Seafood Watch

Seafood Report

MONTEREY BAY AQUARIUM®

Tongol tuna

Thunnus tonggol

Illustration © Scandinavian Fishing Yearbook

Thailand, Indonesia, Malaysia and Iran

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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 www.seafoodwatch.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® 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 1-877-229-9990.

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I. Executive Summary

Tongol tuna (*Thunnus tonggol*) is a neritic tuna species found on the continental shelves of the Indian and western Pacific Ocean basins. A number of fishing gear types including purse seine, drift gillnet, handline and troll are used to capture tongol tuna across its range at both subsistence and commercial scales. In the United States, tongol tuna is primarily found in canned products. Since the start of commercial exploitation, landings have steadily increased along with the growing popularity of tongol as an alternative to canned albacore.

While the intrinsic growth rate and maximum age of tongol tuna are unknown, other life history characteristics, such as its high fecundity and early age at maturity, suggest that the species is inherently resilient to fishing pressure. Tongol tunas are attracted in schools to fish aggregating devices, but this behavior is not thought to have a substantial impact on their overall vulnerability to fishing pressure. Accordingly, there is little conservation concern about the inherent vulnerability of tongol tuna.

Apart from the localized, sub-regional scale, no stock assessments have been conducted for tongol tuna. Therefore, the status of Indian and western Pacific Ocean stocks is highly uncertain, suggesting a moderate conservation concern. Additional mortality may result from incidental landings in longline fisheries for sharks and large pelagic tuna species like albacore (*Thunnus alalunga*), bigeye (*Thunnus obesus*) and yellowfin (*Thunnus albacares*). There are no reliable estimates of fishery-based and natural tongol mortality, raising a moderate stock status conservation concern.

There is no current information on bycatch specific to the tongol fishery. Information from other fisheries for tuna and tuna-like species in the Indian and western Pacific Oceans suggests a significant bycatch risk for a number of sharks, dolphins and turtles in tongol fisheries that use drift gillnets, handlines/trolls and floating object set purse seines. The conservation concern for bycatch in handline/troll fisheries for tongol tuna is considered moderate according to Seafood Watch® criteria due to moderate levels of shark bycatch. The conservation concern for bycatch in FAD/floating object purse seines and drift gillnets is high. The habitat and ecosystem impacts of the gear types used to capture tongol are low since handlines/trolls, drift gillnets and purse seines have minimal contact with seafloor habitats. However, the overall ecosystem impacts of commercial-scale tongol fishing are not fully understood.

The only available management directive specifically applicable to the tongol tuna fishery is a recent ban on the commercial extraction of tongol tuna from Australian waters. This ban was established primarily to maintain the viability of the recreational tongol fishery. The Indian Ocean Tuna Commission (IOTC) is the only regional fisheries management body listing tongol management within its jurisdiction. This regional fishery management organization (RFMO) has acknowledged both the sparsity and uncertainty of existing data and is moving to review tongol tuna and other species of growing commercial importance in the near future. The Western and Central Pacific Fisheries Commission (WCPFC) has jurisdiction over tongol management in the western Pacific, but has made no effort to coordinate management of this species with its member nations.

Management efforts in the four nations (Indonesia, Iran, Malaysia and Thailand) that accounted for nearly 90% of tongol tuna landing in 2006 currently focus on gear restrictions, limited fishery participation and area closures. While enforcement is lacking in Indonesia, Iran and Thailand, Malaysia has a comprehensive vessel monitoring system along with dockside monitoring, air surveillance and an ISO 9000 certified fisheries licensing system that have all been praised as the most comprehensive in the region. Accordingly, management effectiveness is only a moderate conservation concern in Malaysia, while it remains a high conservation concern in Indonesia, Iran and Thailand.

The overall sustainability rankings for tongol tuna can be summarized as follows: tongol tuna caught with all gear types by the Malaysian artisanal fleet is a **Good Alternative**; tongol tuna caught using handline/troll by all other nations fishing in the western Pacific and Indian Ocean basins is a **Good Alternative**; tongol tuna caught with drift nets and FAD/floating object set purse seines by all other nations fishing in the western Pacific and Indian Ocean basins is recommended as **Avoid**.

Canned Tuna Recommendations

Canned tuna clearly labeled as tongol tuna from Malaysia is a **Good Alternative**. Tongol tuna also can be included in canned light tuna. Canned light tuna that is troll/pole-caught is a **Best Choice**. All other light tuna is **Avoid**. The proportion of light tuna that is from each species cannot be determined. However, based on capture data, only about 3-5% of yellowfin, bigeye and tongol tuna is troll/pole caught, and about 13% of tongol tuna (which is a smaller fishery than the yellowfin and bigeye fisheries) is captured by the Malaysia fleet. Because the majority of light tuna is Avoid, canned light tuna should be **Avoided** unless clearly marked as troll/pole or tongol tuna from Malaysia.

This report was updated on July 13, 2010 and again on February 15, 2011. Please see Appendices II and III for a summary of changes made at those times.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherent Vulnerability	√			
Status of Stocks		√		
Nature of Bycatch		√ **Handline/troll**	√ **FAD/floating object set purse seines, drift gillnets**	
Habitat & Ecosystem Effects	√ **Handline/troll**	√ **Other gears**		
Management Effectiveness		√ **Malaysia**	√ **Indonesia, Iran, Thailand**	

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
Good Alternative	Malaysia (all gear types)
	Indonesia, Iran, Thailand (handline, troll/pole)
Avoid	Indonesia, Iran, Thailand (all other gear types)

Common acronyms and terms

CPUE	Catch per Unit Effort
EEZ	Exclusive Economic Zone
FAD	Fish Aggregating Device
HMS	Highly Migratory Species
IO	Indian Ocean
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.
SPC	Secretariat of the Pacific Community
SBR	Spawning Biomass Ratio
WPO	Western 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 in length. Smaller vertical lines with baited hooks are distributed along the main line and can be rigged for 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.

Handline: Fishers use a fixed length line with a barbless hook and either an artificial lure or live bait. 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 while the top is kept at the surface of the water column by a series of floats. One end of the net is anchored by a skiff while the main vessel encircles the school of tunas. The bottom of the net is closed with a purse line running through the leadline by way of a series of rings. The net is then hauled in and most of the net is brought onboard. Only a small volume of water containing the collected fish remains in the net, allowing the catch to easily be brought onboard using a large dip net (NRC 1992). There are several types of purse seine sets: those set on marine mammals (most commonly dolphins and whales); those set on natural floating objects (e.g., log sets) or Fish Aggregation Devices (FAD sets); and those set on schools of tuna unassociated with marine mammals or floating objects (unassociated sets).

Trolling: Trolling consists of towing artificial lures with barbless hooks on multiple lines behind the fishing vessel (Childers 2003).

Drift Gillnets: A gillnet is a curtain of netting that hangs in the water at various depths, suspended by a system of floats and weights (or anchors). The netting is almost invisible to fish as they swim into it. Mesh spaces are large enough for a fish's head to pass through, but not its body. As the fish tries to back out, its opercles (the uppermost and largest bones that cover the gills) become entangled in the net. Opercles have backwards-facing spines in many higher trophic level commercially important fishes.

II. Introduction

Tongol tuna, *Thunnus tonggol* (Bleeker 1851), is a small tuna species found throughout the waters of northern Australia, the East and South China Seas and the North Indian Ocean (Figure 1) (Yonemori et al. 2005). Tunas have a higher aerobic capacity than most bony fishes, with a standing metabolic rate two to three times that of other fishes in the Scombridae family, including mackerels and bonitos (Collette et al. 2001; Korsmeyer and Dewar 2001). Tunas are also endothermic and maintain internal body temperatures warmer than the surrounding seawater (Graham and Dickson 2001).

This endothermy has afforded the highly migratory tuna species fairly widespread geographic distributions by expanding their thermal niche to include colder high latitude and/or deep waters (Graham and Dickson 2004). Tongol tunas, however, are neritic rather than highly migratory and favor the epipelagic regions over the continental shelves of the Indian and western Pacific Ocean basins, avoiding areas of high turbidity and reduced salinity such as estuaries (IOTC 2006a). Tongol tunas are opportunistic feeders and consume a variety of fish, cephalopods and planktonic crustaceans, including stomatopod larvae and prawns (Griffiths et al. 2007).

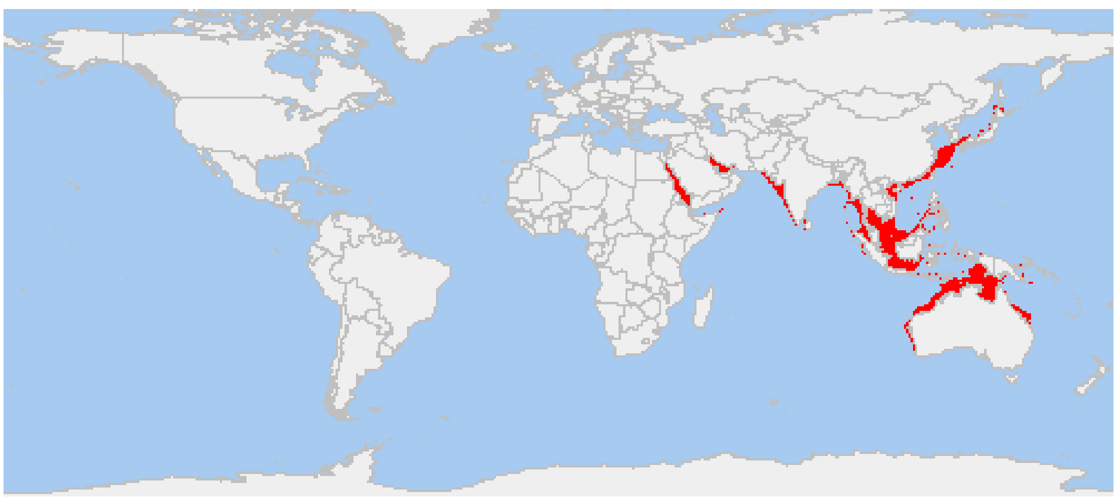


Figure 1. Predicted geographic distribution of tongol tuna, *Thunnus tonggol, is* shown in red. Map courtesy of FAO Fisheries, http://www.fao.org/fishery/species/2495/en.

The type of gear used to capture tongol tuna varies slightly between the Indian Ocean and the western Pacific Ocean, but generally includes drift gillnet and purse seine gear, both operated at artisanal and industrial scales. Handlines and trolls are also used, but to a much lesser extent. Since tongol is a neritic species, there are few reported catches using longlines (Yesaki 1995). Purse seine fishers targeting tongol tuna include those that set on FADs and unassociated schools of tongol tuna. Fisheries in both the Indian and western Pacific Oceans use electric lamps to lure tongol at night along with anchored FADs (Fonteneau et al. 2000), which are also commonly used in other regions of the Pacific and eastern Atlantic Oceans (Fonteneau et al. 2000). In addition to aggregating nearby tunas, FADs also attract fish from a broader region. Studies have shown that tunas within 10 km orient towards nearby FADs but do not necessarily stay in close proximity (Girard et al. 2004). Hypotheses explaining this behavior suggest that FADs provide a resting place for tunas after foraging, and they may also offer tunas the opportunity to assess species diversity in the area (Freon and Dagorn 2000).

Landings of tongol tuna have been reported for Australia, India, Eritria, the Islamic Republic of Iran, Jordan, Oman, Pakistan, Saudi Arabia, the Seychelles, Sri Lanka, Thailand, the United Arab Emirates and Yemen (Anon. 2006). These nations are members of the Indian Ocean Tuna Commission (IOTC), which is a fisheries management body of the Food and Agriculture Organization of the United Nations (FAO). Landings from the western Pacific Ocean include Australia, Indonesia, Malaysia, Papua New Guinea, Thailand and the Philippines (FAO 2008a). Except during the period between 1992 and 1997, global estimated tongol landings have increased steadily since 1960, with landings in 2005 totaling 227,911 metric tons (mt) (Figure 2) (Collette and Nauen 1983; FAO 2008b). Nearly 90% of tongol landings in 2006 came from four countries: Indonesia (36.1%), Thailand (31%), Malaysia (11.2%) and Iran (10%). On average, these four nations account for over 75% of global tongol tuna landings in the past decade (FAO 2008f). It is important to note that because fishing effort for tongol tuna is concentrated at the artisanal scale, it is likely that a substantial fraction of landings are not accounted for in annual global estimates.

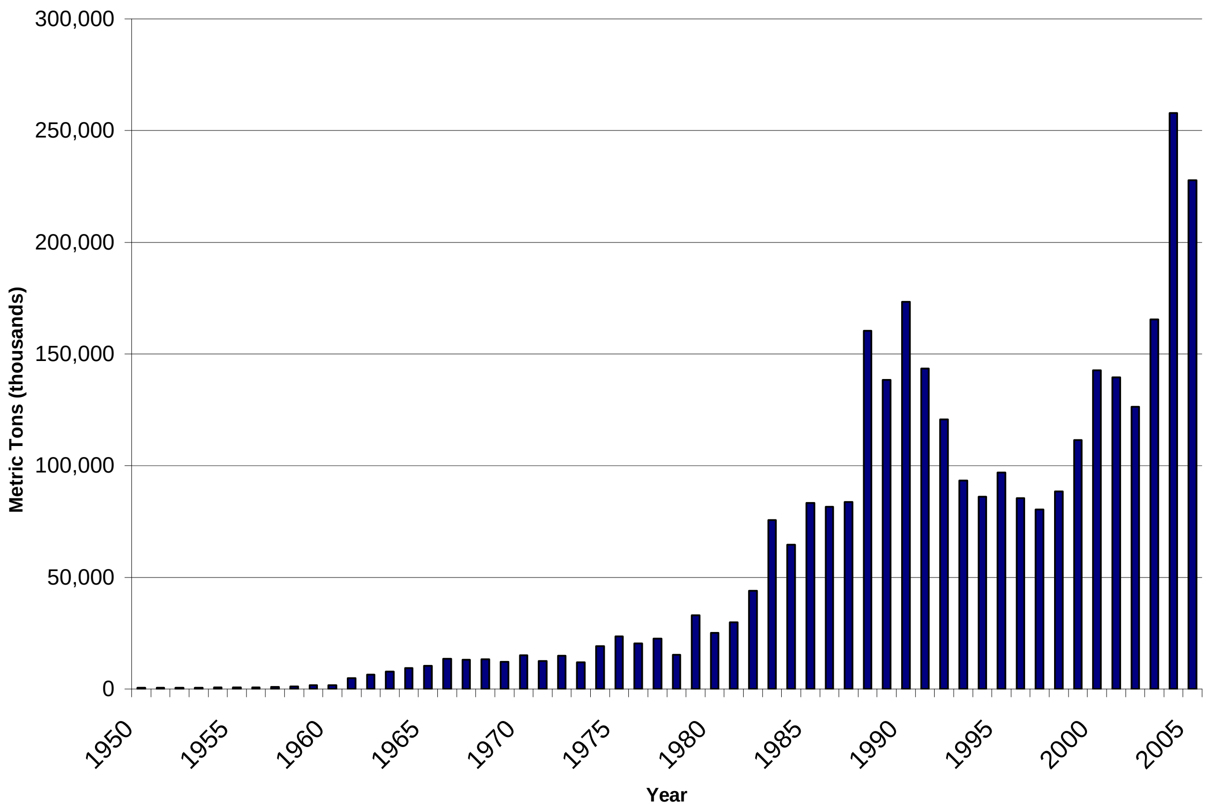


Figure 2. Tongol tuna landings in metric tons reported to FAO for both the Indian Ocean and the western Pacific Ocean (FAO 2008b).

Table 1. Tongol catch by region, country and gear type. See Common Terms and Acronyms at the beginning of this report for definitions of these gear types.

Region	Catch[1]	Fishing Countries	Gear Used[2]	Sources
Indian Ocean	91,574 mt (36.6%)	Indonesia (32.1%); Iran (27.5%); Oman (8.61%); Yemen (8.1%); India (6.7%); Malaysia (5.7%); Pakistan (5.1%); Thailand (3.5%); United Arab Emirates (2.5%,); Australia, Jordan, Saudi Arabia (<0.5% of total)	Drift gillnet (80%); Purse seine (16%); Handline/troll (3%); Other (<1%)	Anon 2006; FAO 2008c; FAO 2008d; FAO 2008f
Western Pacific Ocean	158,456 mt (63.4%)	Thailand (46.9%); Indonesia (38.9%); Malaysia (14.3%); Australia (<0.5%)	Unavailable	FAO 2008e; FAO 2008f

Indian Ocean

Tongol tuna is subject to roughly the same amount of fishing pressure in both the eastern and western Indian Oceans (FAO areas 51 and 57) (Figure 3), with 99% of the 79,103 mt landed in 2003 captured using gillnets (80%), artisanal purse seines (16%) and handlines/trolls (3%) (Anon. 2006). For these regions, the estimated catch of tongol tuna peaked at 111,792 mt in 2000. Average annual catch from 2002 to 2006 was 90,800 mt (IOTC 2006A). Tongol landings accounted for 15% of all tuna landings in the Indian Ocean in 2003. Indonesia, Iran, Oman, Yemen and India are responsible for the highest catches of tongol tuna in recent years (Figure 4) (IOTC 2006a). Management of tongol tuna in the Indian Ocean is overseen by the IOTC.

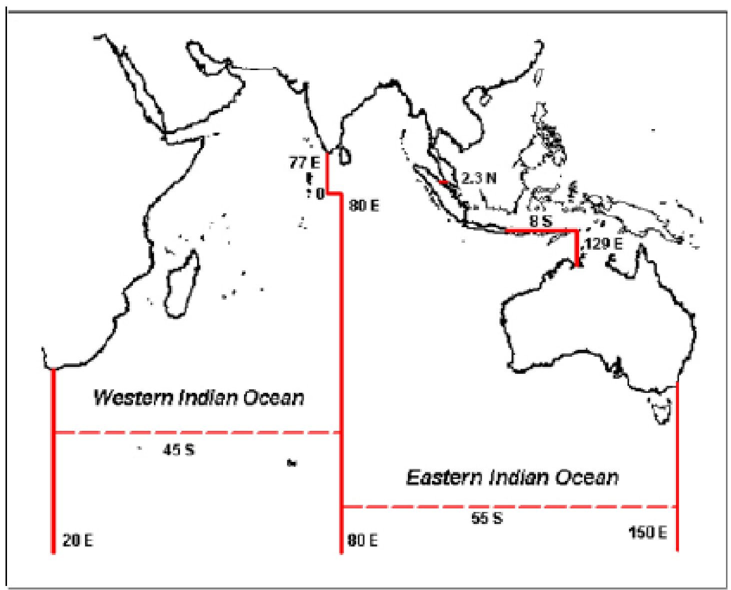
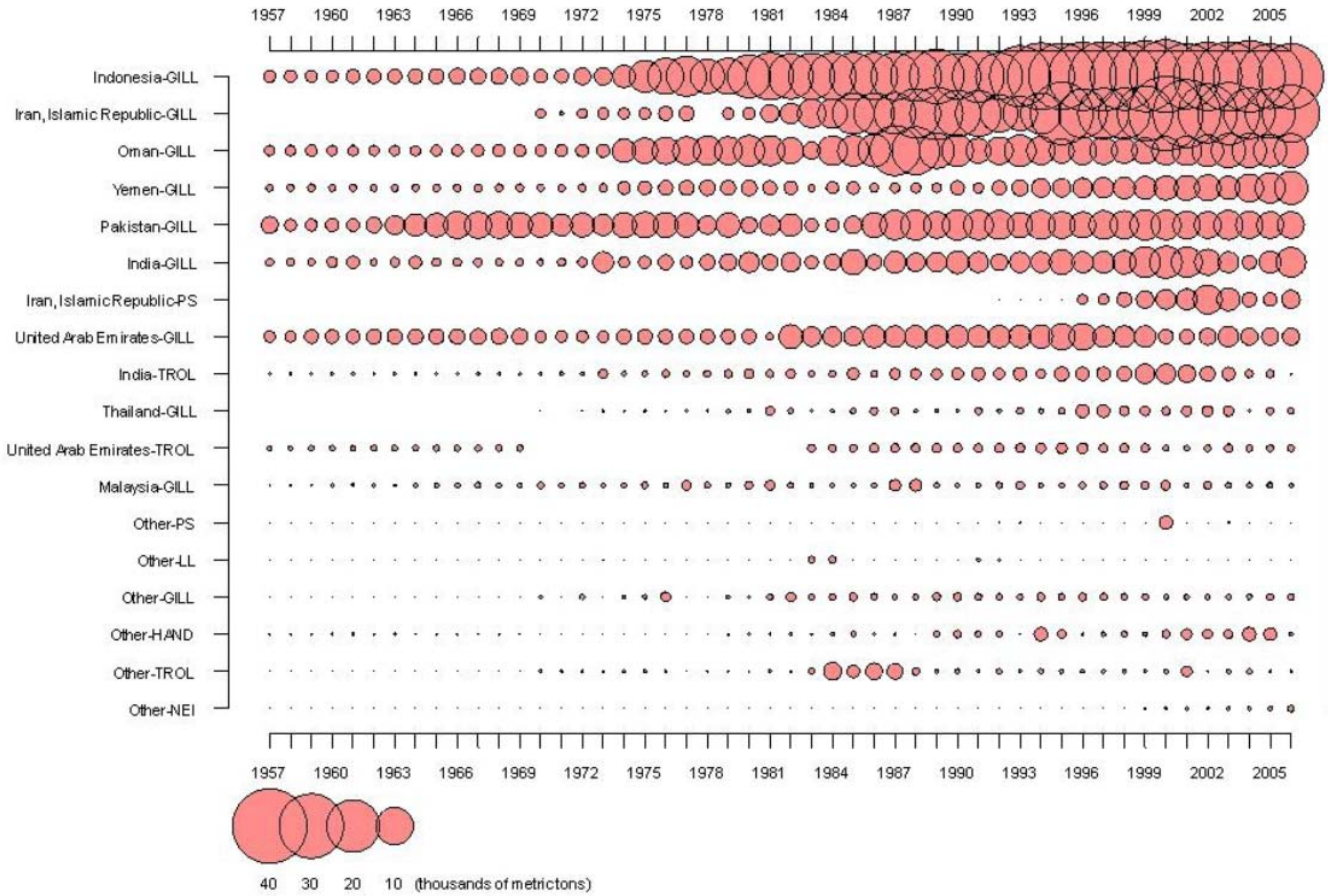


Figure 3. IOTC statistical areas (figure from Anon 2006).

[1] Catch statistics from 2006.
[2] Gear use statistics from 2003.

Figure 4. Catches of tongol tuna in thousands of tons by gear type and fleet for the Indian Ocean from 1957 to 2006 (figure from IOTC 2006a).



Western Pacific Ocean

Tongol is captured in the western Pacific Ocean by fleets from Australia, Indonesia, Malaysia, Papua New Guinea, Taiwan and Thailand (FAO Fishing Area 71) (Figure 5). Very little information is available about landings of tongol in the western Pacific by gear type. Records of overall landings, however, indicate that Thailand, Indonesia and Malaysia are responsible for a majority of tongol capture in the western Pacific, and account for greater than 99% of the 2006 landings in this region (Table 1) (FAO 2008f). The Western and Central Pacific Fisheries Commission (WCPFC) focuses its management efforts on the larger, highly migratory tuna species and does not collect information on tongol landings or effort, either by sampling direct or incidental catch in this region.

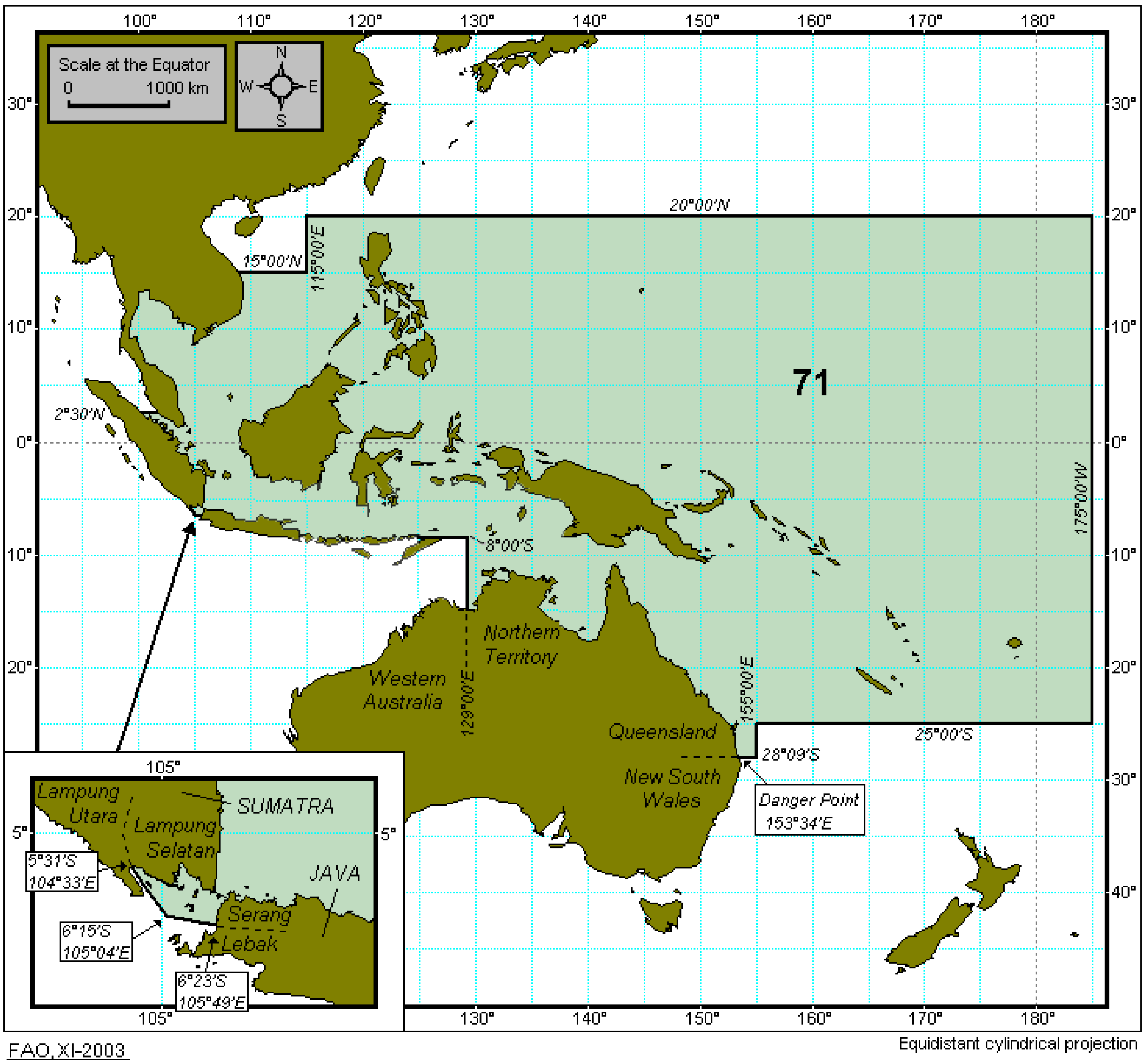


Figure 5. FAO Fishing Area 71, western Pacific Ocean (ftp://ftp.fao.org/fi/maps/Default.htm).

Scope of the analysis and the ensuing recommendation
This analysis encompasses tongol tuna landed off the coasts of Indonesia, Iran, Malaysia and Thailand in the Indian and western Pacific Ocean basins and imported to the United States (U.S.). The U.S. fishing fleet does not target tongol tuna. Our recommendations on bycatch and the habitat and ecosystem impacts of fishing gears will focus on the three gear types used to capture the majority of tongol tuna landings, namely handlines/trolls, purse seines and drift gillnets. Due to the limited data available for some criteria (particularly bycatch), we have made generalizations by country and ocean basin about the severity of bycatch in the drift gillnet and purse seine fisheries.

Availability of Science

In general, basic biological information, including intrinsic rate of growth (*r*), maximum age and age structure, are poorly known for this species. Stock structures in both the Indian and western Pacific Ocean are highly uncertain. Landings reported by management agencies such as the IOTC are estimates that require a large amount of data processing to deal with conflicting catch reports, levels of catch aggregation by species and gear, and the occurrence of unreported fisheries (IOTC 2006a). There are no international data on the bycatch levels and trends associated with drift gillnet and purse seine fisheries. Reviews of bycatch, fishery management and fishery monitoring efforts by the four nations responsible for the majority of tongol tuna landings, namely Indonesia, Thailand, Malaysia and the Islamic Republic of Iran, will be general in nature since there are no available regulations specifically geared towards the tongol tuna fisheries in these nations.

Market Availability

Common and market names
Thunnus tonggol is known as tongol tuna, longtail tuna and oriental bonito. Tongol tuna is also known as northern bluefin tuna in Australia (Serdy 2004). Tongol is most commonly marketed as chunk light tuna.

Seasonal availability
Canned tongol tuna is available year-round.

Product forms
Tongol tuna is primarily available in the U.S. as canned light tuna, which can be a mixture of the following species: yellowfin, bigeye, skipjack and tongol. While the United States Food and Drug Administration (FDA) requires that tongol tuna (and those listed above) be labeled as "chunk light," it is often labeled as "white meat" in Europe, as is albacore tuna, because the meat of these tunas passes spectrographic tests for lightness. Tongol-only cans have been increasingly marketed in the U.S., as it is a slightly moister alternative to albacore.

Import and export sources and statistics
The U.S. has been the largest global importer of canned tuna almost every year since 1976 (Defenders of Wildlife 2006; FAO 2008a). Canned tuna imports in 2007 totaled 171,667 mt,

16% of which was canned albacore (NMFS 2008). The 144,667 mt of non-albacore[1] canned tuna imported in 2007 was valued at over US$417 million. Just over 96% of non-albacore tuna imports came from six countries: Thailand (49%), the Philippines (17%), Vietnam (8%), Indonesia (9%), Ecuador (9%) and China (4%) (NMFS 2008). Overall, U.S. demand for tuna is declining, likely due to increased concern about the mercury content of tuna (Defenders of Wildlife 2006; FAO 2008a). Consumption of canned tuna in the U.S. dropped in 2007 for the fourth consecutive year to 2.7 pounds per capita (Johnson, 2008).

In 2006, 94% of non-albacore tuna (including yellowfin, bigeye, bluefin and tongol) canned in domestic canneries had been captured in the western Pacific while the remaining 6% came from the eastern Pacific (Figure 6) (NMFS 2006).

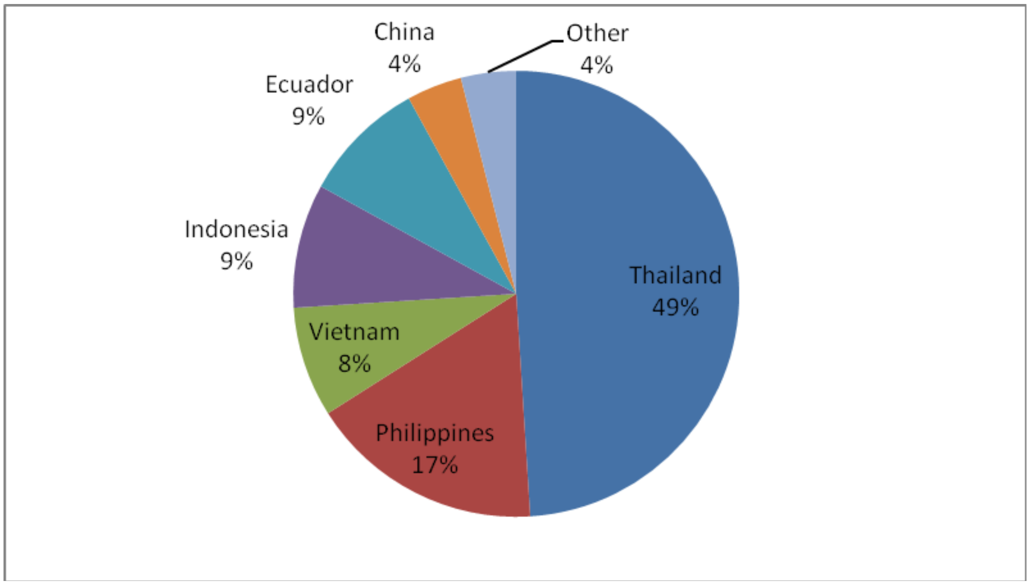


Figure 6. Sources of imported canned tuna (non-albacore) in 2007 (data from NMFS 2008).

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

Criterion 1: Inherent Vulnerability to Fishing Pressure

Tongol tunas grow rapidly early in life, reaching a length of at least 50cm after 1 year (Griffiths, Fry et al. 2010). Growth parameters do not appear to be significantly different between the sexes, but there is high variability in length-at-age after age 2 across both sexes (Griffiths, Fry et

[1] This tuna was listed as "not specifically provided for" and is likely a mix of yellowfin, bigeye and tongol tunas.

al. 2010). The maximum recorded age of tongol caught off northern Australia is 18.7 years, but modeling suggests maximum age may be closer to 30 years (Griffiths, Fry et al. 2010). Maximum length and weight may be around 145cm fork length (FL) and 35.9 kg (IOTC 2006a).

There is considerable uncertainty in age- and length-at-maturity (Griffiths, Pepperell et al. 2010; Griffiths 2010). Several studies conducted in southeastern Asia indicate that female tongol reach sexual maturity after one year at lengths between 39 and 42 cm. However, other studies from Papua New Guinea and Australia failed to find mature ovaries in females of less than 60 cm (Yesaki 1991). More recently, Griffiths (2010) states that the limited data available on the reproductive potential of the species indicates the species appear to reach sexual maturity at around 60 cm FL and two years of age (and possibly three or four years) off Australia and New Guinea. According to unpublished data referenced in Griffiths, Pepperell et al. (2010), length-at-maturity for 50% of the population may be 72cm FL for males and 65 cm FL for females. There seems to be a large difference between the length at first maturity of females between the northern and southern hemispheres (Griffiths, Pepperell et al. 2010).

Spawning locations of tongol tuna are unknown, but likely spawning grounds are in the Gulf of Thailand, western Sea of Japan, East China Sea, northern Australia (Griffiths, Pepperell et al. 2010). The spawning seasons of tongol tuna vary by location. Yesaki (1991) presents studies that suggest the following three spawning season scenarios across the entire tongol tuna range: 1) a major spawning season during the northeast monsoon from January to April and a minor season from August to September; 2) March to May and July to December in the Gulf of Thailand (derived from the gonad indices of Cheupan 1984); and 3) austral summer off Papua New Guinea and Australia (based on fish absence and gonad development from Wilson 1981). Mature females of 70–87 cm FL have been recorded to produce between 1 and 2.5 million eggs per year (Darvishi et al. 2003).

Table 2. Life history characteristics of tongol tuna.

Intrinsic rate of increase (*r*)	Age at maturity	Growth rate	Max. age	Max size	Fecundity	Species range	Special behaviors	Sources
Unknown	2 years	vBgf[3]: L_∞ = 135 cm k = 0.223	30 yrs	145 cm FL	1 to 2.5 million eggs per year	Indo-West Pacific and Indian Ocean	Associates with floating objects, schooling species, restricted neritic distribution	Yesaki 1991; Froese and Pauly 2007; Griffiths, Fry et al. 2010

Synthesis
Intrinsic rate of increase of tongol tunas is unknown. However, the species matures at an early age, has relatively high growth and reproductive rates and is well distributed throughout the continental shelf areas of the Indian and western Pacific Ocean basins. A maximum age of up to 30 years and some special behaviours suggest slightly increased vulnerablity to fishing pressure, but their primary life history characteristics make them inherently resilient.

Inherent Vulnerability Rank:

Resilient **Moderately Vulnerable** **Highly Vulnerable**

<u>Criterion 2: Status of Wild Stocks</u>

Indian Ocean
The IOTC (2006a) notes that several localized, sub-regional stock assessments have been conducted for the Indian Ocean. The only accessible assessment is a 1995 study focused on the inshore tongol tuna fishery in the Indian Exclusive Economic Zone (EEZ). Landings data from 1989 to 1991 were used to estimate an average biomass of 7,965 mt for that time period—almost three times the estimated B_{MSY} (biomass at which maximum sustainable yield is produced) (Pillai et al. 1995). The study concluded that the fishery could likely withstand substantial increases in effort. Because the study was conducted in 1995, its findings are unlikely to apply to the current state of the tongol tuna fishery in the Indian EEZ, especially given the substantial increase in tongol tuna landings from this and surrounding areas since the time of the study. The IOTC has consistently recorded landings for tongol tuna, but makes clear that there is marked

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

uncertainty about catch estimates because of conflicting catch reports and a lack of reporting from certain fisheries (Figure 7) (IOTC 2006a).

Overall, as the majority of the factors used by Seafood Watch® to evaluate stock status are unknown for tongol tuna, the status of this species in the Indian Ocean is considered moderate/unknown according to Seafood Watch® criteria.

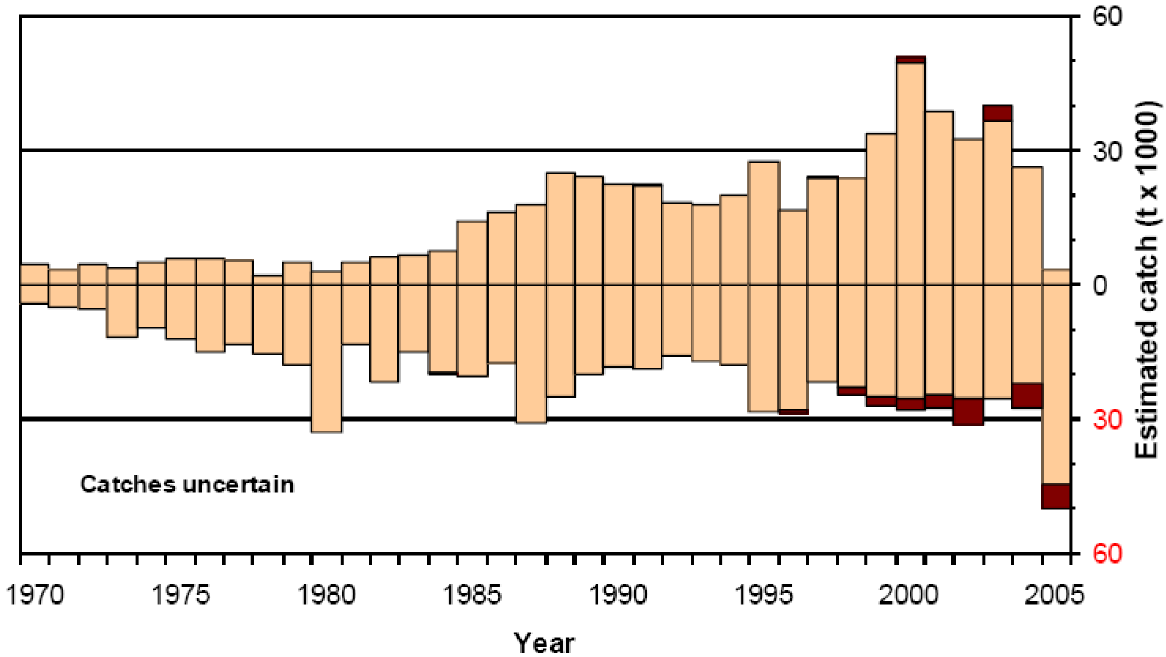


Figure 7. Uncertainty estimates for annual tongol tuna catch from 1970 to 2006 (figure from IOTC 2006a). Catch listed below the zero-line has been categorized as uncertain based on the IOTC criteria, including the amount of data processing required to account for conflicting catch reports, the level of catch aggregation by species and gear type, and the occurrence of unreported fisheries for which catch must be estimated. Dark sections represent catch estimates for industrial fleets.

Western Pacific Ocean

No stock assessments have been conducted for tongol tuna in the western Pacific Ocean, and thus the status of tongol tuna in this region is unknown. A study conducted by Chee (1995) observed an overall decrease in the average size of tongol tunas since 1989 in troll, purse seine and gillnet fisheries in Malaysia. Chee suggested that the harvest of tongol tuna at a particular time, age and size in one country in the western Pacific Ocean basin was likely to affect landings for the same species in other countries. The author suggested further studies of size segregation by gear type and location in conjunction with regional management to address this issue.

Other fishery-based mortality for tongol tuna

Additional fishery-based mortality for tongol tuna results from bycatch of this species in other fisheries and as dropout from drift gillnets during haul-in. Bycatch in other fisheries includes incidental catch in the western Pacific Ocean albacore, bigeye and yellowfin longline fisheries, the Indonesian pole and line fishery, and the Australian northern shark longline fishery (Bailey et al. 1996; Bray and Kennedy 1998). In the few poorly documented instances of incidental capture in these fisheries, tongol has been landed rather than discarded. The Australian northern shark longline fishery is the only fishery with management measures related to the incidental catch of tongol and limits landings to ten tongol tunas at any time (Bray and Kennedy 1998). Dropout from drift gillnet fisheries is unintentional and occurs as nets are hauled into the boat. This mortality, observed to average between 3.7% and 8.7% of total landings, is notable because it is not included in stock assessments (Northridge 1996).

Table 3. Stock status of tongol tuna.

Classification status	B/B_{MSY}	Occurrence of overfishing	F/F_{MSY}	Abundance trends/CPUE	Age/size/sex distribution	Degree of uncertainty in stock status	Sources	SFW rank
Indian Ocean	Unknown	Unknown	Unknown	Unknown	Unknown	High	IOTC 2006a	Unknown
Western Pacific Ocean	Unknown	Unknown	Unknown	Unknown	Unknown	High	None Available	Unknown

Synthesis
The status of tongol tuna stocks is highly uncertain across its range, and incidental catch for tongol is unregulated in most fisheries. Despite the high level of stock uncertainty, landings of tongol tuna appear to be increasing across its range. As such, the conservation concern for tongol tuna stocks is considered moderate/unknown according to the Seafood Watch® criteria.

Status of Wild Stocks Rank:

Healthy | **Moderate/Unknown** | Poor | Critical

Criterion 3: Nature and Extent of Bycatch

Seafood Watch® defines sustainable wild-caught seafood as marine life captured using fishing techniques that successfully minimize the catch of unwanted and/or unmarketable species (i.e., bycatch). Bycatch is defined as species that are caught but subsequently discarded (injured or dead) for any reason. 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 tongol tuna fishery are not available for any of the regions where tongol is caught. This analysis generally uses extrapolations from comparable tuna drift gillnet and purse seine fisheries.

Handline and troll

Shark bycatch is something of a concern in handline and troll fisheries for tuna and tuna-like species in coastal waters of the Indian Ocean. Since 1950, shark bycatch retained on reporting vessels has composed between 20% and 30% of total landings in the handline and troll fisheries (Figure 8) (IOTC 2006b). The population impact of shark bycatch is discussed in the section on drift gillnet shark bycatch below.

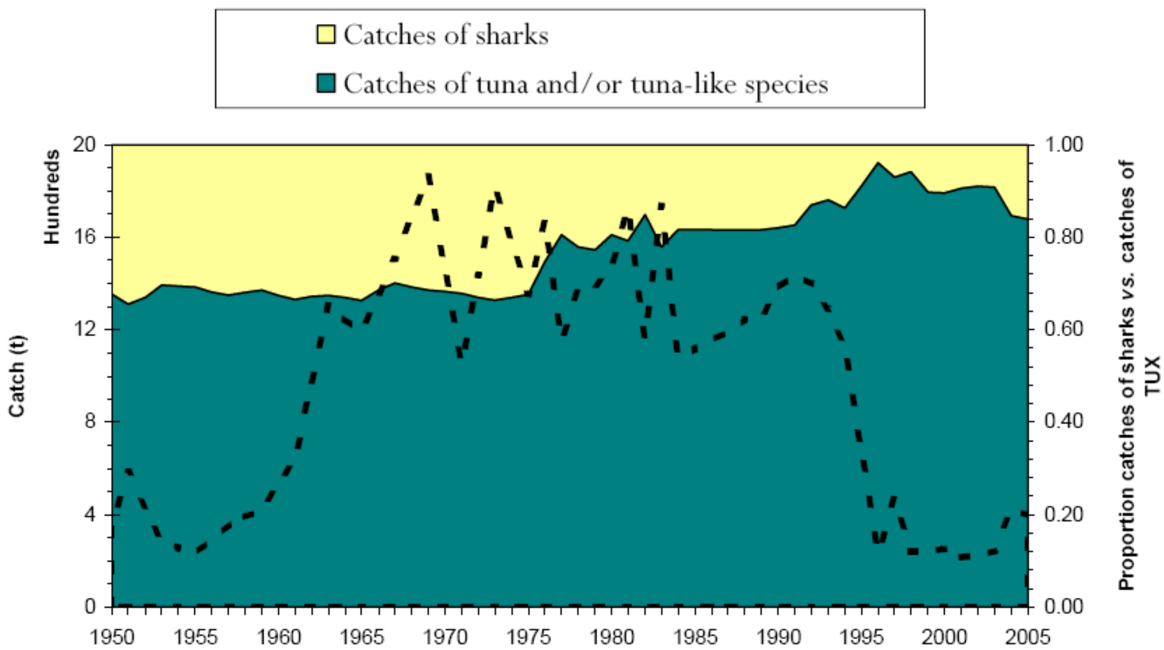


Figure 8. Proportion of total shark catch from hand line and troll fisheries for tuna and tuna-like species as recorded by the IOTC (IOTC 2006b). Total shark catch is indicated by the dashed line.

Longline

There is minimal longline catch of tongol tuna. Longlines are primarily used to capture highly migratory tuna and billfish species in the pelagic zone off the continental shelf. Tongol is a neritic species with the vast majority of landings captured using drift gillnet and purse seines set over the continental shelves of the Indian and western Pacific Oceans. However, rare instances of tongol tuna bycatch in longline fisheries for sharks and larger pelagic tuna species like albacore (*Thunnus alalunga*), bigeye (*Thunnus obesus*) and yellowfin (*Thunnus albacares*) are mentioned in Bailey et al. (1996) and Bray and Kennedy (1998). A discussion of the tuna longline fishery can be found in the Seafood Watch® Bigeye Tuna Report available at: http://www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_BigeyeTunaReport.pdf.

Drift gillnet

The drift gillnet fishery accounts for 80% of tongol tuna landings in the Indian Ocean. No information is available regarding the proportion of tongol tuna landings made with this gear type in the western Pacific Ocean. The primary conservation concern with the use of drift gillnets in tuna fisheries is related to the high level of bycatch of vulnerable non-target species including other finfish, sea turtles, marine mammals and sharks (Lewison et al. 2004). Gillnets are an unselective gear type, and large numbers of species can be landed in a single set (Northridge 1991). Like other fishing gears, this non-selectivity has been shown to vary by region. Drift gillnets are often set near the top of the water column, thus increasing the likelihood that marine mammals and reptiles (e.g., sea turtles), who must surface to breathe, will become entangled in the netting (Northridge 1991). While drift gillnets were banned on the high seas through a 1992 United Nations Resolution, gillnets of less than 2.5 km in length can be used in sovereign waters (Lewison et al. 2004). However, UN General Assembly Resolution 44/225 stipulates that the ban can be lifted if effective conservation and management efforts are put into place to mitigate the devastating impacts of this type of fishing gear on marine resources (UNGA 1989).

Bycatch in drift gillnets is a concern in both commercial and artisanal scale tuna fisheries, the former because of their large scale and the latter because of their sparse reporting. The limited bycatch and discard information is based on shipboard observations made during a single season (1989-1990) by the Japanese Marine Resource Research Center (JAMARC) and simultaneously by a separate group of Greenpeace observers. This information is focused on drift gillnet fisheries for albacore and slender tuna (*Allothunnus fallai*) (Bailey et al. 1996). Based on this small sample, bycatch rates for both of these fisheries ranged from 16% to 30% and included skipjack (*Katsuwonus pelamis*) along with various sharks, billfish and other species, depending on season and location.

It is important to note that the drift gillnet fisheries for albacore and slender tuna are high-seas fisheries and are likely to differ significantly in terms of bycatch from the neritic fishery for tongol tuna. There are currently no studies available that quantify bycatch rates in neritic, pelagic driftnet fisheries in the western Pacific and Indian Ocean basins.

Marine mammals: bycatch rates and population impacts

There is little information about the bycatch of marine mammals in drift gillnets over the continental shelves of the Indian and western Pacific Oceans (IOTC 2006b). A commercial Taiwanese large-mesh drift gillnet fishery for tongol operating north of Australia was outlawed because of excessive dolphin bycatch: 0.033–0.088 dolphins per kilometer of drift gillnet (Bailey et al. 1996). Observers on a vessel operating off the Federated States of Micronesia observed a marine mammal bycatch rate of 6.2% (55.3% of target catch) (Bailey et al. 1996).

Fishes: bycatch rates and population impacts

There is little recorded information about the bycatch of fishes in drift gillnets in the Indian and western Pacific Oceans. Observers from JAMARC recorded that skipjack composed between 3% and 30% of total landings in a single season while swordfish (*Xiphias gladius*) and striped marlin (*Tetrapturus audax*) accounted for 0.1% to 0.2% of landings (Bailey et al. 1996). Since many fisheries operate on the artisanal scale, it is likely that non-target fishes are retained if they are of suitable size. Bycatch of finfish, however, is unregulated and is not included in overall fishery management efforts. The impact of bycatch on finfish populations is unknown.

Sharks: bycatch rates

Overall bycatch of sharks in drift gillnet fisheries is high, but the species and abundance of shark bycatch varies with the area of operation (Figure 9) (IOTC 2006b). Available bycatch estimates are thought to represent retained shark landings. Gillnet operations in the coastal regions of Sri Lanka and Indonesia and the high seas have the highest observed levels of shark bycatch. Between 1950 and 2005, shark bycatch accounted for between 20% and 30% of landings in the drift gillnet tuna fishery (Figure 10) (IOTC 2006b).

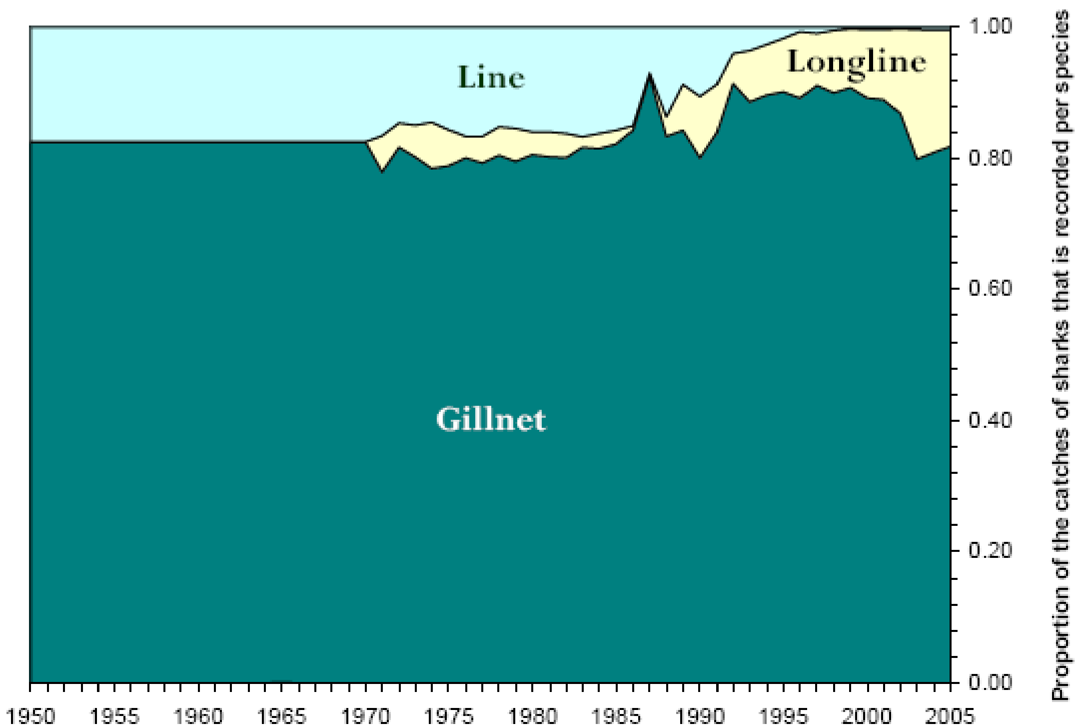


Figure 9. Shark catch by gear type as a proportion of total catch as recorded in the IOTC nominal catch database from 1950 to 2005 (IOTC 2006b).

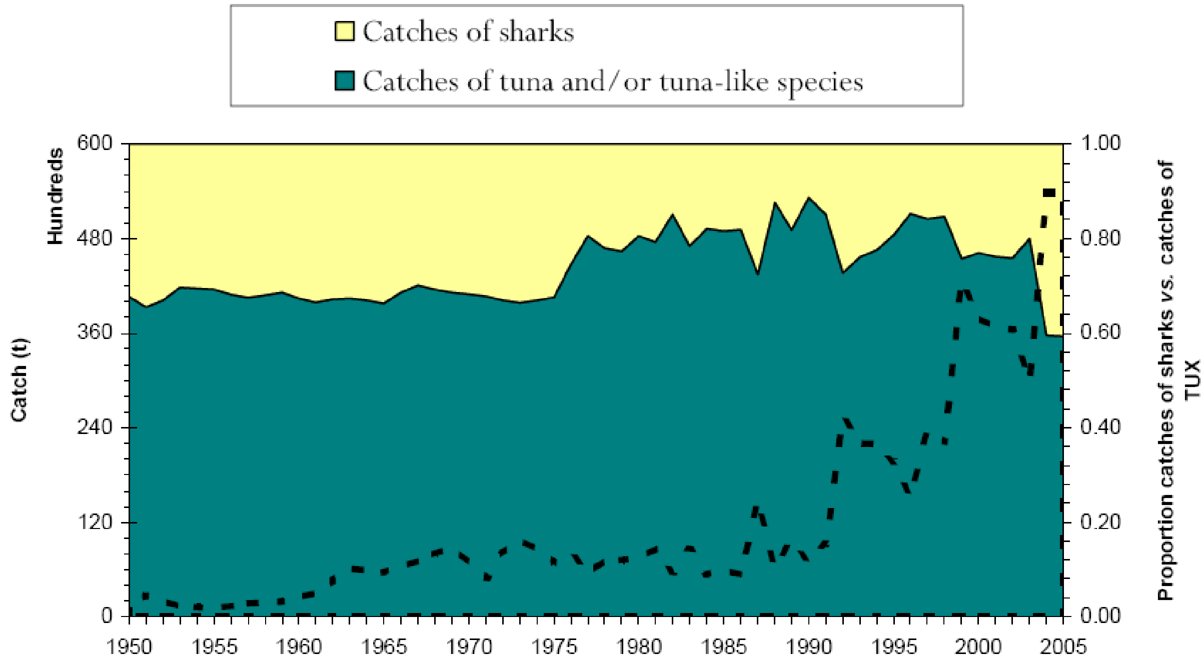


Figure 10. Shark catch as proportion of total landings in drift gillnet fisheries for tuna and tuna-like species as recorded by the IOTC (IOTC 2006b). Total shark catch is indicated with the dashed line.

The IOTC bycatch database provides information about the overall composition of shark bycatch in Indian Ocean fisheries for tuna and tuna-like species. Blue sharks (*Prionace glauca*) and silky sharks (*Carcharhinus falciformis*) each account for more than 10% of total recorded shark catch for all fishing gears in the Indian Ocean between 1950 and 2005, which suggests that these species may be the most affected by fishing pressure (IOTC 2006b). Oceanic white tip (*Carcharhinus longimanus*) along with various requiem sharks (*Carcharinidae spp.*), hammerhead sharks (*Sphyrna spp.*) and thresher shark species (*Alopius spp.*) were also commonly captured in Indian Ocean tuna fisheries. Catches for each of these shark types composed between 5% and 10% of total shark catch over the same time period.

Sharks: population impacts[4]

Sharks are generally not resilient to fishing pressure (Hoenig and Gruber 1990 *in* Musick et al. 2000) as they have a low intrinsic rate of increase (Smith et al. 1998), low fecundity, slow growth rates, and late age at maturity (Camhi et al. 1998 *in* Musick et al. 2000).

Of all predatory fishes, sharks are probably the most sensitive to fishing pressure, and thus generalizations about declines in predatory fish may underestimate declines in shark species. Indeed, the high sensitivity of sharks to fishing pressure means that they may be twice as likely to face extinction as bony fishes at moderate fishing pressures (Myers and Worm 2003). Although the best data for sharks are from the North Atlantic, many shark populations seem to have declined worldwide (Myers and Ottensmeyer 2005). This reduction has led to considerable concern among national and international organizations such as the International Union for

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[4] Portions of this section were taken verbatim from the Seafood Watch® Sharks Report written by Santi Roberts: http://www.mbayaq.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_SharksReport.pdf.

Conservation of Nature (IUCN), the Convention on International Trade in Endangered Species (CITES), and the FAO (Musick et al. 2000). Indeed, there are more elasmobranch (shark, skate and ray) species (263) than other marine fish species (210) on the IUCN Red List. Of the listed elasmobranch species, 199 are sharks while the other 64 are skates and rays.

Due to the high level of unreported catches of pelagic shark species in many fisheries, including purse seine fisheries operating in the western Indian Ocean, there may be severe population impacts on many of these species (Romanov 2002). Throughout the world's oceans, sharks are facing an increasing threat from tuna fisheries since they are frequently caught as bycatch (Fonteneau and Richard, 2003). Several of the shark species commonly caught as bycatch in tuna drift gillnet (and purse seine) fisheries are on the IUCN Red List of Threatened Species, including the blue shark, dusky shark, shortfin mako, various hammerhead shark species and the tiger shark. Estimates of annual worldwide blue shark fishing mortality range from 10 to 20 million (IUCN 2004).

Sea turtles: bycatch rates

The only information about the incidental catches of sea turtles available through the IOTC comes from observer programs and is still preliminary because of low observer coverage (IOTC 2006b). Population impacts are covered in the following section on bycatch in purse seine fisheries.

Seabirds: bycatch rates and population impacts

The only information about the incidental catches of seabirds available through the IOTC comes from observer programs and is still preliminary because of low observer coverage (IOTC 2006b). Bailey et al. (1996) suggest that driftnet bycatch of seabirds may be low because the squid and fish caught in large mesh driftnets commonly used in the area are too large for seabird consumption.

Purse seine[5]

Purse seines are the second most common gear type used to capture tongol in the Indian Ocean. No information is available regarding the proportion of tongol tuna landings made with this gear type in most areas of the western Pacific Ocean, but recent evidence suggests that nearly 90% of tongol tunas landed by Thailand's fishing fleet were caught using purse seines (Pokapunt and Thummachua 2006). Purse seines set on floating objects and FADs have a high bycatch level for juvenile tuna, other fishes and vulnerable species such as sea turtles and sharks (Hall 1998; IATTC 2004). Bycatch in FAD sets is estimated to be 10% of the total catch per set, while bycatch from unassociated sets is estimated to be 1–2% of the total catch per set. This high level of bycatch in the FAD fishery is a cause for concern (Bromhead et al. undated). These estimates are similar to bycatch rates described in Bailey et al. (1996), which estimated school-set bycatch at 0.35–0.77% of the total catch by weight; log sets were estimated higher at 3.0–7.3%. Bromhead et al. (undated, p. 63) cite five reasons why FAD sets are a cause for concern:

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[5] Portions of this section were taken verbatim from the Seafood Watch® Skipjack Tuna report written by Jesse Marsh: http://www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_SkipjackTunaReport.pdf

1) The catch efficiency of purse seiners has increased dramatically with the use of FADs;
2) The species composition of tuna caught using FADs differs from that of free-schooling tuna;
3) Juvenile tuna are significantly more vulnerable to capture using FADs;
4) The advent of FADs means that some species are now caught by multiple gears, both as juveniles and adults; and
5) FADs may trap tuna in unproductive regions, with implications for condition, growth and biological productivity.

Bycatch of sharks, rays and marlins has been linked to log sets (Bailey et al. 1996). While Bailey et al. (1996) speculate that decreased shark, ray and marlin bycatch could result from the gradual shift away from artisanal scale fisheries that set on logs towards larger, more technologically advanced fleets that set on free schools, many studies (see references listed in Fonteneau et al. 2000) note that there has instead been a shift away from free and marine mammal sets towards FAD and log sets. In general, sharks, rays and marlins will likely continue to comprise a significant portion of purse seine bycatch in the coming decades.

Bycatch in the tropical purse seine fishery may be high, and depends on the type of purse seine set (Romanov 2002). Observer data from Russian purse seiners operating in the Indian Ocean from 1986–1992 indicate that average bycatch levels were 27.1 mt/1000 mt of target species (Romanov 2002). In the western Indian Ocean, the greatest amount of bycatch is associated with FAD schools. Non-tuna bycatch (most commonly sharks, rays, marlins and sailfish) occurred in 22% of sets, comprising approximately 3.5% of the total catch (Romanov 2002).

Russian purse seines in the western Indian Ocean also set on whale-associated and log-associated schools with bycatch in the log-associated schools being the highest and most diverse of all set types (Romanov 2002). In the western Indian Ocean, the combined bycatch for all purse seiners from Spain, France, the Russian Federation, Japan and Mauritius increased from 1985–1994 (Romanov 2002).

Marine Mammals: bycatch rates and population impacts
There is no marine mammal bycatch in purse seine sets on free schools and FADs, and very little in the sets on marine mammals (Romanov 2002). Accordingly, the population impacts on marine mammals due to this type of fishing are likely to be low.

Fishes: bycatch rates and population impacts
Bailey et al. (1996) describe bycatch of blue marlin (*Makaira nigricans)*, black marlin (*Istiompax indica*), striped marlin (*Kajikia audax*) and sailfish (*Istiophorus platypterus*) recorded by observers from the Micronesian Marine Authority (MMA) at combined rates of 14.3% and 42.5% on 98 and 108 log sets, respectively. These sets were on highly migratory fish species in off-shelf areas. The composition of finfish bycatch is likely to differ substantially for tongol. Overall, floating object fisheries have the potential to cause serious problems for the conservation of tropical tuna stocks. Studies have cited the large-scale bycatch of juvenile fish species in floating object fisheries as particularly detrimental to populations (Dickson and Natividad 2000; Fonteneau et al. 2000; Bromhead et al. undated).

Sharks: bycatch rates
Sets on whale sharks are described in Bailey et al. (1996) with a note that such sets are generally avoided because of the trouble associated with releasing whale sharks after the set.

While there are no recorded incidents of shark bycatch by tuna purse seiners in the IOTC database, there is strong anecdotal evidence that sharks are captured in purse seine sets on FADs as well as on natural and artificial logs (IOTC 2006b). In these instances, it is believed that only the fins are kept aboard and that the rest of the shark is discarded. The population impacts of shark bycatch are described in the drift gillnet section above.

Sea turtles: bycatch rates and population impacts
Sea turtle species caught by purse seines in the Indian and western Pacific Oceans include the olive ridley (*Lepidochelys olivacea*), hawksbill (*Eretmochelys imbricate)* and leatherback (*Dermochelys coriacea)* turtles. Observers from the MMA recorded a sea turtle bycatch rate of 1.34 turtles per 100 school sets and 1.92 turtles per 100 log sets in the western Pacific Ocean between 1993 and 1994 (Bailey et al. 1996). While most turtles are released alive after being captured in purse seines, they can be injured or killed. Turtles entangled in purse seine nets can drown if they are unable to surface for breath, or can be injured during removal from the net or by contact with net retraction devices. Because the catch rates described above are based on a small sample size taken over ten years ago and only on ships with observers, it is not advisable that these observations be extrapolated to the present western Pacific sea turtle bycatch situation.

The only information about incidental sea turtles catch available through the IOTC comes from observer programs and is still preliminary because of low observer coverage (IOTC 2006b).

Sea turtle populations face many threats including incidental catch in fisheries, nesting female mortality, egg collection from nesting beaches and habitat loss. All seven species of sea turtles are either endangered or threatened. The population impact of sea turtle bycatch in the purse seine fisheries is unknown, but increasing use of FADs in the purse seine fishery may be a cause for concern.

Seabirds: bycatch rates and population impacts
There are no records of seabird bycatch in purse seine sets for tuna in the statistical area covered by the Secretariat of the Pacific Community (SPC) or IOTC (Bailey et al 1996; IOTC 2006b).

Synthesis
Most of the information available for driftnet and purse seine bycatch presented here is for high-seas tuna fisheries. There is no observer program for tongol tuna vessels, and bycatch figures for neritic tuna species are not globally available and may be different for the species of concern (e.g., sea turtles and seabirds) described in this paper. Accordingly, assessment of the potential impact of tongol tuna fisheries on associated species is highly uncertain, and the impact level of this fishery will continue to be difficult to assess. The remainder of this synthesis of the nature and extent of bycatch focuses on the information available for high seas tuna fisheries.

Though bycatch of finfish, turtles and marine mammals in handline and troll fishing gear is minimal, shark bycatch is of moderate concern in the coastal waters where this gear type is primarily used. Shark bycatch can range between 20% and 30% in fisheries for tuna and tuna-like species. There is inadequate information to substantiate the extent and impact of bycatch in the nearshore drift gillnet fishery for tongol tuna, but information available for other tuna fisheries in the Indian and western Pacific Oceans suggests extremely high levels of bycatch for finfish, marine mammals and sharks. The UN ban on the use of drift gillnets on the high seas is a testament to the severity of bycatch associated with drift gillnet gear. Floating object and FAD purse seines result in notable levels of bycatch for juvenile tuna species, other finfish, sharks and sea turtles. Since the demand for tongol is increasing, and both drift gillnet and FAD/floating purse seine fisheries for tongol are expanding, there is likely to be a related increase in bycatch of vulnerable marine species. Overall, the bycatch-related conservation concern for tongol caught in handline/troll and unassociated purse seine fisheries is moderate, and the conservation concern for FAD/floating object purse seine and drift gillnets is high.

Nature of Bycatch Rank:
Handline/troll (IO and WPO)

Low	**Moderate**	High	Critical

FAD/floating object purse seine (IO and WPO);
Drift gillnet (IO and WPO)

Low	Moderate	**High**	Critical

Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems

Habitat effects
The gear types used to catch tongol tuna, namely handlines, trolls, purse seines and drift gillnets, have minimal habitat effects, as they are either pelagic or surface gears and do not come into contact with the seafloor (Chuenpagdee et al. 2003).

Ecosystem effects
Both climate change and fishing pressure have been linked to ocean-wide declines in the diversity and abundance of large marine predators, with industrialized fishing pressure being the primary driver behind long-term variation (Ward and Myers 2005; Worm et al. 2005). Studies have suggested that diversity in the world's oceans has declined by 10–50% in the last 50 years (Worm et al. 2005), and some project the global collapse of all taxa being fished by 2048 (Worm et al. 2006).

A study by Myers and Worm (2003) suggested that widespread expansion of industrialized fishing was responsible for a marked decrease in community biomass and the proportion of large predatory fishes in continental shelf systems, and a 90% decline in large marine predators throughout the world's oceans. An analysis of catch per unit effort (CPUE) data showed that while landings in unfished areas were consistently high at the start of exploitation, they declined after sustained fishing pressure (Myers and Worm 2003). Other studies have suggested that the magnitude of biomass decline for large predators varies by region (Cox et al. 2002; Sibert et al. 2006) but acknowledged that, overall, more conservative management measures were needed for ecosystem-based management (Walters et al. 2001 *in* Sibert et al. 2006).

While questions have been raised about methodology (Walters 2003) and the magnitude of the declines (Hampton et al. 2005; Sibert et al. 2006) presented in the Myers and Worm (2003) study, it nonetheless raises appropriate concern that scientists and managers may not be aware of the true magnitude of changes in ocean ecosystems due to fishing pressure because much of the population decline and community alteration occurred before surveys were conducted. Myers and Worm (2005) concluded that their "estimates of decline remain conservative," after correcting for the biases suggested in Hampton et al. (2005) and Sibert et al. (2006). The removal of large predators such as tunas, sharks and billfish from the ecosystem may affect interactions between these species and may result in considerable top-down effects (effects on prey species populations and other elements of the food chain below these large predators) (Fonteneau 2003; Worm and Myers 2003).

The increased use of FADs in purse seine fisheries heightens the risk of juvenile tuna removal and the occurrence of bycatch (Sakagawa 2000; Fonteneau 2003). These FADs may also change the overall migration pattern of tuna species and other species by causing them to remain in areas they ordinarily would have passed through, thus impacting growth and population dynamics (Marsac et al. 2000; Sakagawa 2000). While the overall ecosystem effects of FADs have not been fully explored, several studies have demonstrated significant ecosystem impacts resulting from their use.

Synthesis
The habitat impacts of handline and troll gear, drift gillnets and purse seines are low. However, the ecosystem effects of removing tongol tunas and other moderately sized and large marine predators are not fully understood. The scale of purse seine sets for tongol using FADs is increasing and may have ecosystem impacts that warrant further investigation. Nevertheless, unassociated purse seines have been shown to have lower ecological impacts than FAD purse seines. Overall, the conservation concern for the handlines, trolls and unassociated purse seines used to capture tongol on habitats and ecosystems is benign, while the conservation concern for all other gear types is moderate.

Effect of Fishing Practices Rank:
Handline/troll:

Benign	Moderate	Severe	Critical

Drift gillnet, pelagic longline, purse seine:

Benign | **Moderate** | Severe | Critical

Criterion 5: Effectiveness of the Management Regime[6]

For tuna fisheries worldwide, regulations are generally based on recommendations by the regional commission (e.g., IOTC) or scientific committees, and are 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 recommendations or regulations suggested by the regional commission.

The complexity of tuna management is further 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 also fish in other oceans (Bayliff et al. 2005). Despite management measures implemented by the tuna commissions, vessels sometimes avoid these regulations by seeking registration in countries that do not require compliance (Bayliff et al. 2005).

Overall, the decline of some tuna stocks has been due to the open-access nature of the tuna fisheries in combination with the low level of regulation imposed on non-industrial fleets (Bayliff et al. 2005). To address this lack of regulation, a rights-based management system for non-industrial fleets may be the best option to maintain tuna populations and control the growth of tuna fleets (Bayliff et al. 2005).

Four nations—Indonesia, Thailand, Malaysia and the Islamic Republic of Iran—were responsible for nearly 90% of global tongol tuna landings in 2006 and have, on average, been responsible for three quarters of global tongol tuna landings in the past decade (FAO 2008f). While specific management plans for tongol tuna are not available for these nations, general information about bycatch mitigation efforts, fishing practices, and enforcement and management track records can be used in evaluating the effectiveness of the management regimes for this species. With the exception of the Islamic Republic of Iran, which operates exclusively in the Indian Ocean, all of the other primary tongol tuna fisheries operate in both the Indian and western Pacific Ocean basins. In all of the nations reviewed below, tongol tunas are landed and managed as part of artisanal fisheries for multiple neritic pelagic species.

Indian Ocean

Tongol in the Indian Ocean is managed by the Indian Ocean Tuna Commission (IOTC), which is a fisheries management body of the Food and Agriculture Organization of the United Nations (FAO). There are currently no specific regulations governing the management of tongol in the Indian Ocean, but IOTC notes the lack of species data and has proposed a review of the species

[6] Portions of this section were taken verbatim from the Seafood Watch® Skipjack Tuna report written by Jesse Marsh: http://www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_SkipjackTunaReport.pdf

during the first meeting of the newly created Working Party on Neritic Tunas (IOTC 2006a). Iran, Thailand, Malaysia and Indonesia are all full members of IOTC. Overall, fishery-dependent catch estimates for tongol tuna in the Indian Ocean are highly uncertain due of a lack of reporting and the high level of data processing required to rectify conflicting catch reports. The available stock assessments account for only small portions of the tongol tuna range across the Indian Ocean and were completed over ten years ago. Because of their regional focus and the fact that landings are estimated to have increased since the time these stock assessments were completed, it is unlikely that they reflect the current status of tongol tuna stocks. There is currently no plan in place through the IOTC to reduce bycatch in the tongol tuna fishery.

Western Pacific Ocean
In the western Pacific Ocean, tongol tunas are not actively managed by any international Regional Fishery Management Organization (RFMO). Australia placed a ban on the commercial extraction of tongol tunas in 2007 in order to maintain stocks for the burgeoning recreational fishery; tongols can now only be landed recreationally (SETFIA 2008). While fishery-dependent data, namely landings data, are collected for tongol in Australia, there are no stock assessments or fishery-independent data available for this species. There is no management in place to reduce bycatch or mitigate the impact of gear used to capture tongol tuna on habitats or ecosystems.

Indonesia (Pacific and Indian coasts)
Indonesia accounted for 36% of the global landings for tongol tuna in 2006 (FAO 2008f). Fisheries in Indonesia are managed by the Ministry of Marine Affairs and Fisheries (MMAF). Regulations for capture fisheries are developed by a Directorate General for Capture Fisheries and implemented within various provinces and districts by local fisheries administrators (Flewwelling and Hosch 2006a). Three research institutions, the Indonesian Institute of Science and Technology, the Central Fisheries Research Institute and the Research Institute for Marine Fisheries, provide scientific advice to the MMAF to aid in fisheries management and legislation (Flewelling and Hosch 2006a). In general, data collection and analysis for the Indonesian fleet are weak (Novaczek et al. 2001).

At the industrial scale, fisheries resources are lumped into species groups, and tongol tuna falls into the “large pelagic” group along with skipjack, billfish, oceanic sharks and other tunas. Species groups, which encompass between 33% and 66% of the nation’s fisheries, are primarily managed through legislative measures such as licensing, limited access, area designations, total allowable catches (TACs), taxes and gear restrictions. Formalized fisheries management plans are in place for less than one third of Indonesian fisheries (Flewwelling and Hosch 2006a). Total allowable catches typically allow extraction of up to 80% of the estimated potential fisheries yield for a species group in a given year (Flewwelling and Hosch 2006a). Legislation-focused management (rather than management structured around fisheries management plans) is also the primary means of fisheries regulation in Indonesian artisanal fisheries (Flewwelling and Hosch 2006a). Artisanal fisheries are also governed through informal, traditional laws passed between generations (Novaczek et al. 2001). Specific regulations for the large pelagic multi-species fishery in Indonesian waters are unknown.

While there is no information available about bycatch reduction initiatives in place in Indonesia for the types of fishing gear used to capture tongol tunas, the MMAF has prohibited setting FADs during fish migration periods, banned the use of poisons such as cyanide for fishing and implemented vessel capacity reduction strategies to address the effects of fishing on marine ecosystems (Flewwelling and Hosch 2006a). There is little licensing or registration of the vessels involved in the Indonesian fisheries. Enforcement of fisheries legislation is the responsibility of the Navy, and neither the Navy nor other law enforcement agencies effectively impose penalties on industrial fishermen for violations of fisheries legislation, in great part because of a lack of resources and the sheer size of the coastal area they are responsible for monitoring (Novaczek et al. 2001). Illegal, unreported and unregulated (IUU) fishing is still a major concern in Indonesian waters (Yamashita 2000).

In summary, management of tongol tuna in Indonesia is ineffective according to Seafood Watch ® criteria. There is no Indonesian stock assessment specific to tongol tuna, and none are planned for the near future. There is regular collection of fishery dependent data related to the large pelagic species management group that contains tongol tuna, but these data are likely to be less robust for tongol tuna because this species is primarily caught by artisanal, informally governed fishing vessels. Fisheries independent data are unavailable, and there is no historical information regarding adherence to yearly quota limits set by scientific advisors at the Indonesian Institute of Science and Technology, the Central Fisheries Research Institute and the Research Institute for Marine Fisheries. The efficacy of bycatch reduction efforts and efforts to mitigate the impacts of fishing practices on habitats and ecosystems, specifically the prohibition of FAD sets during fish migration periods and vessel capacity reduction schemes, has not been demonstrated. Finally, enforcement of existing fisheries regulations is lacking due to limited resources and the sheer expanse of the Indonesian coastal waters.

Iran (Indian Ocean)

Iran was responsible for 10% of global landings of tongol tuna in 2006 (FAO 2008f). Tongol tunas are primarily taken by artisanal vessels using longline, handline and gillnet in the Gulf of Oman and the Persian Gulf (Morgan, G. pers. comm.). These vessels catch a variety of pelagic species, and tongol tuna landings are monitored as part of an overall artisanal pelagic fishery (Morgan, G. pers. comm.). Very little management is in place for this fishery, but licensing requirements and closed areas, detailed further below, contribute to a general management strategy. Because the pelagic artisanal fishery is multi-species, the vast majority of landings are retained and sold.

Fisheries management in Iran is the result of a strong partnership between the public and private sectors. Federal fisheries management falls under the jurisdiction of the Iran Fisheries Company (known as *Shilat*) and a number of private-sector affiliates that share responsibilities for training, research and industrial fisheries management (Morgan 2006). Artisanal fisheries fall under local jurisdiction, with the direction of overall management coming from *Shilat* (Morgan 2006). Though there are management arrangements specific to certain fisheries, including the artisanal pelagic fishery encompassing tongol tuna, formal management plans do not exist for many Iranian fisheries (Morgan, G. pers. comm.). Accordingly, management objectives are often poorly articulated and hard to achieve. Fisheries management is primarily achieved with capacity and effort control and not through landings quotas.

Declining stock abundance, environmental degradation, overfishing and overcapacity are the primary problems associated with Iranian marine resources. The government has a number of legislative provisions related to fisheries and marine ecosystem management, but the overlapping nature of these pieces of legislation makes it difficult to mobilize and coordinate targeted mitigation efforts to address new and continuing fisheries issues (Morgan 2006).

In recent years, a moratorium has been placed on the issuance of new industrial fishing vessel licenses, and the task of fisheries enforcement was turned over to both a newly established coastguard agency (for nearshore waters) and the Navy (for offshore waters). This allows *Shilat* to function more fully in its conservation and management capacities (Morgan 2006). Iran currently uses a logbook program that details landings, effort and associated socioeconomic data (Morgan, G. pers. comm.). Vessels licenses specify their allowed regions of fishing operation and assigned gear type (Morgan 2006). Gear restrictions are also in place for specific commercial fisheries.

In summary, management of tongol tuna in the Islamic Republic of Iran is ineffective according to Seafood Watch ® criteria. There is no Iranian stock assessment specific to tongol tuna, and none are planned for the near future. There is regular collection of fishery-dependent data related to artisanal pelagic fisheries that contain tongol tuna, but there is no singular management and data collection strategy for this species. Fishery-independent data are unavailable, and there is no historical information regarding adherence to scientific advice from *Shilat's* private sector research affiliates. Finally, enforcement has changed hands in recent years to enable more firm efforts to uphold regulations, but the results of this change are not yet known.

Malaysia (Pacific and Indian coasts)
Malaysia was responsible for 11% of the global landings of tongol tuna in 2006 (FAO 2008f). The Malaysian Department of Fisheries (DOF), which is primarily responsible for the development and implementation of fisheries management measures, relies on the Ministry of Science, Technology and the Environment (MOSTE) for scientific advice, the Fisheries Development Authority (FDAM) for industry improvement, and the Navy, Coast Guard and Marine Police for the enforcement of fisheries regulations (Flewwelling and Hosch 2006b).

In addition to limited fisheries access, gear and vessel size restrictions are used to regulate fishing activity in different coastal zones within the Malaysian EEZ:

- Fishing in areas less than five nautical miles from shore is limited to non-commercial, owner-operated vessels using traditional gear;
- Owner-operated vessels using trawls and purse seines with engines of less than 40 horsepower are allowed to fish beyond five nautical miles;
- Commercial vessels weighing more than 40 gross tons using trawls and purse seines are restricted to fishing beyond 12 nautical miles;
- Vessels weighing more than 70 gross tons are limited to fishing beyond 30 nautical miles (Flewwelling and Hosch 2006b).

In conjunction with the nearly 40 coastal marine parks and reserves in the country, these fishing regulations limit fishing activities that damage sensitive coral reef and nursery habitats to deep water areas and reduce conflicts between industrial and artisanal fisheries (Flewwelling and Hosch 2006b). Pair and beam trawls, the use of poison and explosives, and gillnets with mesh sizes greater than 10 inches (to minimize the capture of large rays) have also been prohibited (Flewwelling and Hosch 2006b).

While Malaysia has yet to enact an onboard observer system or electronic catch reporting, it does monitor catch, landings and effort for scientific purposes using logbooks. Malaysia also uses vessel monitoring systems (VMS), dockside monitoring, air surveillance and an ISO 9000 certified fisheries licensing system that has been lauded as "one of the better systems in Asia" (Flewwelling and Hosch 2006b, p. 559). Large, highly visible markings allow surveillance aircraft and marine patrols to easily identify registered Malaysian fishing vessels from afar. Illegal, unreported and unregulated fishing has not been entirely eradicated, but severe penalties have been established and enforced against foreign vessels fishing in Malaysian waters. These penalties include fines for vessel captains and crew members, and immediate forfeit of the vessel, gear and landings.

In summary, management of tongol tuna in Malaysia is moderately effective according to Seafood Watch ® criteria. There is no Malaysian stock assessment specific to tongol tuna, and none are planned for the near future. There is regular collection of fishery-dependent data, but fishery-independent data are unavailable, and there is no historical information regarding adherence to yearly quota limits set by scientific advisors at the Ministry of Science, Technology and the Environment. The efficacy of bycatch reduction efforts and efforts to mitigate the impacts of fishing practices on habitats and ecosystems, specifically the strict zoning of Malaysian coastal waters, has not been demonstrated. Finally, enforcement of fisheries regulations is strong, with strict monitoring of landings and effort, VMS, dockside and aerial surveillance, and severe, well-enforced penalties for violators.

Thailand (Pacific coast and Andaman Sea)

Thailand was responsible for 31% of the global landings of tongol tuna in 2006 (FAO 2008f). The Department of Fisheries (DOF) is the primary agency responsible for offshore and international fisheries management, and a recently established Department of Coastal and Marine Resources (DCMR) will share responsibility for fisheries management in coastal areas (Panjarat 2008). The DOF only licenses trawl, gillnet and purse seine vessels—gear types with high potential for environmental impact. The Department of Harbors maintains registrations for all fishing vessels and operators. A recently enacted multi-year fisheries improvement strategy set the goal of attaining an annual 1.58 million mt capture fisheries production while reducing the level of bycatch and low value landings by 100,000 metric tons per year (Flewwelling and Hosch 2006d).

Overall, fisheries management efforts in Thailand include a combination of spatial and temporal restrictions, gear restrictions and limited fisheries participation (Panjarat 2008). There are several gear restrictions in place for fisheries licensed through the DOF, including a minimum mesh size and zone limitations for purse seines, the prohibition of the use of trawl nets within three kilometers of the coast and the requirement that trawl nets be equipped with turtle excluder devices (TEDs) (Flewwelling and Hosch 2006d). Fish sanctuaries and closed seasons have also been established to protect important nursery habitats and yearly spawning aggregations (Flewwelling and Hosch 2006c). License buyback efforts have been effective in the purse seine and gillnet fisheries, but unsuccessful for the trawl fishery.

The DOF recently partnered with IOTC and the Overseas Fishery Cooperation Foundation (OFCF) to enact the "Cooperation Project for Enhancing the Data Collection and Processing Systems for Tuna Resources in the Indian Ocean" with the goal of assessing current landings estimates for neritic and pelagic tuna fisheries by comparing current estimates with new sampling results (Pokapunt and Thummachua 2006). The program, which concluded in December 2006, also collected fishing effort information and fork length data for neritic tuna species. Preliminary data from this study note that tongol tunas accounted for 11% of the tuna landings in the 2005 trials (Pokapunt and Thummachua 2006). Nearly 90% of recorded tongol tuna landings came from the purse seine fishery; the remaining landings were captured using drift gillnets. Plans are in place to extend this successful program.

In summary, management of tongol tuna in Thailand is ineffective according to Seafood Watch ® criteria. There is no Thai stock assessment specific to tongol tuna, and none are planned for the near future. There has been recent success with improved collection of fishery-dependent data related to purse seine and gillnet fisheries that land tongol tuna, but fishery-independent data are unavailable. While there is a newly established multi-year capture fisheries production target, there is no historical information regarding past adherence to quota limits set by scientific advisors. Capacity reduction efforts have been successful for both of the fisheries that land tongol tunas, but there is no evidence that fish sanctuary areas have been enforced or have been successful in safeguarding nursery habitats and spawning aggregations. Finally, there is no evidence that enforcement of fisheries regulations is being successfully practiced.

Table 4. Commercial catch management measures in the four nations responsible for nearly 90% of total 2006 tongol tuna landings.

Management Jurisdictions & Agencies	Total Allowable Landings	Size Limit	Gear Restrictions	Trip Limit	Area Closures	Sources
Indonesia EEZ: Ministry of Marine Affairs and Fisheries	TAC of up to 80% of potential annual fisheries yield	None	FADs prohibited during fish migration periods; Poisons banned	None	None	Flewwelling and Hosch 2006a; Novaczek et al. 2001
Islamic Republic of Iran EEZ: Iran Fisheries Company (*Shilat*)	None	None	Yes, for commercial fisheries; Gillnets banned in Caspian Sea; Trawls only in Persian Gulf	Unknown	Unknown	Morgan 2006
Malaysia EEZ: Department of Fisheries	None	None	Pair and beam trawl, poisons, explosives, gillnets with mesh greater than 10 inches prohibited; Traditional gear only in areas <5nm from shore; Commercial trawl/purse seines prohibited <12nm from shore	None	40 marine reserves and parks; Owner operated vessels <40 hp only permitted beyond 5nm; Vessels >70 gross tons prohibited <30nm from shore	Flewwelling and Hosch 2006b
Thailand EEZ: Department of Fisheries; Department of Coastal and Marine Resources	1.58 million mt overall capture fisheries production	Unknown	Minimum mesh size for purse seines; Trawl nets required to be equipped with TEDs	None	Fish sanctuaries; Zone restrictions for purse seines; Trawls prohibited within 3km of coast	Flewwelling and Hosch 2006c and Flewwelling and Hosch 2006d; Panjarat 2008

Synthesis

Regional management of tongol tuna is lacking, as landings of this species primarily occur in the artisanal sector. The four nations—Indonesia, Thailand, Malaysia and the Islamic Republic of Iran—that were responsible for nearly 90% of global tongol tuna landings in 2006 use a combination of gear and area restrictions to manage fisheries rather than landings quotas directed at specific fisheries. Indonesia and Thailand do set a quota for overall fisheries production, but all of these nations manage tongol tuna as part of a suite of species, and none have stock assessment information available specifically for this species. The occurrence of IUU fishing is still a serious problem across the whole tongol range, and enforcement efforts vary from the insufficient measures in place in Indonesian waters to the complex and well-developed strategies employed in Malaysia. Overall, the conservation concern for management effectiveness is moderate for Malaysia, while the conservation concern for management effectiveness is high for Indonesia, Iran and Thailand.

Effectiveness of Management Rank:

Malaysia (Pacific and Indian coasts)

Highly Effective **Moderately Effective** Ineffective Critical

Indonesia (Pacific and Indian coasts);
Islamic Republic of Iran (Indian Ocean);
Thailand (Pacific coast and Andaman Sea)

Highly Effective Moderately Effective **Ineffective** Critical

IV. Overall Evaluation and Seafood Recommendation

While the intrinsic rate of growth and maximum age for tongol are unknown, other life history characteristics, such as high fecundity and early age at maturity, suggest that the species is inherently resilient to fishing pressure. Tongol tunas are a schooling species and are attracted to fish aggregating devices, but these behaviors are not though to have a substantial impact on their overall vulnerability to fishing pressure. Accordingly, the conservation concern related to the inherent vulnerability of tongol tuna is low.

Apart from localized, sub-regional assessments, no stock assessments have been conducted for tongol tuna. The status of tongol stocks is highly uncertain for both the Indian and western Pacific Ocean, suggesting a moderate conservation concern. Additional fishery-based mortality may result from incidental landings in longline fisheries for sharks and large pelagic tuna species like albacore, bigeye and yellowfin. The majority of factors related to stock status are unknown, and thus the conservation concern for stock status is moderate/unknown.

There is little information on bycatch specific to the tongol fishery, but information from other fisheries and records of fishing for tuna and tuna-like species in the Indian and western Pacific Oceans on the whole suggests concerning levels of bycatch for a number of sharks, dolphins and turtles in fisheries that use drift gillnets, handlines/trolls, and floating object set purse seines. The conservation concern for bycatch in handline/troll fisheries for tongol tuna is considered moderate according to Seafood Watch® criteria due to moderate levels of shark bycatch. The conservation concern for bycatch in FAD/floating object purse seine and drift gillnets is high. Habitat and ecosystem impacts of the gear types used to capture tongol are low, but the overall ecosystem impacts of the commercial-scale removal of this species are not fully understood.

The only available management directive specifically applicable to the tongol tuna fishery is a recent ban on commercial extraction of tongol tuna in Australian waters. The Indian Ocean Tuna Commission (IOTC) is the only regional fisheries management body that lists the management of tongol under its jurisdiction. This regional fisheries management organization has acknowledged both the lack of data and the uncertainty surrounding existing data and is moving to launch a review of this and other species of growing commercial importance in the near future. The Western and Central Pacific Fisheries Commission (WCPFC) has jurisdiction over tongol management in the western Pacific, but has made no efforts to coordinate management of this species with its member nations.

Management efforts in the four nations (Indonesia, Iran, Malaysia and Thailand) that accounted for nearly 90% of tongol tuna landing in 2006 mainly focus on gear restrictions, limited fishery participation and area closures. While enforcement is lacking in Indonesia, Iran and Thailand, Malaysia's comprehensive vessel monitoring system, dockside monitoring, air surveillance and ISO 9000 certified fisheries licensing system have been praised as the most comprehensive in the region. Accordingly, management effectiveness is a moderate conservation concern in Malaysia, while management effectiveness is a high conservation concern in Indonesia, Iran and Thailand. The management effectiveness rankings for Indonesia, Iran and Thailand could be improved to highly effective according to Seafood Watch® criteria if these nations add the following three components to their management programs: 1) Complete an initial assessment of national tongol tuna stocks using fishery-independent data and set regular intervals to update the assessment; 2) create regulations to maintain stocks based on recent assessments; and 3) create a plan to address the bycatch of protected and vulnerable species, particularly in the FAD purse seine and drift gillnet fisheries for tongol tuna.

Overall, sustainability rankings for tongol tuna can be summarized as follows: tongol tuna caught with all gear types by the Malaysian artisanal fleets is a **Good Alternative**; tongol tuna caught using handlines/trolls by all other nations fishing in the western Pacific and Indian Ocean basins is a **Good Alternative**; tongol tuna caught with drift nets and FAD/floating object set purse seines by all other nations fishing in the western Pacific and Indian Ocean basins is recommended as **Avoid**.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherent Vulnerability	√			
Status of Stocks		√		
Nature of Bycatch		√ **handline/troll**	√ **FAD/floating object set purse seines, drift gillnets**	
Habitat & Ecosystem Effects	√ **handline/troll**	√ **other gears**		
Management Effectiveness		√ **Malaysia**	√ **Indonesia, Iran, Thailand**	

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
Good Alternative	Malaysia (all gear types)
	Indonesia, Iran, Thailand (handline, troll/pole, unassociated purse seines)
Avoid	Indonesia, Iran, Thailand (all other gear types)

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Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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VI. Capture Fisheries Evaluation

Species: *Tongol Tuna*	**Region**: *IO/WPO*
Analyst: *Aja Peters-Mason*	**Date**: *11 November 2008*

Seafood Watch™ defines sustainable seafood as originating from sources, whether fished[7] or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

The following **guiding principles** illustrate the qualities that capture fisheries must possess to be considered sustainable by the Seafood Watch program. Species from sustainable capture fisheries:

- have a low vulnerability to fishing pressure, and hence a low probability of being overfished, because of their inherent life history characteristics;
- have stock structure and abundance sufficient to maintain or enhance long-term fishery productivity;
- are captured using techniques that minimize the catch of unwanted and/or unmarketable species;
- are captured in ways that maintain natural functional relationships among species in the ecosystem, conserves the diversity and productivity of the surrounding ecosystem, and do not result in irreversible ecosystem state changes; and
- have a management regime that implements and enforces all local, national and international laws and utilizes a precautionary approach to ensure the long-term productivity of the resource and integrity of the ecosystem.

Seafood Watch has developed a set of five sustainability **criteria,** corresponding to these guiding principles, to evaluate capture fisheries for the purpose of developing a seafood recommendation for consumers and businesses. These criteria are:

1. Inherent vulnerability to fishing pressure
2. Status of wild stocks
3. Nature and extent of discarded bycatch
4. Effect of fishing practices on habitats and ecosystems
5. Effectiveness of the management regime

Each criterion includes:

- Primary factors to evaluate and rank
- Secondary factors to evaluate and rank
- Evaluation guidelines[8] to synthesize these factors
- A resulting **rank** for that criterion

Once a rank has been assigned to each criterion, an **overall seafood recommendation** for the species in question is developed based on additional evaluation guidelines. The ranks for each criterion, and the resulting overall seafood recommendation, are summarized in a table. Criterion ranks and the overall

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[7] "Fish" is used throughout this document to refer to finfish, shellfish and other wild-caught invertebrates.

[8] Evaluation Guidelines throughout this document reflect common combinations of primary and secondary factors that result in a given level of conservation concern. Not all possible combinations are shown – other combinations should be matched as closely as possible to the existing guidelines.

seafood recommendation are color-coded to correspond to the categories of the Seafood Watch pocket guide:

Best Choices/Green: Consumers are strongly encouraged to purchase seafood in this category. The wild-caught species is sustainable as defined by Seafood Watch.

Good Alternatives/Yellow: Consumers are encouraged to purchase seafood in this category, as they are better choices than seafood in the Avoid category. However there are some concerns with how this species is fished and thus it does not demonstrate all of the qualities of a sustainable fishery as defined by Seafood Watch.

Avoid/Red: Consumers are encouraged to avoid seafood in this category, at least for now. Species in this category do not demonstrate enough qualities to be defined as sustainable by Seafood Watch.

CRITERION 1: INHERENT VULNERABILITY TO FISHING PRESSURE

Guiding Principle: Sustainable wild-caught species have a low vulnerability to fishing pressure, and hence a low probability of being overfished, because of their inherent life history characteristics.

Primary Factors[9] to evaluate

Intrinsic rate of increase ('r'): Unknown

- High (> 0.16)
- Medium (0.05 - 0.16)
- Low (< 0.05)
- Unavailable/Unknown

Age at 1st maturity : 2 years (Griffiths, Fry et al. 2010)

- Low (< 5 years)
- Medium (5 - 10 years)
- High (> 10 years)
- Unavailable/Unknown

Von Bertalanffy growth coefficient ('k'): All published values range from 0.228 to 1.44. Griffiths, Fry et al. 2010 suggest a slightly lower value of 0.22.

- High (> 0.16)
- Medium (0.05 - 0.15)
- Low (< 0.05)
- Unavailable/Unknown

Maximum age: Maximum reported age of 18.7 years. Models suggest maximum longevity of up to 30 years (Griffiths, Fry et al. 2010).

- Low (< 11 years)
- Medium (11 - 30 years)
- High (> 30 years)
- Unavailable/Unknown

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[9] These primary factors and evaluation guidelines follow the recommendations of Musick et al. (2000). Marine, estuarine, and diadromous fish stocks at risk of extinction in North America (exclusive of Pacific salmonids). Fisheries 25:6-30.

Reproductive potential (fecundity): Numbers of fertilized eggs per year are between 1 and 2.5 million (Daveshi et al. 2003). There are no published survivability studies, so it is unclear how many of these individuals reach maturity. In any case, this suggests a high reproductive potential.

- High (> 100 inds./year)
- Moderate (10 – 100 inds./year)
- Low (< 10 inds./year)
- Unavailable/Unknown

Secondary Factors to evaluate

Species range: Indian and western Pacific Oceans. Broad.

- Broad (e.g. species exists in multiple ocean basins, has multiple intermixing stocks or is highly migratory)
- Limited (e.g. species exists in one ocean basin)
- Narrow (e.g. endemism or numerous evolutionary significant units or restricted to one coastline)

Special Behaviors or Requirements: Existence of special behaviors that increase ease or population consequences of capture (e.g. migratory bottlenecks, spawning aggregations, site fidelity, unusual attraction to gear, sequential hermaphrodites, segregation by sex, etc., OR specific and limited habitat requirements within the species' range): Older studies mention the use of electric lamp lures and fish shelters in the Thai purse seine fishery (Yonemori et al., 1995). These techniques are presumably still used to attract tongol tuna.

- No known behaviors or requirements OR behaviors that decrease vulnerability (e.g. widely dispersed during spawning)
- Some (i.e. 1 - 2) behaviors or requirements
- Many (i.e. > 2) behaviors or requirements

Quality of Habitat: Degradation from non-fishery impacts: Climate change is the largest non-fishery impact on habitat quality. Tongol avoid areas of reduced salinity. Changes in precipitation associated with climate change (higher levels of rain during monsoon seasons) may alter distribution. On the other hand, decreases in the amount of rain in these areas may allow tongol to venture closer to coastal areas and may increase population vulnerability due to increased coastal fishing pressure.

- Habitat is robust
- Habitat has been moderately altered by non-fishery impacts

- Habitat has been substantially compromised from non-fishery impacts and thus has reduced capacity to support this species (e.g. from dams, pollution, or coastal development)

Evaluation Guidelines

1) Primary Factors
   a) If 'r' is known, use it as the basis for the rank of the Primary Factors.
   b) If 'r' is unknown, then the rank from the remaining Primary Factors (in order of importance, as listed) is the basis for the rank.

2) Secondary Factors
   a) If a majority (2 out of 3) of the Secondary Factors rank as Red, reclassify the species into the next lower rank (i.e. Green becomes Yellow, Yellow becomes Red). No other combination of Secondary Factors can modify the rank from the Primary Factors.
   b) No combination of primary and secondary factors can result in a Critical Conservation Concern for this criterion.

Conservation Concern: Inherent Vulnerability

- Low (Inherently Resilient)
- Moderate (Moderately Vulnerable)
- High (Highly Vulnerable)

CRITERION 2: STATUS OF WILD STOCKS

Guiding Principle: Sustainable wild-caught species have stock structure and abundance sufficient to maintain or enhance long-term fishery productivity.

Primary Factors to evaluate

Management classification status: Overall unknown. One stock assessment completed in India in 1995, estimated an MSY of 3096 mt in the Indian Ocean based on effort and landings data from 1989–1991 (Piilai, 1995). Based on this analysis, effort at that time could be increased fourfold to reach MSY. Between 2000 and 2003, India's total tongol landings declined from over 10,000 tons per year to 4,000 tons per year.

- Underutilized OR close to virgin biomass
- Fully fished OR recovering from overfished OR unknown
- Recruitment or growth overfished, overexploited, depleted or "threatened"

Current population abundance relative to B_{MSY} : Unknown

- At or above B_{MSY} (> 100%)
- Moderately Below B_{MSY} (50 – 100%) OR unknown
- Substantially below B_{MSY} (< 50%)

Occurrence of overfishing (current level of fishing mortality relative to overfishing threshold): Unknown, but landings have steadily increased across species range.

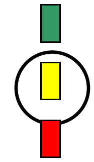
- Overfishing not occurring ($F_{curr}/F_{msy} < 1.0$)
- Overfishing is likely/probable OR fishing effort is increasing with poor understanding of stock status OR Unknown
- Overfishing occurring ($F_{curr}/F_{msy} > 1.0$)

Overall degree of uncertainty in status of stock: High degree of uncertainty in both Indian Ocean and western Pacific Ocean

- Low (i.e. current stock assessment and other fishery-independent data are robust OR reliable long-term fishery-dependent data available)
- Medium (i.e. only limited, fishery-dependent data on stock status are available)
- High (i.e. little or no current fishery-dependent or independent information on stock status OR models/estimates broadly disputed or otherwise out-of-date)

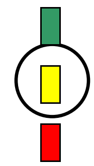
Long-term trend (relative to species' generation time) in population abundance as measured by either fishery-independent (stock assessment) or fishery-dependent (standardized CPUE) measures: Unknown

- ➢ Trend is up
- ➢ Trend is flat or variable (among areas, over time or among methods) OR Unknown
- ➢ Trend is down



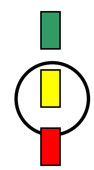
Short-term trend in population abundance as measured by either fishery-independent (stock assessment) or fishery-dependent (standardized CPUE) measures: Unknown

- ➢ Trend is up
- ➢ Trend is flat or variable (among areas, over time or among methods) OR Unknown
- ➢ Trend is down



Current age, size or sex distribution of the stock relative to natural condition: Older fisheries dependent-information suggests an overall decrease in average tongol size since 1989 in troll, PS and gillnet fisheries (Chee, 1995). As the harvesting of tuna at a particular time, age and size in one country will definitely affect the catch of another country fishing the same species, more studies into size segregation of tuna species by fishing gear and location need to be conducted (also regional management). Recent studies have not been published on this issue.

- ➢ Distribution(s) is(are) functionally normal
- ➢ Distribution(s) unknown
- ➢ Distribution(s) is(are) skewed



Evaluation Guidelines

A "Healthy" Stock:

1) Is underutilized (near virgin biomass)
2) Has a biomass at or above BMSY AND overfishing is not occurring AND distribution parameters are functionally normal AND stock uncertainty is not high

A "Moderate" Stock:

1) Has a biomass at 50-100% of BMSY AND overfishing is not occurring
2) Is recovering from overfishing AND short-term trend in abundance is up AND overfishing not occurring AND stock uncertainty is low
3) Has an Unknown status because the majority of primary factors are unknown.

A "Poor" Stock:

1) Is fully fished AND trend in abundance is down AND distribution parameters are skewed
2) Is overfished, overexploited or depleted AND trends in abundance and CPUE are up.
3) Overfishing is occurring AND stock is not currently overfished.

A stock is considered a **Critical Conservation Concern** and the species is ranked "Avoid", regardless of other criteria, if it is:

1) Overfished, overexploited or depleted AND trend in abundance is flat or down
2) Overfished AND overfishing is occurring
3) Listed as a "threatened species" or similar proxy by national or international bodies

Conservation Concern: Status of Stocks

- Low (Stock Healthy)
- Moderate (Stock Moderate or Unknown)
- High (Stock Poor)
- Stock Critical

CRITERION 3: NATURE AND EXTENT OF DISCARDED BYCATCH[10]

Guiding Principle: A sustainable wild-caught species is captured using techniques that minimize the catch of unwanted and/or unmarketable species.

Primary Factors to evaluate

Quantity of bycatch, including any species of "special concern" (i.e. those identified as "endangered", "threatened" or "protected" under state, federal or international law)

- Quantity of bycatch is low (< 10% of targeted landings on a per number basis) AND does not regularly include species of special concern
- Quantity of bycatch is moderate (10 – 100% of targeted landings on a per number basis) AND does not regularly include species of special concern OR Unknown
- Quantity of bycatch is high (> 100% of targeted landings on a per number basis) OR bycatch regularly includes threatened, endangered or protected species

Population consequences of bycatch
Moderate/unknown for FAD/floating object purse seines, possibly severe for sharks in drift gillnets, hand line and troll.

- Low: Evidence indicates quantity of bycatch has little or no impact on population levels
- Moderate: Conflicting evidence of population consequences of bycatch OR **Unknown**
- Severe: Evidence indicates quantity of bycatch is a contributing factor in driving one or more bycatch species toward extinction OR is a contributing factor in limiting the recovery of a species of "special concern"

Trend in bycatch interaction rates (adjusting for changes in abundance of bycatch species) as a result of management measures (including fishing seasons, protected areas and gear innovations)
Appears flat for sharks in hand line/troll and drift gillnet, unknown for other gears.

- Trend in bycatch interaction rates is down
- Trend in bycatch interaction rates is flat OR **Unknown**
- Trend in bycatch interaction rates is up
- Not applicable because quantity of bycatch is low

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[10] 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, is accounted for, and is managed in some way.

Secondary Factor to evaluate

Evidence that the ecosystem has been or likely will be substantially altered (relative to natural variability) in response to the continued discard of the bycatch species
Low for all gear types.

- Studies show no evidence of ecosystem impacts
- Conflicting evidence of ecosystem impacts OR Unknown
- Studies show evidence of substantial ecosystem impacts

Evaluation Guidelines

Bycatch is "**Minimal**" if:

1) Quantity of bycatch is <10% of targeted landings AND bycatch has little or no impact on population levels.

Bycatch is "**Moderate**" if:

1) Quantity of bycatch is 10 - 100% of targeted landings
2) Bycatch regularly includes species of "special concern" AND bycatch has little or no impact on the bycatch population levels AND the trend in bycatch interaction rates is not up.

Bycatch is "Severe" if:

1) Quantity of bycatch is > 100% of targeted landings
2) Bycatch regularly includes species of "special concern" AND evidence indicates bycatch rate is a contributing factor toward extinction or limiting recovery AND trend in bycatch is down.

Bycatch is considered a **Critical Conservation Concern** and the species is ranked "Avoid", regardless of other criteria, if:

1) Bycatch regularly includes species of special concern AND evidence indicates bycatch rate is a factor contributing to extinction or limiting recovery AND trend in bycatch interaction rates is not down.
2) Quantity of bycatch is high AND studies show evidence of substantial ecosystem impacts.

Conservation Concern: Nature and Extent of Discarded Bycatch
Moderate for handline/troll; high for FAD/floating object, unassociated purse seine and drift gillnets.

- Low (Bycatch Minimal)
- Moderate (Bycatch Moderate)
- High (Bycatch Severe)
- Bycatch Critical

CRITERION 4: EFFECT OF FISHING PRACTICES ON HABITATS AND ECOSYSTEMS

Guiding Principle: Capture of a sustainable wild-caught species maintains natural functional relationships among species in the ecosystem, conserves the diversity and productivity of the surrounding ecosystem, and does not result in irreversible ecosystem state changes.

Primary Habitat Factors to evaluate

Known (or inferred from other studies) effect of fishing gear on physical and biogenic habitats: Gear includes longline, gillnet, purse seine and troll→ little environmental impact

- Minimal damage (i.e. pelagic longline, midwater gillnet, midwater trawl, purse seine, hook and line, or spear/harpoon)
- Moderate damage (i.e. bottom gillnet, bottom longline or some pots/ traps)
- Great damage (i.e. bottom trawl or dredge)

For specific fishery being evaluated, resilience of physical and biogenic habitats to disturbance by fishing method: Not applicable b/c gear damage is minimal, see above.

- High (e.g. shallow water, sandy habitats)
- Moderate (e.g. shallow or deep water mud bottoms, or deep water sandy habitats)
- Low (e.g. shallow or deep water corals, shallow or deep water rocky bottoms)
- Not applicable because gear damage is minimal

If gear impacts are moderate or great, spatial scale of the impact

- Small scale (e.g. small, artisanal fishery or sensitive habitats are strongly protected)
- Moderate scale (e.g. modern fishery but of limited geographic scope)
- Large scale (e.g. industrialized fishery over large geographic areas)
- Not applicable because gear damage is minimal

Primary Ecosystem Factors to evaluate

Evidence that the removal of the targeted species or the removal/deployment of baitfish has or will likely substantially disrupt the food web

- The fishery and its ecosystem have been thoroughly studied, and studies show no evidence of substantial ecosystem impacts
- Conflicting evidence of ecosystem impacts OR **Unknown**
- Ecosystem impacts of targeted species removal demonstrated

Evidence that the fishing method has caused or is likely to cause substantial ecosystem state changes, including alternate stable states

- The fishery and its ecosystem have been thoroughly studied, and studies show no evidence of substantial ecosystem impacts
- Conflicting evidence of ecosystem impacts OR **Unknown** handline/troll;
- **Ecosystem impacts from fishing method demonstrated** PLL and FADs

Evaluation Guidelines

The effect of fishing practices is **"Benign"** if:

1) Damage from gear is minimal AND resilience to disturbance is high AND neither Ecosystem Factor is red.

The effect of fishing practices is **"Moderate"** if:

1) Gear effects are moderate AND resilience to disturbance is moderate or high AND neither Ecosystem Factor is red.
2) Gear results in great damage AND resilience to disturbance is high OR impacts are small scale AND neither Ecosystem Factor is red.
3) Damage from gear is minimal and one Ecosystem factor is red.

The effect of fishing practices **is "Severe"** if:

1) Gear results in great damage AND the resilience of physical and biogenic habitats to disturbance is moderate or low.
2) Both Ecosystem Factors are red.

Habitat effects are considered a **Critical Conservation Concern** and a species receives a recommendation of "**Avoid**", regardless of other criteria if:

- Four or more of the Habitat and Ecosystem factors rank red.

Conservation Concern: Effect of Fishing Practices on Habitats and Ecosystems

- Low (Fishing Effects Benign) handline/troll
- Moderate (Fishing Effects Moderate) PLL, FAD purse seine sets
- High (Fishing Effects Severe)
- Critical Fishing Effects

CRITERION 5: EFFECTIVENESS OF THE MANAGEMENT REGIME

Guiding Principle: The management regime of a sustainable wild-caught species implements and enforces all local, national and international laws and utilizes a precautionary approach to ensure the long-term productivity of the resource and integrity of the ecosystem.

Primary Factors to evaluate

From ITOC 2006: For the Indian Ocean, catch estimates are based on very little information and are therefore highly uncertain. The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

Information on management in the four primary fishing nations (Indonesia, Iran, Malaysia, Thailand) can be used to make generalizations for management of the tongol fishery.

Stock Status: Management process utilizes an independent scientific stock assessment that seeks knowledge related to the status of the stock

- Stock assessment complete and robust
- Stock assessment is planned or underway but is incomplete OR stock assessment complete but out-of-date or otherwise uncertain
- No stock assessment available now and none is planned in the near future

Scientific Monitoring: Management process involves regular collection and analysis of data with respect to the short and long-term abundance of the stock

- Regular collection and assessment of both fishery-dependent and independent data
- Regular collection of fishery-dependent data only

Malaysia, Thailand, Indonesia and Iran

- No regular collection or analysis of data

Scientific Advice: Management has a well-known track record of consistently setting or exceeding catch quotas beyond those recommended by its scientific advisors and other external scientists:

- No
- Yes
- Not enough information available to evaluate OR not applicable because little or no scientific information is collected

Bycatch: Management implements an effective bycatch reduction plan

- Bycatch plan in place and reaching its conservation goals (deemed effective)

- Bycatch plan in place but effectiveness is not yet demonstrated or is under debate
- No bycatch plan implemented or bycatch plan implemented but not meeting its conservation goals (deemed ineffective)

  All nations
- Not applicable because bycatch is "low"

Fishing practices: Management addresses the effect of the fishing method(s) on habitats and ecosystems

- Mitigative measures in place and deemed effective
- Mitigative measures in place but effectiveness is not yet demonstrated or is under debate

  All nations: restriction of damaging gear and protected areas in place but not monitoring of the effect of these areas on ecosystems.
- No mitigative measures in place or measures in place but deemed ineffective
- Not applicable because fishing method is moderate or benign

Enforcement: Management and appropriate government bodies enforce fishery regulations

- Regulations regularly enforced by independent bodies, including logbook reports, observer coverage, dockside monitoring and similar measures

  Malaysia - monitors catch, landings and effort for scientific purposes using logbooks. Malaysia also uses vessel monitoring systems (VMS), dockside monitoring, air surveillance and an ISO 9000 certified fisheries licensing system that has been lauded as "the most effective licensing system in Asia" (Flewwelling and Hosch 2006b).
- Regulations enforced by fishing industry or by voluntary/honor system
- Regulations not regularly and consistently enforced

  Indonesia, Thailand, Iran

Management Track Record: Conservation measures enacted by management have resulted in the long-term maintenance of stock abundance and ecosystem integrity

- Management has maintained stock productivity over time OR has fully recovered the stock from an overfished condition
- Stock productivity has varied and management has responded quickly OR stock has not varied but management has not been in place long enough to evaluate its effectiveness OR **Unknown** All nations
- Measures have not maintained stock productivity OR were implemented only after

significant declines and stock has not yet fully recovered

Evaluation Guidelines

Management is deemed to be "**Highly Effective**" if the majority of management factors are green AND the remaining factors are not red.

Management is deemed to be "**Moderately Effective**" if:
1) Management factors "average" to yellow
2) Management factors include one or two red factors

Management is deemed to be "**Ineffective**" if three individual management factors are red,

including especially those for Stock Status and Bycatch.

Management is considered a **Critical Conservation Concern** and a species receives a recommendation of "**Avoid"**, regardless of other criteria if:
1) There is no management in place
2) The majority of the management factors rank red.

Conservation Concern: Effectiveness of Management

- Low (Management Highly Effective)
- Moderate (Management Moderately Effective)

Malaysia

- High (Management Ineffective)

Thailand, Indonesia, Iran

- Critical (Management Critically Ineffective)

Overall Seafood Recommendation

Overall Guiding Principle: Sustainable wild-caught seafood originates from sources that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

Evaluation Guidelines

A species receives a recommendation of "**Best Choice**" if:

1) It has three or more green criteria and the remaining criteria are not red.

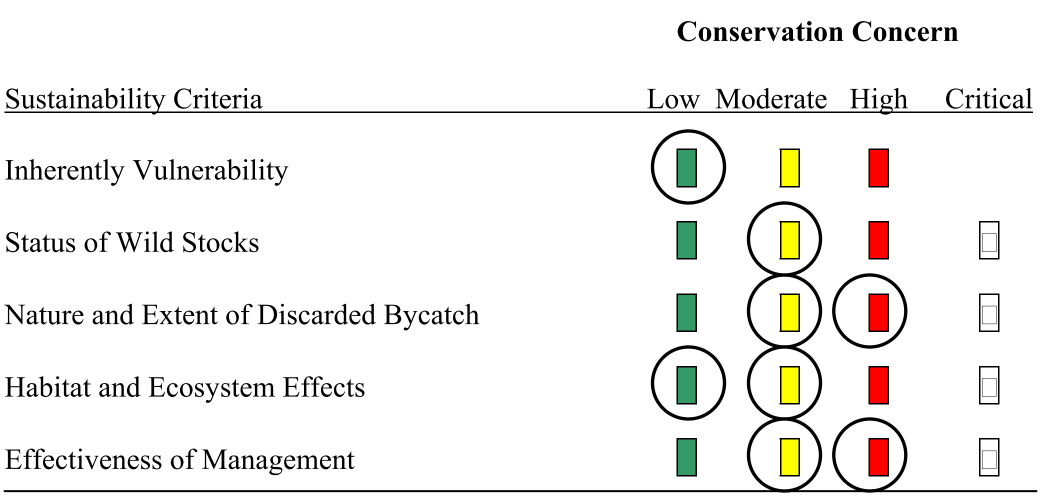
A species receives a recommendation of "**Good Alternative**" if:

1) Criteria "average" to yellow
2) There are four green criteria and one red criteria
3) Stock Status and Management criteria are both ranked yellow and remaining criteria are not red.

A species receives a recommendation of "**Avoid**" if:

1) It has a total of two or more red criteria
2) It has one or more Critical Conservation Concerns.

Summary of Criteria Ranks



Overall Seafood Recommendation:

Seafood Watch® Recommendation	Where Caught and Gear Used
Good Alternative	Malaysia (all gear types)
	Indonesia, Iran, Thailand (handline, troll/pole)
Avoid	Indonesia, Iran, Thailand (all gear types)

Appendix II

Due to data that Seafood Watch® has collected regarding which tuna species are used in canned tuna and what gear types are predominately used to catch those species, Seafood Watch® has changed its canned tuna recommendations. Canned tuna clearly labeled as tongol tuna from Malaysia is a **Good Alternative**. Tongol tuna also can be included in canned light tuna. Canned light tuna that is troll/pole-caught is a **Best Choice**. All other light tuna is **Avoid**. The proportion of light tuna that is from each species cannot be determined. However, based on capture data, only about 3-5% of yellowfin, bigeye and tongol tuna is troll/pole caught, and about 13% of tongol tuna (which is a smaller fishery than the yellowfin and bigeye fisheries) is captured by the Malaysia fleet. Because the majority of light tuna is Avoid, canned light tuna should be **Avoided** unless clearly marked as troll/pole or tongol tuna from Malaysia. The Executive Summary has been updated to reflect this change.

Appendix III

In February, 2011, the "Criterion 1: Inherent Vulnerability to Fishing Pressure" section of this report was updated to reflect new information on the life history of tongol tuna, particularly the maximum age and age at maturity. This new information did not result in a recommendation change.