Skipjack and Yellowfin Tuna

Katsuwonus pelamis, Thunnus albacares

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Indian Ocean

Hand-operated pole and lines and Trolling lines

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Disclaimer
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Seafood Watch Standard used in this assessment: Standard for Fisheries vF2
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About Seafood Watch

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.
Guiding Principles

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

Based on this principle, Seafood Watch had developed four sustainability criteria for evaluating wildcatch fisheries for consumers and businesses. These criteria are:

- How does fishing affect the species under assessment?
- How does the fishing affect other, target and non-target species?
- How effective is the fishery’s management?
- How does the fishing affect habitats and the stability of the ecosystem?

Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and rating

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide and online guide:

**Best Choice/Green:** Are well managed and caught in ways that cause little harm to habitats or other wildlife.

**Good Alternative/Yellow:** Buy, but be aware there are concerns with how they’re caught.

**Avoid/Red** Take a pass on these for now. These items are overfished or caught in ways that harm other marine life or the environment.

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1 “Fish” is used throughout this document to refer to finfish, shellfish and other invertebrates
Summary

This report focuses on skipjack (Katsuwonus pelamis) and yellowfin tuna (Thunnus albacares) caught by troll and pole fisheries in the Indian Ocean.

All the tuna species in this report are of medium inherent vulnerability to fishing pressure based on life history characteristics, including when they reach sexual maturity, maximum size, and spawning strategy. Almost all these species are either top predators or occupy a high trophic level in the ecosystem.

The skipjack tuna population in the Indian Ocean is healthy, and fishing mortality rates are well below maximum sustainable yield, indicating that overfishing is not occurring. Yellowfin tuna in the Indian Ocean is overfished and overfishing is occurring.

Bycatch in the troll and pole fisheries is typically very low, but other tunas such as bigeye, bullet, and frigate are incidentally captured; other bycatch species are not common.

These species are managed through various measures by the Indian Ocean Tuna Commission (IOTC) within the Indian Ocean. Recently, the IOTC implemented a harvest control rule for skipjack tuna and measures to reduce fishing mortality of yellowfin tuna, though it is unknown if the measures will be sufficient to end overfishing of yellowfin tuna and rebuild its populations. Overall management is considered moderately effective, with a mixed record of following scientific advice and ensuring compliance with regulations. The fishery does not impact the benthic habitat and has moderately effective ecosystem-based measures in place.
### Final Seafood Recommendations

<table>
<thead>
<tr>
<th>SPECIES/FISHERY</th>
<th>CRITERION 1: IMPACTS ON THE SPECIES</th>
<th>CRITERION 2: IMPACTS ON OTHER SPECIES</th>
<th>CRITERION 3: MANAGEMENT EFFECTIVENESS</th>
<th>CRITERION 4: HABITAT AND ECOSYSTEM</th>
<th>OVERALL RECOMMENDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skipjack tuna Indian Ocean, Hand-operated pole and lines</td>
<td>Green (5.000)</td>
<td>Red (1.410)</td>
<td>Yellow (3.000)</td>
<td>Green (3.870)</td>
<td>Good Alternative (3.007)</td>
</tr>
<tr>
<td>Yellowfin tuna Indian Ocean, Hand-operated pole and lines</td>
<td>Red (1.410)</td>
<td>Yellow (2.640)</td>
<td>Yellow (3.000)</td>
<td>Green (3.870)</td>
<td>Good Alternative (2.563)</td>
</tr>
<tr>
<td>Yellowfin tuna Indian Ocean, Trolling lines</td>
<td>Red (1.410)</td>
<td>Yellow (2.640)</td>
<td>Yellow (3.000)</td>
<td>Green (3.870)</td>
<td>Good Alternative (2.563)</td>
</tr>
<tr>
<td>Skipjack tuna Indian Ocean, Trolling lines</td>
<td>Green (5.000)</td>
<td>Red (1.410)</td>
<td>Yellow (3.000)</td>
<td>Green (3.870)</td>
<td>Good Alternative (3.007)</td>
</tr>
</tbody>
</table>

### Summary
Skipjack and yellowfin tuna caught by handline, troll or pole-and-line in the Indian Ocean are a Good Alternative.

### Eco-Certification Information
A portion of this fishery is certified by the Marine Stewardship Council.

### Scoring Guide
Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

- **Best Choice/Green** = Final Score >3.2, and no Red Criteria, and no Critical scores
- **Good Alternative/Yellow** = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern\(^2\), and no more than one Red Criterion, and no Critical scores
- **Avoid/Red** = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

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\(^2\) Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).
Introduction

Scope of the analysis and ensuing recommendation

This report focuses on skipjack (Katsuwonus pelamis) and yellowfin tuna (Thunnus albacares) caught by troll, handline, and pole fisheries in the Indian Ocean.

Species Overview

Skipjack and yellowfin tuna are found in tropical and subtropical waters worldwide including in the Indian Ocean. These species are each assessed as single populations in the Indian Ocean. In the Pacific Ocean, there are two populations: Eastern Pacific, and Western and Central Pacific. In the Atlantic Ocean, there is one population of yellowfin and two of skipjack (Eastern and Western). Both skipjack and yellowfin tuna are highly migratory and are commonly found as juveniles schooling together below floating objects (IOTC 2013b) (IOTC 2013c) (IOTC 2013d).

Globally, purse seines are the primary gear used to capture skipjack and yellowfin tuna. Skipjack and yellowfin tuna catches have all increased substantially over time, peaking in the early 2000s for yellowfin tuna and around 2009 for skipjack tuna (ISSF 2013b).

In the Indian Ocean, tuna are managed by the Indian Ocean Tuna Commission (IOTC).

Production Statistics

Historically, the pole-and-line and trolling fisheries captured the majority of skipjack tuna in the Indian Ocean until the mid-1980s, when purse seining was introduced. Since then, both fisheries have contributed far less to the overall catches in the region. Total catches of skipjack tuna have been increasing over time and peaked in 2006 at around 600,000 MT, with less than 50,000 MT coming from other fisheries including trolling, handline, and longline. In 2012, total catches were 384,537 MT, with 183,594 MT coming from trolling, handline, and longline fishing gears (combined). The top fishing nations for skipjack tuna using handline gear (troll and pole; in decreasing order) are Maldives, Indonesia, India, and Sri Lanka (IOTC 2013c).

![Skipjack tuna annual catches, 1950-2012, in the Indian Ocean (IOTC 2013c).](image-url)
Total annual catches of yellowfin tuna have increased significantly since the 1980s due to the expansion of the purse seine, gillnet, and troll and pole fisheries. Total catches peaked in 2004 at 528,797 MT (20,929 MT troll and 4,631 MT handline) but have since dropped, with total catches in 2012 being 370,000 MT (21,444 MT troll and 6,253 MT handline). The top fishing nations for yellowfin tuna using handline gear (in decreasing order) are Maldives, Yemen, Indonesia, India, and Sri Lanka (IOTC 2013d).

![Yellowfin tuna annual catches, 1950-2012, in the Indian Ocean (IOTC 2013d).](image)

**Importance to the US/North American market.**

The United States imported over half (55%) of its skipjack tuna from Panama (55%) during 2013. Other important countries included the Philippines (15%) and Mexico (13%). The majority of yellowfin tuna were imported from Trinidad and Tobago (49%) in 2013.
Major contributors to U.S. skipjack tuna imports (%), all countries and regions (country of origin) (NMFS 2014).
Major contributors to U.S. yellowfin tuna imports (%), all countries and regions (country of origin) (NMFS 2014).

**Common and market names.**

In Hawaii, bigeye and yellowfin tuna are known as ahi, and skipjack as aku. Skipjack tuna, often together with smaller amounts of bigeye and yellowfin tuna, is canned as "light" tuna.

**Primary product forms**

These species are sold canned, in fresh and frozen form, and for the sushi and sashimi markets.
**Assessment**

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Criteria for Fisheries, available at http://www.seafoodwatch.org.

**Criterion 1: Impacts on the species under assessment**

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown.

The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- **Score >3.2=Green or Low Concern**
- **Score >2.2 and ≤3.2=Yellow or Moderate Concern**
- **Score ≤2.2=Red or High Concern**

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical

**Criterion 1 Summary**

<table>
<thead>
<tr>
<th>Region</th>
<th>Method</th>
<th>Inherent Vulnerability</th>
<th>Abundance</th>
<th>Fishing Mortality</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>SKIPJACK TUNA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indian Ocean Hand-operated pole and lines</td>
<td>2.00: Medium</td>
<td>5.00: Very Low Concern</td>
<td>5.00: Very Low Concern</td>
<td>Green (5.00)</td>
<td></td>
</tr>
<tr>
<td>Indian Ocean Trolling lines</td>
<td>2.00: Medium</td>
<td>5.00: Very Low Concern</td>
<td>5.00: Very Low Concern</td>
<td>Green (5.00)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th>Method</th>
<th>Inherent Vulnerability</th>
<th>Abundance</th>
<th>Fishing Mortality</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>YELLOWFIN TUNA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indian Ocean Hand-operated pole and lines</td>
<td>2.00: Medium</td>
<td>2.00: High Concern</td>
<td>1.00: High Concern</td>
<td>Red (1.41)</td>
<td></td>
</tr>
<tr>
<td>Indian Ocean Trolling lines</td>
<td>2.00: Medium</td>
<td>2.00: High Concern</td>
<td>1.00: High Concern</td>
<td>Red (1.41)</td>
<td></td>
</tr>
</tbody>
</table>

Skipjack populations are healthy and their fishing levels are sustainable. Yellowfin tuna is currently undergoing overfishing and is overfished.

**Criterion 1 Assessment**

**SCORING GUIDELINES**

**Factor 1.1 - Inherent Vulnerability**

- **Low**—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that
make it resilient to fishing, (e.g., early maturing).

- Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor resilient to fishing, (e.g., moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain).

- High—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator). Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.

**Factor 1.2 - Abundance**

- 5 (Very Low Concern)—Strong evidence exists that the population is above target abundance level (e.g., biomass at maximum sustainable yield, BMSY) or near virgin biomass.
- 4 (Low Concern)—Population may be below target abundance level, but it is considered not overfished
- 3 (Moderate Concern) —Abundance level is unknown and the species has a low or medium inherent vulnerability to fishing.
- 2 (High Concern)—Population is overfished, depleted, or a species of concern, OR abundance is unknown and the species has a high inherent vulnerability to fishing.
- 1 (Very High Concern)—Population is listed as threatened or endangered.

**Factor 1.3 - Fishing Mortality**

- 5 (Very Low Concern)—Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY), OR fishery does not target species and its contribution to the mortality of species is negligible (≤ 5% of a sustainable level of fishing mortality).
- 3.67 (Low Concern)—Probable (>50%) chance that fishing mortality is at or below a sustainable level, but some uncertainty exists, OR fishery does not target species and does not adversely affect species, but its contribution to mortality is not negligible, OR fishing mortality is unknown, but the population is healthy and the species has a low susceptibility to the fishery (low chance of being caught).
- 2.33 (Moderate Concern)—Fishing mortality is fluctuating around sustainable levels, OR fishing mortality is unknown and species has a moderate-high susceptibility to the fishery and, if species is depleted, reasonable management is in place.
- 1 (High Concern)—Overfishing is occurring, but management is in place to curtail overfishing, OR fishing mortality is unknown, species is depleted, and no management is in place.
- 0 (Critical)—Overfishing is known to be occurring and no reasonable management is in place to curtail overfishing.

**SKIPJACK TUNA**

**Factor 1.1 - Inherent Vulnerability**

| INDIAN OCEAN, HAND-OPERATED POLE AND LINES |
| INDIAN OCEAN, TROLLING LINES |

**Medium**

FishBase assigned a moderate vulnerability score of 39 out of 100 (Froese and Pauly 2013). Skipjack's life history characteristics support this score. Sexual maturity is reached around 41–43 cm and before 2 years of
age, and skipjack can reach a maximum size of 110 cm and age of 12 years. It is a broadcast spawner and has a high trophic level (Froese and Pauly 2013) (IOTC 2013c).

**Factor 1.2 - Abundance**

| INDIAN OCEAN, HAND-OPERATED POLE AND LINES |
| INDIAN OCEAN, TROLLING LINES |

**Very Low Concern**

Skipjack tuna populations in the Indian Ocean are considered healthy. The ratio of the biomass in 2011 to that needed to produce the maximum sustainable yield (SB/MSY) was estimated to be well above the interim target reference point of 1 (1.20 (1.01–1.40)) and was also above the limit reference point, indicating the population is not overfished. In addition, there is a low probability of the biomass falling below the limit reference point (0.4 × BMSY) over the next 3 to 10 years (IOTC 2013c). We have therefore awarded a “very low” concern score based on these results.

**Factor 1.3 - Fishing Mortality**

| INDIAN OCEAN, HAND-OPERATED POLE AND LINES |
| INDIAN OCEAN, TROLLING LINES |

**Very Low Concern**

Total catches of skipjack tuna in the Indian Ocean have been declining over time and were well below the maximum sustainable yield (MSY) (478,000 t) in 2011. Fishing mortality rates (F2011) in 2011 were estimated to be 80% (68%–92%) of those needed to produce the maximum sustainable yield (FMSY), the provisional target reference point, and were also below the provisional limit reference point (1.5 × FMSY) (IOTC 2013c). There is a low probability that fishing mortality rates will exceed the limit reference point in 3 to 10 years. In addition, there is a low risk of catches exceeding MSY levels if catches are maintained at current levels, or even increased slightly to levels from 2005–2010 (IOTC 2013c). Overfishing of skipjack tuna is not occurring and we have therefore awarded a “very low” concern score.

**YELLOWFIN TUNA**

**Factor 1.1 - Inherent Vulnerability**

| INDIAN OCEAN, HAND-OPERATED POLE AND LINES |
| INDIAN OCEAN, TROLLING LINES |

**Medium**

FishBase assigned a moderate vulnerability score of 46 out of 100 (Froese and Pauly 2013). Yellowfin tuna reaches sexual maturity around 100 cm in size and 3–5 years in age. A maximum length of 240 cm in size can be attained and it can live 8–9 years. It is a broadcast spawner and high-level predator in the ecosystem (Froese and Pauly 2014) (IOTC 2013d). These life history characteristics also support a moderate level of vulnerability and a score of “medium” concern.

**Factor 1.2 - Abundance**

| INDIAN OCEAN, HAND-OPERATED POLE AND LINES |
| INDIAN OCEAN, TROLLING LINES |
**High Concern**

According to the most recent assessment of yellowfin tuna in the Indian Ocean (2015), the ratio of the biomass in 2014 to that needed to produce the maximum sustainable yield was estimated to be well below the provisional target level of 1 (SB\textsubscript{2014}/SB\textsubscript{MSY} = 0.66 (C.I. 0.58–0.74)), although the biomass is above the provisional limit reference point (0.4 × SB\textsubscript{MSY}). Therefore, yellowfin tuna is currently considered overfished, which is a change from the 2012 assessment results (IOTC 2015b). We have awarded a “high” concern score based on the overfished status.

**Factor 1.3 - Fishing Mortality**

**INDIAN OCEAN, HAND-OPERATED POLE AND LINES**

**INDIAN OCEAN, TROLLING LINES**

**High Concern**

The current fishing mortality rates are estimated to be well above both the provisional target reference point of $F_{2014}/F_{MSY} = 1.34$ (1.02–1.67) and right around the limit reference point (1.4 × $F_{MSY}$). The 2012 assessment results were unclear if the status of yellowfin tuna was moving toward overfishing occurring, because catches in recent years had exceeded previous maximum sustainable yield estimates (IOTC 2013d). Based on the 2014 assessment, it is clear that the population is undergoing overfishing (IOTC 2015b). We have therefore awarded a “high” concern score.
**Criterion 2: Impacts on other species**

All main retained and bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. Seafood Watch® defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing.

To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch. The Criterion 2 rating is determined as follows:

- Score >3.2=Green or Low Concern
- Score >2.2 and ≤3.2=Yellow or Moderate Concern
- Score ≤2.2=Red or High Concern

Rating is Critical if Factor 2.3 (Fishing Mortality) is Critical

**Criterion 2 Summary**

Only the lowest scoring main species is/are listed in the table and text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix A.

<table>
<thead>
<tr>
<th><strong>SKIPJACK TUNA - INDIAN OCEAN - HAND-OPERATED POLE AND LINES</strong></th>
<th>Subscore: 1.410</th>
<th>Discard Rate: 1.00</th>
<th>C2 Rate: 1.410</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Species</strong></td>
<td>Inherent Vulnerability</td>
<td>Abundance</td>
<td>Fishing Mortality</td>
</tr>
<tr>
<td>Yellowfin tuna</td>
<td>2.00:Medium</td>
<td>2.00:High Concern</td>
<td>1.00:High Concern</td>
</tr>
<tr>
<td>Bullet tuna</td>
<td>3.00:Low</td>
<td>3.00:Moderate Concern</td>
<td>2.33:Moderate Concern</td>
</tr>
<tr>
<td>Frigate tuna</td>
<td>3.00:Low</td>
<td>3.00:Moderate Concern</td>
<td>2.33:Moderate Concern</td>
</tr>
<tr>
<td>Bigeye tuna</td>
<td>2.00:Medium</td>
<td>5.00:Very Low Concern</td>
<td>5.00:Very Low Concern</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SKIPJACK TUNA - INDIAN OCEAN - TROLLING LINES</strong></th>
<th>Subscore: 1.410</th>
<th>Discard Rate: 1.00</th>
<th>C2 Rate: 1.410</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Species</strong></td>
<td>Inherent Vulnerability</td>
<td>Abundance</td>
<td>Fishing Mortality</td>
</tr>
<tr>
<td>Yellowfin tuna</td>
<td>2.00:Medium</td>
<td>2.00:High Concern</td>
<td>1.00:High Concern</td>
</tr>
<tr>
<td>Bullet tuna</td>
<td>3.00:Low</td>
<td>3.00:Moderate Concern</td>
<td>2.33:Moderate Concern</td>
</tr>
</tbody>
</table>
Bycatch in troll and pole fisheries is typically very low (Kelleher 2005). In the Indian Ocean troll and pole fisheries, the primary targets are skipjack and yellowfin tuna. In addition to these main species, bigeye tuna are caught, and bullet and frigate tuna make up as much as 7% of the total catch (Adrille et al. 2012), so they are included in this report.

**Criterion 2 Assessment**

**SCORING GUIDELINES**
**Factor 2.1 - Inherent Vulnerability**
*(same as Factor 1.1 above)*

**Factor 2.2 - Abundance**
*(same as Factor 1.2 above)*

**Factor 2.3 - Fishing Mortality**
*(same as Factor 1.3 above)*

### BULLET TUNA

#### Factor 2.1 - Inherent Vulnerability

<table>
<thead>
<tr>
<th>REGION</th>
<th>Vulnerability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Ocean, Hand-Operated Pole and Lines</td>
<td>Low</td>
</tr>
<tr>
<td>Indian Ocean, Trolling Lines</td>
<td>Low</td>
</tr>
</tbody>
</table>

FishBase assigned a low vulnerability score of 34 out of 100 (Froese and Pauly 2013). Bullet tuna reaches sexual maturity around 35 cm in size and 2 years of age. It reaches a maximum size of 50 cm (Froese and Pauly 2013).

#### Factor 2.2 - Abundance

<table>
<thead>
<tr>
<th>REGION</th>
<th>Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Ocean, Hand-Operated Pole and Lines</td>
<td>Moderate Concern</td>
</tr>
<tr>
<td>Indian Ocean, Trolling Lines</td>
<td>Moderate Concern</td>
</tr>
</tbody>
</table>

Bullet and frigate tuna are considered species of Least Concern with a stable population trend by the International Union for the Conservation of Nature (IUCN). They are considered some of the most abundant juvenile tunas in the world (Collette et al. 2011a). Frigate tuna is considered to be abundant. It is possible that declines in individual species of small tunas may not be apparent, because overall trends for small tunas (combined species) mask these issues (Collette et al. 2011b). The status of bullet and frigate tuna in the Indian Ocean is unknown and no assessments have been conducted due to a lack of data. Information on abundance from catch rate series is also lacking (IOTC 2013f) (IOTC 2013g). We have awarded a “moderate” concern score due to the lack of information for these species.

#### Factor 2.3 - Fishing Mortality

<table>
<thead>
<tr>
<th>REGION</th>
<th>Fishing Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Ocean, Hand-Operated Pole and Lines</td>
<td>Moderate Concern</td>
</tr>
<tr>
<td>Indian Ocean, Trolling Lines</td>
<td>Moderate Concern</td>
</tr>
</tbody>
</table>

Troll and pole fisheries are one of the main fisheries targeting bullet and frigate tuna in the Indian Ocean. Fishing mortality rates for bullet and frigate tuna in the Indian Ocean are not available due to a lack of data. Although increased fishing pressure will affect the populations to some degree, the full impact is unknown. The catches of bullet tuna in 2012 were similar to the most recent 5-year average (2008–2012; 8,468 t), and catches of frigate tuna were slightly less in 2012 (83,029 t) compared to the 5-year average (90,221 t) (IOTC 2013f)(IOTC 2013g).
We have awarded a “moderate” concern score due to a lack of information.

**Factor 2.4 - Discard Rate**

<table>
<thead>
<tr>
<th>Area</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIAN OCEAN, HAND-OPERATED POLE AND LINES</td>
<td>&lt; 20%</td>
</tr>
<tr>
<td>INDIAN OCEAN, TROLLING LINES</td>
<td></td>
</tr>
</tbody>
</table>

Troll and pole fisheries typically have a negligible discard rate, even as low as zero in some areas (Kelleher 2005). In the Indian Ocean, baitfish, which make up the majority of bycatch in this fishery, are consumed locally, so discard rates are very low (Adrill et al. 2012).

**FRIGATE TUNA**

**Factor 2.1 - Inherent Vulnerability**

<table>
<thead>
<tr>
<th>Area</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIAN OCEAN, HAND-OPERATED POLE AND LINES</td>
<td>Low</td>
</tr>
<tr>
<td>INDIAN OCEAN, TROLLING LINES</td>
<td></td>
</tr>
</tbody>
</table>

FishBase assigned a low vulnerability score of 34 out of 100 (Froese and Pauly 2013). Frigate tuna reaches sexual maturity around 30 cm in size. It reaches a maximum size and age of 65 cm and 5 years, respectively (Froese and Pauly 2013).

**Factor 2.2 - Abundance**

<table>
<thead>
<tr>
<th>Area</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIAN OCEAN, HAND-OPERATED POLE AND LINES</td>
<td>Moderate Concern</td>
</tr>
<tr>
<td>INDIAN OCEAN, TROLLING LINES</td>
<td></td>
</tr>
</tbody>
</table>

Bullet and frigate tuna are considered species of Least Concern with a stable population trend by the International Union for the Conservation of Nature (IUCN). They are considered some of the most abundant juvenile tunas in the world (Collette et al. 2011a). Frigate tuna is considered to be abundant. It is possible that declines in individual species of small tunas may be not be apparent, because overall trends for small tunas (combined species) mask these issues (Collette et al. 2011b). The status of bullet and frigate tuna in the Indian Ocean is unknown and no assessments have been conducted due to a lack of data. Information on abundance from catch rate series is also lacking (IOTC 2013f) (IOTC 2013g). We have awarded a “moderate” concern score due to the lack of information for these species.

**Factor 2.3 - Fishing Mortality**

<table>
<thead>
<tr>
<th>Area</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIAN OCEAN, HAND-OPERATED POLE AND LINES</td>
<td>Moderate Concern</td>
</tr>
<tr>
<td>INDIAN OCEAN, TROLLING LINES</td>
<td></td>
</tr>
</tbody>
</table>

Troll and pole fisheries are one of the main fisheries targeting bullet and frigate tuna in the Indian Ocean. Fishing mortality rates for bullet and frigate tuna in the Indian Ocean are not available due to a lack of data. Although increased fishing pressure will affect the populations to some degree, the full impact is unknown. The catches of bullet tuna in 2012 were similar to the most recent 5-year average (2008–2012; 8,468 t), and
catches of frigate tuna were slightly less in 2012 (83,029 t) compared to the 5-year average (90,221 t) (IOTC 2013f)(IOTC 2013g).

We have awarded a “moderate” concern score due to a lack of information.

**Factor 2.4 - Discard Rate**

<table>
<thead>
<tr>
<th>INDIA OCEAN, HAND-OPERATED POLE AND LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDIA OCEAN, TROLLING LINES</td>
</tr>
</tbody>
</table>

< 20%

Troll and pole fisheries typically have a negligible discard rate, even as low as zero in some areas (Kelleher 2005). In the Indian Ocean, baitfish, which make up the majority of bycatch in this fishery, are consumed locally, so discard rates are very low (Adrill et al. 2012).
Criterion 3: Management Effectiveness

Management is separated into management of retained species (harvest strategy) and management of non-retained species (bycatch strategy).

The final score for this criterion is the geometric mean of the two scores. The Criterion 3 rating is determined as follows:

- Score >3.2=Green or Low Concern
- Score >2.2 and ≤3.2=Yellow or Moderate Concern
- Score ≤2.2 or either the Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern = Red or High Concern

Rating is Critical if either or both of Harvest Strategy (Factor 3.1) and Bycatch Management Strategy (Factor 3.2) ratings are Critical.

Criterion 3 Summary

<table>
<thead>
<tr>
<th>Region / Method</th>
<th>Harvest Strategy</th>
<th>Bycatch Strategy</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Ocean / Trolling lines</td>
<td>3.000</td>
<td>0.000</td>
<td>Yellow (3.000)</td>
</tr>
<tr>
<td>Indian Ocean / Hand-operated pole and lines</td>
<td>3.000</td>
<td>0.000</td>
<td>Yellow (3.000)</td>
</tr>
</tbody>
</table>

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Harvest Strategy

Seven subfactors are evaluated: Management Strategy, Recovery of Species of Concern, Scientific Research/Monitoring, Following of Scientific Advice, Enforcement of Regulations, Management Track Record, and Inclusion of Stakeholders. Each is rated as ‘ineffective,’ ‘moderately effective,’ or ‘highly effective.’

- 5 (Very Low Concern)—Rated as ‘highly effective’ for all seven subfactors considered
- 4 (Low Concern)—Management Strategy and Recovery of Species of Concern rated ‘highly effective’ and all other subfactors rated at least ‘moderately effective.’
- 3 (Moderate Concern)—All subfactors rated at least ‘moderately effective.’
- 2 (High Concern)—At minimum, meets standards for ‘moderately effective’ for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated ‘ineffective.’
- 1 (Very High Concern)—Management exists, but Management Strategy and/or Recovery of Species of Concern rated ‘ineffective.’
- 0 (Critical)—No management exists when there is a clear need for management (i.e., fishery catches threatened, endangered, or high concern species), OR there is a high level of Illegal, unregulated, and unreported fishing occurring.

Factor 3.1 Summary
The United Nations Straddling and Highly Migratory Fish Stocks Agreement (1995) indicated that the management of straddling and highly migratory fish stocks should be carried out through Regional Fisheries Management Organizations (RFMOs). RFMOs are the only legally mandated fishery management body on the high seas and within EEZ waters. There are currently 18 RFMOs (www.fao.org) that cover nearly all of the world’s waters. Member countries must abide by the management measures set forth by individual RFMOs in order to fish in their waters (Cullis-Suzuki and Pauly 2010). Some RFMOs manage all marine living resources within their authority (e.g., General Fisheries Commission for the Mediterranean (GFCM)), while others manage a group of species such as tunas (e.g., Inter-American Tropical Tuna Commission (IATTC)). This report focuses on troll and pole fisheries for tuna in international waters within the Indian Ocean, which are managed by the Indian Ocean Tuna Commission (IOTC). The following countries are current members of the IOTC: Australia, Belize, China, Comoros, Eritrea, European Union, France, Guinea, India, Indonesia, Iran, Japan, Kenya, Republic of Korea, Madagascar, Malaysia, Maldives, Mauritius, Mozambique, Oman, Pakistan, Philippines, Seychelles, Sierra Leone, Somalia, South Africa, Sri Lanka, Sudan, Tanzania, Thailand, United Kingdom, and Yemen. In addition, Bangladesh, Djibouti, Liberia, and Senegal are Cooperating Non-Contracting Parties. For this report we have scored this section for IOTC and CCSBT management.

Subfactor 3.1.1 – Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? To achieve a highly effective rating, there must be appropriate management goals, and evidence that the measures in place have been successful at maintaining/rebuilding species.

<table>
<thead>
<tr>
<th>Region / Method</th>
<th>Strategy</th>
<th>Recovery</th>
<th>Research</th>
<th>Advice</th>
<th>Enforce</th>
<th>Track</th>
<th>Inclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Ocean / Trolling lines</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Highly Effective</td>
</tr>
<tr>
<td>Indian Ocean / Hand-operated pole and lines</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Moderately Effective</td>
<td>Highly Effective</td>
</tr>
</tbody>
</table>

The Indian Ocean Tuna Commission (IOTC) has adopted several management measures that affect species caught in troll and pole fisheries. For example, the IOTC has requested that countries provide information on the number of licensed vessels larger than 24 m in length (under 24 m if fishing outside of their EEZ). Countries are also required to introduce a Fleet Development Plan for capacity control (IOTC 2013I). In 2005, countries were required to limit their catches of bigeye tuna to recent levels, and Taiwan and China were asked to limit their catches to 35,000 t. This measure was to be readdressed in 2006 but was not (although it is still considered an active measure) (IOTC 2013e). Starting in 2017, fleets that caught more than 5,000 MT of yellowfin tuna during 2014 must reduce their catches by 5% of 2014 levels (IOTC 2016). In addition to these management measures, the IOTC adopted a measure to implement the precautionary approach in 2012, which included the use of stock-specific reference points, associated harvest control rules, the ability to enact emergency measures in the face of natural phenomena having a negative impact on resources, and to evaluate the performance of reference points and potential harvest control rules through management strategy evaluation (IOTC 2013e). Currently, interim target and limit reference points are used in the IOTC for...
albacore, bigeye, and yellowfin tuna, and swordfish, and the IOTC Scientific Committee is to advise the Commission on target and limit reference points for albacore tuna by the end of 2014 (IOTC 2013j). A harvest control rule and reference points have been formally adopted for skipjack tuna (IOTC 2016). In addition, the Scientific Committee is to provide management advice for albacore tuna based on the use of Management Strategy Evaluation by the end of 2014 (IOTC 2013e).

In 2009, a performance review of the IOTC identified several areas of the current conservation and management plans that needed to be addressed. These included modification of the timing of data reporting; any noncompliance should be monitored and identified at the member level; causes of noncompliance need to be identified; data quality (catch, effort, and size) needs to be improved; a scientific observer program should be established; a statistical committee should be developed; the list of shark species should be expanded to include five additional species and applied to all gear types; alternative reporting means (e.g., port sampling) should be explored; assessment methods for data-deficient species should be developed; and measures such as catch limits and total allowable catches (TACs) should be explored. Various degrees of work have been implemented since 2009 to address these issues (IOTC 2013j).

We have awarded a “moderate concern” score because the IOTC is taking initiative to define target and limit reference points and to adopt management measures for certain species.

Subfactor 3.1.2 – Recovery of Species of Concern

Considerations: When needed, are recovery strategies/management measures in place to rebuild overfished/threatened/endangered species or to limit fishery's impact on these species and what is their likelihood of success? To achieve a rating of Highly Effective, rebuilding strategies that have a high likelihood of success in an appropriate timeframe must be in place when needed, as well as measures to minimize mortality for any overfished/threatened/endangered species.

INDIAN OCEAN, TROLLING LINES
INDIAN OCEAN, HAND-OPERATED POLE AND LINES

Moderately Effective

Yellowfin tuna were last assessed as overfished in the Indian Ocean (IOTC 2015b). The IOTC has adopted measures to address the status of yellowfin tuna but the success of these measures are not yet known (IOTC 2016). It should be noted that management measures enacted in 2010 to address overfishing of this species (based on the 2008 assessment) were successful at rebuilding the population for a short time period. We have therefore awarded a moderately effective score.

Subfactor 3.1.3 – Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the health of the population and the fishery's impact on the species? To achieve a Highly Effective rating, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.

INDIAN OCEAN, TROLLING LINES
INDIAN OCEAN, HAND-OPERATED POLE AND LINES

Moderately Effective

Stock assessments for key tuna species are conducted on a regular basis but assessments for bullet and frigate tuna are hampered due to a lack of data. Logbook data on catch and effort in the troll and pole fishery are required to be submitted to the Commission (IOTC 2013e). Member countries are required to record and
Subfactor 3.1.4 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g. do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

Indian Ocean, Trolling Lines

Moderately Effective

The Indian Ocean Tuna Commission’s Scientific Committee provides advice to the Commission. In 2016, the IOTC adopted a harvest control rule for skipjack tuna in line with scientific advice (IOTC 2016). Otherwise, no specific advice was provided for bigeye or skipjack tuna besides monitoring skipjack tuna catches (IOTC 2013b) (IOTC 2013c). In 2015, it was advised that future catches of yellowfin tuna should be 80% or less of current levels to allow the population to rebuild (IOTC 2015b). In 2016, the Commission adopted a measure to reduce catches for fleets that caught 5,000 MT or more of yellowfin in 2014 by 5% of 2014 catch levels (additional catch reductions are required in other fisheries) (IOTC 2016). For bullet and frigate tuna, due to a lack of information, annual catches should be reviewed and data collection should be improved (IOTC 2013g) (IOTC 2013f). We have awarded a “moderately effective” score to account for the IOTC’s mixed record of adhering to scientific advice.

Indian Ocean, Hand-Operated Pole and Lines

Moderately Effective

The IOTC maintains a record of fishing vessels larger than 24 m in length, and all vessels (purse seine, longline, gillnet, pole and line, handline, and trolling) authorized to fish must have in place a data recording system (all vessels over 24 m and under 24 m if fishing outside EEZs). This includes logbooks (paper or electronic) that collect information (each fishery has specific required catch and effort data) (IOTC 2013e). Information on Illegal, Unreported, and Unregulated (IUU) vessels is required to be reported by individual countries to the Commission (IOTC 2013e). Vessel monitoring systems (VMS) are required on all vessels larger than 15 m in length, and compliance with the time/area closure must be monitored by individual countries through methods such as VMS; these records must be provided to the Commission (IOTC 2013e). In addition, countries must inspect at least 5% of landings or transshipments in their ports per year (IOTC 2013e). There are no TACs currently in place that need enforcement. There are continued issues with IUU
fishing in the Indian Ocean. In 2016, the Commission took further action to address IUU fishing (IOTC 2016).

The IOTC has a Compliance Committee that verifies compliance by countries with regard to implementing and following adopted management measures (IOTC 2016b). The Committee meets prior to the annual Commission meeting to assess compliance and enforcement of management measures by individual countries. According to information provided during the 2016 meeting, compliance with providing a record of authorized vessels increased from 30% in 2010 to 60% in 2015. Compliance with the Bigeye Tuna Statistical Document Program increased steadily since 2010 (13%) through 2014 (60%), decreasing slightly during 2015 (54%). Compliance with observing transshipments at sea was 64% in 2015. Compliance with the regional observer program has remained fairly poor over time, at just 20% during 2015. Reporting of mandatory statistics had a 43% compliance rate in 2015 for target species. Compliance with limiting fishing capacity had a 65% compliance rate in 2015, up from only 27% in 2010 (IOTC 2016b).

The Committee is responsible for reporting its recommendations to the Commission. The Committee also discusses problems related to the implementation of management measures and provides the Commission with advice on how to address these issues. The Committee has also been tasked with developing incentives and sanctions to encourage compliance with adopted measures (IOTC 2013e). But the Committee considers only compliance with a measure, not quality or completeness of data submitted. In addition, although the Committee will let countries know through a formal letter that they are not in compliance, it does not necessarily inform them on how to comply with the measures (IOTC 2013h). The IOTC is currently assessing and reviewing compliance issues with regard to the implementation of management measures, to help strengthen compliance and to provide technical support to developing nations (IOTC 2013h). Information on compliance with measures, such as the observer scheme, is reported in publicly accessed reports (IOTC 2012) (IOTC 2013i) (IOTC 2013k). Individual country compliance reports are also produced (IOTC 2013s). But it has been noted that many countries fail to provide all the information necessary to monitor compliance (Pillai and Satheeshkumar 2012).

Though there have been strong improvements in both compliance with IOTC regulations and reducing IUU fishing in recent years, some concerns remain, leading to a score of "moderately effective."

### Subfactor 3.1.6 – Management Track Record

**Considerations:** Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels? A Highly Effective rating is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.

| INDIAN OCEAN, TROLLING LINES |
| INDIAN OCEAN, HAND-OPERATED POLE AND LINES |

**Moderately Effective**

The Indian Ocean Tuna Commission has been mostly successful in maintaining healthy populations for species in this fishery, but the status of frigate and bullet tuna is unknown. In addition, the Scientific Committee recommended that catches of yellowfin tuna not exceed 300,000 t; however, catches exceeded this amount during both 2011 and 2012 (IOTC 2013d). We have therefore awarded only a "moderately effective" score.

### Subfactor 3.1.7 – Stakeholder Inclusion

**Considerations:** Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management
The process is transparent and includes stakeholder input.

INDIAN OCEAN, TROLLING LINES
INDIAN OCEAN, HAND-OPERATED POLE AND LINES

Highly Effective

The IOTC allows for the inclusion of stakeholders in developing management objectives through participation in countries’ delegations and allows for accredited observers to attend Commission meetings (IOTC 2012).

Factor 3.2 - Bycatch Strategy

SCORING GUIDELINES

Four subfactors are evaluated: Management Strategy and Implementation, Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations. Each is rated as ‘ineffective,’ ‘moderately effective,’ or ‘highly effective.’ Unless reason exists to rate Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations differently, these rating are the same as in 3.1.

- 5 (Very Low Concern)—Rated as ‘highly effective’ for all four subfactors considered
- 4 (Low Concern)—Management Strategy rated ‘highly effective’ and all other subfactors rated at least ‘moderately effective.’
- 3 (Moderate Concern)—All subfactors rated at least ‘moderately effective.’
- 2 (High Concern)—At minimum, meets standards for ‘moderately effective’ for Management Strategy but some other factors rated ‘ineffective.’
- 1 (Very High Concern)—Management exists, but Management Strategy rated ‘ineffective.’
- 0 (Critical)—No bycatch management even when overfished, depleted, endangered or threatened species are known to be regular components of bycatch and are substantially impacted by the fishery

<table>
<thead>
<tr>
<th>Region / Method</th>
<th>All Kept</th>
<th>Critical Strategy</th>
<th>Research Advice</th>
<th>Enforce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Ocean / Trolling lines</td>
<td>Yes</td>
<td>All Species Retained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indian Ocean / Hand-operated pole and lines</td>
<td>Yes</td>
<td>All Species Retained</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subfactor 3.2.3 – Scientific Research and Monitoring

Considerations: Is bycatch in the fishery recorded документed and is there adequate monitoring of bycatch to measure fishery’s impact on bycatch species? To achieve a Highly Effective rating, assessments must be conducted to determine the impact of the fishery on species of concern, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are being met.

Subfactor 3.2.4 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g., do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

Subfactor 3.2.5 – Enforcement of Management Regulations

Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management
regulations and what is the level of fishermen’s compliance with regulations? To achieve a Highly Effective rating, there must be consistent enforcement of regulations and verification of compliance.
Criterion 4: Impacts on the habitat and ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery’s overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment.

The final score is the geometric mean of the impact of fishing gear on habitat score (plus the mitigation of gear impacts score) and the Ecosystem Based Fishery Management score. The Criterion 2 rating is determined as follows:

- Score >3.2=Green or Low Concern
- Score >2.2 and ≤3.2=Yellow or Moderate Concern
- Score ≤2.2=Red or High Concern

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

<table>
<thead>
<tr>
<th>Region / Method</th>
<th>Gear Type and Substrate</th>
<th>Mitigation of Gear Impacts</th>
<th>EBFM</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Ocean / Trolling lines</td>
<td>5.00: None</td>
<td>0.00: Not Applicable</td>
<td>3.00: Moderate Concern</td>
<td>Green (3.870)</td>
</tr>
<tr>
<td>Indian Ocean / Hand-operated</td>
<td>5.00: None</td>
<td>0.00: Not Applicable</td>
<td>3.00: Moderate Concern</td>
<td>Green (3.870)</td>
</tr>
<tr>
<td>pole and lines</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

- 5 (None) - Fishing gear does not contact the bottom
- 4 (Very Low) - Vertical line gear
- 3 (Low)—Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Bottom seine on resilient mud/sand habitats. Midwater trawl that is known to contact bottom occasionally (2 (Moderate)—Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Bottom seine except on mud/sand
- 1 (High)—Hydraulic clam dredge. Dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)
- 0 (Very High)—Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)

Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Mitigation of Gear Impacts

- +1 (Strong Mitigation)—Examples include large proportion of habitat protected from fishing (>50%) with gear, fishing intensity low/limited, gear specifically modified to reduce damage to seafloor and modifications
shown to be effective at reducing damage, or an effective combination of "moderate" mitigation measures.

- +0.5 (Moderate Mitigation)—20% of habitat protected from fishing with gear or other measures in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.
- +0.25 (Low Mitigation)—A few measures are in place (e.g., vulnerable habitats protected but other habitats not protected); there are some limits on fishing effort/intensity, but not actively being reduced
- 0 (No Mitigation)—No effective measures are in place to limit gear impacts on habitats

**Factor 4.3 - Ecosystem-Based Fisheries Management**

- 5 (Very Low Concern)—Substantial efforts have been made to protect species’ ecological roles and ensure fishing practices do not have negative ecological effects (e.g., large proportion of fishery area is protected with marine reserves, and abundance is maintained at sufficient levels to provide food to predators)
- 4 (Low Concern)—Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. Measures are in place to minimize potentially negative ecological effect if hatchery supplementation or fish aggregating devices (FADs) are used.
- 3 (Moderate Concern)—Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species, OR negative ecological effects from hatchery supplementation or FADs are possible and management is not place to mitigate these impacts
- 2 (High Concern)—Fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.
- 1 (Very High Concern)—Use of hatchery supplementation or fish aggregating devices (FADs) in the fishery is having serious negative ecological or genetic consequences, OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.

**Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate**

<table>
<thead>
<tr>
<th>INDUSTRY, TROLLING LINES</th>
<th>INDUSTRY, HAND-OPERATED POLE AND LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

Fishing gears such as handline and troll and pole rarely impact bottom habitats (Seafood Watch 2013).

**Factor 4.2 - Mitigation of Gear Impacts**

<table>
<thead>
<tr>
<th>INDUSTRY, TROLLING LINES</th>
<th>INDUSTRY, HAND-OPERATED POLE AND LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Applicable</td>
<td></td>
</tr>
</tbody>
</table>

**Factor 4.3 - Ecosystem-Based Fisheries Management**

<table>
<thead>
<tr>
<th>INDUSTRY, TROLLING LINES</th>
<th>INDUSTRY, HAND-OPERATED POLE AND LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate Concern</td>
<td></td>
</tr>
</tbody>
</table>

These troll, handline, and pole fisheries target tuna, which are top predators and considered "exceptional species." In addition to tuna, troll and pole fisheries rely on live baitfish, which could include other "exceptional species" such as anchovy or sardines. The effect of the removal of these species on the ecosystem is
unknown, and few baitfish fisheries are managed (Gillet 2012) (FAO 2014). The IOTC has a Working Party on Ecosystems and Bycatch (WPEB) that analyzes technical problems related to the management goals, identifies research priorities, and indicates data and information requirements that are needed. In addition, it provides advice on management measures (IOTC 2013t). This WP meets annually and presents a final report of the meeting, which includes information on the outcomes of the Scientific Committee, progress on recommendations from the WPEB, review of information available on ecosystems and bycatch (including any new information), and a review of national bycatch issues (IOTC 2013h). We have therefore awarded a “moderate concern” score because “exceptional species” are caught but some work is being done to include them in the management process.
Acknowledgements

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.

Seafood Watch would like to thank the consulting researcher and author of this report, Alexia Morgan, as well as several anonymous reviewers for graciously reviewing this report for scientific accuracy.
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Appendix A: Extra By Catch Species

BIGHYE TUNA

Factor 2.1 - Inherent Vulnerability

<table>
<thead>
<tr>
<th>INDIA OCEAN, HAND-OPERATED POLE AND LINES</th>
<th>INDIA OCEAN, TROLLING LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medium</strong></td>
<td></td>
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</tbody>
</table>

FishBase assigned a high to very high vulnerability of 72 out of 100 for bigeye tuna (Froese and Pauly 2013). But bigeye tuna's life history characteristics suggest a medium vulnerability to fishing. For example, bigeye tuna reaches sexual maturity around 100 cm or 3 years of age, reaches a maximum size of 200 cm, and lives around 15 years (IOTC 2013b). It is a broadcast spawner and top predator (Froese and Pauly 2013). Based on these life history characteristics, we have awarded a “medium” score.

Factor 2.2 - Abundance

<table>
<thead>
<tr>
<th>INDIA OCEAN, HAND-OPERATED POLE AND LINES</th>
<th>INDIA OCEAN, TROLLING LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very Low Concern</strong></td>
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</tbody>
</table>

According to the most recent assessment, the biomass of bigeye tuna is estimated to currently be well above target levels that produce the maximum sustainable yield (SB/SB<sub>MSY</sub> = 1.44 (0.87–2.22)). The current biomass is around 40% of virgin levels (IOTC 2013b). We have awarded a “very low” concern score because the biomass is well above target levels.

Factor 2.3 - Fishing Mortality

<table>
<thead>
<tr>
<th>INDIA OCEAN, HAND-OPERATED POLE AND LINES</th>
<th>INDIA OCEAN, TROLLING LINES</th>
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<tr>
<td><strong>Very Low Concern</strong></td>
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Fishing mortality rates for bigeye tuna are estimated to be below the provisional target levels needed to produce the maximum sustainable yield (F<sub>MSY</sub>) as well as below the interim limit reference point. Currently, fishing mortality is only 42% (21%–80% range) of F<sub>MSY</sub> and therefore overfishing is not occurring. Catches over the last 5 years have been below MSY levels. Maintaining catches at the current level should not negatively affect the population (IOTC 2013b), so we have awarded a “very low” concern score.

Factor 2.4 - Discard Rate

<table>
<thead>
<tr>
<th>INDIA OCEAN, HAND-OPERATED POLE AND LINES</th>
<th>INDIA OCEAN, TROLLING LINES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>&lt; 20%</strong></td>
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</tbody>
</table>

Troll and pole fisheries typically have a negligible discard rate, even as low as zero in some areas (Kelleher 2005). In the Indian Ocean, baitfish, which make up the majority of bycatch in this fishery, are consumed locally, so discard rates are very low (Adrill et al. 2012).
Appendix B: Update Summary

This report was updated during August 2016 to incorporate a new stock assessment for yellowfin tuna that was published in November 2015 and new management measures adopted in May of 2016. The status change for yellowfin resulted in a change to the Criterion 1 score from green to red and no change in the overall recommendation. Recommendations for albacore tuna and bigeye tuna caught by troll/pole were removed due to low volume.