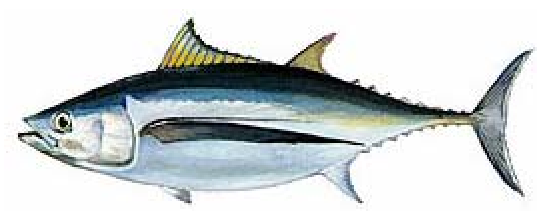
Seafood Watch
Seafood Report

MONTEREY BAY AQUARIUM®

Albacore tuna
Thunnus alalunga



(Image courtesy of Duane Raver, Jr.)

All Regions

Final Report
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Jesse Marsh
Senior Fisheries Research Analyst
Monterey Bay Aquarium

About Seafood Watch® and the Seafood Reports

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from the Internet (seafoodwatch.org) or obtained from the Seafood Watch® program by emailing seafoodwatch@mbayaq.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices," "Good Alternatives," or "Avoid." The detailed evaluation methodology is available upon request. In producing the Seafood Reports, Seafood Watch® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch® Fisheries Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch's sustainability recommendations and the underlying Seafood Reports will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling (831) 647-6873 or emailing seafoodwatch@mbayaq.org.

Disclaimer

Seafood Watch® strives to have all Seafood Reports reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science and aquaculture. Scientific review, however, does not constitute an endorsement of the Seafood Watch® program or its recommendations on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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I. Executive Summary

Albacore tuna, *Thunnus alalunga*, is a highly migratory species (HMS) caught in commercial fisheries throughout the world's oceans. As a global commodity, albacore occurs in the market as canned white tuna, but is also sold fresh and frozen in the U.S. market. In the U.S., the main sources of imported canned tuna vary from year to year, but include Thailand, Ecuador, and Indonesia. The tuna used for canning in Thailand is primarily from Taiwanese longline vessels, which operate throughout the Atlantic, Pacific, and Indian Oceans.

Albacore matures at an early age, has a moderate lifespan, is highly fecund, and is widely distributed, making it inherently resilient to fishing pressure. There are six stocks of albacore: North Pacific, South Pacific, North Atlantic, South Atlantic, Indian Ocean, and Mediterranean Sea. The South Pacific and South Atlantic stocks are considered healthy, as these stocks are not overfished and not undergoing overfishing, although South Atlantic stocks have exhibited a declining trend in abundance. There is some uncertainty associated with the status of the North Pacific stock, as biomass trends are increasing but fishing mortality on this stock may be too high and therefore unsustainable; the stock status of North Pacific albacore is thus a moderate conservation concern. The Mediterranean stock has never been assessed and is therefore considered unknown. Caution is warranted regarding this stock, as landings have increased dramatically over the past 10 years. Albacore in the Indian Ocean is overfished and likely undergoing overfishing, thus the status of this stock a high conservation concern. The status of the North Atlantic stock is considered a critical conservation concern, as the stock is overfished and undergoing overfishing.

Smaller albacore are caught in troll and pole and line fisheries, while adults are caught in pelagic longline fisheries. The level of bycatch varies according to the gear type. Pelagic longlines catch a number of incidental species, including endangered and threatened sea turtles, seabirds, marine mammals, sharks, and billfish. Those fisheries with observer data demonstrating that their fishery has declining bycatch trends, or evidence that bycatch levels are not contributing to the decline of species, are considered of high, rather than critical, conservation concern for the bycatch criterion. All other pelagic longline fisheries are considered to have critical bycatch levels. Troll/pole and pelagic longline gear have negligible habitat effects. The ecosystem effects of removing large predators such as tuna and sharks are not understood, and this combined with the benign habitat effects of the gear results in a moderate conservation concern for pelagic longlines and a low concern for troll/pole gear for habitat impacts of the fishery.

International management bodies manage fish stocks, while federal management bodies manage fisheries. International management bodies include the International Commission for the Conservation of Atlantic Tunas (ICCAT) in the Atlantic Ocean and Mediterranean Sea, the Inter-American Tropical Tuna Commission (IATTC) in the eastern Pacific Ocean, the Western and Central Pacific Fisheries Commission (WCPFC) in the central and western Pacific Ocean, and the Indian Ocean Tuna Commission (IOTC) in the Indian Ocean. In the Atlantic, the U.S. fishery is managed under the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks by the Highly Migratory Species division of the National Marine Fisheries Service. In the U.S. exclusive economic zone (EEZ) around Hawaii and the U.S. Pacific Islands, albacore is managed by the Western Pacific Fishery Management Council (WPFMC) under the Pelagics

Fishery Ecosystem Plan. Albacore in the U.S. EEZ off of California, Oregon, and Washington are managed by the Pacific Fishery Management Council (PFMC) under the Highly Migratory Species Fishery Management Plan. Regulations are generally based on recommendations by the staff or scientific committees of commissions, and implemented by the member and cooperating countries.

Management of the albacore tuna resource is complicated by the fact that individual countries may have more or less stringent regulations than those of the international management bodies. As there are numerous countries landing albacore, generalizations are made in this report concerning the effectiveness of the management regime across ocean basins and fishing countries. In those cases where information is available to differentiate individual country management practices, Seafood Watch® has attempted to include this in the overall recommendation.

The management rankings are as follows: Hawaii-based longline fisheries, U.S. and Canada troll fisheries in the Pacific, and U.S. Atlantic longline fisheries are deemed highly effective; Pacific (international, all gears), South Atlantic longline, Atlantic international troll/pole, and Indian Ocean troll/pole fisheries are deemed moderately effective; Atlantic Ocean international longline and Indian Ocean longline fisheries are deemed ineffective; and Mediterranean management is deemed to be critically ineffective.

Troll-caught albacore from the South Pacific and pole and line caught albacore from the South Atlantic is considered a **Best Choice** due to negligible bycatch and healthy to moderate stocks in these regions. U.S. and Canadian-caught troll albacore from the North Pacific is a **Best Choice** while imported troll/pole albacore from the North Pacific is a **Good Alternative**. Albacore from the Hawaii-based longline fishery is a **Good Alternative** due to reduced bycatch concerns in this fishery compared to the international longline fisheries, as well as effective management of the fishery. Troll/pole albacore from the Indian Ocean is a **Good Alternative** due to the minimal ecological impacts of the gear, and the poor stock status of Indian Ocean albacore. Various bycatch, management, and stock concerns throughout these oceans results in a ranking of **Avoid** for longline-caught albacore in international (i.e., non-U.S.) fisheries. Longline-caught albacore in the U.S. fishery in the Atlantic Ocean is also ranked as **Avoid** due to bycatch and stock status concerns. Troll/pole caught albacore from the North Atlantic Ocean and Mediterranean Sea is recommended as **Avoid** due to stock status and management concerns.

Pocket Guide Recommendations

More detailed recommendations are included in this report than are reflected in the general recommendations that appear on the Seafood Watch® pocket guides. Due to space limitations, generalizations must be made when communicating this information via the pocket guide. On the Hawaii Seafood Guide, albacore from the Hawaii-based longline fleet is recommended as a Good Alternative due to the moderate stock status of North Pacific albacore and reduced bycatch concerns in the Hawaii fleet compared to international longline fleets. Canned albacore tuna is recommended as a Good Alternative due to the lack of quantitative data on what gear types are used to catch albacore that is canned. Longline-caught albacore from any fleet other than the Hawaii-based fleet is listed as Avoid.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherent Vulnerability	√			
Status of Stocks	**√ South Pacific, South Atlantic**	**√ North Pacific, Mediterranean**	**√ Indian Ocean**	**√ North Atlantic**
Nature of Bycatch	**√ Troll/pole**		**√ Longline (Hawaii; U.S. Atlantic)**	**√ Longline (all other)**
Habitat & Ecosystem Effects	**√ Troll/pole**	**√ Longline**		
Management Effectiveness	**√ Pacific (U.S. and Canada troll/pole); Hawaii longline; U.S. Atlantic longline**	**√ Pacific (international, all gears); Atlantic (troll/pole); Indian Ocean (troll/pole)**	**√ Indian Ocean (longline); North Atlantic (international longline)**	**√ Mediterranean**

About the Overall Seafood Recommendation:

- A seafood product is ranked **Best Choice** if three or more criteria are of Low Conservation Concern (green) and the remaining criteria are not of High or Critical Conservation Concern.
- A seafood product is ranked **Good Alternative** if the five criteria "average" to yellow (Moderate Conservation Concern) OR if the "Status of Stocks" and "Management Effectiveness" criteria are both of Moderate Conservation Concern.
- A seafood product is ranked **Avoid** if two or more criteria are of High Conservation Concern (red) OR if one or more criteria are of Critical Conservation Concern (black) in the table above.

Overall Seafood Recommendation

Seafood Watch® Recommendation	Where Caught and Gear Used
Best Choice	South Atlantic and South Pacific troll/pole
	North Pacific troll/pole (U.S. and Canada/BC)
Good Alternative	North Pacific troll/pole (non-U.S.)
	Hawaii-based (North Pacific) longline
	Indian Ocean troll/pole
Avoid	North Atlantic troll/pole
	South Pacific and South Atlantic longline
	North Atlantic longline (U.S.)
	North Pacific longline (imported)
	Indian Ocean longline
	North Atlantic longline (imported)
	Mediterranean any gear

Common acronyms and terms

CPUE	Catch per Unit Effort
EEZ	Exclusive Economic Zone
EPO	Eastern Pacific Ocean
FAD	Fish Aggregating Device
FFA	Forum Fisheries Agency
FMP	Fishery Management Plan
FR	Federal Rule
HMS	Highly Migratory Species
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
IUU	Illegal, Unreported, and Unregulated
MSY	Maximum Sustainable Yield
NEI	Nowhere Else Included. These landings are mostly flag of convenience landings.
NMFS	National Marine Fisheries Service
PFMC	Pacific Fishery Management Council
SCRS	Standing Committee on Research and Statistics
SPC	Secretariat of the Pacific Community
SBR	Spawning Biomass Ratio
WCPO	Western and Central Pacific Ocean
WIO	Western Indian Ocean
WPFMC	Western Pacific Fishery Management Council

Longline: Longlines consist of a main horizontal fishing line that can be 50 – 65 nautical miles long. Smaller vertical lines with baited hooks are spaced intermittently along the main line and can be rigged to fish at various depths depending on the target species and fishing conditions. The longlines used to target tuna are pelagic longlines, and are fished in the upper water column.

Pole and line: Fishers use a pole with fixed length line that has a barbless hook with either artificial lure or live bait. In this way, fish are caught one at a time, and fishers can immediately throw back any unwanted catch. Pole and line-caught is another term for baitboat-caught; throughout this report the term pole and line will be used.

Purse seine: Purse seining involves encircling a school of tunas with a long net (typically 200 meters (m) deep and 1.6 kilometers (km) long). The net is weighted at the bottom and the top is kept at the top of the water column by a series of floats. One end of the net is pulled out from the main vessel by a skiff, which encircles the school of tuna, and the bottom of the net is then closed by a purse line run through the leadline by a series of rings. The net is then hauled in, and most of the net is brought onboard, leaving a small volume of water in the net and allowing the catch to be brought onboard using a large dip net (NRC 1992). There are several types of purse seine sets: those set on dolphins (dolphin sets); those set on floating objects or FADs (floating object sets); and those set on a school of tuna that is not associated with dolphins or a floating object (unassociated sets).

Trolling: Trolling consists of towing artificial lures with barbless hooks behind the fishing vessel (Childers 2003). Troll gear is also called jig gear; the term trolling will be used in this report.

II. Introduction

Albacore tuna, *Thunnus alalunga*, is a temperate tuna occurring throughout oceanic waters of the Atlantic, Pacific, and Indian Oceans, and the Mediterranean Sea. Albacore is exploited throughout its range, and supports a number of both large and small-scale fisheries. Tunas such as albacore are highly migratory, and the physiology of tunas is different from that of most other bony fishes. Countercurrent heat exchangers allow albacore and the other tunas to dive, forage, and swim in deep, cold waters. There is a positive correlation between endothermy and red-muscle mass in tunas, and albacore has less than 4% of its muscle mass as red-muscle (Graham and Laurs 1982). Tunas such as albacore have a high metabolic rate, with a standing metabolic rate that is 2 – 10 times higher than most other active fishes (Korsmeyer and Dewar 2001). Tunas are also endothermic, and maintain internal body temperatures warmer than the surrounding seawater (Graham and Dickson 2001).

In general, juvenile albacore are caught with surface gears such as pole and line or troll gear (ICCAT 2004). Larger albacore are caught with longlines, as they are found at greater depths in the water column (ICCAT 2004). However, in temperate waters, younger albacore are also caught with longlines (ICCAT 2004). Of the global albacore catch, approximately 60% is caught in the Pacific Ocean (38% in the North Pacific and 23% in the South Pacific), 23% in the Atlantic Ocean (13% in the South Atlantic and 11% in the North Atlantic), 13% in the Indian Ocean, and 3% in the Mediterranean Sea (Table 1). The type of gear used varies by ocean basin.

Atlantic Ocean and Mediterranean Sea

Albacore in the Atlantic Ocean comprises a North Atlantic and South Atlantic stock, as well as a stock in the Mediterranean Sea. In the North Atlantic, albacore is caught with surface gear (e.g., pole and line) and longlines (ICCAT 2004). Catch in the North Atlantic has generally declined since the 1960s (Figure 1) (ICCAT 2004). In the South Atlantic, the predominant gear used is longlines, with the surface fisheries from South Africa and Namibia generally catching juvenile albacore (Figure 2) (ICCAT 2004). The longline fleets from Brazil and Taiwan catch larger albacore, in both a directed fishery as well as bycatch in the swordfish fishery (ICCAT 2004). Despite considerable uncertainty associated with albacore catches in the Mediterranean, reported catches have increased dramatically since 1995 (Figure 3) (ICCAT 2004). The international management agency responsible for albacore in the Atlantic Ocean is the International Commission for the Conservation of Atlantic Tunas (ICCAT). U.S. fisheries operating in the Atlantic are also managed by the Highly Migratory Species (HMS) Division of the National Marine Fisheries Service (NMFS). Regulations are based on recommendations by the staff or scientific committees of ICCAT, and implemented by member and cooperating countries.

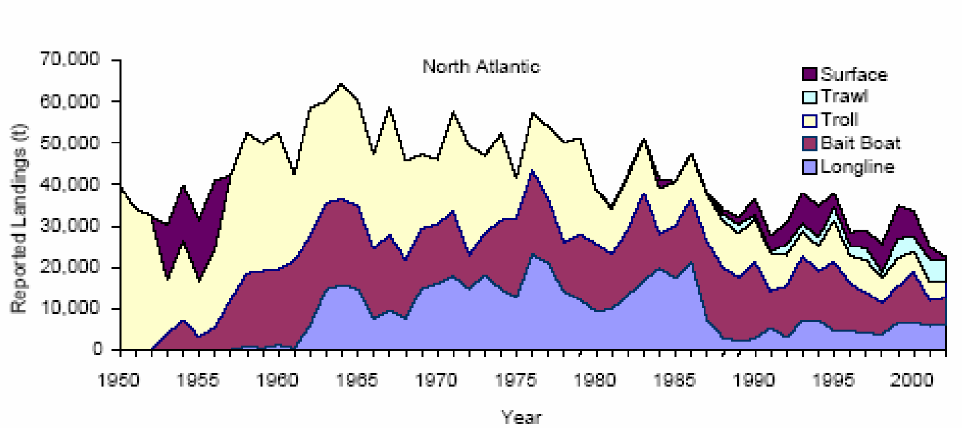

Figure 1. Albacore landings in the North Atlantic, 1950 – 2002 (Figure from ICCAT 2004).

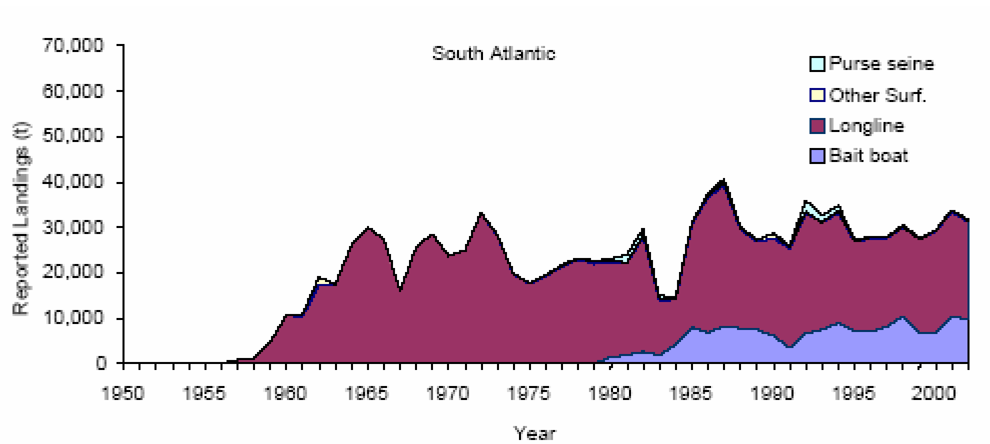

Figure 2. Albacore landings in the South Atlantic, 1950 – 2002. Longlines have been the predominant gear used over this time period (Figure from ICCAT 2004).

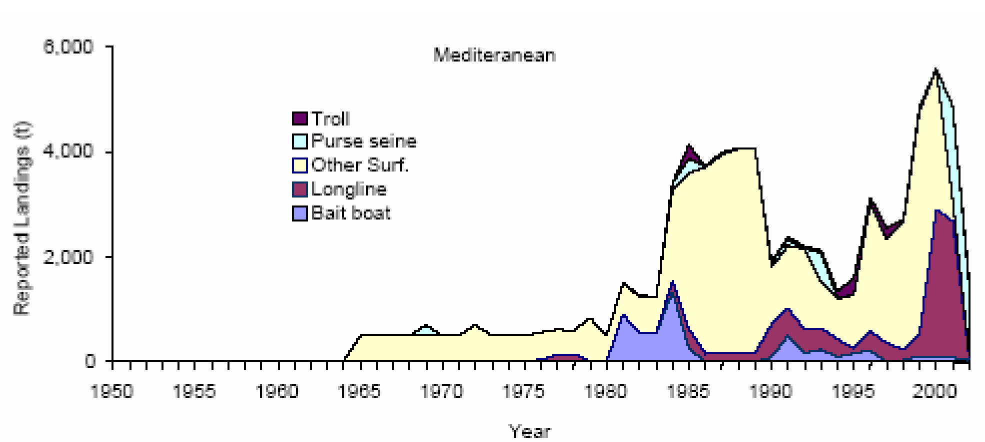

Figure 3. Albacore landings in the Mediterranean, 1950 – 2002. Landings have increased steadily over time. A stock assessment has not been conducted for Mediterranean albacore (Figure from ICCAT 2004).

Pacific Ocean

In the Pacific Ocean there is a North Pacific stock and a South Pacific stock of albacore (defined as south of the equator from 140°E to 100°W). The majority of albacore caught in the Pacific is caught in the western and central Pacific Ocean (WCPO) (Figure 4), which includes the western parts of the North and South Pacific.

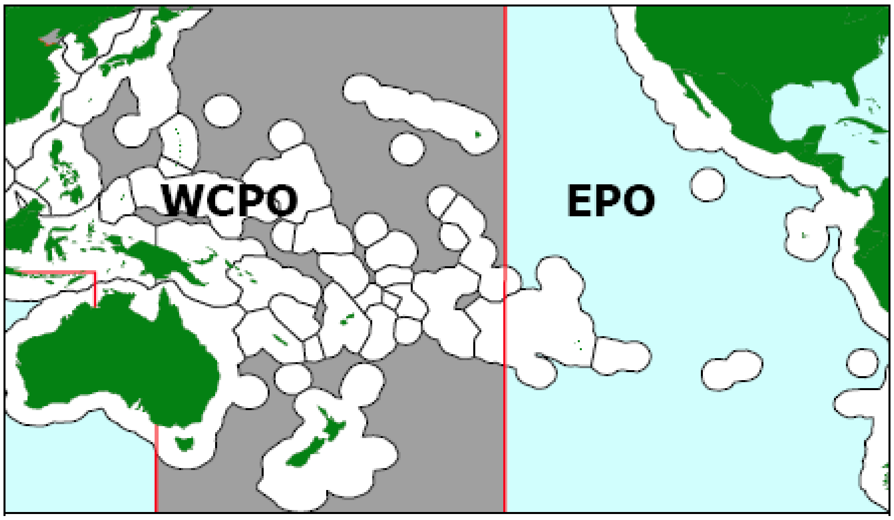

Figure 4. The WCPO and EPO, delineated at 150° (Figure from PFMC 2006).

In the WCPO, albacore is targeted primarily with longlines and troll gear (Langley et al. 2004). In the North Pacific, 51% of albacore is caught with troll/pole gear and 47% is caught with longlines (Figure 5) (IATTC 2004a). Japan is the predominant country landing albacore in the North Pacific. Fishing effort by Japanese longliners in the eastern Pacific Ocean (EPO) increased from 14 million hooks in 1960 to 200 million hooks in 1992, and then declined to 100 million hooks in 1997 in part due to a shift in effort to other regions (Okamoto and Bayliff 2003). The longlines used by Japanese fishing vessels in the eastern Pacific are 60 – 75 nautical miles long (Okamoto and Bayliff 2003).

The longline fishery in the WCPO consists of both distant-water freezer vessels and offshore vessels (Langley et al. 2004). The freezer vessels are generally larger, and target both tropical and subtropical species (e.g., albacore), while the offshore vessels are generally smaller, are domestically based, and tend to target tropical species (Langley et al. 2004). Catches by Pacific Island fleets (Fiji, Samoa, French Polynesia, American Samoa, and other Pacific Islands states) have increased over the past several years, and accounted for approximately 30% of albacore catch in the South Pacific in 2002 (Childers 2003). The Taiwanese fleet continues to catch large amounts of albacore in the South Pacific, second only to the Pacific Island fleets (Langley et al. 2004). In the EPO, albacore catches declined during the 1960s, and have remained relatively stable with a slight increase since (Okamoto and Bayliff 2003). Albacore catches in the South Pacific (55,812 metric tons, mt) were the highest on record in 2002 (Figure 6) (Williams and Reid 2004). Most of the albacore caught in this fishery is landed in American Samoa and Fiji, or shipped to Thailand for processing (SCTB 2003).

Pacific Ocean trolling efforts

The U.S. South Pacific troll fishery is the only significant troll fishery in the WCPO, with far more albacore caught in the Japanese pole and line fisheries. A troll fishery for albacore occurs in New Zealand's coastal waters and along the sub-tropical convergence zone (STCZ) predominantly by U.S. fishing vessels (Langley et al. 2004). East of Japan there is a seasonal pole and line fishery for albacore (Langley et al. 2004). There are two Canadian troll fleets targeting albacore in the North Pacific: a coastal fleet that fishes in Canadian and U.S. waters, and a high seas fleet fishing predominantly in the western Pacific (Stocker and Shaw 2003). The catch from the coastal fleet is sold to the U.S. and Canada and enters the market as canned tuna or sashimi, while the majority of the high seas albacore ends up in the market as sashimi (Stocker and Shaw 2003). Vessels in the coastal fleet are 10.7 – 18.3 m (35 – 60 ft) in length, while vessels in the high seas fleet are greater than 18.3 m (60 ft) in length (Stocker and Shaw 2003). There are also a few Canadian troll vessels fishing in the South Pacific, and most of this catch is sold to American Samoa, Fiji, Polynesia, and Canada (Stocker and Shaw 2003). The catch estimate for Canada in 2002 in the Pacific was 4,996 mt (Stocker and Shaw 2003). U.S. fisheries for albacore in the Pacific use troll gear, which consists of towing artificial lures with barbless hooks behind the fishing vessel (Childers 2003). The U.S. troll fishery in the North and South Pacific generally catches albacore age 3 – 5 (Childers 2003). From 1975 – 2003, juvenile fish (ages ≤ 5 years) represented approximately 95% of the U.S., Canadian, and Mexican catch in the North Pacific each year (Stocker 2005). Adult albacore are caught primarily in lower latitudes than juvenile albacore (Bertignac et al. 1999).

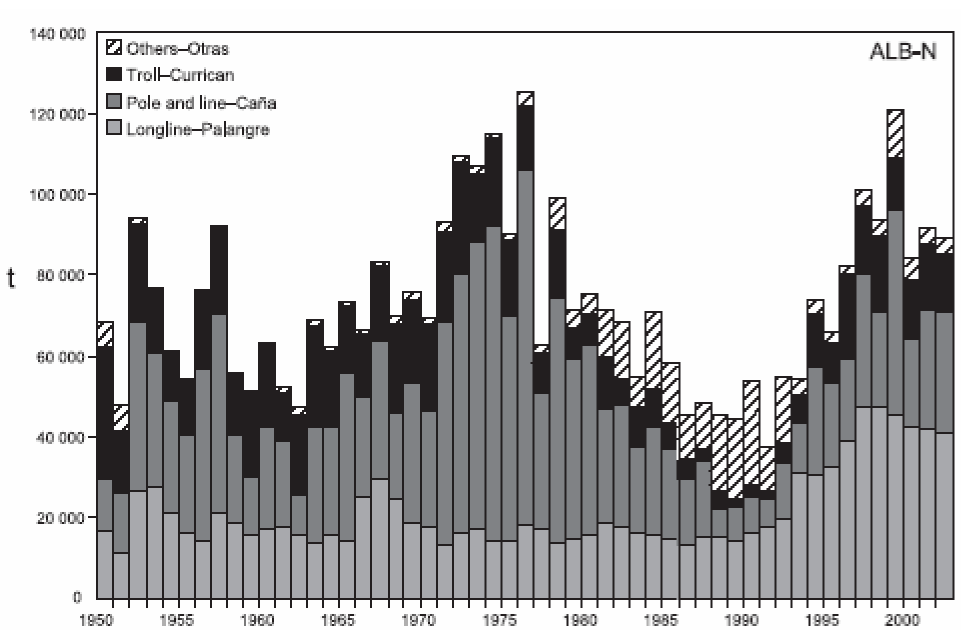

Figure 5. Retained catches of North Pacific albacore by gear type, 1950 – 2002. A number of gear types are used. (Figure from IATTC 2004a).

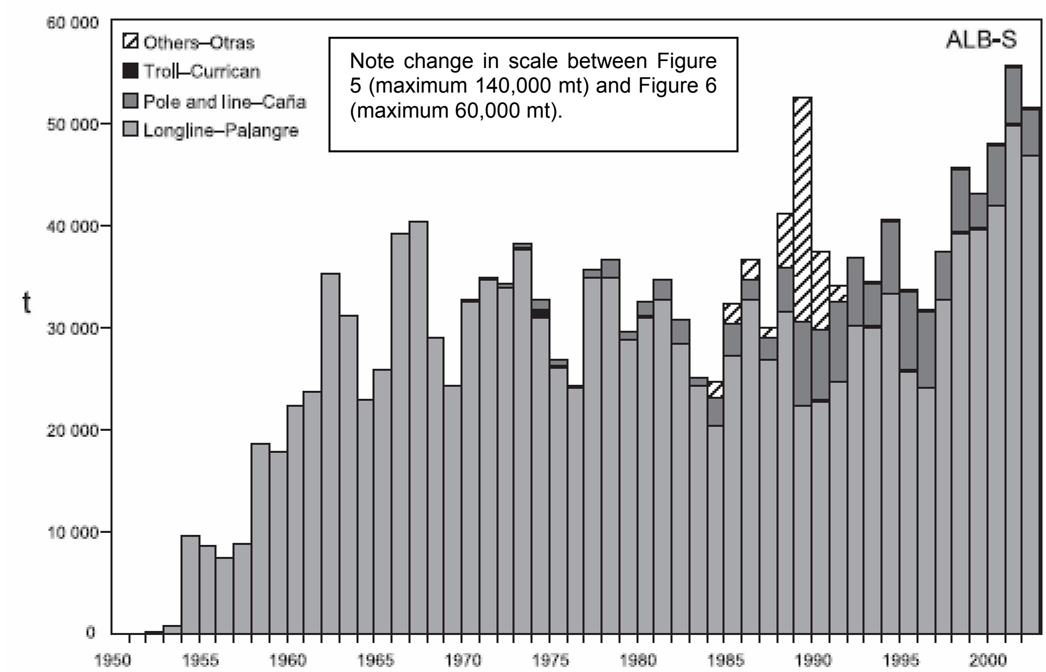

Figure 6. Retained catches of South Pacific albacore by gear type, 1950 – 2002. Longlines are the predominant gear used (Figure from IATTC 2004a).

Management of albacore in the Pacific is divided at 150°W longitude into the WCPO and the EPO (Langley et al. 2004). The international management agencies responsible for albacore in the Pacific Ocean include the Inter-American Tropical Tuna Commission (IATTC) in the EPO and the Western and Central Pacific Fisheries Commission (WCPFC) in the WCPO. The Pacific Islands Forum Fisheries Agency and the Secretariat of the Pacific Community (SPC) conduct research and coordinate agreements between Pacific Islands (Safina 2001). Individual countries may be managed by additional bodies; U.S. fisheries (including those in Guam, the Marianas, and American Samoa) are also managed by NMFS, the Pacific Fishery Management Council (PFMC), and the Western Pacific Regional Fishery Management Council (WPFMC). Regulations are based on recommendations by the staff or scientific committees of the IATTC and WCPFC, and implemented by the member and cooperating countries.

Indian Ocean

In the Indian Ocean, there is one stock of albacore. Younger albacore are found in the higher latitudes and older albacore are found in both the high and low latitudes of the Indian Ocean (IOTC 2004). The main gear type used to catch albacore in the Indian Ocean is longline (98%), and albacore it is caught predominantly by Japanese and Taiwanese fleets (Figure 7) (IOTC 2004). Small-scale longliners also operate in the Indian Ocean, and the catch is often consumed locally (Miyake 2005a). Catch by the Taiwanese fleet has been close to 20,000 mt annually since 1998, while catch by the Japanese fleet has been between 2,000 mt and 3,000 mt in recent years (IOTC 2004). In addition to the Taiwanese and Japanese fleets, there is a fleet of fresh-tuna longliners from Indonesia catching about 3,000 mt annually and a fleet of deep-freezing longliners catching 5,000 – 10,000 mt annually (IOTC 2004). Overall, albacore catch in the Indian Ocean increased from the mid-1950s until about 2000, and has declined in recent years.

The Taiwanese fishery generally occurs in high seas areas off the west coast of Australia from February to July, in the southwest Indian Ocean from March to August, and off Madagascar from October to January (IOTC 2004). Albacore in the Indian Ocean is managed by the Indian Ocean Tuna Commission (IOTC). Regulations are based on recommendations by the staff or scientific committees of the IOTC, and implemented by member and cooperating countries.

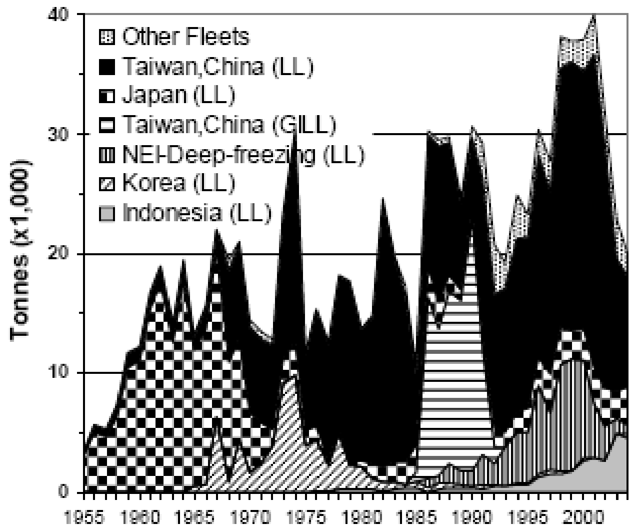

Figure 7. Indian Ocean albacore catches by fleet and gear, 1955 – 2004. Taiwanese longliners catch the majority of albacore in the Indian Ocean (Figure from IOTC 2005).

Table 1. Albacore catch by region, country, and gear. See Common Terms and Acronyms at the beginning of this report for definitions of these gear types. "Surface gears" refers to gear types such as troll, pole and line, purse seine, and gillnet methods.

Region	Catch[1]	Fishing Countries	Gears Used	Sources
North Atlantic	25,516 mt (11% of total)	Spain (49%); Taiwan (18%); France (14%); St. Vincent & Grenadines (6%); Japan (3%); Ireland (3%); Portugal (2%); U.S. (2%); Venezuela (2%); China P.R. (1%); Canada, Grenada, St. Lucia, and Barbados (<1% each)	Pole and line (31%); longline (29%); troll (21%); trawl (15%); other surface gears (4%); purse seine (<1%)	ICCAT 2004
South Atlantic	27,811 mt (12% of total)	Taiwan (62%); South Africa (12%); Namibia (11%); Brazil (10%); Portugal (1%); Spain (1%); Japan (1%); China P.R. and U.S (< 1% each)	Longline (74%); pole and line (25%); purse seine (1%); other surface gears (<1%)	ICCAT 2004
Mediterranean	7,415 mt (3% of total)	Italy (93%); Greece (6%); Cyprus and Spain (<1% each)	Longline (57%); surface gears (43%)	ICCAT 2004
North Pacific	86,797 mt (38% of total)	Japan (70%); U.S. (13%); Taiwan (5%); Canada (4%); other countries (7%); Korea (<1%)	Longline (47%); pole and line (35%); troll (16%); other (1%); purse seine (1%); gillnet (<1%)	Childers 2003
South Pacific	53,249 mt (23% of total)	Taiwan (23%); Fiji (15%); U.S. (13%); New Zealand (10%); Western Samoa (9%); Japan (9%); French Polynesia (8%); other countries (5%); Tonga (2%); New Caledonia (2%); Korea (2%); Canada and Solomon Islands (<1%)	Longline (91%); troll (9%); pole and line (<1%)	Childers 2003
Indian Ocean	Approx. 30,000 mt (13% of total)	Taiwan (60%); Japan; NEI deep-freezing; Indonesia	Longline (98%)	IOTC 2004

Scope of the analysis and the ensuing recommendation:

This analysis encompasses albacore caught by domestic and foreign vessels in the Atlantic, Pacific, and Indian Oceans, and the Mediterranean Sea. Due to the limited data available for some criteria, particularly bycatch, generalizations by both country and ocean basin have been made concerning the severity of bycatch in the pelagic longline fisheries for tunas.

[1] Catch data for the Atlantic Ocean, Indian Ocean, and Mediterranean Sea are from 2003, catch data for the Pacific Ocean are from 2002.

Availability of Science

There is uncertainty associated with the catch-at-size data in both the North and South Atlantic, which has affected the completion of a satisfactory assessment for the North Atlantic (ICCAT 2004). There is also uncertainty associated with the catch data of albacore in the Indian Ocean, as the level of non-reporting has increased since 1985 and it is likely that catches by the fresh-tuna longline fleets have been underestimated (IOTC 2004). In addition, catch data are sometimes aggregated (IOTC 2004). The Working Party on Temperate Tunas (WPTMT) identified several sources of uncertainty in the Indian Ocean, including lack of size-frequency data from the Republic of Korea, Philippines, Taiwan, and China; small sample sizes for Japanese fleets; lack of catch and effort data for the Taiwanese fleets; lack of data from the fresh-tuna fleets and non-reporting from the deep-freezing tuna fleets; and recently, a lack of accurate data for the Indonesian longline fleet (IOTC 2004). There are no international data on the bycatch levels and trends in pelagic longline fisheries, although summaries for some regions have been conducted. Although individual countries may have bycatch mitigation regulations or observer programs, much of these data are not available to the public and therefore cannot be evaluated. Illegal, unreported, and unregulated (IUU) fishing creates the additional problem of a lack of data collection and reporting. Observer data from the WCPO has high confidence intervals due to low rates of observer coverage, with an overall coverage rate of less than 0.1% (Molony 2005).

Due to the complexity of the tuna fishery, more detailed recommendations are included in this report than will be reflected in the general recommendation that appears on the Seafood Watch® pocket guides.

Market Availability

Common and market names:

When canned, albacore is sold as white tuna. Albacore is also sold as tombo tuna by retailers such as restaurants. In Hawaii, albacore is known as palaha.

Seasonal availability:

Albacore is available year-round.

Product forms:

The majority of albacore is processed for canning. Albacore tuna is sold as "white" tuna, while skipjack and yellowfin are sold as "light" tuna. Albacore is also sold fresh, smoked, and deep frozen (Froese and Pauly 2005), and often used for sashimi.

Import and export sources and statistics:

In 2003 in the U.S., albacore was primarily landed in Washington (62.2%), Oregon (24.1%), California (9.8%), and Hawaii (3.5%) (NMFS 2005a). In 2004, 34,932 mt of albacore (all product forms) were imported into to the U.S. from 31 countries, with the majority coming from Thailand (39%), Ecuador (21%), Indonesia (18%), Canada (4%), Trinidad and Tobago (6%), and Malaysia (4%) (Figure 8) (NMFS 2005a). Canned albacore imports from Thailand are mostly caught by Taiwanese longline vessels before being shipped to Thailand for processing (WCPFC 2005). In 2004, Fiji and Trinidad and Tobago dominated as the primary source of tuna loins for the U.S. (Eurofish 2005). Some of the tuna imported into the U.S. is canned in Californian, American Samoan, or Puerto Rican canneries (Eurofish 2005). Canneries in American Samoa and Fiji receive longline-caught albacore caught by foreign freezer vessels (Beverly 2002). The U.S. was the largest importer of canned tuna globally almost every year from 1979 – 2001 (FAO 2003). Canned tuna imports in 2004 were 201,078 mt, 14% of which was canned albacore (NMFS 2005a). However, overall tuna consumption in the U.S. is declining (Eurofish 2005), possibly due to increased concerns about mercury in canned tuna and increased prices due to lower world tuna supply (Johnson 2004).

Domestic and imported cannery receipts for 2004 indicate that 87% of domestic canned albacore is from (i.e., caught in) the western Pacific, with the remaining 13% from the eastern Pacific (NMFS 2004a; NMFS 2004b). Imported canned albacore is from the West Pacific (62%), West Atlantic (27%), Indian Ocean (10%), and East Atlantic (1%) (NMFS 2004b). Overall, a total of 63% of the canned albacore in the U.S. in 2004 was from the West Pacific, 26% from the West Atlantic, 10% from the Indian Ocean, and less than 1% each from the East Atlantic and East Pacific.

Of the total albacore imported in 2005, 94% was canned, 4% was frozen, and 2% was fresh (NMFS 2005a). Frozen albacore was imported from Canada (97%, 990 mt), Ecuador (2%, 2 mt), Singapore (<1%, 5 mt), and Vietnam (<1%, 1 mt). Fresh albacore was imported from Fiji (67%, 474 mt), French Polynesia (14%, 100 mt), Western Samoa (8%, 58 mt), Canada (4%, 28 mt), Tunisia (2%, 11 mt), India (1%, 10 mt), and Sri Lanka, Philippines, Cook Islands, Tonga, Vietnam, Australia, Trinidad and Tobago, Peru, and Uruguay (each less than 1%).

The U.S. exports less albacore than it imports, with only 12,097 mt exported in 2004, mainly to Spain, Ecuador, Japan, and Canada (NMFS 2005a). Of total U.S. albacore landings in 2003, 62% was exported. Of total albacore imports in 2003, only 5% was re-exported. Therefore the U.S. fishery contributes approximately 16% of the total albacore (canned, fresh, and frozen) available in the U.S. market. Very little albacore is imported from Mexico; approximately 1 mt of albacore was imported from Mexico in 2004 (NMFS 2005a). The albacore caught by Mexican fleets are likely caught incidentally in fisheries targeting other species (Stocker 2005), and the majority of the Mexican fleet is a pole and line fishery (NMFS 2005b). The Canadian fishery is a troll fishery (Beverly 2002; NMFS 2005b).

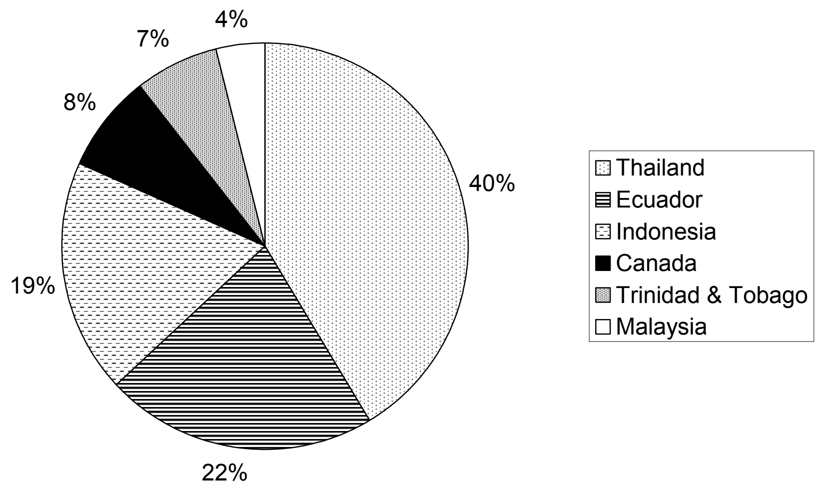

Figure 8. Imports of canned, fresh, and frozen albacore, 2003 (NMFS 2005).

III. Analysis of Seafood Watch® Sustainability Criteria for Wild-caught Species

Criterion 1: Inherent Vulnerability to Fishing Pressure

Albacore is a temperate tuna species occurring throughout the world's oceans, as well as the Mediterranean Sea (Table 2) (Froese and Pauly 2005). In the Pacific, albacore is most commonly found from the surface to 200 – 260 m depth, but has been caught as deep as 380 m (Laurs and Lynn 1991).

The intrinsic rate of increase[2] for albacore in the Indian Ocean has been estimated at r = 0.397 (IOTC 2004). Albacore matures by approximately 5 years of age (90 cm fork length, FL) in the Atlantic and Pacific, and 2 years of age (62 cm FL) in the Mediterranean (ICCAT 2004; Stocker 2005). Albacore has a maximum age of 10 years (Froese and Pauly 2005).

Several parameters are useful when looking at a species' life history and vulnerability, including asymptotic length (L_∞) and body growth coefficient (k). For North Pacific albacore, L_∞ has been estimated at 131.3 cm for males and 110.1 cm for females; k has been estimated at 0.184 for males and 0.282 for females (Stocker 2005). For South Pacific albacore, L_∞ has been estimated at 121.0 cm for males and females combined, and k has been estimated at 0.134 (Labelle et al. 1993). In the Indian Ocean, estimates of L_∞ range from 128.1 – 171.4 cm, with a median value of 147.2 cm (IOTC 2004); estimates of k range from 0.10 – 0.16, with a median value of 0.13

[2] Intrinsic rate of increase is "the change in the amount of harvestable stock estimated by recruitment increases plus growth minus natural mortality" (definition from www.fishbase.org).

(IOTC 2004). The maximum size for albacore is 140 cm FL, and the maximum published weight is 60.3 kg (Froese and Pauly 2005).

In the Atlantic, albacore spawn in the subtropical western regions in the North and South Atlantic, as well as in the Mediterranean Sea (ICCAT 2004). In the South Pacific, juveniles leave the tropics and head south until they reach the subtropical convergence zone, where they move east along this zone (Jones 1991; Murray 1994). When they reach maturity, albacore return to the tropics to spawn (Jones 1991; Murray 1994). Estimates of fecundity in the Pacific range from 0.8 to 2.6 million eggs per spawning (IATTC 2000). Within the North Pacific, there is a northern and southern subgroup of albacore (IATTC 2000). Low recruitment is correlated with El Niño events in the South Pacific, while high recruitment is correlated with La Niña events (Fournier et al. 1998).

Table 2. Life history characteristics of albacore.

Intrinsic Rate of Increase (r)	Age at Maturity	Growth Rate	Max Age	Max Size	Fecundity	Species Range	Special Behaviors	Sources
r = 0.397	2 – 5 yrs, depending on region	vBgf[3]: max. published L_∞ = 171.4 cm, median k = 0.13 or 0.34	10 yrs	140 cm FL	0.8 – 2.6 million eggs per spawning	Atlantic, Pacific, & Indian Oceans; Mediterranean Sea	None that increase ease or population consequences of capture	Laurs & Wetherall 1981; Froese & Pauly 2005; IATTC 2000; ICCAT 2004; IOTC 2004

Synthesis

Albacore has a high rate of intrinsic increase, and reaches maturity at an early or moderate age depending on the stock. As the species is not long-lived, is highly fecund, and has a broad range, albacore is considered inherently resilient to fishing pressure. In addition, albacore does not exhibit any characteristics that increase ease or population consequences of its capture.

Inherent Vulnerability Rank:

Resilient Moderately Vulnerable Highly Vulnerable

[3] vBgf = The von Bertalanffy growth function is commonly used in fisheries science to determine length as a function of age. L_∞ is asymptotic length, and k is growth coefficient. Note that maximum size may be larger than L_∞ due to individual variation around L_∞.

Criterion 2: Status of Wild Stocks

Atlantic Ocean

North Atlantic

The North Atlantic albacore stock is overfished and undergoing overfishing (Table 3) (ICCAT 2004). Biomass estimates for the North Atlantic stock indicate that the current biomass is approximately 30% below B_{MSY} (the biomass at which maximum sustainable yield is produced), although there is uncertainty associated with this estimate (Figure 9) (ICCAT 2004). Based on the 2000 model results, spawning stock biomass (SSB) exhibited a continuous decline from 1976 – 1987, and has been variable at a low level since (ICCAT 2004). Based on the current estimate of SSB_{MSY}, North Atlantic albacore has been overfished since the early to mid-1980s. Fishing mortality is estimated to be 10% above F_{MSY} (the fishing mortality at maximum sustainable yield) (ICCAT 2004). Overall, fishing mortality on the younger age classes (age-1 and ages 2-4) has increased since 1975 (ICCAT 2004). The most recent assessments of albacore in the North Atlantic and South Atlantic were conducted in 2000 and 2003, respectively (ICCAT 2004). In the North Atlantic, fishery dependent CPUE trends vary depending on the data used. Spanish troll data (juveniles) generally exhibit a decline over the past 10 years while longline data (primarily adults) from Japan, Taiwan, and the U.S. have generally been steady since the 1990s, although declines were observed prior to the 1990s (ICCAT 2004). It is unknown whether the age/size/sex distribution of North Atlantic albacore is skewed relative to the unfished condition. There is little uncertainty associated with the stock status of North Atlantic albacore, however, as a recent robust assessment has been conducted. **Because albacore in the North Atlantic is overfished and overfishing is occurring, the status of this stock is a critical conservation concern according to Seafood Watch® criteria.**

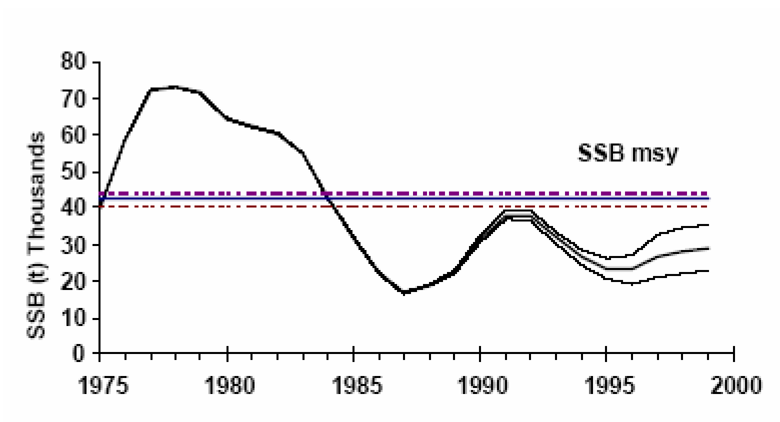

Figure 9. Spawning stock biomass of North Atlantic albacore with 80% confidence limits (Figure from ICCAT 2004).

South Atlantic

The South Atlantic albacore stock is not overfished and not undergoing overfishing. Although spawning stock biomass has generally declined since 1955, biomass was stable from the 1970s until the mid-1980s, then declined until the early 1990s, and has been relatively stable since (ICCAT 2004). Despite declining biomass levels, spawning stock biomass remains above B_{MSY} (Figure 10) (ICCAT 2004). In the South Atlantic, the current fishing mortality rate is estimated to be 60% of F_{MSY} (ICCAT 2004). The ratio of B_{2003}/B_{MSY} is 1.66, and F_{2003}/F_{MSY} is 0.62 (ICCAT 2004). CPUE data for South Atlantic albacore are variable, with Taiwanese and

Japanese longline CPUE data exhibiting a large decline from the 1950s to about the 1980s, after which the CPUE trend appears stable at low levels (ICCAT 2004). South Africa pole and line and Brazil/Taiwan longline data are highly variable, but do not exhibit any major declines (ICCAT 2004). It is unknown whether the age/size/sex distribution of South Atlantic albacore is skewed relative to the unfished condition, though there is little uncertainty associated with the stock status of South Atlantic albacore. **As albacore in the South Atlantic is not overfished and overfishing is not occurring, and biomass has been at a relatively stable level over the past 15 years, the South Atlantic stock is considered healthy according to Seafood Watch® criteria.**

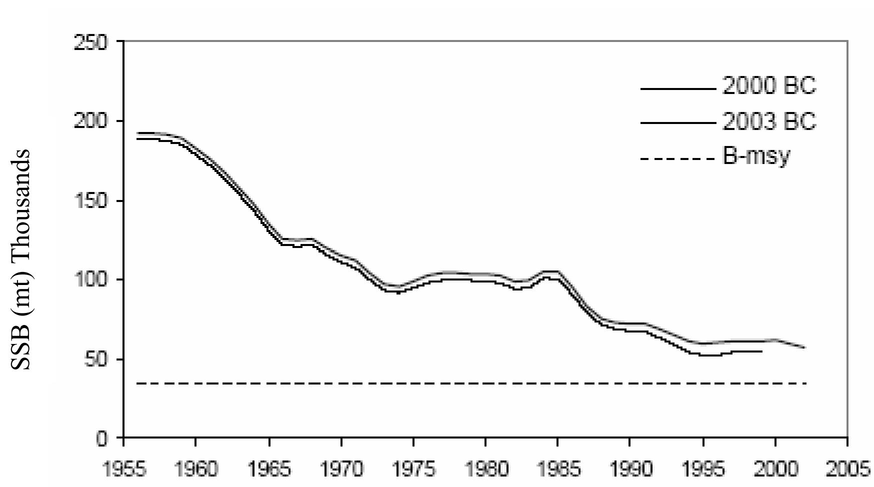

Figure 10. South Atlantic spawning stock biomass, as estimated from model fits for the 2003 (heavy line) and 2000 (thin line) base cases (Figure from ICCAT 2004).

Mediterranean Sea

Due to a lack of data, no assessment of albacore has been conducted in the Mediterranean (ICCAT 2004). The status of albacore in the Mediterranean is therefore considered unknown; however, caution is warranted as catches of albacore in the Mediterranean have increased since the mid-1960s.

Pacific Ocean

North Pacific

Appropriate reference points have not been agreed upon for North Pacific albacore (Stocker 2005). As such, both low productivity and high productivity stock hypotheses were considered in the most recent assessment. Using the high productivity hypothesis, estimates of B_{MSY} range from 560,000 – 660,000 mt; B_{2004} is 22% below this range (Stocker 2005). Estimates of SSB_{MSY} range from 220,000 – 290,000 mt; SSB_{2004} is 25% below this range (Stocker 2005). Using the low productivity hypothesis, B_{MSY} ranges from 410,000 – 480,000 mt; B_{2004} (429,000 mt) falls within this range (Stocker 2005). Estimates of SSB_{MSY} range from 160,000 – 210,000 mt; SSB_{2004} (165,000 mt) falls within this range (Stocker 2005).

Possible F_{MSY} reference points include $F_{40\%}$, $F_{30\%}$, or $F_{0.1}$. Current F (F_{2003}) is between 0.68 ($F_{17\%}$) and 0.43 ($F_{30\%}$) (Stocker 2005). Based on the high productivity hypothesis, current catch is within the MSY range. Based on the low productivity hypothesis, current catch is 34% above the MSY range (Stocker 2005), and overfishing may be occurring. After a strong 1999 year-class, recruitment has returned to more typical levels. Thus, SSB in the future is forecasted to decrease; this combined with a current F that is high relative to the commonly-used reference points is cause for concern for North Pacific albacore stocks (Stocker 2005). A resolution was passed at the June 2005 IATTC meeting in Spain stating that albacore in the North Pacific are either fully exploited, or fishing mortality is above that which is sustainable in the long-term (IATTC 2005a). In general, juvenile fishing mortality is considered high (IATTC 2004a). An IATTC resolution has been drafted for the IATTC and WCPFC to adopt uniform conservation and management measures for North Pacific albacore, including a cap on effort for this species (PFMC 2005a).

In the North Pacific, recruitment declined until the late 1980s, followed by a dramatic increase until 2000 (IATTC 2000). Spawning stock biomass appears to have exhibited a similar trend, with an increase observed in the 1990s (Figure 11) (IATTC 2000; Shono and Ogura 2000). CPUE exhibited an increasing trend through the late 1990s, although this increase may have been a result of a shift in fishing effort to this area (Okamoto and Bayliff 2003). CPUE data from the U.S. troll fishery has been relatively stable since 1960, although CPUE generally declined from 1960 to 1987, and has been increasing since (although there has been large variability) (Childers 2003). It is unknown whether the age/size/sex distribution of North Pacific albacore is skewed relative to the unfished condition.

As is evidenced above, there is moderate uncertainty associated with the stock status of albacore in the North Pacific. **Due to this uncertainty, the fact that the stock is not overfished and that overfishing may or may not be occurring there is a moderate conservation concern for this stock according to Seafood Watch® criteria.**

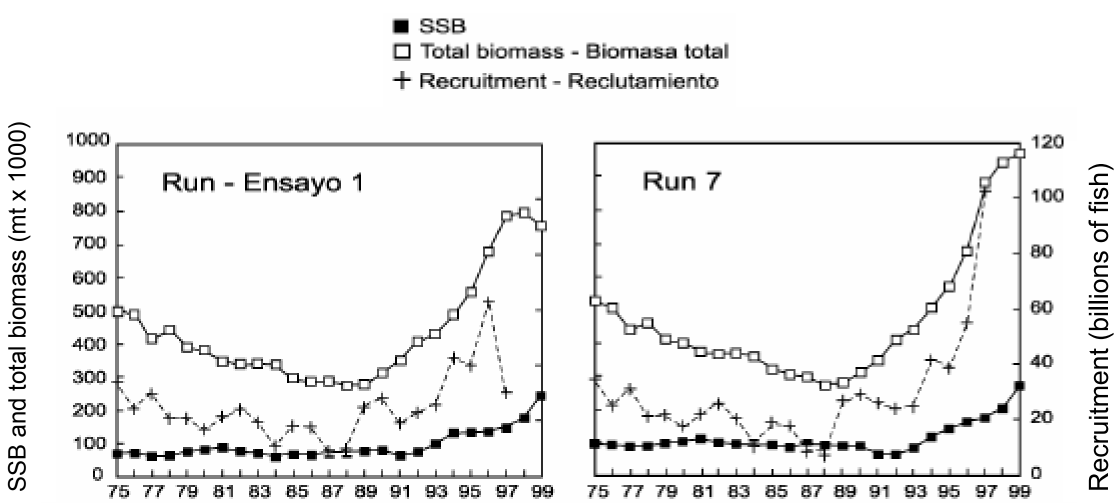

Figure 11. Estimates of spawning stock biomass, total biomass, and number of recruits for albacore in the North Pacific from an age-structured model, using different estimates of length at age and different assumptions concerning the fishing mortality in the last two age classes. All runs showed an increase in both spawning and total biomass since the late 1990s (figure from IATTC 2000, after Uosaki et al. 2001, Figure 1).

South Pacific

Adult biomass (SB) of South Pacific albacore is above SB_{MSY} (Figure 12) and fishing mortality is below F_{MSY} (Figure 13) (Langley and Hampton 2005); therefore, the stock is not overfished and overfishing is not occurring. Recent catches (approximately 90,000 mt) are at or near the MSY level (Langley and Hampton 2005). $B/B_{MSY} = 1.69$ and $F/F_{MSY} = 0.05$. Long-term biomass trends exhibit a relatively stable trend, although biomass has been declining slowly since the 1980s (IATTC 2000; Langley et al. 2004). This biomass decline has been attributed to recruitment variability; the impact of the South Pacific albacore fishery is considered small, with the stock likely able to sustain higher levels of catch (Langley et al. 2004). Up until the mid-1970s, biomass exhibited a strongly positive trend (Fournier et al. 1998).

Fishing mortality rates on juvenile albacore were generally stable until the late 1980s, when F began to increase with the development of the drift gillnet fishery (Fournier et al. 1998; Langley et al. 2004). Fishing mortality rates declined with the cessation of driftnet fishing in 1992 and have been generally low since. Fishing mortality rates on adult albacore have increased in recent years with the development of the Pacific Islands longline fleets (Langley et al. 2004). Fishing mortality on albacore ages 6 – 11 declined from the 1960s – 1970s, remained stable from the 1970s – 1980s, and increased from the late 1980s – present (Fournier et al. 1998).

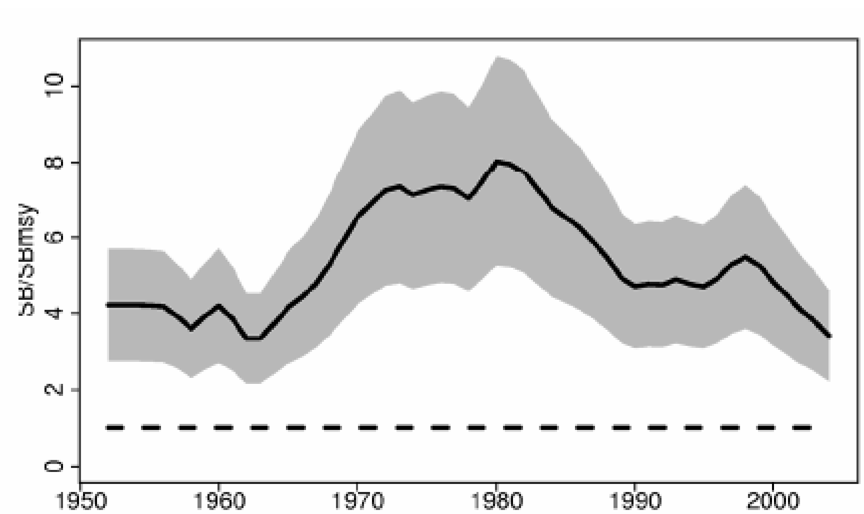

Figure 12. Adult biomass of albacore (SB) in the South Pacific, relative to SB_{MSY}. The solid line represents SB/SB_{MSY} and the grey shaded area represents the 95% confidence interval. The dashed horizontal line at 1.0 represents the overfished threshold (Figure from Langley and Hampton 2005).

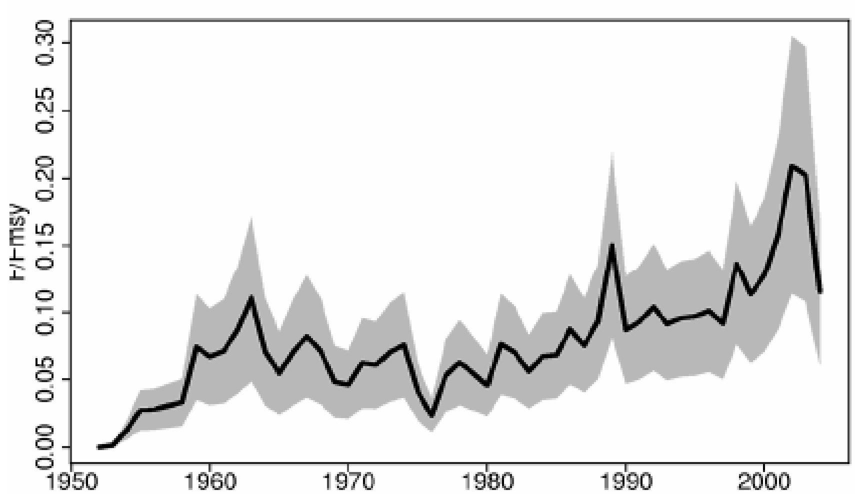

Figure 13. Exploitation rate $(E)/E_{MSY}$ for albacore in the South Pacific. The shaded grey area represents the 95% confidence interval (Figure from Langley and Hampton 2005).

In the WCPO, CPUE data from the Taiwanese longline fleet have exhibited a stable trend in the central region and an increasing trend in the southern region since 1999 (Langley et al. 2004). CPUE data from the New Zealand troll fishery exhibited an increasing trend during the 1980s and have been relatively stable since the 1990s (Langley et al. 2004). CPUE data from Japanese longline vessels in the EPO exhibit a long-term declining trend (Okamoto and Bayliff 2003). CPUE data from the U.S. troll fishery have exhibited a generally declining trend since the late 1980s (Childers 2003). Declines in catch rates of major Pacific Islands longline fleets indicate that some localized depletion of albacore may be occurring (Langley 2004). The size distribution of albacore in the South Pacific is not skewed based on the sizes of albacore caught in the fishery (Langley et al. 2004). There is moderate uncertainty associated with the stock status of South Pacific albacore due to uncertainties associated with the magnitude of the stock size (Langley and Hampton 2005). **Albacore in the South Pacific is not overfished, overfishing is not occurring, and long-term biomass trends have been relatively stable; therefore, this stock is considered healthy according to Seafood Watch® criteria.**

Indian Ocean
There is conflicting information regarding the status of albacore in the Indian Ocean. The most recent assessment considered five scenarios, or cases, and the Working Party on Temperate Tunas (WPTMT) found that Case 2 was the most realistic. Case 2 concluded that albacore in the Indian Ocean is overfished ($B/B_{MSY} < 1$) and undergoing overfishing ($F/F_{MSY} > 1$) (IOTC 2004). The most recent assessment, using data from 1952 – 2002, estimated B/B_{MSY} at 0.80 and F/F_{MSY} at 1.52 (IOTC 2004). This indicates that current catch levels are not considered sustainable and an increase in fishing effort in the Indian Ocean could be detrimental to the albacore stock (IOTC 2004). Catch levels decreased in both 2003 and 2004, and totaled 20,000 mt in 2004. The long-term CPUE for the Taiwanese and Japanese longline fleets exhibits a long-term declining trend; from 1960 – 1964 Japanese CPUE was 10 fish/1000 hooks and has been less than 2 fish/1000 hooks since 1989 (Figure 14) (IOTC 2004). However, Japanese CPUE may not be an accurate indication of albacore abundance in the Indian Ocean owing to changes in targeting practices over the time period (IOTC 2004). There is high uncertainty associated with the 2004 assessment, in part due to uncertainties associated with the stock structure of albacore and possible mixing between the South Atlantic and Indian Ocean stocks (IOTC 2004). The results of the recent stock assessment are generally considered unreliable (IOTC 2005). It is unknown if age/size/sex distributions of albacore in the Indian Ocean are skewed relative to the unfished condition of the stock. **Due to the high uncertainty associated with albacore in the Indian Ocean, and the possibility that the stock is overfished and overfishing is occurring, this stock is considered a high conservation concern according to Seafood Watch® criteria.**

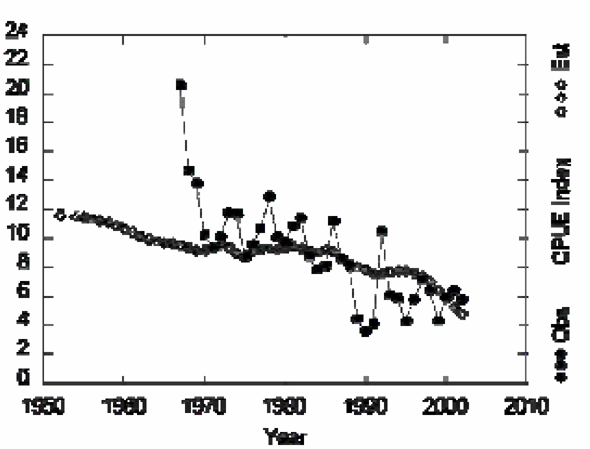

Figure 14. CPUE data for Indian Ocean albacore based on Taiwanese longline data, showing the decline observed in both long-term and short-term CPUE (Figure from IOTC 2004).

Table 3. Stock status of albacore in the Atlantic, Pacific, and Indian Oceans, and Mediterranean Sea.

Region	Classification Status (Management Body/FAO)	B/B_{MSY}	Occurrence of Overfishing	F/F_{MSY}	Abundance Trends/ CPUE	Age/Size/ Sex Distrib.	Degree of Uncert. in Stock Status	Sources	SFW Rec.
North Atlantic (11% of total catch)	Overfished/ Overexploited	0.68	Yes	1.10	Long-term decline in spawning stock biomass; short-term biomass and CPUE variable	Unknown if distributions are skewed relative to the unfished condition	Low	ICCAT 2004	Critical
South Atlantic (12% of total catch)	Not overfished/ Moderately exploited	1.66	No	0.62	General decline in biomass and CPUE; short-term biomass stable	Unknown if distributions are skewed relative to the unfished condition	Low	ICCAT 2004	Healthy
Med. Sea (3% of total catch)	Unknown/ Unknown	Unknown	Unknown	Unknown	Unknown	Unknown if distributions are skewed relative to the unfished condition	High	ICCAT 2004	Moderate
North Pacific (38% of total catch)	Not overfished/Fully exploited to overexploited	Range from 0.65 – 1.04	Overfishing likely	$F_{current}$ = 0.43 – 0.68	Stable long-term biomass trend, increasing short-term trend	Unknown if distributions are skewed relative to the unfished condition	Moderate	IATTC 2004a; Stocker 2005	Moderate
South Pacific (23% of total catch)	Not overfished/ Moderately exploited	1.69 (SB/SB_{MSY} = 4.29)	No	0.05	General stable long-term biomass trend, with slow decline since the 1980s	Size distribution not skewed	Moderate	IATTC 2000; Hampton 2002; Langley et al. 2004	Healthy
Indian Ocean (13% of total catch)	Overfished/ Unknown	0.80	Overfishing likely	1.52	Declining long-term trend, stable short-term trend	Unknown if distributions are skewed relative to the unfished condition	High	IOTC 2004	Poor

Synthesis

In the South Atlantic and South Pacific, albacore stocks are considered healthy, and although the biomass trend has declined biomass remains above B_{MSY} for both these stocks. Additionally, fishing mortality is below F_{MSY}. The status of albacore in the North Atlantic is considered to be of critical conservation concern, as it is overfished and undergoing overfishing. In the North Pacific, estimates of current albacore biomass range from below to at B_{MSY}. However, the stock is likely experiencing overfishing, and current fishing mortality ranges from 0.43 – 0.68. Although the IATTC defines the North Pacific albacore stock as not overfished, the stock may be fully exploited with excessive fishing mortality. Due to this uncertainty regarding whether or not overfishing is occurring, the status of the North Pacific albacore stock is a moderate conservation concern. As there is no stock assessment for albacore in the Mediterranean, the status of this stock is unknown but of concern due to increasing catches. Albacore in the Indian Ocean is considered a high conservation concern due to the high uncertainty of the stock assessment and the possibility that the stock is overfished and overfishing is occurring.

Status of Wild Stocks Rank:

South Pacific (23% of total catch);
South Atlantic (12% of total catch):

Healthy | Moderate or Unknown | Poor | Critical

North Pacific (38% of total catch);
Mediterranean (3% of total catch):

Healthy | **Moderate or Unknown** | Poor | Critical

Indian Ocean (13% of total catch):

Healthy | Moderate or Unknown | **Poor** | Critical

North Atlantic (11% of total catch):

Healthy | Moderate or Unknown | Poor | **Critical**

Criterion 3: Nature and Extent of Bycatch[4]

Seafood Watch® defines a sustainable wild-caught species as that captured using techniques that minimize the catch of unwanted and/or unmarketable species. Bycatch is defined as species that are caught but subsequently discarded because they are of undesirable size, sex, or species composition. Unobserved fishing mortality associated with fishing gear (e.g., animals passing through nets, breaking free of hooks or lines, ghost fishing, illegal harvest, and under or misreporting) is also considered bycatch. Bycatch does not include incidental catch (non-targeted catch) if it is utilized, accounted for, and managed in some way.

Specific bycatch data for the albacore fishery are not available in all the regions where albacore are caught, and extrapolations from tuna longline fisheries in general have been applied to the albacore fishery in this analysis.

For many of the longline fisheries, there are no consistent bycatch data (IATTC 2004b). In some cases, there are detailed observer data for some fishing nations while none exist for many others. In the WCPO for instance, SPC and FFA observer coverage was limited to one trip from 1995 – 1999 for the distant-water albacore fishery, which includes the Taiwanese fishery (Lawson 2004); other national programs may have additional coverage. Both the level and population effects of bycatch should be considered when examining the effects of bycatch (Lewison et al. 2004a). Many of the species caught as bycatch in the longline fishery are long-lived, late-maturing, and slow-growing. These species are particularly vulnerable to excessive mortality (Musick 1999). In general, catch data may underestimate the total mortality of certain bycatch species, as hooked animals may fall off the hook prior to the line being retrieved (Ward et al. 2004).

It is also important to note that not all longline fisheries are faced with the same bycatch concerns. While logbook data from some fleets suggests that bycatch is not a concern, the veracity of such data may be questionable in some fisheries that lack an observer program. Logbook data from the American Samoa longline fishery, for instance, shows that from 2002 – 2004 (the only years for which data are available), there were zero takes of marine mammals, sea turtles, and seabirds. NMFS (2005c) estimates, on the other hand, that a total of 7 sea turtles are captured annually in the American Samoa longline, Hawaiian troll, Hawaiian pole and line, and Hawaiian handline fisheries. Additionally, billfish (e.g., 0.18 blue marlin/1,000 hooks) and sharks (e.g., 0.60 blue sharks/1,000 hooks) were caught, with some landed and some discarded, in the American Samoa fishery (DMWR 2005).

The existence of IUU fishing vessels introduces added uncertainty to the issue of bycatch in the pelagic longline fishery. For instance, the incidental mortality of certain bycatch species, such as seabirds, may be substantial on these vessels, but its magnitude is unknown (Tuck et al. 2003). It is believed that IUU fishing is more prevalent in the Atlantic and Indian Oceans than in the Pacific Ocean (Tuck et al. 2003). In the Indian Ocean, for instance, there are a number of Taiwanese longline vessels flagged to Belize, Honduras, and Equatorial Guinea fishing illegally for albacore (Anonymous 2000 in Tuck et al. 2003).

[4] Portions of the "Nature and Extent of Bycatch" section are taken verbatim from other Seafood Watch® reports, including the Hawaiian swordfish and tuna reports.

Purse Seine
Purse seine catch of albacore is minimal, as this species does not exhibit the same schooling behavior as tropical tunas. However, a discussion of the tuna purse seine fishery can be found in the Seafood Watch® Bigeye, Yellowfin, and Skipjack Tuna Reports.

Troll & Pole and Line Gear
In the eastern and central Pacific, albacore is caught in surface fisheries, either in the troll or pole and line fishery. Off the coast of Oregon, albacore trollers tow 10 – 20 lines at a time, and the vessels range from 11.6 m to 30.5 m (38 ft – 100 ft) in length (Goblirsch and Theberge 2003). In the pole and line fishery, there is little bycatch because fish are caught one at a time, and fishers can immediately throw back any unwanted catch. In general, there are little data on discards in the surface hook and line fishery in the eastern and central Pacific; only 27 trips were observed in 8 years (PFMC and NMFS 2003). The most common species caught incidentally in the U.S. Pacific troll fishery for albacore are skipjack tuna, dolphinfish, yellowtail, eastern Pacific bonito, bigeye tuna, and bluefin tuna (Childers 2003; PFMC and NMFS 2003). Bycatch in troll fisheries is considerably less than in the longline fishery, although discards do occur due to undersized or damaged fish (Childers 2003). In the surface fisheries for albacore, bycatch is minimal when compared to bycatch in the pelagic longline fisheries. The average discard rate, or proportion of total catch that is discarded, in HMS troll fisheries globally is 0.1% (Kelleher 2004). Although there have been anecdotal reports of sea turtles being caught in the California troll fishery, any turtle caught is likely to be released alive, as troll gear is retrieved immediately (NMFS 2004d in NMFS 2005c).

Longline Gear
While pelagic longlines are set at different depths and configured to target specific species, non-target species are known to interact with the gear. In longline fisheries, interactions occur with a range of species including endangered and protected sea turtles, seabirds, marine mammals, sharks and other fishes. These non-target animals approach or are attracted to baited longline hooks and may become hooked or entangled in the gear, causing them to be injured or drown (NMFS 2001). Tuna are caught using both shallow and deep-set longline gear, with bycatch rates in deep sets generally 10% of those in shallow sets targeting swordfish (Lewison et al. 2004; Kaplan 2005). However, if there is more effort in the deep-set fishery the overall impact could be higher. Although comprehensive global bycatch data for longlines are non-existent, there are some data for specific longline fisheries. Longline gear varies according to the size and intensity of the fishery, the actual configuration of the gear, the region in which the gear is used, and the country fishing with the gear. Although these differences may result in differing levels of bycatch, Seafood Watch® adopts a precautionary approach in assuming that problematic bycatch levels in one fishery are similar to other fisheries, unless there are data to show otherwise. The average discard rate, or the proportion of total catch that is discarded, is 22% of total catch for HMS longline fisheries (Kelleher 2004). Of all the gears used to catch tuna in the Atlantic, longlines catch the highest diversity of both fish and seabirds (ICCAT 2005a).

In the U.S., the discard to landings ratio for finfish in the HMS fishery (pelagic longline, bottom longline, and drift/set gillnets) is estimated to be 0.52. The discard to landings ratio for the pelagic longline fishery alone is 0.67, with swordfish and sharks comprising the major species group that are discarded (Harrington et al. 2005). That is, for every 10 fish that are landed (i.e., kept) in the pelagic longline fishery, 6.7 fishes, sharks, etc. are discarded.

As evidenced by observer data in the WCPO, mortality rates differ for the various types of longlines (Figure 15). According to Bailey et al. (1996), logsheet data from the WCPO longline fishery is limited. Due to low observer coverage in the western Pacific Ocean (WPO), observer data cannot be used to estimate overall bycatch levels (Bailey et al. 1996).

A. **B.** **C.**

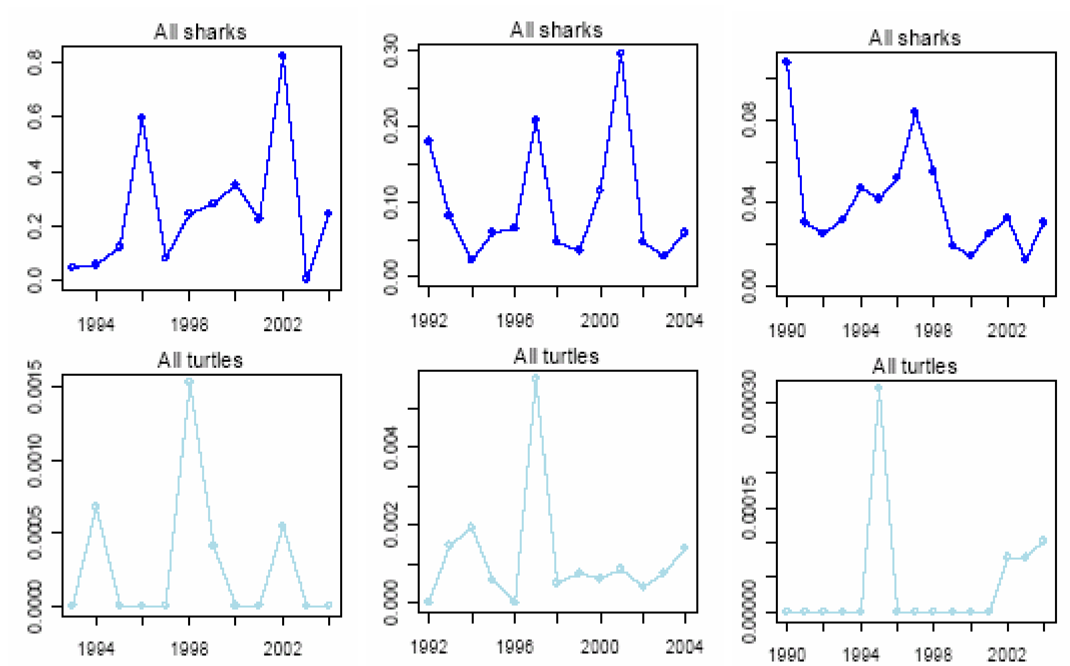

Figure 15. Mortality rates in the A. WCPO shallow-set longline fishery, B. WCPO deep-set longline fishery, and C. temperate albacore fishery. The x-axis is mortalities per 100 hooks and the y-axis is year. Noting the change in scale for each panel, sea turtle mortalities were highest in the deep-set fishery and shark mortalities were highest in the shallow-set fishery (figure from Molony 2005).

Fishes: bycatch rates

Discards of swordfish and tuna in the U.S. Atlantic pelagic longline fishery generally exhibited a gradual decline from 1995 – 2004 (NMFS 2006). Discards of these target species may be economic or regulatory discards. The only fish species for which discards were higher than landings were bluefin tuna. In 2004, the most recent year for which data are available, slightly two times more bluefin tuna were discarded than kept (NMFS 2006). For highly migratory species, both the number of individuals kept and the number of individuals discarded have declined over this time period, as has fishing effort (Figure 16) (NMFS 2004c). The reason for this decline is unknown.

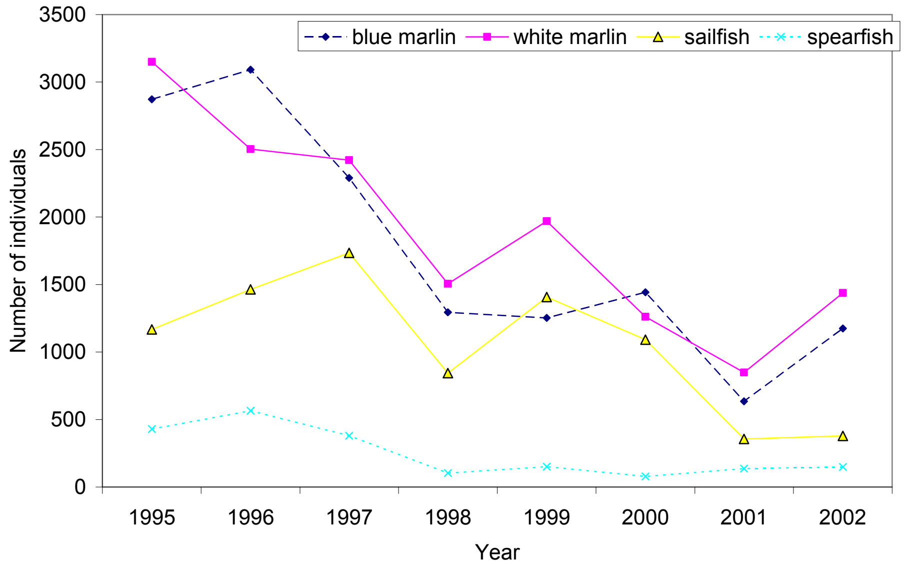

Figure 16. Decline of marlin, sailfish, and spearfish discards in the U.S. Atlantic pelagic longline fishery (NMFS 2004c).

Longline fisheries targeting tuna and swordfish are responsible for the majority of the fishing mortality of blue and white marlin (Goodyear 1999; Peel at el. 2003). In the Atlantic, the commercial sale of billfish was prohibited in 1991, and although the reported catch of billfish dropped greatly after this (Goodyear 1999), it is likely that reported bycatch rates in the logbooks are underestimates of the actual bycatch rates, based on observer data (Cramer 1996). For fisheries where logbook data are available, the catch ratio of billfish to the targeted species is low. Billfish catch is approximately 5% of the total combined catch of albacore, yellowfin, bigeye, bluefin, and southern bluefin (Uozumi 2003).

Other pelagic species that are regularly caught in the directed tuna fishery are dolphinfish, moonfish, oilfish, pomfret, and wahoo. While some of these species are kept and are thus not deemed bycatch, others such as moonfish and pomfret are largely discarded in some fisheries. It is important to note that recreational catch-and-release fisheries for these billfish species also contribute to the mortality rates of these species, although the magnitude of these mortalities is far less than for the pelagic longline fishery. For instance, over 99% of all white marlin are released in recreational fisheries (Goodyear and Prince 2003). The survival of released marlin may be affected by the type of hook used. In the western North Atlantic recreational fishery, white marlin survivability is higher when caught on circle hooks (100%) compared to those caught on J hooks (65%) (Horodysky and Graves 2005). In addition, there are few data examining survival rates following stomach eversion (Horodysky and Graves 2005). Although this mortality does affect the stock status of billfish, Seafood Watch® does not incorporate recreational fisheries effects when evaluating commercial fisheries. When 16/0 circle hooks were compared to 9/0 J-hooks in the U.S. Atlantic pelagic longline fishery, circle hooks were found to reduce mortality of non-target species, and may result in higher survival for undersize swordfish and billfishes (Kerstetter and Graves 2006). In addition, the use of 16/0 0º circle hooks was found to have a minimal impact on the catch of target species (Kerstetter and Graves 2006).

The mortality of billfish in longline fisheries targeting swordfish and tuna varies according to fishery and species. When data sets from the U.S., Japanese, and Venezuelan fisheries were combined, the proportion of billfish that were dead when the gear was retrieved ranged from 0.472 for blue marlin in the Gulf of Mexico to 0.673 for white marlin in the northwest Atlantic (Farber and Lee 1991). Observer data from Japanese fisheries in Australia suggest that 74% of black marlin, 71% of blue marlin, and 60% of striped marlin were dead or moribund when the gear was retrieved (Findlay et al. 2003). There are, however, differences in billfish mortality rates in different fisheries operating in the same waters; Japanese and Australian fisheries operating in the same waters have been shown to have different billfish mortality rates due to differences in gear configuration (Findlay et al. 2003). According to the most recently available logbook data for the Atlantic pelagic longline fishery, discards of blue marlin declined from 1995 – 2002, but have been somewhat stable since 1998, averaging 1,160 individuals discarded annually from 1998 – 2002 (NMFS 2004c). White marlin discards exhibited a similar pattern, with an average of 1,404 individuals discarded annually from 1998 – 2002 (NMFS 2004c).

The Hawaii-based pelagic longline fishery targeting tuna and swordfish also catches, and often lands, several billfish species including blue and striped marlins. There are no specific management measures for either of these marlin species (Dalzell and Boggs 2003). CPUE data for striped marlin in Hawaiian fisheries from 1990 – 1999 indicate a declining trend in the recreational, commercial longline, and commercial troll fisheries (Dalzell and Boggs 2003). However, CPUE data may not be an accurate indicator of abundance due to increases in the proportion of the fleet setting deep-set longlines. The most recent stock assessment shows that stocks are at about the MSY level, and given the assessment uncertainty the results may be more optimistic (Kleiber et al. 2003). While the population could have been subject to $F > F_{MSY}$ over the past several decades, high recruitment maintained the population near B_{MSY}. Deep-set longlines are likely to have lower marlin bycatch rates than shallow-set longlines targeting swordfish (Dalzell and Boggs 2003).

In the Indian Ocean, 2005 observer data from Western Australia longline vessels suggest that more than half of the species caught were bycatch, the most common of which were sharks. While some bycatch species are kept and sold, such as dolphinfish, there is no market for other species that are commonly caught, such as stingrays (IOTC 2005b).

Fishes: population impacts for bycatch species

The stock status of billfish species varies by ocean basin and species (Table 4). The pelagic longline fisheries targeting yellowfin and bigeye tuna and swordfish cause the highest Atlantic marlin mortality (Peel et al. 2003). In the Atlantic, biomass estimates for blue marlin, white marlin, and sailfish are all below B_{MSY} while fishing mortality on these stocks is above F_{MSY} (Peel et al. 2003; Uozumi 2003). The Atlantic blue marlin stock is at 40% of B_{MSY}, current fishing mortality is four times F_{MSY}, and overfishing has been occurring for the last 10 – 15 years (ICCAT 2001a). The only management measure in place for Atlantic blue marlin is reduced pelagic longline and purse seine landings to 50% of 1996 or 1999 levels, whichever is greater (ICCAT 2001a). White marlin occurs only in the Atlantic; the most recent assessment for this species was in 2000, and indicated that biomass throughout the late 1990s was about 15% of B_{MSY} while fishing mortality was more than five times F_{MSY} (ICCAT 2001a). As with blue marlin, the only management measure in place is a limit on longline and purse seine landings to 33% of the 1996 or 1999 level (ICCAT 2001a). For Atlantic sailfish, MSY is not estimated and there are no management measures in place (ICCAT 2001b).

Observer data from the U.S. pelagic longline fishery in the Atlantic show that the number of bluefin tuna discarded has been higher than the number kept every year from 1995 – 2002. Both East and West Atlantic bluefin stocks are overfished and experiencing overfishing, and considered overexploited and depleted, respectively (NMFS 2004c; Majkowski 2004). Any dead-discarding of bluefin tuna in Atlantic pelagic longline fisheries removes individuals from stocks that are already in critical shape, thus warranting a critical conservation concern for these longline fisheries.

Although no stock assessments were conducted for marlin, sailfish, and spearfish in the Indian Ocean in the 1990s, previous assessments indicate that biomass of blue marlin, striped marlin, and black marlin are either at or above MSY (Uozumi 2003). The status of sailfish and spearfish in the Indian Ocean is unknown. Therefore, high uncertainty exists concerning the status of these stocks, as well as the level of discarding. Catch of non-tuna species has not been well documented in the Indian Ocean, and the level of discarding in the industrial fisheries may be high based on data from other oceans (IOTC 2005b). The level of bycatch in the artisanal fisheries in the Indian Ocean is likely very low (IOTC 2005b).

In contrast to the Atlantic, blue and striped marlin biomass is either at or above the MSY level in the Pacific. In addition, current fishing mortality is below F_{AMSY} (fishing mortality at which the average maximum sustainable yield is produced) for striped marlin (Hinton and Maunder 2004). The status of black marlin, sailfish, and spearfish is unknown in the Pacific (Uozumi 2003). Blue marlin in the Pacific is close to being fully exploited, although due to model uncertainty the situation may be more optimistic (Kleiber et al. 2003). There is, however, uncertainty associated with stock assessment results derived from production models, due to uncertainty in catch and abundance indices, particularly as these data are from fisheries that do not target billfish (Uozumi 2003). In addition, changes in both spatial coverage and depth coverage over time may result in a misinterpretation of CPUE data for billfish if changes in the fisheries do not adequately cover billfish habitat (Uozumi 2003). At this time, there does not appear to be a critical conservation concern associated with billfish bycatch in the Pacific, although caution is warranted, as the stock status of many of these species is unknown.

Table 4. Stock status of billfish in the Atlantic, Pacific, and Indian Oceans (Table from Uozumi 2003).

Species	Stock	Stock status
Atlantic blue marlin	Atlantic	Lower than MSY
White marlin	Atlantic	Lower than MSY
Atlantic sailfish	East Atlantic	Lower than MSY
Longbill spearfish	Atlantic	Unknown
Indo-Pacific blue marlin	Indian	At MSY level
Striped marlin	Indian	Higher than MSY
Black marlin	Indian	At MSY level

Indo-Pacific sailfish	Indian	Unknown
Shortbill spearfish	Indian	Unknown
Indo-Pacific blue marlin	Pacific	Higher than MSY
Striped marlin	North Pacific	At or higher than MSY
Black marlin	Pacific	Unknown
Indo-Pacific sailfish	Pacific	Unknown
Shortbill spearfish	Pacific	Unknown

Sea turtles: bycatch rates

All seven species of sea turtle are listed as threatened or endangered under the U.S. Endangered Species Act of 1978, and six of these species are also listed on the IUCN's Red List (Table 5). Several of these sea turtle species are caught as bycatch in the pelagic longline fisheries targeting tuna and swordfish, particularly green, hawksbill, Kemp's ridley, leatherback, loggerhead, and olive ridley. Sea turtles are commonly caught as bycatch in tropical waters, and more often in shallow-set fisheries (Beverly et al. 2004). As evidenced by the closure of the U.S. longline fishery in the Northeast Distant Waters (NED), sea turtles are also caught as bycatch in other regions. Loggerheads have been shown to spend the majority of their time at depths shallower than 100 m, and the elimination of shallow-set longlines would result in reduced bycatch of loggerheads (Polovina et al. 2003). Even in deep-set longlines, however, there is the potential for hooks to be present at shallow depths when the gear is being set and retrieved, or if the line does not sink to the appropriate depth (Polovina et al. 2003). Although some turtles are hooked in the esophagus and others are hooked only in the jaw, there does not appear to be a difference in the survivability between light and deeply hooked turtles (Polovina et al. 2000; Parker et al. in press). Leatherbacks are attracted to squid bait used on longlines (Skillman and Balazs 1992), and commonly get entangled in the branch lines even if they don't bite the hook (NMFS and USFWS 1998). Estimates of sea turtle post-release mortality using satellite tracking has been both controversial and problematic (Hays et al. 2003; Chaloupka et al. 2004a; Chaloupka et al. 2004b; Hays et al. 2004a) with estimates ranging from 0.08 for lightly hooked turtles, to 0.38 for deeply hooked turtles (Chaloupka et al. 2004a). In general, takes greatly exceed documented mortalities in longline fisheries, although there are few data on post-release mortality. It is important to note that an interaction does not imply mortality.

Table 5. Global conservation status of sea turtles that interact with pelagic longline fisheries.

Species	Status under the U.S. ESA	Status on the IUCN Red List
Green	Threatened, Endangered[5]	Endangered
Hawksbill	Endangered	Critically endangered
Kemp's ridley	Endangered	Critically endangered
Leatherback	Endangered	Critically endangered
Loggerhead	Threatened	Endangered
Olive ridley	Threatened	Endangered

Although more countries are beginning to collect bycatch data, they are generally not available and therefore a thorough analysis of sea turtle bycatch interactions with international vessels is difficult. However, Lewison et al. (2004b) attempted to quantify the incidental take of loggerhead and leatherback sea turtles on a global scale. By integrating catch data from more

[5] There are two green turtle populations, with different statuses under the ESA.

than 40 nations and bycatch data from 13 international observer programs, they estimated that over 200,000 loggerheads and 50,000 leatherback sea turtles were taken as bycatch in pelagic longline fisheries in the year 2000. This amounted to 20,000 – 40,000 leatherback and 30,000 – 75,000 loggerhead sea turtles caught as bycatch in the Pacific Ocean alone (Lewison et al. 2004b). Lewison et al. (2004b) suggest that a large number of interactions with protected species continue regularly with the international (non-U.S.) longline fleet, and jeopardize the continued survival of these endangered and threatened sea turtle species.
In contrast, Hatase et al. (2002) estimate that in 2000 international pelagic longline fisheries resulted in 800 to 1,266 loggerhead takes and 139 to 222 loggerhead mortalities in the Pacific. Certain areas in the Pacific may have less sea turtle bycatch than other areas; for instance, leatherbacks have rarely or never been seen in the waters of American Samoa, Guam, the Republic of Palau, the Commonwealth of the Northern Marianas, Republic of the Marshall Islands, and the Federated States of Micronesia (NMFS and USFWS 1998), thereby reducing the potential for fishery interactions in these areas. It is estimated that Australian longline vessels incidentally take about 400 sea turtles per year, which is lower than estimates from other longline fisheries (Robins et al. 2002). The average catch rate of sea turtles in the Australian longline fishery is estimated at 0.024 turtles/1000 hooks (Robins et al. 2002). Bycatch rates in the temperate western Pacific have been estimated at 0.007 turtles/1000 hooks for both the deep-set fresh and freezer vessels, with annual estimates of 129 turtle takes and 564 turtle takes, respectively (Robins et al. 2002). Observer data from <1% of the longline fleet in the WCPO suggest that 2,182 turtles are taken in this fishery annually, with a 23-27% mortality rate (OFP 2001 in NMFS 2005c). The Japanese tuna longline fleet is estimated to take 6,000 turtles annually in the EPO, with a 50% mortality rate (Meeting Minutes, 4th Meeting of the Working Group on Bycatch, IATTC, January 14-16, 2004 in NMFS 2005c). Sea turtle bycatch rates in the Costa Rican longline fleet have been estimated at 19.43 turtles/1,000 hooks with an 8.8% mortality rate and 14.4 turtles/1,000 hooks with a 0% mortality rate (Arauz 2001).

Off the southern coast of Brazil, loggerhead and leatherback takes have been documented in the longline fishery targeting swordfish, sharks, and tuna species (including *Thunnus albacares*, *T. alalunga*, and *T. obesus*) (Kotas et al. 2004). Over the course of three trips and 34 sets, 145 loggerheads (4.31/1000 hooks) and 20 leatherbacks (0.59/1000 hooks) were taken (Kotas et al. 2004). Of these turtles, 19 loggerheads and 1 leatherback were released dead (Kotas et al. 2004). These mortality levels may be underestimated, however, due to post-release mortality related to hooking wounds and stress from capture (Kotas et al. 2004). It has been estimated that in 2000, Japanese longline vessels targeting tunas in the eastern Pacific resulted in 25 leatherback mortalities (166 total leatherback takes) and approximately 3,000 mortalities of all other turtle species, most of which were olive ridleys (IATTC 2004b). In Uruguay, loggerhead and leatherback bycatch has been estimated at 1.8 individuals/1000 hooks, with incidental mortality at 1.9% (Achaval et al. 1998).

Sea turtle mortalities in the Hawaii-based longline fishery have dropped considerably since the 2001 closure of the shallow-set swordfish fishery, which was reopened in April 2004 (Figure 17). From 2002 – 2004, interactions of green turtles remained relatively stable, leatherback interactions increased, and olive ridley interactions increased, while loggerhead interactions declined to zero in both 2003 and 2004 (NMFS 2005c; PIR 2005a). In 2004, it was estimated that 0 loggerheads, 15 leatherbacks, 46 olive ridleys, and 5 green turtles were taken as bycatch in the Hawaiian deep-set longline fishery (PIR 2005a). The maximum number of leatherback interactions allowed in the shallow-set fishery is 16; if this number is reached in the shallow-set fishery the fishery is closed. This regulation does not apply to the deep-set fishery, however. In 2004, the first year that the shallow-set fishery targeting swordfish opened, two sea turtles were observed as takes; one leatherback and one loggerhead were released injured (PIR 2005a). However, 2004 data from the shallow-set fishery should not be considered a source of new information due to low fishing effort (NMFS 2005c). With 26.1% observer coverage in 2005, four olive ridleys were observed as "released dead" and one leatherback was "released injured" in the deep-set fishery; with 100% observer coverage in the shallow-set component of the fishery, 10 loggerheads and eight leatherbacks were "released injured" (PIRO 2005b). Mortality rates based on observer data are 0.86 for green turtles, 0.34 for leatherbacks, 0.44 for loggerheads, and 0.96 for olive ridleys (Boggs 2005 in NMFS 2005c).

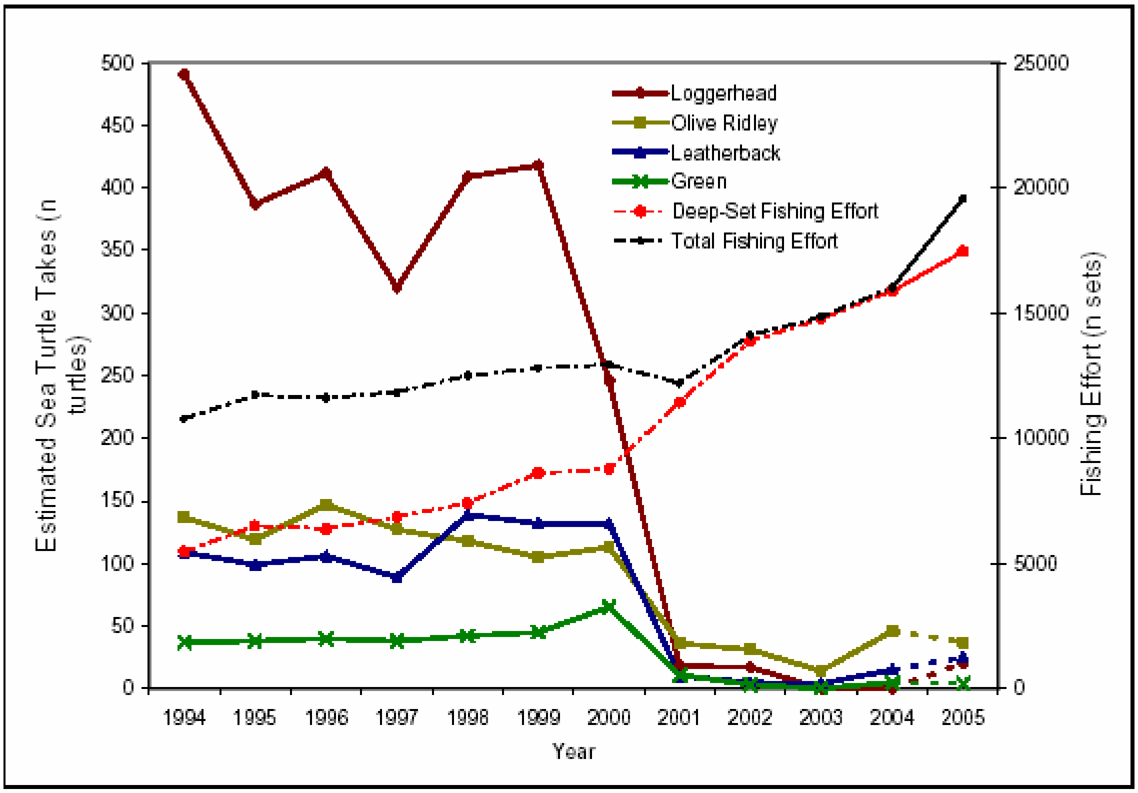

Figure 17. Sea turtle mortalities in 1994 – 2004 and projected for 2005 in the Hawaii-based longline fleet (Figure from NMFS 2005c). The shallow-set swordfish fishery was closed from 2001 – 2004.

The U.S. pelagic longline fishery in the Atlantic interacts with several sea turtle species; however, loggerheads and leatherbacks are the primary concern due to their high interaction rates (Figure 18). Sea turtle bycatch estimates for the U.S. pelagic longline fishery in the Atlantic in 2002 were 575 loggerhead takes[6] (2 mortalities), 962 leatherback takes (33 mortalities), and 50 unidentified turtle takes (NMFS 2004d). The number of loggerhead and leatherback turtle takes was generally stable from 1992 to 2002, although there was a peak in loggerhead takes in 1995.

[6] These take estimates do not include any estimates of post-release mortality.

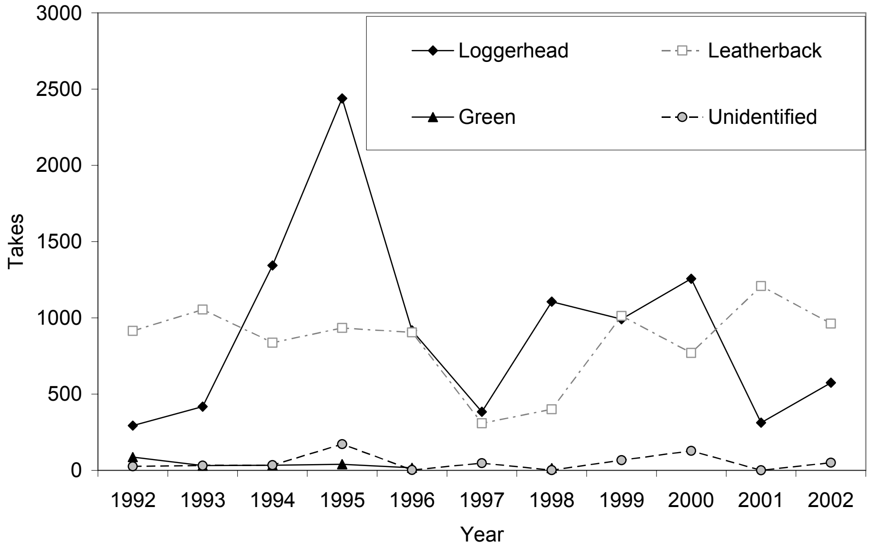

Figure 18. Estimated takes in the U.S. Atlantic pelagic longline fishery, 1992 – 2002. Takes do not imply mortalities (NMFS 2004e).

Total loggerhead takes appear high in the U.S. Atlantic longline fishery, but the estimated mortalities are low; average annual loggerhead morality from 1992 – 2002 was 7 individuals, and in 2002 was only an estimated 2 loggerheads (NMFS 2004d). The mortality data for leatherbacks is far more variable, with an estimated 88 leatherbacks killed in 1992, and then no leatherbacks killed again until 2002, when 33 leatherbacks were estimated killed in this fishery (NMFS 2004d). The estimated zero mortalities may be a reflection of the low level of observer coverage in this fishery, rather than low sea turtle bycatch, however; from 1995 – 2000, observer coverage ranged from only 2.5 – 5.2% (NMFS 2004d).

For the pelagic longline fishery, the most effective management measures are likely gear modifications, rather than area closures; this can, however, potentially result in the displacement of effort to other areas where bycatch may be higher (James et al. 2005), unless effort is reduced. Hook and gear modifications were required in the U.S. Atlantic pelagic longline fishery in mid-2004, and in 2005 the take of leatherbacks was greatly reduced (NMFS 2006). If this declining trend continues, the conservation concern for this fishery will continue to be ranked differently than the international longline fleets. Mexican longline vessels targeting tuna in the Gulf of Mexico have been shown to catch 5 turtles/100 trips with incidental mortality at 1.6 turtles/100 trips (Ulloa Ramírez and González Ania 2000).

Estimates of loggerhead bycatch in the Spanish swordfish fishery are high, at greater than 20,000 turtles annually with a 20% mortality rate (Aguilar et al. 1995). Sea turtle bycatch in the pelagic longline fisheries targeting swordfish and tuna in the Mediterranean are estimated at 25,000 turtles each year, although the mortality rate is unknown (IUCN 2000).

Additional bycatch estimates from longline fisheries in the South Atlantic have found that the CPUE for loggerheads and leatherbacks combined in these fisheries was 0.37/1000 hooks from 86 sets (Achaval et al. 2000). With over 13 million hooks set in 1999 by Brazilian boats alone in the southwest Atlantic (ICCAT 2001c), the potential for large amounts of sea turtle bycatch is high. In addition, fishery closures in the North Atlantic due to overfished species such as swordfish and tunas may result in effort being displaced to the South Atlantic, possibly increasing sea turtle bycatch there (Kotas et al. 2004). Lewison et al. (2004b) estimate that 1.4 billion hooks were set on pelagic longline gear in the year 2000 alone, with 1.2 billion of those hooks targeting tuna. In the eastern Atlantic, olive ridleys and leatherbacks have been observed interacting with longlines targeting swordfish and tunas, with a CPUE of 0.09 for olive ridleys and 0.39 for leatherbacks (Carranza et al. 2006). In the Gulf of Guinea, the CPUE for olive ridleys was 0.38 and the CPUE for leatherbacks was 0.64 (Carranza et al. 2006). Of the 40 leatherbacks caught, 5% were observed mortalities (Carranza et al. 2006). There are no estimates for post-release mortality for either of these species in this study.

In the Indian Ocean, South African observer data suggest a catch rate of 0.05 turtles/1,000 hooks; turtles were alive in 85% of these interactions (IOTC 2005b). In the WCPO, the highest CPUEs were in the tropical shallow-set longline fishery, although the highest mortalities were in the tropical deep-set fishery. Turtle bycatch was lower in the temperate albacore fishery (Molony 2005).

All these studies demonstrate that sea turtle bycatch occurs in many fisheries across most ocean basins. Although there are not observer coverage or logbook data for every fishery targeting tuna, the available data suggest that sea turtle bycatch is an issue in many, if not all, of these fisheries.

Sea turtles: population impacts
Sea turtle populations face several threats, including incidental take in fisheries, the killing of nesting females, egg collection at nesting beaches, habitat loss, and pollution and debris. The population impacts of sea turtle bycatch vary according to the sea turtle species and the region.

Pacific
In the Pacific Ocean, nesting populations of both loggerhead and leatherback sea turtles have exhibited severe declines, with loggerheads exhibiting an 80 – 86% decline over the last 20 years (Figure 19) (Kamezaki et al. 2003; Limpus and Limpus 2003) and leatherbacks exhibiting a decline of greater than 95% (Crowder 2000; Spotila et al. 2000) over the same time period. The number of nesting females at several nesting beaches in Japan have been declining since 1990 (Sato et al. 1997), and population declines of loggerheads nesting in Japan have been attributed to the bycatch of small females in pelagic longline fisheries in the Pacific (Hatase et al. 2002). Recent increases in nesting females have been observed in several Japanese beaches (I. Kinan, pers. comm.; Sea Turtle Association of Japan unpubl. data).

Some sea turtle species, such as green turtles in the Hawaiian Islands, are recovering (Balazs and Chaloupka 2004); however, there is an overall declining trend for green turtle abundance worldwide (Seminoff 2004). While research has shown that leatherbacks have migratory pathways in the Pacific, the same is not true in the Atlantic, where leatherbacks are likely to disperse widely from the main nesting beaches in French Guiana and Suriname (Ferraroli et al. 2004; Hays et al. 2004). The distribution of leatherbacks in the Atlantic also shows that these animals spend time and forage in the same areas and depths where pelagic longline fisheries operate (Ferraroli et al. 2004; Hays et al. 2004b). Spotila et al. (2000) estimate that if leatherbacks in the eastern Pacific can sustain 1% annual anthropogenic mortality, this is equal to the loss of 17 adult females and 13 subadult females per year. The 2005 Biological Opinion on the Hawaii-based, deep-set pelagic longline fishery concluded that the continued authorization of this fishery *is not likely* to jeopardize the continued existence of green, leatherback, loggerhead, and olive ridley sea turtles (NMFS 2005c).

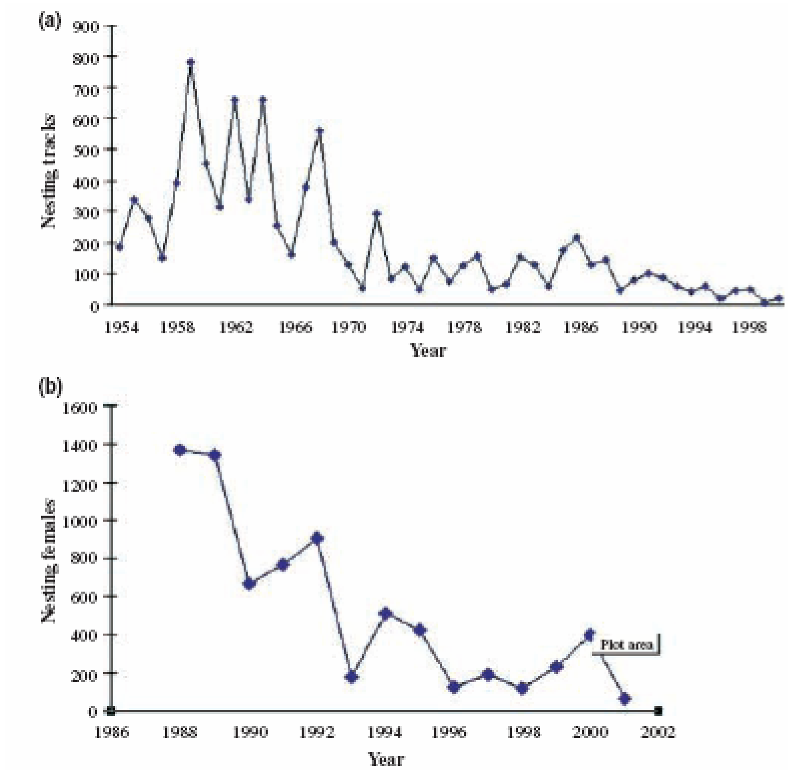

Figure 19. a) Declines in nesting loggerheads in Japan (Figure from Kamezaki et al. 2003 in Lewison et al. 2004b), and b) declines in nesting leatherbacks in Costa Rica (Figure from Spotila et al. 2000 in Lewison et al. 2004b).

Mediterranean

The conservation of loggerheads is threatened by the level of loggerhead bycatch associated with longline fisheries in the Mediterranean (Laurent et al. 1998). Loggerheads found in the Mediterranean are from several populations, including loggerheads from the southeast U.S. (Laurent et al. 1998), thus Mediterranean longline fisheries impact more than just the loggerheads from the Mediterranean population. Even considering that bycatch in deep-set longline fisheries is lower than in shallow-set longline fisheries, this level of bycatch is still cause for concern.

Atlantic

Population data for leatherbacks in the Atlantic is uncertain and conflicting. However, the main nesting beaches in French Guiana and Suriname have exhibited a declining trend, with nesting declining at about 15% annually (NMFS 2004d). Leatherback bycatch in the Atlantic pelagic longline fishery has more severe population consequences than loggerhead bycatch for several reasons. Approximately half of the leatherbacks taken in the pelagic longline fishery are mature breeders while the other half are sub-adults; because leatherbacks are sexually mature in 5 – 15 years, the bycatch of leatherback sub-adults has more severe population consequences than for loggerheads, which mature later (NMFS 2004d). Using the estimates of turtle bycatch from Lewison et al. (2004b), post interaction mortality, sex ratio data, and adult to juvenile ratio data, total leatherback mortality for adult females was estimated at 4,100 leatherbacks per year in the international fisheries in the Atlantic and Mediterranean (NMFS 2004d). While the U.S. longline fleet in the Atlantic accounts for 1.2 – 1.4% of this mortality per year, the annual mortality of adult and sub-adult females in the U.S. fishery is “not discountable” (NMFS 2004d p. 6-8). In addition, there is considerable uncertainty associated with the status and trends of leatherbacks in the Atlantic. It has been shown that a combination of 18/0 circle hooks and mackerel bait reduces loggerhead interaction rates by 90% and leatherback interactions by 65% (Watson et al. 2005). The 2004 Biological Opinion (BiOp) concludes that the proposed management measures in the U.S. Atlantic pelagic longline fishery *are likely* to jeopardize the continued existence of leatherbacks, but not the existence of the other turtle species that are taken as bycatch in this fishery. NMFS' jeopardy finding was based on estimated annual mortalities in the U.S. fishery of approximately 200 leatherbacks, continuing indefinitely (NMFS 2004d).

Seabirds: bycatch rates
There are an estimated 61 seabird species that are affected by longline fisheries, 25 of which are threatened with extinction as a result of their bycatch in longline fisheries (Brothers et al. 1999). Estimates for seabird bycatch in longline fisheries in the North Pacific alone are approximately 35,000 albatross takes per year (Cousins et al. 2001). Additionally, observed mortalities of seabirds may be underestimated, as seabirds may fall from hooks before being hauled on deck (Cousins and Cooper 2000; Ward et al. 2004); mortality estimates for some seabirds may be underestimated by as much as 45% (Ward et al. 2004). According to the FAO (1998), tuna longlines in the temperate waters of the North Pacific and in the Southern Ocean catch large numbers of seabirds as bycatch. Lewison and Crowder (2003) estimate that approximately 10,000 black-footed albatrosses are killed each year in all of the fleets in the North Pacific, and this level of mortality is likely contributing to population declines. The U.S. rate was estimated at 2,000 individuals per year while the international rates were estimated as a moderate-case scenario at 8,000 individuals per year (Lewison and Crowder 2003). In the northeast Pacific, black-footed albatrosses have been shown to overlap with the distribution of longline fisheries both spatially and temporally (Hyrenbach and Dotson 2003). Recent data from the Hawaii-based deep-set longline fishery indicate that takes of black-footed and Laysan albatrosses have declined, with only 16 black-footed and 10 Laysan albatrosses taken in 2004 (Figure 20) (PIR 2005a). As of the writing of this report in 2005, 11 black-footed albatrosses, 6 Laysan albatrosses, and 1 brown booby had been released dead in the deep-set Hawaii fishery; observer coverage was 16.3% in the first quarter, 22.7% in the second quarter, and 37.9% in the third quarter of 2005 (PIRO 2005b).

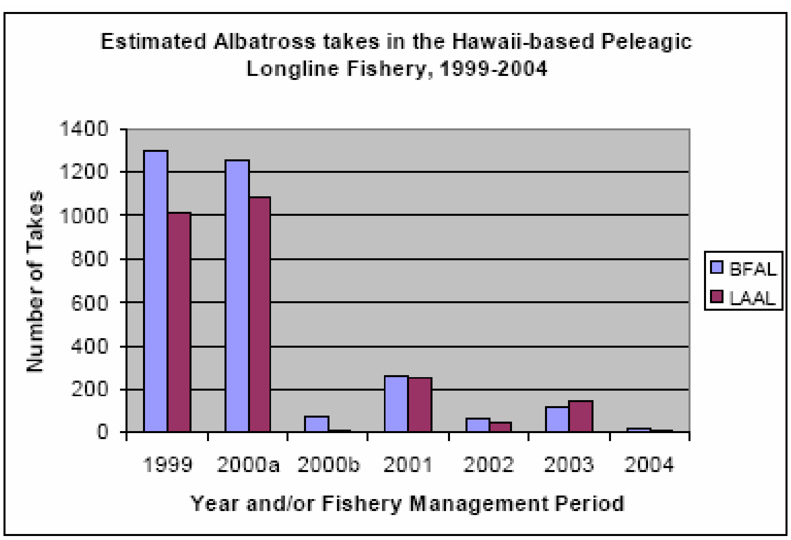

Figure 20. Total estimated takes of black-footed (BFAL) and Laysan albatross (LAAL) in the Hawaii-based longline fishery, 1999 – 2004 (Figure from PIR 2005a).

High seabird bycatch rates are also found in the Japanese longline fishery, where the mean catch rate is 0.92 birds/1000 hooks (Brothers and Foster 1997). Catch rates have been shown to be even higher in the Australian fishery, possibly due to a lack of bird-scaring devices such as tori lines (Brothers and Foster 1997). More recent data suggest that declines in seabird bycatch in Australian and New Zealand fisheries have been attributed to both an increase in the use of mitigation measures and a decrease in effort (Tuck et al. 2003).

In addition to albatrosses, there is also bycatch of seabird species that are not listed on either the U.S. ESA or the IUCN Red List in longline fisheries. Cory's shearwaters, for instance, are caught in large numbers in the Mediterranean. Spanish longlining vessels alone have been estimated to catch as much as 4 – 6% of the local breeding population each year, which is considered unsustainable for the long-term existence of this colony (Cooper et al. 2003). In the western Mediterranean, however, Spanish longline vessels targeting albacore have been shown to have a seabird bycatch rate of 0.0234 birds/1000 hooks, which is lower than the bycatch rates shown for South African and Japanese fleets in Australian waters (Valeiras and Camiñas 2003). In general, there are little data concerning seabird bycatch in the Mediterranean (Cooper et al. 2003).

Despite the consistent use of mitigation measures by some fisheries, the sustainability of seabird species in the Southern Ocean may be threatened as a result of the combined effects of those fisheries that only sporadically use mitigation measures and IUU fisheries (Tuck et al. 2003). Although seabird bycatch mitigation measures are likely necessary in the WCPO, none are required (Small 2005). Observer data suggest that annual seabird takes in WCPO longline fisheries are from 0 – 9,800 birds, with annual mortality rates from 24 – 100% (Molony 2005). Seabird takes in the Atlantic are low, which is likely due to the night-setting of pelagic longlines (NMFS 2004e).

In the Indian Ocean, an estimated 100,000 albatrosses and 300,000 other seabirds are killed annually (IOTC 2005b). Of the albatrosses that interact with longline fisheries in the Indian Ocean, 19 out of the 21 species are threatened with extinction (IOTC 2005b). Observer data from South African vessels indicate that the most common seabird species caught are white-chinned petrel, black-browed albatross, shy albatross, and yellow-nosed albatross (IOTC 2005b). The catch rate averaged 0.2 birds/1000 hooks in the domestic fleet and 0.8 birds/1000 hooks in the foreign fleet (IOTC 2005b).

Seabird bycatch: population impacts
The bycatch of seabirds in longline fisheries worldwide is one of the principal threats to these seabird populations (Gilman 2001). Some seabird species are at risk of becoming extinct, and their survival is threatened by the global presence of longline fisheries (Gilman 2001). Lewison and Crowder (2003) conclude that U.S., Japanese, and Taiwanese longline vessels are the largest source of mortality to the black-footed albatross. The combined mortality due to U.S. and international longline vessels is likely above the threshold of estimated potential biological removal (PBR) of 10,000 birds per year (Lewison and Crowder 2003).

Pelagic longlines also result in seabird bycatch in the Southern Ocean and the Mediterranean (Prince et al. 1998; Belda and Sanchez 2001). Fishing effort in the Southern Ocean, particularly by Taiwanese vessels, has been expanding since the 1970s, and seabird populations in the region have shown dramatic declines attributed to incidental take in longline fisheries (Brothers 1991; Cooper 2000; Nel et al. 2002). The continuation of current fishing levels, without the presence of mitigation measures, may be jeopardizing the sustainability of these seabird populations (Tuck et al. 2003).

It cannot be assumed that fisheries with higher fishing effort have higher levels of seabird bycatch, or that the population impacts of fisheries with higher effort are more substantial (Tuck et al. 2003).

Marine mammals: bycatch rates

In the Pacific, the Hawaii-based longline fishery for swordfish, tuna, and billfish is listed as a Category I fishery[7] in the NOAA Fisheries List of Fisheries for 2004, due to interactions with humpback whales, false killer whales, Risso's dolphins, bottlenose dolphins, spinner dolphins, short-finned pilot whales, and sperm whales. While there has been one observed interaction of an endangered sperm whale with the longline fishery in the Hawaiian EEZ, the effects of interactions with the Hawaii-based longline fishery in U.S. and international waters is unknown (Caretta et al. 2005). However, one cetacean species, the false killer whale (*Pseudorca crassidens*), is presently categorized as a "strategic" stock under the 1994 Marine Mammal Protection Act (MMPA) (Caretta et al. 2002). According to the CRS Report for Congress (Buck 1994), a strategic stock is defined as:

> Any marine mammal stock: (1) for which the level of direct human-caused mortality exceeds the potential biological removal level; (2) which is declining and likely to be listed as threatened under the Endangered Species Act; or (3) which is listed as threatened or endangered under the Endangered Species Act or as depleted under the MMPA.

All marine mammals, regardless of whether or not they are listed under the ESA, are protected under the MMPA. In 2004, 28 false killer whales were estimated as takes (but not necessarily mortalities) in the Hawaii-based deep-set longline fishery. Uncertainty in population size and stock structure of false killer whales make it difficult to evaluate population-level impacts of the fishery on this species.[8] Efforts are presently underway by NMFS to address these critical research needs (Carretta et al. 2002).

The U.S. longline fishery for large pelagics in the Atlantic Ocean, Gulf of Mexico, and Caribbean is also a Category I fishery due to interactions with humpback whales, minke whales, Risso's dolphins, long-finned pilot whales, short-finned whales, common dolphins, Atlantic spotted dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins, harbor porpoises, and pygmy sperm whales (69 FR 153, August 10, 2004). The only two of these species that are listed as endangered under the ESA, and therefore strategic under the MMPA, are Humpback whales and pygmy sperm whales in the western North Atlantic.

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[7] To be considered a Category I fishery, the annual mortality and serious injury of a marine mammal stock in the fishery is greater than or equal to 50% of the PBR level. The PBR level is "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimal sustainable population" (69 CR 153, August 10 2004).

[8] Karin Forney. 2003. Personal Commun. Scientist. NOAA/SWFSC. 110 Shaffer Road, Santa Cruz CA 95060.

Of all the protected species interactions, pelagic longlines do not generally result in as much bycatch as other gear types such as gillnets (Lewison et al. 2004a; Reeves et al. 2005).

Marine mammals: population impacts
The annual PBR for the Hawaiian stock of false killer whales is 1.0, while the estimate of mortality and serious injury of this species in the Hawaii-based longline fishery is 4.4 individuals (Caretta et al. 2005). The contribution of pelagic longline gear to humpback whale mortalities is not included in the most recent humpback whale stock assessment; however, the average annual fishery-related mortality exceeds the PBR for this species (NMFS 2005d). There has also been one report of serious injury to a pygmy sperm whale in the pelagic longline fishery off Florida, and the average annual estimated mortality is 6 for this stock of marine mammals. Because the PBR is 3, this stock is considered strategic (NMFS 2005d).

Sharks and rays: bycatch rates
Despite their known vulnerability to overfishing, sharks have been increasingly exploited in recent decades, both as bycatch, from the 1960s onward, and as targets in directed fisheries, which expanded rapidly beginning in the 1980s (Baum et al. 2003). The most common shark and ray species caught in longline fisheries are blue sharks, silky sharks, pelagic stingrays, and oceanic whitetip sharks (Williams 1997). As with the other species caught as bycatch in pelagic longline fisheries targeting tunas, the type and quantity of shark bycatch may vary with fishing location, gear configuration, etc. In the New Zealand longline fishery for tuna, in which albacore is the most commonly caught species, blue, porbeagle, and shortfin mako sharks comprise most of the shark catch (Francis et al. 2001). In New Zealand waters, blue shark bycatch declined by about 40% from 1988-1989 to 1990-1991 while porbeagle and mako shark bycatch has been variable over the same time period (Francis et al. 2001). In the Japanese longline fishery operating in the EPO, the most common shark species caught are blue, silky, oceanic whitetip, crocodile, shortfin mako, longfin mako, salmon, bigeye thresher, and pelagic thresher sharks. From 1971 – 1997, the total shark bycatch in this fishery generally increased, although catch declined in 1996 and 1997 due to decreases in fishing effort (Okamoto and Bayliff 2003).

Based on observer data (42 sets observed in 2001 – 2002) in the U.S. west coast pelagic longline fishery, the discard rate varies greatly by species. Economically valuable species such as swordfish had a discard rate of approximately 14% while 100% of the blue sharks caught were discarded (PFMC and NMFS 2003). Blue sharks are the most commonly discarded species in the pelagic longline fishery, as well as *Carcharinus* spp. (Kelleher 2004). Data from the observer program in the U.S. Atlantic longline fishery targeting swordfish and tunas suggest that 69% of the blue sharks caught were released alive (Diaz and Serafy 2005). Discard mortality was higher in younger blue sharks (Diaz and Serafy 2005). Other than the recent work on the decline of Atlantic shark species by Baum et al. (2003), few data are available detailing the international exploitation of sharks, particularly in the Pacific. The magnitude of the declines found by Baum et al. (2003) has been challenged based on a number of factors, such as inadequate data and the exclusion of data sets such as stock assessments (Burgess et al. 2005). Earlier studies, such as that conducted by Stevens (1996) suggest that high seas Pacific fisheries take millions of blue sharks each year, with unknown consequences to the population structure of the species. Estimates of annual fishing mortality range from 10 to 20 million blue sharks worldwide (IUCN 2004). In the U.S. pelagic longline fleet in the Atlantic, pelagic shark discards are greater than the retained catch of pelagic sharks; in 2003 the discard/catch ratio for pelagic sharks was 0.88 (NMFS 2005e).

Limited observer data (an average of 6% observer coverage) from 1999 – 2003 in the WCPO show that after tuna (bigeye, yellowfin, and albacore), blue sharks were the most common species caught in the western tropical Pacific shallow-set fishery, the western tropical Pacific deep-set fishery, and the western South Pacific albacore fishery (Langley et al. 2005b). The number of blue sharks discarded relative to the number caught is not available in Langley et al. 2005b. In general, sharks and billfish were the most commonly non-tuna species caught. Molony (2005) found that shark CPUE was highest in the tropical shallow-set longline fishery, although levels were similar in the tropical deep-set longline fishery and the temperate albacore longline fishery. It is likely that shark catch is equivalent to shark mortality, as anecdotal evidence suggests that possibly all of the sharks brought on board are killed before being discarded (Molony 2005). In the central WCPO, total shark mortalities have been estimated at 500,000 – 1.4 million sharks annually based on observer data from the longline fisheries (Molony 2005).

In the Indian Ocean, South African observer data (from 9% of the hooks set) suggest a catch rate of 7 sharks/1000 hooks, with blue and mako sharks the most commonly caught shark species (IOTC 2005b).

Sharks and rays: population impacts

Blue sharks have been shown to be sensitive to low exploitation rates (Kleiber et al. 2001; Schindler et al. 2002), but in the Atlantic, blue shark biomass appears to be above B_{MSY} (ICCAT 2005b). The status of the Atlantic shortfin mako stock is highly uncertain, and it is possible that current biomass levels are below B_{MSY}, particularly in light of the 50% depletion seen in the CPUE data (ICCAT 2005b). Although blue sharks are not protected under the U.S. Endangered Species Act, the IUCN Red List of Threatened Species categorizes the blue shark as “Lower Risk,” which is close to qualifying for the “Vulnerable” category (IUCN 2004). The IUCN defines “Vulnerable” as facing a high risk of extinction in the wild (IUCN 2004). In addition to blue sharks, most other sharks caught in the Pacific are considered incidental catch and are not retained; the exceptions are thresher and mako sharks, whose meat has market value with no special processing required (NMFS 2003). Although most sharks are not kept, shark fins are frequently taken before the carcass is discarded and these sharks are counted as part of the catch in several distant water fishing nation (DWFN) fleets. The potential impact of this unaccounted additional mortality adds to the uncertain stock status of these species. Post-release mortality of discarded sharks is unknown. Given the observed declines in CPUE of heavily fished sharks in the Atlantic Ocean (Crowder and Myers 2001), and the fact that fishing pressure in the Pacific is greater than in the Atlantic (52% of global fishing effort in 2000 was in the Pacific, 37% in the Atlantic, 11% in the Indian Ocean) (Lewison et al. 2004b), it is reasonable to assume the incidental catch of many shark species in the Pacific may be having a negative impact on population levels.

As with seabirds and sea turtles, the impacts of longline fisheries on shark populations are not fully understood. The population consequences of bycatch for shark species in the Pacific is not well known, but the findings of Baum et al. (2003) in the Atlantic Ocean indicate caution is warranted for these highly vulnerable species. For more information on sharks, please see the Seafood Watch® Sharks Report available at: http://www.mbayaq.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_SharksReport.pdf.

Synthesis
Although there are limited data regarding international bycatch levels and trends, the continued bycatch of sea turtles, seabirds, marine mammals, sharks, billfish, and other pelagic fishes remains a critical conservation concern for the majority of tuna longline fleets. **In the absence of data demonstrating that bycatch rates are declining, Seafood Watch® must adopt the precautionary approach in considering the severity of the bycatch problem in global longline fisheries.** Even for those fisheries that can demonstrate low or declining bycatch as a result of sufficient observer coverage and management measures, the bycatch of species with vulnerable life histories (e.g., sea turtles and sharks) or critical stock status (e.g., some species of billfish) remains a high conservation concern. The jeopardy finding for leatherbacks in the Atlantic, combined with interaction rates that are not decreasing, results in a critical conservation concern for this fishery, which applies to both U.S. and international pelagic longline fisheries operating in the Atlantic. In addition, in the Atlantic there are several marine mammal species for which the PBR is exceeded in the pelagic longline fishery, and the continued bycatch of marlin species with critical stock status remains a concern. In the Pacific, the bycatch of leatherbacks, loggerheads, sharks, and seabirds results in a critical conservation concern. Albatross and spectacled petrel bycatch remains a problem in the southern Indian Ocean, South Atlantic, and the Mediterranean. Observer data from the Hawaii-based and U.S. Atlantic longline fisheries indicates that bycatch concerns in these fisheries are only a high concern compared to the critical bycatch concerns associated with global longline fisheries. The limited data available from the Mediterranean suggest high interaction rates with a number of species. Although there are no data available from the Indian Ocean, Seafood Watch® must adopt the precautionary approach and concludes that bycatch levels for protected and highly vulnerable bycatch species in this region remain a critical conservation concern. For the purposes of this report, generalizations are made in order to make recommendations to the general public, although Seafood Watch® recognizes that there are differences between the various longline fisheries. Country or fishery-specific data could be used to refute these generalizations.

Nature of Bycatch Rank:

Troll & pole and line (all oceans):

Low | Moderate | High | Critical

Hawaii-based Pacific longline;
U.S. Atlantic longline:

Low ▮ Moderate ▮ **High ▮** Critical ▮

International longline (all oceans):

Low ▮ Moderate ▮ High ▮ **Critical ▮**

<u>Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems</u>

Habitat Effects
Pelagic longline gear and troll/pole gear have no contact with the seafloor, and thus have negligible effects on its biogenic and physical habitat (Chuenpagdee et al. 2003).

Ecosystem Effects
It has been suggested the global oceans have lost 90% of the large predators such as tuna due to the expanding and pervasive pelagic longline fishery (Myers and Worm 2003). Based on CPUE data, Myers and Worm (2003) found that while catches in a previously unfished area remained high at first, catch declined after several years of fishing pressure. However, this argument has proven to be controversial, with questions raised concerning the methodology used (Walters 2003) and the magnitude of the declines (Hampton et al. 2005; Sibert et al. 2006). A recent study (Sibert et al. 2006) concluded that the magnitude of the decline in the biomass of large predators varied by stock and region; for instance, exploited bigeye and yellowfin declined in the western Pacific while skipjack increased. The authors acknowledge that more conservative management measures may be needed for ecosystem-based management (Walters et al. 2001 in Sibert et al. 2006). Both climate change and fishing pressure have been linked to ocean-wide declines in large predator diversity, with fishing being the primary driver behind long-term variation (Ward and Myers 2005; Worm et al. 2005). According to Worm et al. (2005), diversity in the world's oceans has declined by 10 – 50% over the last 50 years.

In the tropical Pacific, large-scale commercial fishing has been linked to ocean ecosystem changes, such as declines in large predator abundance and increases in small species abundance (Ward and Myers 2005). Ward and Myers (2005) used data from a scientific survey conducted in the 1950s and observer data from the 1990s to find that the number of albacore caught declined from 323 in the 1950s to 31 in the 1990s (Ward and Myers 2005). However, other studies have found less pronounced declines in large predators (Cox et al. 2002). Using an ecosystem model, Cox et al. (2002) found fewer declines of large predators such as tunas and billfishes in a larger area of the Pacific.

Kitchell et al. (2002) found that central North Pacific tuna and swordfish are likely more important predators than blue sharks. Pauly and Palomares (2005) found that the total length of tuna and billfish caught worldwide exhibited a continual decline from 1950 – 2000, and that "fishing down the foodweb" is more prevalent than previously thought.

Note that the environmental impacts of fishing are not limited to the direct impacts on the fisheries resource, but include emissions (e.g., from fossil fuel and anti-fouling paint) from the operating of these industrial fisheries (Hospido and Tyedmers 2005).

Synthesis
Pelagic longline gear and troll/pole gear have negligible habitat effects. The ecosystem effects of removing large predators such as tuna, however, remain controversial, particularly surrounding the methodology used as well as the magnitude of the observed declines. Due to the controversial nature of the ecosystem effects caused by the removal of large predators from the ecosystem by longline fisheries, combined with the benign habitat effects of troll/pole and longline gear, the conservation concern for troll/pole gear types is low, while the conservation concern for pelagic longlines is moderate for this criterion.

Effect of Fishing Practices Rank:

Troll & pole and line:

Benign Moderate Severe Critical

Longline:

Benign **Moderate** Severe Critical

<u>Criterion 5: Effectiveness of the Management Regime</u>

Management of albacore tuna varies by ocean basin (Table 6). Illegal, unreported, and unregulated (IUU) fishing, where vessels from one country are registered in another to avoid compliance with regulations, remains problematic throughout the world's oceans, particularly the longline fisheries. In the 1980s, for example, when quotas were implemented by the regional fishery management organizations (RFMOs), vessel owners registered their vessels in non-contracting parties to avoid the RFMO regulations. Additionally, some catches by IUU fishing may be transferred to legal fishing vessels at sea (IOTC 2002).

The existence of IUU fishing vessels introduces added uncertainty to the issue of bycatch in the pelagic longline fishery, as the incidental mortality of certain bycatch species may be substantial on these vessels, but its magnitude is unknown (Tuck et al. 2003). It is believed that IUU fishing is more prevalent in the Atlantic and Indian Oceans than in the Pacific Ocean (Tuck et al. 2003), but there are great uncertainties worldwide regarding the trend and extent of these IUU longline fisheries. The most stringent measures that the tuna commissions can implement are trade measures, and ICCAT was the first to do so, as well as discouraging buyers to buy from IUU vessels (Miyake 2005b). The IOTC and IATTC have followed suite by maintaining and publishing the list of IUU vessels fishing in their respective oceans (Miyake 2005b). In addition, smaller longline vessels are considered a different type of IUU vessel; because they are too small to be listed on the positive list of fishing vessels, they are not subject to the regulations that are imposed on the vessels that are listed (Miyake 2005b). As of June 2004, it was estimated that there are 30 IUU longliners in operation (Miyake 2005b). To address the issue of IUU, the U.S. has implemented a HMS international trade permit for all dealers who import or export bluefin tuna, swordfish, southern bluefin tuna, and bigeye tuna.

For tuna fisheries worldwide, regulations are generally based on recommendations by the commission (i.e., IATTC, ICCAT, etc.) staff or scientific committees, and implemented by member and cooperating countries. It is thus difficult to assess tuna management by ocean basin, as individual cooperating countries may or may not enforce the commission recommendations/regulations.

The complexity of tuna management is increased by the fact that tuna caught in one ocean may be transported to another region for processing, and fleets licensed in a country in one ocean may fish in other oceans (Bayliff et al. 2005). Despite management measures implemented by the tuna commissions, vessels are sometimes registered in countries that do not require their vessels to comply, purposely to avoid these regulations (Bayliff et al. 2005).

Overall, the decline of some tuna stocks has been in part due to the open-access nature of the tuna fisheries, and additionally there is little regulation on the non-industrial fleets (Bayliff et al. 2005). Thus, a rights-based management system that also considers the non-industrial fleets may be the best option to be effective and curtail the growth of the tuna fleets (Bayliff et al. 2005). Many countries have limits on the number of large-scale longliners, but not the small and medium sized longliners (Miyake 2005b). To improve tuna fisheries management, a Technical Advisory Committee to the FAO recommended some of the following changes (Bayliff et al. 2005):

- A moratorium on the entry of large-scale tuna vessels until there is an improved management system for fishing capacity.
- A system for the transfer of fishing capacity.
- Monitoring, surveillance, and control systems to manage fishing capacity.

Fishing capacity has been reduced by some countries; Japan for instance, reduced its fishing capacity (licenses given to large-scale tuna longliners) by 20% in 2001 as a result of the FAO's 1999 International Plan of Action (IPOA) (Miyake 2005a). In 2001, China adopted a limited-license system (Miyake 2005a). While some fleets have limited the number of licenses (Republic of Korea in the 1980s, Taiwan and China in 2003), other countries have continued to issue fishing licenses without any restrictions (Panama, Honduras, Belize, Vanuatu, Cambodia) (Miyake 2005a).

It has been estimated that 20% observer coverage is a minimal level for common bycatch species and 50% is the minimal level for rare species (Babcock et al. 2003). Factors such as the size of a fishery and the distribution of catch may warrant increased levels of observer coverage (Babcock et al. 2003). In some instances low mortality levels can jeopardize the recovery of a protected species, and 100% observer coverage is necessary (Babcock et al. 2003).

Atlantic Ocean
The International Commission for the Conservation of Atlantic Tunas (ICCAT) is the international management agency responsible for albacore management in the Atlantic Ocean (including the Mediterranean Sea). Individual countries may have their own management measures for their respective tuna fisheries. U.S. fisheries operating in the Atlantic are managed by the HMS Division of NMFS.

The Standing Committee on Research and Statistics (SCRS) is the fishery statistics body of ICCAT, and provides advice on issues such as stock status and fishing effort. Within the SCRS, there are several sub-committees, including a Sub-Committee on Bycatch, which is responsible for research and analysis of bycatch issues. There is no comprehensive observer program in the Atlantic, no requirements for logbook reporting, and no bycatch reduction plan in place. Some fleets do have observer programs, while others use logbook data to report bycatch (ICCAT 2005a); however, specific bycatch reduction measures have been implemented fleet-wide only in the U.S. pelagic longline fleet in the Atlantic.

The U.S. pelagic longline fishery targeting tuna in the Atlantic is managed under the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks. The bycatch reduction program put into place by NMFS includes gear modifications and time/area closures (see Figure A1 in Appendix for map of closed areas). The Atlantic pelagic longline fishery was closed from 2001 – 2004 in the Northeast Distant Waters (NED) due to high sea turtle bycatch rates. Bycatch reduction measures, including testing of different hook sizes and bait types, were conducted in this region to determine if the bycatch of sea turtles could be reduced using gear and fishing modifications. Study results concluded that using 18/0 circle hooks and mackerel bait reduced the bycatch of both loggerheads and leatherbacks (Watson et al. 2005). When these measures were used concurrently, loggerhead interactions were reduced by 90% and leatherback interactions were reduced by 65%; circle hooks have also been shown to have lower mortality rates than J hooks when sea turtles are caught (Watson et al. 2005). However, the study did not include data on post-hooking mortality. The authors conclude that foul hooking of leatherbacks is likely to be reduced by the use of both 16/0 and 18/0 hooks, and that the experimental results are applicable to other regions, as a large size range of leatherbacks were caught in the study (Watson et al. 2005). However, the authors caution that the experimental results for loggerheads apply only to the size range of loggerheads caught, and only to the 18/0 hook size (Watson et al. 2005). In the Azores, Bolten et al. (2002) found that 16/0 circle hooks did not reduce sea turtle interactions compared to 9/0 J hooks.

As a result of the NED research, current bycatch mitigation requirements in the Atlantic include mandatory use of circle hooks and specified bait, and mandatory possession and use of sea turtle release equipment (69 FR 128, July 6, 2004). Within the NED area, only 18/0 circle hooks with either squid or mackerel bait may be used. Outside of the NED area, 16/0 (non-offset only) or 18/0 circle hooks may be used with whole finfish or squid bait (69 FR 128, July 6, 2004). Bycatch assessments are conducted as are corresponding time/area investigations. The use of live bait in the longline fishery in the Gulf of Mexico is prohibited under a "Regulatory" Amendment 1 to the HMS FMP due to concerns of billfish bycatch (NMFS 2004a). To date, the time/area closures established in the Atlantic appear to be successful at reducing the discarding of most HMS, excluding large coastal sharks (NMFS 2004a). In the Gulf of Mexico, all Mexican longline vessels are required to have an observer on board during all trips. Observer coverage for U.S. vessels in the Gulf of Mexico has ranged from 3 – 5% (Brown et al. 2004), although the minimum observer coverage level is 8% throughout the Atlantic (including the Gulf of Mexico and Caribbean) versus just 5% in the Gulf of Mexico (NMFS 2004d).

There are quotas in place for albacore in the North and South Atlantic; the total allowable catch (TAC) for albacore in the North Atlantic has been 34,500 mt since 2001, and this was recently extended until 2006 (ICCAT 2004). Catches for 2001, 2002, and 2003 were below the TAC (ICCAT 2004). Fishing capacity is limited to the 1993 – 1995 average (ICCAT 2004); however, the SCRS is unable to determine whether or not these regulations are effective (ICCAT 2004). The SCRS recommends that catches not exceed 31,000 mt (ICCAT 2004). The North Atlantic stock productivity has not been maintained, as the stock is currently overfished and undergoing overfishing, and landings have generally declined. In the South Atlantic, the TAC for the albacore stock has been set at 29,200 mt since 1999 and was set at this level until 2004 (ICCAT 2004). From 2000 – 2002, catches exceeded the TAC, but did not do so in 2003 (ICCAT 2004). As in the North Atlantic, the SCRS has not determined whether or not the established regulations are effective (ICCAT 2004). The SCRS recommends that the catch not exceed 31,000 mt for the next three to five years (ICCAT 2004). Stock productivity has been maintained in the South Atlantic, as the albacore stock is considered healthy according to Seafood Watch® criteria and landings have generally been stable.

International fishing fleets operating in the Atlantic are not managed by a comprehensive enforcement system, and there is no international observer program to quantify the amount of bycatch in the pelagic longline fisheries operating throughout the Atlantic. Taiwan, for instance, implemented an experimental observer program in 2001, placing a total of six observers in the Atlantic, Pacific, and Indian Oceans in 2002 and 2003 (SCTB 2003). There is also an observer program for the U.S. fisheries. ICCAT has not taken the steps necessary to prevent the overfishing of several billfish species. Bycatch of sharks has also not been addressed, as ICCAT has not implemented any management measures for shark species (ICCAT 2005). Additionally, current shark statistics that are reported to ICCAT are not thought to represent the actual removals by the reporting fisheries (ICCAT 2005).

In the Mediterranean, ICCAT has not implemented any regulations regarding albacore. Several factors have been identified by the IUCN as contributing to fisheries problems in the Mediterranean, including insufficient regulations, control, and enforcement, and disregard for regulation (IUCN 2000). It is unknown if the stock productivity of albacore in the

Mediterranean has been maintained, as data are judged to be inadequate and no stock assessment has been conducted despite increased landings. The FAO Regional Fishery Body in the Mediterranean, the General Fisheries Commission for the Mediterranean (GFCM), found that there are insufficient data to conduct an assessment of albacore in the Mediterranean (FAO 2004).

Pacific Ocean
In the Pacific, the Forum Fisheries Agency (FFA) and the Secretariat of the Pacific Community (SPC) conduct research and coordinate agreements between Pacific Island nations (Safina 2001). The Western and Central Pacific Fisheries Commission (WCPFC) came into force in June 2004, and the newly established Commission has the competence to regulate and manage all highly migratory species (HMS) in the western and central Pacific, although its initial focus is on four tuna stocks. Tuna fishing fleets are also subject to domestic fisheries regulations within EEZs and in some cases on the high seas; the U.S. fisheries are also managed by NMFS, the Pacific Fishery Management Council (PFMC), and the Western Pacific Regional Fishery Management Council (WPFMC). There is no quota for albacore in the Pacific.

U.S. fisheries targeting albacore in the U.S. EEZ around Hawaii and the U.S. Pacific Islands are managed under the Pacific Pelagics Fishery Ecosystem Plan. Management measures included in the plan include fishing permits, area closures, observer requirements, and catch reporting. The Hawaii-based longline fleet operates under a number of new management measures to minimize protected species interactions and bycatch. These measures include: an effort limit on the number of shallow sets north of the equator (2,120 shallow sets per year); the requirement that all shallow sets made north of the equator use circle hooks 18/0 or larger with a 10-degree offset and only mackerel-type bait; and the provision that shallow sets made north of the equator must occur at night. There is also a limit on the number of allowable interactions with leatherbacks (16) and loggerheads (17); if either of these limits is reached the shallow-set fishery is closed for the remainder of the year (69 FR 64 April 2, 2004). The fishery was closed in March 2006 as a result of 17 loggerhead interactions with the fishery.

The requirements for hook and bait type now apply to all permitted vessels shallow-setting north of the equator in the Pacific, not just the Hawaii-based vessels (WPFMC 2006). These regulations do not apply to the deep-set longline fishery targeting several species of tuna, however. To clearly differentiate between shallow sets and deep sets, deep sets are required to have a minimum of 15 branch lines between successive floats, use a float line at least 20 m in length, set the main line using a line shooter, and not retain more than 10 swordfish per trip (Federal Register April 2, 2004, volume 69, pages 17329-17354). These regulations have resulted in longlines targeting tuna being set deeper in the water column, and possibly inadvertently reducing sea turtle interactions with the deep-set fishery. There is an average of 20% observer coverage on deep-set longline vessels.

Blue-dyed bait is often used in pelagic longline fisheries, as it is thought to increase fish catches (McNamara et al. 1999 in Swimmer et al. 2005). Blue-dyed bait has been shown to reduce seabird bycatch in pelagic longline fisheries; however, it has not been shown to reduce sea turtle bycatch in these fisheries (Swimmer et al. 2005). Required seabird mitigation measures for the deep-set tuna fishery include the use of thawed, blue dyed-bait, strategic offal discharge, and the use of a line-setting machine. Optional measures include night setting, side setting, and the use of Tori lines or towed buoys (PIRO 2005).

U.S. fisheries targeting albacore in the U.S. EEZ off the west coast are managed under the HMS Fishery Management Plan (FMP). Under the FMP, there are no quotas for any HMS, but there are permitting and reporting requirements. U.S. vessels fishing in the high seas and landing their catch in the U.S. must also follow the management measures specified in the HMS FMP. Area closures implemented under this FMP include the prohibition of longlines targeting HMS within the HMS management area (PFMC 2005b). In 2005, 100% logbook reporting was required, rather than the previous 40% (Stocker 2005). Canada is a major supplier of the fresh and frozen tuna imported into the U.S.; 59% of the tuna landed in Canada is landed on the Atlantic coast, while 41% is landed in British Columbia (DFO website 2005). On the Pacific coast, the U.S./Canada Albacore Treaty permits troll vessels from either nation to fish in the other nation's EEZ and land albacore in specified ports. Effort limits were introduced under the Albacore Treaty for the first time in 2004. The Pacific Region of Fisheries and Oceans Canada manages the Canadian albacore troll fishery under the Tuna Integrated Fisheries Management Plan (IFMP), and the most current IFMP covers April 1, 2005 – March 31, 2006. This IFMP covers albacore in the Canadian EEZs, as well as high seas albacore caught by the Canadian fleet. Management measures include reporting requirements, monitoring and surveillance of Canadian vessels, and a prohibition on Canadian longline fleets fishing in U.S. waters.

In the Pacific, there is no basin-wide observer program (either internationally mandated or Commission implemented) or logbook requirement program, although individual countries may have these programs in place. In the eastern Pacific (EPO), for instance, logbook coverage for the Japanese fleets ranged from 92 – 97.8% from 1995 to 1997 (Okamoto and Bayliff 2003). The U.S. and EU both have observer programs. Canadian jig fleets carry logbooks when fishing for HMS, which includes information on the catch and bycatch of all fish caught (in numbers), fishing effort, location, average fish weight, and sea surface temperature (Stocker and Shaw 2003). The U.S. troll fishery in the North Pacific has collected logbook data since 1954 (Childers 2003).

In the South Pacific, the U.S. troll fishery has collected logbook and catch data since 1986, and length-frequency data since 1987 (Childers 2003). There are national observer programs for Fiji, Marshall Islands, Papua New Guinea, Palau, and the Solomon Islands (Williams 1997), as well as other countries such as Australia and New Zealand. Management measures implemented in Australian waters include gear restrictions to reduce soak times (and therefore some marlin mortality) and closed areas to minimize interactions with certain billfish species (Findlay et al. 2003). The WCPFC recently voted to cap effort in the North Pacific at current levels, and in the South Pacific, the number of vessels fishing in the WCPFC convention area will be limited to 2005 levels or an average of the last five years. Catches will also be capped at 2005 levels or an average of the last five years (WPFMC 2006).

Throughout the Pacific, stock productivity has generally been maintained. Catches have been at or above the average maximum sustainable yield over the last 15 years (IATTC 2000), and the stock status of North Pacific albacore is of moderate concern. There is no TAC for albacore in the Pacific, nor is there a comprehensive enforcement program. The IATTC has, however, passed numerous resolutions regarding the management of tuna in the EPO. The Consolidated Resolution on Bycatch, for example, requires that all purse seine-caught skipjack, bigeye, and yellowfin are retained and landed to minimize the discarding of juveniles. The resolution also requires fishermen to release all sea turtles to the extent practicable.

Indian Ocean
The Indian Ocean Tuna Commission (IOTC), which is a fishery body of the FAO, has responsibility for management of albacore in the Indian Ocean. In 2003, there were 348 large-scale, licensed vessels fishing for tuna and tuna-like species in the Indian Ocean (IOTC 2004). There are no specific regulations governing the management of albacore in the Indian Ocean, but the IOTC has passed numerous resolutions. There is no quota for albacore, and no comprehensive bycatch reduction plan. It is unknown whether enforcement of regulations in the Indian Ocean is adequate, and it is unknown if scientific advice is followed or not. Overall, stock productivity of albacore in the Indian Ocean has not been maintained, as this albacore stock is overfished and undergoing overfishing. In addition, albacore catches have been increasing in the Indian Ocean since the early 1950s.

Protected Species Interactions
Although albacore is not always the target species for pelagic longline operations, albacore is caught and retained in trips targeting species such as yellowfin and bigeye. Thus, protected species interactions apply to the target species as well as secondary species that are retained such as albacore.

To date, studies of sea turtle bycatch mitigation have been fishery-specific. However, there are currently a number of additional mitigation measures being studied, including the use of small circle hooks in place of small J and Japan style hooks, setting gear at deeper depths where turtles are less abundant, reducing soak times, and avoiding bycatch hotspots (Gilman et al. 2006). Differences between study results may be due to the number of turtles caught in different fisheries, as well as different target species, gear methods, etc. (Gilman et al. 2006). There are also important differences between the shallow and deep-set fisheries, as turtles caught in the deep-set fishery are likely to drown regardless of where they are hooked (Gilman et al. 2006).

It is important to note that options that are viable for some fisheries may not be viable for others; while the Hawaii fleet can set longlines at depths > 100 m with little/no change in target species CPUE, for example, this option is not economically viable for Ecuadorian vessels targeting tuna and dolphinfish (Gilman et al. 2006). Particular longline fisheries may also have higher sea turtle bycatch than others. For instance, the artisanal longline fleet in Ecuador, which uses shallow sets and small J hooks to target bigeye and swordfish, also overlaps with the migration paths of leatherback and olive ridley turtles (Eckert 1997; Spotila et al. 2000; Hall 2003). In addition, high sea turtle capture rates have been documented in the Peruvian and Costa Rican dolphinfish fisheries (Programa Restauración de Tortugas Marinas unpub. data; Alfaro-Shigueto et al. in press a, b). Pelagic longline fisheries in the eastern Pacific and Mediterranean have been identified as high priority fleets threatening sea turtles (FAO 2004b).

In several Central and South American countries (e.g., Ecuador, Costa Rica, Brazil, Chile, Peru, Columbia, Panama, and Guatemala) work is being conducted with fishermen in the pelagic longline fishery to exchange J hooks and small circle hooks for larger circle hooks. Results from the first year of the program in Ecuador show that circle hooks reduced the hooking rates of sea turtles by 44 – 88% in the tuna fishery as well as the hooking severity (Largacha et al. 2005).

Due to the lack of a comprehensive bycatch plan by any of the international regulatory bodies, bycatch mitigation research and measures vary by fishing nation, rather than ocean basin. Japan, Taiwan, and Spain are working to address seabird bycatch in their longline fisheries (IATTC 2004b), for example, and Japan also recently proposed a three-year program to the IATTC that would collect data on sea turtle bycatch and work on measures to address this bycatch. At the 2004 IATTC meeting held in Japan, several measures were proposed for the longline fishery targeting tuna in the Pacific, including, but not limited to: the requirement that fishers promptly release all unharmed sea turtles caught during fishing; the requirement that fishers make every effort to remove hooks and lines from such sea turtles before they are released; and the initiation of observer programs for longline tuna fleets (IATTC 2004c).

The current absence of an observer program in this fishery remains a concern for Seafood Watch®, as it does not demonstrate a precautionary approach to the management of protected species interactions. The exception is Taiwan, as it has taken some measures to protect species by establishing a sanctuary area for green turtles southwest of Taiwan (SCTB 2003), and has begun to address the issue of seabird bycatch through an observer program (D. Nel, pers. comm. in Tuck et al. 2003). Taiwanese fleets are encouraged through an incentive program to install vessel monitoring systems (VMS), although it is not mandated (SCTB 2003).

Although mitigation measures may be in place, actual mitigation use has been poor (Tuck et al. 2003). Japanese researchers have initiated research to address sea turtle interactions with the longline fishery, and they have developed standard methods to handle sea turtles that are hauled on deck when the longline is retrieved (Masashi et al. 2003). Japanese fishers have been required to keep logbooks on shark catch since 1952, and these data show that the catch of blue sharks has been stable over this time period (Masashi et al. 2003). However, if a shark is finned or discarded it is not required to be recorded. In addition, seabird bycatch mitigation devices such as tori poles (a line and streamers towed from a pole on the stern of a fishing vessel) are required in the southern bluefin tuna fishery, but not for the albacore fishery (Masashi et al. 2003). New Zealand regulations include mandatory use of bird-scaring devices, and 100% observer coverage on large vessels (Tuck et al. 2003). Observer coverage on Australian vessels in domestic waters has been poor (less than 1% of effort observed over the last 5 years), although observer coverage increased in 2002 (A. DeFries, pers. comm. in Tuck et al. 2003). There are observer programs for the Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Marshall Islands, Nauru, New Caledonia, Palau, Papua New Guinea, Samoa, Solomon Islands, and Tonga. In the WCPO, observer coverage varies by fishing method and region, and comprehensive observer programs have only been in place for the last 10 years (Langley et al. 2005b). Thus, observer data are limited and cannot be used to estimate overall catches by these fleets (Langley et al. 2005b). For instance, observer coverage for the U.S. and Pacific Island fleets operating in the WCPO is considered high, at >20%, while observer coverage for the Taiwan, Japan, and Korea fleets is <5% (Langley et al. 2005b). In the WCPO, logbook data do not generally include non-commercial catch (i.e., protected species) (Molony 2005), and are thus not useful in tracking bycatch of non-commercial species.

Table 6. Commercial management measures for the albacore fishery.

Region	Management Jurisdictions & Agencies	Total Allowable Landings	Size Limit	Gear Restrictions	Trip Limit	Area Closures	Sources
Atlantic Ocean	ICCAT, NMFS	34,500 mt in the North Atlantic, 29,200 mt in the South Atlantic	None	Several gear restrictions and area closures designed to reduce non-target species bycatch in addition to protected species and sea turtles; net gear not permitted in Canadian fishery	None	Closed areas to reduce protected species bycatch (U.S. fishery)	NMFS 2004c
Pacific Ocean	IATTC, NMFS, PFMC, WPFMC, WCPFC	None	None	Longlining prohibited in U.S. EEZ off the coast of CA, OR, WA	None	Closed areas to reduce protected species bycatch (U.S. fishery)	IATTC; WPFMC
Indian Ocean	IOTC	None	None	None	None	None	IOTC 2004
Mediterranean Sea	ICCAT, GFCM	None	None	None	None	None	ICCAT 2005

Synthesis

There is no comprehensive observer program for the international pelagic longline fleets, although many countries are actively conducting research regarding bycatch mitigation. While several countries have begun to modify their longline gear with hook/bait combinations and other bycatch mitigation efforts, Seafood Watch® adopts a precautionary approach until these modifications are implemented as regulations. There is also no comprehensive international enforcement program, as enforcement is the responsibility of individual countries and not the international management agencies. Management of the tuna fisheries is complex, and while there are concerns with the management of some gear types (e.g., bycatch in the longline fishery), these same concerns may be minimal for other gear types (e.g., bycatch in the troll fishery).

In the Pacific, there is a complete and robust stock assessment, and adequate scientific monitoring. Management has not been in place long enough to determine if management measures have maintained stock productivity, however. In the North Pacific, management of the Hawaii longline fishery is considered highly effective primarily due to the effectiveness of their bycatch reduction plan and enforcement of management measures. Management of the U.S. and Canada troll fisheries is considered highly effective as a result of the provisions of the U.S./Canada Albacore Treaty, such as effort limits and enforcement. Management of the international longline fisheries operating in the Pacific is deemed moderately effective due to a lack of a bycatch mitigation plan and inadequate enforcement.

In the Atlantic, there is also a complete and robust stock assessment and adequate scientific monitoring. Management of U.S. fisheries in the Atlantic is deemed effective due to adequate enforcement and data collection, as well as regulations regarding gear modifications in the longline fishery (i.e., hook and bait use). International longline fishery management in the North Atlantic is deemed ineffective due to the combined issues of bycatch, enforcement, and the fact that management measures have not maintained stock productivity in the region. International longline fishery management in the South Atlantic is deemed moderately effective, as this stock is not in as poor a condition as the North Atlantic stock. In the Mediterranean there are no management measures for albacore, thus management of this fishery is deemed a critical conservation concern.

In the Indian Ocean, management measures have not maintained stock productivity, there is moderate uncertainty associated with the most recent stock assessment, and there is no bycatch mitigation plan or enforcement. Management of the longline fisheries in the Indian Ocean is therefore deemed ineffective. Management of the pole and line fishery in the Indian Ocean, on the other hand, is deemed moderately effective, as this fishery does not have the same bycatch concerns as the longline fishery.

Effectiveness of Management Rank:

North Pacific (Hawaii longline);
Pacific (U.S. and Canada troll);
Atlantic (U.S. longline):

Highly Effective Moderately Effective Ineffective Critical

Pacific (international, all gears);
Atlantic (international troll/pole);
South Atlantic (international longline);
Indian Ocean (troll/pole):

Highly Effective **Moderately Effective** Ineffective Critical

North Atlantic (international longline);
Indian Ocean (longline):

Highly Effective Moderately Effective **Ineffective** Critical

Mediterranean:

Highly Effective Moderately Effective Ineffective **Critical**

IV. Overall Evaluation and Seafood Recommendation

Albacore is highly migratory with a broad geographic range, early age at maturity, moderate longevity, and high fecundity. These characteristics make it inherently resilient to fishing pressure. There are six albacore stocks occurring throughout the world's oceans: the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian Ocean, and Mediterranean Sea stocks. The status of these stocks varies by location, with the South Pacific and South Atlantic stocks considered healthy, the North Pacific stock deemed a moderate conservation concern, the status of the Mediterranean stock unknown, the Indian Ocean stock overfished and thus deemed a high conservation concern, and the North Atlantic stock deemed a critical conservation concern as it is overfished and undergoing overfishing. Albacore landings in both the Mediterranean Sea and Indian Ocean have been increasing steadily, despite the unknown status of these stocks, and thus caution is warranted.

The gear most commonly used to catch albacore are pelagic longlines, troll gear, and pole and line gear (i.e., baitboats). Pelagic longlines result in the incidental catch, or bycatch, of a number of species including endangered and threatened sea turtles, seabirds, marine mammals, sharks, billfish, and other finfish. There are little data detailing the levels and trends in this bycatch in the global longline fisheries. Bycatch is deemed a critical concern in all those fisheries for which there are no data demonstrating a decline in bycatch, or demonstrating that bycatch levels are not limiting the recovery of any bycatch species. There is minimal bycatch in the troll/pole fisheries, thus it is a low conservation concern. Likewise, the habitat and ecosystem effects of troll/pole gear are considered benign due to the lack of contact with the seafloor. The habitat and ecosystem effects of pelagic longlining are a moderate conservation concern due to potential effects of the removal of large predators from the ecosystem.

Management of the albacore resource is complex, with numerous international management organizations in addition to individual country management measures. The management rankings are as follows: Hawaii-based longline, U.S. Atlantic longline and U.S. and Canada troll fisheries in the Pacific are deemed highly effective; Pacific international (all gears), South Atlantic longline, Atlantic international troll/pole, and Indian Ocean troll/pole fisheries are deemed moderately effective; Atlantic Ocean international longline and Indian Ocean longline fisheries are deemed ineffective; and Mediterranean management is deemed critically ineffective.

Overall, troll-caught albacore from the North and South Pacific and pole and line caught albacore from the South Atlantic is considered a **Best Choice** due to negligible bycatch and healthy to moderate stocks in these regions. Albacore from the Hawaii-based longline fishery is a **Good Alternative** due to reduced bycatch concerns in this fishery compared to the international longline fisheries, as well as effective management of the fishery. Troll/pole caught albacore from the Indian Ocean is a **Good Alternative** due to concerns with the stock status of albacore in the Indian Ocean. Various bycatch, management, and stock concerns throughout these oceans result in a ranking of **Avoid** for longline-caught albacore in international fisheries. Longline-caught albacore in the U.S. fishery in the Atlantic Ocean is also ranked as **Avoid** due to bycatch and stock status concerns. Troll/pole caught albacore from the North Atlantic and Mediterranean is recommended as **Avoid** due to stock status and management concerns.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherent Vulnerability	√			
Status of Stocks	**√ South Pacific, South Atlantic**	**√ North Pacific, Mediterranean**	**√ Indian Ocean**	**√ North Atlantic**
Nature of Bycatch	**√ Troll/pole**		**√ Longline (Hawaii; U.S. Atlantic)**	**√ Longline (all other)**
Habitat & Ecosystem Effects	**√ Troll/pole**	**√ Longline**		
Management Effectiveness	**√ Pacific (U.S. and Canada troll/pole); Hawaii longline; U.S. Atlantic longline**	**√ Pacific (international, all gears); Atlantic (troll/pole); Indian Ocean (troll/pole)**	**√ Indian Ocean (longline); North Atlantic (international longline)**	**√ Mediterranean**

Overall Seafood Recommendation

Seafood Watch® Recommendation	Where Caught and Gear Used
Best Choice	South Atlantic and South Pacific troll/pole
	North Pacific troll/pole (U.S. and Canada/BC)
Good Alternative	North Pacific troll/pole (non-U.S.)
	Hawaii-based (North Pacific) longline
	Indian Ocean troll/pole
Avoid	North Atlantic troll/pole
	South Pacific and South Atlantic longline
	North Atlantic longline (U.S.)
	North Pacific longline (imported)
	Indian Ocean longline
	North Atlantic longline (imported)
	Mediterranean any gear

Supplemental Information

Health consumption information on the Seafood Watch® pocket guides is provided by Environmental Defense. Environmental Defense applies the same risk-based methodology as the U.S. Environmental Protection Agency (EPA) to data from government studies and papers published in scientific journals. The Environmental Defense consumption advisory for albacore is based on mercury contamination. The number of meals of albacore that can safely be eaten each month is 3 for females, 3 for males, 2 for older children, and 1 for younger children. More detailed information about the Environmental Defense advisory can be found at http://www.oceansalive.org/eat.cfm?subnav=fishpage&fish=152.

The U.S. FDA/EPA joint consumption advisory recommends that women of child-bearing age and children eat up to 6 ounces (1 meal-size) of albacore tuna per week (FDA/EPA 2004). However, studies have shown that the mean level of mercury found in canned albacore (0.407 parts per million, ppm) is significantly higher than the mean value used in the FDA risk assessment (0.17 ppm) (Burger and Gochfeld 2004). The FDA limit for human consumption is 1.0 ppm (FDA 1994).

Troll/pole caught albacore have lower mercury levels (average total mercury content of 0.14 ppm), as these gear methods catch younger tuna (Morrissey et al. 2004). Older tuna caught in deeper waters with longline gear are likely to have higher mercury levels in their tissue.

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Appendix I

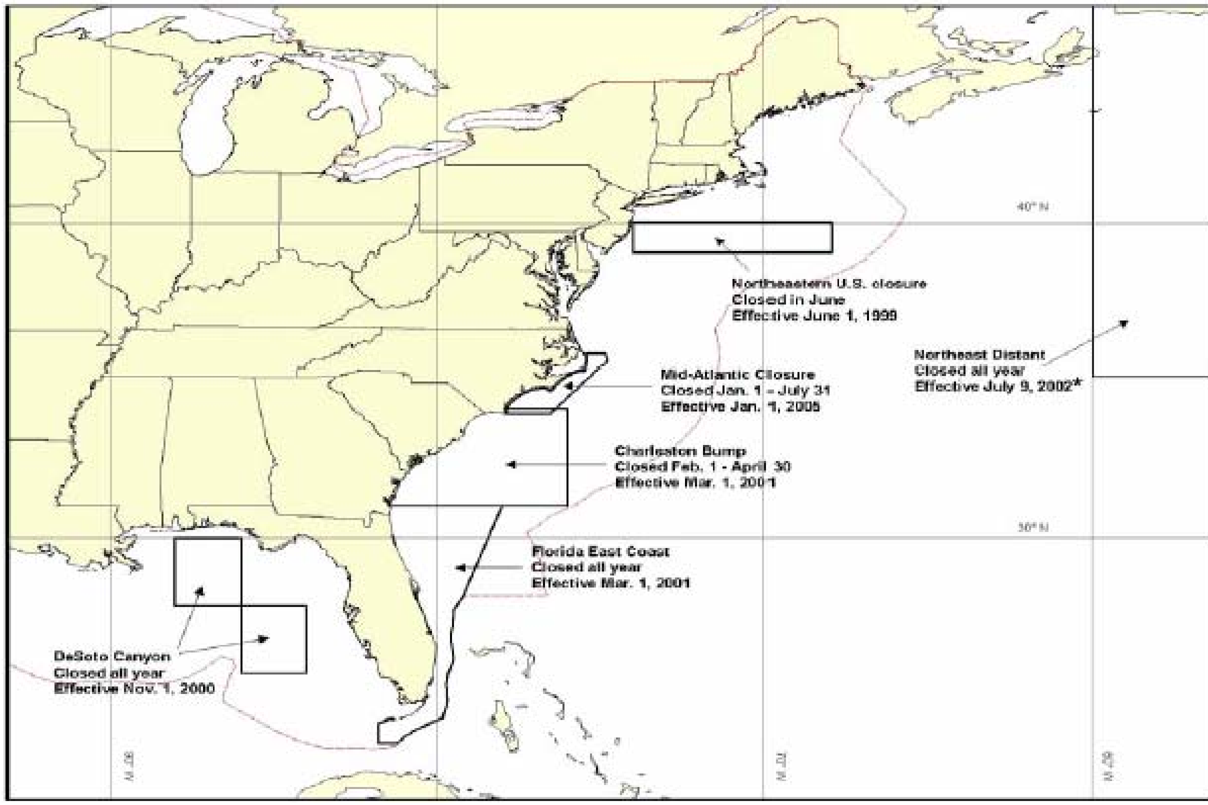

Figure A1. Map of closed areas in the Atlantic to the U.S. pelagic longline fleet. Several closures have been implemented in the Atlantic, including the De Soto Canyon closure, the Charleston Bump Closure Area, the Florida East Coast Closure, and the Northeast Distant (NED) Statistical Reporting Area (NMFS 2004). Effective March 1, 2001, the Charleston Bump Closure Area is closed each year from February to April; recent data suggests that numbers of most discarded species has declined since the implementation of the closure (NMFS 2004). The Florida East Coast Closure was implemented synchronously with the Charleston Bump closure, with most species showing considerable declines in discards (NMFS 2004). The NED closure was a result of an emergency rule due to sea turtle interactions with pelagic longlines (NMFS 2004). The June Mid-Atlantic Bight closure was implemented in 1999 to decrease the bycatch of bluefin tuna in the pelagic longline fishery (NMFS 2004).

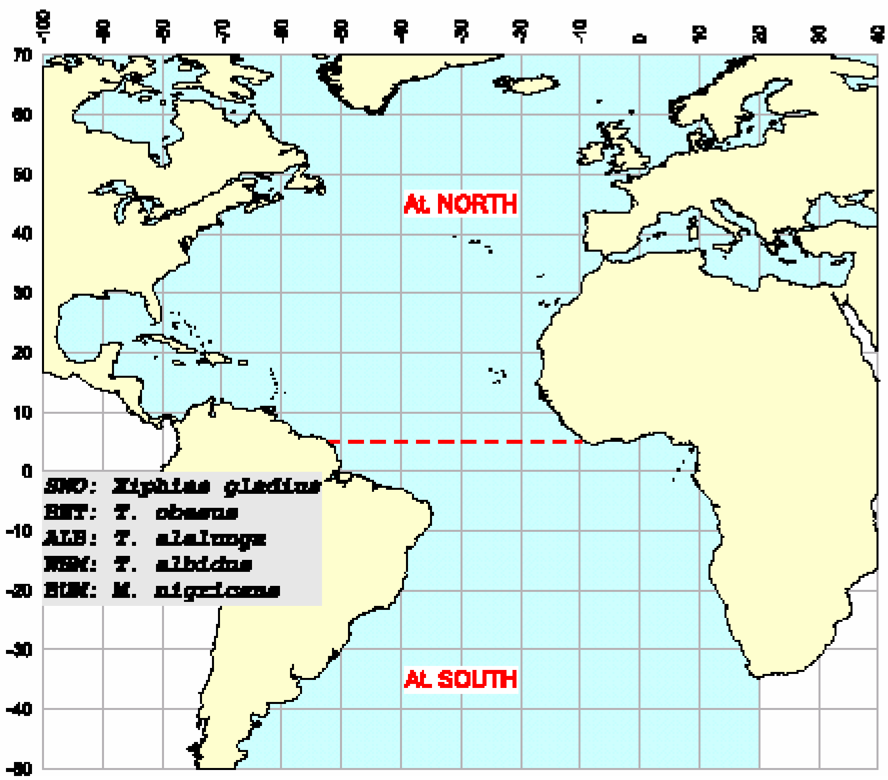

Figure A2. Stock boundary for albacore in the Atlantic (Figure from Statistical Bulletin Vol. 34, ICCAT, June 2005, Available at: http://www.iccat.es/Documents/SCRS/Other/StatBull.pdf)