Monterey Bay Aquarium

Seafood Watch®

Dolphinfish (Mahi mahi)

Coryphaena hippurus

Taiwan, Western Central Pacific

Pelagic longline

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About Seafood Watch

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

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

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling 1-877-229-9990.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] 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.

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

This report focuses on mahi mahi (Coryphaena hippurus) caught in the Taiwanese longline fishery. Mahi mahi is both targeted and caught as a secondary species in other targeted fisheries, such as tuna and shark. Mahi mahi targeted fisheries in Taiwan occur mainly during the spring (April through June), with a smaller fishery occurring in the fall (September through November).

Mahi mahi populations in the Pacific Ocean have not been assessed through a stock assessment process. In Taiwan, mahi mahi are typically caught by longline vessels targeting tuna (including bigeye and yellowfin tuna), but also in mixed longline targeted fisheries. Yellowfin tuna populations are fairly healthy but bigeye tuna are overfished and undergoing overfishing in the western and central Pacific Ocean. In addition to tuna, several shark, sea turtle, and seabird species are also incidentally captured. There are concerns over the status of these bycatch species throughout the Pacific Ocean.

The Fisheries Authority, Council of Agriculture is in charge of fisheries management in Taiwan. Taiwan is also a member of the western and central Pacific regional fishery management organization, the Western and Central Pacific Fisheries Commission. Management of mahi mahi by Taiwan is considered ineffective because there are no management measures in place. Management of bycatch species is also considered ineffective because there are measures in place for seabirds but management for sharks is still lacking.

Taiwan does not appear to have included ecological impacts in its management of large pelagic species.

This fishery targets mahi mahi in pelagic waters; therefore, there are no negative interactions with bottom habitat.

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
Dolphinfish (Mahi Mahi) Taiwan Western Central Pacific, Pelagic longline	Yellow (2.644)	Red (1.343)	Red (1.000)	Green (3.873)	**Avoid (1.925)**

Summary

Mahi mahi caught by Taiwan longline vessels 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 Concern2, 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.

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

Introduction

Scope of the analysis and ensuing recommendation

This report focuses on mahi mahi (Coryphaena hippurus) caught in pelagic longline fisheries operated by Taiwan. Longlines are the primary fishing gear used by Taiwanese fishers to target mahi mahi. Mahi mahi fisheries in Taiwan primarily operate in the spring months from April through June, with a second smaller fishery occurring from September through November (Chang et al. 2013).

Species Overview

Mahi mahi is a highly migratory species found worldwide in tropical and subtropical waters. Mahi mahi reaches sexual maturity around 2 years of age or 45 cm in length and produces a large number of young. It can attain a maximum size of 110 cm and live up to 12 years. Mahi mahi is typically found in pelagic habitats, where it forms schools, and is commonly found associated with floating objects. Mahi mahi is a top predator feeding on small fish and squid (Froese and Pauly 2015).

In Taiwan, the Fisheries Authority (FA), part of the Council of Agriculture (COA), is in charge of managing species such as mahi mahi.

Production Statistics

In Taiwan, mahi mahi are caught by several fishing gears including longline, set net, and gillnets. Taiwan reports that longliners, both distant and offshore fleets, capture the majority of mahi mahi. Mahi mahi are both targeted and caught as secondary species in tuna and shark targeted fisheries (Chang et al. 2013). The offshore fleet fishes in Taiwan's EEZ waters as well as international waters of the Pacific Ocean, while the distant water fleet fishes outside of Taiwan's EEZ, within international waters and other countries' EEZs (FA 2014c). The distant water longline fleet caught 6,127 MT in 2012, the last year that data were available, while the offshore fleet caught 4,060 MT. The total amount of mahi mahi captured by Taiwan in 2012 was 10,756 MT (COA 2012).

Importance to the US/North American market.

During 2014, the United States imported 26,467 t of mahi mahi. The largest portion (26%) came from Ecuador, followed by Chinese Taipei (21%) and Peru (21%). Another 1,595 t or 6% was imported from Panama (NMFS 2015).

Common and market names.

Mahi mahi is also known as dolphinfish.

Primary product forms

Mahi mahi are commonly sold in fresh and frozen forms.

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

DOLPHINFISH (MAHI MAHI)				
Region / Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
Taiwan/Western Central Pacific Pelagic longline	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.644)

Mahi mahi are a fast growing species of fish that reaches sexual maturity at a size of 20 cm, can llive up to 4 years of age and produces a large number of young. The status of mahi mahi in both the western and central Pacific Ocean (WCPO) is currently unknown as no stock wide assessment has been conducted.

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Inherent Vulnerability

- *Low—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing).*
- *Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor resilient to fishing, (e.g., moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain).*
- *High—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator). Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

Factor 1.2 - Abundance

- *5 (Very Low Concern)—Strong evidence exists that the population is above target abundance level (e.g., biomass at maximum sustainable yield, BMSY) or near virgin biomass.*
- *4 (Low Concern)—Population may be below target abundance level, but it is considered not overfished*
- *3 (Moderate Concern) —Abundance level is unknown and the species has a low or medium inherent*

vulnerability to fishing.

- *2 (High Concern)—Population is overfished, depleted, or a species of concern, OR abundance is unknown and the species has a high inherent vulnerability to fishing.*
- *1 (Very High Concern)—Population is listed as threatened or endangered.*

Factor 1.3 - Fishing Mortality

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

DOLPHINFISH (MAHI MAHI)

Factor 1.1 - Inherent Vulnerability

TAIWAN/WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Medium

FishBase assigned a moderate vulnerability of 39 out of 100 (Froese and Pauly 2013). Mahi mahi's life history characteristics support this score. Sexual maturity is reached around 45 cm or 2 years of age and it can reach a maximum size of 110 cm and age of 12 years. It is a broadcast spawner and has a high trophic level (Froese and Pauly 2013).

Factor 1.2 - Abundance

TAIWAN/WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Moderate Concern

No stock-wide population assessments of mahi mahi in the Pacific Ocean have been conducted. Catch rate data show an increasing trend, suggesting that abundance is increasing, which may be due to declines in dolphinfish predators, such as sharks and billfish (WPRFMC 2013a). Taiwan has conducted an assessment indicating that the biomass in 2008 was 91% of virgin levels and over two times the levels necessary to produce the maximum sustainable yield (Wang et al. 2013). But no stock-wide assessments have been conducted, so there is no way of knowing whether total biomass is above a sustainable level. The International Union for Conservation of Nature (IUCN) considers mahi mahi a species of Least Concern with a stable population trend (Collette et al. 2011). We have awarded a "moderate" concern score because the status is unknown, but mahi mahi is not of high vulnerability or considered threatened or vulnerable according to IUCN.

Factor 1.3 - Fishing Mortality

TAIWAN/WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Moderate Concern

No stock-wide population assessment of mahi mahi has been conducted in the Western and Central Pacific Ocean, so the current fishing mortality rate is unknown. But Taiwan has conducted a national assessment of mahi mahi. The results indicate that fishing mortality rates in 2008 were lower than the levels necessary to produce the maximum sustainable yield (Wang et al. 2013). The IUCN does not consider that there are any major threats for mahi mahi from commercial fishing (Collette et al. 2011), but we have awarded a "moderate" concern score to account for a lack of information.

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 Crtitical

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 B.

DOLPHINFISH (MAHI MAHI) - TAIWAN/WESTERN CENTRAL PACIFIC - PELAGIC LONGLINE					
Subscore:	**1.414**	**Discard Rate:**	**0.95**	**C2 Rate:**	**1.343**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Bigeye tuna	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)
Shortfin mako shark	1.00:High	2.00:High Concern	1.00:High Concern	Red (1.414)
Silky shark	1.00:High	2.00:High Concern	1.00:High Concern	Red (1.414)
Olive ridley turtle	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Blue shark	1.00:High	4.00:Low Concern	3.67:Low Concern	Green (3.831)
Yellowfin tuna	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)

Mahi mahi in Taiwan is primarily caught in longline fisheries targeting mahi mahi along with tuna and other pelagic species, such as sharks. Information on bycatch in these fisheries primarily comes from the pelagic longline observer program. According to this program, the most commonly caught species is the blue shark, which makes up 70%–80% of the shark species, followed by silky and shortfin mako sharks. Hammerhead and thresher shark species are also caught but do not make up a large portion of the total catch {FA 2012b}. In addition, these stocks have been assessed as healthy in Taiwanese waters {FA 2012b}. Taiwanese pelagic longline vessels also report interactions with a number of seabird species, particularly in the western north and south Pacific regions {FA 2014b}. Observer data from 2002 to 2008 indicated that 32 species of birds were observed caught throughout the Pacific Ocean {Huang 2011}. Annual estimates of seabird bycatch are 1,700 birds between 2002 and 2006 {Huang 2011}. The two most commonly caught species include the black-footed and Laysan albatross {Huang 2011} {FA 2014b}. During 2007, black-footed albatross made up 26% of all sea bird interactions, while Laysan albatross made up around 60% of the interactions {FA 2014b}. Frigatebirds are also caught in tropical waters, along with wandering albatrosses and southern giant petrels in the south Pacific. For this report we have only included the black-footed and Laysan albatross.

Sea turtle interactions are mostly made up of olive ridley sea turtles, although hawksbill, green, leatherback, and loggerhead sea turtles have also been incidentally captured (in far fewer numbers) {Huang 2011} {FA 2014c}. Between 2002 and 2006, 82 sea turtle interactions were observed in the Pacific Ocean {Huang 2011}. We have only included olive ridley turtles in this report.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Inherent Vulnerability

(same as Factor 1.1 above)

Factor 2.2 - Abundance

(same as Factor 1.2 above)

Factor 2.3 - Fishing Mortality

(same as Factor 1.3 above)

Bigeye tuna

Factor 2.1 - Inherent Vulnerability

TAIWAN/WESTERN CENTRAL PACIFIC

Medium

FishBase assigned a high to very high vulnerability of 72 out of 100 (Froese and Pauly 2013). But bigeye tuna's life history characteristics suggest a medium vulnerability to fishing. For example, bigeye tuna reach sexual maturity around 100–125 cm, reach a maximum size of 200 cm, and live around 11 years (Davies et al. 2014) (Froese et al. 2013). It is a broadcast spawner and top predator (Froese and Pauly 2013). 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; however, the stock status of bigeye tuna is known, so this inherent vulnerability score will not affect the overall outcome. We have 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	brocast spawner	3
Trophic level	>3.25	1

Factor 2.2 - Abundance

TAIWAN/WESTERN CENTRAL PACIFIC

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 average (2008–2011) spawning biomass to that needed to produce the maximum sustainable yield ($SB_{CURRENT}/SB_{MSY}$) was 0.94. The ratio of the latest (2012) spawning biomass (mature fish) to that needed to produce the maximum sustainable yield (SB_{LATEST}/SB_{MSY}) was 0.77, indicating that the population is overfished (Harley et al. 2014). We have therefore awarded a "high" concern score.

Factor 2.3 - Fishing Mortality

TAIWAN/WESTERN CENTRAL PACIFIC

High Concern

The ratio of current (2008–2011) and latest (2012) fishing mortality rates to those that produce the maximum sustainable yield ($F_{CURRENT}/F_{MSY}$ and C_{LATEST}/F_{MSY}) for all model runs (base case model plus sensitivity analysis) were much higher than 1, with the ratios from all runs estimated at 1.57 and 1.45,

respectively, indicating that overfishing is occurring (Harley et al. 2014). 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). We have awarded a “high” concern score based on the assessment results that overfishing is occurring and has been for some time.

Factor 2.4 - Discard Rate

TAIWAN/WESTERN CENTRAL PACIFIC

20-40%

Information on discards is not available for this fishery. Tuna longline fisheries that capture mahi mahi in Taiwan have a discard range of 0-40% worldwide (Kelleher 2005). We have therefore awarded a moderate score.

Shortfin mako shark

Factor 2.1 - Inherent Vulnerability

TAIWAN/WESTERN CENTRAL PACIFIC

High

Fishbase assigned a very high vulnerability of 86 out of 100 (Froese and Pauly 2013).

Factor 2.2 - Abundance

TAIWAN/WESTERN CENTRAL PACIFIC

High Concern

There has been some question about the stock structure of shortfin mako sharks in the Pacific Ocean. Currently the consensus is that there is a single population in the North Pacific (PIFSC 2014). A stock-wide assessment was attempted in 2015; previously an assessment of shortfin mako sharks was conducted in the Northwest Pacific in 2009. The 2015 assessment used four indicators (proportion of positive sets, abundance, sex ratio, and size components) to determine the status of shortfin mako sharks. Trends for the proportion of positive sets varied by fishery, as did the abundance indices. The Japanese abundance indices, which were considered the best, showed a flat trend through 2004 followed by a sharp increase through 2013. The Hawaii shallow and deep set abundance indices showed contrasting trends. No trends in sex ratio were evident, but the size composition appeared to remain stable across fleets. No stock status could be determined due to an overall lack of data (ISC 2015). The International Union for the Conservation of Nature has assessed this species globally as Vulnerable (Cailliet et al. 2009). We have awarded a “high” concern score because the status is unknown and shortfin mako sharks have a high inherent vulnerability score.

Factor 2.3 - Fishing Mortality

TAIWAN/WESTERN CENTRAL PACIFIC

High Concern

The 2015 assessment was unable to calculate fishing mortality rates due to a lack of data (ISC 2015). The previous 2009 assessment of shortfin mako sharks conducted in the Northwest Pacific suggested that fishing mortality should be reduced by 32% (Chang and Liu 2009). Estimated average annual longline catches between 1992 and 2009 were 71 t, although catch estimates have declined by 50% over the past decade. A separate analysis of shortfin mako (not an assessment) indicated no evidence for the impact of fishing on mako sharks in the North Pacific (Lawson 2011) (Clarke 2011). There are no management measures in place and fishing mortality rates are unknown, so we have awarded a “high” score.

Factor 2.4 - Discard Rate

TAIWAN/WESTERN CENTRAL PACIFIC

20-40%

Information on discards is not available for this fishery. Tuna longline fisheries that capture mahi mahi in Taiwan have a discard range of 0-40% worldwide (Kelleher 2005). We have therefore awarded a moderate score.

Silky shark

Factor 2.1 - Inherent Vulnerability

TAIWAN/WESTERN CENTRAL PACIFIC

High

Fishbase assigned a high score of 79 out of 100 (Froese and Pauly 2013).

Factor 2.2 - Abundance

TAIWAN/WESTERN CENTRAL PACIFIC

High Concern

The International Union for the Conservation of Nature (IUCN) considers silky sharks to be Near Threatened globally (Bonfil et al. 2009). The first assessment of silky sharks in the Western and Central Pacific Ocean (WCPO) was conducted in 2012 and updated during 2013 (Rice and Harley 2013). According to this model, the spawning biomass levels (abundance of mature fish) consistently declined over the modeled time period (1995–2009). The spawning biomass has declined by 67% since 1995. The spawning biomass in 2009 was far below target levels needed to produce the maximum sustainable yield ($SB_{CURRENT}/SB_{MSY}$ = 0.70; 95% CI = 0.51–1.23), so the stock is overfished. We have awarded a “high” concern score because the SSB is below MSY.

Factor 2.3 - Fishing Mortality

TAIWAN/WESTERN CENTRAL PACIFIC

High Concern

According to the 2013 updated silky shark assessment in the Western and Central Pacific Ocean (WCPO), fishing mortality rates in 2009 (the last year of the modeled period) exceeded levels needed to produce the maximum sustainable yield ($F_{CURRENT}/F_{MSY}$ = 4.48 (1.41–7.96)). This indicates that overfishing is occurring (Rice and Harley 2013). The Western and Central Pacific Fisheries Commission has recently banned the catch, landing, and sale of silky sharks (WCPFC 2013f). The success of this measure is highly dependent on post-release survival of silky sharks. We have awarded a “high” concern score based on the high fishing mortality rates.

Factor 2.4 - Discard Rate

TAIWAN/WESTERN CENTRAL PACIFIC

20-40%

Information on discards is not available for this fishery. Tuna longline fisheries that capture mahi mahi in Taiwan have a discard range of 0-40% worldwide (Kelleher 2005). We have therefore awarded a moderate score.

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	Harvest Strategy	Bycatch Strategy	Score
Taiwan / Western Central Pacific / Pelagic longline	1.000	1.000	Red (1.000)

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: Harvest Strategy

Factor 3.1 Summary

FACTOR 3.1: MANAGEMENT OF FISHING IMPACTS ON RETAINED SPECIES							
Region / Method	Strategy	Recovery	Research	Advice	Enforce	Track	Inclusion
Taiwan / Western Central Pacific / Pelagic longline	Ineffective	Moderately Effective	Highly Effective	Highly Effective	Moderately Effective	Moderately Effective	Moderately Effective

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.

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Ineffective

The agency charged with fisheries management is the Ministry of Agriculture and Fisheries, housed within Taiwan's Council of Agriculture.

Taiwan's fisheries management legislation includes the Fisheries Act, regulations on the management of fishing crews, enforcement of fisheries, and regulations related to longline fisheries (CO 2015). Taiwan also has a no-entry policy in place, which restricts the number of vessels (Huang and Chung 2010). A Taiwan-Japan Fisheries Agreement regulates a special cooperation zone termed the Taiwan-Japan Area. Fishing in these area requires authorization through a fishing license and requires the use of an automatic location communication (i.e., vessel monitoring system). In addition, longline vessels are restricted to offloading in a single port and there are set length restrictions (CO 2014). In 2005–2006, Taiwan implemented a 2-phase reduction program to deal with overcapacity in tuna fisheries, which also catch mahi mahi. This resulted in a 26% reduction in capacity (FA 2012c). There are no catch limits or other measures in place for mahi mahi in Taiwan.

Taiwan is also a member of the Western and Central Pacific Fisheries Commission (WCPFC), a regional fisheries management organization (RFMO) in the Western and Central Pacific Ocean. But there are currently no recommendations specific to mahi mahi under the WCPFC.

We have awarded an "ineffective score" because there is no current management of mahi mahi in Taiwan.

Taiwan is also a member of the Western and Central Pacific Fisheries Commission (WCPFC), a regional fisheries management organization (RFMO) in the western and central Pacific Ocean. However, there are currently no mahi mahi-specific recommendations under the WCPFC.

We have awarded an ineffective score because there is no current management of mahi mahi in Taiwan.

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.

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Moderately Effective

The status of mahi mahi in the western Pacific Ocean is unknown. Bigeye tuna is classified as overfished in the most recent stock assessment and is experiencing overfishing; management measures have been ineffective at reducing bigeye fishing mortality rates (Harley et al. 2014). But bigeye tuna has 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. This results in 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.

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Highly Effective

Taiwan has a Fisheries Research Institute, which has a Coastal and Offshore Resources Research Center. This Center conducts biological studies on coastal and offshore fisheries, among other work (FRI 2015). Taiwan has conducted several research studies on mahi mahi (Chuang 2007) (Chen et al. 1999) (Chen et al. 2006) (Chang 2006) (Cheng 2006) (Wang et al. 2013) (Chang et al. 2013) (Chang and Maunder 2012). Catch and effort data are collected from fisheries that target mahi mahi and catch them as secondary species. Other tuna species, which are caught along with mahi mahi, are regularly assessed as well (Harley et al. 2014) (Davies et al. 2014) (IATTC 2015c) (IATTC 2015b) (IATTC 2015d) (Rice et al. 2014). We have therefore awarded a "highly effective" score.

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.

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Highly Effective

Although no specific scientific advice has been provided on mahi mahi, Taiwan abides by scientific advice related to other retained species, such as tuna. For example, Taiwan abides by management measures adopted by regional fishery management organizations and advice provided by the Food and Agriculture Organization (FA 2012c) (WCPFC 2014). We have therefore awarded a "highly 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.

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Moderately Effective

Taiwan uses a logbook system to collect information on target and bycatch species. Port sampling is also conducted in domestic ports, and Taiwan has a maritime law enforcement agency (FA 2014c). But there are known to be issues with enforcement of longline vessels operating in this region (e.g., compliance with adopted management measures, and illegal fishing). Because a large portion of this fishery operates in the high seas, it is unclear if enforcement measures cover the entire fleet. We have therefore awarded a "moderately effective" score to account for these measures.

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.

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Moderately Effective

It is unclear if management has been successful for mahi mahi because its status is unknown. Management has not been very successful for species such as bigeye tuna. 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.

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Moderately Effective

There is some inclusion of stakeholders in Taiwan's fisheries management. For example, information is publicly available on fisheries regulations and Taiwan provides information on their fisheries to the various regional fishery management organizations. But it is unclear exactly how much inclusion actually occurs, so we have awarded a "moderately effective" score.

Factor 3.2: Bycatch Strategy

FACTOR 3.2: BYCATCH STRATEGY						
Region / Method	**All Kept**	**Critical**	**Strategy**	**Research**	**Advice**	**Enforce**
Taiwan / Western Central Pacific / Pelagic longline	No	No	Ineffective	Ineffective	Moderately Effective	Moderately Effective

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.).

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Ineffective

Taiwan has a National Plan of Action (NPOA) for the Conservation and Management of Sharks, and Taiwan developed a shark management working group in 2001. Currently, only the whale shark is managed with a catch reporting scheme and total allowable catch, along with banning shark finning. There are also reporting requirements for fishers who incidentally capture great white, basking, or megamouth sharks, but none of these species is caught in this fishery. Silky sharks are prohibited from being captured in the Western and Central Pacific Ocean. Taiwan provides species identification guides to fishers and conducts workshops on the sustainable use of sharks with fishers and the public. Shark finning is prohibited (FA 2012b) (FA 2014).

Taiwan has implemented an NPOA for Seabirds and complies with seabird bycatch mitigation measures required by the regional fishery management organizations. Tori lines are required in areas south of 30°S and north of 23° N. In areas south of 30°S, fishers must use two mitigation methods, one of which must be a bird-scaring line (FA 2014b).

Taiwan also complies with mandated sea turtle mitigation measures of the various regional fishery management organizations. But none of these measures mandates best practices, and Taiwan has not instituted any additional measures.

We have awarded an "ineffective" score because Taiwan has management measures in place for seabirds but management is still lacking for most shark species caught in this fishery and for sea turtles.

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

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Ineffective

Taiwan collects information on shark catches through logbooks, port sampling, captain questionnaires, and observers. An observer program has been in place since 2002 and currently there are nine observers that work on far sea tuna longline vessels, although this number is projected to increase in the future (FA 2012b). Observer coverage was increased in 2012 to include small-scale longline vessels in addition to large-scale vessels. It is unclear what percentage coverage this program has achieved. In 2013, a total of 15 trips each were observed of the small- and large-scale fisheries (FA 2014c). Under the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC), Taiwan is required to attain only 5% observer coverage of longline fleets (WCPFC 2007) (IATTC 2011). According to the WCPFC, they are compliant with this measure (WCPFC 2014). Taiwan also reports just under 7% observer coverage of their longline fleet operating in the eastern Pacific Ocean (IATTC 2015a). Taiwan reports information on 11 species of sharks to the WCPFC but has not provided adequate information on sea turtles and seabirds (CT 2015).

Taiwan has also conducted a number of studies on the effects of tori lines for bycatch mitigation of seabirds (FA 2014b).

We have awarded an "ineffective" score because Taiwan may be meeting mandated observer coverage rates for their longline fleet but 5% observer coverage is still considered too limited for a full understanding of bycatch impacts.

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.

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Moderately Effective

Taiwan complies with mandated Conservation and Management Measures adopted by the Western and Central Pacific Fisheries Commission (WCPFC) for seabirds, sea turtles, cetaceans, and sharks. These include the use of bycatch mitigation techniques (i.e., tori lines) for seabirds, the required immediate release of sea turtles and marine mammals along with carrying the proper sea turtle release gear, and prohibited capture of oceanic whitetip and silky sharks (FA 2014c) (WCPFC 2014). But observer coverage rates are low, so information on compliance is limited. We have therefore awarded a score of "moderately effective" and not a highly effective score.

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.

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Moderately Effective

Taiwan uses a logbook system to collect information on target and bycatch species. Port sampling is also conducted in domestic ports, and Taiwan has a maritime law enforcement agency (FA 2014c). But there are known to be issues with enforcement of longline vessels operating in this region (e.g., compliance with adopted management measures, and illegal fishing). Because a large portion of this fishery operates in the high seas, it is unclear if enforcement measures cover the entire fleet. We have therefore awarded a "moderately effective" score to account for these measures.

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

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Taiwan / Western Central Pacific / Pelagic longline	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.873)

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

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

None

Pelagic longline fishing gear is fished at the surface and therefore does not come into contact with bottom habitats.

Factor 4.2 - Mitigation of Gear Impacts

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Not Applicable

We have rated this factor not applicable because longline gear is benign.

Factor 4.3 - Ecosystem-Based Fisheries Management

TAIWAN / WESTERN CENTRAL PACIFIC, PELAGIC LONGLINE

Moderate Concern

Pelagic longline fisheries that capture mahi mahi also capture a number of ecologically important species, including sharks and tuna. Sharks are considered top predators in many ecosystems and play a critical role in how these ecosystems are structured and function (Stevens et al. 200). Tunas are also top predators (Froese and Pauly 2015) and declines in their population could impact individual ecosystems (Heithaus et al. 2008). It does not appear that Taiwan has taken initiatives to include ecosystem impacts into their large pelagic fisheries management policies. But they do mandate seabird mitigation measures and have prohibited shark finning (FA 2014b) (FA 2012b). We have therefore awarded a "moderate" concern score.

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

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Appendix A: Extra By Catch Species

Yellowfin tuna

Factor 2.1 - Inherent Vulnerability

TAIWAN/WESTERN CENTRAL PACIFIC

Medium

FishBase assigned a moderate to high vulnerability of 46 out of 100 (Froese and Pauly 2013). Yellowfin tuna'u 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. It can attain a maximum size of 180 cm and live to at least 4 years of age and perhaps as much as 9 years. It is a broadcast spawner and an important predator in the ecosystem (Langley et al. 2011) (Froese and Pauly 2013).

Factor 2.2 - Abundance

TAIWAN/WESTERN CENTRAL PACIFIC

Very Low Concern

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

Factor 2.3 - Fishing Mortality

TAIWAN/WESTERN CENTRAL PACIFIC

Very Low Concern

The current fishing mortality rate is below levels needed to produce the maximum sustainable yield ($F_{CURRENT}/F_{MSY} = 0.72$) for the most realistic models. Therefore overfishing is not occurring (Davies et al. 2014). We have therefore awarded a "very low" concern score.

Factor 2.4 - Discard Rate

TAIWAN/WESTERN CENTRAL PACIFIC

20-40%

Information on discards is not available for this fishery. Tuna longline fisheries that capture mahi mahi in Taiwan have a discard range of 0-40% worldwide (Kelleher 2005). We have therefore awarded a moderate score.

Blue shark

Factor 2.1 - Inherent Vulnerability

TAIWAN/WESTERN CENTRAL PACIFIC

High

FishBase assigned a high to very high vulnerability score of 67 out of 100 (Froese and Pauly 2013). Blue shark reaches sexual maturity around 4–7 years of age and reaches a maximum size and age of 380 cm and 16 years, respectively. Blue sharks give birth to live pups every 1–2 years (ISCSWG 2014). The life history characteristics of this species may lend more to a medium ranking, but because the stock status is known and therefore the inherent vulnerability does not affect the overall score, we have left this factor as a "high"

vulnerability.

Factor 2.2 - Abundance

TAIWAN/WESTERN CENTRAL PACIFIC

Low Concern

An updated assessment of blue sharks in the North Pacific was completed during 2014. Two different models were used in the assessment. The base case results of the two models indicated that the population (biomass (B) and spawning stock biomass (SSB)) of blue sharks is not overfished (B_{2011}/B_{MSY} = 1.65 and SSB_{2011}/SSB_{MSY} = 1.621) and that the population will remain above the level necessary to maintain the maximum sustainable yield (B_{MSY}) in the future (ISCSWG 2014). But evidence including declines in median size and catch rates suggest declines in abundance of blue sharks in recent years (Clarke 2011) and there is uncertainty in the assessment of blue shark. We have therefore awarded a “low” concern rather than very low concern score.

Factor 2.3 - Fishing Mortality

TAIWAN/WESTERN CENTRAL PACIFIC

Low Concern

Blue sharks are widely distributed throughout the North Pacific and dominate shark catches in that region. According to the 2014 updated assessment, the fishing mortality rate estimated in 2011 (F_{2011}) was around 34% of that needed to produce the maximum sustainable yield (F_{MSY}) (ISCSWG 2014). Therefore overfishing is not occurring. But there is uncertainty surrounding these results due to reporting issues, and previous assessments have indicated some issues with the data. We have therefore awarded a “low” concern instead of very low concern score.

Factor 2.4 - Discard Rate

TAIWAN/WESTERN CENTRAL PACIFIC

20-40%

Information on discards is not available for this fishery. Tuna longline fisheries that capture mahi mahi in Taiwan have a discard range of 0-40% worldwide (Kelleher 2005). We have therefore awarded a moderate score.

Olive ridley turtle

Factor 2.1 - Inherent Vulnerability

TAIWAN/WESTERN CENTRAL PACIFIC

High

Sea turtles have a high level of vulnerability according to the Seafood Watch criteria, based on their life history characteristics that include being long-lived, attaining sexual maturity at a later age, and having a low reproductive rate (Seafood Watch 2013).

Factor 2.2 - Abundance

TAIWAN/WESTERN CENTRAL PACIFIC

High Concern

The International Union for Conservation of Nature (IUCN) considers olive ridley sea turtles to be Vulnerable with a decreasing population trend. Olive ridley turtles have been listed as Threatened under the United

States Endangered Species Act (ESA) since 1978 (NMFS 2012a). Along several beaches in Thailand, current estimates of the number of nests/km/day are around 20, while in Indonesia this number is 230. It is estimated that the annual nesting subpopulation on these Thai beaches has decreased 97%–98% over time, while in Indonesia they have increased substantially. Overall, in the Western and Central Pacific Ocean, there has been a decrease in annual nesting females of 92%, from 1,412 to 108 (Abreu-Grobois and Plotkin 2008). We have awarded a “high concern” score because of the IUCN listing.

Factor 2.3 - Fishing Mortality

TAIWAN/WESTERN CENTRAL PACIFIC

Moderate Concern

The incidental capture of olive ridley turtles occurs worldwide, although other fisheries such as trawls and gillnets appear to have a larger negative impact compared to longlines (Wallace et al. 2013) (Abreu-Grobois and Plotkin 2008). Data related to incidental captures are scarce due to low reporting by some countries and low observer coverage rates (≈1%) (Brouwer and Bertram 2009) (Williams et al. 2009). Bycatch is thought to be a low threat to population in the west Pacific region and the population is at low risk (Wallace et al. 2013). Taiwan reports olive ridley to be the most commonly observed incidentally captured sea turtle in their tuna fisheries operating in the Western and Central Pacific Ocean (FA 2014c). In 2012, 22 olive ridley turtles were observed and 23 in 2013 (FA 2014c). Taiwan complies with sea turtle management measures mandated by the Western and Central Pacific Ocean Commission (WCPFC 2014). We have awarded a moderate concern score because the population is depleted, but this fishery is not a major contributor.

Factor 2.4 - Discard Rate

TAIWAN/WESTERN CENTRAL PACIFIC

20-40%

Information on discards is not available for this fishery. Tuna longline fisheries that capture mahi mahi in Taiwan have a discard range of 0-40% worldwide (Kelleher 2005). We have therefore awarded a moderate score.