. However, retention is permitted in the recreational and treaty fisheries (PFMC, 2003a).

In summary, for the 2003 fishing year, 5,169.6 mt of salmon were landed commercially and 114,100 undersized or over-quota chinook and 49,400 undersized or over-quota coho were discarded dead in the commercial troll fishery. In the recreational fishery, 167,924 chinook, 253,327 coho and 13,400 pink salmon were landed and 20,700 undersized or over-quota chinook and 45,200 undersized or over-quota coho were discarded dead.

In coho mark selective fisheries for the 2003 fishing year, 15,668 coho were landed and 16,974 unmarked coho were discarded in the commercial fishery, and 345,693 coho were landed and 45,368 unmarked coho were discarded in the recreational fishery.

In the recreational coho and chinook mark selective fisheries conducted inside the Strait of Juan de Fuca (Table 110 and Table 111), 187,722 salmon (6,637 chinook, 44,008 coho, 52,429 pink and 84,648 other salmon) were landed and 33,634 chinook salmon, 27,627 pink salmon, and an additional 122,765 coho salmon were discarded. The amount of coho discards was arrived at by subtracting the total unmarked coho discards from the Strait of Juan de Fuca in Table 109 (1,706) from the total coho discards in Table 110 and Table 111.

In order to obtain weight estimates of these landings and bycatch, the average chinook salmon was assumed to weigh 14 kg, the average pink salmon was assumed to weigh 1.875 kg, and the average coho salmon was assumed to weigh 4.05 kg (Great Canadian Rivers.com, 2005). "Other salmon" were assumed to weigh an average of 5 kg each.

In total, when converted to weight data, 10,648.7 mt of salmon were landed in the commercial, recreational and mark selective fisheries and 3,542.7 mt of salmon were discarded for a d/l ratio of 0.333. The 44,008 coho landed in the Strait of Juan de Fuca were not included in this calculation, because they were already accounted for in the total recreational mark selective coho landings (345,693 salmon).

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Coastal Pelagic Species of the Pacific

Major Target Species:	Pacific jack mackerel (<i>Trachurus symmetricus</i>), Pacific chub mackerel (<i>Scomber japonicus</i>), Northern anchovy (<i>Engraulis mordax</i>), Pacific sardine (<i>Sardinops Sagax</i>), California market squid (<i>Loligo opalescens</i>)
Major Discard Species:	Flatfish, Skates, Halibut (<i>Hippoglossus stenolepis</i>), Scorpionfish, Salmon, Sharks
Primary Gear Types:	Round haul gear (Purse seines, Drum seines, Lampara nets, Dip nets)
Total Landings (2003):	123,138 mt
Total Discards (2003):	2,560 mt
Total Discards Rank (of 27):	19
Discard to Landings Ratio:	0.021
d/I Rank (of 27):	25
Source of Estimates:	NMFS, Authors
Discard Type:	Primarily non-target, non-regulatory (all target species bycatch is landed)
Notes:	Most of these discards are from the CA market squid fishery, the data from WA and OR are incomplete. There were no discard data available for the mackerel or anchovy fisheries or for the CA sardine fishery. This is an estimate of bycatch, not discards. Total discards include 17,100 fish, the vast majority of which were sardines and anchovies estimated to weigh 0.25 kg each. It also includes 460 salmon estimated to weigh 5 kg each, and 4,182 hake and spiny dogfish estimated to weigh 1 kg each. These weights were assumed in the absence of accurate weight data.

The FMP for the Coastal Pelagic Species (CPS) of the Pacific Ocean includes five species and six stocks, Pacific (chub or blue) mackerel, Pacific sardine, Jack (Spanish) mackerel south of 39 degrees north latitude, northern anchovy (central and northern subpopulations), and market squid. Pacific bonito (*Sarda chiliensis*), Pacific saury (*Cololabis saira*) and Pacific herring (*Clupea pallasii*) are also coastal pelagic species off the western coast of the U.S., but they are not actively managed under the FMP.

The CPS of the Pacific are mainly schooling species and their fishing grounds can be divided into two areas: north and south of Pigeon Point, California (approximately 37° 10' N latitude). Prior to 1999, virtually the entire commercial fishery for CPS finfish and market squid took place south of Pigeon Point, CA. Starting in 1999, the Pacific sardine fishery expanded into waters off Oregon and Washington. Oregon and Washington actively manage these northern fisheries, in part, because of the heightened potential for salmon bycatch (PFMC, 1998). Sardine and anchovy were historically the most prominent fisheries but today, all of the fisheries' landings are small compared to landings in the 1930's and 1940's (NMFS, 1999). Pacific chub mackerel and Pacific sardine stocks are not overfished; Overfishing is not occurring on the stocks of Pacific chub mackerel, Pacific sardine, Jack mackerel and the central anchovy stock. All other statuses are undefined (NMFS, 2004c).

Target landings

Landings of Pacific sardine and California market squid (first group) are currently 20 times the landings of Pacific mackerel, jack mackerel and northern anchovy (second group) (Table 112) (NMFS, 2004a).

Table 112: 2002 commercial landings of coastal pelagic species. Landings of pacific sardine and California market squid are much higher than landings of Pacific and jack mackerel and northern anchovy.

Species	2002 Landings (mt)	2003 Landings
Pacific jack mackerel	1,031.80	247.7
Pacific chub mackerel	3,493.50	4,252.1
Northern anchovy	4,875.70	1,929.3
Pacific sardine	96,829.60	71,832.1
California market squid	72,870.70	44,876.3
Total	179,101.30	123,137.5

Pacific sardine and California market squid landings have been increasing steadily since the mid 1980's with the exception of a drastic drop in market squid landings in 1998 which rebounded quickly the following year (Figure 69). There was a very cold La Niña event in December of 1998, following an extremely strong 1997-1998 El Niño event, which may be responsible for this dip in landings. Landings of Pacific sardine and California market squid are currently close to their 20-year maximum of 118,900 mt 1999.

In contrast, landings of Pacific chub and jack mackerel were at their maximum (31,680 mt) in 1990, then decreased rapidly from 1990-1997. In 1997, Pacific chub mackerel and northern anchovy landings began to increase while landings of jack mackerel stayed low. Pacific chub mackerel and northern anchovy landings peaked again at 20,000 mt in 2000 and 2001, respectively, before declining to their current landings level of 5,000 mt (Figure 70).

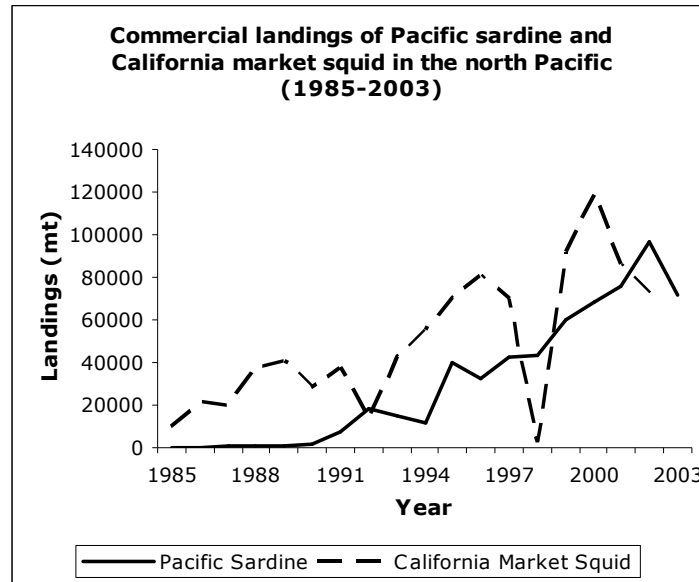


Figure 69: Commercial landings of Pacific sardine and California market squid (1985-2003).

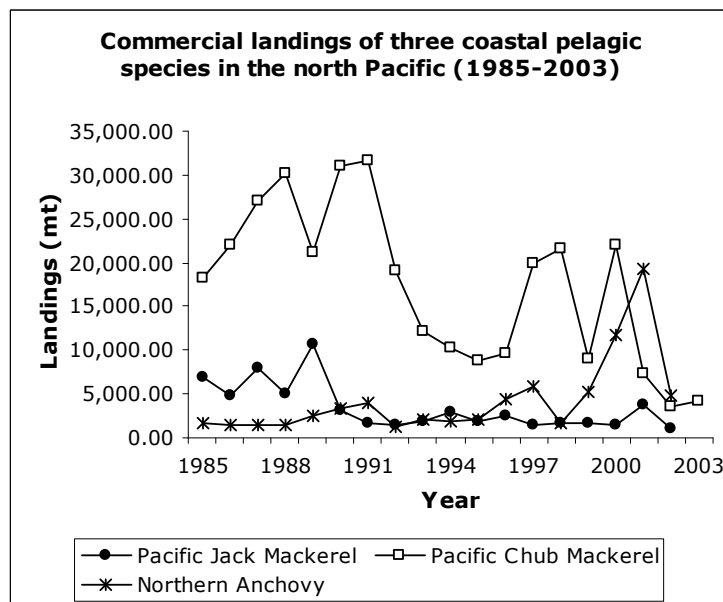


Figure 70: Commercial landings of Pacific and jack mackerel and northern anchovy (1985-2003).

All species in this fishery are fished with purse seines, drum seines, lampara nets and dip nets. Incidentally, CPS are taken with mid-water trawls, pelagic trawls, gillnets, trammel nets, trolls, pots, hook-and-line and jigs (PFMC, 1998; PFMC, 2003a).

Regulations

The CPS FMP was initially created in 1978 to manage northern Anchovy, but it was subsequently amended on January 1, 2000 to include all of the current CPS species. Amendment 9 of the plan, which dealt with bycatch and Indian fishing rights, went into effect in March, 2001. However, as of June, 2004, no tribal fisheries for CPS exist. On January 27, 2003, NMFS implemented Amendment 10 to the CPS FMP, which established a maximum fleet capacity of 65 vessels and allows limited entry permits to be transferred from one vessel or individual to another as long as the second vessel is of comparable capacity. The purchase of multiple permits may be necessary when a transfer is being made to a larger vessel. This amendment also established criteria for issuing new permits if economic or resource conditions indicate that such permits would be beneficial (PFMC, 2004a).

Federal harvest guidelines for Pacific sardine and Pacific mackerel are set annually. They are not set for species that are only monitored (jack mackerel, northern anchovy and market squid). However, market squid are regulated separately by the state of California.

The Pacific sardine fishery runs from January 1 through December 31. For the 2004 fishing year, the Pacific sardine harvest guideline is 122,747 mt. One-third of the harvest guideline (40,916 mt) is allocated for the Northern Subarea (north of 39° 00' N. lat. to the Canadian border), and two-thirds of the harvest guideline (81,831 mt) is allocated for the Southern Subarea (south of 39°00' N. lat. to the Mexican border). If the harvest guideline is reached and the fishery is closed, a landings allowance of sardine of up to 45% by weight of any landings of CPS is authorized (NMFS, 2004b).

The Pacific mackerel fishery runs from July 1, through June 30, and the 2004 directed harvest guideline is 9,100 mt, with a total incidental fishery allowance of 4,168 mt. If the directed fishery is closed due to the attainment of the 9,100 mt harvest guideline, an incidental allowance of 40% of Pacific mackerel in landings of any CPS is authorized. In addition, 1 mt of mackerel is allowed to be landed during the incidental fishery if no other CPS is landed (NMFS, 2004b).

The California market squid regulations are set by the state of California. The market squid fishery is now a limited access fishery. July 31, 2004 was the last day to apply for a permit. There is a total allowable catch limit of 125,000 short tons (113,398 mt). Market squid cannot be taken by light boat between noon on Fridays and noon on Sundays. An incidental catch limit of two metric tons is in effect, and squid can be taken for live bait purposes as well. Currently, light boats cannot use more than 30,000 watts of shielded lights. However, there is a proposed action to reduce this wattage to somewhere between 15,000 and 30,000 watts. Other options are being considered, such as the option to add daily trip limits, seasonal closure areas for seabird protection and stock replenishment and incidental take limits (CDFG, 2004).

Discards

Discards and bycatch are thought to be fairly uncommon in all CPS fisheries due to the manner in which they are fished. CPS species form pelagic schools of fish which are targeted with round haul gear such as purse seines, drum seines, lampara nets or dip nets. When fished in this manner, very little besides the targeted school is caught in the nets. The most common incidental catch in a CPS fishery is another CPS species. Larger species that are caught incidentally can be released by lowering a portion of the net or by using a dip net. If these species are not prohibited, they are often taken home for personal use or processed (PFMC, 2003a). There are data on bycatch and discards in the California market squid, Pacific mackerel and Pacific sardine fisheries. Unfortunately, the northern anchovy and jack mackerel fisheries are not observed by either onboard observers or port samplers, so there are no bycatch or

discard data available for those fisheries. The bycatch data are split into two regions, south of Pigeon Point, CA (all of California), and north of Pigeon Point, CA (Washington and Oregon).

South of Pigeon Point

In California, the Department of Fish and Game (CDFG) regularly samples landings of California market squid, Pacific mackerel and Pacific sardine in several different ports. They do not sample northern anchovy or jack mackerel landings at this time. Biological samples are taken to monitor the fish stocks, and dock samplers report incidentally caught fish. The occurrence of bycatch is small, and the dock samples are likely representative of actual bycatch, as the fishermen pump fish directly from the nets into the fish hold; they do not sort their catch at sea (PFMC, 1998).

Bycatch in the California market squid fishery (Table 113-Table 114) is reported in numbers of animals; no weight data are available. The market squid fishery is observed by dock samplers. In 2002, 461 trips were observed out of 3,106 total for almost 15% observer coverage (Valerie Taylor, California Department of Fish and Game, Personal Communication, November 22, 2004). 2003 bycatch was obtained by multiplying the 2002 bycatch of each species by the ratio of 2003 California market squid landings to 2002 California market squid landings (0.616). The bycatch species most often caught in the market squid fishery are other coastal pelagic species. Less than 100 non-CPS animals were caught as bycatch in the 2002 or 2003 market squid fisheries (Table 113). In addition, the bycatch of other CPS species was most likely sold, rather than simply discarded, although the actual bycatch disposition is unknown.

Table 113: Bycatch in the 2002 and 2003 California market squid fishery, expanded from observer data. All bycatch is reported in numbers of fish (PFMC, 2003b).

Bycatch species	2002 bycatch (number of animals)	2003 bycatch (number of animals)
Pacific sardine	14,048.0	8,651.2
Northern anchovy	2,293.9	1,412.7
Pacific mackerel	448.0	275.9
Jack mackerel	101.4	62.4
Ridgeback prawn	93.2	57.4
Dover sole	31.8	19.6
Sea cucumber	14.9	9.2
Jacksmelt	11.5	7.1
Sablefish	6.1	3.7
Bank rockfish	4.7	2.9
Albacore	3.4	2.1
Spot prawn	3.4	2.1
California halibut	2.0	1.2
Pacific butterfish	2.0	1.2
Sole	1.4	0.8
Skate	1.4	0.8
Pacific ocean shrimp	0.7	0.4
California sheephead	0.7	0.4
Bluefin tuna	0.7	0.4
Sand sole	0.7	0.4
Rockfish	0.7	0.4
Surfperch	0.7	0.4
Gray smoothhound shark	0.7	0.4
26 other species	28.4	17.5
Total	17,100.0	10,530.8

A larger list of bycatch species in the California market squid fishery is available (Table 114), but bycatch amounts for these species are unknown. However, the percent frequency of occurrence for each species is known. To illustrate, in 2002, Pacific sardine (this could have been one fish, or 1,000 fish) was found in 17.3 percent of all landings of California market squid.

Table 114: Percent frequency of occurrence for bycatch species in the California market squid fishery, 2002-2003 (PFMC, 2003b; PFMC, 2004b).

Species	Percent frequency of occurrence, 2002	Species	Percent frequency of occurrence, 2003
Pacific sardine	17.3	Pacific sardine	42.1
Colonial invertebrates	10.9	Kelp	23.4
Kelp	9.5	Jack mackerel	19
Market squid eggs	6.7	Pacific mackerel	18.5
Pacific mackerel	6	Market squid egg capsules	10.9
Northern anchovy	3.8	Northern anchovy	8.1
Jack mackerel	3	Jellyfish	8.1
Pacific butterfish	3	Sanddab	7.9
Jacksmelt	2.6	Butterfish (Pacific pompano)	5.3
Bat ray	2.4	Jacksmelt	4.8
Dungeness crab	2	Colonial invertebrates	3.6
Miscellaneous fish	2	Pacific electric ray	3.3
Pacific electric ray	1.4	California scorpionfish	3.3
Pelagic red crab	1.4	Dungeness crab	2.8
Sanddab	1.2	Bat ray	2.5
King salmon	1	Pacific sanddab	2.3
Rock crab	0.8	Sea stars	2
Sculpin	0.8	Turbot (unspecified)	2
Sea star	0.8	Eel grass	1.5
White croaker	0.6	California Halibut	1.5
Bocaccio	0.4	Sea cucumber (unspecified)	1.5
Cabezon	0.4	Plainfish midshipman	1.3
Pacific herring	0.4	Bocaccio rockfish	1.3
Pacific saury	0.4	Pacific saury	1
Rockfish	0.4	Horneyhead turbot	1
Bigmouth sole	0.2	sheep crab	0.8
Curfin turbot	0.2	Crab shells	0.8
Diamond turbot	0.2	Flyingfish	0.8
English sole	0.2	Octopus (unspecified)	0.8
Greenspotted rockfish	0.2	Salema	0.8
Horn shark	0.2	Longfin sanddab	0.8
Hornyhead turbot	0.2	Sculpin (unidentified)	0.8
Midshipman	0.2	Horn shark	0.8
Mussel	0.2	English sole	0.8
Olive rockfish	0.2	Stingray	0.8
Pacific sanddab	0.2	Curfin turbot	0.8
Pink surfperch	0.2	Purple sea urchin	0.8
Queenfish	0.2	Blacksmith	0.5
Ray	0.2	Purple globe crab	0.5
Sea urchins	0.2	Rock crab (unspecified)	0.5
Shovelnose guitarfish	0.2	White croaker	0.5
Sole	0.2	Pacific herring	0.5
Stingray	0.2	California Lizardfish	0.5
Surfperch	0.2	Queenfish	0.5
Triggerfish	0.2	Rockfish (unspecified)	0.5
Turbot	0.2	Speckled sanddab	0.5
		Thornback skate	0.5
		Fantail sole	0.5
		Sand sole	0.5
		Surfperch (unspecified)	0.5
		Tunicates	0.5
		California Barracuda	0.3
		Barred sand bass	0.3
		Pacific bonito	0.3
		Cabezon	0.3
		Box crab	0.3
		Decorator crab	0.3
		Painted greenling	0.3
		Hermit crab	0.3
		Round herring	0.3

Species	Percent frequency of occurrence, 2002	Species	Percent frequency of occurrence, 2003
		Kelp surfperch	0.3
		Medusa fish	0.3
		Poacher (unspecified)	0.3
		Ray (unspecified)	0.3
		Blue rockfish	0.3
		Olive rockfish	0.3
		Shortbelly rockfish	0.3
		Salmon	0.3
		Chinook salmon	0.3
		Salps	0.3
		Pacific angel shark	0.3
		Big skate	0.3
		Night smelt	0.3
		Smelt (unidentified)	0.3
		True smelts	0.3
		Sole (unspecified)	0.3
		Curlfin sole	0.3
		Bigmouth sole	0.3
		Jumbo squid	0.3
		Ocean sunfish	0.3
		Pink surfperch	0.3
		Thornyheads	0.3
		Diamond turbot	0.3

For the Pacific mackerel and Pacific sardine fisheries in California, 261 of 3,191 trips (8%) were sampled in 2001, 231 of 3,458 trips (7%) in 2002, and 225 of 2,455 trips (9%) in 2003. Only percent frequency of occurrence was recorded for bycatch data, not actual amounts of fish (Table 115). For example, unspecified flatfish occurred in 12.64% of all sampled trips in 2001, but the actual number of unspecified flatfish is unknown. The bycatch species are separated by group: fishes, elasmobranchs and invertebrates and vegetation. Pacific mackerel and Pacific sardine occur in the bycatch lists since each occurs as bycatch in the other fishery.

Table 115: Percent frequency of occurrence of bycatch species in the California Pacific mackerel and Pacific sardine fisheries, 2001-2003 (PFMC, 2004b).

Bycatch Species	2001 incidents (% frequency of occurrence)	Bycatch Species	2002 incidents (% frequency of occurrence)	Bycatch Species	2003 incidents (% frequency of occurrence)
Fishes		Fishes		Fishes	
Flatfish (unspecified)	12.64	Flatfish (unspecified)	12.55	California scorpionfish	16.44
Jack mackerel	11.11	California scorpionfish	11.26	White croaker	16.00
California scorpionfish	9.96	White croaker	10.39	California halibut	14.22
Pacific mackerel	8.05	Northern anchovy	5.63	Northern anchovy	7.56
White croaker	7.28	Plainfin midshipman	5.63	Plainfin midshipman	7.11
Sardine	4.98	Butterfish	4.76	Hornyhead turbot	7.11
Midshipman	4.98	Cusk-eel	3.90	Sanddab	6.22
Anchovy	3.83	California lizardfish	3.90	Butterfish	5.78
California halibut	3.07	California halibut	2.60	Flatfish (unspecified)	4.44
Lizardfish	2.30	Barred sand bass	2.16	Sand sole	4.44
Butterfish	1.92	California corbina	2.16	Pacific mackerel	3.56
Barracuda	1.92	Jacksmelt	1.30	Barred sand bass	2.22
Cusk eel	1.53	Tonguefish	1.30	Kelp bass	2.22
Jacksmelt	1.53	Hornyhead turbot	1.30	Cusk-eel	2.22
Sablefish	1.15	California Barracuda	0.87	Jacksmelt	2.22
Tonguefish	1.15	Kelp bass	0.87	California lizardfish	1.78
Sand bass	0.77	Flyingfish	0.87	Tonguefish	1.78

Bycatch Species	2001 incidents (% frequency of occurrence)	Bycatch Species	2002 incidents (% frequency of occurrence)	Bycatch Species	2003 incidents (% frequency of occurrence)
Bonito	0.38	Pink surfperch	0.87	Whitebait smelt	1.33
Kelp bass	0.38	Pacific Bonito	0.43	Flyingfish	0.89
Flyingfish	0.38	Yellowfin croaker	0.43	Midshipman	0.89
Pompano	0.38	Yellow Snake eel	0.43	Jack mackerel	0.89
Senorita	0.38	Round herring	0.43	Pacific herring	0.89
Bass (unspecified)	0.38	Sanddab	0.43	Starry flounder	0.89
Elasmobranchs		Giant black seabass	0.43	Turbot (unspecified)	0.89
Bat ray	8.43	Senorita	0.43	Staghorn sculpin	0.89
Skates (unspecified)	1.53	Bigmouth sole	0.43	Surfperch (unspecified)	0.89
Thornback skate	1.53	Fantail sole	0.43	Longspine combfish	0.44
Horn shark	1.53	Surfperch (unspecified)	0.43	Yellow Snake eel	0.44
Pacific electric ray	0.77	Topsmelt	0.43	Curfin turbot	0.44
Stingray	0.77	Curfin turbot	0.43	Diamond turbot	0.44
Sand shark (unspecified)	0.38	Diamond turbot	0.43	Sole (unspecified)	0.44
Spiny dogfish	0.38	Ocean whitefish	0.43	Pacific Sanddab	0.44
Smoothhound	0.38	Elasmobranchs		American shad	0.44
Shark (unspecified)	0.38	Bat ray	8.66	Wolf eel	0.44
Sevengill shark	0.38	Thornback skate	2.16	Sturgeon (unspecified)	0.44
Swell shark	0.38	Pacific electric ray	1.30	Elasmobranchs	
Invertebrates and vegetation		Skate (unspecified)	0.87	Bat ray	16.00
Kelp	19.16	Shovelnose guitarfish	0.43	Thornback skate	7.56
Squid	6.13	California butterfly ray	0.43	Guitarfish	4.00
Crab	2.68	Round stingray	0.43	Round stingray	2.22
Seaweed	1.53	Brown shark	0.43	Shortfin mako shark	0.89
Lobster	1.15	Smoothhound	0.43	Pacific electric ray	0.89
Sea cucumber	0.77	Pacific angel shark	0.43	Skate (unspecified)	0.89
Sea star	0.77	Shark (unspecified)	0.43	Big skate	0.89
Kelp fronds	0.38	Invertebrates and vegetation		California skate	0.44
Snail	0.38	Kelp	29.00	Gray smoothhound shark	0.44
Squid eggs	0.38	Market squid	15.15	Invertebrates and Vegetation	
		Salps	8.23	Jellyfish	2.22
		Pelagic red crab	2.60	Dungeness crab	2.22
		Rock crab (unspecified)	1.30	Rock crab (unspecified)	1.78
		Sea cucumber	1.30	Sea cucumber	1.78
		Eelgrass	1.30	Eelgrass	1.78
		California spiny lobster	1.30	Squid	1.33
		Octopus (unspecified)	1.30	Sea star	1.33
		Sea stars	0.87	Kelp	0.89
		Gorgonians	0.43	Slender crab	0.89
		Jellyfish	0.43	Elbow crab	0.44
		Pleurobranch	0.43	Squid egg cases	0.44
		Spot prawn	0.43	Decorator crab	0.44
		Squid egg cases	0.43		

North of Pigeon Point

The Pacific sardine fishery off Oregon and Washington did not begin until 1999, and is the only directed CPS fishery in these states. In Oregon in 2003, 17 vessels made 712 landings for a total of 25,253 mt,

but only three trips were observed in 2003 due to budget constraints. In Washington in 2003, 10 vessels landed 11,604 mt. Observer coverage in Washington was at 27%, and bycatch was low. Bycatch species included chinook and coho salmon, Pacific and jack mackerel, spiny dogfish, blue shark and other species (PFMC, 1998).

Salmonid bycatch is reported jointly for the Oregon and Washington sardine fishery (Table 116). However, there is no observer program in Oregon, so the only Oregon data available are from logbooks.

Table 116: Salmonid bycatch in the OR and WA sardine fishery, expanded from observer data, where available. Bycatch is reported in numbers of animals (PFMC, 2004b).

Species	2000		2001		2002		2003	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead
Chinook	81	75	494	215	150	356	92	262
Coho	435	159	772	638	61	765	81	231
Pink	0	0	22	0	0	0	0	0
Unidentified salmonid	310	43	125	0	200	0	32	119
Total*	826	277	1413	853	610	1202	520	797
Combined Total	1,103		2,266		1,812		1,317	

* For 2002-2003, OR only recorded "salmon." They did not record salmon type which is why the total is more than the sum of the parts.

Bycatch of all species in the Washington sardine fishery (including salmon) is recorded in numbers of animals except for a few species (Table 117). The large amounts of herring bycatch reported in Table 117 are the result of one fisherman setting on a school of herring mistaking it for sardines. That set was released. However, this may happen when observers are not on board as well, so the data cannot be discounted, and therefore was included in the expansion of the bycatch. Numbers and weights of the bycatch species were expanded for the entire year using effort data: In 2002, 102 trips were observed out of 424 total, and in 2003, 78 trips out of 288 were observed.

Table 117: Bycatch in the 2002 and 2003 Washington Pacific sardine fishery, expanded from observer data. Bycatch is reported in numbers of animals except where indicated otherwise (PFMC, 2003b; PFMC, 2004b).

Species	2002		2003	
	No. released alive	No. released dead	No. released alive	No. released dead
Anchovy	4.16 mt	0	0	0.35 mt
Blackcod	0	4	0	0
Blue Shark	37	42	66	18
Cabezon	4	0	0	0
Chinook salmon	71	175	89	251
Chum salmon	54	229	0	0
Coho salmon	0	0	78	222
Dogfish	1467	715	162	1,030
Dungeness crab	0	37	18	18
Hake	0	898	11	2,012
Herring	4.16 mt	0	3.69 mt	192 mt
Jack mackerel	0	0	217.85 mt	14.77 mt
Pacific Mackerel	0	0	1,846.15 mt	173.54 mt
Pink salmon	0	0	0	4
Salmon (unidentified)	96	46	59	114
Sanddab	981	416	0	4
Shad	187	13,967	0	4
Skate	17	21	0	0
Smelt	100	0	0	0
Soupfin shark	12	0	7	7
Squid	0	4	0	0
Starry flounder	12	62	0	0
Sunfish	8	0	0	0
Thresher shark	8	0	4	4
Wolf eel	0	4	0	0
Yellowtail rockfish	0	4	0	0

Species	2002		2003	
	No. released alive	No. released dead	No. released alive	No. released dead
Total individuals	3,054.00	16,624.00	494.00	3,688.00
Total metric tons	8.32	0	2,067.69	380.66

The Oregon sardine fishery is the only CPS fishery that has no observers either on the boats or at the docks, but some logbook data are available (Table 118).

Table 118: Bycatch in the 2002 and 2003 Oregon Pacific sardine fishery, logbook data. Bycatch is in numbers of animals except where indicated otherwise (PFMC, 2003b; PFMC, 2004b).

Species	2002 bycatch	2003 bycatch
Blue shark	1	1
Thresher shark	1	5
Unknown shark	0	3
Salmon (unidentified)	274 (71% alive)	460 (63% alive)
Dogfish shark	0 mt	0.03 mt
Mackerel	60.52 mt	102.06 mt
Anchovy	10.23 mt	0.23 mt
Herring	24.95 mt	0 mt
Shad	0.09 mt	0 mt
Unknown	0.20 mt	0 mt
Total	95.7 mt +276 individuals	102.3 mt + 469 individuals

In summary, there are data available on the types of species caught as bycatch in CPS fisheries, and the frequency of their occurrence in target landings; unfortunately, actual discard amounts are not generally available.

In the 2003 California market squid fishery, 10,531 fish and invertebrates were discarded and 44,876.3 mt of market squid were landed (NMFS, 2004b). This amounts to only one animal taken as bycatch for every four metric tons of squid landed. Since the vast majority of these 10,531 fish are sardines and anchovies, a 0.25 kg average weight was used to find a total bycatch weight of 2.63 mt and a b/l ratio of 0.00006. This average weight was assumed in the absence of weight data in order to approximate the weight of the bycatch. In the California Pacific mackerel and Pacific sardine fisheries, no discard amounts are available, but flatfish, other pelagics, scorpionfish, halibut, white croakers and plainfin midshipmen are the species caught as bycatch most often. No discard data are available for the California sardine fishery. However, bycatch is assumed to be small in the California sardine fishery, as in the Washington and Oregon sardine fisheries.

In the 2003 Washington sardine fishery, 11,920 mt of sardine were landed (NMFS, 2004b), and 2,448 mt of pelagic species (herring, mackerel and anchovy) plus 4,182 individuals (non-pelagic species including salmon) were caught as bycatch. These 4,182 individuals were mostly hake and spiny dogfish, and were estimated to weigh on average 1 kg each, for a bycatch weight of 4.2 mt. Again, we assumed this average weight in the absence of weight data to approximate the bycatch weight. Of the total bycatch, 380.66 mt and 3,688 individuals (3.7 mt) were discarded. Using the weight data, the b/l ratio for this fishery is 0.206 and the d/l ratio is 0.031.

In the 2003 Oregon sardine fishery, 25,258 mt of sardines were landed, but bycatch data are only available from logbook data because there is no observer program. In total, 9 sharks, 460 salmon (170 of which were dead) and 102 mt (almost entirely mackerel) of other species were reported as bycatch. If the salmon were estimated to weigh 5 kg each (2.3 mt in total), the total bycatch weight would be 105 mt, for a b/l ratio of 0.004. These estimates are low because of the unreliability of the logbook data. The 2003 Oregon sardine landings were over twice the sardine landings in Washington, but Oregon's bycatch was more than 23 times smaller than Washington's. The habitats and fisheries are very similar, so the bycatch rates are expected to be similar as well.

Overall, 123,138 mt of target species were landed and there was 2,560 mt of bycatch in the 2003 Pacific coastal pelagics fishery for a b/l ratio of 0.021. At least 384 mt of this bycatch was discarded, for a

minimum d/l ratio of 0.0031. The bycatch data are incomplete as there were no bycatch estimates for the mackerel or anchovy fisheries. However, these fisheries only account for 5.2% of the total Pacific CPS landings. The bycatch from the sardine fisheries are also incomplete, since there are no data available from California, and there is no observer program in Oregon.

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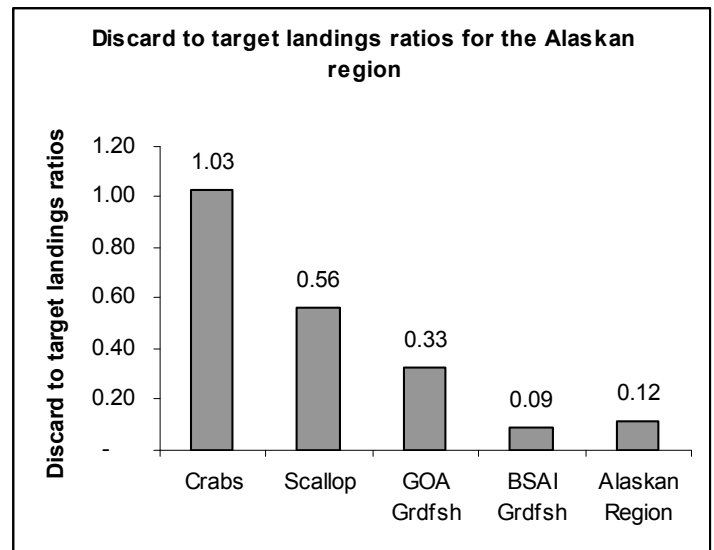
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Alaska



Alaskan Regional overview of landings, discards and discard to landings ratios by fishery

Fishery	Landings (mt)	Discards (mt)	d/l ratio
BSAI Crabs	21,646	22,369	1.03
Weathervane Scallop	1,788	997	0.56
GOA Groundfish	142,787	47,278	0.33
BSAI Groundfish	1,793,088	160,119	0.09
Alaskan Region	1,959,309	230,763	0.12



Alaskan Salmon Fishery

Major Target Species:	Chinook salmon (<i>Oncorhynchus tshawytscha</i>), Coho salmon (<i>Oncorhynchus kisutch</i>), Pink salmon (<i>Oncorhynchus gorbuscha</i>) Sockeye salmon (<i>Oncorhynchus nerka</i>), Chum salmon (<i>Oncorhynchus keta</i>)
Major Discard Species:	Salmon
Primary Gear Types:	Gillnet, Purse seine, Troll
Total Landings (2003):	368,020 mt
Total Discards (2003):	8,474 mt
Total Discards Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Discard to Landings Ratio:	1.1 (this is the weighted average d/l ratio from the commercial troll and recreational fisheries, it does not include landings from the other commercial fishery for which we did not have discard data.
d/l Rank (of 27):	NA (not enough data available to be considered in ranking scheme)
Source of Estimates:	Alaska Department of Fish and Game, Independent research studies, Authors
Discard Type:	Primarily target, regulatory
Notes:	Total landings include both the commercial and recreational fisheries, but the discards only account for the recreational and SE commercial troll fisheries. There are no non-target species discards. The discards from the majority of the commercial salmon are unknown, and are thus underestimated.

The Pacific Salmon Treaty, the plan that governs five shared salmon stocks was initially signed by the United States and Canada in 1985. The treaty expired in 1992 but was renewed in 1999. The five species of salmon managed under the Pacific Salmon Treaty are: chinook, chum, coho, pink and sockeye. The Pacific Salmon Commission is the body formed by the governments of Canada and the United States to implement the Pacific Salmon Treaty. The Commission itself does not regulate the salmon fisheries but provides regulatory advice and recommendations (PSC, 2004). Alaskan salmon fall under the official jurisdiction of the North Pacific Fishery Management Council, but the Alaska Department of Fish and Game (ADF&G) has assumed all management responsibilities. None of these five species of salmon are overfished, and overfishing is not occurring (NMFS, 2004).

The chinook salmon is the largest salmon, and one of the most important sport and commercial fish native to the Pacific coast of North America. Chinook salmon range from the Monterey Bay area of California north to the Chukchi Sea of Alaska. Unlike other salmon species, chinook salmon rear in inshore marine waters and are, therefore, available to commercial and sport fishers all year (Delaney, 1994). Chum salmon have the widest distribution of any of the Pacific salmon. In the south, they range from the Sacramento River in California to the Sea of Japan. In the north they range from the southern Arctic Ocean to Siberia (Buklis, 1994). Coho salmon also called silver salmon, are found in coastal waters of Alaska from the Chukchi Sea to the Alaska-Yukon border. Adults usually weigh 8 to 12 pounds and are 24 to 30 inches long (Elliot, 1994). The pink salmon is native to Pacific and arctic coastal waters from northern California to the Mackenzie River, Canada, and to the west from Siberia to Korea. Pink salmon mature in two years which means that odd-year and even-year populations are essentially unrelated (Kingsbury, 1994). The sockeye salmon occurs in the North Pacific and Arctic oceans and associated freshwater systems. This species ranges south as far as the Klamath River in California and northern Japan, to as far north as the Canadian Arctic and Siberia (Commercial fisheries management and development staff, 1994a).

Target landings

The landings for all species of Alaskan salmon are given in Figure 71 and Figure 72. The total commercial harvest for 2004 was almost 364,000 mt (ADF&G, 2004f), while the total recreational harvest only reached five and a half metric tons (ADF&G, 2004g).

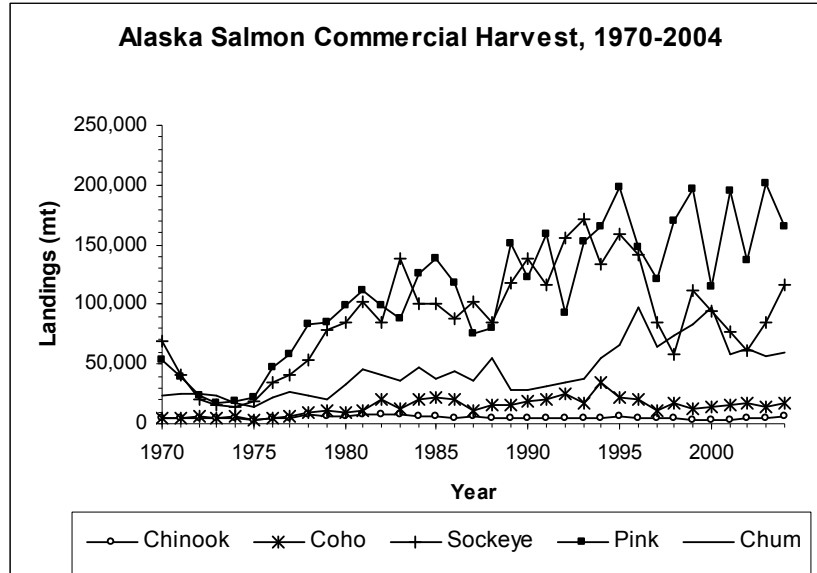


Figure 71: Commercial landings of Alaskan Salmon from 1970-2004.

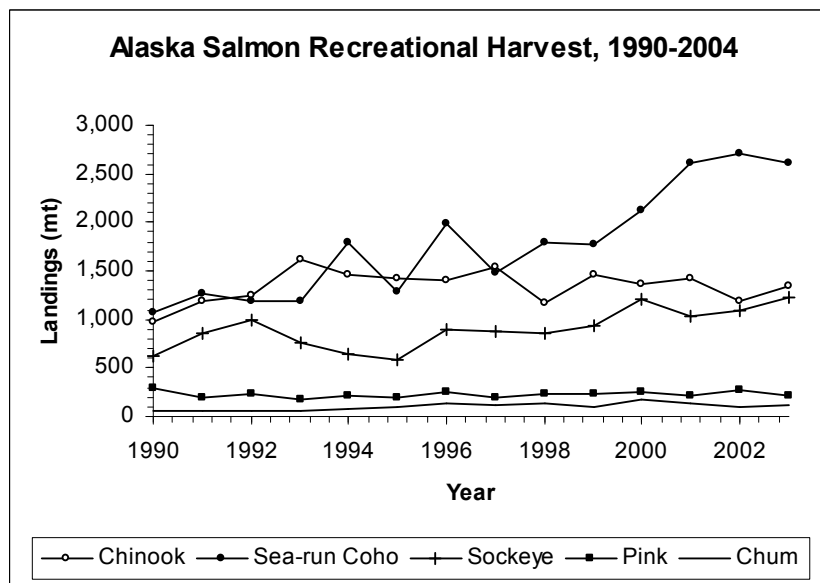


Figure 72: Recreational landings of Alaskan salmon from 1990-2004.

Commercially, pink and sockeye salmon have the highest landings. Pink salmon landings follow an odd-year cycle, and sockeye salmon landings are rising after a short period of decline in the 1990s. Landings of chum salmon have increased since the early 1990's, and landings of coho and chinook salmon have been consistently low. The most recent commercial landings for all the species are given in Table 119. Recreational landings follow a very different pattern. Coho is landed most frequently, followed by chinook and sockeye. Pink and chum salmon are only landed in very small amounts. Total recreational landings are only a fraction of commercial landings.

Table 119: Recent commercial landings of Alaskan salmon (mt), 2002-2004 (ADF&G, 2004I).

Year	Chinook	Sockeye	Coho	Pink	Chum	All salmon
2002	4,181.93	61,394.33	17,712.92	136,310.22	63,536.34	283,135.74
2003	4,562.44	85,135.92	14,069.55	201,919.86	56,810.44	362,498.21
2004	5,641.33	116,988.73	17,571.26	164,393.21	59,022.35	363,616.88

Gear types used in the Alaska salmon fisheries include drift and set gillnets, purse seines and trolls. Purse seines are typically used to target pink salmon, and are responsible for the largest amount of the harvest except in the Arctic/Yukon/Kuskokwim, Bristol Bay/Bering Sea, and Yukatat regions, where their use is prohibited. In these areas, gillnets have become the predominant gear type (ADF&G, 2004e).

Regulations

Recreational

The Alaska Department of Fish and Game uses a number of strategies to manage the sport fishery for salmon (chinook, coho, chum, pink, and sockeye) in state marine and fresh waters. The primary regulations include possession limits, gear specifications, and seasonal/area closures. In general, minimum size restrictions are only used for chinook in some marine areas to limit the number of sub-adults that are taken from the populations. When used, the minimum size for chinook from marine waters is usually 20 to 28 inches.

Possession limits range from one fish/day with an annual harvest limit of three fish (chinook 28" or larger, non-resident anglers in the Southeast region) to ten fish/day with no annual harvest limit (pink salmon in marine waters of Kotzebue and Norton Sounds). Possession limits are extremely variable by watershed or marine area and often differ according to the season, species, and size of the salmon being caught.

Gear restrictions, as a means of controlling angler effort, are also widely used in Alaska. In general, the practice of "snagging" or hooking a salmon not through the mouth is prohibited in freshwater except for certain species during specified seasons and areas. The use of baited hooks, as opposed to artificial lures and flies, is also highly restricted. Spear fishing and bow and arrow fishing are allowed in some areas. However, hook and line is the primary allowable gear for salmon sport fishing. Usually, only one hook of a specific size may be used to target salmon.

Season and area closures often center on the breeding activities of fish. In most areas, the sport fishing season for salmon is open year round, with the exception of established closed seasons during the second half of the year to protect chinook and coho salmon. Closed areas, such as certain tributaries of the Kuskokwim River, which are closed to chum salmon harvest year round, are also used to protect key breeding or migrating salmon populations. Spatial fishing regulations are also used to minimize conflict between commercial, subsistence, and recreational user groups. For example, sport anglers are not allowed to fish within 300 ft. of subsistence salmon gillnets in the Kanektok River, which drains into Kuskokwim Bay.

In addition to the published sport fishery regulations, the ADF&G also issues emergency orders regularly during the sport fishing seasons. Emergency orders commonly close an area to fishing, extend the fishing season, or modify gear restrictions or possession limits (ADF&G, 2004c).

Commercial

Alaska Department of Fish and Game utilizes a very complex set of regulations to manage the commercial salmon fisheries. The primary strategies are fishing seasons, area closures, guideline harvest levels, and gear restrictions that vary depending on multiple factors. The ADF&G may also issue in-season emergency orders to specify fishing regulations based on harvest performance. The stringency of management measures is often based on the projected biological escapement levels for each population of salmon. If the projected biological escapement levels are below the goal range, then all commercial, subsistence, and recreational fisheries may be closed. If the projected biological escapement levels are above the goal range, then fishing restrictions will be significantly relaxed to harvest the "excess" salmon, with the majority of remaining restrictions aimed at protecting other stocks of salmon which may be caught along with the target species.

Commercial harvest guidelines for each area, species, user group, and gear are derived from the Annual Allowable Harvest (AAH). The AAH is typically calculated by subtracting the required (goal) biological escapement from the projected run size of a particular species. The AAH is then allocated between the US and Canada and divided into harvest quotas for each area, fishing group, and gear type. The harvest quotas of salmon are often influenced by the projected hatchery contribution to the salmon stocks. Private hatcheries are allowed to participate in special “cost-recovery” fisheries where they harvest a certain quantity of salmon to cover production costs.

The commercial salmon fisheries in Alaska are divided into nine management areas. Each management area has specific open seasons for salmon fishing. These seasons are generally prolonged and occur between May and October, depending on gear type. The use of weekly “fishing periods,” which are certain days of the week on which commercial salmon fishing is allowed, are used to extend the fishing season. The only fishery that usually takes place during extended times throughout the year is the Southeast chinook/coho troll fishery, which can open and close by emergency order and take place in the winter, spring, and summer.

The principle gear types authorized in the commercial salmon fishery are troll, gillnet (set/drift), and seine (beach/purse). Commercial trolling is typically only authorized in the Southeast district and targets large coho and chinook salmon. The number of main lines from a vessel is generally restricted to six. The majority of effort in the salmon fishery comes from gillnetters. Specific regulations regarding the length, mesh size, and placement of gillnets is extremely variable between areas and seasons. Mesh size typically ranges from 4.5 to 7.5 inches, depth between 15 and 300 fms, and length less than 125 meshes. Seine gears, predominately purse seine, but also some beach seine, harvest mostly pink salmon in the Gulf of Alaska but also take some other salmon species including coho, sockeye, and chum. Seine specifications are also highly variable by area and season. Typically depth, length, and mesh size vary between 100 to 225 fathoms, 100 to 375 meshes, and 4 to 7.5 inches, respectively (ADF&G, 2004a; ADF&G, 2004e; Frenette et al., 1997; PSC, 1999; State of Alaska, 2004).

Discards

As in the west coast salmon fishery, bycatch and discard data are limited in the Alaskan salmon fishery. Recreational target species discard data are the primary discard data available. Bloomquist and Carlisle (2002) estimated commercial discards of chinook in the southeast Alaska summer troll fishery (Table 120), but the entire year-round Alaska troll fishery accounts for less than 1% of the total salmon landings (ADF&G 2004f). Thus, it is impossible to expand this estimate to other gear types of salmon species, as the discard to landings ratios may be completely different.

Table 120: Chinook discards in the southeast Alaska summer troll salmon fishery (Bloomquist and Carlisle, 2002).

Year	Landed Chinook (number)	Released Chinook (number)	d/l ratio
1998	29,462	39,836	1.35
1999	51,087	53,637	1.05
2000	39,484	61,544	1.56
2001	59,535	89,239	1.50
1998-2001 Average	44,892	52,101	1.37

Table 120 was expanded to include total landings and discards for chinook in the entire 2003 southeast Alaska troll fishery. The landed weights were calculated by multiplying the number of fish landed (13,510 chinook in the hand troll fishery and 317,173 chinook in the power troll fishery) (ADF&G, 2004b) by the known average weight of harvested chinook for 2003 in the southeast Alaska region (15.35 lbs) (ADF&G, 2004b). The 1998-2001 average chinook d/l ratio of 1.37 was used to calculate the weight of discards of chinook (Table 121). However, these will be high estimates of discards because the d/l ratio is based on numbers of fish and not weight.

Table 121: 2003 Landings and discards (mt) of chinook from the southeast Alaska power and hand troll fisheries.

Species		Hand troll	Power troll	Total Troll
Chinook	Landings (mt)	94.1	2,208.4	2302.5
	d/l ratio	1.37	1.37	1.37
	Discards (mt)	128.9	3,025.5	3154.4

The southeast troll fishery is the only troll fishery in the state, so this represents landings and discards of chinook for the entire troll fishery. It is impossible to expand this data to the gillnet and purse seine fisheries because the discard to landings ratios are almost certainly different. It would also be misleading to apply recreational discard to landings ratios to commercial data because the salmon species are not preferentially targeted in the same manner in the commercial and recreational fisheries.

Recreational target species discard data is given (Table 122) and is extrapolated for the 2003 fishing year. It is not expanded to the 2004 fishing year because landings for that year were preliminary. Data in this table are based on a mail survey. Responses were in numbers of fish and were converted to weights using the average weight of commercially landed fish. Harvest was subtracted from total catch to obtain discards, and it was assumed that all discarded fish were the same weight as landed fish. This could potentially give high estimates of discards as discarded fish tend to weigh less than landed fish, but low estimates of landings due to high grading in the recreational fishery.

Table 122: Recreational landings (mt), discards (mt) and d/l ratios for all Alaskan salmon species (ADF&G, 2004d; ADF&G, 2004g).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2003*
Chinook landings	969.0	1,195.0	1,241.0	1,621.0	1,453.0	1,414.0	1,412.0	1,539.0	1,162.0	1,460.0	1,364.0	1,342.0
Chinook discards	2,130.0	1,052.0	1,706.0	2,240.0	1,088.0	1,357.0	2,282.0	2,825.0	1,991.0	1,649.0	2,172.0	1,882.0
Chinook d/l ratio	2.2	0.9	1.4	1.4	0.8	1.0	1.6	1.8	1.7	1.1	1.6	1.4
Sea-run coho landings	1,081.0	1,260.0	1,188.0	1,188.0	1,795.0	1,286.0	1,992.0	1,488.0	1,794.0	1,780.0	2,130.0	2,619.0
Sea-run coho discards	680.0	448.0	555.0	540.0	692.0	621.0	1,294.0	1,052.0	1,001.0	1,031.0	1,376.0	1,408.0
Sea-run coho d/l ratio	0.6	0.4	0.5	0.5	0.4	0.5	0.7	0.7	0.6	0.6	0.7	0.5
Sockeye landings	629.0	850.0	996.0	758.0	636.0	593.0	902.0	878.0	867.0	938.0	1,200.0	1,232.0
Sockeye discards	610.0	517.0	697.0	786.0	460.0	425.0	760.0	765.0	665.0	713.0	860.0	976.0
Sockeye d/l ratio	1.0	0.6	0.7	1.0	0.7	0.7	0.8	0.9	0.8	0.8	0.7	0.8
Pink landings	287.0	187.0	228.0	172.0	205.0	188.0	253.0	187.0	236.0	238.0	250.0	222.0
Pink discards	549.0	184.0	536.0	328.0	339.0	404.0	746.0	572.0	792.0	724.0	1,206.0	568.0
Pink d/l ratio	1.9	1.0	2.4	1.9	1.7	2.2	3.0	3.1	3.4	3.0	4.8	2.6
Chum landings	52.0	59.0	58.0	63.0	74.0	94.0	135.0	123.0	132.0	101.0	168.0	108.0
Chum discards	182.0	128.0	264.0	237.0	257.0	427.0	730.0	593.0	658.0	743.0	853.0	485.0
Chum d/l ratio	3.5	2.2	4.5	3.8	3.5	4.6	5.4	4.8	5.0	7.3	5.1	4.5
Total landings	3,018.0	3,550.0	3,711.0	3,802.0	4,162.0	3,575.0	4,694.0	4,215.0	4,190.0	4,518.0	5,112.0	5,522.0
Total discards	4,151.0	2,329.0	3,757.0	4,132.0	2,837.0	3,235.0	5,812.0	5,806.0	5,107.0	4,860.0	6,467.0	5,320.0
Overall d/l ratio	1.4	0.7	1.0	1.1	0.7	0.9	1.2	1.4	1.2	1.1	1.3	1.0

* 2003 Discards are estimated using actual 2003 landings and the 1990-2000 average d/l ratio

In summary, discard data are very scarce for the Alaskan salmon fisheries. Target species discards and marine mammal data are all that are available. Commercially, data are only available for the southeast Alaska power and hand troll fisheries. In 2003, 2,302.5 mt of chinook salmon were landed in the troll fishery, and 3,154.4 mt of chinook salmon were discarded for a d/l ratio of 1.37. In the recreational fishery, 5,522 mt of salmon were landed in 2003, and 5,320 mt of salmon were discarded for a discard to landings ratio of 0.96.

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Bering Sea and Aleutian Islands King and Tanner Crab Fishery

Major Target Species:	Snow crab (<i>Chionoecetes opilio</i>), Red king crab (<i>Paralithodes camtschaticus</i>), Golden king crab (<i>Lithodes aequispinus</i>)
Major Discard Species:	Pacific cod (<i>Gadus macrocephalus</i>), Pacific halibut (<i>Hippoglossus stenolepis</i>), Pollock (<i>Theragra chalcogramma</i>), Rockfish, Sculpins, Skates
Primary Gear Types:	Pot, Trap
Total Landings (2002):	21,646 mt
Total Discards (2002):	22,369 mt
Total Discards Rank (of 27):	9
Discard to Landings Ratio:	1.03
d/I Rank (of 27):	5
Source of Estimates:	ADF&G, Authors
Discard Type:	Primarily target, regulatory
Notes:	Total discards include 21,419,382 crabs estimated to weigh 1 kg each and 417,871 fish estimated to weigh 5 lb (2.3 kg) each (based on the size of the pot opening). The weights were assumed in the absence of accurate weight data. Crabs are assumed to survive when discarded. Approximately 1,840,000 non-crab invertebrates were also caught, but no weight was estimated for these species.

The BSAI King and Tanner crab FMP includes four major stocks: the Aleutian Islands golden king crab, the Bristol Bay red king crab, the Norton Sound red king crab, and the Bering Sea snow crab. The golden king crab is distributed from British Columbia to Japan, but the largest populations are in the Aleutian Islands (Blau, 1997); the red king crab occurs from British Columbia to Japan with their largest populations in Bristol Bay and the Kodiak Archipelago (Blau, 1997); and the snow crab's range extends from southeastern Alaska north through the Bering Sea (Commercial fisheries management and development staff, 1994b). The Tanner crab is considered a minor stock in the FMP, so data on this fishery are not included in the report.

The crab fisheries of the BSAI are managed jointly between the NPFMC and the ADF&G. The FMP for BSAI King and Tanner crab, approved by the NPFMC in June 1989, delegates the majority of fishery management measures to the ADF&G. Overfishing is not known to be occurring in any of these fisheries, and none of the stocks are overfished (NMFS, 2004).

Target landings

Landings of the four major crab stocks in the crab fishery are given from 1980-2004 with the exception of the Bristol Bay red king crab fishery. Landings for that fishery are reported from 1970-2004 in order to show the pattern of increasing landings followed by a quick decline. In each of these stocks, the landings closely follow the guideline harvest levels (GHL), with the exception of the Aleutian Islands golden king crab fishery (Figure 75). In the golden king crab fishery, the GHL was set at a very low level for the first five years (1991-1995). In 1996, however, the GHLs were raised, and the landings began to follow the GHLs.

The Bering Sea snow crab fishery is the largest of the crab fisheries (Figure 73). Landings peaked in 1991 at just over 140,000 mt. They then plummeted to a low of 29,800 mt in 1996, rose again, and declined to their current levels of just under 10,000 mt (ADF&G, 2001; Bowers, 2003b). The Bristol Bay red king crab landings reached a peak in 1980 and declined sharply to almost zero (Figure 74). Landings now hover around 5,000 mt (ADF&G, 2001; Bowers, 2003a). Landings for the Aleutian Islands golden king crab peaked in 1986 to just under 7,000 mt, then declined to their current levels of between two and three thousand metric tons annually (ADF&G, 2001; Granath, 2003) (Figure 75). Landings for the Norton sound red king crab fishery were highest in 1980 and 1981, before dropping to their current landings levels of under 200 mt per year (ADF&G, 2001; ADF&G, 2002; ADF&G, 2003a; ADF&G, 2003b; ADF&G, 2004e) (Figure 76).

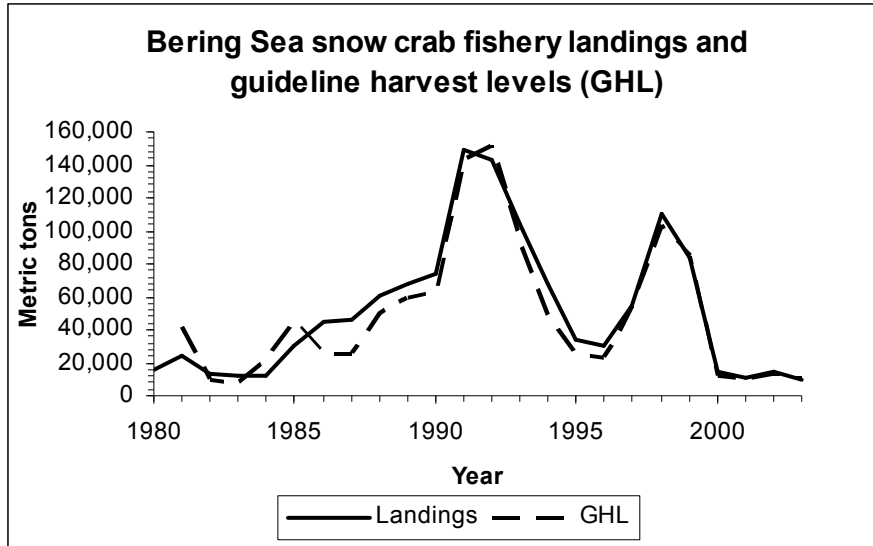


Figure 73: Landings of the Bering Sea snow crab from 1980 to 2003 with guideline harvest levels.

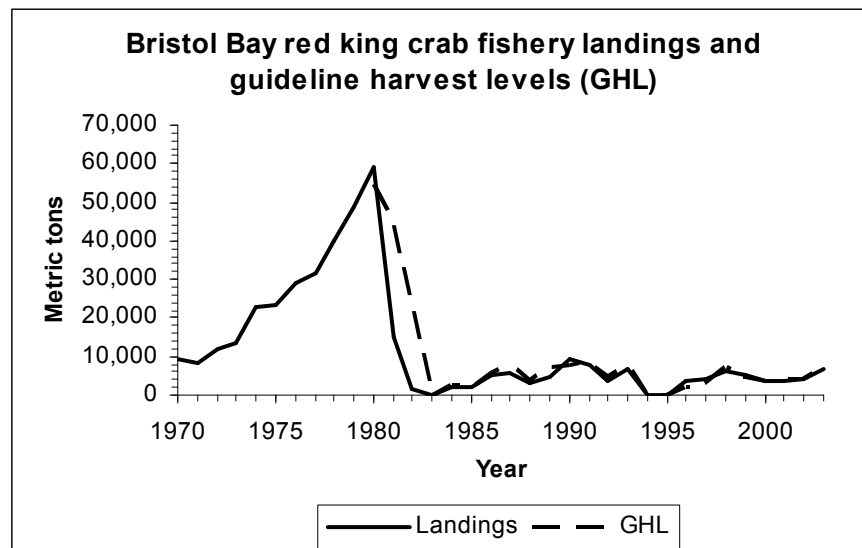


Figure 74: Landings of Bristol Bay red king crab from 1970-2003 with guideline harvest levels.

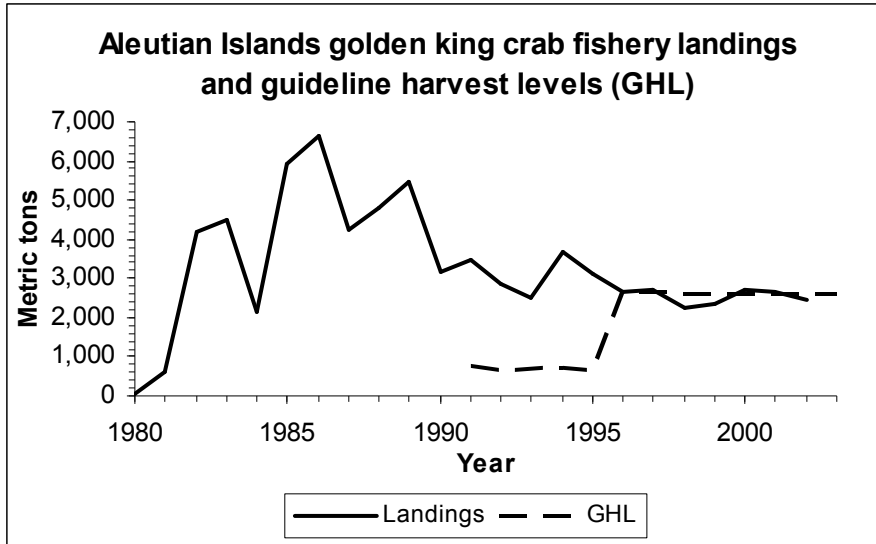


Figure 75: Landings of Aleutian Islands golden king crab from 1980-2002 with guideline harvest levels.

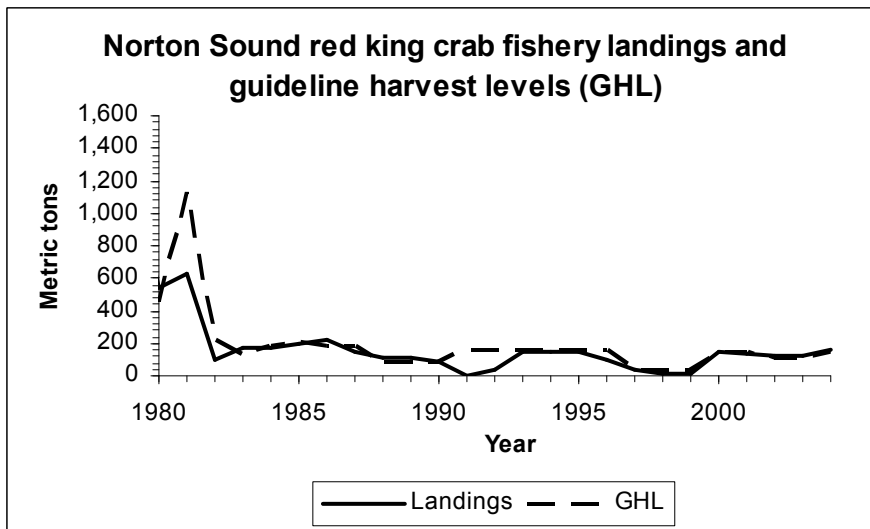


Figure 76: Landings of Norton Sound red king crab from 1980-2004 with guideline harvest levels.

Recent landings of the four stocks of king and Tanner crab are given separately (Table 123) (ADF&G, 2002; ADF&G, 2003a; ADF&G, 2003b; ADF&G, 2004e).

Table 123: Recent landings of the four major stocks of crab in the BSAI king and Tanner crab fishery. Landings are in metric tons.

Stock	2002 Landings	2003 Landings	2004 Landings
Aleutian Islands golden king crab	2,477.9	—	—
Bering Sea snow crab*	14,669.2	9,280.5	—
Bristol Bay red king crab	4,381.7	6,554.4	—
Norton Sound red king crab**	117.8	121.2	154.6
Total***	21,646.6		

* Does not include CDQ landings

** Includes CDQ landings

*** Only 2002 was totaled because that is the only year for which landings data are available for all four stocks.

Regulations

The regulations for the crab fishery are two-fold. There are federal regulations which are fixed in the FMP, and there are also state regulations for the four major species of crab. The federal management measures include a license limitation program, registration areas, gear restrictions and observer requirements. The state management measures include minimum size limits, guideline harvest levels, in-season adjustments, management districts and subdivisions, seasons, sex restrictions, closed waters, pot limits, and registration areas.

Federal Management Measures

A federal vessel moratorium was applied to the BSAI king and Tanner crab fisheries on January 1, 1996. Vessel moratorium permits are transferable to a new vessel under certain limitations. Crab landing history between 1988 and 1992 was used as the qualifying criteria for vessels, with some opportunity for vessels landing groundfish to also obtain crab vessel moratorium permits. In addition to restricting the number of vessels in the fishery, the vessel moratorium also served to prevent licensed vessels from increasing more than 20% in fishing power, or exceeding 125 feet in length. The federal crab vessel moratorium was replaced by the federal license limitation program (LLP) in January, 2000. Licenses were issued to the owners of moratorium vessels. All of the same regulations that applied to vessel moratorium permits also apply to LLP licenses. LLP licenses also carry specific species and area endorsements. The owner must register at the beginning of the fishing season to participate in each fishery and area. The LLP does not apply to vessels less than 32 ft in length, vessels fishing in state waters, or community development program vessels (Bowers, 2003b; NPFMC, 1998a; NPFMC, 1998b).

The FMP also established an exclusive registration area in Norton Sound, in the northern Bering Sea. It stipulates that vessels registered to fish crab in Norton Sound are not allowed to participate in the crab fishery in any other registration areas.

The use of trawls and tangle nets for the harvesting of crab is strictly prohibited, and federal requirements state that any vessel fishing for crab in the Bering Sea or Aleutian Islands is required to carry an observer if they are requested to do so by NMFS (NPFMC, 1998b).

State Management Measures

Aside from the state measures listed previously, other management measures that are left to the sole discretion of the ADF&G include reporting requirements, gear placement/removal, gear storage, gear modifications, vessel tank inspections, state observer requirements, and bycatch limits. The minimum size, sex restrictions, season, and guideline harvest levels are summarized in Table 124 for four stocks of crab. Table 125 specifies the gear restrictions applicable to these four fisheries (State of Alaska, 2004a).

Table 124: Minimum size, sex restrictions, season, and guideline harvest levels. The 2004 general fishery closure dates are given in parentheses.

Species, Stock	Minimum Size (inches, carapace width)	Season ⁶		2004 Guideline Harvest Level (GHL, mt)
		Opens	Closes	
Red king crab, Bristol Bay	Male only, 6.5	4:00 PM, October 15	When landings approach GHL and emergency order is issued by ADF&G (Midnight, Oct. 18, 2004 (ADF&G, 2004e))	6,471.4
Red king crab, Norton Sound	Male only, 4.75	Summer – July 1	Summer – September 5 or when landings approach GHL and emergency order is issued by ADF&G (Noon, Aug 8, 2004 (ADF&G, 2004a))	148.1
		Winter – November 15	Winter – May 15	none set
			When landings approach GHL and emergency	

⁶ Openings will be delayed if the weather forecast indicates. Community development program seasons are usually later.

Species, Stock	Minimum Size (inches, carapace width)	Season ⁶		2004 Guideline Harvest Level (GHL, mt)
		Opens	Closes	
Golden king crab, Aleutian Islands	Male only, 6.0	Noon, August 15	order is issued by ADF&G (East- 8:00 PM, Aug. 29, 2004, West- currently open ⁷ (ADF&G, 2004d))	2,585.5 subdivided between eastern and western regions
Snow crab, Bering Sea	Male only, 3.1	Noon, January 15	When landings approach GHL and emergency order is issued by ADF&G (10:00 PM Jan. 23, 2004 (ADF&G, 2004c))	8,740.3

Table 125: Gear specifications for the Bristol Bay red king crab, Norton Sound red king crab, Aleutian Islands golden king crab, and Bering Sea snow crab fisheries.

Species	Number of Pots	Pot, Entrance Dimensions	Openings for escapement of undersized crabs	Biodegradable requirements	Marking
Red king crab, Bristol Bay	Variable depending on size of vessel, # of vessels in fishery, and GHL. Range = 60-250 pots/vessel	10' x 10' x 42", Opening >5" one dimension, total perimeter >36"	1/3 of any vertical surface must be 9" mesh	18" opening covered with biodegradable cotton thread or mesh and a Galvanic timed release (GTR) device.	1 buoy and leader line/pot with fishery specific identification tag
Red king crab, Norton Sound	50 pots/vessel>125' 40 pots/vessel<125'		1/3 of any vertical surface must be 9" mesh		1 buoy and leader line/pot with fishery specific identification tag
Golden king crab, Aleutian Islands	Variable depending on size of vessel and number of vessels in fishery. Not to exceed: 50 pots/vessel>125' 40 pots/vessel<125'		1/3 of any vertical surface must be 9" mesh or 4 openings >5.5" diameter		At least 10 pots per shellfish longline. Clusters of buoys required at each end.
Snow crab, Bering Sea	Variable depending on size of vessel and GHL. Range = 70-250 pots/vessel		8 openings >4" diameter		1 buoy and leader line/pot with fishery specific identification tag

Discards

Observers monitor catch and bycatch in three of the major Alaskan crab fisheries; Bristol Bay red king crab, Bering Sea snow crab, and Aleutian Islands golden king crab. Observers are not deployed in the Norton Sound red king crab fishery; it is extremely small, and lands under 200 mt of crab per year (Table 123, Figure 76) (Barnard and Burt, 2004). Bycatch in the Norton Sound fishery appears to be minimal and consists mainly of assorted sculpin species, saffron cod, hairy tritons, and several species of sea stars (Tom Kohler, Alaska Department of Fish and Game, Personal communication, 11/23/04).

Unfortunately, observers in the other three fisheries only sample a very small percentage of the total catch in the fisheries. This is mainly due to the fast-paced derby style of the fishery. For example, the 2004 Bristol Bay red king crab fishery lasted only three days (Table 124). Observer coverage in the CDQ fisheries is better than in the general fisheries; but CDQ landings comprise a very small percentage of the total catch. Depending on the crab stock and type of vessel that the observer is stationed on (catcher-only, catcher-processor, or floater-processor), observers try to characterize bycatch for between five and

⁷ The 2002 Aleutian Islands golden king crab fishery in the western region opened on August 15, 2002 and remained open for 17 months until landings approached the 2002 regional GHL of 2.7 million lbs. The western region fishery was closed by the ADF&G at noon on February 6, 2004. Therefore, it is reasonable to speculate that the 2004 fishery will remain open in the western region until at least late 2005 or early 2006.

fifteen pot-lifts per day. Overall, the number of observed versus total pot lifts for each of these fisheries varies widely (Table 126) (Barnard and Burt, 2004).

Table 126: Number of observed and total pot lifts in the 2002 Alaskan crab fisheries (Barnard and Burt, 2004).

	Observed pot lifts, 2002	Total pot lifts, 2002	Percent coverage
Bristol Bay red king crab (general fishery)	1,316	308,132	0.4%
Bristol Bay red king crab (CDQ fishery)	1,099	18,835	5.8%
Bristol Bay red king crab combined	2,415	326,967	0.7%
Bering Sea snow crab (general fishery)	487	68,328	0.7%
Bering Sea snow crab (CDQ fishery)	251	3,513	7.1%
Bering Sea snow crab combined	738	71,841	1.0%
Aleutian Islands golden king crab (combines east and west, no CDQ fishery)	8,433	157,256	5.4%

The methodology used to obtain total discard estimates for each of these fisheries is a straightforward ratio estimator approach. The observed discards was simply multiplied by the ratio of observed to total pot lifts. This was done individually for the general and CDQ fisheries, and then combined within each stock (Table 127). For the Aleutian Islands crab fishery, discards were calculated for the east and west regions separately and then combined (Table 127). The legal sized male commercial crab discard data are from the observer program database and not calculated.

Table 127: Discards in the Alaskan crab fisheries for the 2002 fishing year. Discards are reported in numbers of individuals (Barnard and Burt, 2004).

2001/2002 Aleutian Islands golden king crab fishery discards (E&W combined)		2002 Bering Sea snow crab fishery discards (includes CDQ)		2002 Bristol Bay red king crab fishery discards (includes CDQ)	
Species and Group	Number discarded	Species and Group	Number discarded	Species and Group	Number discarded
FISH		FISH		FISH	
Pacific halibut	5,277	Pacific cod	189,428	Yellowfin sole	60,084
Pacific cod	1,753	Sculpin	35,056	Pacific cod	55,286
Skate	1,492	Walleye pollock	22,462	Sculpin, uni	6,706
Arrowtooth flounder	615	Yellowfin sole	9,730	Pacific halibut	4,419
Yellow Irish lord	559	Pacific halibut	7,134	Yellow Irish lord	1,319
Greenland turbot	522	Yellow Irish lord	3,993	Great sculpin	281
Pacific ocean perch	448	Snailfish, uni	3,970	Arrowtooth flounder	140
Sablefish	392	Flathead sole	952	Bigmouth sculpin	140
Sculpin, uni	298	Flatfish, uni	907	Spinyhead sculpin	140
Snailfish, uni	261	Alaska plaice	885	Walleye pollock	140
Rockfish, uni	242	Arrowtooth flounder	719	Total Fish	128,655
Grenadier, uni	205	Skate	508		
Shortspine thornyhead	205	Prowfish	251	INVERTEBRATES	
Walleye pollock	149	Rougheye rockfish	234	Snail	29,575
Flatfish, uni	131	Dusky rockfish	17	Sea star	11,322
Atka mackerel	112	Eelpout	17	Sea jelly, uni	6,229
Rock sole	56	Greenland turbot	17	Leech, uni	2,806
Rougheye rockfish	56	Greenling	17	Hermit crab, uni	1,417
Bigmouth sculpin	19	Pacific ocean perch	17	Hairy triton	561
Dover sole	19	Rock sole	17	Lyre crab	295
Dusky rockfish	19	Searcher	17	Coral	281
Flathead sole	19	Total Fish	276,348	Sponge	224
Great sculpin	19			Barnacle, uni	140
Total Fish	12,868	INVERTEBRATES		Mussel	140
		Snail	1,397,368	Total Invertebrates	52,990
INVERTEBRATES		Hermit crab, uni	150,447		
Coral	29,463	Sea star, uni	93,418	COMMERCIAL CRAB	
Sponge	16,317	Sea jelly, uni	14,256	Red king crab sublegal male	1,480,726
Basket star	14,247	Lyre crab	10,025	Red king crab female	49,401
Sea star	7,832	Hairy triton	9,319	Red king crab legal	79,400

2001/2002 Aleutian Islands golden king crab fishery discards (E&W combined)		2002 Bering Sea snow crab fishery discards (includes CDQ)		2002 Bristol Bay red king crab fishery discards (includes CDQ)	
Species and Group	Number discarded	Species and Group	Number discarded	Species and Group	Number discarded
				male	
Brittle star	7,198	Sea anemone, uni	6,290	Tanner crab sublegal male	51,628
Sea urchin	5,837	Octopus	5,156	Tanner crab female	6,271
Snails	4,904	Brittle star, uni	1,222	Snow crab sublegal male	870
Hairy triton	2,350	Basket star, uni	645	Snow crab female	0
Tunicate	1,678	Decorator crab	468	Tanner x snow crab hybrid sublegal male	912
Hydroid	1,287	Sea urchin, uni	468	Tanner x snow crab female	0
Invertebrate, uni	820	Mussel	268	Total Commercial Crabs	1,669,208
Octopus	709	Barnacle, uni	234		
Barnacle, uni	354	Sponge	234		
Bryozoan, uni	317	Worm	234		
Sea lily	317	Scallop	17		
Sea cucumber, uni	242	Total Invertebrates	1,690,069		
Lyre crab	205				
Sea anemone, uni	131	COMMERCIAL CRAB			
Sea spider, uni	112	Snow crab sublegal male	820,503		
Scallop, uni	93	Snow crab female	66,488		
Tubeworm, uni	93	Snow crab legal male	14,937,400		
Sea pen, uni	75	Tanner x snow crab hybrid sublegal male	234,296		
Leech, uni	56	Tanner x snow crab female	14,085		
scale worm, uni	56	Tanner crab sublegal male	1,111,275		
shrimp, uni	37	Tanner crab female	112,415		
Worm, uni	37	Blue king crab sublegal male	531		
Hermit crab, uni	19	Blue king crab female	17		
Mussel	19	Golden king crab sublegal male	679		
Paralomis crab	19	Golden king crab female	120		
Scaled crab	19	Hair crab sublegal male	234		
Sea jelly, uni	19	Hair crab female	0		
Total Invertebrates	94,862	Total Commercial Crabs	17,298,043		
COMMERCIAL CRAB					
Golden king crab sub-legal male	1,243,223				
Golden king crab female	1,195,392				
Golden king crab legal male	10,700*				
Scarlet king crab sub-legal male	1,119				
Scarlet king crab female	970				
Red king crab sub-legal male	112				
Red king crab female	186				
Grooved Tanner crab sub-legal male	131				
Grooved Tanner crab female	298				
Total Commercial Crabs	2,452,131				

In summary, 21,646.6 mt of Alaska crab was landed commercially in 2002. The Bering Sea snow crab fishery is responsible for over two-thirds of the total catch. Bycatch for the three observed fisheries (Bristol Bay red king crab, Bering Sea snow crab and Aleutian Islands golden king crab) is only recorded in numbers of animals, and the majority of the bycatch is crabs which are assumed to survive when discarded. The legal size male commercial crab discard estimates can be rather large, sometimes exceeding the estimated number of sub-legal male discards for a particular fishery. This could be occurring due to high-grading, because processors prefer crabs of a certain size whereas legal size might be smaller. One example is in the snow crab fishery. Processors prefer crabs with a four inch carapace or larger, while the legal size is only 3.1 inches. In 2002, 21,419,382 crabs were discarded. If each of these crabs weighs on average one kilogram, the discards amount to 21,419 mt, giving a discard to landings ratio of 0.99. The average weight of 1 kg was assumed in the absence of reliable weight data. The weight was chosen because the majority of the crab species weigh close to one kilogram when fully grown (king crabs are the exception: they weigh closer to three or four kilograms each), and because of the abundance of sub-legal crabs in the bycatch.

Typically, non-target species bycatch in crab traps is mainly composed of slow or sessile organisms such as sponges, corals, sea stars and snails. 1,837,921 invertebrates and 417,871 finfish were caught as bycatch in the Alaskan crab fisheries in 2002. However, it is impossible to obtain accurate weight data for these discards as we do not know the size selectivity of the traps. The main fish species taken as bycatch in the Alaska crab fishery were halibut, Pacific cod, walleye pollock, yellowfin sole, yellow Irish lord and sculpin. A very rough estimate of the weight of fish bycatch could be made if it is assumed that each fish weighs on average approximately five pounds. This weight was chosen because the fish that are able to enter the trap must fit through a small opening with a perimeter of only 36 inches; if it were a square opening, it would be nine inches on a side. Using the five-pound average weight, the total amount of fish bycatch is 950 mt.

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Alaskan Weathervane Scallop Fishery

Major Target Species:	Weathervane scallop (<i>Patinopecten caurinus</i>)
Major Discard Species:	Sea stars, skates, flatfish
Primary Gear Types:	Dredge
Total Landings (2002):	1,788 mt
Total Discards (2002):	997 mt
Total Discards Rank (of 27):	23
Discard to Landings Ratio:	0.56
d/I Rank (of 27):	11
Source of Estimates:	ADF&G, Independent research studies, Authors
Discard Type:	Primarily target, regulatory
Notes:	Landings and discards are reported in whole weight (including shell). The total discards includes 176,034 crabs that were estimated to weigh 1 kg each in the absence of accurate weight data.

The fishery for weathervane scallops in Alaska began in 1967 and exists in Alaskan waters from Yakutat to the eastern Aleutian Islands. Historically, the weathervane scallop fishery was regulated by the ADF&G. However, in 1995, the NPFMC developed the FMP for the Scallop Fishery off Alaska, delegating most of the regulatory responsibility to the ADF&G, and added a vessel moratorium that was later replaced by a federal license limitation program. There currently are only nine federal limited license vessels authorized to fish for weathervane scallops in the Alaskan EEZ (Kruse et al., 1999; NMFS et al., 2004). The Alaskan weathervane scallop fishery is not overfished, and overfishing is not occurring (NMFS et al., 2004).

Target landings

Landings of weathervane scallop have been fluctuating greatly for the past four decades (Figure 77). They peaked at 857 metric tons of meat weight in 1969, then declined to just above zero from 1977-1979. Landings eventually peaked again in 1992 at 790 metric tons, but have slowly declined back to 145 metric tons in 2002 (NMFS, 2004). These landings are reported in meat weight rather than whole weight, because the meat weight to whole weight conversion was only known for 1999-2002 (Barnhart and Rosenkrantz, 2003). It was impossible to convert the meat weight to whole weight for years prior to 1999, but the shape of the graph and landing trends would be similar.

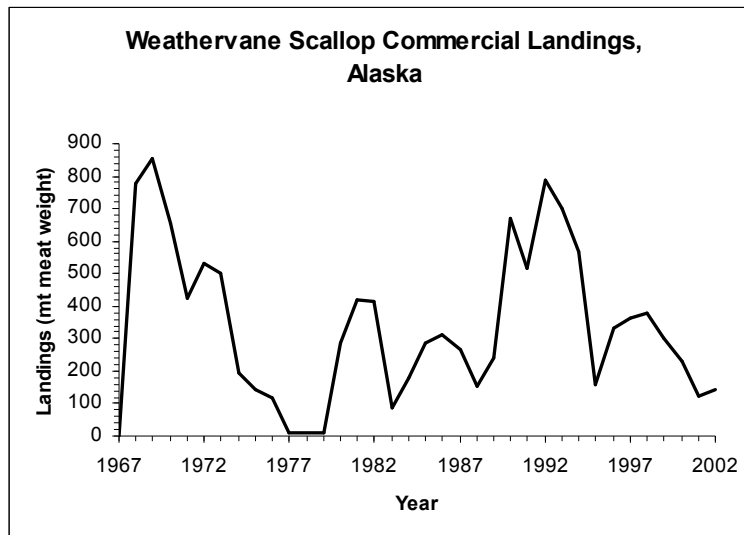


Figure 77: Commercial landings in meat weight of Alaskan weathervane scallop, 1967-2002.

Scallops are fished almost exclusively with dredge gear, but all weathervane scallop landings in the NMFS commercial landings database are reported to have been made with combined or unspecified gears. It is probable that some scallops are landed with trawl or pot gear, but these landings are most likely a result of bycatch in other fisheries (NMFS, 2004e).

Regulations

The weathervane scallop fishery is regulated using multiple methods that include seasonal and area closures, guideline harvest levels, bycatch limits, prohibited species, efficiency limits, a federal license limitation program, and gear restrictions. In addition, this fishery is required to have 100% observer coverage.

Registration areas, guideline harvest levels and efficiency limits

The Alaska state waters and Exclusive Economic Zone (EEZ) are divided into nine scallop management registration areas. Each registration area has an open season and open districts to scallop harvesting. Every year, the ADF&G sets guideline harvest levels for each of the 9 registration areas. Guideline harvest levels for 2004 are shown in Table 128. The ADF&G can close the fishery or make in-season adjustments to management measures based on present take from the guideline harvest level. In addition, to encourage the harvest of only the largest and oldest scallops from the weathervane scallop stock, efficiency limits are placed on the fishery. Crew size is limited to 12 people and the use of mechanical shucking machines is prohibited (ADF&G, 2004; NMFS et al., 2004).

Table 128: 2004-2005 guideline harvest levels for the Alaska weathervane scallop commercial fishery (ADF&G, 2004).

Registration Area	Guideline Harvest Range		
	Pounds of Shucked Meats	Metric Tons Shucked Meats	Approximate metric tons of whole scallops
Yakutat			
Area D	0 to 200,000	0 to 90.7	0 to 1,116
District 16	0 to 35,000	0 to 15.9	0 to 192
Prince William Sound	0 to 50,000	0 to 22.7	0 to 279
Kodiak			
Shelikof District	0 to 180,000	0 to 81.6	0 to 1,004
Northeast District	0 to 80,000	0 to 36.3	0 to 446
Alaska Peninsula	0 to 10,000	0 to 4.5	0 to 55
Dutch Harbor	Closed	Closed	Closed
Bering Sea	0 to 50,000	0 to 22.7	0 to 279
Adak	0 to 75,000	0 to 34.0	0 to 418

Bycatch limits and prohibited species

The retention of salmon, halibut, king crab, Tanner crab, and herring by scallop vessels is prohibited by the ADF&G. The ADF&G has established bycatch limits for red king crab and Tanner crab in the scallop fishery. The bycatch limits for the scallop fishery as a whole are usually set at 0.5% or 1.0% of the total red king or Tanner crab population. Once the bycatch limits of either crab species are caught by the scallop fleet, the scallop fishery may be closed. The 2004 red king and Tanner crab bycatch limits for the scallop fishery are shown in Table 129 (Barnhart, 2003; NMFS et al., 2004).

Table 129: 2004-2005 Alaska commercial scallop fishery red king and Tanner crab bycatch limits (Barnhart, 2003).

Registration Area	Bycatch Limits (number of animals)	
	Tanner Crab	Red King Crab
Yakutat		
Area D	NA	NA
District 16	NA	NA
Prince William Sound	11,400	NA
Kodiak		
Shelikof District	35,069	25
Northeast District	527,388	40

Registration Area	Bycatch Limits (number of animals)	
	Tanner Crab	Red King Crab
Alaska Peninsula	85,021	199
Dutch Harbor	NA	NA
Bering Sea	65,000 <i>C. bairdi</i>	500
	150,000 <i>C. opilio</i> and hybrids	
Adak	10,000	50

Federal license limitation program

Currently, to obtain a fishing license for Alaskan weathervane scallop, a vessel owner needs to have made a legal landing of scallops in two of the years from 1996 to 1998. Federal limited fishing licenses for the scallop fishery are not vessel specific, but cannot be transferred to a vessel of greater length (NPFMC and ADF&G, 2004).

Gear restrictions

The minimum inside diameter of a dredge ring is four inches in both state and federal waters. All vessels are limited to one dredge no wider than six feet when fishing inside the Kamishak district of Cook Inlet. Those vessel owners who only fished inside the Cook Inlet area during the qualifying period for the federal license limitation program are limited to one dredge no wider than six feet in all waters. There are only two vessels that are subject to this restriction. The seven vessels that did make landings of scallops from outside the Cook Inlet area during the qualifying period are limited to two dredges with a maximum width of 15 feet each. The NPFMC is currently considering modifying the single six foot dredge restriction placed on those two fishing vessels because paying for observers when outside of the Cook Inlet area produces disproportionate economic hardship (NMFS et al., 2004; NPFMC and ADF&G, 2004).

Discards

Discards and bycatch in the weathervane scallop fishery are extremely well characterized. One hundred percent of scallop vessels have observers onboard. However, not every haul is observed. Observers generally sample five or six dredges per day for scallops, commercial crab and halibut bycatch, and only one dredge per day for all other species composition. When necessary, they employed general sub-sampling techniques to obtain weights. For example, if there were 30 baskets of a particular species, observers might weigh two baskets and multiply the weight by 15. On occasion, observers will use visual estimates of bycatch if there are large amounts. Sampling coverage ranged from 36% (1999/2000 season) down to 32% (2000/2001 and 2001/2002 seasons). There were no data available from Cook Inlet. However, Cook Inlet is the area where only one six foot dredge is allowed to be fished. As a result, there is probably very little fishing occurring in Cook Inlet (Barnhart and Rosenkranz, 2003).

Discards from the weathervane scallop fishery for the 1999, 2000 and 2001 fishing seasons are reported in metric tons (Table 130). On average, weathervane scallops accounted for just over 40% of the total amount of discards by weight, sea stars, skates, crabs and flatfish were other commonly discarded species (Barnhart and Rosenkranz, 2003). Weights of weathervane scallops are reported in whole weights. Discarded scallops are generally assumed to survive.

Table 130: Target and non-target species discards in the Alaska weathervane scallop fishery, 1999-2002. Discards are in metric tons.

Species	Discards, whole weight		
	1999-2000 Metric tons	2000-2001 Metric tons	2001-2002 Metric tons
Weathervane scallop (whole)	515.54	449.72	349.07
Twenty-arm sea star	87.01	94.31	112.59
Skate	126.84	35.03	36.31
Sea star, unidentified	143.26	26.49	27.12
Arrowtooth flounder	54.20	24.34	26.12
Snow crab and hybrids	43.93	32.98	23.17
Sea anemone, unidentified	51.04	12.72	21.21
Flathead sole	42.91	18.66	17.27

Species	Discards, whole weight		
	1999-2000	2000-2001	2001-2002
	Metric tons	Metric tons	Metric tons
Hermit crab, unidentified	32.54	21.08	13.49
Big skate	1.89	24.95	34.89
Yellowfin sole	17.93	20.61	13.10
Basket sea star, unidentified	39.48	6.15	0
Moon snail, unidentified	45.18	0	0
Tanner crab	13.75	11.77	19.60
Longnose skate	5.00	20.62	19.44
Notched brittle star	14.06	5.20	23.83
Hairy triton	6.72	24.83	8.64
Snail, unidentified	26.32	7.06	3.02
Sponge, unidentified	31.56	0	3.02
Rock sole	21.14	5.62	1.67
English sole	3.50	2.46	12.85
Shark, unidentified	17.11	0	0
Greenland turbot	15.06	0	0
Alaska plaice	7.82	3.20	3.61
Spiny dogfish	2.86	1.45	9.00
Pacific halibut	3.11	5.77	3.42
Lingcod	3.89	3.97	4.41
Horse mussel	10.98	0.07	0
Dover sole	6.08	4.75	0.17
Nudibranch, unidentified	10.04	0	0
Common octopus	1.97	2.75	5.28
Blood sea star	0	6.79	2.03
Big skate egg case	0	8.53	0
Snail shells	0	7.06	0
Pacific cod	5.62	1.07	0.26
Rex sole	0.33	1.33	4.84
Sand dollar, unidentified	6.35	0	0
Butter sole	1.54	2.84	1.35
Jellyfish, unidentified	5.02	0	0
Brittle star, unidentified	0.24	3.14	1.62
Sea urchin, unidentified	4.54	0.44	0
Sea star	0	4.63	0
Snail eggs, unidentified	3.88	0	0
Lyre crab	0	3.82	0
Sea mouse	0.96	0	2.48
Wolf-eel	2.27	0	0
Bay scallop	1.56	0.63	0
Ribbed neptune snail	0.06	0	2.01
Aleutian hermit crab	0	0	2.01
Starry flounder	0.08	1.70	0
Brown box crab	1.73	0	0
Sea peach	0	1.37	0
Box crab, unidentified	0.77	0	0
Sea pen, unidentified	0.06	0	0.56
Red box crab	0	0.45	0
Majestic sea star	0	0.38	0
Petrale sole	0	0	0.34
Sand sole	0	0.19	0
Green sea urchin	0	0.19	0
Crab barnacle	0	0.18	0
Longnose skate egg case	0	0.18	0
Pacific sanddab	0	0	0.17
Walleye pollock	0	0	0.13
Spinyhead sculpin	0.12	0	0
Sculpin, unidentified	0	0	0.10
Polychaete worm	0	0.07	0
Ladder whelk	0.06	0	0
Total	1,437.91	911.51	810.21

The discarded amount of scallops in Table 130 may appear somewhat inflated, as it is reported in whole weights, while scallop landings (Figure 77) are reported in meat weights. In order to compare these

numbers, a whole weight to meat weight conversion ratio was needed. For the 1999-2000 fishing year, observers determined that the average whole weight to meat weight ratio was 10.88, for 2000-2001 it was 10.96, and for 2001-2002 it was 12.30 (Barnhart and Rosenkranz, 2003). The total scallop discards for the 2001-2002 fishing year were 349.07 mt whole weight, and adjusted landings were 1,788.4 mt whole weight. This would make the 2002 discard to total catch ratio for scallops 0.14, or 14 percent of the total scallop catch was discarded.

Table 131 contains discards of prohibited species in numbers of animals. Tanner crab and snow crab are affected the most by scallop dredges, while red king crab species are hardly affected (Barnhart and Rosenkranz, 2003).

Table 131: Prohibited species discards in the Alaska weathervane scallop fishery, 1999-2002. Discards are in numbers of animals.

Species	Prohibited Species Discards (number of animals)		
	1999-2000	2000-2001	2001-2002
Tanner crab	152,594	102,074	105,840
Snow/hybrid crab species	159,656	103,350	68,458
Dungeness crab	3,033	392	1,733
Pacific halibut	1,165	631	663
King crab species	3	5	3

In summary, 1,788.4 mt of whole scallops (obtained by multiplying 145.4 mt meat weight by 12.3, the meat to whole weight conversion factor) were landed in 2002, and 349 metric tons of scallops (whole weight) were discarded. For non-target species, 461 metric tons of fish and other species (mainly sea stars, crabs and flatfish) were discarded. In addition, in 2002, the weathervane scallop fishery took 176,034 crabs. Each crab was estimated to weight 1 kg for a total of 176 mt. Overall, 997 mt were discarded, including scallop and non-target discards for a d/I ratio of 0.56.

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Gulf of Alaska Groundfish Fishery

Major Target Species:	Pacific cod (<i>Gadus macrocephalus</i>), Rock sole (<i>Pleuronectes bilineatus</i>), Flathead sole (<i>Hippoglossoides elassodon</i>), Pacific Ocean perch (<i>Sebastes alutus</i>), Arrowtooth flounder (<i>Atheresthes stomias</i>), Sablefish (<i>Anoplopoma fimbria</i>), Shortraker rockfish (<i>Sebastes borealis</i>), Rougheye rockfish (<i>Sebastes aleutianus</i>), Walleye pollock (<i>Theragra chalcogramma</i>), Northern rockfish (<i>Sebastes polyspinis</i>), Butter sole (<i>Pleuronectes isolepis</i>), Rex sole (<i>Glyptocephalus zachirus</i>), Dusky rockfish (<i>Sebastes ciliatus</i>), Flathead sole (<i>Hippoglossoides elassodon</i>), Shortspine thornyhead (<i>Sebastolobus alascanus</i>), Longspine thornyhead (<i>Sebastolobus altivelis</i>), Broadbanded thornyhead (<i>Sebastolobus macrochir</i>), Dover sole (<i>Microstomus pacificus</i>), Yelloweye rockfish (<i>Sebastes ruberrimus</i>)
Major Discard Species:	Halibut (<i>Hippoglossus stenolepis</i>), Crabs, Salmon
Primary Gear Types:	Trawl, Pot (Pacific cod), Hook and line (Sablefish, Greenland turbot)
Total Landings (2002):	142,787 mt
Total Discards (2002):	47,278 mt
Total Discards Rank (of 27):	6
Discard to Landings Ratio:	0.33
d/I Rank (of 27):	13
Source of Estimates:	NMFS, AMCC, Authors
Discard Type:	Primarily target, regulatory
Notes:	Total discards include 188,600 crabs estimated to weigh 1 kg each, and 16,600 salmon estimated to weigh 5 kg each in the absence of accurate weight data.

The groundfish fishery in the Gulf of Alaska (GOA) is managed by the North Pacific Fishery Management Council. The GOA is an area of U.S. waters south of Alaska and east of the Aleutian Islands. The FMP for GOA Groundfish includes 16 species: Pacific cod, walleye pollock, sablefish, shortspine thornyhead, arrowtooth flounder, Pacific Ocean perch, northern rockfish, butter sole, Dover sole, flathead sole, rex sole, rock sole, dusky rockfish, yelloweye rockfish, shortraker rockfish and rougheye rockfish. Walleye pollock is split into two stocks, a western/central stock and an eastern stock, Pacific ocean perch is split into three stocks, western, central and eastern, and rock sole is split into a northern and southern stock. There are no stocks that are overfished, and overfishing is not occurring (NMFS et al., 2004). Approximately half of the 16 species are caught and landed solely as bycatch when targeting other groundfish species. Here, we include all types of landings, bycatch and discards, including data from inshore catcher/processors, catcher vessels, motherships and CDQs.

Target landings

This fishery is much smaller in terms of landings than the Bering Sea and Aleutian Islands (BSAI) fishery. Overall, the landings of groundfish in the Gulf of Alaska have ranged from a low of 130,000 mt in 1978 to a high of 350,000 mt in 1984 (NMFS, 1999). There was a drastic decline in landings from 350,000 mt back down to 130,000 mt between 1984 and 1986, followed by a climb back up to 250,000 mt in the mid to late 1990's (NMFS, 1999). Current 2002 and 2003 landings for each of the major species in the GOA groundfish FMP are shown in Table 132 (AMCC, 2004).

Table 132: 2002 and 2003 landings of major species within the GOA groundfish fishery.

Species or Species Grouping	2002 Landings	2003 Landings (mt)
Pacific cod	38,504	49,584
Walleye pollock	50,750	49,337
Arrowtooth flounder	10,121	12,727
Sablefish	12,451	13,791
Pacific Ocean perch	10,820	8,551

Species or Species Grouping	2002 Landings	2003 Landings (mt)
Other groundfish (minor species)	811	3,389
Northern rockfish	3,003	4,837
Shallow water flatfish (butter sole, rock sole and minor species)	6,103	4,142
Rex sole	2,813	3,234
Pelagic shelf rockfish (dusky rockfish and minor species)	3,148	2,971
Flathead sole	1,644	2,032
Shortraker/rougheye rockfish	995	1,004
Thornyhead rockfish (shortspine, longspine and broad banded)	967	1,025
Deep water flatfish (dover sole and minor species)	333	452
Demersal shelf rockfish (yelloweye rockfish and minor species)	324	246
Total	142,787	157,322

Together, Pacific cod and walleye pollock account for over 60% of all groundfish landings in the Gulf of Alaska. Arrowtooth flounder, sablefish and Pacific Ocean perch account for another 30% of the landings. The other species all have small landings contributions of three percent or less.

Gear usage for the GOA groundfish fishery (Figure 78) was not separated by fishery, but for the most part, landings are made using trawl gear. The exception is Pacific cod, which is targeted mainly with pot gear, and sablefish, Greenland turbot and "other species" which are mostly caught using hook and line (AMCC, 2004).

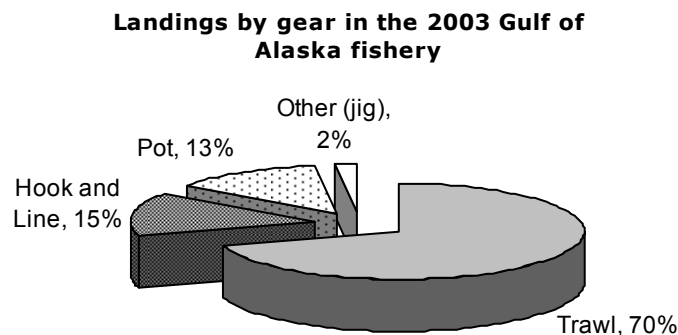


Figure 78: Landings by gear in the 2003 GOA groundfish fishery. Trawl gear accounts for the large majority of landings.

Regulations

The groundfish fishery in the GOA is regulated using various measures. Total allowable catch (TAC) rates (Table 133), area closures, seasonal closures and incidental catch limits for prohibited species are the most commonly used regulations. The groundfish species do not fall under minimum size regulations, and gear regulations mainly pertain to gear type, marking and deployment, fishing and retrieval methods (NMFS, 2003).

Table 133: Annual TACs for groundfish in the Gulf of Alaska. This includes incidental catch limits, CDQ and IFQ allocations (NMFS, 2003).

Species	GOA Total TAC (mt)
Pollock	54,350
Pacific cod	40,540
Atka mackerel	600
Sablefish	14,890
Pacific Ocean perch	13,660
Shortraker/rougheye	1,620
Northern rockfish	5,530
Thornyhead rockfish	2,000

Species	GOA Total TAC (mt)
Demersal shelf rockfish (Yelloweye and minor species)	390
Pelagic shelf rockfish (Dusky and minor species)	5,490
Other rockfish (minor species)	990
Rex sole	9,470
Flathead sole	11,150
Arrowtooth flounder	38,000
Deep-water flatfish (Dover sole, Greenland turbot, deep sea sole)	4,880
Shallow-water flatfish (butter sole, rock sole)	21,620
Other species (squid, sculpins, sharks, skates and octopi)	11,260
Total	236,440

The TAC from Table 133 is further distributed by sub-area, district and region, and then divided among gear type and season. The TACs for four of the species (Atka mackerel, thornyhead rockfish, shortraker/roughey rockfish and other rockfish), and a portion of the TACs for sablefish and other rockfish are actually incidental catch limits needed to support other directed fisheries in the GOA. The catch of Atka mackerel, thornyhead rockfish, shortraker/roughey rockfish and other rockfish is prohibited except for the allowable catch limit listed in Table 133. The sablefish trawl fishery and the offshore pollock fishery also exist only as incidental fisheries, with catch limits of 2,096 mt and unknown, respectively (NMFS, 2003).

When either the TAC or incidental catch limit for a fishery is reached, the fishery is closed. Other limits (sideboard limits) also exist to prevent AFA eligible vessels from increasing their catch of groundfish in other fisheries beyond the average 1995-1997 levels. Sideboard limits also decrease the likelihood that the fishing capacity of AFA eligible vessels will increase in order to compete in those fisheries (AFSC, 2002). There are also directed fishing closures for sideboard fisheries.

The catch of Pacific halibut in the GOA groundfish fishery is also prohibited. There is an overall incidental catch limit of 2,000 mt, but it is split by gear type, season, and target species. In order to protect Steller sea lions from the Atka mackerel, pollock and Pacific cod fisheries, areas immediately adjacent to rookeries and important haulouts are closed to trawling (NMFS, 2003).

Discards

Discard data for the Gulf of Alaska groundfish fishery is available from two different sources, NMFS and the Alaska Marine Conservation Council (AMCC). For some species, data were only available from one source, but for others, estimates were made by both. The majority of discards in the GOA groundfish fishery are groundfish, followed by halibut, crab, salmon and a variety of other species.

Target species discards

NMFS published an economic SAFE report in 2003 detailing the discards and discard rates of Alaskan groundfish in the Alaskan groundfish fishery. The data are reported by target species, discard species and gear type (Table 134 and Table 135). NMFS reported the weights rounded to the nearest 100 mt, therefore zero values may not indicate that there is no discard of that particular species, rather, they indicate discards of 50 mt or less. The totals reflect the sum of the raw discards, rounded to the nearest 100. The totals may also include some categories or species that are not included in the table. Not all species were separately reported by NMFS but discards of those species were included in the totals.

NMFS calculated discards by obtaining weekly observer discard estimates by target fishery, and applying these estimates to the weekly blend estimate of retained catch from the NMFS regional office and summed over the fishing year. The NMFS Blend system (used from 1992-2002) was based on weekly data from processors and was not capable of accounting for some management programs implemented in recent years - including cooperatives, sideboards, complex seasonal allocations, harvest limit area quotas, and quotas assigned to vessels of a particular size class.

In 2003, a new groundfish catch accounting system was implemented that utilizes the same data sources as the Blend (observer data, shoreside processor landings data, and processor weekly production report

data). Where the Blend aggregated all data to the level of processor and week, the new system accounts for data at the haul (observer) and delivery (shoreside landings) level and can track all the current quotas. The new system is also more adaptable for anticipated future changes, and will aid in more accurate discard estimates (<http://www.fakr.noaa.gov/sustainablefisheries/catchaccounting.htm>). However, bycatch estimates from the new accounting system are not yet publicly available, so the older Blend data is presented.

Table 134: Gulf of Alaska groundfish discards by species, gear and target fishery for 2002 (discards in mt, round weight) (Hiatt et al., 2003)

Gear and Target	Discarded Species											
	Pollock	Sablefish	Pacific cod	Arrow. flounder	Flat. sole	Rex sole	DW flatfish	SW flatfish	Rockfish	Atka mackerel	Other	Total
Hook and Line												
Sablefish	0	200	0	400	0	NA	0	0	300	NA	500	1,600
Pacific cod	0	0	100	100	0	0	0	0	0	0	300	700
Rockfish	NA	0	0	0	NA	NA	0	NA	0	0	0	100
Total	0	300	100	600	0	0	0	0	300	0	1,000	2,400
Pot												
Pacific cod	0	0	100	0	0	NA	NA	0	0	0	200	300
Total	0	0	100	0	0	NA	0	0	0	0	200	300
Trawl												
Bottom Pollock	0	0	0	0	0	0	0	0	0	NA	200	300
Pelagic Pollock	200	0	0	0	0	0	0	0	0	0	100	400
Pacific cod	500	0	400	400	100	0	0	100	100	0	100	1,800
Arrowtooth flounder	0	100	200	2,400	0	0	0	0	300	0	100	3,300
Flat. sole	0	0	300	900	0	0	0	0	0	0	100	1,300
Rex sole	0	100	0	3,100	0	0	100	0	300	0	100	3,800
DW flatfish	0	0	0	100	0	0	0	0	0	NA	000	200
SW flatfish	200	0	2,300	2,100	100	0	0	300	0	0	600	5,700
Rockfish	100	500	300	1,000	0	100	100	0	1,100	0	200	3,200
Total	1,100	700	3,500	10,100	300	100	200	600	1,900	0	1,800	20,300
All gear Total	1,100	1,000	3,700	10,700	300	100	200	600	2,200	100	3,000	23,100

* Totals may include additional categories. These estimates include only catches counted against federal TACs.

Table 135: Gulf of Alaska groundfish discard to landings ratios by species, gear and target fishery for 2002. (Hiatt et al., 2003)

Gear and Target	Discard to landings ratios (d/l)											
	Pollock	Sablefish	Pacific cod	Arrow. flounder	Flat. sole	Rex sole	DW flatfish	SW flatfish	Rockfish	Atka mackerel	Other	Total
Hook and Line												
Sablefish	0.99	0.02	0.23	0.96	1.00	NA	0.94	1.00	0.24	NA	1.00	0.12
Pacific cod	0.03	0.42	0.01	0.98	1.00	1.00	0.72	1.00	0.41	0.74	0.88	0.04
Rockfish	NA	0.54	0.00	1.00	NA	NA	1.00	NA	0.00	0.00	0.99	0.21
Total	0.15	0.03	0.01	0.97	1.00	1.00	0.84	0.94	0.20	0.74	0.85	0.08
Pot												
Pacific cod	0.63	1.00	0.01	0.98	0.98	NA	NA	1.00	0.99	1.00	0.99	0.04
Total	0.63	0.08	0.01	0.84	0.98	NA	0.00	0.98	0.89	1.00	0.68	0.04
Trawl												
Bottom	0.01	0.00	0.00	0.05	0.41	0.00	0.00	0.04	0.03	NA	0.95	0.04

Gear and Target	Discard to landings ratios (d/l)											
	Pollock	Sablefish	Pacific cod	Arrow. flounder	Flat. sole	Rex sole	DW flatfish	SW flatfish	Rockfish	Atka mackerel	Other	Total
Pollock												
Pelagic Pollock	0.01	0.00	0.00	0.07	0.07	0.00	0.00	0.16	0.08	0.00	0.91	0.01
Pacific cod	0.75	0.95	0.03	0.83	0.39	0.08	0.91	0.23	0.87	0.77	1.00	0.12
Arrowtooth flounder	0.29	0.59	0.23	0.22	0.13	0.04	0.97	0.21	0.52	0.21	0.82	0.24
Flat. sole	0.53	0.01	0.65	0.91	0.02	0.03	0.05	0.07	0.32	0.56	1.00	0.51
Rex sole	0.08	0.34	0.05	0.92	0.12	0.02	0.95	0.71	0.66	0.07	0.85	0.55
DW flatfish	0.30	0.57	0.29	0.72	0.00	0.00	0.00	0.26	0.65	NA	1.00	0.32
SW flatfish	0.51	0.46	0.68	0.87	0.12	0.14	0.06	0.06	0.13	0.22	1.00	0.42
Rockfish	0.51	0.33	0.19	0.73	0.65	0.30	0.72	0.12	0.06	0.63	0.97	0.14
Total	0.02	0.36	0.18	0.49	0.13	0.05	0.34	0.08	0.09	0.60	0.72	0.16
All gear Total	0.02	0.08	0.09	0.50	0.13	0.05	0.36	0.09	0.10	0.61	0.75	0.14

* Totals may include additional categories. These estimates include only catches counted against federal TACs.

NMFS has target species discard and discard rate data available for three other species that are not included in Table 134 and Table 135: northern rockfish, pelagic shelf rockfish and shortraker/rougheye rockfish (Table 136) (Clausen et al., 2003a; Clausen et al., 2003b; Courtney et al., 2003).

Table 136: 2002 Discards of northern rockfish, pelagic shelf rockfish and shortraker/rougheye rockfish (Clausen et al., 2003a; Clausen et al., 2003b; Courtney et al., 2003).

Species	Retained	Discarded	Total Catch	d/l ratio
Northern rockfish	3,007.3	326.7	3,334	0.098
Pelagic shelf rockfish	trace	trace	trace	0.047
Shortraker/ rougheye rockfish	1,047.8	275.2	1,323	0.208
Total	4,055.1	601.9	4,657	0.129

For each of these species, the discard to landings ratio and total catch for that species were obtained from that species' SAFE report. The retained and discarded amounts were calculated using the discard rate and the total catch. Pelagic shelf rockfish were only caught in trace amounts in 2002, and had a very low discard rate. Pelagic shelf rockfish catch has never risen above 7.4 mt in the past decade, and discards have never amounted to more than 0.35 mt in that time span as well (Clausen et al., 2003b).

Non-target species discards

NMFS reports non-target bycatch information for three fisheries: pollock, sablefish and Pacific cod. Species and bycatch amounts are reported, ranked by bycatch weight, in these three fisheries. The amounts reported are total bycatch, and include both landings and discards (Table 137) (Dorn et al., 2003; Sigler et al., 2003; Thompson et al., 2003). The average annual bycatch is presented for all three fisheries because 2002 bycatch data alone were not available for the Pollock and sablefish fisheries.

Table 137: Average annual non-target species bycatch in the pollock, sablefish and Pacific cod fisheries (1997-2002). All units are in mt except for crabs, salmon and birds which are reported in numbers of animals (Dorn et al., 2003; Sigler et al., 2003; Thompson et al., 2003).

Pollock Target Fishery		Sablefish Target Fishery		Pacific Cod Target Fishery	
Bycatch species	Average annual bycatch ('97-'02)	Bycatch species	Average annual bycatch ('97-'02)	Bycatch species	Average annual bycatch ('97-'02)
Smelts	356	Grenadier	12,930	Skates	1,843
Flathead sole	303	Other fish	1,401	Sea star	703
Other	205	Skates	863	Sculpin	431
Jellyfish	178	Shark	246	Grenadier	203
Sleeper shark	178	Sea star	128	Dogfish	193
SW flatfish	125	Dogfish	102	Sleeper shark	182
Other fish	89	Sleeper shark	48	Other fish	174
Skates	62	Sculpin	10	Octopus	158
Grenadier	62	Octopus	6	Benthic inverts	13
Salmon shark	53	Salmon shark	3	Crabs	9
		Birds	3	Shark	8
		Squid	1	Anemone	8
		Anemone	1	Unidentified inverts	8
		Benthic Inverts	1	Echinoderm	6
		Coral	1	Jellyfish	5
		Sticheidae	0	Sponge	2
		Crabs	0	Seapen/whip	1
		Jellyfish	0	Squid	1
		Unidentified inverts	0	Sticheidae	1
		Seapen/whip	0	Birds	1
		Sponge	0	Tunicate	0
		Tunicate	0	Salmon shark	0
		Echinoderm	0	Smelt	0
		Shrimp	0	Gunnel	0
TOTAL	1,611	TOTAL	15,744	TOTAL	3940 + 9 crabs and 1 bird

These three fisheries were the top three landed groundfish species in 2002, and their landings equal 71.2% of the total 2002 landings. In addition, NMFS lists the three most common bycatch species in the pelagic shelf rockfish and shortraker/roughey rockfish fisheries, but does not give bycatch amounts of these species. For the pelagic shelf rockfish fishery, the top three in the bycatch are northern rockfish, Pacific Ocean perch and other slope rockfish. For the shortraker/roughey rockfish fishery, the top three in the bycatch are arrowtooth flounder, sablefish and shortspine thornyhead. NMFS also gives a summary of the discards of prohibited species within the Gulf of Alaska (Table 138).

Table 138: Prohibited species bycatch in the Gulf of Alaska by species, gear and groundfish target fishery, 2002 (discards in mt or number of animals). (Hiatt et al., 2003)

Gear and Target	Discarded Species							
	Halibut mort. (mt)	Herring (mt)	Red King Crab (animals)	Other king crab (animals)	Tanner Crab (animals)	Other Tanner crab (animals)	Chinook Salmon (animals)	Other salmon (animals)
Hook and Line Total	NA	0.0	0	0	0	0	0	0
Pot								
Pacific cod	2.5	0.0	0	0	93,100	2,700	0	0
Total	2.5	0.0	0	0	93,100	2,700	0	0
Trawl								
Bottom Pollock	2.0	1.3	0	0	800	400	1,100	400
Pelagic Pollock	0.6	0.8	0	0	0	0	3,900	400

Gear and Target	Discarded Species							
	Halibut mort. (mt)	Herring (mt)	Red King Crab (animals)	Other king crab (animals)	Tanner Crab (animals)	Other Tanner crab (animals)	Chinook Salmon (animals)	Other salmon (animals)
Pacific cod	195.2	0.0	0	0	4,900	500	4,100	0
Arrowtooth flounder	352.2	0.0	0	0	14,800	100	600	800
Flathead sole	50.2	0.0	0	0	25,500	1,100	0	100
Rex sole	272.2	0.0	0	100	6,800	300	1,300	100
Deep water flatfish	24.0	0.0	0	0	200	100	0	0
Shallow water flatfish	826.2	0.1	0	300	34,100	100	400	600
Rockfish	282.1	0.0	0	400	1,000	0	1,500	1,200
Total	2,004.7	2.2	0	900	88,000	2,600	13,000	3,600
Total (All Gear)	2,007.2 mt	2.2 mt	0 indiv.	900 indiv.	182,400 indiv.	5,300 indiv.	13,000 indiv.	3,600 indiv.

* Totals may include additional categories. These estimates include only catches counted against federal TACs. Halibut numbers in the hook and line fishery are not available.

The AMCC used NMFS best blend data provided by the Alaska Regional Office as their data source. The discard estimates may differ somewhat from those in NMFS annual reports for several reasons. First, slightly different methodologies were used by the AMCC in assigning targets in the data. Second, small amounts of catch in unassigned categories were not included in this report; and third, data for categories with fewer than three processors were not available to the AMCC due to NMFS confidentiality constraints (AMCC, 2003; AMCC, 2004). Table 139 gives the AMCC's overall report of discards in the GOA groundfish fishery. Discards from all target fisheries were combined for the years 2002 and 2003. All discard amounts are in metric tons unless otherwise specified (AMCC, 2003; AMCC, 2004).

Table 139: Annual discards by species in the entire Gulf of Alaska groundfish fishery. All units are in metric tons unless otherwise specified (2002-2003) (AMCC, 2003; AMCC, 2004).

Discarded Species	2002 Discards	2003 Discards
Arrowtooth flounder	10,429	16,649
Pacific cod	3,681	2,121
Other groundfish	2,961	2,350
Halibut mortality	2,197	2,348
Pollock	1,094	1,022
Sablefish	978	1,096
Pacific Ocean perch	838	1,628
Shallow water flatfish	473	409
Slope rockfish	347	611
Northern rockfish	330	490
Flathead sole	283	260
Shortraker/rougheye rockfish	281	388
Deep water flatfish	187	444
Pelagic shelf rockfish	167	71
Rex sole	143	172
Thornyhead rockfish	136	132
Atka Mackerel	25	233
Demersal shelf rockfish	18	0
Herring	2	13
Black/blue rockfish	1	0
Tanner crab	181,694 individuals	146,173 individuals
Chinook salmon	12,855 individuals	15,509 individuals
Other tanner crab	5,203 individuals	1,440 individuals
Other salmon	2,953 individuals	9,890 individuals
Other king crab	872 individuals	846 individuals
Red king crab	48 individuals	88 individuals
Total (mt only)	24,571 mt + individual species	30,437 mt + individual species

The AMCC also collected discard data for each of the groundfish fisheries individually. Where possible, the ten most discarded species in each target fishery in the 2003 GOA groundfish fishery are reported (Table 140-Table 142). Discards from all gear types were combined for an overall discard estimate for the fisheries (AMCC, 2004). Discards of the salmon and crabs were reported in numbers of individuals.

Table 140: Top ten species discarded in the 2003 arrowtooth flounder, bottom pollock, mid-water pollock and deepwater flatfish fisheries. Amounts are in metric tons unless otherwise specified (AMCC, 2004).

Arrowtooth flounder		Bottom Pollock		Mid-water Pollock		Deepwater Flatfish	
<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>
Arrowtooth flounder	4,036	Arrowtooth flounder	154	Pollock	737	Arrowtooth flounder	208
Pacific Ocean perch	637	Other groundfish	12	Other groundfish	126	Sablefish	51
Halibut mortality	395	Halibut mortality	10	Arrowtooth flounder	70	Shortraker/rougheye rockfish	40
Pacific cod	310	Flathead sole	5	Pacific Ocean perch	59	Thornyhead rockfish	35
Sablefish	255	Rex sole	2	Flathead sole	20	Halibut Mortality	21
Other groundfish	188	Pelagic shelf rockfish	1	Herring	13	Other groundfish	2
Deep water flatfish	127	Sablefish	1	Pacific cod	12	Pacific Ocean perch	1
Flathead sole	89	Chinook salmon	912 (indiv.)	Shortraker/rougheye rockfish	5	-	-
Slope rockfish	70	Other salmon	46 (indiv.)	Other salmon	6,325 (indiv.)	-	-
Pollock	60	Tanner crab	1 (indiv.)	Chinook salmon	3,516 (indiv.)	-	-
Total*	6,167 mt	Total*	185 mt + individuals	Total*	1,042 mt + individuals	Total*	358 mt

* Total may include species not on this list and do not include species counted as individuals for which weight data are not available.

Table 141: Top ten species discarded in the 2003 flathead sole, Pacific cod, rex sole and rockfish fisheries. Amounts are in metric tons unless otherwise specified (AMCC, 2004).

Flathead sole		Pacific Cod		Rex sole		Rockfish	
<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>
Arrowtooth flounder	404	Arrowtooth flounder	802	Arrowtooth flounder	5,621	Arrowtooth flounder	967
Flathead sole	37	Halibut mortality	445	Pacific Ocean perch	292	Pacific Ocean perch	601
Halibut mortality	34	Shallow water flatfish	199	Other groundfish	239	Slope rockfish	512
Pacific Ocean perch	24	Other groundfish	163	Halibut mortality	237	Northern Rockfish	380
Pacific cod	21	Pacific cod	163	Deep water flatfish	213	Sablefish	279
Sablefish	12	Pollock	54	Pacific cod	127	Halibut Mortality	262
Other groundfish	10	Flathead sole	35	Rex sole	50	Pacific cod	238
Tanner crab	464 (indiv.)	Sablefish	30	Sablefish	49	Atka Mackerel	212
-	-	Northern rockfish	20	Flathead sole	43	Other groundfish	148
-	-	Chinook salmon	3,156 (indiv.)	Tanner crab	28,583 (indiv.)	Shortraker/rougheye rockfish	125
Total*	512 mt +	Total*	1,748 mt +	Total*	6,871 mt +	Total*	3,724 mt

Flathead sole		Pacific Cod		Rex sole		Rockfish	
<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>
	individuals		individuals		individuals		

* Total may include species not on this list and do not include species counted as individuals for which weight data are not available.

Table 142: Top ten species discarded in the 2003 sablefish, shallow water flatfish and other fisheries. Amounts are in metric tons unless otherwise specified (AMCC, 2004).

Sablefish		Shallow water flatfish		Other	
<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>
Sablefish	410	Arrowtooth flounder	1,794	Arrowtooth.flounder	867
Arrowtooth flounder	221	Pacific cod	920	Halibut	618
Other groundfish	205	Halibut mortality	520	Halibut.Mortality	120
Shortraker/rougheye rockfish	185	Other groundfish	189	Other.groundfish	63
Pacific cod	65	Shallow water flatfish	93	Pacific.cod	51
Thornyhead rockfish	37	Pollock	59	Tanner crab	12 (indiv.)
Deep water flatfish	13	Flathead sole	8	-	-
Slope rockfish	5	Pelagic shelf rockfish	4	-	-
Rex sole	3	Sablefish	3	-	-
Shallow water flatfish	3	Tanner crab	59,211 (indiv.)	-	-
Total*	1,147 mt	Total*	3,590 mt + individuals	Total*	1,719 mt + individuals

* Total may include species not on this list and do not include species counted as individuals for which weight data are not available.

In summary, the NMFS estimates of bycatch appear to be the most comprehensive. Total landings of GOA groundfish in 2002 were 142,787 mt. The target discards were 23,702 mt (Table 134 and Table 136). NMFS also reports 23,304 mt of non-target species bycatch. This number represents bycatch from the pollock, sablefish and Pacific cod fisheries (Table 137), as well as discards of halibut and herring from all groundfish fisheries (Table 138). In addition, 900 king crabs, 187,700 Tanner crabs, and 16,600 salmon (Table 138) were discarded in 2002. In the absence of reliable weight data, the average crab weight was assumed to be one kilogram and the average salmon weight was assumed to be 5 kg. When multiplied out, the total discards of crabs and salmon amounts to 272 mt. Overall, this amounts to 47,278 mt of bycatch and discards for a d/l ratio of 0.33.

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Bering Sea and Aleutian Islands Groundfish Fishery

Major Target Species:	Pollock (<i>Theragra chalcogramma</i>), Pacific cod (<i>Gadus macrocephalus</i>), Yellowfin sole (<i>Limanda aspera</i>), Atka mackerel (<i>Pleurogrammus monopterygius</i>), Rock sole (<i>Pleuronectes bilineatus</i>), Flathead sole (<i>Hippoglossoides elassodon</i>), Pacific Ocean perch (<i>Sebastes alutus</i>), Arrowtooth flounder (<i>Atheresthes stomias</i>), Alaska plaice (<i>Pleuronectes quadrituberculatus</i>), Greenland turbot (<i>Reinhardtius hippoglossoides</i>), Sablefish (<i>Anoplopoma fimbria</i>), Shortraker rockfish (<i>Sebastes borealis</i>), Rougheye rockfish (<i>Sebastes aleutianus</i>)
Major Discard Species:	Skates, Sculpin, Halibut (<i>Hippoglossus stenolepis</i>), Crabs, Salmon
Primary Gear Types:	Trawl, Hook and line (Greenland turbot), Pot (Sablefish)
Total Landings (2002):	1,793,088 mt
Total Discards (2002):	160,119 mt
Total Discards Rank (of 27):	2
Discard to Landings Ratio:	0.087
d/I Rank (of 27):	20
Source of Estimates:	NMFS, AMCC, Authors
Discard Type:	Primarily target, regulatory
Notes:	Total discards include 2.85 million crabs estimated to weigh 1 kg each, and 116,300 salmon estimated to weigh 5 kg each in the absence of accurate weight data.

The groundfish fishery in the BSAI is managed by the North Pacific Fishery Management Council. The BSAI is an area of U.S. waters west of Alaska and south to the Aleutian Islands. The FMP for BSAI Groundfish includes 17 species: Pacific cod, walleye pollock, yellowfin sole, Greenland turbot, Atka mackerel, Alaska plaice, squid, sablefish, shortspine thornyhead, arrowtooth flounder, Pacific ocean perch, flathead sole, rex sole, rock, dusky rockfish, shortraker rockfish and rougheye rockfish. Walleye pollock is split into three stocks, an eastern Bering Sea stock, an Aleutian Islands stock, and a Bogoslof stock, and sablefish is split into an eastern Bering Sea and an Aleutian Islands stock (NMFS, 2004). There are no stocks that are overfished, and overfishing is not occurring (NMFS, 2004). Here, we include landings and bycatch data from inshore catcher/processors, catcher vessels, motherships and CDQs.

Target landings

Landings from the groundfish fishery in the BSAI are an entire order of magnitude larger than the landings from the groundfish fishery in the Gulf of Alaska (GOA). Overall landings for this fishery have been rising since 1977, with only a slight dip between 1988 and 1991 (NMFS, 1999). Landings were 1,200,000 mt in 1977, and over 1,800,000 metric tons in 2003 (Table 143) (AMCC, 2004).

Table 143: 2002 and 2003 landings of major species within the BSAI groundfish fishery.

Species or Species Grouping	2002 Landings	2003 Landings (mt)
Pollock	1,440,314	1,473,062
Pacific cod	191,416	202,124
Yellowfin sole	63,608	68,374
Atka mackerel	37,704	40,728
Rock sole	23,776	19,624
Other species (sculpins, sharks, skates, octopi)	5,584	10,167
Flathead sole	11,266	10,264
Pacific Ocean perch	9,429	11,256
Arrowtooth flounder	4,001	4,315
Alaska plaice	-	467
Northern rockfish (minor species)	349	203
Greenland turbot	2,891	2,437
Sablefish	1,899	1,640
Other rockfish	509	381

Species or Species Grouping	2002 Landings	2003 Landings (mt)
Shortraker/rougheye rockfish	342	191
Total	1,793,088	1,845,233

Pollock accounts for over 75% of all groundfish landings in the BSAI. Pacific cod accounts for another 11% of groundfish landings, the other groundfish species all have landings contributions of four percent or less. This table does not account for landings of squid, rex sole, shortspine thornyhead, and dusky rockfish. It is probable that landings of these species fall into either the "other species" or "other rockfish" category (AMCC, 2004).

The majority of landings in the BSAI are made using trawl gear (Figure 79). The few exceptions are Greenland turbot, sablefish and "other species" which are mostly caught using hook and line. There is a large pot fishery for sablefish (AMCC, 2004).

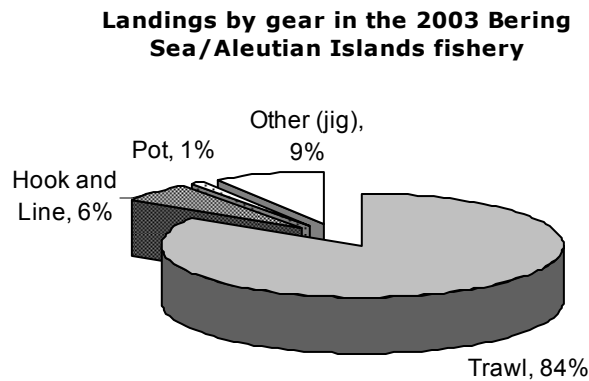


Figure 79: Landings in the 2003 BSAI groundfish fishery. Trawl gear accounts for the large majority of landings.

Regulations

The groundfish fishery in the BSAI is regulated using total allowable catch (TAC) (Table 144), area closures, seasonal closures and incidental catch limits for prohibited species. The groundfish species do not fall under minimum size regulations, and gear regulations mainly pertain to gear type, marking and deployment, fishing and retrieval methods (NMFS, 2003).

Table 144: TAC limits for groundfish in the Bering Sea and Aleutian Islands. This includes incidental catch limits, CDQ and IFQ allocations (NMFS, 2003).

Species	BSAI Total TAC (mt)
Pollock	1,492,810
Pacific cod	207,500
Atka mackerel	60,000
Sablefish	6,000
Pacific ocean perch	14,100
Shortraker/rougheye rockfish	967
Northern rockfish	6,000
Other rockfish (minor species)	1594
Yellowfin sole	83,750
Rock sole	44,000
Flathead sole	20,000
Greenland turbot	4,000
Arrowtooth flounder	12,000
Alaskan plaice	10,000

Species	BSAI Total TAC (mt)
Other flatfish (minor species)	3,000
Squid	1,970
Other species (sculpins, sharks, skates and octopi)	32,309
Total	2,000,000

The TACs from Table 144 are further distributed by sub-area, district and region, and then divided among gear type and season. Additionally, there are four main directed fishing area closures in the BSAI fishing grounds. Within these areas, the catch of certain groundfish species is prohibited, with incidental catch limits to regulate the take of these species (Table 145) (NMFS, 2003).

Table 145: Incidental catch limits for groundfish in certain areas. These incidental catch limits are included in the total allowable catch limits from Table 144.

Closed Area	Prohibited Species	Incidental Catch Limit (mt)
Bogoslof district	Pollock	50
Aleutian Islands sub-area	Pollock	1,000
	Shortraker/rougheye rockfish, trawl and non-trawl	830
	Other rockfish	634
Bering Sea sub-area	Northern rockfish	121
	Other rockfish	960
	Pacific ocean perch	1,410
	Shortraker/rougheye	137
BSAI	Other species	32,309

When either the TAC or incidental catch limit for a fishery is reached, the fishery is closed. Other limits (called sideboard limits) exist to prevent AFA eligible vessels from increasing their catch of groundfish in other fisheries beyond the average 1995-1997 levels. Sideboard limits also decrease the likelihood that the fishing capacity of AFA eligible vessels will increase in order to compete in those fisheries (AFSC, 2002). There are also directed fishing closures for sideboard fisheries.

The catch of five non-groundfish species: Halibut, herring, red king crab, snow crab and Tanner crab, is prohibited in the trawl fishery, and there are incidental catch limits for these species. In the non-trawl fisheries, halibut is the only species that is prohibited (NMFS, 2003).

Discards

Discard data for the BSAI groundfish fishery is available from two different sources, NMFS and the AMCC. For some species, data were only available from one source, but for others, estimates were made by both. The majority of discards in the BSAI groundfish fishery are groundfish, followed by halibut, crab, salmon, and a variety of other species.

Target species discards

NMFS published an economic SAFE report in 2003 detailing the discards and discard rates of Alaskan groundfish in the fishery. The data are reported by target species, discard species and gear type (Table 134 and Table 135). NMFS reported the weights rounded to the nearest 100 mt, therefore zero values may not indicate that there is no discard of that particular species, rather, they indicate discards of 50 mt or less. The totals reflect the sum of the raw discards, rounded to the nearest 100, and so may not equal the sum of all the individual discards. The totals may also include some categories or species that are not included in the table. Not all species were reported separately by NMFS, but discards of those species were included in the totals.

NMFS calculated discards by obtaining weekly observer discard estimates by target fishery, and applying these estimates to the weekly blend estimate of retained catch from the NMFS regional office and summed over the fishing year. The NMFS Blend system (used from 1992-2002) was based on weekly data from processors and was not capable of accounting for some management programs implemented

in recent years - including cooperatives, sideboards, complex seasonal allocations, harvest limit area quotas, and quotas assigned to vessels of a particular size class.

In 2003, a new groundfish catch accounting system was implemented that utilizes the same data sources as the Blend (observer data, shoreside processor landings data, and processor weekly production report data). Where the Blend aggregated all data to the level of processor and week, the new system accounts for data at the haul (observer) and delivery (shoreside landings) level and can track all the current quotas. The new system is also more adaptable for anticipated future changes, and will aid in more accurate discard estimates (<http://www.fakr.noaa.gov/sustainablefisheries/catchaccounting.htm>). However, bycatch estimates from the new accounting system are not yet publicly available, so the older Blend data is presented.

Table 146: BSAI groundfish discards by species, gear and target fishery for 2002 using Blend data (discards in mt, round weight) (Hiatt et al., 2003).

Gear and Target	Discarded Species												
	Pollock	Sablefish	Pacific cod	Arrow. flounder	Flat. sole	Rock sole	Turbot	YF sole	Other flat.	Rockfish	Atka	Other/Unknown	Total
Hook and Line													
Sablefish	0	0	100	100	0	0	200	NA	0	200	0	400	1,000
Pacific cod	900	0	2,100	800	400	0	0	600	100	100	0	9,900	15,000
Turbot	0	100	0	100	0	0	0	NA	0	0	NA	100	400
Total	900	200	2,300	1,100	400	0	300	600	100	300	0	11,700	17,900
Pot													
Sablefish	0	0	0	0	0	NA	0	NA	0	0	0	0	0
Pacific cod	0	0	100	200	0	0	100	0	0	0	0	400	800
Total	0	0	100	200	0	0	100	0	0	0	100	400	900
Trawl													
Bottom Pollock	500	0	0	100	100	200	0	300	0	0	0	200	1,500
Pelagic Pollock	900	0	0	200	700	800	0	100	100	400	0	600	3,800
Pacific cod	5,900	0	1,000	2,600	900	4,400	0	100	700	200	100	1,100	18,100
Arrowtooth flounder	100	0	0	500	0	0	100	0	0	0	0	100	900
Flat. sole	700	0	100	1,100	1,300	1,100	0	400	700	0	0	900	6,100
Rock sole	6,500	0	300	300	300	7,200	0	1,400	1,700	0	0	900	18,600
Turbot	0	0	0	100	0	0	0	NA	0	0	0	0	100
YF sole	5,800	NA	400	600	500	4,100	0	7,600	10,200	0	0	2,200	31,300
Other flat.	0	0	0	500	0	100	0	0	0	0	0	100	900
Rockfish	0	0	0	400	0	0	0	0	0	400	200	100	1,100
Atka Mac.	100	0	100	100	0	0	0	0	0	4,500	7,100	700	12,600
Other/Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,100	5,100
Total	20,600	0	1,900	6,400	3,900	17,900	300	10,700	13,400	5,500	7,500	12,000	100,100
All gear Total	21,400	200	4,300	7,600	4,200	1,800	700	11,300	13,500	5,900	7,600	24,100	118,900

* Totals may include additional categories. These estimates include only catches counted against federal TACs.

Table 147: BSAI groundfish discard to landings ratios by species, gear and target fishery for 2002 using Blend data (Hiatt et al., 2003).

Gear and Target	Discard to Landings Ratios (d/l)												
	Pollock	Sablefish	Pacific cod	Arrow. flounder	Flat. sole	Rock sole	Turbot	YF sole	Other flat.	Rockfish	Atka	Other	Total
Hook and Line													
Sablefish	0.87	0.03	0.81	0.92	1.00	1.00	0.66	NA	1.00	0.55	1.00	0.99	0.42
Pacific cod	0.13	0.33	0.02	0.86	0.96	0.99	0.21	0.98	0.96	0.78	0.97	0.79	0.12
Turbot	0.55	0.62	0.19	0.71	1.00	1.00	0.03	NA	1.00	0.38	NA	0.96	0.17
Total	0.13	0.11	0.02	0.84	0.96	0.99	0.13	0.98	0.96	0.59	0.97	0.77	0.14
Pot													
Sablefish	0.35	0.00	0.19	0.41	0.02	NA	0.20	NA	0.85	0.35	0.99	0.73	0.07
Pacific cod	0.62	0.01	0.01	1.00	0.29	0.99	0.98	1.00	1.00	0.99	1.00	0.99	0.05
Total	0.62	0.01	0.01	0.88	0.11	0.99	0.71	1.00	0.99	0.80	1.00	0.99	0.05
Trawl													
Bottom Pollock	0.04	0.49	0.06	0.49	0.34	0.37	0.80	0.45	0.45	0.84	0.91	0.77	0.10
Pelagic Pollock	0.00	0.12	0.00	0.37	0.43	0.48	0.26	0.37	0.35	0.60	0.11	0.52	0.00
Pacific cod	0.70	0.56	0.02	0.86	0.65	0.73	0.45	0.70	0.78	0.82	0.25	0.87	0.22
Arrowtooth flounder	0.44	0.16	0.00	0.26	0.05	0.32	0.45	0.02	0.09	0.16	0.00	0.54	0.25
Flat. sole	0.36	0.03	0.03	0.68	0.15	0.61	0.20	0.19	0.89	0.06	0.04	0.85	0.31
Rock sole	0.61	0.48	0.06	0.87	0.37	0.31	1.00	0.18	0.98	0.41	1.00	0.95	0.37
Turbot	0.08	0.04	0.00	0.37	0.00	0.71	0.12	NA	0.02	0.00	1.00	1.00	0.18
YF sole	0.42	NA	0.07	0.56	0.25	0.49	0.81	0.12	0.97	0.25	0.79	0.88	0.30
Other flat.	0.31	0.23	0.01	0.79	0.21	0.83	0.60	0.04	0.05	0.36	0.00	0.94	0.51
Rockfish	0.05	0.01	0.00	0.71	0.09	0.99	0.09	0.06	0.56	0.05	0.15	0.98	0.09
Atka Mac.	0.33	0.01	0.05	0.47	0.87	0.63	0.09	1.00	0.26	0.80	0.17	1.00	0.25
Total	0.01	0.15	0.02	0.63	0.26	0.43	0.29	0.14	0.91	0.34	0.17	0.84	0.06
All gear Total	0.01	0.09	0.02	0.65	0.27	0.43	0.19	0.15	0.91	0.35	0.17	0.81	0.06

* Totals may include additional categories. These estimates include only catches counted against federal TACs.

NMFS has target species bycatch data available for two other species not included in Table 146 and Table 147: Pacific Ocean perch and shortraker/rougheye rockfish (Table 148) (Spencer and Ianelli, 2003; Spencer and Reuter, 2003). For each of these species, the retained catch, discarded catch and discard rate values were obtained from the SAFE report. Total catch was calculated by summing the retained and discarded catch.

Table 148: 2002 discards of BSAI Pacific Ocean perch and shortraker/rougheye rockfish (Spencer and Ianelli, 2003; Spencer and Reuter, 2003).

Species	Retained (mt)	Discarded (mt)	Total Catch (mt)	d/l ratio
Pacific ocean perch	8,935	1,584	10,519	0.15
Shortraker/ rougheye rockfish	367	200	567	0.35
Total	9,302	1,784	11,086	0.16

Non-target species discards

NMFS reports non-target bycatch information for three fisheries: pollock, Pacific cod and yellowfin sole. Bycatch species and weights are reported and ranked by bycatch weight in these three fisheries. The amounts reported are total bycatch, and include both landings and discards (Table 149) (Barbeaux et al., 2003; Ianelli et al., 2003; Thompson and Dorn, 2003; Wildebuer and Nichol, 2003). Pollock, Pacific cod and yellowfin sole were the top three species landed by weight in the 2002 groundfish fishery; their landings, 1,743,560 mt, equal 94.5% of all groundfish landings in 2002.

Table 149: Non-target species bycatch in the 2002 pollock, Pacific cod and yellowfin sole fisheries. Units are in mt except for crabs, salmon and birds, which are reported as individuals (Barbeaux et al., 2003; Ianelli et al., 2003; Thompson and Dorn, 2003; Wildebuer and Nichol, 2003).

Yellowfin Sole Target Fishery		Pollock Target Fishery		Pacific Cod Target Fishery	
Bycatch species	2002 bycatch	Bycatch species	2002 bycatch	Bycatch species	2002 bycatch
Sculpin, general	1,226	Jellyfish	1,530	Skates	19,153
Skate, general	1,042	Squid	1,708	Sculpin	3,037
Jellyfish, unspecified	161	Skates	870	Grenadier	433
Starry flounder	133	Other fish	134	Jellyfish	100
Sea cucumber	0	Sculpins	199	Sea star	501
Snails	4	Sleeper shark	149	Other fish	320
Butter sole	7	Smelts	15	Octopus	377
Lingcod	0	Grenadiers	6	Sleeper shark	262
English sole	1	Salmon shark	27	Anemone	205
Squid	1	Sea star	17	Sponge	48
		Shark	2	Benthic inverts	39
		Benthic invertebrates	2	Shark	25
		Sponges	0	Unidentified invertebrates	62
		Octopus	8	Birds	13
		Crabs	1	Tunicate	2
		Anemone	1	Echinoderm	16
		Tunicate	4	Crabs	13
		Unidentified invertebrates	0	Seapen/whip	41
		Seapen/whip	2	Coral	14
		Lanternfish	3	Dogfish	9
				Squid	5
				Salmon shark	10
				Sandfish	1
TOTAL	2,575 mt	TOTAL	4,677 mt (+ 1 crab)	TOTAL	24,660 mt (+ 13 crabs and 13 birds)

NMFS also gives a summary of the discard and discard rates of prohibited species within the BSAI (Table 150). It appears that halibut is by far the most common bycatch, followed by Tanner crabs.

Table 150: Prohibited species discards in the BSAI by species, gear and groundfish target fishery, 2002 (discards in mt or number) (Hiatt et al., 2003).

Gear and Target	Discarded Species							
	Halibut mort. (mt)	Herring (mt)	Red King Crab (animals)	Other king crab (animals)	Tanner Crab (animals)	Other Tanner crab (animals)	Chinook Salmon (animals)	Other salmon (animals)
Hook and Line								
Sablefish	NA	0	0	1,200	0	100	0	0
Pacific cod	573	0	26,100	16,600	17,000	75,200	0	100
Arrow. flounder	0.1	0.0	0	0	0	0	0	0
Turbot	48.8	0	0	100	100	600	0	0
Rockfish	0.3	0	0	0	0	0	0	0
Total	628.1	0	26,100	18,000	17,100	76,000	0	100
Pot								
Sablefish	3.1	0	0	16,300	100	700	0	0
Pacific cod	5.2	0	1,000	9,900	79,900	279,200	0	0
Total	8.4	0	1,000	26,900	80,000	279,900	0	0
Trawl								
Bottom	50.3	1.5	2,100	300	21,800	7,300	200	400

Gear and Target	Discarded Species							
	Halibut mort. (mt)	Herring (mt)	Red King Crab (animals)	Other king crab (animals)	Tanner Crab (animals)	Other Tanner crab (animals)	Chinook Salmon (animals)	Other salmon (animals)
Pollock								
Pelagic Pollock	125.8	104.0	0	100	100	600	32,200	76,600
Pacific cod	1009.5	1.3	19,700	900	223,400	128,200	3,200	900
Arrowtooth flounder	67.9	0.0	0	3,400	8,300	35,000	100	0
Flathead sole	188.7	4.2	200	900	212,800	143,000	0	100
Rock sole	851.4	2.4	67,200	500	381,700	134,900	700	100
Turbot	4.4	0.0	0	200	700	8,800	0	0
YF sole	869.7	16.2	15,500	1,600	250,200	632,100	300	400
Other flat.	33.0	0.7	0	800	2,900	13,300	0	0
Rockfish	66.2	0.0	0	6,000	200	2,200	0	0
Atka mac.	53.2	0.0	200	1,800	0	0	900	0
Total	3320	130.5	105,000	16,500	1,102,100	1,105,400	37,500	3,320
Total (All Gear)	3,956.6 mt	130.5 mt	132,100 indiv.	61,300 indiv.	1,199,100 indiv.	1,461,300 indiv.	37,500 indiv.	78,800 indiv.

* Totals may include additional categories. These estimates include only catches counted against federal TACs. Halibut numbers in the sablefish hook and line fishery are not available.

The AMCC used NMFS best blend data provided by the Alaska Regional Office as their data source. The numbers may differ somewhat from those in NMFS annual reports for several reasons. First, slightly different methodologies were used by the AMCC in assigning targets in the data. Second, small amounts of catch in unassigned categories were not included in this report; and third, data for categories with fewer than three processors were not available to the AMCC due to NMFS confidentiality constraints. Table 151 gives the AMCC's alternate overall report of discards in the BSAI groundfish fishery. Discards from all target fisheries were combined for the years 2002 and 2003. All discard amounts are in metric tons unless otherwise specified (AMCC, 2003; AMCC, 2004).

Table 151: Annual discards by species in the entire BSAI groundfish fishery (2002-2003). All discards are in metric tons unless otherwise specified (AMCC, 2003; AMCC, 2004).

Discarded Species	2002 Discards	2003 Discards
Other species	23,994	18,158
Pollock	20,576	16,416
Rock sole	17,867	15,927
Other flatfish	13,454	1,690
Yellowfin sole	11,294	11,115
Arrowtooth flounder	7,727	8,694
Atka Mackerel	7,267	13,305
Halibut Mortality	4,203	3,923
Flathead sole	4,175	3,828
Pacific cod	4,033	2,998
Sharpchin/northern rockfish	3,604	4,443
Pacific Ocean perch	1,582	2,639
Greenland turbot	624	768
Other rockfish	332	248
Sablefish	238	206
Shortraker/rougheye rockfish	151	71
Herring	148	1,099
Alaska plaice	0	9,423
Tanner crab	1,233,203 individuals	1,088,760 individuals
Chinook salmon	39,320 individuals	54,923 individuals
Other king crab	90,519 individuals	150,592 individuals
Other salmon	81,018 individuals	194,688 individuals
Other tanner crab	1,531,598 individuals	791,319 individuals
Red king crab	135,711 individuals	107,304 individuals
Total (mt only)	121,269 mt + individuals	114,951 mt + individuals

The AMCC also collected discard data for each of the groundfish fisheries individually. Where possible, the ten most discarded species in each target fishery in the 2003 GOA groundfish fishery are reported (Table 152-Table 154). Discards from all gear types were combined for an overall discard estimate for the fisheries (AMCC, 2004). Discards of the salmon and crabs were reported in numbers of individuals.

Table 152: Top ten species discarded in the 2003 arrowtooth flounder, Atka mackerel, bottom pollock, and mid-water pollock fisheries. Amounts are in metric tons unless otherwise specified (AMCC, 2004).

Arrowtooth Flounder		Atka Mackerel		Bottom Pollock		Mid-Water Pollock	
Discarded species	2003 Discards	Discarded species	2003 Discards	Discarded species	2003 Discards	Discarded species	2003 Discards
Arrowtooth flounder	407	Atka mackerel	9039	Other species	180	Herring	1029
Pollock	115	Northern rockfish	4127	Atka mackerel	91	Other species	881
Other species	86	Pacific Ocean perch	1754	Pacific Ocean perch	64	Flathead sole	482
Flathead sole	57	Other species	405	Herring	18	Rock sole	474
Greenland turbot	54	Pollock	180	Rock sole	4	Pollock	439
Halibut mortality	46	Arrowtooth flounder	156	Flathead sole	2	Pacific Ocean perch	429
Rock sole	23	Other rockfish	144	Arrowtooth flounder	1	Atka mackerel	232
Atka mackerel	21	Rock sole	89	Halibut mortality	1	Arrowtooth flounder	124
Other flatfish	9	Halibut Mortality	74	Other salmon	1,739 (indiv.)	Other salmon	190,865 (indiv.)
Chinook salmon	1,648 (indiv.)	Pacific cod	61	Chinook salmon	886 (indiv.)	Chinook salmon	46,304 (indiv.)
Total*	818 mt + individuals	Total*	16,029 mt	Total*	362 mt + individuals	Total*	4,090 mt + individuals

* Totals may include species not on this list and do not include species counted as individuals for which weight data are not available.

Table 153: Top ten species discarded in the 2003 flathead sole, Greenland turbot, Pacific cod and rock sole fisheries. Amounts are in metric tons unless otherwise specified (AMCC, 2004).

Flathead sole		Greenland Turbot		Pacific cod		Rock Sole	
Discarded species	2003 Discards	Discarded species	2003 Discards	Discarded species	2003 Discards	Discarded species	2003 Discards
Pollock	1551	Other species	231	Other species	12,193	Rock sole	6456
Arrowtooth flounder	1147	Arrowtooth flounder	174	Pollock	7,388	Pollock	2147
Flathead sole	884	Pollock	73	Arrowtooth flounder	4,788	Yellowfin sole	1652
Other species	718	Sablefish	43	Rock sole	4,637	Halibut mortality	889
Alaska plaice	630	Greenland turbot	41	Atka mackerel	3,822	Other species	774
Rock sole	426	Halibut mortality	28	Pacific cod	2,398	Other flatfish	742
Yellowfin sole	357	Shortraker/rougheye rockfish	10	Halibut mortality	1,780	Arrowtooth flounder	352
Halibut mortality	150	Other rockfish	8	Yellowfin sole	1,365	Alaska plaice	337
Tanner crab	320,661 (indiv.)	Other flatfish	6	Flathead sole	1,255	Flathead sole	319
Other tanner crab	231,680 (indiv.)	Flathead sole	5	Other flatfish	672	Pacific cod	248
Total*	5,863 mt + individuals	Total*	619 mt	Total*	40,298 mt	Total*	13,916 mt

* Totals may include species not on this list and do not include species counted as individuals for which weight data are not available.

Table 154: Top ten species discarded in the 2003 rockfish, yellowfin sole, sablefish and other fisheries. Amounts are in metric tons unless otherwise specified (AMCC, 2004).

Rockfish		Yellowfin Sole		Sablefish		Other	
<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>	<i>Discarded species</i>	<i>2003 Discards</i>
Arrowtooth flounder	282	Alaska plaice	8,207	Greenland turbot	515	Other species	3
Pacific ocean perch	148	Yellowfin sole	7,664	Arrowtooth flounder	165	Arrowtooth flounder	2
Other species	130	Pollock	4,374	Other species	108	Halibut mortality	1
Pollock	126	Rock sole	3,808	Other rockfish	36	Pacific cod	1
Atka mackerel	92	Other species	2,418	Sablefish	16	-	-
Halibut mortality	66	Arrowtooth flounder	807	Shortraker/rougheye rockfish	16	-	-
Northern rockfish	55	Flathead sole	805	Pacific cod	7	-	-
Shortraker/rougheye rockfish	7	Halibut mortality	765	Rock sole	4	-	-
Rock sole	6	Pacific cod	257	Halibut mortality	3	-	-
Flathead sole	4	Tanner crab	241,037 (indiv.)	Other king crab	142,785 (indiv.)	-	-
Total*	916 mt	Total*	29,105 mt + individuals	Total*	870 mt + individuals	Total*	7 mt

* Totals may include species not on this list and do not include species counted as individuals for which weight data are not available.

In summary, the NMFS estimates of bycatch appear to be the most comprehensive. Total landings of BSAI groundfish in 2002 were 1,793,088 mt, and target discards were 120,684 mt (Table 146 and Table 148). NMFS also reports 36,000 mt of non-target species bycatch. This number represents bycatch from the pollock and Pacific cod and yellowfin sole fishery (Table 149), as well as discards of halibut and herring (Table 150). Landings of pollock, Pacific cod and yellowfin sole comprise almost 95% of the total groundfish landings, so this should be a fairly accurate estimate of non-target species bycatch. In addition, 193,400 king crabs, 2,660,400 Tanner crabs and 116,300 salmon were discarded in 2002 (Table 150). In the absence of reliable weight data, each crab was assumed to weigh on average 1 kg and each salmon assumed to weigh on average 5 kg. When multiplied out, the total bycatch of crabs and salmon amounted to 3,435 mt. Overall, this comes to 160,119 mt of bycatch and discards for a d/I ratio of 0.089.

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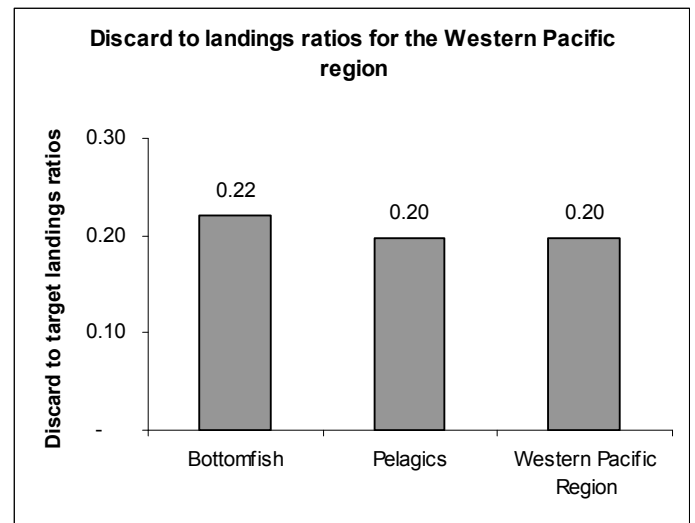
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Western Pacific



Western Pacific regional overview of landings, discards and discard to landings ratios by fishery

Fishery	Landings (mt)	Discards (mt)	d/l ratio
Bottomfish and Seamount Groundfish	291	64	0.22
Pelagics	52,594	10,372	0.20
Western Pacific Region	52,885	10,436	0.20



Bottomfish and Seamount Groundfish of the Western Pacific

Major Target Species:	Pink snapper (<i>Lutjanus goreensis</i>), Longtail red snapper (<i>Etelis coruscans</i>), Shorttail red snapper (<i>Etelis carbunculus</i>), Gray snapper/jobfish (<i>Aprion virescens</i>), Giant trevally (<i>Caranx ignobilis</i>), Sea bass (<i>Epinephelus quernus</i>), Thicklip trevally (<i>Pseudocaranx dentex</i>) Silvermouth red snapper (<i>Aphareus rutilans</i>), Lavendar jobfish (<i>Pristipomoides sieboldii</i>), Yellowtail snapper (<i>Pristipomoides auricilla</i>), Yelloweye snapper (<i>Pristipomoides flavipinnis</i>), Flower snapper (<i>Pristipomoides zonatus</i>), Blueline snapper (<i>Lutjanus kasmira</i>), Black jack (<i>Caranx lugubris</i>), Amberjack (<i>Seriola dumerili</i>), Brassy trevally (<i>Caranx papuensis</i>), Blacktip grouper (<i>Epinephelus fasciatus</i>), Lunartail grouper (<i>Variola louti</i>), Redgill emperor (<i>Lethrinus rubrioperculatus</i>), Ambon emperor (<i>Lethrinus amboinensis</i>)
Major Discard Species:	Squirrelfish, Sharks, Rockfish, Goatfish
Primary Gear Types:	Handline
Total Landings (2003):	291 mt
Total Discards (2003):	64 mt
Total Discards Rank (of 27):	27
Discard to Landings Ratio:	0.22
d/I Rank (of 27):	17
Source of Estimates:	NMFS, Research surveys, Authors
Discard Type:	Primarily non-target, non-regulatory
Notes:	Total discards include both the commercial and recreational fishery. This is an underestimate because no discard estimates were available for Guam, American Samoa and the Commonwealth of the Northern Mariana Islands

There are 22 species managed under the Bottomfish and Seamount Groundfish FMP of the Western Pacific. All of the species contained within this FMP are considered minor, but it is an important fishery to the Main Hawaiian Islands (MHI), Northwestern Hawaiian Islands (NWHI), Commonwealth of the Northern Mariana Islands (CNMI), American Samoa (AS) and Guam, therefore is included in this report. The commercial fishery is centered primarily around the Hawaiian Islands, both the MHI and NWHI; fishing in the remaining areas (CNMI, AS, Guam) is primarily recreational. The only area that has a large federal fishery is the NWHI. Bottom fishing in the other areas, including the MHI, occurs mainly in state waters (WPRFMC, 2003b). The species managed under this FMP are divided into three groups for management: shallow water bottomfish species (0-100 m), deep water bottomfish species (100-400 m) and seamount groundfish (0-300 fm (548.6 m)) (NMFS, 2004b). The shallow water bottomfish group is mainly composed of groupers and emperors, the deep water bottomfish group consists of snappers, and the seamount groundfish group includes pelagic armorhead, alfonsin and raftfish. Five major species dominate the NWHI bottomfish fishery and they are the grey snapper (Uku), shorttail red snapper (Ehu), longtail red snapper (Onaga), pink snapper (Opakapaka), and sea bass (Hapuupuu,) (WPRFMC, 2003a).

The seamount groundfish fishery was solely a foreign fishery from 1969-1975 during which time the U.S. was not a participant and one million tons of armorhead were harvested. The fishery declined in 1975, after which the foreign fleets left the fishery. In 1977, the Hancock Seamount and the Emperor Seamount Chain, the southernmost seamounts, were included in the U.S. Exclusive Economic Zone (EEZ), and in 1986 a fishing moratorium on the seamounts was imposed. Unfortunately, these seamounts account for only five percent of the total fishery for seamount groundfish, thus the moratorium is most likely too small to be effective (NMFS, 1999). Since there is no commercial U.S. fishery for the seamount groundfish, the bottomfish fishery will be the focus of this chapter.

Pelagic armorhead is the only species that is currently considered overfished, but seabass, shorttail red snapper and longtail red snapper are possibly approaching an overfished condition in the Hawaiian archipelago (NMFS et al., 2004).

Target landings

For several of the regions, landings data split by species were only available for 2002 and 2003, for that reason, the total landings of all bottomfish management unit species (BMUS), a term used to represent only those species contained within the FMP, were graphed for each region over a two decade time span (WPRFMC, 2004a).

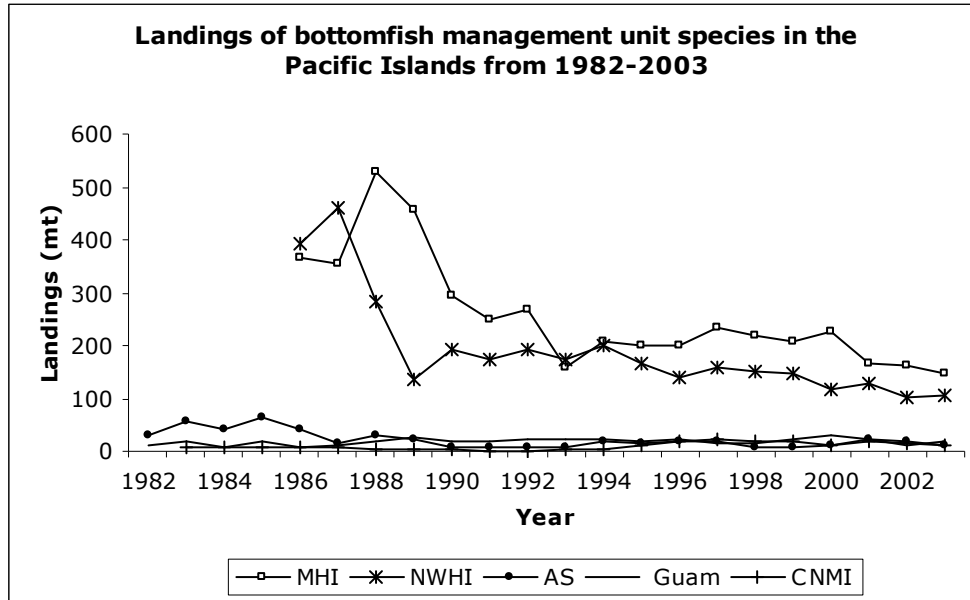


Figure 80: Commercial landings of BMUS from 1982 to 2003.

The commercial landings of many individual species are known for the 2003 fishing year. Landings from the combined Hawaiian Islands (MHI and NWHI) comprised almost 88% of the total landings of bottomfish management unit species (Table 155) (WPRFMC, 2004a).

Table 155: 2003 Landings (mt) of bottomfish management unit species in the Western Pacific.

Species	MHI*	NWHI*	Guam	CNMI	AS	Total
Pink snapper (Opakapaka)	37.93	23.28	0.13	1.03	0.34	62.70
Longtail red snapper (Onaga)	35.03	24.62	3.89	3.02	0.39	66.94
Shorttail red snapper (Ehu)	7.36	4.85	1.03	0.33	0.39	13.97
Gray snapper/jobfish (Uku)	35.07	26.14	0.68	0.25	0.41	20.54
Giant trevally (White ulua)	0.98	0.71	0.19	0.01	—	10.19
Sea bass (Hapuupuu)	4.39	16.15	—	—	—	61.89
Thicklip trevally (Butaguchi)	0.98	9.21	—	—	—	1.69
Silvermouth red snapper (Lehi)	—	—	0.16	0.74	0.23	1.13
Lavender jobfish (Kalekale)	—	—	—	1.39	—	1.39
Yellowtail snapper (Yellowtail kalekale)	—	—	1.18	—	0.03	1.21
Yelloweye snapper (Yelloweye opakapaka)	—	—	0.09	—	—	0.09
Flower snapper (Gindai)	—	—	0.73	1.16	0.05	1.94
Blueline snapper (Ta'ape)	—	—	0.58	0.03	1.14	1.75
Black jack (Black ulua)	—	—	0.07	0.06	0.23	0.67
Amberjack (Kahala)	—	—	0.00	0.15	—	0.20
Brassy trevally	—	—	—	0.33	—	0.33
Blacktip grouper	—	—	3.75	—	0.05	0.36
Lunartail grouper	—	—	3.87	—	2.80	0.15
Redgill emperor	—	—	1.42	—	0.03	3.80
Emperor	—	—	—	3.49	—	6.66
Other BMUS	25.61	2.46	—	—	—	1.45
Total	147.35	107.42	17.77	11.98	6.09	290.61

* 2003 landings by species were reported for the two Hawaiian areas combined. To get separate values for the two Hawaiian areas, the total 2003 landed value for each BMUS was multiplied by the 1990-2002 average percent of total landings for each species in each region. For example, the NWHI catches on average 38% of the pink snapper in Hawaii, while the MHI catches on average 62%. In 2003, 61 mt of pink snapper were caught in the Hawaiian Islands, so 23 mt would be from the NWHI, and 38 mt would be from the MHI.

Empty cells within Table 155 do not necessarily indicate that no fish of that species were caught; it simply indicates a lack of information. In the case of the Hawaiian Islands (MHI and NWHI), the "Other BMUS" category accounts for the species that have no recorded landings. The other three regions are more complete as far as the species list is concerned. Most likely, the total landings for Guam, the CNMI and American Samoa would not increase by more than a few metric tons if the empty cells were accounted for as the catch in those regions is so small.

The gear used to fish for these species is primarily handline consisting of five or six hooks baited with squid or strip bait. This is a highly selective method of fishing, and almost 100% of all catch is retained and sold. Occasionally longlines are used, but they are more prevalent in the international armorfish fishery (WPRFMC, 2003a).

Regulations

There are two sets of regulations for the bottomfish fishery: one for federal waters which regulates 22 species, and one for state waters around Hawaii. There is a prohibition on the use of bottom trawls and bottom set gillnets. It is also illegal to use explosives, poisons or intoxicating substances. A complete moratorium on the harvest of seamount groundfish within U.S. federal waters has been in effect since 1986; but some experimental fishing permits are available to allow fishing under controlled conditions when it might otherwise be prohibited. In the NWHI, a limited entry permit system is in place (WPRFMC, 1986); this led to the 1989 establishment of two zones within the NWHI, the Mau zone and the Hoomalu zone. In the Mau zone, only 10 permits are available and two are reserved for indigenous communities and CDQ use. In the Hoomalu zone, only seven permits are allowed (WPRFMC, 2003a). Also in the NWHI, monk seals and sea turtles are prohibited species and must be released if an incidental capture occurs. Vessel restrictions include size limits of 35-60 feet within the NWHI and ≤ 50 ft when fishing within 50 miles of Guam (WPRFMC, 1986).

In the waters surrounding the main Hawaiian Islands, only seven species of bottomfish are managed: shorttail red snapper (Ehu), longtail red snapper (Onaga), lavender jobfish (kalekale), pink snapper (opakapaka), flower snapper (gindai), sea bass (hapuupuu), and silvermouth (Iehi). The use of traps, trawls, bottomfish longlines and nets (with the exception of scoop nets used to take any fish out of the water harvested by a legal gear type) is prohibited and there are 19 restricted areas in Hawaiian waters. All restricted areas are designated by boundary coordinates that are connected by straight lines. A recreational bag limit exists which allows for the daily take of five onaga, five ehū, or a combined total of five of both species (Hawaii Department of Land and Natural Resources, 1998).

Discards

Discards and bycatch in the Western Pacific bottomfish fishery are not well documented. The majority of the information available is from the commercial fishery around the NWHI islands. Landings from the MHI, CNMI, AS and Guam are mainly recreational, therefore data on the catch and discards there are limited to only a few creel survey interviews. Even though the data are highly unreliable for the CNMI, AM and Guam, it is thought that bycatch amounts from those fisheries are substantially less than bycatch amounts from the Hawaiian fisheries because the NWHI, and to a lesser extent the MHI, are the center of the commercial bottomfish fishery (WPRFMC and PIRO, 2003).

Hawaii

In the NWHI, Logbook data collects information on total catch (including bycatch) and its disposition. The most recent logbook data available are from 1997 and are in numbers of fish only (Table 156). Both released and damaged fish (mainly shark damage) are counted as discards. Large amounts of thicklip trevally (butaguchi) are discarded due to a short shelf-life and low market value; amberjack (kahala) is often discarded because of concerns of ciguatera poisoning (Table 156) (WPRFMC, 1998). In addition sharks, oilfish, snake mackerel, pufferfish and moray eels are discarded because they are normally not considered food fish, unfortunately discard amounts for most of these species are not available (WPRFMC, 1998).

Table 156: 1997 logbook data documenting bycatch and discards in the NWHI. Data are in numbers of fish. BMUS are highlighted in bold (WPRFMC, 1998).

Common Name	Number Caught	Number Landed	Number Discarded
Pink snapper	16,556	16,554	2
Longtail red snapper	8,207	8,207	0
Lavender jobfish	6,324	6,312	12
Shorttail red snapper	6,070	6,070	0
Seabass	4,603	4,586	17
Thicklip trevally	5,573	4,396	1,177
Gray snapper	3,516	3,500	16
Flower snapper	2,133	2,133	0
Giant trevally	231	231	0
Island jack	224	224	0
Large-headed scorpionfish	193	193	0
Silverjaw	123	123	0
Bluefin trevally	49	49	0
Black trevally	46	46	0
Little tunny	29	29	0
Amberjack	2,139	25	2,114
Blueline snapper	24	24	0
Smalltooth jobfish	23	23	0
Pomfret	17	17	0
Yellowfin tuna	23	16	7
Mahi mahi	16	16	0
Great barracuda	10	10	0
Yellowfin goatfish	9	9	0
Hawaiian hogfish	9	9	0
Threadfin jack	5	5	0
Mackerel scad	5	5	0
Bigeye/glasseye fish	4	4	0

Common Name	Number Caught	Number Landed	Number Discarded
Others	4	4	0
Rainbow runner	3	3	0
Bigeye emperor	2	2	0
Dusky jack	2	2	0
Misc. Jack	1	1	0
Whitesaddle goatfish	1	1	0
Scorpionfish	1	1	0
Miscellaneous shark	166	0	166
Tiger shark	5	0	5
Total	56,346	52,830	3,516

According to the NWHI logbook data in Table 156, 4,090 fish, or 7.3% of the total catch, were caught as bycatch (non-BMUS catch plus BMUS discards). The majority of this bycatch (86%) was discarded. However, NMFS research cruises conducted in Hawaii determined that bycatch represents approximately 19% of the total Hawaiian catch by weight (Figure 81) (WPRFMC, 1998). This discrepancy is explained by the fact that the logbook data estimate is in numbers of fish while the NMFS estimate is in weight of fish. NMFS then separated the discards by species group to determine the composition of bycatch in the bottomfish fishery (Figure 81) (WPRFMC and PIRO, 2003). The species groups are defined in Table 157.

NMFS research cruise estimates of composition of bottomfish bycatch in Hawaii

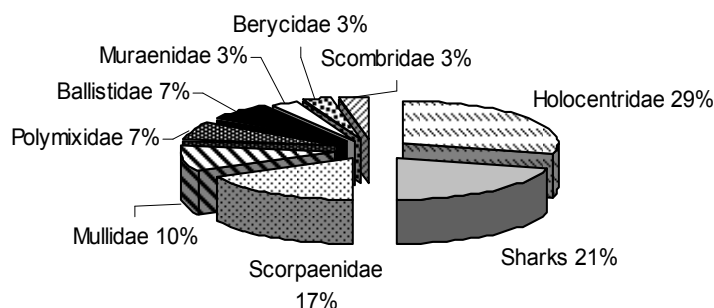


Figure 81: Estimates of the composition of bycatch in the bottomfish fishery in Hawaii.

In 2003, 254.7 mt of bottomfish were landed in Hawaii (MHI and NWHI). This number constitutes 81% of the total catch if we assume that 19% of the total catch was bycatch (WPRFMC and PIRO, 2003). Dividing 254.7 by 0.81 reveals the total catch to be 314.4 mt, and the discards in the Hawaiian fishery to be 59.7 mt. The percentages from Figure 81 were then multiplied by 59.7 to get the bycatch amount for each species group (Table 157). In addition, observer data from the NWHI provides landings and discards in numbers of fish and the discard to landings ratio for certain bottomfish and shark species (Table 158) (WPRFMC, 2004a).

Table 157: Bycatch from the Hawaiian bottomfish fishery by species group for 2003.

Species Group	Percent of total bycatch	Total amount of bycatch (mt)
Holocentridae (squirrelfishes and soldierfishes)	29%	17.3
Sharks	21%	12.5
Scorpaenidae (scorpionfishes and rockfishes)	17%	10.1
Mullidae (goatfishes)	10%	6.0
Polymixidae (beardfish)	7%	4.2
Ballistidae (triggerfishes)	7%	4.2
Muraenidae (moray eels)	3%	1.8

Species Group	Percent of total bycatch	Total amount of bycatch (mt)
Berycidae (alfonsins)	3%	1.8
Scombridae (tunas and mackerels)	3%	1.8
Total	100%	59.7

Table 158: Observed landings and discards from the 2002 bottomfish fisheries in the Mau and Hoomalu zones of the NWHI. This is non-expanded observer data.

Mau Zone				Hoomalu Zone			
Species	Number landed	Number discarded	d/l ratio	Species	Number landed	Number discarded	d/l ratio
Shark (unid)	0	57	All discards	Shark (unid)	0	8	All discards
Tiger shark	0	3	All discards	Tiger shark	0	4	All discards
Shorttail red snapper	2070	2	0.00097	Pink snapper	2206	1	0.00045
Seabass	1254	12	0.0096	Lavender jobfish	474	439	0.93
Thicklip trevally	641	184	0.29	Thicklip trevally	1248	303	0.24
Black trevally	81	2	0.025	Giant trevally	128	221	1.73
Amberjack	0	226	All discards	Amberjack	0	1610	All discards
Bluefin Trevally	193	20	0.10	Bluefin trevally	0	43	All discards
Barracuda	9	1	0.11				

The discard to landings ratios from Table 158 were then applied to 2003 landings for each species in the NWHI (Mau and Hoomalu combined) (Table 159). Unfortunately, total landings for the NWHI were only available for five of the species in Table 158. For thicklip trevally, the only species landed in both the Mau and Hoomalu zones in 2003, the observed number of fish landed and observed number of fish discarded were combined and an overall d/l ratio was calculated.

Table 159: Discards (mt) of five species of bottomfish from the NWHI in 2003.

Species	2003 landings (mt)	2002 d/l ratio	2003 discards (mt) using 2002 d/l ratio
Shorttail red snapper	4.9	0.00097	0.0
Seabass	16.1	0.0096	0.2
Thicklip trevally	9.2	0.26	2.4
Pink snapper	23.3	0.00045	0.0
Giant trevally	0.7	1.73	1.2
Total	54.2		3.8

American Samoa, Guam and the CNMI

Survey data from American Samoa in 1978 and 1988 suggest that the catch of non-target species is less than 1% of the total catch and consists mainly of snake mackerel. The NMFS Resource Assessment and Investigation of the Mariana Archipelago (RAIOMA) project suggests that in Guam and the Northern Mariana Islands pufferfish, gurnards, beardfish and sharks are the main bycatch species, and that potential bycatch comprises only about 1% of the total catch. A list of bycatch species from charter and non-charter trips in Guam and the CNMI was obtained through creel survey interviews (Table 160). Bycatch is not reported, however this list does provide an overview of incidental catches in the fisheries (WPRFMC, 2004a).

Table 160: Bycatch species from charter and non-charter boats in Guam and CNMI.

Bycatch Species in Guam (2003)	Bycatch Species in CNMI (2000-2003)
Non Charter	Non-charter
Honeycomb grouper	Black jack
Thumbprint emperor	Dogtooth tuna
Yellowstriped emperor	Charter
Yellowlip emperor	Jobfish
Five stripe wrasse	Blueline snapper
Redtooth triggerfish	Blacktip grouper
Darkfin hind	Lyretail grouper
Charter	Red snapper
Gray snapper	Redgill emperor
Graceful lizardfish	Emperors
Groupers and sea basses	Triggerfish
Honeycomb grouper	
Picasso triggerfish	
Blueline snapper	
Goatfish	
Doublebar goatfish	
Multibar goatfish	
Dogtooth tuna	
Triggerfishes	
Pinktail triggerfish	
Redtooth triggerfish	
Black-tipped rockcod	

In summary, overall bycatch is low in the Western Pacific bottomfish and seamount groundfish fishery due to extremely low landings. In the Hawaiian Islands, total landings were 254.8 mt in 2003 and total bycatch of non-target species was 59.7 mt (Table 157). There are at least 3.8 mt of target species discards as well. In the rest of the Western Pacific, the total landings amounted to 35.8 mt, and bycatch is only believed to make up 1% of the total landings, or 0.4 mt. Overall, the total bycatch appears to be 63.8 mt, and the overall b/l ratio equals 0.22.

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Western Pacific Pelagics Fishery

Major Target Species:	Albacore tuna (<i>Thunnus alalunga</i>), Bigeye tuna (<i>Thunnus obesus</i>), Yellowfin tuna (<i>Thunnus albacares</i>), Skipjack tuna (<i>Katsuwonus pelamis</i>), Swordfish (<i>Xiphias gladius</i>), Blue marlin (<i>Makaira mazara</i> and <i>Makaira nigricans</i>) Mahi mahi (<i>Coryphaena hippurus</i> and <i>Coryphaena equiselis</i>), Striped marlin (<i>Tetrapterus audax</i>), Moonfish (<i>Lampris immaculatus</i> and <i>Lampris guttatus</i>), Wahoo (<i>Acanthocybium solandri</i>), Shortbill spearfish (<i>Tetrapterus angustirostris</i>)
Major Discard Species:	Sharks, Marlins, Swordfish (<i>Xiphias gladius</i>)
Primary Gear Types:	Troll, Longline
Total Landings (2003):	52,594 mt
Total Discards (2003):	10,372 mt
Total Discards Rank (of 27):	13
Discard to Landings Ratio:	0.20
d/I Rank (of 27):	18
Source of Estimates:	NMFS, Survey data, Authors
Discard Type:	Primarily target, regulatory
Notes:	Total landings and discards from the Hawaii, Guam and Americas Samoa areas include recreational data and also include the purse seine fishery which is responsible for over 50% of total landings, but only 150 mt of total discards.

The FMP for the Pelagic Fisheries of the Western Pacific manages eleven major species in thirteen different stocks. The species are: yellowfin tuna, albacore tuna, skipjack tuna, bigeye tuna, striped marlin, blue marlin, swordfish, shortbill spearfish, wahoo, mahi mahi and moonfish (NMFS et al., 2004; WPRFMC, 1986a). These stocks are managed by the Western Pacific Fishery Management Council. The council's jurisdiction covers the U.S. fishery conservation zone around Hawaii (648,000 mi²), American Samoa (75,000 mi²), Guam (60,000 mi²) and U.S. possessions (476,000 mi²) (WPRFMC, 1986a). Many of the same species and stocks are also managed under the Pacific Fishery Management Council's Highly Migratory Species FMP which was implemented in 2003. There is collaboration between the councils even though they have decided to manage these stocks separately. Overfishing levels have not been defined for any of these stocks, and the tunas, marlins and swordfish stocks are not overfished. It is unknown whether the shortbill spearfish, wahoo, mahi mahi and moonfish stocks are overfished (NMFS et al., 2004).

Target landings

The landings data for pelagic species in the Western Pacific is extensive when presented by species for each of the four areas: Hawaii, Guam, American Samoa (AS) and the Commonwealth of the Northern Mariana Islands (CNMI). For this reason, historical commercial landings are presented for the Western Pacific as a whole (Figure 82 and Figure 83), and then 2003 commercial and recreational landings are presented and summarized by area (Table 161) (PIFSC, 2004).

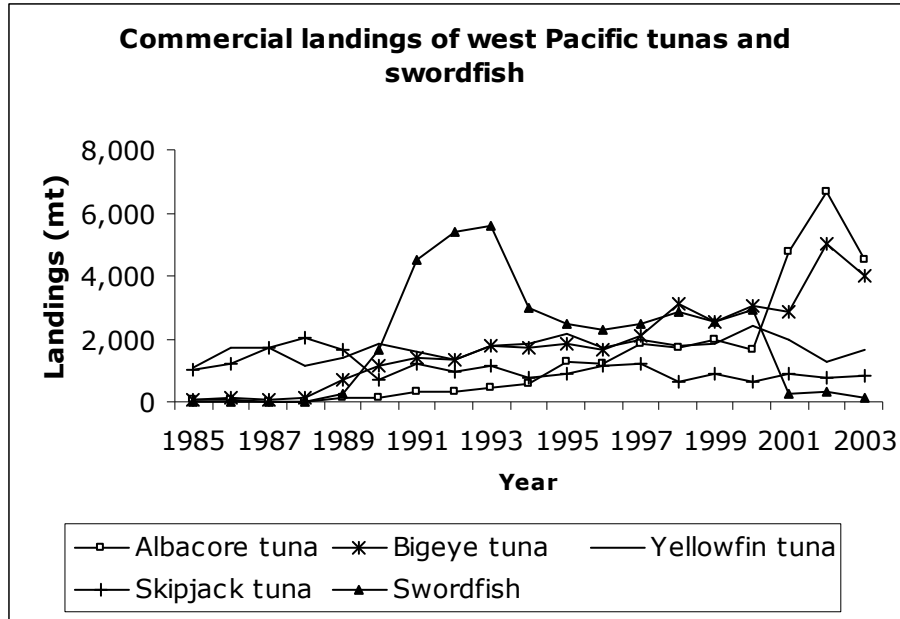


Figure 82: Commercial landings of tunas and swordfish for all Western Pacific areas combined, 1985-2003 (PIFSC, 2004).

With the exception of albacore tuna, the majority of tuna and swordfish landings occur in Hawaii. Since the mid 1990s, when American Samoan fishermen started using longline gear to target tunas, American Samoa has been the main source of albacore tuna landings contributing 86.6% of albacore landings in 2003 (PIFSC, 2004). In 2003, Hawaii landed 84% of the non-tuna/swordfish pelagic species; Guam, American Samoa and the CNMI landed the other 16%. The exact breakdown of 2002 and 2003 landings by species and by area is given in Table 161.

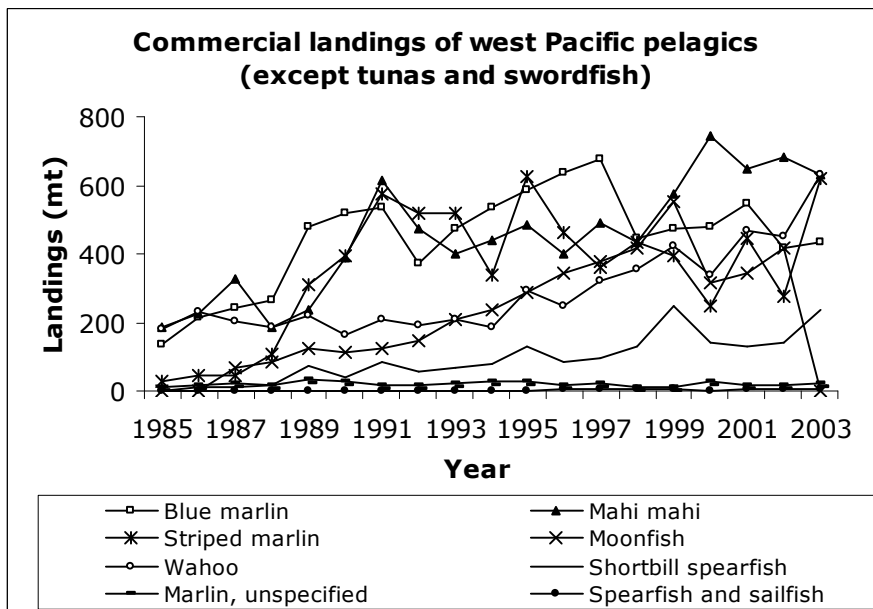


Figure 83: Commercial landings of eight major pelagic species in all Western Pacific areas combined, 1985-2003 (PIFSC, 2004).

Table 161: 2002 and 2003 landings of major Western Pacific pelagic species. Landings are in metric tons. Blank entries indicate that no data were available (PIFSC, 2004).

Species	Hawaii		American Samoa		Guam		CNMI		Total	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
Commercial Landings										
Yellowfin tuna	1,192.0	1,552.2	473.5	487.5	14.5	17.2	13.6	11.6	1,693.7	2,068.4
Blue marlin	396.4	432.2	19.3	2.1	14.22*	20.03*	0.6	0.5	430.4	454.8
Mahi mahi	623.1	595.5	16.1	7.9	35.2	25.0	8.2	3.3	682.5	631.6
Wahoo	299.1	445.3	125.4	167.1	24.4	16.6	3.7	3.5	452.5	632.6
Skipjack tuna	435.5	603.3	194.3	114.6	48.5	37.7	81.6	77.7	759.9	833.4
Shortbill spearfish	142.3	234.5	0.27**	0.00**	0.1	0.1	0.0	0.0	142.7	234.6
Swordfish	326.6	149.7	1.7	3.7	0.0	0.0			328.3	153.4
Bigeye tuna	4,826.2	3,746.7	179.9	235.6					5,006.2	3,982.3
Albacore tuna	744.4	608.3	5,946.6	3,929.9					6,691.0	4,538.2
Moonfish	415.0		0.0	1.9					415.0	1.9
Striped marlin	278.4	621.6	0.0	0.0					278.4	621.6
Commercial Total	9,679.0	8,989.1	6,956.9	4,950.3	136.9	116.6	107.7	96.6	16,880.5	14,152.6
Recreational Landings										
Skipjack tuna	208.1	1024.2	41.7	8.1	30.1	45.2			279.9	1077.5
Yellowfin tuna	933.3	5117.8	4.1	12.5	5.6	13.5			943.0	5143.8
Mahi mahi	801.0	908.6	16.7	29.2	39.8	13.0			857.5	950.8
Blue marlin	887.3	458.0	14.4	9.0	9.86*	9.94*			911.5	476.9
Wahoo	540.3	1132.8	23.2	27.5	5.1	12.1			568.5	1172.4
Striped marlin		6.3	16.2	4.0					16.2	10.4
Spearfish		7.6	1.8	2.3					1.8	9.8
Albacore			37.2	0.7					37.2	0.7
Bigeye tuna			4.7	6.8					4.7	6.8
Swordfish			1.1	3.5					1.1	3.5
Moonfish			3.1	2.4					3.1	2.4
Other pelagics***	35.4	15.7	8.6	10.1	0.0	0.0			44.0	25.8
Recreational Total	3405.4	8670.9	172.6	116.1	90.4	93.7	0.0	0.0	3668.4	8880.8

* These landings are for all marlin, not just blue marlin

** These landings are for all spearfish, not just shortbill spearfish

*** Other pelagics includes landings of kawakawa, black marlin, sailfish, oilfish, pomfret, barracuda, rainbow runner, dogtooth tuna, other tunas, sharks and others.

The gear usage in this fishery depends largely on the area fished. Hawaii is the most diverse in their gear type use, and landings are split among longline, troll, handline and pole and line (Figure 84) (WPRFMC, 2004b).

Gear usage in the commercial Hawaii pelagic fishery, 2002

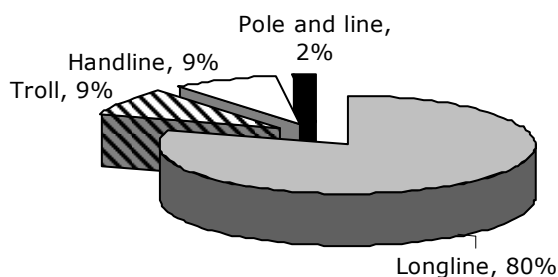


Figure 84: Gear usage in the Hawaiian pelagics fishery (WPRFMC, 2004b).

American Samoa's landings are almost 100% from longlining (PIFSC, 2004), but landings in Guam and the CNMI are almost 100% from trolling (WPRFMC, 2004c). American Samoa was mainly a troll fishery as well until the early 1990s when fishermen started using longlines, increasing the landings of albacore tuna exponentially (PIFSC, 2004).

Regulations

Fisheries management regulations for the pelagic fisheries in the Western Pacific are highly variable by area, ranging from stringent in Hawaii to minimal in the Northern Marianas Islands. The majority of management measures are generally aimed at minimizing fishery interactions with, and the mortality of, protected sea turtles, birds, and marine mammals, as well as preserving the traditional island fisheries from the encroachment of large longline vessels.

Hawaii

The Hawaii-based pelagic longline fishery is operated under a federal limited access permit system which was incorporated into the FMP in June, 1994. Qualification for a Hawaii longline limited access permit is contingent on fishery participation before the control date in December, 1990. At the start of the limited access program, all pelagic longline vessels based out of Hawaii were less than 101 ft (overall length), which effectively limited the size of vessels participating in the fishery. The limited access program was initiated to halt the rapid growth of the longline fishery, which was beginning to take over Hawaii's traditional small boat troll, handline and pole-and-line fisheries. Vessel Monitoring Systems (VMS) are also required aboard Hawaii-based limited entry longline vessels to monitor the locations of fishing effort.

In order to prevent longline fisheries interactions with, and possible mortalities of, protected species, especially Hawaiian monk seals, multiple gear and area restrictions are utilized. Protected species zones exist around and between all Hawaiian Islands, from shore to approximately 50 to 75 nmi, and pelagic longlining is prohibited in all zones. The precise locations of the protected species zones is subject to change and varies by season. Many longline regulations have also been aimed at reducing sea turtle mortalities. Hawaii-based longline vessels are now required to carry sea turtle disentanglement equipment and follow specific NMFS sea turtle handling procedures. The use of shallow set longline gear, which targets swordfish and was indicated as a significant source of sea turtle mortality, was prohibited in all areas of Hawaii and the PRIA north of the equator in June, 2002. The total number of sea turtle interactions (i.e., hooked and released alive, dead) is limited to 16 leatherback sea turtles and 17 loggerhead sea turtles annually. Finally, longline regulations have also been enacted to reduce the amount of sea bird mortality, particularly that of the endangered short-tailed albatross. Specific regulations are variable according to the area where gear is deployed and the type of longline set being used. Pelagic longline fishermen are required to carry specific sea bird dehooking and handling tools, attend sea bird education classes, and follow required handling and reporting procedures.

The Hawaii handline and troll fisheries are subject to relatively sparse regulations in comparison with the longline fishery. There are no effort, area, or gear restrictions applied to the handline and troll fisheries. Fishing permits are not required around the Hawaiian Islands. However, a fishing permit is required by vessels using troll or handline gear in the EEZs of the Pacific Remote Islands (NOAA Fisheries, 2004a; WPRFMC, 1986; WPRFMC, 2003b).

American Samoa

American Samoa has experienced a dramatic shift in gear usage from troll/handline to longline in the pelagic fisheries over the past ten years. In particular, the number of large (>50 ft) longline vessels in the fishery has increased. In an effort to limit gear conflicts and preserve the traditional Samoan troll/handline fisheries and recreational fisheries, area restrictions were added in March, 2002. These measures specified an area around American Samoa, approximately 50 nmi from shore, where pelagic longlining by vessels greater than 50 ft (overall length) which entered the fishery after November, 1997 is prohibited. Currently, general longline permits (which are not part of a limited access system) are required by all longline vessels in American Samoa (NOAA Fisheries, 2004; WPRFMC, 1986b; WPRFMC, 2000; WPRFMC, 2003b).

Guam and the Commonwealth of the Northern Marianas Islands

The pelagic fisheries in Guam and the CNMI are conducted primarily by troll and handline, with a large recreational component, especially in Guam. Very few fisheries regulations are utilized in these regions. As with the Hawaiian Islands and American Samoa, no permits or reporting requirements are applied to the troll and handline fisheries. A general permit, of the same type required in American Samoa, is required to conduct longlining activities in the EEZs of Guam and the CNMI. Since March, 1992, a longline prohibited area has existed around Guam to a distance of approximately 50 nmi (NOAA Fisheries, 2004; WPRFMC, 1986b; WPRFMC, 2003b).

Discards

Discard data for the Western Pacific pelagics fishery is mainly limited to target species discards in the commercial longline fisheries. However, some data on discards of a few important non-target species are available. For the troll and handline fisheries, there is relatively little information on the nature and amount of bycatch. Since the gear is selective, bycatch and discards probably constitute a small part of the catch. Almost all the fish caught by troll and handline vessels, including charter boats, in Hawaii, American Samoa, Guam and the Northern Mariana Islands are either sold or kept for personal consumption (WPRFMC, 1998). Table 162 gives 2002 and 2003 discards of pelagic species in the commercial longline fishery in the EEZ around the Hawaiian Islands. The 2003 discards were calculated using 2003 landings and 2002 d/l ratios.

Hawaii

Table 162: Discards from the 2002 and 2003 commercial pelagic longline fishery in Hawaii (WPRFMC, 2004b).

Species	2002 landings (mt)	2002 discards (mt)	2002 d/l ratio	2003 landings (mt)	2003 discards (mt) (using 2002 d/l ratio)
Albacore	519.6	3.4	0.007	608.4	4.3
Bigeye	4424.9	111.1	0.025	3746.3	93.7
Bluefin	0.8	0.2	0.250	Unknown	Unknown
Skipjack	129.3	17.2	0.133	603.9	80.3
Yellowfin	556.9	16.1	0.029	1522.4	44.2
Other tunas	0.9	0.0	0.008	10.0	0.1
Blue marlin	263.2	5.1	0.020	432.2	8.6
Spearfish	137.6	4.4	0.032	234.5	7.5
Striped marlin	217.7	4.1	0.019	621.5	11.8
Other marlins	8.7	0.2	0.022	1.8	0.0
Swordfish	195.7	47.2	0.241	150.0	36.1
Mahi mahi	300.2	6.0	0.020	595.5	11.9
Moonfish	409.6	3.3	0.008	Unknown	Unknown
Oilfish	87.8	1.9	0.022	126.2	2.8
Pomfret	216.6	3.2	0.015	208.1	3.1
Wahoo	131.8	1.1	0.008	445.3	3.6
Other pelagics	8.5	27.5	3.228	Unknown	Unknown
Total finfish	7609.9	252.1	0.033	9306.0	308.0
Blue shark	30.4	1827.2	60.127	Unknown	Unknown
Mako shark	83.1	73.8	0.888	Unknown	Unknown
Thresher shark	42.6	351.1	8.244	Unknown	Unknown
Other sharks	17.2	311.4	18.062	Unknown	Unknown
Total sharks	173.3	2563.5	14.792	Unknown	Unknown
Overall total	7783.2	2815.6	0.362	Unknown	Unknown

Table 162 only reports discards of pelagic species and sharks. However, NMFS observer data from 1994–1997 (Observer coverage = 4-5%) reports that discarded non-target species include lancet fish, pelagic stingray, snake mackerel, escolar, remora, crocodile shark and mola mola, among others. No specific discard amounts were reported (WPRFMC, 1998).

The commercial pole-and-line fishery in Hawaii is highly selective. Non-target species that are occasionally caught, such as kawakawa, blue and striped marlin and rainbow runner, are usually either sold or retained for personal consumption by the crew. No specific discard amounts were available (WPRFMC, 1998).

Overall discard amounts for the Hawaiian recreational fisheries were reported in numbers of fish (Table 163). Weight data cannot be extrapolated because the species discarded are not known. Data collection expanded in 2003, and the result is much higher bycatch figures than for 2002.

Table 163: Discards from the 2002 and 2003 recreational pelagic fisheries in Hawaii (WPRFMC, 2004a; WPRFMC, 2004b).

	2002	2003
Boat Fishery		
Discards (#)	6,772	341,264
Landings (#)	671,064	490,020
d/l ratio	0.010	0.696
Shore Fishery		
Discards (#)	0	15,369
Landings (#)	33,386	18,975
d/l ratio	0	0.810

American Samoa

Discards from the American Samoa fishery are reported for both the recreational and commercial sectors combined, because it is difficult to separate the two (Table 164). The two sectors are not composed of different user groups, and commercial fishermen only sell a small portion of their catch. The part of the catch that is not sold is considered recreational.

Table 164: Total discards in the American Samoa commercial and recreational longline pelagic fishery combined (WPRFMC, 2004b).

Species	2002			2003		
	Landed (mt)	Discarded (mt)	d/l ratio	Landed (mt)	Discarded (mt)	d/l ratio
Black marlin	0.1	0.7	5.79	0.1	1.2	10.00
Blue marlin	36.3	287.1	27.37	10.5	114.2	10.89
Striped marlin	1.5	9.2	4.35	2.1	5.2	2.47
Sailfish	1.3	4.2	2.52	1.7	12.7	7.68
Spearfish	1.5	4.5	1.93	2.3	7.0	3.02
Swordfish	3.2	2.3	0.18	13.3	10.1	0.76
Albacore	6868.8	16.1	0.00	4067.8	1.9	0.00
Bigeye tuna	280.6	79.7	0.28	251.3	20.9	0.08
Bluefin tuna	1.6	2.6	1.58	5.7	0.5	0.08
Skipjack tuna	228.6	95.6	0.42	116.2	45.8	0.39
Yellowfin tuna	219.9	27.8	0.13	232.8	12.8	0.05
Mahi mahi	49.4	31.0	0.63	36.2	21.5	0.59
Moonfish	6.5	26.0	3.97	8.9	37.6	4.20
Oilfish	0.3	31.7	101.42	0.5	36.3	70.62
Pomfret	1.0	2.9	2.91	1.0	3.4	3.37
Wahoo	148.9	29.5	0.20	198.9	25.3	0.13
Other pelagic fish	0.3	27.5	81.03	0.4	25.7	71.53
Blue shark	0.7	165.7	230.85	1.9	164.1	87.35
Mako Shark	0.1	9.8	131.50	0.2	12.9	86.50
Thresher Shark	0.1	15.1	107.25	0.4	13.3	34.45
White-Tip Shark	0.9	63.4	69.00	1.2	77.3	64.57
Other Sharks	0.2	13.8	68.60	0.1	15.8	131.67
Total (without sharks)	7850.0	678.3	0.09	4949.6	382.1	0.08
Total (with sharks)	7852.0	946.0	0.12	4953.4	665.6	0.13

Guam, CNMI and the Pacific Insular Islands (PIA)

Discard data for Guam and the CNMI is sparse. Data for some species in the commercial and recreational Guam pelagic fishery are reported in Table 165.

Table 165: Discards from the 2001 Guam pelagic fishery (WPRFMC, 2002; WPRFMC, 2003b; WPRFMC, 2004a; WPRFMC, 2004b).

Year	Type	Species	Amount landed (mt)	Amount discarded (mt)	d/l ratio*
2001	Non-charter	Silky shark	unknown	2.2	0.030
		Jack, unidentified	unknown	0.0	0.0002
		Wahoo	48.6	0.2	0.003
		Yellowfin tuna	25.0	1.5	0.020
	Charter	Mahi mahi	11.6	0.1	0.004
		Blue marlin	5.0	1.3	0.077
		Shortbill spearfish	0.0	0.2	0.010
Total	All	90.3	5.4	0.060	

* d/l ratios calculated using landings of wahoo and yellowfin for non-charter boats in 2001 and mahi mahi and blue marlin for charter boats in 2001.

The overall landings for the Guam commercial and recreational 2001 fisheries were 330.6 mt. This is 3.7 times the amount observed landed in 2001 (90.2 mt, Table 165). If this number is multiplied by the total observed discards in 2001, the total discards become 19.8 mt. In order to obtain 2003 discards, the ratio of total landings (commercial and recreational) in 2003 to total landings in 2001 was calculated to be 0.6. Multiplying this number by the 2001 total discards determines that total 2003 discards are 12.6 mt.

For the CNMI, survey discard data are only available for two species of fish, mahi mahi and yellowfin tuna (Table 166). The d/l ratio from the survey was applied to total commercial landings for the two species to give overall discard rates of those species only. There is supposedly no bycatch aboard charter boats in the CNMI (WPRFMC, 2004b).

Table 166: Discards from the 2003 CNMI commercial non-charter pelagic fisheries (WPRFMC, 2004b).

Species	Total landed in survey from 2000-2003 (#)	Total released in survey from 2000-2003 (#)	d/l ratio	2003 total landings (mt)	2003 total discards (mt)
Mahi mahi	570	3	0.0053	3.3	0.02
Yellowfin tuna	400	1	0.0025	11.6	0.03
Total				14.8	0.05

Total commercial landings in the CNMI were 96.6 mt in 2003, 6.52 times the landings of 14.8 mt reported in Table 166. If the reported discards (0.046 mt) are multiplied by 6.5, they amount to 0.3 mt of total bycatch.

In the Pacific Insular Areas (PIA) (Howland Island, Baker Island, Jarvis Island, Johnston Atoll, Midway Island, Kingman Reef, Palmyra Atoll, and Wake Island), bycatch data from purse-seining vessels are available (Table 167) (WPRFMC, 1998). According to Catch Report Form data collected by purse-seine vessels in U.S. EEZ waters in 1997, purse-seine discards amounted to less than 0.5% of the total volume of catch by weight. Based on this percentage, the total number of landings for the PIA was approximately 30,250 mt per year between 1994 and 1997. The landings for this area for 2002 are unknown and therefore the discards for the 2002 fishing year cannot be estimated. Purse-seine logbooks indicate that skipjack tuna forms the largest fraction of the discard volume by weight. These data are confirmed by the weight and numbers of discards recorded by observers aboard U.S. purse-seiners operating within the U.S. EEZ waters between 1994 and 1997 (Table 167).

Table 167: Purse-seine bycatch (mt) in the U.S. EEZ waters around the uninhabited islands of the Pacific Insular Areas (1994-1997 average) (expanded observer data) (WPRFMC, 1998).

Species	1994-1997 average bycatch (mt)
Skipjack tuna	124.5
Rainbow runner	7.91
Yellowfin tuna	7.07
Mackerel	3.27
Triggerfish	2.65
Other tuna	1.84
Blue marlin	1.73
Bigeye tuna	1.48
Black marlin	0.22
Shark	0.22
Manta ray	0.13
Mahi mahi	0.09
Unknown sp.	0.08
Sailfish	0.03
Barracuda	0.02
Wahoo	0
Total	151.24

In summary, in Hawaii, the total 2003 commercial landings (all gears) were 9,679 mt and 2,816 mt were discarded (pelagic longline) for a discard to landings ratio of 0.31. The majority of these discard were of blue sharks. In addition, 8,671 mt were landed in the 2003 Hawaiian recreational fishery (boat and shore combined), and the average 2003 d/l ratio for the boat and shore fisheries was 0.75. Using this ratio, the 2003 recreational discards amount to 6,529 mt. However, this ratio is based on numbers of fish, so the discard amount is likely overestimated as discarded fish are typically small. Commercial and recreational discard data are not available for the same year. The 2002 recreational discard data is from the first year of an observer program that obviously underestimated the amount of discards, and the 2003 commercial discard data were incomplete. If we combined the 2002 commercial data with the 2003 recreational data, total annual landings would be 18,350 mt and total discards would be 9,345 for an overall d/l ratio of 0.51.

In American Samoa, the commercial and recreational pelagic fisheries data are reported together. In 2003, 4,950 mt were landed, and 666 mt was discarded for a d/l ratio of 0.13. Discard data for Guam was also presented for both the commercial and recreational fisheries. In 2003, 210 mt were landed in the commercial and recreational fisheries and approximately 13 mt were discarded for a d/l ratio of 0.06. In the CNMI, the 2003 commercial landings were 97 mt, and there were approximately 0.3 mt of discards in the commercial fishery for a d/l ratio of 0.003.

The annual average catch from 1994-1997 in the PIA purse seine fishery was 30,250 mt, only 0.5% of this catch was discarded, or 151 mt. It was impossible to expand this data to 2002 or 2003 because the landings for those years are not known.

Overall, there were 22,344 mt of landings in the 2003 commercial and recreational Western Pacific pelagic fisheries (not including purse seine, including 2002 commercial Hawaii landings), and there were 10,221 mt of discards. In addition, there is approximately 30,250 mt of annual purse seine landings and 151 mt of annual purse seine discards. Combined, the annual landings are 52,594 mt and annual discards are 10,372 mt for an overall d/l ratio of 0.20.

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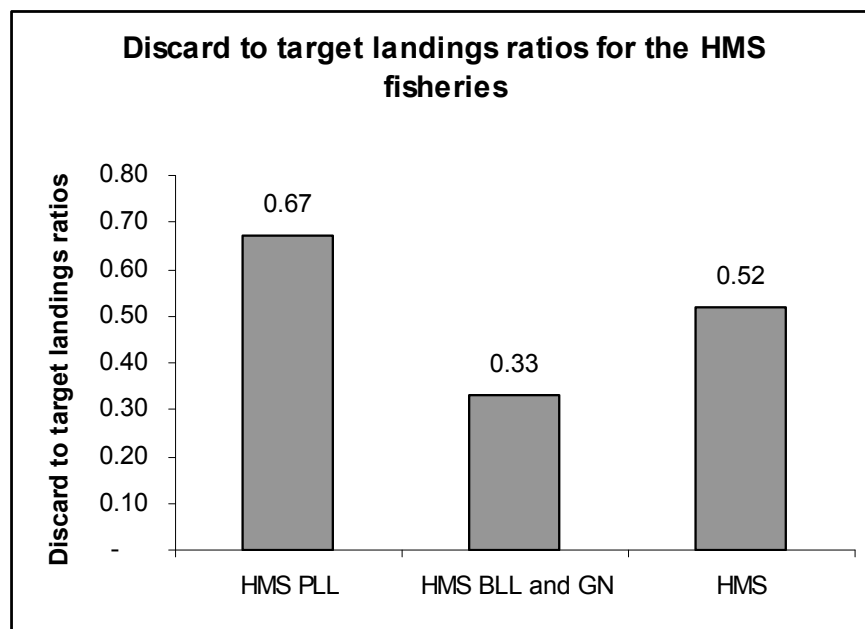
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Highly Migratory Species Fisheries

Highly migratory species overview of landings, discards and discard to landings ratios by fishery

Fishery	Landings (mt)	Discards (mt)	d/l ratio
HMS Pelagic Longline	5,716	3,813	0.67
HMS Bottom Longline and Gillnet	4,671	1,548	0.33
All HMS Fisheries	10,387	5,362	0.52



Atlantic Highly Migratory Species Fisheries: Atlantic Tunas, Swordfish and Sharks

ATLANTIC HIGHLY MIGRATORY SPECIES PELAGIC LONGLINE FISHERY

Major Target Species:	Albacore tuna (<i>Xiphias gladius</i>), Bigeye tuna (<i>Thunnus obesus</i>), Bluefin tuna (<i>Thunnus thynnus</i>), Yellowfin tuna (<i>Thunnus albacares</i>), Swordfish (<i>Xiphias gladius</i>),
Major Discard Species:	Swordfish (<i>Xiphias gladius</i>), sharks
Primary Gear Types:	Pelagic longline
Total Landings (2001):	5,716 mt
Total Discards (2001):	3,813 mt
Total Discards Rank (of 27):	17
Discard to Landings Ratio:	0.67
d/I Rank (of 27):	9
Source of Estimates:	NMFS, Independent research studies,
Discard Type:	Primarily target, regulatory
Notes:	Total discards include 3,690 finfish estimated to weigh 1 kg each, and 922 sharks estimated to weigh 5 kg each in the absence of accurate weight data.

ATLANTIC HIGHLY MIGRATORY SPECIES BOTTOM LONGLINE/GILLNET FISHERY

Major Target Species:	Sandbar shark (<i>Carcharhinus plumbeus</i>), Blacktip shark (<i>Carcharhinus limbatus</i>), Bull shark (<i>Carcharhinus leucas</i>), Finetooth shark (<i>Carcharhinus isodon</i>), Atlantic sharpnose shark (<i>Rhizoprionodon porosus</i>), Blacknose shark (<i>Carcharhinus acronotus</i>), Bonnethead shark (<i>Sphyrna tiburo</i>), Shortfin mako shark (<i>Isurus oxyrinchus</i>), Smooth dogfish shark (<i>Mustelus canis</i>)
Major Discard Species:	Sharks
Primary Gear Types:	Bottom longline, gillnet
Total Landings (2003):	4,671 mt
Total Discards (2003):	1,548 mt
Total Discards Rank (of 27):	21
Discard to Landings Ratio:	0.33
d/I Rank (of 27):	14
Source of Estimates:	NMFS, Independent research studies
Discard Type:	Primarily target, regulatory
Notes:	

The FMP for Atlantic Tunas, Swordfish and Sharks includes four species of tuna: albacore, bigeye, bluefin, and yellowfin. It also includes swordfish and nine species of shark: sandbar, blacktip, bull, finetooth, Atlantic sharpnose, blacknose, bonnethead, shortfin mako and smooth dogfish. Because of the extensive range of these species and the fishery, this FMP was directly developed and implemented by NMFS rather than through the regional council system. Along with the national FMP for Atlantic tunas, swordfish and sharks, ICCAT, CITES and IPOA agreements exist to protect these species in international waters (NOAA Fisheries, 2004). The stock status of each of these species according to U.S. federal management authority is given in Table 168.

Table 168: Stock status of the species in the highly migratory species fishery management plan (NMFS, 2004c).

Species	Overfished? (Is biomass below threshold?)	Overfishing? (Is fishing mortality above threshold?)
Albacore tuna	Yes	Yes
Bigeye tuna	Yes	Yes
Bluefin tuna	Yes	Yes
Yellowfin tuna	No	No
Swordfish	Yes	Yes
Sandbar shark	Yes	Yes
Blacktip shark	Yes	Yes
Bull shark	Yes	Yes
Finetooth shark	Yes	No
Atlantic sharpnose shark	No	No
Blacknose shark	No	No
Bonnethead shark	No	No
Shortfin mako shark	Unknown	Unknown
Smooth dogfish shark	Unknown	Unknown

There is another highly migratory species FMP which regulates the take of blue and white marlin, sailfish and spearfish. However, the take of all of these species is strictly prohibited; any catch reported is treated as bycatch in the fishery in which it was caught, and will be covered in other chapters where elevant.

Target landings

Between 1985 and 2002, the majority of tuna landings by species have been at or under 1,000 mt with the exception of yellowfin tuna. Yellowfin tuna landings peaked in 1988 at almost 9,000 mt, and then declined sharply to just over 2,000 mt. Tuna landings have been quantified for many years, but only bluefin were landed in any quantity before 1985 (Figure 85). Landings of little tunny tuna are included in Figure 85 as well. Even though they are not included in the FMP, they constitute 9% of the U.S. tuna landings (NMFS, 2004a).

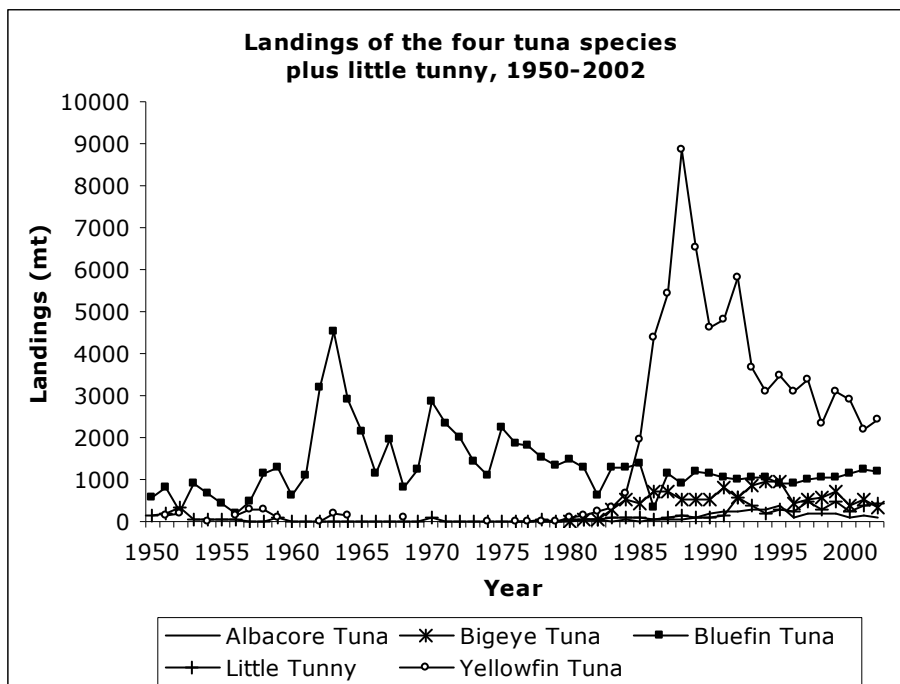


Figure 85: Total commercial landings of tuna in the North Atlantic (1950-2002). Landings of bluefin and yellowfin tuna have declined considerably (NMFS, 2004e).

Swordfish landings reached just over 5,000 mt per year in the 1980's (1980, 1988 and 1989), but in the past decade, they have fallen to 1975 levels of 2,000 mt per year (NMFS, 2004a).

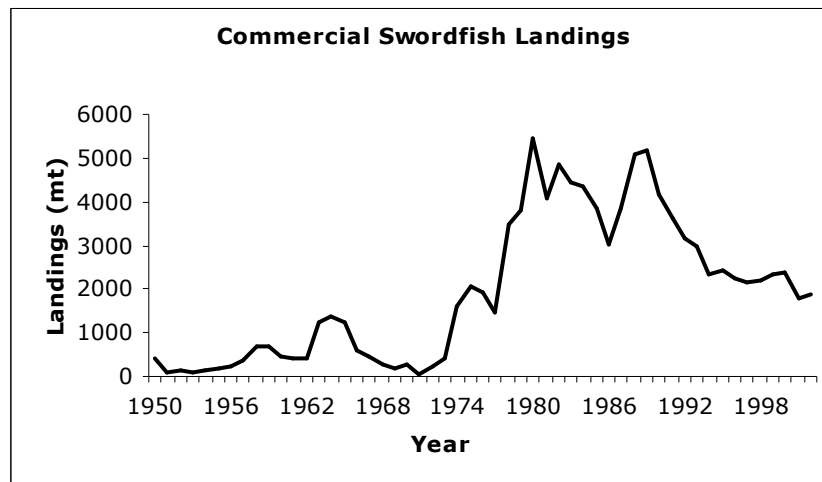


Figure 86: Total commercial U.S. swordfish landings from the North Atlantic, 1950-2002 (NMFS, 2004a).

The landings data for sharks are reported in two different ways: individually and categorically. The three commonly used groupings are large coastal sharks, small coastal sharks, and pelagic sharks. Bull sharks, blacktip sharks and sandbar sharks fall into the large coastal sharks (LCS) category. Atlantic sharpnose sharks, blacknose sharks, bonnethead sharks and finetooth sharks fall into the small coastal sharks category (SCS), and shortfin mako sharks fall into the pelagic sharks (PS) category. Smooth dogfish does not fall into any of these categories and are reported individually. In Figure 87, shark landings are reported by species. It is clear that the sandbar shark, blacktip shark and smooth dogfish shark are the three most commonly landed species. Figure 88 groups the sharks into categories of LCS, SCS, PS and smooth dogfish.

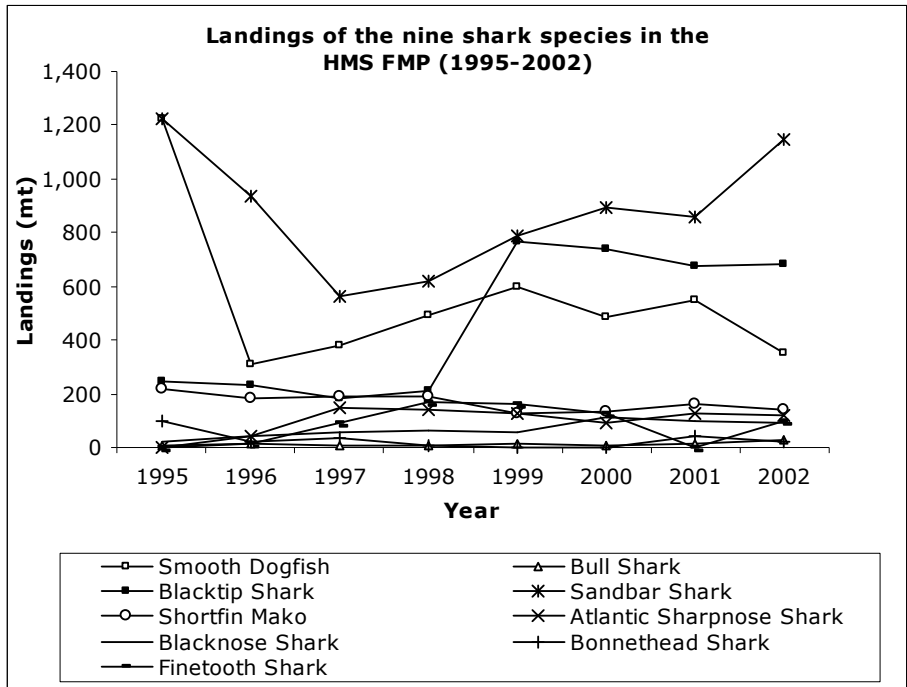


Figure 87: Total commercial U.S. landings of shark in the North Atlantic, 1995-2002 (NMFS, 2004a).

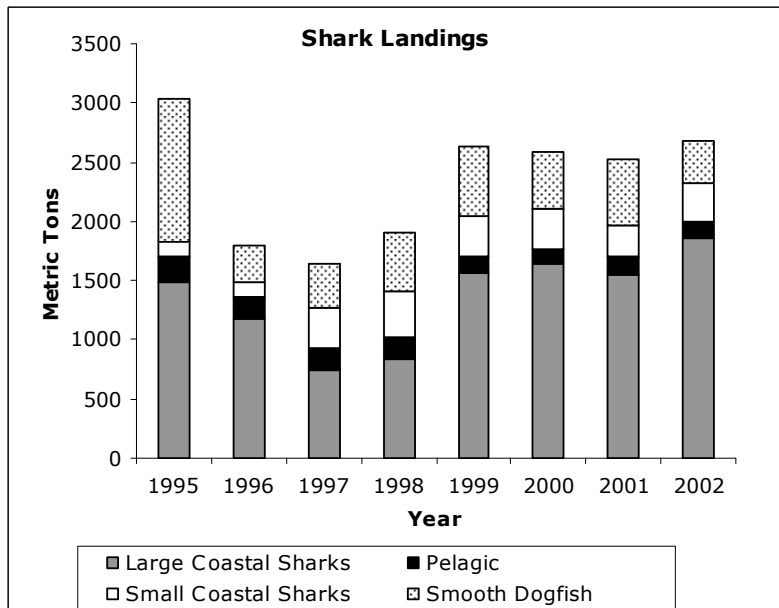


Figure 88: Commercial U.S. landings of shark, 1995-2002, grouped into LCS, SCS, PS and smooth dogfish categories.

All of these species, with the exception of small coastal sharks, are fished predominantly with longlines. Eighty-four percent of the small coastal shark catch is made with gillnets, and approximately 18% of bluefin tuna landings are made using purse seines. Gillnets also are occasionally used to land pelagic and large coastal sharks (12% and 7%, respectively) (NMFS, 2004a).

Regulations

Sharks

Besides the nine species of shark discussed in this chapter, there also are 19 other species of shark that cannot be kept, either commercially or recreationally. The retained sharks are categorized accordingly as described above. There are no minimum size limits, finning is prohibited for all species, and gear restrictions are the same for all three categories of shark. Authorized gear types include pelagic or bottom⁸ longline, gillnet, rod and reel, handline and bandit gear.

For the LCS sharks, the overall quota of approximately 1000 mt dressed weight is allocated among three regions, with the vast majority being split between the South Atlantic and the Gulf of Mexico. The North Atlantic receives only 4% of the quota. There also are per trip retention limits for the directed and incidental fisheries (5 sharks per vessel per trip). For PS sharks, the quota is split among species rather than by region, and no directed retention limit exists. There is an incidental retention limit of 16 sharks per vessel per trip. SCS sharks have a quota of approximately 450 mt dressed weight which is split among regions, with over 80% being allocated to the South Atlantic. No directed retention limit exists, but there is an incidental retention limit of 16 sharks per vessel per trip.

Recreationally, only specific species of LCS, SCS and PS may be retained. For the majority of these species, the following regulations apply: a one shark per vessel per trip retention limit with a minimum size of 4.5 feet fork length. The only authorized gear types are rod and reel and handline. Harvested sharks must have their fins, head, and tail attached (NMFS, 2003b).

Swordfish

The directed swordfish fishery is limited access. However, there are three types of permits which may be obtained. The directed permit allows fishermen to target swordfish using any authorized gear. They must also hold an Atlantic tunas longline category permit and an Atlantic shark permit. During a directed fishery closure, permit holders may land 15 fish/trip. The handgear permit allows fishermen to target swordfish using only handgear; longline gear may not be on board the vessel. During a directed fishery closure, handgear permit holders may land 15 fish/trip. Finally, the incidental permit allows fishermen to land swordfish incidental to the catch of other fishing activities. Fishermen with an incidental permit must also hold an Atlantic tunas longline category permit and an Atlantic shark permit. Incidental limits are 2 fish/trip for most gear types. Squid trawlers may keep 5 fish/trip. North and South Atlantic swordfish must be larger than 29 inches, cleithrum to keel, 47 inches lower jawfork length, or 33 lb dressed weight. A swordfish damaged by shark bite may only be retained if the remainder of the carcass meets the minimum size. Authorized gear types in the North Atlantic are handgear and longline only, except when landed as incidental catch in a squid trawl. In the South Atlantic, longline is the only allowable gear type (NMFS, 2003d).

Tuna

When fishing for tuna, vessel permits are required. However, only one type of permit (specific to gear type) may be held at a time. When fishing for bluefin tuna, fishermen are limited to the gear type for which their vessel is permitted. When fishing for any other tuna, fishermen may use any gear authorized for use in the Atlantic tunas fishery, regardless of the category of permit they hold. The minimum sizes for tuna are given in Table 169 (NMFS, 2003d).

Table 169: Minimum size limits for five species of tuna

Species	Minimum size (curved fork length)
Bluefin	185 cm
Skipjack	No minimum
Albacore	No minimum
Bigeye	68.5 cm
Yellowfin	68.5 cm

⁸ There are time/area closures for this gear type, as well as gear specifications.

Discards

Pelagic Longline Discards

The bycatch data for highly migratory species fisheries are available by gear type. Detailed catch and bycatch data are available for the pelagic longline fisheries fisheries (Beerkircher et al., 2003; Carlson, 2001; Carlson and Baremore, 2001; Carlson and Baremore, 2002a; Carlson and Baremore, 2002b; Cramer, 2003; NMFS, 2002b; NMFS, 2003a; NMFS, 2003b). The predicted landings and discards for many species of shark, tuna and swordfish in the pelagic longline fishery appear in Table 170. In addition, estimates of landings and discards of certain finfish also are included. In the last column of the table, predictions are made regarding the amount of discards that are dead when thrown back into the ocean. It was impossible to expand this data to 2002 or 2003 because it was not clear which species were the target species to use in the expansion.

Table 170: Predicted landings and discards in the 2001 pelagic longline fishery. These estimates are based on observer data from 1992-2000 (NMFS, 2002b; NMFS, 2003a; NMFS, 2003b).

Species	2001 Predicted landings (mt)	2001 d/I ratio	2001 Predicted discards (mt)	2001 Predicted dead discards (mt)
Swordfish	2,606.4	0.22	582.3	435.0
Yellowfin tuna	1,700.2	0.06	110.2	45.9
Bigeye tuna	701.3	0.08	57.2	24.6
Dolphinfish spp.	166.3	0.04	6.5	1.4
Albacore tuna	147.6	0.16	23.3	17.6
Shortfin mako	100.9	0.44	44.1	13.4
Wahoo	43.2	0.13	5.8	4.7
Mako spp.	39.0	0.44	17.1	4.9
Escolar	84.4	0.64	53.6	26.7
Silky shark	33.5	4.85	162.5	101.0
Bluefin tuna	28.9	4.56	131.8	79.2
Sandbar shark	8.4	4.85	40.5	6.9
Oilfish	15.3	0.64	9.7	3.6
Scalloped hammerhead	6.6	4.85	32.1	18.2
Hammerhead spp.	5.9	4.85	28.8	12.4
Whitetip oceanic	6.6	4.66	30.8	9.3
Blackfin tuna	5.0	2.75	13.6	8.9
Skates/rays	2.4	48.29	115.6	0.9
Skipjack tuna	2.6	2.75	7.1	6.6
Blacktip shark	1.4	4.85	6.7	4.5
Common thresher	1.7	4.66	8.1	2.4
Great hammerhead	1.0	4.85	4.9	2.9
Little tunny	1.3	2.75	3.7	2.8
Bull shark	0.4	4.85	2.1	0.7
Thresher shark	0.6	4.66	3.0	1.1
Porbeagle shark	0.6	4.66	2.8	1.2
Spinner shark	0.3	4.85	1.2	0.4
Atlantic sharpnose shark	0.2	7.85	1.9	1.0
Bonito	0.3	2.75	0.7	0.6
Smooth hammerhead	0.1	4.85	0.3	0.2
Lemon shark	0.0	4.85	0.1	0.0
Nurse shark	0.0	4.85	0.1	0.0
Atlantic sailfish	0.0	All discards	71.7	42.5
Blue marlin	0.0	All discards	124.0	43.8
White marlin	0.0	All discards	205.2	95.5
Longnose spearfish	0.0	All discards	6.2	3.9
Roundscale spearfish	0.0	All discards	1.1	0.9
Spearfish spp.	0.0	All discards	5.6	2.7
Lancetfish spp.	0.0	All discards	25.7	18.5
Blue shark	0.0	All discards	1574.9	249.8
Dusky shark	0.0	All discards	112.6	45.5
Night shark	0.0	All discards	31.8	24.6
Bigeye thresher shark	0.0	All discards	38.9	16.2
Other fish and invertebrates	3.14	34.24	107.5	All discards
Total	5,715.7	0.65	3813.1	1383.1

Blue shark constituted almost half of the total discards, but swordfish is the species most likely affected by discarding as it was the second most discarded species, and approximately 75% of discarded swordfish were assumed dead (NMFS, 2003b). Other frequently discarded species are blue and white marlin, sailfish, bluefin and yellowfin tuna, and silky and disky shark. Skates and rays have a high discard rate, but their survival rate appears to be high.

Table 171 gives the predicted catch of finfish in the “other finfish” category. The data are given in numbers of fish, since weights were not available, and it would be difficult to determine an appropriate average weight for each species. Along with predicted catch, the predicted number of dead fish is reported. Smooth dogfish is included in Table 171 with “other elasmobranchs” rather than in Table 170.

Table 171: Predicted number of other finfish and elasmobranchs caught, and their predicted mortality in the pelagic longline fishery based on observer data from 1992-2000 (NMFS, 2002b; NMFS, 2003a; NMFS, 2003b).

Species	2001 Predicted number caught	2001 Predicted number dead
Other finfish		
Sunfish spp.	933	6
Miscellaneous finfish	782	120
Pomfret spp.	627	130
Barracuda	399	29
Bigeye cigarfish spp.	279	67
Puffer spp.	203	7
Bluefish	158	44
King mackerel	81	25
Opah	72	16
Remora	27	1
Dealfish	16	6
Red drum	16	0
Amberjack spp.	14	1
Jack spp.	11	2
Rainbow runner	11	3
Cobia	9	0
Frigate mackerel	9	2
Cutlass fish	7	0
Atlantic mackerel	7	2
Triggerfish	7	0
Haddock	5	1
Tripletail	5	1
Goosefish	2	0
Grouper spp.	2	1
Herring	2	0
Crevalle jack	2	0
Black seabass	2	1
Tarpon	2	0
Total	3,690	465
Other elasmobranchs		
Crocodile shark	363	45
Longfin mako shark	237	48
Bignose shark	92	26
Dogfish shark	77	1
Smooth dogfish shark	74	3
Spiny dogfish shark	47	0
Reef shark	16	2
Sand tiger shark	9	1
Collared dogfish shark	5	1
Basking shark	2	0
Total	922	127

Sunfish, miscellaneous fish, pomfrets, barracudas, bigeye cigarfish, puffers and bluefish are the non-targeted finfish most often discarded in the pelagic longline fishery. Crocodile sharks, longfin makos, bignose sharks and dogfish sharks (all species) are the most commonly discarded elasmobranchs.

Cramer (2003) evaluated bycatch in pelagic longline gear (Table 172). However, the bycatch numbers resulting from the study are somewhat lower than the numbers resulting from the observer data. This is most likely due to the fact that time and area closures were implemented in 2001, while the estimates from the observer data (Table 170 and Table 171) were made using data from several years prior to the closures. Cramer (2003) takes these closures into consideration when calculating his estimates.

Table 172: Alternative estimates of dead target species bycatch from pelagic longlines (Cramer, 2003).

Species	Dead bycatch (mt)	Total estimated bycatch (mt)
Swordfish	302.71	405.23
Blue Shark	105.4	662.89
Hammerhead	53.81	105.3
Pelagic Shark	48.92	161.45
Silky Shark	32.01	51.55
Night Shark	24.94	32.14
Blue Marlin	22.4	63.46
Coastal Shark	18.65	72.85
White Marlin	16.89	36.32
Sailfish	10.85	18.33
Dusky Shark	2.61	6.46
Total	639.19	1,615.98

Dead bycatch was the only estimate given in Cramer (2003). Total bycatch of these species for 2003 was estimated using the dead discard to total discard ratios from the observer data (Table 170). The pelagic shark category included mako, oceanic whitetip, porbeagle, thresher, and unidentified pelagic sharks, and the coastal shark category includes bignose shark, blacktip shark, sandbar shark, tiger shark, white shark, spinner shark, and unidentified coastal sharks.

Gillnet and Bottom Longline Discards

Gillnet and bottom longlines are typically used when targeting sharks. Discards for the gillnet fisheries were separated into strike gillnets (strikenets) and other gillnets because of differences in the manner of fishing (Table 173 and Table 174), and discards from the bottom longline fishery are given in Table 175. The data were given in total numbers rather than in weights, so weight was estimated from Carlson and Baremore (2003) or the Marine Recreational Fisheries Statistics Survey (MRFSS) catch database, or from average species weights using FishBase.org. For all gillnets, observed catch data were collected from 2000 to 2003, and were recorded in numbers of sets. Carlson & Baremore (2001) suggest that effort may follow a uniform distribution with a mean of 225 sets per year ranging from 88 to 337 sets per year. An average of 225 sets/year was assumed for these estimates (Carlson, 2002a). Since the data do not distinguish between the two types of fishing, it will be assumed that the ratio of observed strikenet to observed passive gillnet sets (Carlson and Baremore, 2003) represents the true proportions of strike and passive gillnet sets. Therefore, on average, there would be 142 strikenet and 83 gillnet sets per year. Discard data from passive gillnets are reported in Table 173, while data from strike gillnets are reported in Table 174.

Table 173: Average discards in the HMS passive gillnet fishery targeting from 2001-2003.

Species	Landings (number/year)	Discards (number/year)	Estimated weight per individual (kg)	Total landings (mt)	Total discards (mt)
Atlantic sharpnose shark	11,594.37	59.24	1.74**	20.18	0.10
Blacktip shark	2,908.59	378.21	18.06**	52.52	6.83
Bonnethead	2,322.22	8.00	5.00†††	11.61	0.04
Blacknose shark	1,777.49	2.44	5.00†††	8.89	0.01
Little tunny	1,605.20	161.87	3.48*	5.58	0.56
Finetooth shark	1,535.92	0.00	5.00†††	7.68	0.00
King mackerel	260.96	767.00	4.46*	1.16	3.42
Great barracuda	457.33	0.00	5.00†††	2.29	0.00
Cownose ray	5.00	197.93	8.00***	0.04	1.58
Cobia	139.45	42.32	9.80*	1.37	0.41
Red drum	9.12	152.31	1.97*	0.02	0.30
Scalloped hammerhead shark	86.71	45.68	111.00	9.61	5.06
Spinner shark	115.79	13.69	30.50**	3.53	0.42
Blue runner	107.07	0.42	5.00†††	0.54	0.00
Great hammerhead shark	75.55	19.48	86.29**	6.52	1.68
Atlantic moonfish	53.11	30.72	0.11††	0.01	0.00
Crevalle jack	31.54	19.09	0.55*	0.02	0.01
Atlantic sailfish	2.07	40.26	21.89†	0.05	0.88
Remora	0.00	38.6	1.00***	0.00	0.04
Spanish mackerel	24.90	0.83	5.00†††	0.12	0.00
Blackfin tuna	21.58	0.42	5.00†††	0.11	0.00
Bluefish	16.18	5.40	5.00†††	0.08	0.03
Spotted eagle ray	0.00	17.02	5.00†††	0.00	0.09
Tarpon	0.00	14.53	13.87††	0.00	0.20
Manta ray	0.42	12.87	5.00†††	0.00	0.06
Other fish & Elasmobranchs	65.00	32.45	5.00†††	0.32	0.16
Total	23,215.57	2,060.78		132.25	21.88

* These weights are estimated using the mean fish weight from the MRFSS database (NMFS, 2004b)

** Weight estimated using values from Carlson and Baremore (2003)

*** Rough estimate from the authors' personal experience

† From mean length frequencies in FishBase.org (FishBase, 2004)

†† Mean of minimum and maximum weights from FishBase.org length frequency data (FishBase, 2004)

††† All other fish were assumed to weigh 5 kg, in the absence of reliable weight data

Table 174: Average discards in the HMS strike gillnet fishery from 2001-2003.

Species	Total Landings (number/year)	Discards (number/year)	Estimated weight per individual (kg)	Total Landings (mt)	Total discards (mt)
Blacktip shark	20,082.17	311.33	18.06*	362.61	5.62
Blacknose shark	1,560.57	0.00	10.00***	15.61	0.00.00
Creville jack	296.67	11.72	0.13**	0.04	0
Great barracuda	51.63	7.18	10.00***	0.52	0.07
Spinner shark	20.08	14.34	30.50*	0.61	0.44
Red drum	0.00	25.82	1.97**	0.00	0.05
Manta ray	0.00	14.34	10.00***	0.00	0.14
Bull shark	10.04	2.87	10.00***	0.10	0.03
Permit	5.74	5.74	10.00***	0.06	0.06
Other Fish & Elasmobranchs	11.47	12.89	10.00***	0.11	0.22
Total	22,038.36	406.24		379.65	6.63

* Weight estimated using values from Carlson and Baremore (2003)

** These weights are estimated using the mean fish weight from the MRFSS database (NMFS, 2004b)

*** All other fish were estimated at 10 kg.

Discards from the bottom longline fishery are more substantial than those in the gillnet fisheries (Burgess and Morgan, 2003). Unfortunately, the data were given in total numbers rather than in weights, so average weight for each species was estimated using data from Burgess and Morgan (2003), Hoey and Moore (1999), or from the Marine Recreational Fisheries Statistics Survey (MRFSS) database, or from FishBase.org mean species weights. Some of the average weights used here are different from the average weights used to calculate weight discarded in the gillnet fisheries because of differences in the way the gears fish and the size of fish that each gear targets.

Table 175: Average discards in the bottom longline fishery targeting highly migratory species in 2002 and 2003. The estimates are for one year, but the data were collected in the last half of 2002 and the first half of 2003 (Burgess and Morgan, 2003).

Species	Number Landed	Number Discarded	Est. weight per individual (kg)	Weight Landed (mt)	Weight Discarded (mt)
Sandbar shark	75,350	2,325	38*	2,870	89
Blacktip shark	26,843	317	16*	425	5
Tiger shark	1,929	17,675	32**	63	574
Nurse shark	0	10,066	32**	0	327
Spinner shark	6,711	238	32**	218	8
Bull shark	5,178	423	32**	168	14
Scalloped hammerhead shark	2,774	2,246	32**	90	73
Lemon shark	4,597	396	32**	149	13
Dusky shark	978	2,774	32*	31	89
Sandtiger shark	0	3,197	32**	0	104
Great hammerhead shark	1,083	740	32**	35	24
Silky shark	1,295	528	32**	42	17
White shark	0	79	32**	0	3
Bignose shark	0	26	32**	0	1
Night shark	0	26	32**	0	1
Atlantic sharpnose shark	4,835	33,395	2*	7	51
Blacknose shark	11,149	9,538	5**	51	44
Bonnethead shark	0	53	5**	0	0
Finetooth shark	79	0	5**	0	0
Smooth dogfish	26	7,820	5***	0	39
Florida smoothhound	0	79	5***	0	0
Smoothhound	0	26	5***	0	0
Shortfin mako shark	423	26	20***	8	1
Thresher shark	53	106	20***	1	2
Sevengill shark	0	53	20***	0	1

Species	Number Landed	Number Discarded	Est. weight per individual (kg)	Weight Landed (mt)	Weight Discarded (mt)
Sixgill shark	0	26	20***	0	1
Red grouper	0	1,030	3†	0	3
Black grouper	0	661	8††	0	5
Cobia	0	634	11†	0	7
Goliath grouper	0	449	5***	0	2
Southern stingray	0	396	18†††	0	7
Redfish	0	396	2†	0	1
Bluefish	0	370	1†	0	0
Remora	0	343	1***	0	0
Clearnose skate	0	317	5***	0	2
Roughtail stingray	0	291	5***	0	1
Stingray	0	264	5***	0	1
Yellowedge grouper	0	264	5***	0	1
Great barracuda	0	238	4†	0	1
Sea bass/grouper	0	211	5***	0	1
Misc	0	211	0***	0	0
Gag grouper	0	159	3†	0	1
Black seabass	0	159	2†	0	0
Cownose ray	0	106	5***	0	1
Dolphinfish	0	106	3†	0	0
Other fish and elasmobranchs	0	898	5***	0	4
Total	143,303	99,683		4,159	1,519

* Weight estimated using values from Burgess and Morgan (2003).

** Weight estimated using values from Hoey and Moore (1999).

*** Rough estimate from the authors' personal experience

† These weights are estimated using the mean fish weight from the MRFSS database (NMFS, 2004b)

†† From mean length frequencies in FishBase.org (FishBase, 2004)

††† Mean of minimum and maximum weights from FishBase.org length frequency data (FishBase, 2004)

In summary, according to NMFS 2001 observer data, total landings in the pelagic longline fishery were approximately 5,716 mt and total discards were 3,813 mt for an overall d/l ratio of 0.67 (Table 170). The Cramer (2003) pelagic longline data (Table 172) were not used in the final estimate because they did not account for any non-target species bycatch data.

In the 2003 gillnet and bottom longline fisheries, there were 4,671 mt of landings combined (obtained from a 2001-2003 annual mean). Overall, 1,548 mt of fish were discarded from these fisheries for a d/l ratio of 0.331. The majority of the landings and discards in this fishery were from the bottom longline.

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