



# Monterey Bay Aquarium Seafood Watch®

Bigeye tuna, Skipjack tuna, Yellowfin tuna

*Thunnus obesus*, *Katsuwonus pelamis*, and *Thunnus albacares*



Image © Monterey Bay Aquarium

## Western Central Pacific Ocean

Handline, Troll/Pole

August 17, 2015

Alexia Morgan, 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.

## **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 wild-catch 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 the Safina Center's 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.

---

<sup>1</sup> "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates.

## Summary

Bigeye, skipjack and yellowfin tuna are caught in a number of fisheries throughout the world, including the Western and Central Pacific Ocean (WCPO). This report focuses on the troll, handline, and pole fisheries for these species in the WCPO. Bigeye tuna is considered one of the main target species in the troll/pole fishery. The catch of bigeye catch in the handline fishery is much lower, so bigeye is not considered a main target species in that fishery. This report considers the yellowfin tuna handline fishery to be separate from the troll/pole fishery. Yellowfin tuna handline fisheries primarily occur in the Philippines and Indonesia. The use of kites to target yellowfin tuna also occurs in regions of Indonesia (e.g., central Maluku).

Skipjack and yellowfin tuna populations are healthy in the WCPO but bigeye tuna are overfished and overfishing is occurring. The troll, handline, and pole fisheries make up a smaller portion of the bigeye and yellowfin tuna catches compared to that of skipjack tuna. Troll, handline, and pole fisheries have a low amount of bycatch associated with them, and interactions with species of concern (e.g., marine mammals, sea birds, and sea turtles) are not often reported. In addition, troll, handline, and pole fisheries have a minimal impact on the bottom habitat.

The Western and Central Pacific Fisheries Commission (WCPFC) manages these species in the WCPO.

Due to the status of bigeye tuna in this region, the recommendation for the troll/pole fishery is “Good Alternative,” while the recommendation for the handline fishery is “Best Choice.”

### **Table of Conservation Concerns and Overall Recommendations**

Stock / Fishery	Impacts on the Stock	Impacts on other Spp.	Management	Habitat and Ecosystem	Overall Recommendation
Yellowfin tuna Western Central Pacific - Troll/Pole	Green (5.00)	Red (1.41)	Yellow (3.00)	Green (3.87)	<b>Good Alternative (3.011)</b>
Bigeye tuna Western Central Pacific - Troll/Pole	Red (1.41)	Green (5.00)	Yellow (3.00)	Green (3.87)	<b>Good Alternative (3.011)</b>
Skipjack tuna Western Central Pacific - Troll/Pole	Green (5.00)	Red (1.41)	Yellow (3.00)	Green (3.87)	<b>Good Alternative (3.011)</b>
Yellowfin tuna Western Central Pacific - Handline	Green (5.00)	Green (3.32)	Yellow (3.00)	Green (3.87)	<b>Best Choice (3.726)</b>

### 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.

---

<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).

## **Table of Contents**

About Seafood Watch® .....	2
Guiding Principles .....	3
Assessment .....	13
Criterion 1: Stock for which you want a recommendation.....	13
Criterion 2: Impacts on Other Species .....	22
Criterion 3: Management effectiveness .....	26
Criterion 4: Impacts on the habitat and ecosystem.....	35
Acknowledgements.....	38
References .....	39

## **Introduction**

### **Scope of the analysis and ensuing recommendation**

This report covers the troll, handline (a single line fished by hand), and pole and line (hooked line attached to a pole) fisheries operating in the Western and Central Pacific Ocean for bigeye tuna (*Thunnus obesus*), skipjack tuna (*Katsuwonus pelamis*), and yellowfin tuna (*Thunnus albacares*). The yellowfin tuna handline fishery operates primarily in the Philippines and Indonesia, and it is considered a separate fishery within this report. Kite fishing (a kite with a drop line attached to a hook and bait that is fished on the surface) is also used in certain regions of Indonesia (e.g., central Maluku) to target yellowfin tuna.

### **Overview of the species and management bodies**

Bigeye, skipjack, and yellowfin tuna are found in tropical and subtropical waters of the Pacific Ocean (Harley et al. 2014) (Rice et al. 2014) (Langely et al. 2011). There are four populations of bigeye and yellowfin and five of skipjack: Western and Central Pacific Ocean, Eastern Pacific Ocean, Atlantic (eastern and western skipjack), and Indian Ocean.

Globally, purse seines capture the majority of skipjack and yellowfin tuna while longlines capture the majority of bigeye tuna. Bigeye, skipjack, and yellowfin tuna catches have all increased substantially over time and peaked in the early 2000s for bigeye and yellowfin tuna and around 2009 for skipjack tuna (ISSF 2013b).

The Western and Central Pacific Fisheries Commission (WCPFC) manages these three species within the Western and Central Pacific Ocean.

### **Production Statistics**

Troll and pole fisheries do not represent a major proportion of the total catch of tunas in the Western and Central Pacific Ocean (WCPO). For example, troll and pole fisheries catch only a small amount of bigeye tuna in the WCPO. The equatorial region of the WCPO is where most of the troll fishing for bigeye tuna occurs. Surface gears (such as trols) target and capture juveniles but have mostly had only a minor impact on bigeye tuna populations. The two main gear types that catch bigeye tuna in this region are longline (50%) and purse seine (43%), with “other” and pole and line fisheries capturing the remaining 7% or around 11,156 t during 2011 (ISSF 2013b). Total catches of bigeye tuna in the WCPO have increased over time, peaking in the mid-2000s at just under 200,000 mt. Longline catches of bigeye tuna in the WCPO ranged from 44,000 t to 62,000 t between 1980 and 1993, and since 2004 have ranged from 67,000 t to 77,000 t (Davies et al. 2014).

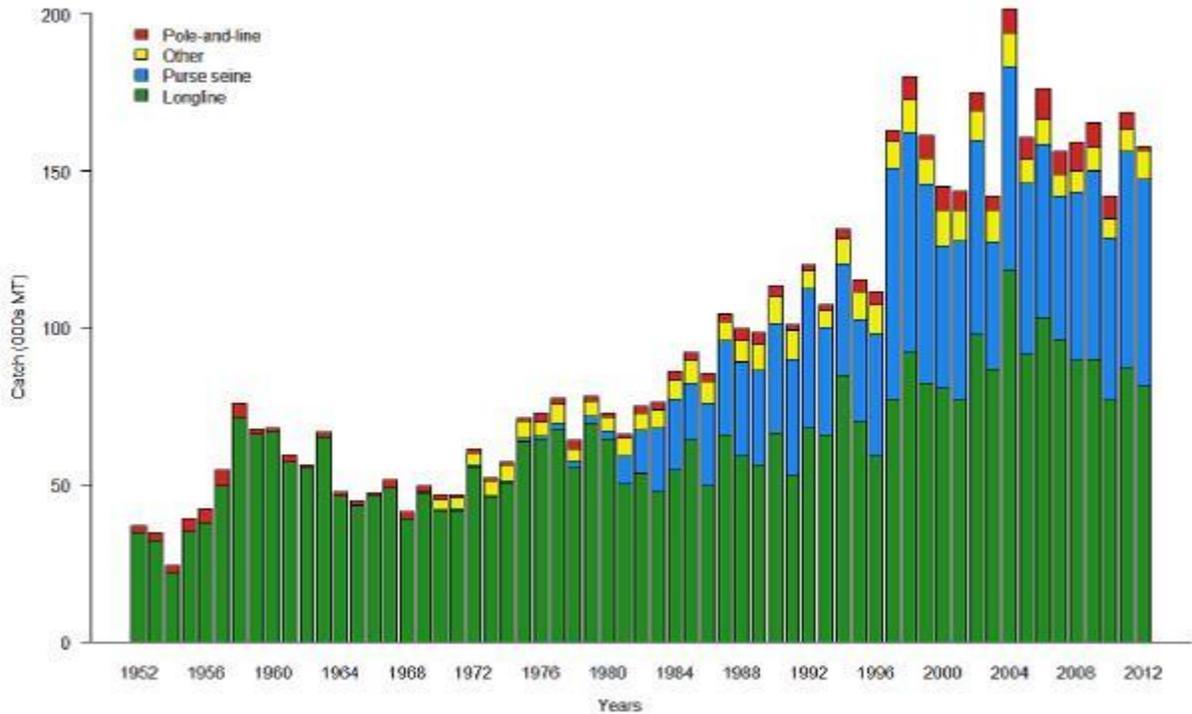


Figure 1. Total annual catch (1000s mt) of bigeye tuna from the WCPO by fishing method from 1952–2012 (Harley et al. 2014)

Skipjack tuna caught in the WCPO represent 36% of global tuna landings (ISSF 2013b). Pole and line fisheries historically dominated the catches of skipjack tuna, which peaked at 380,000 t in 1984. Japan's distant-water and offshore pole and line fisheries and its domestic pole and line fisheries are some of the primary pole and line fisheries for skipjack tuna in the region. Catches of skipjack tuna in the WCPO have increased over time, reaching 1.6 million t in 2009. The importance of the pole and line fisheries has diminished in recent times as the purse seine fleet has expanded in size (Rice et al. 2014).

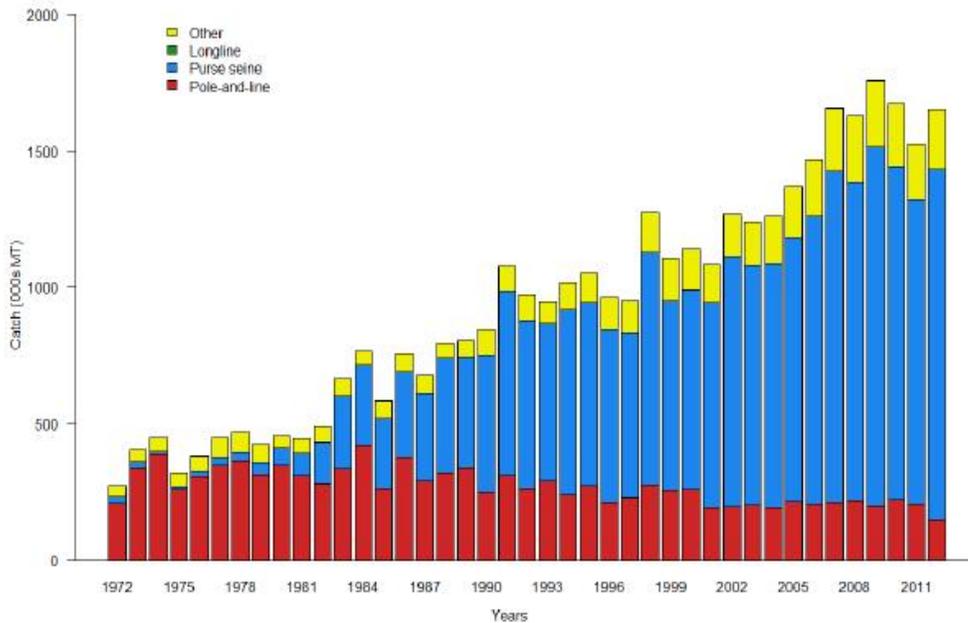


Figure 2. Skipjack catches, 1972–2012, in the WCPO by fishing gear (Rice et al. 2014).

Yellowfin tuna are caught by a range of gears, including troll/pole and line. Total catches of yellowfin tuna in the WCPO have increased from less than 50,000 t during the mid 1950s to over 600,000 t in 2012 (Davies et al. 2014b). Between 2005 and 2008, only 18% of yellowfin tuna catches were made by a variety of surface gears including pole and line. Catches from the Japanese distant-water pole and line fishery and from the Solomon Islands and Papua New Guinea pole and line fisheries peaked at around 8,000 t in the late 1970s to early 1980s but have been insignificant since 2000. Catches by the Japanese coastal surface fishery peaked in the mid-1980s at 15,000 t, but in recent years catches have only been around 5,000 t (Davies et al. 2014b).

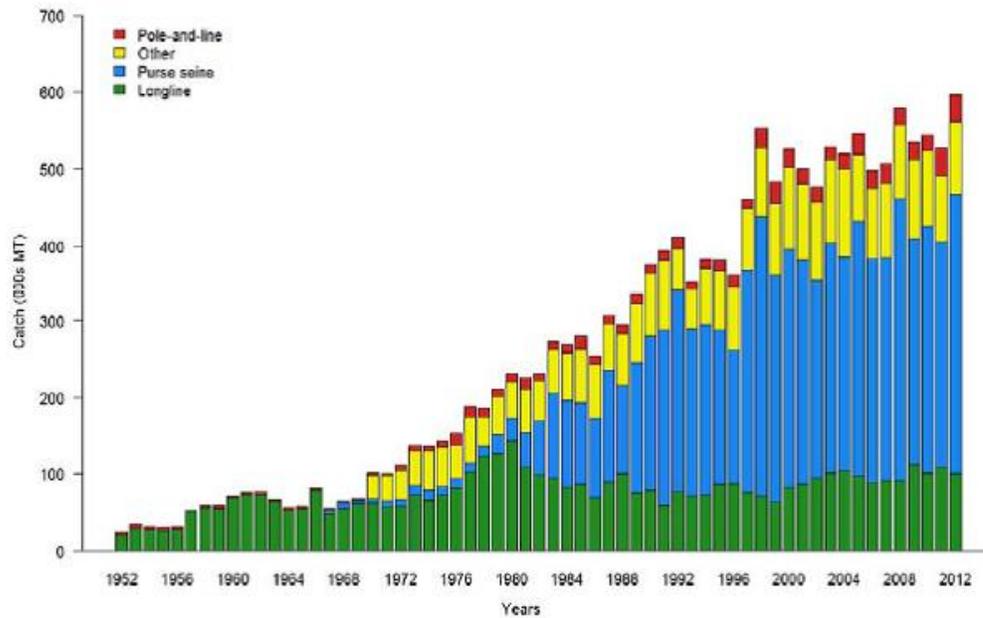


Figure 3. Annual catches (1000 t) of yellowfin tuna in the WCPO from 1952–2012 by fishing gear (Davies et al. 2014)

### Importance to the U.S./North American market

The United States imported around 19% of its bigeye tuna from Ecuador, 16% from the Marshall Islands, and 14% from Sri Lanka during 2013. The United States imported over half of its skipjack tuna from Panama (55%) during 2013. Other important countries included the Philippines (15%) and Mexico (13%). The majority of yellowfin tuna for the United States were imported from Trinidad and Tobago in 2013 (49%) (NMFS 2014).

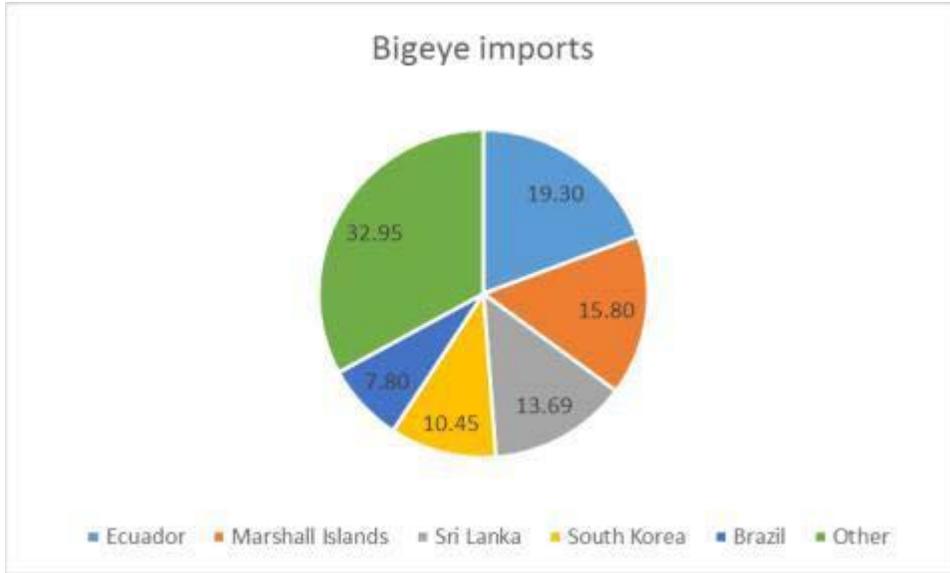


Figure 4. Major contributors to U.S. bigeye tuna imports (%) from all countries and regions (country of origin) (NMFS 2014)

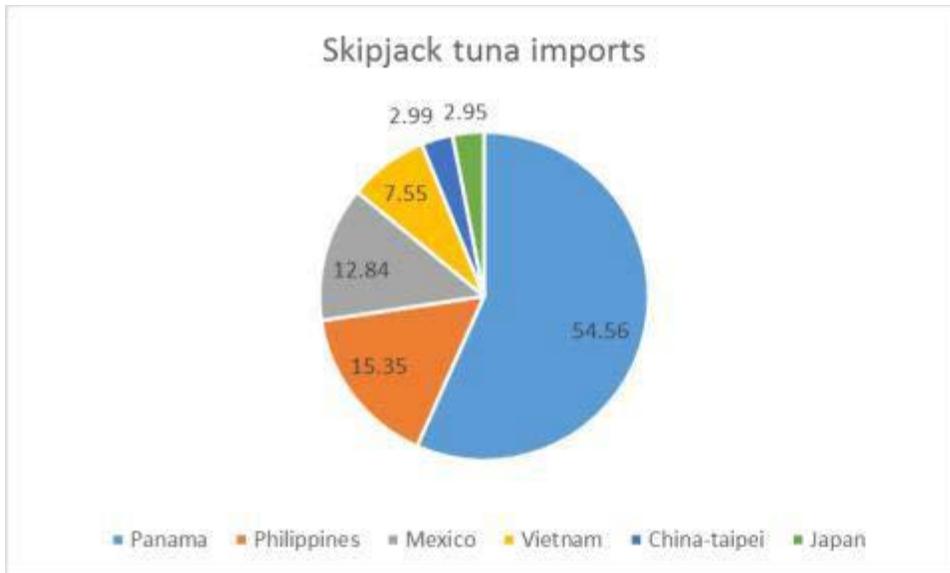


Figure 5. Major contributors to US skipjack tuna imports (%) from all countries and regions (country of origin) (NMFS 2014)

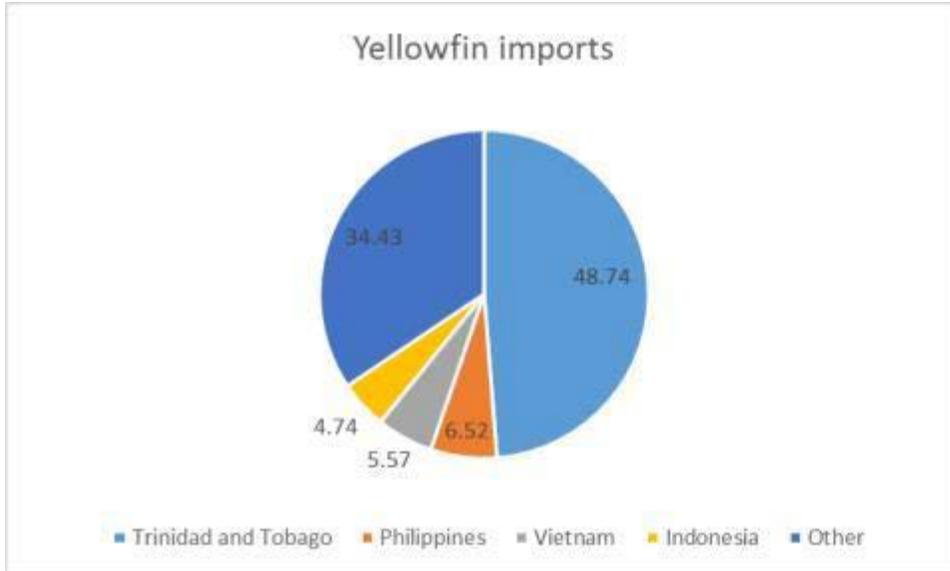


Figure 6. Major contributors to U.S. yellowfin tuna imports (%) from all countries and regions (country of origin) (NMFS 2014)

Around 200 t of bigeye and skipjack and 300 t of yellowfin were exported in 2011. Exports of bigeye tuna and yellowfin tuna were higher in 2012 (679 t and 843 t, respectively). Skipjack tuna exports during 2012 were 339 t (NMFS 2013).

### Common and market names

Skipjack tuna is also known as ocean bonito and lesser tuna, and in Hawaii as aku. Bigeye is known as big eye and bigeye, and yellowfin tuna are known as ahi in Hawaii.

### Primary product forms

Bigeye, skipjack, and yellowfin tuna are primarily sold as fresh and frozen products, and skipjack and yellowfin may also be canned.

## 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: Stock for which you want a recommendation

*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

BIGEYE TUNA				
Region / Method	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
Western Central Pacific Troll/Pole	2.00:Medium	2.00:High Concern	1.00:High Concern	<b>Red (1.414)</b>

SKIPJACK TUNA				
Region / Method	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
Western Central Pacific Troll/Pole	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	<b>Green (5.000)</b>

YELLOWFIN TUNA				
Region / Method	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
Western Central Pacific Handline	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	<b>Green (5.000)</b>
Western Central Pacific Troll/Pole	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	<b>Green (5.000)</b>

Skipjack and yellowfin tuna have healthy populations in the Western and Central Pacific Ocean and low fishing mortality rates. However, bigeye tuna are overfished and overfishing is currently occurring. The

troll/pole fisheries make up a smaller portion of bigeye and yellowfin tuna catches than of skipjack tuna catches.

## Criterion 1 Assessment

### **BIGEYE TUNA**

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

##### *Scoring Guidelines*

- *Low—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing (*
- *Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor resilient to fishing, (e.g., moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain).*
- *High—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator).*

*Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

#### **Western Central Pacific, Troll/Pole**

##### **Medium**

FishBase assigned a high to very high vulnerability of 72 out of 100 (Froese and Pauly 2013). However, bigeye tuna's life-history characteristics suggest a medium vulnerability to fishing. For example, bigeye tuna reaches sexual maturity at around 100–125 cm, reaches a maximum length of 200 cm, and lives around 11 years (Davies et al. 2014) (Froese et al. 2013). It is a broadcast spawner and top predator (Froese and Pauly 2013). Based on the Seafood Watch productivity analysis table, these life-history characteristics suggest a medium level of vulnerability according to the SWAT productivity and susceptibility table (inherent vulnerability = 2). We acknowledge that other methods may suggest a different vulnerability rating. But the stock status of bigeye tuna is known, so this inherent vulnerability score will not affect the overall outcome. Thus, this factor is awarded a “medium” vulnerability based on the productivity table analysis.

**Rationale:**

Life history attribute	Value	PSA score
Average maximum age	10–25 years	2
Average maximum size	100–300 cm	2
Average size at maturity	40–200 cm	2
Reproductive strategy	Broadcast spawner	3
Trophic level	>3.25	1

**Factor 1.2 - Stock Status***Scoring Guidelines*

- *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.*

**Western Central Pacific, Troll/Pole****High Concern**

Bigeye tuna in the Western and Central Pacific Ocean (WCPO) were last assessed in 2014. According to the base case model, the ratio of the current (2008–2011) average spawning biomass to that needed to produce the maximum sustainable yield ( $SB_{\text{current}}/SB_{\text{MSY}}$ ) was 0.94, and the ratio of the latest (2012) spawning biomass (mature fish) to that needed to produce the maximum sustainable yield ( $SB_{\text{latest}}/SB_{\text{MSY}}$ ) was 0.77, indicating that the population is overfished (Harley et al. 2014). We have therefore awarded a “high” concern score.

**Factor 1.3 - Fishing Mortality***Scoring Guidelines*

- *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.*

#### Western Central Pacific, Troll/Pole

##### High Concern

The ratios of current fishing mortality rates to those that produce the maximum sustainable yield ( $F_{\text{current}}/F_{\text{MSY}}$ ) for all model runs were much higher than 1, with the ratio from all runs estimated at 1.57, indicating that overfishing is occurring. Based on this estimate, fishing mortality needs to be reduced by more than 30% from 2008–2011 levels to become sustainable (Harley et al. 2014), so we have awarded a “high” concern score.

## **SKIPJACK TUNA**

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

#### *Scoring Guidelines*

- *Low—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing (*
- *Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor resilient to fishing, (e.g., moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain).*
- *High—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator).*

*Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

#### Western Central Pacific, Troll/Pole

##### Medium

FishBase assigned a moderate vulnerability of 39 out of 100 (Froese and Pauly 2013). The life-history characteristics support this score. Sexual maturity is reached around 45 cm or 2 years of age, and skipjack can reach a maximum length of 110 cm and age of 12. It is a broadcast spawner and has a high trophic level (Froese and Pauly 2013). According to the SWAT productivity and susceptibility table, these life-history characteristics suggest a moderate level (2.16) level of vulnerability.

##### Rationale:

Life history attribute	Value	PSA score
Average maximum age	10–25 years	2
Average age at maturity	>5 years	3
Average maximum size	100–300 cm	2
Average size at maturity	40–200 cm	2
Reproductive strategy	Broadcast spawner	3
Trophic level	>3.25	1

#### Factor 1.2 - Stock Status

##### Scoring Guidelines

- *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.*

#### Western Central Pacific, Troll/Pole

### Very Low Concern

Skipjack tuna in the Western and Central Pacific Ocean (WCPO) were last assessed in 2014. According to the assessment, the total biomass has been higher than the reference point ( $B_{MSY}$ , the biomass needed to produce the maximum sustainable yield) over the entire period (1972–2010). The current total biomass is around 52% of virgin levels ( $B_0$ ) and the ratio of the current spawning biomass to that needed to produce the maximum sustainable yield is well above 1 ( $SB_{current}/SB_{MSY} = 1.94$ ) (Rice et al. 2014). Therefore, skipjack tuna is not overfished and is above target levels. We have awarded a “very low” concern score.

### Factor 1.3 - Fishing Mortality

#### Scoring Guidelines

- *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.*

#### Western Central Pacific, Troll/Pole

### Very Low Concern

The current level of exploitation of skipjack tuna is below that needed to provide the maximum sustainable yield (MSY). Although fishing mortality rates have been increasing over time, the current fishing mortality rate is below that needed to produce MSY ( $F_{current}/F_{MSY} = 0.62$ ) (Rice et al. 2014). Therefore, overfishing of skipjack tuna is not occurring. We have awarded a “very low” concern score.

## **YELLOWFIN TUNA**

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

#### *Scoring Guidelines*

- *Low—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing (*
- *Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor resilient to fishing, (e.g., moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain).*
- *High—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator).*

*Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

#### **Western Central Pacific, Handline**

#### **Western Central Pacific, Troll/Pole**

#### **Medium**

FishBase assigned a moderate to high vulnerability of 46 out of 100 (Froese and Pauly 2013). The life-history characteristics support a moderate vulnerability score. Yellowfin tuna reaches sexual maturity by 100 cm in length (although growth rates vary by location), and 2–3 years of age (Itano 2000). It can attain a maximum length of 180 cm and live to at least 4 and perhaps 9 years. It is a broadcast spawner and an important predator in the ecosystem (Davies et al. 2014) (Froese and Pauly 2013). These life-history characteristics suggest a moderate level of vulnerability (2.33), according to the SWAT productivity and susceptibility analysis.

#### **Rationale:**

Life history attribute	Value	PSA score
Average maximum age	<10 years	3
Average age at maturity	<5 years	3
Average maximum size	100–300 cm	2
Average size at maturity	40–200 cm	2

Reproductive strategy	Broadcast spawner	3
Trophic level	>3.25	1

## Factor 1.2 - Stock Status

### Scoring Guidelines

- *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.*

### Western Central Pacific, Handline

### Western Central Pacific, Troll/Pole

#### Very Low Concern

The ratio of the current (2008–2011) spawning (mature fish) biomass to that needed to produce the maximum sustainable yield ( $SB_{\text{current}}/SB_{\text{MSY}}$ ) was 1.37. The ratio of the latest (2012) spawning biomass to the level needed to produce the maximum sustainable yield ( $SB_{\text{latest}}/SB_{\text{MSY}}$ ) was 1.24. Therefore, yellowfin tuna is not overfished (Davies et al. 2014b). We have awarded a “very low” concern score.

## Factor 1.3 - Fishing Mortality

### Scoring Guidelines

- *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.*

#### **Western Central Pacific, Handline**

#### **Western Central Pacific, Troll/Pole**

#### **Very Low Concern**

The current fishing mortality rate is estimated to be below the levels needed to produce the maximum sustainable yield ( $F_{\text{current}}/F_{\text{MSY}} = 0.72$ ) for the most realistic models, although there is some uncertainty surrounding these results. But overfishing is not occurring (Davies et al. 2014), so we have awarded a “very low” concern score.

## **Criterion 2: Impacts on Other Species**

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

<b>Bigeye tuna: Western Central Pacific, Troll/Pole</b>					
<b>Subscore::</b>	<b>5.000</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>5.000</b>
Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore	
<b>BIGEYE TUNA</b>	Medium	2.00: High Concern	1.00: High Concern	<b>1.414</b>	
<b>SKIPJACK TUNA</b>	Medium	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>	
<b>YELLOWFIN TUNA</b>	Medium	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>	

<b>Skipjack tuna: Western Central Pacific, Troll/Pole</b>					
<b>Subscore::</b>	<b>1.414</b>	<b>Discard Rate:</b>	<b>1.00</b>	<b>C2 Rate:</b>	<b>1.414</b>
Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore	
<b>BIGEYE TUNA</b>	Medium	2.00: High Concern	1.00: High Concern	<b>1.414</b>	
<b>SKIPJACK TUNA</b>	Medium	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>	
<b>YELLOWFIN TUNA</b>	Medium	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>	

**Yellowfin tuna: Western Central Pacific, Handline**

**Subscore:: 3.318      Discard Rate: 1.00      C2 Rate: 3.318**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
FINFISH	Medium	3.00: Moderate Concern	3.67: Low Concern	<b>3.318</b>
<b>YELLOWFIN TUNA</b>	Medium	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>

**Yellowfin tuna: Western Central Pacific, Troll/Pole**

**Subscore:: 1.414      Discard Rate: 1.00      C2 Rate: 1.414**

Species	Inherent Vulnerability	Stock Status	Fishing Mortality	Subscore
BIGEYE TUNA	Medium	2.00: High Concern	1.00: High Concern	<b>1.414</b>
SKIPJACK TUNA	Medium	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>
<b>YELLOWFIN TUNA</b>	Medium	5.00: Very Low Concern	5.00: Very Low Concern	<b>5.000</b>

Bycatch in troll and pole fisheries is generally very low (Kelleher 2005). Bycatch may consist of other tunas, billfish, other fish, and sharks, but not in large amounts (i.e., 5% or more of the total catch for an individual species). Although baitfish are used in this fishery, 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). For these reasons, baitfish species are not included in this report; we have included only the three target species: bigeye, skipjack, and yellowfin tuna. Although a small percentage of the catch is bigeye, this fishery accounts for over 5% of the total mortality of bigeye tuna throughout the WCPO, and this level is considered sufficient for inclusion as a “main species.”

The yellowfin handline fishery targets only yellowfin tuna, and bycatch of bigeye and skipjack tuna is less than 5% of the total catch. Other small tuna species and billfish may be caught in this fishery, but individual species do not make up 5% or more of the total catch. Handline catches of bigeye tuna in the WCPO make up less than 1% of the total catch of bigeye in the region (WCPFC 2014). We have therefore assessed only yellowfin in the yellowfin targeted handline fishery.

## Criterion 2 Assessment

### **FINFISH**

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

*Scoring Guidelines (same as Factor 1.1 above)*

**Western Central Pacific, Handline**

#### **Medium**

Finfish have a moderate vulnerability to fishing (SFW 2013).

#### **Factor 2.2 - Stock Status**

*Scoring Guidelines (same as Factor 1.2 above)*

**Western Central Pacific, Handline**

#### **Moderate Concern**

Handline fisheries that target yellowfin tuna also capture several small tuna species, such as bullet and kawakawa. We have awarded a “moderate” concern score based on the Seafood Watch unknown bycatch matrix for finfish species (SFW 2013).

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

*Scoring Guidelines (same as Factor 1.3 above)*

**Western Central Pacific, Handline**

#### **Low Concern**

According to the Seafood Watch unknown bycatch matrix, finfish score a “low” concern for fishing mortality (SFW 2013).

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

**Western Central Pacific, Handline**

**< 20%**

The average discard rate in tuna pole and line fisheries is 0.1%, although slightly higher at 0.4% in the Western and Central Pacific Ocean (Kelleher 2005). Yellowfin targeted deep-set handline fisheries typically target large tuna, while other fisheries (e.g., skipjack pole and line) may target juvenile tunas (Davies 2014). Troll/pole and handline fisheries can depend heavily on the use of baitfish (some fisheries may use tuna and/or squid), which most often comes from other fisheries (Gillett 2012). However, the amount of tuna caught is much greater than the amount of baitfish used. The tuna to bait ratio is typically around 30:1, although this can vary by fishery due to differences in the baitfish used and in fishing technique (Gillett 2010). Therefore, we have left the score as <20%, our lowest score possible.

## **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**

Region / Method	Management of Retained Species	Management of Non-Retained Species	Overall Recommendation
Western Central Pacific Handline	3.000	All Species Retained	Yellow(3.000)
Western Central Pacific Troll/Pole	3.000	All Species Retained	Yellow(3.000)

### **Factor 3.1: Harvest Strategy**

#### Scoring Guidelines

*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
Western Central Pacific Handline	Moderately Effective	N/A	Moderately Effective				
Western Central Pacific Troll/Pole	Moderately Effective						

The United Nations Straddling and Highly Migratory Fish Stocks Agreement (1995) indicated that the management of straddling and highly migratory fish stocks should be carried out through Regional Fisheries Management Organizations (RFMOs). RFMOs are the only legally mandated fishery management body on the high seas and within EEZ waters. There are currently 18 RFMOs ([www.fao.org](http://www.fao.org)) that cover nearly all the world’s waters. Member countries must abide by the management measures set forth by individual RFMOs in order to fish in their waters (Cullis-Suzuki and Pauly 2010). Some RFMOs manage all marine living resources within their authority (e.g., General Fisheries Commission for the Mediterranean (GFCM)), while others manage a group of species such as tunas (e.g., Inter-American Tropical Tuna Commission (IATTC)).

This report focuses on troll/pole and handline fisheries targeting tunas within the Western and Central Pacific Ocean (WCPO). The RFMO in charge in this region is the Western and Central Pacific Fisheries Commission (WCPFC) (see below for member countries). Management of bigeye, skipjack, and yellowfin tunas by the WCPFC has been moderately effective. Recent management measures have been put in place for overfished bigeye tuna but so far have not been successful. In addition, scientific advice is not always followed and there is no proven track record for successful enforcement of enacted measures.

WCPFC members: Australia, China, Canada, Cook Islands, European Union, Federated States of Micronesia, Fiji, France, Indonesia, Japan, Kiribati, Republic of Korea, Republic of Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Philippines, Samoa, Solomon Islands, Chinese Taipei, Tonga, Tuvalu, United States of America, and Vanuatu.

### **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.*

#### **Western Central Pacific, Handline**

#### **Western Central Pacific, Troll/Pole**

#### **Moderately Effective**

In fisheries other than longline and purse seine, such as the troll/pole, members of the Western and Central Pacific Fisheries Commission (WCPFC) must keep total effort in their tuna fisheries below the average level from 2001–2004 or in 2004 (WCPFC 2012a) (WCPFC 2014b). Biomass-based limit reference points have been adopted by the WCPFC for bigeye, yellowfin, and skipjack tuna and are used to determine the status of tuna populations, but there are no harvest control rules. Target reference points are not yet in place for these species, except for bigeye tuna (in the short term), although the WCPFC has a working group that is developing reference points for other species (WCPFC 2013b). In contrast to the Inter-American Tropical Tuna Commission (IATTC), which has been much more proactive in using interim target and limit reference points and currently has an interim harvest control rule in place for tropical tunas and albacore, the WCPFC has no type of harvest control rule in place and does not have interim target reference points for all species. We have awarded a “moderately effective” score based on the current management scheme.

### **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.*

#### **Western Central Pacific, Handline**

#### **N/A**

Yellowfin tuna is not overfished and therefore not in need of a recovery plan. We have therefore awarded a score of N/A.

### Western Central Pacific, Troll/Pole

#### **Moderately Effective**

Most species targeted in the fishery are not overfished. Bigeye tuna are classified as overfished in the most recent stock assessment and are experiencing overfishing; management measures have been ineffective at reducing bigeye fishing mortality rates (Harley et al. 2014). But the majority of bigeye tuna are caught in the associated fishery and the longline fishery. In addition, bigeye tuna have only recently been classified as overfished and it is too early to determine if the fishery will be able to recover the population in a timely manner. We have therefore awarded a “moderately effective” score.

### **Subfactor 3.1.3 – Scientific Research and Monitoring**

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

### Western Central Pacific, Handline

### Western Central Pacific, Troll/Pole

#### **Moderately Effective**

Bigeye, yellowfin, and skipjack tuna stocks are regularly monitored and assessed (Harley et al. 2014) (Rice et al. 2014) (Davies et al. 2014). A variety of information including catch and effort data, size (for some species) and biological information is included in these assessments. But there are cited issues with regard to some countries’ compliance with collecting and providing this data to the Commission. This non-compliance can lead to great degrees of uncertainty in these assessments (Davies et al. 2014) Other species that are not regularly assessed are not typical bycatch species in this fishery. We have awarded a “moderately effective” score due to the large uncertainty surrounding some assessment results.

### **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.*

### Western Central Pacific, Handline

### Western Central Pacific, Troll/Pole

#### **Moderately Effective**

The last bigeye, skipjack, and yellowfin tuna assessments recommended ways to improve the current statistical model used and identified needs for data improvement but did not identify specific management measures (Davies et al. 2014) (Davis et al. 2011) (Rice et al. 2014) (Davies et al. 2014). Based on the assessment results, bigeye fishing mortality levels need to be 36% less than the 2008–2011 level in order to be sustainable. The Scientific Committee noted that spatial management could be utilized for yellowfin tuna and that catches should not be increased from 2012 levels (WCPFC 2014b). In addition, reducing the fishing mortality on juveniles would increase the overall yield (Harley et al. 2014). The Scientific Committee did recommend in 2009 that the Commission consider fishing limits for skipjack (Rice et al. 2014). The Commission does recognize that fishing mortality needs to be reduced to improve the status of bigeye and yellowfin tuna in this region (WCPFC 2012). The Commission has recently prohibited discarding of these species but there are not catch limits for either species in this fishery. The 2014 Commission meeting had not occurred at the time of this report, so it is unknown if additional management measures are to be adopted based on the updated 2014 stock assessments. We have therefore awarded a “moderately effective” score.

### **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.*

### Western Central Pacific, Handline

### Western Central Pacific, Troll/Pole

#### **Moderately Effective**

The Western and Central Pacific Fisheries Commission (WCPFC) has a compliance monitoring scheme in place that assesses members’ compliance with obligations, identifies areas of conservation and management that may need refinement, responds to non-compliance, and monitors and resolves non-compliance issues. The Commission annually evaluates compliance by members with respect to catch and effort limits and reporting for target species, spatial and temporal closures, observer and Vessel Monitoring Systems (VMS) coverage, and provision of scientific data (WCPFC 2012a).

Vessel Monitoring Systems are required on all vessels fishing for highly migratory species in the Western and Central Pacific Ocean south of 20°N and east of 175°E. The area north of 20°N and west of 175°E had a VMS activation date of December 31, 2013 (WCPFC 2012c). There are measures in place allowing for the boarding and inspection of vessels in the Convention Area (WCPFC 2006), and the WCPFC

maintains a list of illegal, unreported, and unregulated vessels (IUU) (WCPFC 2010a). But assessing the effectiveness of these enforcement measures is difficult because there is a general lack of transparency of information with regard to surveillance activities, infractions, and enforcement actions and outcomes (Gilman et al. 2013).

A recent study, which developed a standard way of assessing transparency in RFMOs, found the WCPFC had a lack of transparency with regard to the availability of compliance-related data, a lack of incentive for countries to comply with management measures, and lacked the processes needed to respond to non-compliance (Gilman and Kingma 2013). Koehler (2013) also found both the WCPFC and IATTC to be ineffective with regard to compliance transparency; specifically, the WCPFC's compliance assessment process (there is a compliance monitoring scheme in place (WCPFC 2013d)) is closed to the public and it does not have ways of dealing with non-compliance, while the IATTC does not appear to deal with compliance issues in a thorough manner. In 2013 the Commission finally started releasing some information on the compliance of individual nations (WCPFC 2013g).

### **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.*

#### **Western Central Pacific, Handline**

##### **Moderately Effective**

Management appears to have allowed yellowfin tuna populations to remain healthy throughout most of the region, although fishing mortality rates have not been reduced (Davies et al. 2014) (WCPFC 2014b). We have therefore awarded a “moderately effective” score.

#### **Western Central Pacific, Troll/Pole**

##### **Moderately Effective**

Management measures enacted by the Western and Central Pacific Fisheries Commission (WCPFC) have shown mixed results in their ability to meet stock management objectives of principal market species (Gilman et al. 2013). In terms of bigeye tuna, the WCPFC has been unable to reduce fishing mortality rates to appropriate levels (Harley et al. 2014), and it is unclear if newly enacted management measures will be successful (WCPFC 2014b). We have therefore 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.*

#### Western Central Pacific, Handline

#### Western Central Pacific, Troll/Pole

##### **Moderately Effective**

The Western and Central Pacific Fisheries Commission allows for accredited observers to participate in most meetings. Historically, the WCPFC has lacked transparency (Gilman et. al. 2013) in some factors but this has improved in recent years (WCPFC 2013g). We have therefore awarded a “moderately effective” score.

## **Bycatch Strategy**

Factor 3.2: Management of fishing impacts on bycatch species						
Region / Method	All Kept	Critical	Strategy	Research	Advice	Enforce
Western Central Pacific Handline	Yes					
Western Central Pacific Troll/Pole	Yes	No	Highly Effective	Moderately Effective	Moderately Effective	Moderately Effective

### **Subfactor 3.2.1 – 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.).*

#### Western Central Pacific, Troll/Pole

##### **Highly Effective**

Bycatch in troll/pole fisheries is extremely low.

### **Subfactor 3.2.2 – 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.*

#### **Western Central Pacific, Troll/Pole**

##### **Moderately Effective**

CCMs (WCPFC members, cooperating nonmembers, and participating territories) were to achieve 5% observer coverage in each fishery by June 30, 2012 (WCPFC 2007). This monitoring level is very low, so data collection protocols are considered deficient (Gilman et al. 2013).

### **Subfactor 3.2.3 – 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.*

#### **Western Central Pacific, Troll/Pole**

##### **Moderately Effective**

An analysis of all RFMOs found that management on the high seas is inadequate throughout. Although the WCPFC scored the highest (74% out of 100%) in theoretical performance, its score for performance in practice was much lower at 66.7%. The high theoretical performance score may reflect this newer RFMO's ability to conform to more recent conservation measures (Cullis-Suzuki and Pauly 2010).

### **Subfactor 3.2.4 – 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.*

#### **Western Central Pacific, Troll/Pole**

##### **Moderately Effective**

The WCPFC has a compliance monitoring scheme in place to assess CCMs' compliance with obligations, identify areas of conservation and management that may need refinement, respond to non-compliance, and monitor and resolve non-compliance. The Commission annually evaluates compliance by CCMs with respect to catch and effort limits and reporting for target species, spatial and temporal closures, observer and Vessel Monitoring Systems (VMS) coverage, and provision of scientific data (WCPFC 2012b).

Vessel Monitoring Systems are required on all vessels fishing for highly migratory species in the Convention Area south of 20°N and east of 175°E. The area north of 20°N and west of 175°E will have a VMS activation date set at a later time (WCPFC 2012c).

The WCPFC maintains a list of illegal, unreported, and unregulated vessels (IUU) (WCPFC 2010).

There are measures in place allowing for the boarding and inspection of vessels in the Convention Area (WCPFC 2006).

Assessing the effectiveness of these enforcement measures is difficult because there is a general lack in the transparency of information with regard to surveillance activities, infractions, and enforcement actions and outcomes (Gilman et al. 2013).

## **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>Overall Recomm.</b>
<b>Western Central Pacific Handline</b>	5.00:None	0.00:Not Applicable	3.00:Moderate Concern	<b>Green (3.873)</b>
<b>Western Central Pacific Troll/Pole</b>	5.00:None	0.00:Not Applicable	3.00:Moderate Concern	<b>Green (3.873)</b>

Troll/pole gear does not typically come in contact with the bottom and therefore has a limited (if any) impact to bottom habitats.

### **Justification of Ranking**

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

##### *Scoring Guidelines*

- *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.*

#### **Western Central Pacific, Handline**

#### **Western Central Pacific, Troll/Pole**

#### **None**

Vertical gears rarely affect bottom habitats. Tuna are pelagic species, so troll, handline, and pole fisheries targeting tuna operate in deep water where bottom contact is not likely.

### **Factor 4.2 – Mitigation of Gear Impacts**

#### *Scoring Guidelines*

- *+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.*

#### **Western Central Pacific, Handline**

#### **Western Central Pacific, Troll/Pole**

#### **Not Applicable**

### Factor 4.3 – Ecosystem-Based Fisheries Management

#### Scoring Guidelines

- *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.*

#### Western Central Pacific, Handline

#### Western Central Pacific, Troll/Pole

##### **Moderate Concern**

One of the core articles of the WCPFC Convention is to assess the impacts of fishing on target and non-target species. Management measures are in place to protect bycatch and target species, ecological risk assessments are being conducted, and there is an Ecosystem Monitoring and Analysis section within the Secretariat of the Pacific Community, which provides scientific assistance to the WCPFC (SPC 2010). But troll, handline, and pole fisheries rely on live baitfish, which could include “exceptional species” such as anchovy or sardines. The effect of the removal of these species on the ecosystem is unknown, and few baitfish fisheries are managed (Gillet 2012) (FAO 2014). In addition, tuna are considered “exceptional species,” so we have only awarded a “moderately effective” score.

## **Acknowledgements**

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

Seafood Watch® would like to thank three anonymous reviewers for graciously reviewing this report for scientific accuracy.

## **References**

- Cheung, W.W.L., T.J. Pitcher and D. Pauly, 2005. A fuzzy logic expert system to estimate intrinsic extinction vulnerabilities of marine fishes to fishing. *Biol. Conserv.* 124:97-111.
- Cullis-Suzuki, S. and Pauly, D. 2010. Failing the high seas: a global evaluation of regional fisheries management organizations. *Marine Policy* 34:1036-1042
- Davies, N., Harley, S., Hampton, J. and McKechnie, S. 2014. Stock assessment of yellowfin tuna in the Western and Central Pacific Ocean. WCPFC-SC10-2014/SA-WP-04.
- FAO. 2014. Fishing techniques tuna pole and line fishing. FAO Fisheries and Aquaculture Department.
- Gillett, R. 2012. Report of the 2012 ISSF Workshop: the management of tuna bait fisheries: The results of a global study. ISSF Technical Report 2012-08. International Seafood Sustainability Foundation, Washington, D.C.
- Gillett, R. 2010. Replacing purse seining with pole and line fishing in the Western Pacific: some aspects of the baitfish requirements. Gillett, Preston and Associates Inc. for the ISSF.
- Gilman, E. and Kingma, E. 2013. Standard for assessing transparency in information on compliance with obligations of regional fisheries management organizations: validation through assessment of the Western and Central Pacific Fisheries Commission. *Ocean Coastal Management* 84:31-39.
- Gilman et al.. 2013. Gilman, E., Pasfield, K. and Nakamura, K. 2013. Performance of regional fisheries management organizations: ecosystem-based governance of bycatch and discards. *Fish and Fisheries* DOI:10.1111/faf.12021
- Harley, S., Davies, N. and Hampton, J. 2014. Stock assessment of bigeye tuna in the Western and Central Pacific Ocean. WCPFC-SC10-2014/SA-WP-01
- Ianelli, J., M. Maunder, and A. E. Punt. 2012. Independent peer review of 2011 WCPFC bigeye tuna stock assessment. WCPFC-SC8-2012/SA-WP-01. Available online <http://www.wcpfc.int/node/4587>.
- International Seafood Sustainability Foundation (ISSF). 2013b. ISSF stock status ratings 2013 status of the world fisheries for tuna. ISSF Technical Report 2013-4, April 2013
- International Seafood Sustainability Foundation (ISSF). 2013a. ISSF stock assessment workshop: control rules and reference points for tuna RFMOs. ISSF Technical Report 2013-03. International Seafood Sustainability Foundation, Washington, DC. 34 p.
- Itano, D.G. 2000. The Reproductive Biology of Yellowfin Tuna (*Thunnus albacares*) in Hawaiian Waters and the Western Tropical Pacific Ocean : Project Summary. SOEST 00-01 JIMAR Contribution 00-328 (Joint Institute of Marine and Atmospheric Research, University of Hawaii, Honolulu): 69pp.

Kelleher, K. 2005. Discards in the world's marine fisheries. An update. FAO Fisheries Technical Paper No. 470. Rome, FAO. 131 p.

Koehler, H.R., 2013. Promoting compliance in tuna RFMO's: a comprehensive baseline survey of the current mechanics of reviewing, assessing and addressing compliance with RFMO obligations and measures. ISSF Technical Report 2013-02.

MMAF. 2012d. Review of policy and legal arrangement of WCPFC related matters and checklist of compliance shortfalls. West Pacific East Asia Oceanic Fisheries Management. November 2012.

Rice, J., Harley, S., Davies, N. and Hampton, J. 2014. Stock assessment of skipjack tuna in the western and central Pacific Ocean. Scientific Committee Ninth Regular Session, Majuro, Republic of the Marshall Islands. WCPFC-SC10-2014/SA-WP-05.

Schindler, D.E., Essington, T.E., Kitchell, J.F., Boggs, C. and Hilborn, R. 2002. Sharks and tunas: fisheries impacts on predators with contrasting life histories. *Ecological Applications* 12:735-748.

Secretariat of the Pacific Community. 2010. Ecosystem monitoring and analysis. SPC Oceanic Fisheries Program.

Western and Central Pacific Fisheries Commission (WCPFC). 2014. Estimates of annual catches in the WCPFC statistical area. WCPFC-SC10-2014/ST IP-1.

Western and Central Pacific Fisheries Commission (WCPFC). 2014b. Conservation and management measure for bigeye, yellowfin and skipjack tuna in the Western and Central Pacific Ocean. Conservation and Management Measure 2014-01. Eleventh regular session, December 1-5, 2014, Apia, Samoa.

Western and Central Pacific Fisheries Commission (WCPFC). 2013b. WCPFC management objectives workshop 2. 28-29 November, 2013, Cairns, Australia.

Western and Central Pacific Fisheries Commission (WCPFC). 2013c Conservation and management measure for compliance monitoring scheme. Conservation and Management Measure 2013-02. Tenth Regular Session, 2-6 December 2013, Cairns, Australia.

Western and Central Pacific Fisheries Commission (WCPFC). 2013d. Commission for the Conservation and Management of highly migratory fish stocks in the Western and Central Pacific Ocean Summary Report. Scientific Committee Ninth Regular Session, 6-14 August, 2013, Federated States of Micronesia.

Western and Central Pacific Fisheries Commission (WCPFC). 2012a. Conservation and management measure for bigeye, yellowfin and skipjack tuna in the western and central Pacific Ocean. Conservation and Management Measure 2012-01. Commission Ninth Regular Session, Manila, Philippines, 2-6 December 2012.

Western and Central Pacific Fisheries Commission (WCPFC). 2012b. Conservation and management measure for compliance monitoring scheme. Conservation and Management Measure 2012-02. Commission Ninth Regular Session, Manila, Philippines, 2-6 December 2012.

Western and Central Pacific Fisheries Commission (WCPFC). 2012c. Commission vessel monitoring system. Conservation and Management Measure 2011-02. Commission Eighth Regular Session, Tumon, Guam, 26-30 March 2012.

Western and Central Pacific Fisheries Commission (WCPFC). 2010. Conservation and management measure to establish a list of vessels presumed to have carried out illegal, unreported and unregulated fishing activities in the WCPO. Conservation and Management Measure 2010-06. Seventh Regular Session, Honolulu, HI, 6-10 December 2010.

Western and Central Pacific Fisheries Commission. 2008. Conservation and management measure for bigeye and yellowfin tuna in the Western and Central Pacific Ocean. Conservation Management Measure 2008-01.

Western and Central Pacific Fisheries Commission (WCPFC). 2007. Conservation and management measure for the -regional observer programme. Conservation and Management Measure 200. Fourth Regular Session, Tumon, Guam, USA, 2-7 December 2007.

Western and Central Pacific Fisheries Commission (WCPFC). 2006. Western and central Pacific fisheries commission boarding and inspection procedures. Conservation and Management Measure 2006-08. Third Regular Session, Apia, Samoa, 11-15 December 2006.