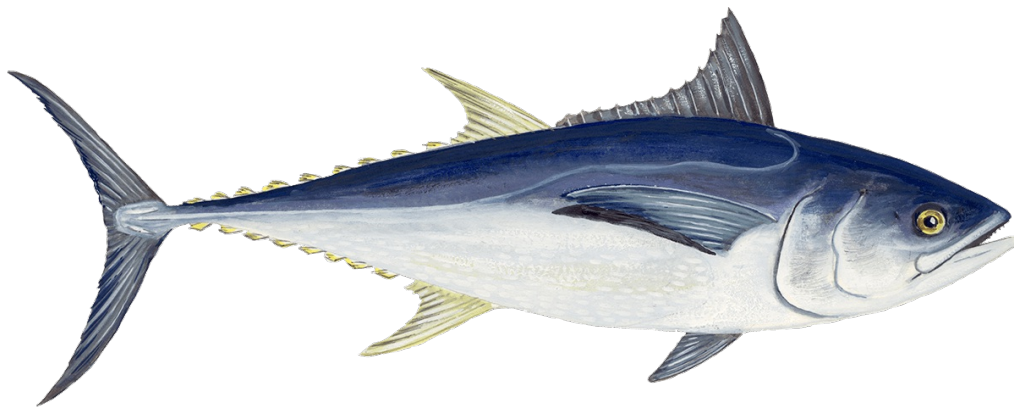


# Monterey Bay Aquarium Seafood Watch®

## Longtail tuna

*Thunnus tonggol*



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**Indonesia, Iran, Malaysia, Thailand**

**Drift gillnets, Unassociated purse seine (non-FAD), Trolling lines, Hand-operated pole and lines**

*August, 17, 2015*

*Seafood Watch Consulting Researcher*

### **Disclaimer**

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

# **Table of Contents**

About Seafood Watch .....	3
Guiding Principles .....	4
Summary .....	5
Final Seafood Recommendations .....	6
Introduction .....	9
Assessment .....	11
<i>Criterion 1: Impacts on the species under assessment</i> .....	11
<i>Criterion 2: Impacts on other species</i> .....	17
<i>Criterion 3: Management Effectiveness</i> .....	27
<i>Criterion 4: Impacts on the habitat and ecosystem</i> .....	44
Acknowledgements .....	49
References .....	50
Appendix A: Extra By Catch Species .....	54

## **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](http://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<sup>1</sup> 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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<sup>1</sup> "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

## **Summary**

This report is on tongol tuna (*Thunnus tonggol*) caught by purse seines (unassociated, which includes light luring), gillnets and troll and pole fisheries in the Indian (IO) and Western and Central Pacific Oceans (WCPO) of Indonesia, Iran (Indian Ocean), Malaysia and Thailand.

Tongol tuna is a neritic species of tuna, remaining in more coastal waters compared to other pelagic tuna species, found in the Indo-Pacific region. The top fishing nations in the IO include Indonesia, Iran, Malaysia and Thailand and in the WCPO Indonesia, Malaysia and Thailand are the top fishing nations.

The Indian Ocean Tuna Commission (IOTC), a regional fisheries management organization (RFMO), manages tongol tuna at the international level in the Indian Ocean, while individual countries are responsible for implementing IOTC and their own management measures. In the WCPO, the corresponding RFMO, the Western and Central Pacific Fisheries Commission does not manage tongol or other neritic species of tuna and so all management is left to individual countries.

There is some bycatch, mostly other neritic species such as kawakawa and frigate tunas, associated with gillnet and purse seine fisheries that target tongol tuna. Sharks may also be incidentally captured in gillnet fisheries. Recording and reporting of bycatch interactions is very poor in these fisheries.

## Final Seafood Recommendations

SPECIES/FISHERY	CRITERION 1: IMPACTS ON THE SPECIES	CRITERION 2: IMPACTS ON OTHER SPECIES	CRITERION 3: MANAGEMENT EFFECTIVENESS	CRITERION 4: HABITAT AND ECOSYSTEM	OVERALL RECOMMENDATION
Longtail tuna Indonesia Indian Ocean, Drift gillnets, Indonesia	Red (2.00)	Critical (0.00)	Red (1.41)	Green (3.87)	<b>Avoid (0.00)</b>
Longtail tuna Iran, Islamic Republic of Indian Ocean, Unassociated purse seine (non-FAD), Iran, Islamic Republic of	Red (2.00)	Green (3.83)	Red (2.00)	Green (3.87)	<b>Avoid (2.77)</b>
Longtail tuna Malaysia Indian Ocean, Unassociated purse seine (non-FAD), Malaysia	Red (2.00)	Green (3.83)	Red (2.00)	Green (3.87)	<b>Avoid (2.77)</b>
Longtail tuna Thailand Indian Ocean, Unassociated purse seine (non-FAD), Thailand	Red (2.00)	Yellow (2.64)	Red (2.00)	Green (3.87)	<b>Avoid (2.53)</b>
Longtail tuna Iran, Islamic Republic of Indian Ocean, Drift gillnets, Iran, Islamic Republic of	Red (2.00)	Critical (0.00)	Red (1.41)	Green (3.87)	<b>Avoid (0.00)</b>
Longtail tuna Indonesia Indian Ocean, Trolling lines, Indonesia	Red (2.00)	Green (5.00)	Red (2.00)	Green (3.87)	<b>Avoid (2.97)</b>
Longtail tuna Indonesia Indian Ocean, Hand-operated pole and lines, Indonesia	Red (2.00)	Green (5.00)	Red (2.00)	Green (3.87)	<b>Avoid (2.97)</b>
Longtail tuna Iran, Islamic Republic of Indian Ocean, Trolling lines, Iran, Islamic Republic of	Red (2.00)	Green (5.00)	Red (2.00)	Green (3.87)	<b>Avoid (2.97)</b>
Longtail tuna Iran, Islamic Republic of Indian Ocean, Hand- operated pole and lines, Iran, Islamic Republic of	Red (2.00)	Green (5.00)	Red (2.00)	Green (3.87)	<b>Avoid (2.97)</b>

Longtail tuna Indonesia Western and Central Pacific, Trolling lines, Indonesia	Yellow (2.64)	Green (5.00)	Red (2.00)	Yellow (3.16)	<b>Good Alternative (3.02)</b>
Longtail tuna Indonesia Western and Central Pacific, Hand- operated pole and lines, Indonesia	Yellow (2.64)	Green (5.00)	Red (2.00)	Yellow (3.16)	<b>Good Alternative (3.02)</b>
Longtail tuna Indonesia Western and Central Pacific, Drift gillnets, Indonesia	Yellow (2.64)	Critical (0.00)	Red (1.41)	Yellow (3.16)	<b>Avoid (0.00)</b>
Longtail tuna Malaysia Western and Central Pacific, Unassociated purse seine (non-FAD), Malaysia	Yellow (2.64)	Yellow (2.64)	Yellow (3.00)	Yellow (3.16)	<b>Good Alternative (2.85)</b>
Longtail tuna Thailand Western and Central Pacific, Unassociated purse seine (non-FAD), Thailand	Yellow (2.64)	Yellow (2.64)	Yellow (3.00)	Yellow (3.16)	<b>Good Alternative (2.85)</b>

## Summary

Tongol tuna caught by unassociated purse seine nets operated by Thailand fishing in the western and central Pacific Ocean (WCPO) and by the Indonesian troll/pole fishery operating in the WCPO are a Good Alternative. All other tongol tuna fisheries have an overall recommendation of Avoid.

## 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<sup>2</sup>, 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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<sup>2</sup> 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 tonggol tuna (*Thunnus tonggol*) caught in purse seine, gillnet and troll and pole fisheries operating in the Indo-Pacific region. Countries included in this report are: Indonesia, Iran, Malaysia and Thailand.

### **Species Overview**

Tonggol tuna are a neritic tuna species found in the Indian Ocean and Western Pacific Ocean. Tonggol tuna are commonly found associated with long continental shelf systems. This species tends to form schools of different sized individuals. Common prey includes fish, cephalopods and crustaceans (IOTC 2013).

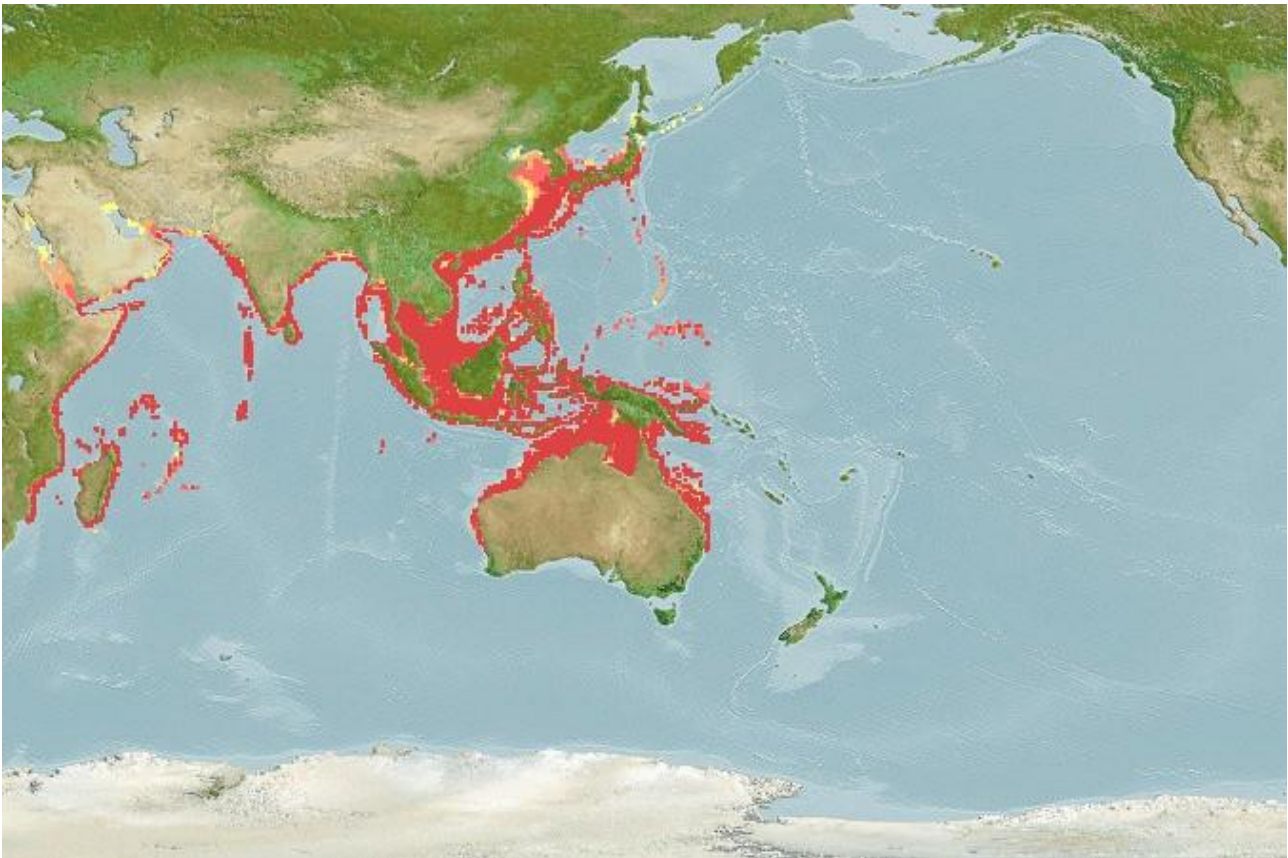


Figure 1 Tonggol tuna distribution map (Froese and Pauly 2014).

The Indian Ocean Tuna Commission, a Regional Fisheries Management Organization (RFMO), manages tonggol tuna throughout the Indian Ocean. Within the Western and Central Pacific Ocean, the Western and Central Pacific Fisheries Commission, the respective RFMO, does not manage neritic tuna species and therefore all management is left to individual nations. In Indonesia, the Ministry of Marine Affairs and Fisheries, is responsible for managing fisheries. Iran's government agency is the Iran Fisheries Organization (IFO). Fisheries in Malaysia and Thailand are managed by their respective Department of Fisheries.

### **Production Statistics**

Tonggol tuna are caught by a variety of gear types including purse seines, drift gillnet, pole and troll.

Within the Indian Ocean, the primary gear used to capture tongol tuna are gillnets. Seine nets (light luring, fish aggregating devices and unassociated) and trolling gear are also used by some countries. Catches of tongol tuna increased from the 1950's onward, reaching 90,000 t in 2000. Subsequent to this, catches declined until 2005 (67,600 t) but have since increased to the highest levels on record, reaching 165,100 t in 2011 (IOTC 2013). However, it should be noted that there is some uncertainty surrounding these catch estimates due to under reporting by some countries and fishereis.

In the Indian Ocean, Iran (49%) and Indonesia (15%) catch the largest portion of tongol tuna, but Malaysia and Thailand also capture tongol tuna. The majority of Iran's tongol tuna catch comes from gillnets, with purse seine's and troll and pole gear making up only a small proportion. Indonesia uses gillnet, troll and pole and other gears, while Malaysia and Thailand's tongol catch comes mainly from purse seines (IOTC 2013).

Within the Western and Pacific Ocean, Indonesia, Malaysia and Thailand are the top producers (in descending order) of tongol tuna (FAO 2013). During 2011 Indonesia reported catching 79,198 t, Malaysia 14,362 t and Thailand 11,402 t (FAO 2013).

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

Thailand is the main producer of canned tonggol tuna to foreign markets (Sa-nga-ngam et al. 2013).

### **Common and market names.**

Tonggol tuna is also known as longtail tuna and oriental bonito.

### **Primary product forms**

The primary product form is canned, often mixed with other tuna species.

## 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

LONGTAIL TUNA				
Region   Method	Inherent Vulnerability	Abundance	Fishing Mortality	Score
Indonesia/Indian Ocean Drift gillnets   Indonesia	2.00: Medium	4.00: Low Concern	1.00: High Concern	Red (2.00)
Iran, Islamic Republic of/Indian Ocean Unassociated purse seine (non-FAD)   Iran, Islamic Republic of	2.00: Medium	4.00: Low Concern	1.00: High Concern	Red (2.00)
Malaysia/Indian Ocean Unassociated purse seine (non-FAD)   Malaysia	2.00: Medium	4.00: Low Concern	1.00: High Concern	Red (2.00)
Thailand/Indian Ocean Unassociated purse seine (non-FAD)   Thailand	2.00: Medium	4.00: Low Concern	1.00: High Concern	Red (2.00)
Iran, Islamic Republic of/Indian Ocean Drift gillnets   Iran, Islamic Republic of	2.00: Medium	4.00: Low Concern	1.00: High Concern	Red (2.00)
Indonesia/Indian Ocean Trolling lines   Indonesia	2.00: Medium	4.00: Low Concern	1.00: High Concern	Red (2.00)

Indonesia/Indian Ocean Hand-operated pole and lines   Indonesia	2.00: Medium	4.00: Low Concern	1.00: High Concern	Red (2.00)
Iran, Islamic Republic of/Indian Ocean Trolling lines   Iran, Islamic Republic of	2.00: Medium	4.00: Low Concern	1.00: High Concern	Red (2.00)
Iran, Islamic Republic of/Indian Ocean Hand-operated pole and lines   Iran, Islamic Republic of	2.00: Medium	4.00: Low Concern	1.00: High Concern	Red (2.00)
Indonesia/Western and Central Pacific Trolling lines   Indonesia	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
Indonesia/Western and Central Pacific Hand-operated pole and lines   Indonesia	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
Indonesia/Western and Central Pacific Drift gillnets   Indonesia	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
Malaysia/Western and Central Pacific Unassociated purse seine (non-FAD)   Malaysia	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)
Thailand/Western and Central Pacific Unassociated purse seine (non-FAD)   Thailand	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)

Tongol tuna populations in the Indian Ocean are healthy but fishing mortality rates are too high. Their status in the Western and Central Pacific Ocean is unknown because no assessment has been conducted. Work is being made toward a stock assessment of tongol tuna in southeast Asian waters (<http://www.seafdec.org/seafdec-holds-first-meeting-scientific-working-group-neritic-tuna-stock-assessment-southeast-asian-waters-malaysia/>).

## 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 it 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 ( $\leq 5\%$  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.

## LONGTAIL TUNA

### **Factor 1.1 - Inherent Vulnerability**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF  
MALAYSIA/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
INDONESIA/INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA/INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC OF  
INDONESIA/WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA  
INDONESIA/WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

#### **Medium**

Fishbase has assigned a medium to high vulnerability score of 47 out of 100 (Froese and Pauly 2013). Tongol have a life span of around 20 years and reach sexual maturity starting at 27-28 cm in length, with half of the population reaching sexual maturity by 38-42 cm in length. However, the age at which sexual maturity is reached is unknown (DOF 2014). The maximum length attained by tongol is 145 cm (IOTC 2013). Tongol are broadcast spawners and top predators (Froese and Pauly 2013). These life history characteristics also suggest a medium level of vulnerability to fishing.

### **Factor 1.2 - Abundance**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF  
MALAYSIA/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
INDONESIA/INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA/INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC OF

#### **Low Concern**

A preliminary assessment of tongol tuna in the Indian Ocean has recently been conducted by the Indian Ocean Tuna Commission (IOTC). According to the latest assessment, the biomass is larger than that needed to produce the maximum sustainable yield ( $B_{2013}/BMSY=1.01$  (0.53-1.71)) and therefore the population is not overfished. There is some uncertainty surrounding the structure of the tongol tuna population in the Indian Ocean and whether localized depletions are occurring. In addition, there is considerable uncertainty surrounding the influence of changes in targeting and discarding practices over the years and how these have affected the assessment (IOTC 2015). The International Union for the Conservation of Nature considers tongol tuna to be Data Deficient (Collette et al. 2011b). The Thai Department of Fisheries conducted a research study during 2012 and found the catch per unit effort of tongol tuna ranged from 2,106 to 2,851 kg/day in unassociated purse seine sets and was 2777 kg/day in sets made on fish aggregating devices (FADs) (DOF 2014). Due to the uncertainty surrounding their status and the preliminary nature of the region-wide

assessment we have awarded a low and not very low concern score.

INDONESIA/WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA  
INDONESIA/WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

#### **Moderate Concern**

The International Union for the Conservation of Nature considers tongol tuna to be Data Deficient (Collette et al. 2011b). An assessment has been conducted in Australian waters but did not assess whether the population was overfished (Griffiths 2010). No region wide assessment has been conducted. However, Thailand does have an ongoing research project that provides information on the catch per unit effort of tongol tuna. The catch per unit effort during 2012 ranged from 1,471 to 3,005 kg/day for unassociated purse seine sets and was 2982 kg/day for sets made on fish aggregating devices (FADs) (DOF 2014). Because no stock assessment has been conducted and their status is unknown, we have awarded a moderate concern score.

### **Factor 1.3 - Fishing Mortality**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF  
MALAYSIA/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
INDONESIA/INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA/INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC OF

#### **High Concern**

A preliminary assessment of tongol tuna in the Indian Ocean suggests that fishing mortality rates in 2013 were higher than those needed to produce the maximum sustainable yield ( $F_{2013}/F_{MSY} = 1.43$  (0.58-3.12) and therefore overfishing is occurring. There was considerable uncertainty surrounding these results and with respect to annual catches (IOTC 2015). It is estimated that catches in the Andaman Sea ranged from 1,726 to 22,036 t between 1992 and 2012. Catches within the Thai (both Indian Ocean and Western and Central Pacific Ocean) EEZ have been variable stable since 2008 (DFO 2014). Indonesian catches of tongol tuna ranged from 8,616 t to 22,396 t between 2004 and 2012 (MMAF 2014b). We have awarded a high concern score due to the results of the assessment indicating that overfishing is occurring.

INDONESIA/WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA  
INDONESIA/WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

#### **Moderate Concern**

An assessment of tongol tuna was conducted in Australian waters. The assessment found that overfishing was

not occurring and that any increases in fishing mortality would not lead to overfishing occurring (Griffith 2010). A region wide assessment has not been conducted and therefore current fishing mortality rates are unknown. Catches of tongol tuna in the Gulf of Thailand ranged from 10,012 to 79,094 t between 1992 and 2012 (DFO 2014). Catches within the Thai (both Indian Ocean and Western and Central Pacific Ocean) EEZ have been variable stable since 2008 (DFO 2014). Fishing pressure has decreased due to moratorium of fishing license and ex foreign fishing vessel and transshipment made in 2014 (Ministry of MAF Regulation No. 58/2014). We have awarded a moderate concern score because fishing mortality rates are unknown and there are no effective management measures in place.



## 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.

LONGTAIL TUNA - INDONESIA/INDIAN OCEAN - DRIFT GILLNETS - INDONESIA					
<b>Subscore:</b>	<b>0.00</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>0.00</b>
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore	
Turtles (unspecified)	1.00:High	1.00:Very High Concern	0.00:Critical	Critical (0.00)	
Sharks	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.16)	
Kawakawa	3.00:Low	4.00:Low Concern	3.67:Low Concern	Green (3.83)	

LONGTAIL TUNA - INDONESIA/INDIAN OCEAN - HAND-OPERATED POLE AND LINES - INDONESIA					
<b>Subscore:</b>	<b>5.00</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>5.00</b>
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore	
No other main species caught					

LONGTAIL TUNA - INDONESIA/INDIAN OCEAN - TROLLING LINES - INDONESIA					
<b>Subscore:</b>	<b>5.00</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>5.00</b>
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore	
No other main species caught					

LONGTAIL TUNA - INDONESIA/WESTERN AND CENTRAL PACIFIC - DRIFT GILLNETS - INDONESIA					
<b>Subscore:</b>	<b>0.00</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>0.00</b>
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore	
Turtles (unspecified)	1.00:High	1.00:Very High Concern	0.00:Critical	Critical (0.00)	
Sharks	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.16)	
Kawakawa	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)	

LONGTAIL TUNA - INDONESIA/WESTERN AND CENTRAL PACIFIC - HAND-OPERATED POLE AND LINES - INDONESIA					
<b>Subscore:</b>	<b>5.00</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>5.00</b>
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore	
No other main species caught					

LONGTAIL TUNA - INDONESIA/WESTERN AND CENTRAL PACIFIC - TROLLING LINES - INDONESIA					
<b>Subscore:</b>	<b>5.00</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>5.00</b>
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore	
No other main species caught					

LONGTAIL TUNA - IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN - DRIFT GILLNETS - IRAN, ISLAMIC REPUBLIC OF					
<b>Subscore:</b>	<b>0.00</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>0.00</b>
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore	
Turtles (unspecified)	1.00:High	1.00:Very High Concern	0.00:Critical	Critical (0.00)	
Sharks	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.16)	
Frigate tuna	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)	
Kawakawa	3.00:Low	4.00:Low Concern	3.67:Low Concern	Green (3.83)	

**LONGTAIL TUNA - IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN - HAND-OPERATED POLE AND LINES - IRAN, ISLAMIC REPUBLIC OF**

<b>Subscore:</b>	<b>5.00</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>5.00</b>
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>	
No other main species caught					

**LONGTAIL TUNA - IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN - TROLLING LINES - IRAN, ISLAMIC REPUBLIC OF**

<b>Subscore:</b>	<b>5.00</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>5.00</b>
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>	
No other main species caught					

**LONGTAIL TUNA - IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN - UNASSOCIATED PURSE SEINE (NON-FAD) - IRAN, ISLAMIC REPUBLIC OF**

<b>Subscore:</b>	<b>3.83</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>3.83</b>
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>	
Kawakawa	3.00:Low	4.00:Low Concern	3.67:Low Concern	Green (3.83)	

**LONGTAIL TUNA - MALAYSIA/INDIAN OCEAN - UNASSOCIATED PURSE SEINE (NON-FAD) - MALAYSIA**

<b>Subscore:</b>	<b>3.83</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>3.83</b>
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>	
Kawakawa	3.00:Low	4.00:Low Concern	3.67:Low Concern	Green (3.83)	

**LONGTAIL TUNA - MALAYSIA/WESTERN AND CENTRAL PACIFIC - UNASSOCIATED PURSE SEINE (NON-FAD) - MALAYSIA**

<b>Subscore:</b>	<b>2.64</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>2.64</b>
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>	
Kawakawa	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)	
Frigate tuna	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)	

LONGTAIL TUNA - THAILAND/INDIAN OCEAN - UNASSOCIATED PURSE SEINE (NON-FAD) - THAILAND					
<b>Subscore:</b>	<b>2.64</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>2.64</b>
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>	
Frigate tuna	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)	
Kawakawa	3.00:Low	4.00:Low Concern	3.67:Low Concern	Green (3.83)	
Skipjack tuna	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.00)	

LONGTAIL TUNA - THAILAND/WESTERN AND CENTRAL PACIFIC - UNASSOCIATED PURSE SEINE (NON-FAD) - THAILAND					
<b>Subscore:</b>	<b>2.64</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>2.64</b>
<b>Species</b>	<b>Inherent Vulnerability</b>	<b>Abundance</b>	<b>Fishing Mortality</b>	<b>Subscore</b>	
Kawakawa	3.00:Low	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.64)	

Tongol tuna are commonly found associated with kawakawa in both the Western and Central Pacific Ocean (WCPO) and Indian Ocean (IO) and to a lesser extent frigate tuna in both the WCPO and IO and skipjack tuna in the IO in both gillnet and purse seine fisheries (Banks 2011). For example, within the Andaman Sea, kawakawa made up 7.33% of the catch during 2012, compared to 9.33% for longtail (DFO 2014). Information on other bycatch species associated with tonggol tuna fisheries is generally limited. Iran completed a pilot project in 2011 to collect bycatch information from gillnet fisheries targeting tunas, including those fisheries targeting other tuna species. According to the results, around 12% of the total catches were made up of bycatch and discard species but the full results have not been published (Shahifar 2012). Marine mammal bycatch in Iranian gillnet fisheries is reported to be very low (Shahifar et al. 2013). Research studies conducted in the Gulf of Thailand and Andaman Sea indicate that bycatch in purse seine fisheries operating in these regions is low and that protected, threatened and endangered species are hardly ever incidentally captured (DOF 2014). Malaysia reports that although sharks are caught in purse seine fisheries targeting tonggol and other neritic tuna species, they occur in very low numbers (Samsudin 2013). Thailand reports that information on shark interactions was only recorded during 2007 (Singhaboon 2013).

Although baitfish are used in troll and pole fisheries, the ratio of tuna to baitfish is around 30:1. In addition, baitfishing typically makes up only a small proportion of the total fishing effort on bait species (Gillet 2012). Due to these reasons, no baitfish species are not included in this report.

For this report, we have included kawakawa in the Iranian, Thai and Malaysian purse seine fisheries and Indonesian and Iranian gillnet fisheries. Frigate tuna was included in the Thailand (IO) purse seine, Malaysian WCPO purse seine, and Iranian gillnet fisheries because they are reported to make up close to 5% of the total catch (DFO 2014). Skipjack tuna was included in Thailand's IO purse seine fishery, sharks in the Indonesian and Iranian gillnet fisheries and turtles in the Indonesian and Iranian gillnet fisheries.

## 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)*

### KAWAKAWA

#### **Factor 2.1 - Inherent Vulnerability**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
MALAYSIA/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC  
REPUBLIC OF  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

#### **Low**

Fishbase has assigned a low vulnerability score of 37 out of 100. Kawakawa reach sexual maturity around 60 cm in size and 2-3 years. Their lifespan is 5 years and they can reach a maximum size of 100 cm. Kawakawa are broadcast spawners and are high level predators (Froese and Pauly 2014). These characteristics also suggest a low vulnerability to fishing.

#### **Factor 2.2 - Abundance**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
MALAYSIA/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC  
REPUBLIC OF

#### **Low Concern**

Kawakawa were assessed in the Indian Ocean by the Indian Ocean Tuna Commission in 2015. Due to issues with uncertainty surrounding the stock structure and catches, data poor methods were used to assess the status of the population. The results indicate the biomass is above levels needed to produce the maximum sustainable yield ( $B_{2013}/B_{MSY} = 1.15 (0.97-1.38)$ ), indicating the population is not overfished. The IOTC has suggested that further increases in annual catches could put pressure on this population (IOTC 2015). The International Union for the Conservation of Nature (IUCN) considers kawakawa to be a species of Least Concern, because they are widespread and considered to be abundant (Collette et al. 2011c). We have awarded a low and not very low concern score due to the uncertainty within the model inputs and results.

INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

#### **Moderate Concern**

The International Union for the Conservation of Nature (IUCN) considers kawakawa to be a species of Least Concern, because they are widespread and considered to be abundant (Collette et al. 2011c). No formal stock assessment has been conducted in the western and central Pacific Ocean. We have awarded a moderate concern score because their status is unknown.

### **Factor 2.3 - Fishing Mortality**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
MALAYSIA/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC  
REPUBLIC OF

#### **Low Concern**

Kawakawa are caught in several fisheries including troll, gillnet and purse seine (Collette et al. 2011c). The results of an assessment of kawakawa in the Indian Ocean indicate that fishing pressure is likely below levels needed to produce the maximum sustainable yield ( $F_{2013}/F_{MSY}=0.98-1.11$ ). Therefore overfishing is not occurring. There is a lack of fishery data from several fisheries, which has hampered the assessment process, resulting in only data deficient techniques being used. The data quality needs to be improved before more traditional assessment techniques can be used. We have awarded a low concern score because overfishing is likely not occurring but not a very low concern score due to the uncertainty surrounding the results (IOTC 2015).

INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

#### **Moderate Concern**

Kawakawa are caught in several fisheries including troll, gillnet and purse seine (Collette et al. 2011c). No formal assessment has been conducted in the Western and Central Pacific and so fishing mortality rates in this region are unknown. We have awarded a moderate concern score due to this lack of information and because no effective management is in place.

### **Factor 2.4 - Discard Rate**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

#### **< 20%**

Gillnet fisheries have a discard rate range of 0-66%, with an average discard rate of 7.2% (Kelleher 2005).

MALAYSIA/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC  
REPUBLIC OF  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

**< 20%**

Purse seine fisheries have an average discard rate of 5% (Kelleher 2005).

## TURTLES (UNSPECIFIED)

### **Factor 2.1 - Inherent Vulnerability**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

**High**

Turtles have a high vulnerability due to their life history characteristics that include a late age at maturity, long life and low reproductive output (Seafood Watch 2013).

### **Factor 2.2 - Abundance**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF

**Very High Concern**

There are six species of turtles found in the Indian Ocean, flatback, green, hawksbill, leatherback, loggerhead and olive ridley. Of these, the flatback is considered Data Deficient, green and loggerhead Endangered, olive ridley Vulnerable and hawksbill and leatherback Critically Endangered by the International Union for the Conservation of Nature (IOTC 2013g). Information on which species are captured in gillnets is not readily available. We have awarded a very high concern score due to the IUCN classifications.

INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

**Very High Concern**

Wallace et al. (2013) identified leatherback and loggerhead turtles are negatively impacted by net fisheries in the western and central Pacific Ocean. Leatherback sea turtles have been listed as Endangered by the United States Endangered Species Act (ESA) since 1970 (NMFS 2012). The International Union for Conservation of Nature (IUCN) classified leatherback turtles as Critically Endangered with a decreasing population trend in 2000 (Martinez 2000). Leatherback turtles have been listed on the Conventional on International Trade in Endangered Species (CITES) since 1975 and are currently listed on CITES Appendix 1, meaning they are threatened with extinction and international trade is prohibited. Over the past 25 years the population of leatherbacks in the Pacific Ocean has decreased significantly (Spotila et al. 1996). Recent estimates from the Eastern and Western Central Pacific Ocean suggest a population size of 294,068 turtles and out of these 6,199 are adults (Jones et al. 2012). The International Union for Conservation of Nature (IUCN) classified loggerhead turtles as Endangered in 1996, although it has been suggested that this needs to be updated (MTSG 2006). Loggerheads are listed on Appendix 1 of the Convention on International Trade in Endangered Species

(CITES). In the North Pacific Ocean, loggerheads have been listed as Endangered on the United States Endangered Species Act list since 1978 (NMFS 2012). We have awarded a very high concern score based on the ESA, IUCN and CITES listings.

### Factor 2.3 - Fishing Mortality

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF

#### Critical

Despite a lack of data, gillnet fisheries operating in the Indian Ocean are thought to be a substantial cause of mortality for sea turtles, even higher than mortality rates in longline and purse seine fisheries. A recent Ecological Risk Assessment (ERA) estimated that 11,400 to 47,500 turtles are caught in gillnets annually, with green sea turtles being impacted the greatest (50-88% of the catch). However, the target species in these gillnet fisheries were not identified in the ERA. Iran reported 24 sea turtle interactions from 2012, but the gear type was not indicated. Indonesia reported between 51 to 71 turtles caught between 2005 and 2012 but also did not indicate what gear types these interactions occurred with (IOTC 2013g). There are no bycatch mitigation techniques required in these fisheries for sea turtles, so we have awarded a critical concern score.

INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

#### Critical

Fishing mortality is thought to be a major threat to leatherback turtles, especially for juveniles and adults that can be incidentally captured in fisheries along their migration routes (Martinez 2000)(Zug and Parham 1996). The available data in the Western and Central Pacific Ocean are spotty, due to low reporting by some nations and low observer coverage in most fisheries. In addition, due to this low reporting, there is a high amount of uncertainty surrounding current estimates (Brouwer and Bertram 2009)(Williams et al. 2009). Interactions with leatherback are typically higher in sub-tropical and temperate areas (Williams et al. 2013). The incidental capture of loggerhead turtles has historically been considered a primary threat to their populations (MTSG 2006). However, data related to incidental captures is scarce due to low reporting by some countries and low observer coverage rates (~1%) (Brouwer and Bertram 2009) (Williams et al. 2009). Within the western and central Pacific Ocean, leatherback and loggerhead turtles are considered to have a low impact from bycatch capture in net fisheries (Wallace et al. 2013). There are no effective mitigation efforts in place for gillnet fisheries in this region, so we have awarded a critical concern score.

### Factor 2.4 - Discard Rate

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

#### < 20%

Gillnet fisheries have a discard rate range of 0-66%, with an average discard rate of 7.2% (Kelleher 2005).



## FRIGATE TUNA

### **Factor 2.1 - Inherent Vulnerability**

THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

#### **Low**

Fishbase assigned a low vulnerability score of 26 out of 100 (Froese and Pauly 20134). Longevity of frigate tuna is unknown. The size at which sexual maturity is reached is estimated to occur between 29-35 cm. Frigate tuna reach a maximum size of 60 cm. They are broadcast spawners and top level predators (Froese and Pauly 2014). These life history characteristics also suggest a low vulnerability to fishing.

### **Factor 2.2 - Abundance**

THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

#### **Moderate Concern**

The status of frigate tuna in the Indian Ocean is uncertain. No formal stock assessment has been conducted, principally due to a lack of data. The Indian Ocean Tuna Commission has indicated that it is unclear how increased catches will impact the Indian Ocean population (IOTC 2015). Within the western and Central Pacific Ocean, their status is also unknown and no formal assessment has been conducted. The International Union for the Conservation of Nature (IUCN) has classified frigate tuna as a species of Least Concern (Collette et al. 2011). The IUCN notes that it is possible declines in individual species of small tunas, such as frigate, may be not be apparent because overall trends for small tunas mask these issues (Collette et al. 2011). We have awarded a moderate concern score due to the lack of information.

### **Factor 2.3 - Fishing Mortality**

THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

#### **Moderate Concern**

Fishing mortality rates for frigate tuna in the Indian Ocean are unknown. There is some concern about increases in catches and the unreliability of current catch estimates, making a formal assessment difficult (IOTC 2015). Fishing mortality rates in the western and Central Pacific Ocean are also unknown and no formal assessment has been conducted. Frigate tuna are caught by a variety of gears and there is considerable under-reporting and un-reporting of catches due to species identification issues and high discarding rates (Collette et al. 2011). We have awarded a moderate concern score because information of fishing mortality rates is not available and no effective management is in place.

### **Factor 2.4 - Discard Rate**

THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
MALAYSIA/WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

#### **< 20%**

Purse seine fisheries have an average discard rate of 5% (Kelleher 2005).

IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF

**< 20%**

Gillnet fisheries have a discard rate range of 0-66%, with an average discard rate of 7.2% (Kelleher 2005).

## **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**

<b>Region / Method</b>	<b>Harvest Strategy</b>	<b>Bycatch Strategy</b>	<b>Score</b>
Indonesia / Indian Ocean / Drift gillnets / Indonesia	2.00	1.00	Red (1.41)
Indonesia / Indian Ocean / Trolling lines / Indonesia	2.00	0.00	Red (2.00)
Indonesia / Indian Ocean / Hand-operated pole and lines / Indonesia	2.00	0.00	Red (2.00)
Indonesia / Western and Central Pacific / Drift gillnets / Indonesia	2.00	1.00	Red (1.41)
Indonesia / Western and Central Pacific / Trolling lines / Indonesia	2.00	0.00	Red (2.00)
Indonesia / Western and Central Pacific / Hand-operated pole and lines / Indonesia	2.00	0.00	Red (2.00)
Iran, Islamic Republic of / Indian Ocean / Drift gillnets / Iran, Islamic Republic of	2.00	1.00	Red (1.41)
Iran, Islamic Republic of / Indian Ocean / Unassociated purse seine (non-FAD) / Iran, Islamic Republic of	2.00	2.00	Red (2.00)
Iran, Islamic Republic of / Indian Ocean / Trolling lines / Iran, Islamic Republic of	2.00	0.00	Red (2.00)
Iran, Islamic Republic of / Indian Ocean / Hand-operated pole and lines / Iran, Islamic Republic of	2.00	0.00	Red (2.00)
Malaysia / Indian Ocean / Unassociated purse seine (non-FAD) / Malaysia	2.00	0.00	Red (2.00)

Malaysia / Western and Central Pacific / Unassociated purse seine (non-FAD) / Malaysia	3.00	0.00	Yellow (3.00)
Thailand / Indian Ocean / Unassociated purse seine (non-FAD) / Thailand	2.00	0.00	Red (2.00)
Thailand / Western and Central Pacific / Unassociated purse seine (non-FAD) / Thailand	3.00	0.00	Yellow (3.00)

## 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

FACTOR 3.1 - MANAGEMENT OF FISHING IMPACTS ON RETAINED SPECIES							
Region / Method	Strategy	Recovery	Research	Advice	Enforce	Track	Inclusion
Indonesia / Indian Ocean / Drift gillnets / Indonesia	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly Effective
Indonesia / Indian Ocean / Trolling lines / Indonesia	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly Effective
Indonesia / Indian Ocean / Hand-operated pole and lines / Indonesia	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly Effective

Indonesia / Western and Central Pacific / Drift gillnets / Indonesia	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly Effective
Indonesia / Western and Central Pacific / Trolling lines / Indonesia	Moderately Effective	N/A	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	Highly Effective
Indonesia / Western and Central Pacific / Hand-operated pole and lines / Indonesia	Moderately Effective	N/A	Moderately Effective	Moderately Effective	Ineffective	Moderately Effective	Highly Effective
Iran, Islamic Republic of / Indian Ocean / Drift gillnets / Iran, Islamic Republic of	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Highly Effective
Iran, Islamic Republic of / Indian Ocean / Unassociated purse seine (non-FAD) / Iran, Islamic Republic of	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Highly Effective
Iran, Islamic Republic of / Indian Ocean / Trolling lines / Iran, Islamic Republic of	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Highly Effective
Iran, Islamic Republic of / Indian Ocean / Hand-operated pole and lines / Iran, Islamic Republic of	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Ineffective	Highly Effective
Malaysia / Indian Ocean / Unassociated purse seine (non-FAD) / Malaysia	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Ineffective	Highly Effective
Malaysia / Western and Central Pacific / Unassociated purse seine (non-FAD) / Malaysia	Moderately Effective	N/A	Moderately Effective	Highly Effective	Moderately Effective	Moderately Effective	Highly Effective

Thailand / Indian Ocean / Unassociated purse seine (non-FAD) / Thailand	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	Moderately Effective	Ineffective	Highly Effective
Thailand / Western and Central Pacific / Unassociated purse seine (non-FAD) / Thailand	Moderately Effective	N/A	Moderately Effective	Highly Effective	Moderately Effective	Moderately Effective	Highly Effective

The Indian Ocean Tuna Commission, a Regional Fisheries Management Organization (RFMO), manages tonggol tuna throughout the Indian Ocean. RFMO's are legally mandated international fishery management body, which are made up of member countries that agree to abide by adopted management measures. The following countries are current members of the IOTC: Australia, Belize, China, Comoros, Eritrea, European Community, France, Guinea, Indonesia, Iran, Japan, Kenya, Republic of Korea, Madagascar, Malaysia, Maldives, Mauritius, Mozambique, Oman, Pakistan, Philippines, Seychelles, Sierra Leone, Sri Lanka, Sudan, Tanzania, Thailand, United Kingdom, Vanuatu and Yemen. Individual countries, including Iran, Indonesia, Malaysia and Thailand for this report, are responsible for implementing and monitoring agreed upon management measures within their fleets that target tuna and tuna-like species. In Indonesia, the Ministry of Marine Affairs and Fisheries, is responsible for managing fisheries. Iran's government agency which is responsible for this is the Iran Fisheries Organization (IFO). Fisheries in Malaysia and Thailand are managed by their respective Department of Fisheries. Within the western and central Pacific Ocean, the respective RFMO, the Western and Central Pacific Fisheries Commission, do not manage tonggol tuna and therefore all management is left to individual nations, which for the WCPO includes Indonesia, Malaysia and Thailand. In addition, the Southeast Asian Fisheries Development Center (SEAFDEC), Indonesia, Malaysia, and Thailand are members, is working on a Regional Plan of Action on Sustainable Fisheries of Neritic Tunas in Southeast Asia (<http://www.seafdec.org/regional-plan-action-sustainable-utilization-neritic-tuna-asean-region-drafted/1>).

### **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.*

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

#### **Moderately Effective**

The Ministry of Marine Affairs and Fisheries (MMAF) manages fisheries in Indonesia. The Directorate General for Capture Fisheries develops regulations and implements them within the provinces through local fisheries administrators (Flewellling and Hosh 2006). Tonggol tuna is managed along with other large pelagic species through licensing, limited access, area designations and gear restrictions. In addition a moratorium on fishing license's has lead to a decrease in fishing pressure on tonggol tuna (Ministry of MAF Regulation No. 58/2014).

Indonesia has created a National Tuna Management Plan, which addresses neritic and pelagic tuna species and includes ways to improve monitoring, identifying catch limits, and aiding in enforcement and compliance measures (MMAF 2014a). The Indian Ocean Tuna Commission (IOTC) management measures for tongol tuna include required recording and reporting of catches, licensing and limiting fishing capacity (IOTC 2013). The Western and Central Pacific Fisheries Commission does not manage tongol tuna. We have awarded a moderately effective score because there are some management measures in place.

INDONESIA / WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA

INDONESIA / WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA

### **Moderately Effective**

The Ministry of Marine Affairs and Fisheries (MMAF) manages fisheries in Indonesia. The Directorate General for Capture Fisheries develops regulations and implements them within the provinces through local fisheries administrators (Flewwelling and Hosh 2006). Tongol tuna is managed along with other large pelagic species through licensing, limited access, area designations and gear restrictions. Indonesia has created a National Tuna Management Plan, which includes ways to improve monitoring, identifying catch limits, and aiding in enforcement and compliance measures. However, this plan has not yet been implemented (MMAF 2012).

The Western and Central Pacific Fisheries Commission does not manage tongol tuna. We have therefore awarded a moderate concern score because some management is in place.

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC OF

### **Moderately Effective**

The Iran Fisheries Organization is in charge of monitoring and control of all fishing vessels and fishing cooperatives (Naderi 2013)(Shahifar et al. 2013). Included in the management of fisheries is recording of fishery statistics and providing the information to the Indian Ocean Tuna Commission and other international organizations such as the Food and Agriculture Organization (Naderi 2013). Iran has placed a moratorium on issuing new industrial fishing vessel licences. Vessel licences are used to identify allowed gear types and regions where fishing can occur (Morgan 2006). In addition, Iran has recently improved their data collection system for their logbook program specific to tuna (IRI 2013)(Naderi 2013). The Indian Ocean Tuna Commission (IOTC) management measures for tongol tuna include required recording and reporting of catches, licensing and limiting fishing capacity (IOTC 2013). We have awarded a moderately effective score because there are some management measures in place.

MALAYSIA / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

### **Moderately Effective**

Fisheries in Malaysia are managed by the Malaysian Department of Fisheries (DOF) (Flewwelling and Hosch 2006b). Thailand and Malaysia have developed a Joint Development Area (JDA) in the Gulf of Thailand, and fishermen from both regions can fish in the JDA (Banks 2011). In addition, Malaysia uses a limited access fishery, and gear and vessel size restrictions (Flewwelling and Hosch 2006b). The Indian Ocean Tuna Commission (IOTC) management measures for tongol tuna include required recording and reporting of catches, licensing and limiting fishing capacity (IOTC 2013). The Western and Central Pacific Fisheries

Commission (WCPFC) does not manage tonggol tuna but Malaysia is not a member of the WCPFC. We have awarded a moderately effective score because there are some management measures in place.

MALAYSIA / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

**Moderately Effective**

Fisheries in Malaysia are managed by the Malaysian Department of Fisheries (DOF) (Flewwelling and Hosch 2006b). Thailand and Malaysia have developed a Joint Development Area (JDA) in the Gulf of Thailand, and fishermen from both regions can fish in the JDA (Banks 2011). In addition, Malaysia uses a limited access fishery, and gear and vessel size restrictions (Flewwelling and Hosch 2006b). The Western and Central Pacific Fisheries Commission (WCPFC) does not manage tonggol tuna but Malaysia is not a member of the WCPFC. We have awarded a moderate concern score because some management measures are in place.

THAILAND / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

**Moderately Effective**

Thailand has three main fishing laws, the Fisheries Act, the Act Governing the Right to Fish in Thai Waters and the Thai Vessel Act. The Department of Fisheries is responsible for fisheries management in Thai waters but there is currently no fishery management plan in place for tonggol tuna. However, there is some legislation in place that offers some protection to tonggol tuna resources, including restrictions on fishing during spawning seasons and restrictions on the mesh size of surrounding nets (DFO 2014). The purse seine fishery is an open access fishery but there is a mesh size restriction for surrounding nets, such as purse seines (FAO 2005) (Banks 2011). Thailand and Malaysia have developed a Joint Development Area (JDA) in the Gulf of Thailand, and fishermen from both regions can fish in the JDA (Banks 2011). The Indian Ocean Tuna Commission (IOTC) management measures for tonggol tuna include required recording and reporting of catches, licensing and limiting fishing capacity (IOTC 2013). The Western and Central Pacific Fisheries Commission {WCPFC} does not manage tonggol tuna but Thailand is not a cooperating member. We have awarded a moderately effective score because there are some management measures in place.

THAILAND / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

**Moderately Effective**

Thailand has three main fishing laws, the Fisheries Act, the Act Governing the Right to Fish in Thai Waters and the Thai Vessel Act. The Department of Fisheries is responsible for fisheries management in Thai waters but there is currently no fishery management plan in place for tonggol tuna. However, there is some legislation in place that offers some protection to tonggol tuna resources, including restrictions on fishing during spawning seasons and restrictions on the mesh size of surrounding nets (DFO 2014). The purse seine fishery is an open access fishery but there is a mesh size restriction for surrounding nets, such as purse seines (FAO 2005) (Banks 2011). Thailand and Malaysia have developed a Joint Development Area (JDA) in the Gulf of Thailand, and fishermen from both regions can fish in the JDA (Banks 2011). The Western and Central Pacific Fisheries Commission {WCPFC} does not manage tonggol tuna and Thailand is not a cooperating member. We have awarded a moderate concern score because although Thailand does not specifically manage tonggol tuna, they do have some legislation in place that is beneficial to them.

**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.*

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC OF  
MALAYSIA / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **Moderately Effective**

Tongol tuna are undergoing overfishing in the Indian Ocean and there is no recovery plan in place. However, Indonesia is a member of the Southeast Asian Fisheries Development Center (SEAFDEC), which is working towards developing a Regional Plan of Action for Sustainable Neritic Tuna Fisheries (RPOA-Neritic Tuna). The scope and goals of this RPOA-Neritic Tuna have been developed and are geared toward sustainable fishing of neritic tunas in the region (DFO 2014). We have therefore awarded a moderately effective score.

INDONESIA / WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA  
MALAYSIA / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **N/A**

That status of tongol tuna in the western and central Pacific Ocean is unknown, so we have awarded a n/a 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.*

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

### **Moderately Effective**

Indonesia collects some catch and effort data through a partial logbook system and through port sampling programs (Satria et al. 2013). The Indian Ocean Tuna Commission, which has started assessing tongol tuna in the Indian Ocean, collects catch, size and effort information from member countries. However, there are large uncertainties surrounding this data (IOTC 2013). We have awarded a moderately effective score because

information is collected.

INDONESIA / WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA

### **Moderately Effective**

Indonesia collects some catch and effort data through a partial logbook system and through port sampling programs. Logbooks are used for longline/handline, purse seine/pole and other gear's and are mandatory for vessels larger than 5 GT. There are concerns with coverage and quality of the logbooks. The port sampling program is conducted at 3 ports, Nizam Zahman Jakarta, Benoa-Bali and Cilacap Java. There is a minimum coverage at Benoa of 30%, it is unclear what percent coverage occurs at the other sites (Satria et al. 2013). We have awarded a moderately effective score because some data is being collected.

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC  
REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC  
OF

### **Moderately Effective**

Iran collects catch, size and effort information from a port sampling program (IRA 2013). The Indian Ocean Tuna Commission, which has started assessing tongol tuna in the Indian Ocean, collects catch, size and effort information from member countries. However, there are large uncertainties surrounding this data (IOTC 2013). We have awarded a moderately effective score because information is collected.

MALAYSIA / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

### **Moderately Effective**

Malaysia collects catch and effort information from vessels operating beyond 12 nm in a Vessels Operation Report. In addition, the Fisheries Information Management Division conducts a port sampling program for neritic tunas including tonggol (Samsundin et al. 2013). The Indian Ocean Tuna Commission, which has started assessing tonggol tuna in the Indian Ocean, collects catch, size and effort information from member countries. However, there are large uncertainties surrounding this data (IOTC 2013). We have awarded a moderately effective score because information is collected.

MALAYSIA / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

### **Moderately Effective**

Malaysia collects catch and effort information from vessels operating beyond 12 nm in a Vessels Operation Report. In addition, the Fisheries Information Management Division conducts a port sampling program for neritic tunas including tonggol (Samsundin et al. 2013). We have therefore awarded a moderate score.

THAILAND / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **Moderately Effective**

The Fisheries Statistics, Analysis and Research Group (FSARG) and Marine Fisheries Research and Development Bureau (MFRDB) are in charge of collecting and processing fishery information in Thailand, including monitoring purse seine fisheries that target tongol tuna. Information is collected from commercial fisheries and through research (Singhaboon 2013). Production data is produced annually (DFO 2014). Port sampling programs collect information on the catch and size of landed fish, including neritic tunas such as tongol (Singhaboon 2013). In addition, the Department of Fisheries has been conducting research on neritic tuna species, including tongol, since 1991 (DFO 2014). The Indian Ocean Tuna Commission, which has started assessing tongol tuna in the Indian Ocean, collects catch, size and effort information from member countries. However, there are large uncertainties surrounding this data (IOTC 2013). We have awarded a moderately effective score because information is collected.

THAILAND / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **Moderately Effective**

The Fisheries Statistics, Analysis and Research Group (FSARG) and Marine Fisheries Research and Development Bureau (MFRDB) are in charge of collecting and processing fishery information in Thailand, including monitoring purse seine fisheries that target tongol tuna. Information is collected from commercial fisheries and through research (Singhaboon 2013). Production data is produced annually (DFO 2014). Port sampling programs collect information on the catch and size of landed fish, including neritic tunas such as tongol (Singhaboon 2013). In addition, the Department of Fisheries has been conducting research on neritic tuna species, including tongol, since 1991 (DFO 2014). The Western and Central Pacific Fisheries Commission does not collect any information. However, we have awarded a moderately effective score because Thailand does conduct research and collect catch information.

## **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.*

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA

INDONESIA / INDIAN OCEAN, TROLLING LINES, INDONESIA

INDONESIA / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA

INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

INDONESIA / WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA

INDONESIA / WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA

### **Moderately Effective**

Indonesia has three research institutes that provide scientific advice to the Ministry of Marine Affairs and Fisheries. These include the Indonesian Institute of Science and Technology, the Central Fisheries Research Institute and the Research Institute for Marine Fisheries (Flewwelling and Hosch 2006a). The Indian Ocean Tuna Commission Scientific Committee did not provide specific management advice in 2013 but did indicate that in particular, Iran, Indonesia and Oman need to improve their data collection (IOTC 2013). Indonesia has recently published their National Plan of Action, tuna, skipjack and neritic tunas (MMAF 2014a). There is no scientific advice for the western and central Pacific Ocean population of tongol tuna. We have awarded a moderately effective score to account for Indonesia having a system in place to acknowledge scientific advice.

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC  
REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC  
OF

### **Moderately Effective**

The Indian Ocean Tuna Commission Scientific Committee did not provide specific management advice in 2013 but did indicate that in particular, Iran, Indonesia and Oman need to improve their data collection (IOTC 2013). Iran has recently improved their data collection system (IRI 2013), so we have awarded a moderately effective score.

MALAYSIA / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
MALAYSIA / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
THAILAND / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **Highly Effective**

The Indian Ocean Tuna Commission Scientific Committee did not provide specific management advice in 2013 but did indicate that in particular, Iran, Indonesia and Oman need to improve their data collection (IOTC 2013). Malaysia and Thailand were not highlighted by the Scientific Committee. There is no scientific advice for the western and central Pacific Ocean population of tongol tuna. We have awarded a highly effective score because Malaysia and Thailand appear to be in compliance with the current scientific advice.

## **Subfactor 3.1.5 – Enforcement of Management Regulations**

*Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.*

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA

### **Ineffective**

Indonesia has a logbook program in place but the coverage rate and quality of reporting is considered poor. Indonesia has started to use a Database Sharing System for Fisheries Management to help prevent illegal, unregulated and unreported (IUU) fishing. There is also a port sampling program in place and vessels larger than 30 GT must have a vessel monitoring system in place. (Satria et al. 2013). The Indonesian Navy is responsible for enforcement of fisheries laws; however enforcement is thought to be generally poor in this region (Novaczek et al. 2011). We have therefore awarded an ineffective score.

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC  
REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC  
OF

### **Moderately Effective**

The Iran Fisheries Organization is in charge of monitoring and control of all fishing vessels (Shahifar et al. 2013). A number of vessels are set up with vessel monitoring systems and Iran plans to equip all vessels with these systems in the near future (Naderi 2013)(IRI 2013). Iran acknowledges that there have been some deficiencies with regard to the Indian Ocean Tuna Commission (IOTC) mandated measures but that compliance has been improving over time (Shahifar et al. 2013). For example logbooks began being used by the gillnet fishery during 2012 (Shahifar 2012). We have awarded a moderately effective score because Iran is taking measures to improve enforcement of measures and comply with IOTC mandated measures.

MALAYSIA / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
MALAYSIA / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

### **Moderately Effective**

Malaysia relies on their Navy, Coast Guard and Marine police for enforcement of fisheries laws (Flewwelling and Hosch 2006b). Malaysia has not yet implemented a logbook system to record and monitor catch and effort data. However, vessels fishing further than 12 nm from shore must fill out and submit a vessels operation report, which does include catch and effort data and there is a port sampling program in place. Vessel monitoring systems are used on vessels operating on the high seas and there is a National Plan of Action to prevent illegal, unreported and unregulated fishing (IUU) (Flewwelling and Hosch 2006b)(DOF 2013) (Samsudin et al. 2013). We have therefore awarded a moderately effective score.

THAILAND / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
THAILAND / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **Moderately Effective**

Monitoring, control and surveillance is conducted by the Marine Fishery and Management and Compliance Sections of the Department of Fisheries, along with marine police and navy, Marine Department, Department of Marine and Coastal Resources and the Department of Labor Protection and Welfare. There are six regional areas within Thailand, and each has a compliance plan and determines their priorities. Thailand has logbook and port sampling programs in place (Singhagoon 2013). There is a National Plan of Action to address illegal, unregulated and unreported (IUU) fishing. Vessel monitoring system's are in place on some but not all purse seine vessels. Port sampling inspections are considered to not be effective due to IUU fishing. In addition, there is no aerial surveillance used (Banks 2011). We have therefore awarded a moderately effective score.

## **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.*

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC  
REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC  
OF  
MALAYSIA / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **Ineffective**

Management measures in the Indian Ocean have been unable to prevent overfishing of tongol tuna from occurring. So we have awarded an ineffective score.

INDONESIA / WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA  
MALAYSIA / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **Moderately Effective**

The status of tongol tuna in the western and central Pacific Ocean is uncertain so we have awarded 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 process is transparent and includes stakeholder input.*

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA

### **Highly Effective**

The recently developed National Tuna Management Plan included the involvement of many sectors including fishery managers and tuna fisheries organizations. The plan aims at, among other things, improving communication and cooperation between tuna associations and the government (MMAF 2012). Thailand is a member of the Southeast Asian Fisheries Development Center (SEAFDEC), which conducts regular stakeholder consultations for the development of the Regional Plan of Action for Sustainable Neritic Tuna Fisheries (DFO 2014). We have therefore awarded a highly effective score.

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC  
REPUBLIC OF

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC  
OF

### **Highly Effective**

Iran appears to include both the public and private sector in fisheries management decisions (Morgan 2006), so we have awarded a highly effective score.

MALAYSIA / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

MALAYSIA / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

### **Highly Effective**

Malaysia appears to include stakeholder input when developing management plans such as the National Plan of Action to prevent illegal, unreported and unregulated (IUU) fishing (DOF 2013). Malaysia is a member of the Southeast Asian Fisheries Development Center (SEAFDEC), which conducts regular stakeholder consultations for the development of the Regional Plan of Action for Sustainable Neritic Tuna Fisheries (DFO 2014). We have therefore awarded a highly effective score.

THAILAND / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

THAILAND / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **Highly Effective**

Thailand is a member of the Southeast (SEAFDEC), which conducts regular stakeholder consultations for the development of the Regional Plan of Action for Sustainable Neritic Tuna Fisheries (DFO 2014). We have therefore awarded a highly effective score.

## **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 ratings 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*

**FACTOR 3.2 - BYCATCH STRATEGY**

<b>Region / Method</b>	<b>All Kept</b>	<b>Critical</b>	<b>Strategy</b>	<b>Research</b>	<b>Advice</b>	<b>Enforce</b>
Indonesia / Indian Ocean / Drift gillnets / Indonesia	No	No	Ineffective	Ineffective	Moderately Effective	Ineffective
Indonesia / Indian Ocean / Trolling lines / Indonesia	Yes	All Species Retained				
Indonesia / Indian Ocean / Hand-operated pole and lines / Indonesia	Yes	All Species Retained				
Indonesia / Western and Central Pacific / Drift gillnets / Indonesia	No	No	Ineffective	Ineffective	Moderately Effective	Ineffective
Indonesia / Western and Central Pacific / Trolling lines / Indonesia	Yes	All Species Retained				
Indonesia / Western and Central Pacific / Hand-operated pole and lines / Indonesia	Yes	All Species Retained				
Iran, Islamic Republic of / Indian Ocean / Drift gillnets / Iran, Islamic Republic of	No	No	Ineffective	Ineffective	Moderately Effective	Moderately Effective
Iran, Islamic Republic of / Indian Ocean / Unassociated purse seine (non-FAD) / Iran, Islamic Republic of	No	No	Moderately Effective	Ineffective	Moderately Effective	Moderately Effective
Iran, Islamic Republic of / Indian Ocean / Trolling lines / Iran, Islamic Republic of	Yes	All Species Retained				
Iran, Islamic Republic of / Indian Ocean / Hand-operated pole and lines / Iran, Islamic Republic of	Yes	All Species Retained				
Malaysia / Indian Ocean / Unassociated purse seine (non-FAD) / Malaysia	Yes	All Species Retained				
Malaysia / Western and Central Pacific / Unassociated purse seine (non-FAD) / Malaysia	Yes	All Species Retained				
Thailand / Indian Ocean / Unassociated purse seine (non-FAD) / Thailand	Yes	All Species Retained				
Thailand / Western and Central Pacific / Unassociated purse seine (non-FAD) / Thailand	Yes	All Species Retained				

**Subfactor 3.2.2 – Management Strategy and Implementation**

*Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and how successful are these management measures? To achieve a Highly Effective rating, the primary bycatch species must be known and there must be clear goals and measures in place to minimize the impacts on bycatch species (e.g., catch limits, use of proven mitigation measures, etc.).*



INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

### **Ineffective**

Indonesia has a National Plan of Action for Sharks and has worked to improve fishers awareness of shark resources and their importance (Satria et al. 2013). In addition to these national measures, oceanic whitetip sharks are prohibited from being retained, transshipped or landed under the mandate of the Indian Ocean Tuna Commission (IOTC). Shark interactions are to be recorded and reported to the IOTC within 150 days. In addition, the IOTC calls for the full utilization of sharks and prohibits finning (5% ratio) and there are minimum logbook requirements for recording shark interactions (IOTC 2013e). IOTC management measures for sea turtles includes reporting of any incidental interactions and the use of proper handling and release techniques and member countries are asked to research gillnet designs that would reduce incidental interactions (IOTC 2013g). We have awarded an ineffective score because several bycatch species are caught in these fisheries and minimal actions have been taken.

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF

### **Ineffective**

Iran has made progress implementing Indian Ocean Tuna Commission (IOTC) management resolutions. These include recording of shark bycatch in gillnet fisheries, prohibiting the capture of thresher sharks, improving data collection and implementing an observer and logbook program (IRI 2013). Landing sharks is prohibited in Iran and a National Plan of Action for sharks is currently under development (IRI 2013). Iran is planning on starting a pilot project to collect bycatch and discard information from randomly selected vessels (Naderi 2013). In addition, there are specific IOTC mandated sea turtles measures including required recording and reporting of any interactions, proper handling and release techniques, prohibition on encircling sea turtles and member countries are requested to research alternative gillnet designs to reduce turtle interactions (IOTC 2013g). We have awarded an ineffective score because although some management is in place, best practices are not always utilized.

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF

### **Moderately Effective**

Iran has made progress implementing Indian Ocean Tuna Commission (IOTC) management resolutions. These include recording of shark bycatch, prohibiting the capture of thresher sharks, improving data collection and implementing an observer and logbook program (IRI 2013). Landing sharks is prohibited in Iran and a National Plan of Action for sharks is currently under development (IRI 2013). Iran is planning on starting a pilot project to collect bycatch and discard information from randomly selected vessels (Naderi 2013). In addition, there are specific IOTC mandated sea turtles measures including required recording and reporting of any interactions, proper handling and release techniques, prohibition on encircling sea turtles and member countries are requested to research alternative gillnet designs to reduce turtle interactions (IOTC 2013g). We have awarded a moderate concern score because there are some management measures in place and unassociated purse seine fisheries typically have low bycatch rates.

### Subfactor 3.2.3 – Scientific Research and Monitoring

*Considerations: Is bycatch in the fishery recorded/documented 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*

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

#### **Ineffective**

Research on bycatch species is minimal in Indonesia, although they are working towards improving their current observer program (Sataria et al. 2013). We therefore consider the monitoring of bycatch ineffective.

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF

#### **Ineffective**

Iran has been working towards implementing an observer program but it is unclear if this is only for longline vessels (per Indian Ocean Tuna Commission recommendations) or for the gillnet fishery as well (IRI 2013). Iran utilizes port samplers to help identify bycatch and discard species in their gillnet fisheries (Shahifar et al. 2013). However, historical information on bycatch in Iran is not available (Shahifar 2012), so we have awarded an ineffective score.

### 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.*

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

#### **Moderately Effective**

See harvest strategy section for details.

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF

#### **Moderately Effective**

See harvest strategy section for details.

### 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.*

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

**Ineffective**

See harvest strategy section for details.

IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC  
REPUBLIC OF

**Moderately Effective**

See harvest strategy section for details.

## **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**

<b>Region / Method</b>	<b>Gear Type and Substrate</b>	<b>Mitigation of Gear Impacts</b>	<b>EBFM</b>	<b>Score</b>
Indonesia / Indian Ocean / Drift gillnets / Indonesia	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.87)
Indonesia / Indian Ocean / Trolling lines / Indonesia	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.87)
Indonesia / Indian Ocean / Hand-operated pole and lines / Indonesia	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.87)
Indonesia / Western and Central Pacific / Drift gillnets / Indonesia	5.00: None	0.00: Not Applicable	2.00: High Concern	Yellow (3.16)
Indonesia / Western and Central Pacific / Trolling lines / Indonesia	5.00: None	0.00: Not Applicable	2.00: High Concern	Yellow (3.16)
Indonesia / Western and Central Pacific / Hand-operated pole and lines / Indonesia	5.00: None	0.00: Not Applicable	2.00: High Concern	Yellow (3.16)
Iran, Islamic Republic of / Indian Ocean / Drift gillnets / Iran, Islamic Republic of	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.87)
Iran, Islamic Republic of / Indian Ocean / Unassociated purse seine (non-FAD) / Iran, Islamic Republic of	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.87)

Iran, Islamic Republic of / Indian Ocean / Trolling lines / Iran, Islamic Republic of	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.87)
Iran, Islamic Republic of / Indian Ocean / Hand-operated pole and lines / Iran, Islamic Republic of	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.87)
Malaysia / Indian Ocean / Unassociated purse seine (non-FAD) / Malaysia	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.87)
Malaysia / Western and Central Pacific / Unassociated purse seine (non-FAD) / Malaysia	5.00: None	0.00: Not Applicable	2.00: High Concern	Yellow (3.16)
Thailand / Indian Ocean / Unassociated purse seine (non-FAD) / Thailand	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.87)
Thailand / Western and Central Pacific / Unassociated purse seine (non-FAD) / Thailand	5.00: None	0.00: Not Applicable	2.00: High Concern	Yellow (3.16)

## 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

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
 INDONESIA / INDIAN OCEAN, TROLLING LINES, INDONESIA  
 INDONESIA / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
 INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
 INDONESIA / WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA  
 INDONESIA / WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA  
 IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
 IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF  
 IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
 IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC OF  
 MALAYSIA / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
 MALAYSIA / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
 THAILAND / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
 THAILAND / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

#### None

Fishing gears such as gillnet, purse seine and troll and pole that target tonggol tuna do not come in contact with bottom habitats.

## Factor 4.2 - Mitigation of Gear Impacts

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA  
INDONESIA / WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC OF  
MALAYSIA / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
MALAYSIA / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND  
THAILAND / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

**Not Applicable**

## Factor 4.3 - Ecosystem-Based Fisheries Management

INDONESIA / INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA / INDIAN OCEAN, TROLLING LINES, INDONESIA  
INDONESIA / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, TROLLING LINES, IRAN, ISLAMIC REPUBLIC OF  
IRAN, ISLAMIC REPUBLIC OF / INDIAN OCEAN, HAND-OPERATED POLE AND LINES, IRAN, ISLAMIC REPUBLIC OF  
MALAYSIA / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA  
THAILAND / INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **Moderate Concern**

Gillnet fisheries can capture 'exceptional species' such as sharks, which are considered top predators in many ecosystems and play a critical role in how these ecosystems are structured and function (Piraino et al. 2002) (Stevens et al. 2000). The loss of these predators can cause many changes such as to prey abundances, which can lead to a cascade of other affects (Myers et al. 2007)(Duffy 2003)(Ferretti et al. 2010) (Schindler et al. 2002).

The unassociated purse seine fishery does capture "exceptional species" such as tunas but these species are typically monitored and assessed. Interactions with other "exceptional species" common in associated purse seine fisheries, such as sharks, are minimal in the unassociated fishery.

In addition to tuna, troll and pole fisheries rely on live baitfish, which could include other "exceptional species" such as anchovy or sardines, and the effect of the removal of these species on the ecosystem is unknown and few baitfish fisheries are managed (Gillet 2012)(FAO 2014).

The Indian Ocean Tuna Commission (IOTC) has a Working Party on Ecosystems and Bycatch (WPEB). Working

Parties (WP) in the IOTC analyze technical problems related to the management goals and identify research priorities and indicate data and information requirements that are needed. In addition they provide advice on management measures (IOTC 2013h). 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 and information on sharks and rays, marine turtles, seabirds, marine mammals and other bycatch species when necessary ((IOTC 2013i). In addition, the Commission has adopted management measures specific to bycatch species in purse seine fisheries such as sharks. We have awarded a moderate concern score to account for IOTC work in this area.

INDONESIA / WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

INDONESIA / WESTERN AND CENTRAL PACIFIC, TROLLING LINES, INDONESIA

INDONESIA / WESTERN AND CENTRAL PACIFIC, HAND-OPERATED POLE AND LINES, INDONESIA

MALAYSIA / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), MALAYSIA

THAILAND / WESTERN AND CENTRAL PACIFIC, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **High Concern**

Gillnet fisheries can capture 'exceptional species' such as sharks, which are considered top predators in many ecosystems and play a critical role in how these ecosystems are structured and function (Piraino et al. 2002) (Stevens et al. 2000). The loss of these predators can cause many changes such as to prey abundances, which can lead to a cascade of other affects (Myers et al. 2007)(Duffy 2003)(Ferretti et al. 2010) (Schindler et al. 2002).

The unassociated purse seine fishery does capture "exceptional species" such as tunas but these species are typically monitored and assessed. Interactions with other "exceptional species" common in associated purse seine fisheries, such as sharks, are minimal in the unassociated fishery.

In addition to tuna, troll and pole fisheries rely on live baitfish, which could include other "exceptional species" such as anchovy or sardines, and the effect of the removal of these species on the ecosystem is unknown and few baitfish fisheries are managed (Gillet 2012)(FAO 2014).

There are no explicit efforts to include ecosystem impacts in the management of these fisheries, so we have awarded a high concern score.



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## **Appendix A: Extra By Catch Species**

### **SHARKS**

#### **Factor 2.1 - Inherent Vulnerability**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

##### **High**

Fishbase typically assigns a high to very high vulnerability score to shark species due to their life history characteristics that include slow growth, late age at sexual maturity and low reproductive output (Froese and Pauly 2013).

#### **Factor 2.2 - Abundance**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

##### **High Concern**

Sharks are susceptible to incidental capture in drift gillnet fisheries (Rogan and Mackey 2007)(Thorpe and Fierson 2009). Although information on the species of sharks caught in the Indonesian tonggol tuna gillnet fishery is not available, it's likely to include a variety of coastal species (Cosandey-Godin and Morgan 2011). A recent study estimated that one quarter of chondrichthyan fishes (sharks, rays and chimaeras) are Threatened according to the International Union for the Conservation of Nature Red List Criteria, with areas around Indonesia having the highest levels of Threatened species (Dulvy et al. 2014). We have therefore awarded a high concern score for shark interactions in the Indonesian drift gillnet fishery.

IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF

##### **High Concern**

Iran reports the incidental capture of several species of sharks in their gillnet fisheries. The most commonly reported species include (in decreasing order): milk shark, spottail shark, whitecheek shark, oceanic whitetip shark, mako shark and hammerhead sharks. While species such as mako and oceanic whitetip sharks are likely more common in pelagic gillnet fisheries, hammerheads, whitecheek, spottail and milk sharks are common bycatch species in inshore fisheries. The status of shark species in the Indian Ocean is not known due to a general lack of data i.e (IOTC 2013e)(IOTC 2013f). Scalloped hammerheads are classified as Endangered by the International Union for the Conservation of Nature (IUCN) (Baum et al. 2006), oceanic whitetip and shortfin mako as Vulnerable (Baum et al. 2007)(Cailliet et al. 2009), whitecheek and spottail sharks are listed as Near Threatened (Bennet et al. 2003)(Pillans et al. 2009) and milk shark as Least Concern (Simpfendorfer 2003). We have awarded a high concern score based on the IUCN classifications for these species.

#### **Factor 2.3 - Fishing Mortality**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

##### **Moderate Concern**

Sharks are caught by a variety of fishing gears including gillnets and the mortality associated with this incidental capture can be high (Rogan and Mackey 2007)(Thorpe and Fierson 2009). There is a general lack of data related to shark catches throughout the Indian Ocean, which has hampered the assessment of many species i.e. (IOTC 2013e). Within the Western and Central Pacific Ocean, silky and oceanic whitetip sharks have both been found to be undergoing overfishing, although their occurrence rate in gillnet fisheries targeting neritic tuna is unknown (Rice and Harley 2012a)(Rice and Harley 2012b). The continued capture of some species, such as scalloped hammerhead, will likely lead to further population declines [IOTC 2013e]. Indonesia has a National Plan of Action for Sharks developed (Satria et al. 2013). We have therefore awarded a moderate instead of high concern score.

IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF

### **Moderate Concern**

Fishing mortality rates are not known for commonly reported shark species caught in Iran's gillnet fisheries (milk, whitecheek, spottail, mako, oceanic whitetip and hammerhead). This is due to a general lack of information. The Indian Ocean Tuna Commission has indicated that maintaining catches of some species such as scalloped hammerheads will lead to population declines (IOTC 2013f). Iran has prohibited the landing of sharks (IRI 2013). We have therefore awarded a moderate instead of high concern score.

## **Factor 2.4 - Discard Rate**

INDONESIA/INDIAN OCEAN, DRIFT GILLNETS, INDONESIA  
IRAN, ISLAMIC REPUBLIC OF/INDIAN OCEAN, DRIFT GILLNETS, IRAN, ISLAMIC REPUBLIC OF  
INDONESIA/WESTERN AND CENTRAL PACIFIC, DRIFT GILLNETS, INDONESIA

**< 20%**

Gillnet fisheries have a discard rate range of 0-66%, with an average discard rate of 7.2% (Kelleher 2005).

## **SKIPJACK TUNA**

### **Factor 2.1 - Inherent Vulnerability**

THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **Medium**

Fishbase assigned a moderate vulnerability of 39 out of 100 (Froese and Pauly 2013). Skipjack tuna's life history characteristics support this score. Sexual maturity is reached around 45 cm or 2 years of age and they can reach a maximum size of 110 cm and age of 12 years. They are broadcast spawners and have a high trophic level (Froese and Pauly 2013). We have therefore awarded a medium vulnerability level.

### **Factor 2.2 - Abundance**

THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

### **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 (SB2011/SBMSY) was 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 2.3 - Fishing Mortality**

THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

#### **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 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.

### **Factor 2.4 - Discard Rate**

THAILAND/INDIAN OCEAN, UNASSOCIATED PURSE SEINE (NON-FAD), THAILAND

#### **< 20%**

Purse seine fisheries have an average discard rate of 5% (Kelleher 2005).