Monterey Bay Aquarium

Seafood Watch®

Dolphinfish

Coryphaena hippurus

Guatemala/Eastern Central Pacific

Pelagic longline

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Seafood Watch Consulting Researcher

Seafood Watch Standard used in this assessment: Standard for Fisheries vF3

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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 Watch Assessment. Each assessment 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." This ethic is operationalized in the Seafood Watch standards, available on our website here. In producing the assessments, 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 assessments 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 Watch assessments in any way they find useful.

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.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard. 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

Mahi mahi (*Coryphaena hippurus*) is found worldwide in tropical and subtropical waters. This report focuses on the mahi mahi longline fishery in Guatemala.

An exploratory stock assessment was conducted on mahi mahi from the south eastern Pacific Ocean in 2016, which is considered the "core" region of the dorado stock in the EPO (IATTC 2016). The regional fishery management organization, Inter-American Tropical Tuna Commission (IATTC) has begun developing an assessment plan.

The small-scale longline fisheries that target mahi mahi in Guatemala are poorly monitored and managed. There is a paucity of information with respect to mahi mahi abundance, catch, effort, and fishing mortality. Because there are currently no reference points for mahi mahi abundance, a Productivity-Susceptibility Analysis (PSA) was conducted, which suggested mahi mahi are moderately inherently vulnerable; therefore a score of "moderate" concern was given. Fishing mortality (F) for mahi mahi was rated "low" concern because an exploratory stock assessment suggests that fishing mortality rates have decreased slightly since 2007, and that F is likely half of F_{MSY}.

Information about bycatch species associated with the fishery is also lacking. However, there is some indication that several species of sea turtles and sharks are caught in these fisheries. Generally, there are no stock assessments for shark species likely caught in this fishery; however, based on their life-history characteristics, there is concern over their current status. Several sea turtle species that likely interact with this fishery are listed as "Endangered" or "Critically Endangered" by the International Union for the Conservation of Nature (IUCN). Sharks and leatherback, hawksbill, and olive ridley turtles limit the Criterion 2 score due to their conservation status.

Management of mahi mahi in Guatemala is considered ineffective because there are currently no measures in place. Management of bycatch species is considered moderately effective because there are some management measures to protect vulnerable bycatch species, including a national and regional plan for conservation and management of sharks, and some IATTC measures are in place. Pelagic longline fisheries that capture mahi mahi do not come in contact with bottom habitats and therefore do not cause harm to those ecosystems. Currently, there are minimal ecosystem measures included in Guatemala's fishery management plans.

Overall, the longline fishery in Guatemala is rated "red" or "avoid."

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 Guatemala Eastern Central Pacific, Drifting longlines, Guatemala	Green (3.413)	Red (1.000)	Red (1.000)	Green (3.873)	**Avoid (1.906)**

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.

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

Introduction

Scope of the analysis and ensuing recommendation

This report focuses on mahi mahi (*Coryphaena hippurus*) caught by Guatemala's drifting longline fishery.

Species Overview

Coryphaena hippurus is one of two species in the family Coryphaenidae, along with the pompano dolphinfish (*C. equiselis*). Both species have a global distribution, and though pompano dolphinfish are typically smaller than mahi mahi, they share a similar morphology and coloration (Froese and Pauly 2017). Accordingly, pompano dolphinfish are often mistaken for juvenile mahi mahi (Froese and Pauly 2017) and are sometimes sold as mahi mahi (Whoriskey et al. 2011).

Mahi mahi are mid-trophic level predators, feeding primarily on other fishes and, occasionally, crustaceans and squid (Polovino et al. 2009), (Froese and Pauly 2017). They are found worldwide (Figure 1) in tropical and subtropical waters warmer than 20°C (FAO 2004). This species is extremely fast growing and reaches sexual maturity in the first year of life. Size at maturity varies throughout its range (for a summary, see (Collette et al. 2013)). For example, in the western Central Atlantic, female mahi mahi mature at approximately 41.9 cm (50%, 16.5 in; (McBride et al. 2012)) and males mature at approximately 47.6 cm (50%, 18.7 in; (Schwenke and Buckel 2008)), whereas in the eastern Caribbean, 50% of males and females mature at 91 cm and 83 cm, respectively (Fonteneau et al. 2013). Females are highly fecund, producing as many as 1.5 million eggs per spawning event, and short-lived, with a typical lifespan of less than 5 years (Collette et al. 2013), (Froese and Pauly 2017). Mahi mahi are sexually dimorphic, with males significantly larger than females; in the tropical Pacific, maximum sizes of 149 cm fork length (FL) for males and 137 cm FL for females have been recorded (Uchiyama and Boggs 2006). Mahi mahi school in feeding aggregations, and these schools are commonly associated with floating objects; hence, they are often captured near fish aggregation devices (FADs; (Olson and Galván-Magaña 1996)). In the eastern Pacific Ocean the Inter-American Tropical Tuna Commission (IATTC) is charged with the management of tuna and bycatch species, including mahi mahi. Guatemala is bound by the recommendations and management guidelines set forth by this organization.

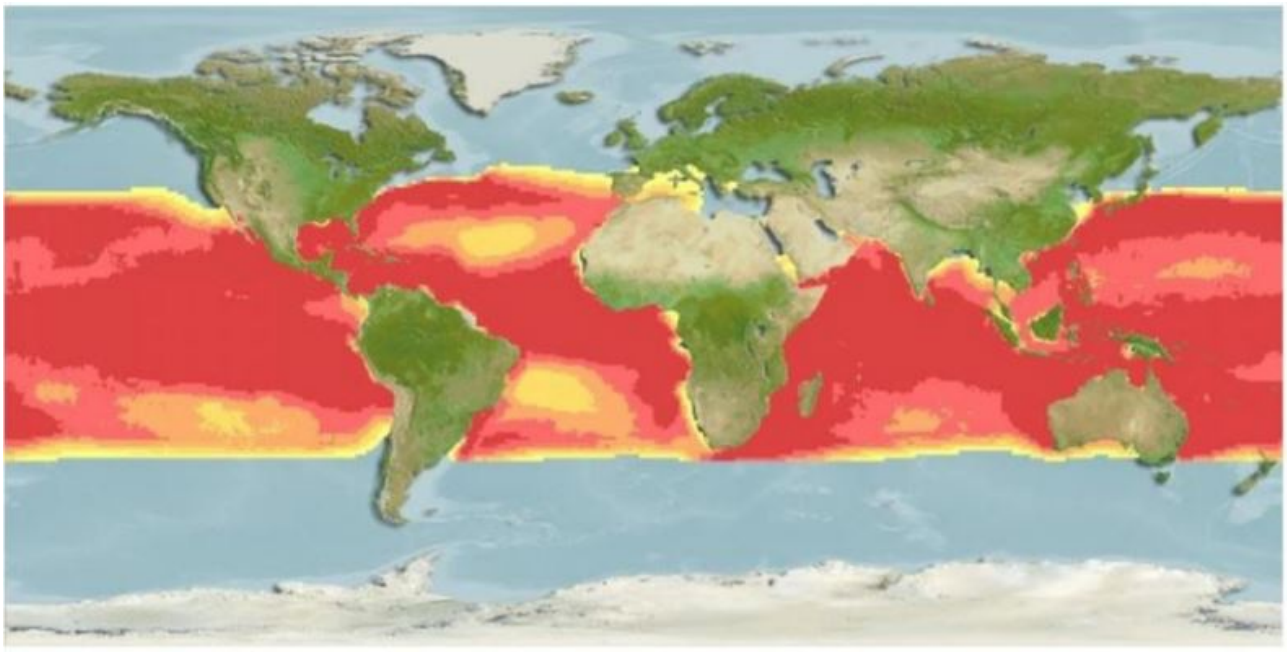

Figure 1 Figure 1. Distribution of mahi mahi. Color variation indicates probability of presence, with mahi mahi more likely to be found in darker areas (www.aquamaps.org).

Guatemalan fisheries are managed through the Directorate of Fisheries and Aquaculture (Dirección de la Pesca y Acuicultura; DIPESCA). Prior to 2011, the fishery ministry was known as Unidad de Manejo de la Pesca y Acuicultura (UNIPESCA). DIPESCA is a subsection of the Ministry of Agriculture, Livestock and Food (Ministerio de Agricultura, Ganadería y Alimentación; MAGA) and its responsibilities include developing strategies for the sustainable management of marine resources in collaboration with MAGA's Unit on Policy and Strategic Information (Unidad de Políticas y Información Estratégica) and ensuring compliance with management guidelines (MAGA 2010). Guatemala is also a country member of the Central American Organization of the Fisheries and Aquaculture Sector (OSPESCA). OSPESCA issues binding regional agreements.

Production Statistics

The majority of Guatemalan mahi mahi destined for export are captured by small-scale vessels, compared to the mid-sized fleet that targets sharks and lands mahi mahi incidentally (Ixquiac and Juarez 2014). Guatemalan fishing activities take place in both the Pacific and Atlantic Oceans (Cifuentes-Velasco 2009), although the bulk of mahi mahi landings are from the Pacific (Cifuentes-Velasco 2009). There is also an artisanal small-scale fleet that targets sharks (MAGA-CONAP 2016) (Vega 2018) and a mid-size fleet that targets mahi mahi (MAGA-CONAP 2016).

Importance to the US/North American market.

The United States imports the majority of mahi mahi from Peru, followed by Ecuador, Panama, and Guatemala (NMFS 2017). In 2017 (to date), the US has imported 1,092,181 lb of mahi mahi (NMFS 2017).

Common and market names.

C. hippurus is most commonly marketed as mahi mahi or dolphinfish in the United States, although it is also known as dorado throughout Latin America and perico in Peru (http://www.accessdata.fda.gov/scripts/search_seafood/index.cfm?other=complete).

Primary product forms

Mahi mahi is primarily available as fresh or frozen fiillets.

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the Species Under Assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. 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

Guiding Principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*

Criterion 1 Summary

DOLPHINFISH			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Guatemala/Eastern Central Pacific | Drifting longlines | Guatemala	2.33: Moderate Concern	5.00: Low Concern	Green (3.413)

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Abundance

Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

DOLPHINFISH

Factor 1.1 - Abundance

GUATEMALA/EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Moderate Concern

An exploratory stock assessment was conducted on mahi mahi from the south eastern Pacific Ocean in 2016, which is considered the "core" region of the stock in the EPO (Aires-da-Silva 2016). The regional fishery management organization, Inter-American Tropical Tuna Commission (IATTC) has begun developing an assessment plan. The spawning stock biomass (time series 2007 to 2015) has remained fairly stable since 2007, with a slight decrease during 2010 (Aires-da-Silva 2016). There are no reference points defined for mahi mahi in the eastern Pacific Ocean. Some common reference points used for species such as tuna were assessed for mahi mahi. According to these reference points, the spawning stock biomass ratio to that of the unfished stock has averaged 0.20 for the time series (Aires-da-Silva 2016). The IUCN has assessed mahi mahi as a species of "Least Concern" (Collete et al. 2011). Because there are no reference points or other indications of abundance for the mahi mahi stock, a Productivity and Susceptibility analysis (PSA) was conducted. The PSA score = 2.81 (see justification section for PSA details), which suggests a medium susceptibility to fishing; therefore we have awarded a score of "moderate" concern for abundance.

Justification:

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	0.5 years (Beardsley 1967)	1
Average maximum age	4 years (Uchiyama et al. 1986)	1
Fecundity	85,000 eggs (Froese and Pauly 2017)	1
Average maximum size (fish only)	210 cm (Collette 1999)	2
Average size at maturity (fish only)	55 cm (Beardsley 1967)	2
Reproductive strategy	Broadcast spawner (Froese and Pauly 2017)	1

Trophic level	4.4 (Froese and Pauly 2017)	3
Density dependence (invertebrates only)	-	-
Total Productivity (average)		**1.57**
Susceptibility Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Areal overlap (Considers all fisheries)	There is areal overlap between the fishery and mahi mahi.	3
Vertical overlap (Considers all fisheries)	There is vertical overlap between the fishery and mahi mahi.	3
Selectivity of fishery (Specific to fishery under assessment)	The selectivity is not available	2
Post-capture mortality (Specific to fishery under assessment)	Post capture mortality information is unknown.	3
Total Susceptibility (multiplicative)		**2.33**

PSA score for mahi mahi in the Guatemala longline fishery is calculated as follows:

Vulnerability (V) = $\sqrt{(P2 + S)^2}$

V = $\sqrt{(1.57 + 2.33)^2}$

V = 2.81

Factor 1.2 - Fishing Mortality

GUATEMALA/EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Low Concern

Fishing mortality rates for mahi mahi in the eastern Pacific Ocean compared to reference points are unknown.

However, the Inter-American Tropical Tuna Commission (IATTC) conducted an exploratory stock assessment that suggests fishing mortality rates have decreased slightly since 2007 and the fishing mortality needed to produce the maximum sustainable yield is two times more than current levels (Aires-da-Silva 2016). In 2008, Guatemala estimated a fishing mortality rate of 4.53 for mahi mahi (Bran 2010) and an exploitation rate (for the artisanal fishery) of 0.36 (Ixquiac and Juarez 2014).

Mahi mahi are caught as bycatch and targeted in longline fisheries (along with coastal gillnet and purse seine fisheries) in the eastern Pacific Ocean (IATTC 2013) (Alfaro-Shigueto et al. 2010). The IUCN does not consider there to be any major threats to mahi mahi from commercial fishing (Collete et al. 2011). Preliminary analysis shows variable, but somewhat steady, catch per unit effort trends in abundance (IATTC 2013). We have awarded a score of "low" concern because commercial fishing does not appear to be a major threat, the catch per unit effort has been somewhat stable over time, and the preliminary stock assessment states that current fishing mortality rates are 50% of the maximum sustainable yield.

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. 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. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait 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 is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding Principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

Criterion 2 Summary

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

DOLPHINFISH - GUATEMALA/EASTERN CENTRAL PACIFIC - DRIFTING LONGLINES - GUATEMALA					
Subscore:	**1.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.000**

Species	Abundance	Fishing Mortality	Subscore
Sharks	1.00:High Concern	1.00:High Concern	Red (1.000)
Leatherback turtle	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Hawksbill turtle	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Green sea turtle	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Olive ridley turtle	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Silky shark	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
Blue shark	3.67:Low Concern	5.00:Low Concern	Green (4.284)

Information on bycatch in Guatemala's mahi mahi fishery is lacking. However, interactions with sea turtles are known to occur
(Jolon 2005) (Secretaria 2006) (CeDePesca 2015). Five species of sea turtles occur in Guatemala's Exclusive Economic Zone (EEZ) in the Pacific: green (*Chelonia mydas),* loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*), olive ridley (*olive Lepidochelys*), and leatherback (*Dermochelys*

coriacea). The populations of the eastern Pacific's green, hawksbill, and leatherback sea turtles are "Endangered" or "Critically Endangered," and the loggerhead is "Vulnerable" (IUCN Red List). All of these species are listed on Appendix I of CITES and Appendix I of the Convention of species migration (CMS). We have included four species of sea turtle in this report: olive ridley, hawksbill, leatherback, and green sea turtles (IAC 2013). The Ministry of Agriculture, Livestock and Food (MAGA) reports that several species of sharks are also caught in mahi mahi fisheries. The top species include silky, pelagic and bigeye thresher, blacktip, bull, shorfin mako, blue and nurse sharks (MAGA-CONAP 2016). We have included sharks as a general group in this report because it is unclear what percentage of the total catch is comprised by each species.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality
(same as Factor 1.2 above)

SHARKS

Factor 2.1 - Abundance

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

High Concern

The most commonly reported shark species in the mahi mahi fishery are silky, bigeye and pelagic thresher, blacktip, bull, blue and nurse sharks (CeDePesca 2013). Blue and silky sharks are assessed individually in this report, but the remaining species have been combined due to a lack of information.

Stock-wide assessments for bigeye and pelagic thresher, blacktip, bull and nurse sharks have not been conducted in the eastern Pacific Ocean. According to the IUCN, blacktip sharks are considered globally as "Near Threatened" because they are commonly captured in commercial and recreational fisheries (Burgess and Branstetter 2009), whereas pelagic and bigeye thresher sharks are considered "Vulnerable" due to global declining populations (Amorim et al. 2009) (Reardon et al. 2009). Bull sharks are globally rated as "Near Threatened" by the IUCN (Simpfendorfer and Burgess 2009) and nurse sharks are considered "Data Deficient" (Rosa et al. 2006).

We have awarded a score of "high" concern for abundance to account for the IUCN listings for blacktip, bull, and thresher sharks.

Factor 2.2 - Fishing Mortality

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

High Concern

Estimates of fishing mortality rates for blacktip, pelagic and bigeye thresher, bull and nurse sharks are not available in the region, but they are reported to be caught in a number of fisheries (Rosa et al. 2006) (Simpfendorfer and Burgess 2009) (Amorim et al. 2009) (Burgess and Branstetter 2009) (Reardon et al. 2009). We have awarded a score of "high" concern because fishing mortality rates are unknown for sharks, and we therefore rely on the Seafood Watch Unknown Bycatch Matrix, which scores shark susceptibility in

longlines in the eastern Pacific Ocean as "high" concern.

Justification:

There is no effective management in place in the eastern Pacific Ocean region for these species. Post-release survival rates are unknown and can vary by species (Musyl et al. 2011) (Gallagher et al. 2014).

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

< 100%

Discard rates are unknown for the mahi mahi fisheries in Guatemala. Small-scale operators typically have lower discard rates than industrial scale vessels (Kelleher 2005), because artisanal fishers are able to utilize more of the incidental catch. Kelleher assumed a discard rate of <1 to 5% for artisanal fisheries (Kelleher 2005), which land the majority of mahi mahi in Guatemala (Arenales et al. 2009). Kelleher also found that industrial-scale longliners targeting tuna averaged a discard rate of 28.5% (Kelleher 2005). We have awarded the lowest discard rate of <100% because the majority of mahi mahi in Guatemala are caught by small-scale vessels, which have lower discard rates.

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective,' 'moderately effective,' 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

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 = Red or High Concern*

Rating is Critical if Management Strategy and Implementation is Critical.

GUIDING PRINCIPLE

- The fishery is managed to sustain the long-term productivity of all impacted species.

Criterion 3 Summary

Fishery	Management Strategy	Bycatch Strategy	Research and Monitoring	Enforcement	Stakeholder Inclusion	Score
Fishery 1: Guatemala / Eastern Central Pacific | Drifting longlines | Guatemala	Ineffective	Moderately Effective				Red (1.000)

Criterion 3 Assessment

Factor 3.1 - 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? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Ineffective

There is neither a management plan nor mahi mahi-specific management measures in place in Guatemala. Because the Guatemalan fishery regularly catches and retains shark species of concern (CeDePesca 2013), and there is no management plan in place, the management strategy is considered to be of "very high" concern. We have therefore awarded a corresponding score of "ineffective."

Justification:

IATTC has recently addressed the broader ecosystem implications of some EPO fishing practices and has supported several measures to reduce the impacts of longline fishers on shark populations (IATTC 2013). Among these are a prohibition on the retention and sale of oceanic white tip sharks (Resolution C-11-10, 2011), catch restrictions for longline caught silky shark (Resolution C-16-06), and the soliciting of funding to support the development of technologies to allow for the release, and post-release monitoring of sharks and rays (Resolution C-04-05, 2006; REF). As a member of IATTC, Guatemala is bound by these guidelines. However, there is no management plan for vulnerable shark populations that are retained.

Factor 3.2 - Bycatch Strategy

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Moderately Effective

Sea Turtles
Guatemala has a National Strategy for the Management and Conservation of Sea Turtles (Jolon 2005). Sea turtle regulations are monitored through the Fishing and Aquaculture Regulations Office of the Ministry of Agriculture (IAC 2013). Although not mandatory, the mahi mahi fishery uses circle instead of J hooks, which has resulted in decreased mortality rates for sea turtles and helps with the release of sea turtles (CeDePesca 2013) (Secretaria 2006) (CeDePesca 2015). DIPESCA, through the General Law of Fisheries and Aquaculture Decree No. 80-2002, limits the number of hooks and size in longline fishing (for small scale vessels, main line with a maximum of 1,000 hooks; for medium- and large-scale vessels, a maximum of 2,000 hooks that are at least 1.5 inches) (DIPESCA 2002). Fishers have attended workshops dealing with bycatch issues. The above measures can potentially reduce incidental capture of sea turtles. However, the level of compliance of all of these measures is not known. Guatemala has additional management measures to protect nesting habitats of sea turtles (IAC 2015).

We have awarded a score of "moderately effective" because sea turtle bycatch has been addressed to some degree.

Factor 3.3 - Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - 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.

Factor 3.5 - 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, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

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 (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 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*

GUIDING PRINCIPLES

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Guatemala / Eastern Central Pacific / Drifting longlines / Guatemala	5	0	Moderate Concern	Green (3.873)

Criterion 4 Assessment

SCORING GUIDELINES

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

Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - 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. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*

- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - 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 - Modifying Factor: Mitigation of Gear Impacts

Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management

Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

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

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

5

Pelagic longlines do not come into contact with bottom habitats; therefore, the effect of fishing gear on the substrate is scored 5 according to the SFW criteria.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

0

Pelagic longline fishing gear does not come in contact with bottom habitats; therefore, no mitigation methods are needed.

Factor 4.3 - Ecosystem-Based Fisheries Management

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Moderate Concern

IATTC has recently addressed the broader ecosystem implications of some EPO fishing practices and has supported several measures to reduce the impacts of longline fishers on shark populations (IATTC 2013). Among these are a prohibition on the retention and sale of oceanic white tip sharks (Resolution C-11-10, 2011), catch restrictions for longline-caught silky shark (Resolution C-16-06), and solicitation of funding to support development of technologies that allow for the release, and post-release monitoring of sharks and rays (Resolution C-04-05, 2006; REF). As a member of IATTC, Guatemala is bound by these guidelines. Guatemala has additional management measures to protect nesting habitats of sea turtles (IAC 2015). Some recent projects are being implemented to address ecosystem impacts. For example, the Ministry of Environment and Natural Resources and the National Council of Science and Technology are working to build the National Coastal Marine Research Strategy of Guatemala (UNDP 2017), and the first phase of a marine spatial arrangement proposal for Guatemala was initiated in May of 2018 (UNDP 2018). We have awarded a score of "moderate" concern because detrimental food web impacts are possible, and there is some ecosystem-based management in place; however, stronger policies may be needed to fully protect the ecological role of harvested species

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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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References

Abreu-Grobois, A & Plotkin, P. (IUCN SSC Marine Turtle Specialist Group) 2008. Lepidochelys olivacea. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2.

Aires-da-Silva, A., Valero, J.L., Maunder, M.N.. Vera, C.M., Cody, C.L. et al. 2016. Stock assessment of dorado (Coryphaena hippurus) in the south eastern Pacific Ocean. 7th Meeting of the IATTC Scientific Advisory Meeting. Available at: http://www.iattc.org/Meetings/Meetings2016/SAC7/PDFfiles/presentations/SAC-07-06a(i)-Dorado-assessment.pdf

Alfaro-Shigueto, J.,Mangel, J.C., Pajuelo,M., Dutton, P., Seminoff, J.& Godley, B.J. (2010) Where small scale can have a large impact: structure and characterization of small-scale fisheries in Peru. Fisheries Research, 106, 8–17.

Amorim, A., Baum, J., Cailliet, G.M., Clò, S., Clarke, S.C., Fergusson, I., Gonzalez, M., Macias, D., Mancini, P., Mancusi, C., Myers, R., Reardon, M., Trejo, T., Vacchi, M. & Valenti, S.V. 2009. Alopias superciliosus. The IUCN Red List of Threatened Species 2009: e.T161696A5482468

Andraka, S., Mug, M., Hall, M., Pons, M. et al. 2013. Circle hooks: developing better fishing practices in the artisnal longline fisheries of the eastern Pacific Ocean. Biological Conservation 160:214-223. https://www.sciencedirect.com/science/article/pii/S0006320713000414

Arenales, I.F., Velasquez, C., Rodas, M. and Prado, J. 2009. Areas de crianza de tiburones en la plataforma continental del Paci??co de Guatemala: Herramienta para el manejo y aprovechamiento sostenido del recurso tiburon. Proyecto Fodecyte No. 13-2006. http://glifos.concyt.gob.gt/library/index.php?title=3587&query=@title=Special:GSMSearchPage@process=@encabezamiento=.%20@mode=&recnum=55

Beardsley, G.L., 1967. Age, growth, and reproduction of the dolphin, Coryphaena hippurus, in the Straits of Florida. Copeia 1967(2):441-451. https://www.jstor.org/stable/1442132?seq=1#page_scan_tab_contents

Bran, R.L. 2010. Contribution al desarrollo de la pesqueria de Dorad (Coryphaena hippurus, Linneaus, 1758), en la zona econmica exclusiva ZEE del Oceano Pacifico gutemalteco. Proyecto Agrocyte No. 32-2006. http://www.academia.edu/10275420/Contribuci%C3%B3n_al_desarrollo_de_la_pesquer%C3%ADa_de_Dorado_

Branstetter, S., 1987. Age, growth and reproductive biology of the silky shark, Carcharhinus falciformis, and the scalloped hammerhead, Sphyrna lewini, from the northwestern Gulf of Mexico. Environ. Biol. Fish. 19(3):161-173. https://link.springer.com/article/10.1007/BF00005346

Burgess, H. G. & Branstetter, S. 2009. Carcharhinus limbatus. The IUCN Red List of Threatened Species 2009: e.T3851A10124862. http://dx.doi.org/10.2305/IUCN.UK.2009-2.RLTS.T3851A10124862.en .

CeDePesca, 2013. Mahi mahi longline fishery in the Pacific coast of Guatemala. Performance study against the Marine Stewardship Council Standard for Sustainable Fisheries. Prepared by DeDePesca, October 2013. http://www.seadelightoceanfund.org/pdf/msc-performance-study-guatemala.pdf

CeDePesca. 2015. Guatemala Pacific mahi mahi fishery improvement project. Centro Desarrollo y Pesca Sustentable. http://cedepesca.net/promes/tuna-and-large-pelagics/guatemala-pacific-mahi-mahi/

Cifuentes-Velasco. B. 2013. National Regulations to Eliminate IUU Fishing in Guatemala. United Nations--Nippon Foundation Fellowship Alumni. http://www.unfalumni.org/national-regulations-to-eliminate-iuu-fishing-in-guatemala/

Clarke, S. 2013. Towards and integrated shark conservation and management measure for the Western and Central Pacific Ocean. Pacific Islands Regional Office and National Oceanic and Atmospheric Administration. WCPFC-SC9-2013/EB-WP-08. https://www.wcpfc.int/system/files/EB-WP-08-Integrated-shark-CMM.pdf

Collette, B.B., 1999. Coryphaenidae. Dolphinfishes, "dolphins". p. 2656-2658. In K.E. Carpenter and V.H. Niem (eds.) FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Volume 4. Bony fishes part 2 (Mugilidae to Carangidae). FAO, Rome. http://www.fao.org/docrep/009/x2400e/x2400e00.htm

Collette, B., Acero, A., Amorim, A.F., Boustany, A., Canales Ramirez, C., Cardenas, G., Carpenter, K.E., de Oliveira Leite Jr., N., Di Natale, A., Fox, W., Fredou, F.L., Graves, J., Viera Hazin, F.H., Juan Jorda, M., Minte Vera, C., Miyabe, N., Montano Cruz, R., Nelson, R., Oxenford, H., Schaefer, K., Serra, R., Sun, C., Teixeira Lessa, R.P., Pires Ferreira Travassos, P.E., Uozumi, Y. & Yanez, E. 2011a. Coryphaena hippurus. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1. http://www.iucnredlist.org/details/154712/0

Compagno, L.J.V., 1984. FAO Species Catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 2 - Carcharhiniformes. FAO Fish. Synop. 125(4/2):251-655. Rome: FAO. http://www.fao.org/docrep/009/ad123e/ad123e00.HTM

Compagno, L.J.V. and V.H. Niem, 1998. Carcharhinidae. Requiem sharks. p. 1312-1360. In K.E. Carpenter and V.H. Niem (eds.) FAO Identification Guide for Fishery Purposes. The Living Marine Resources of the Western Central Pacific. FAO, Rome.

Crowder, LB., Hazen, E.L., Avissar, N., Bjorkland, R., Latanich, C. and Ogburn, M.B. 2008. The impacts of fisheries on marine ecosystems and the transition to ecosystem based management. Annual Review of Ecology, Evolution and Systematics. doi:10.1146/annurev.ecolsys.39.110707.173406

Delgado-Trejo C, Alvarado-Díaz J (2012) Current conservation status of the black sea turtle in Michoacan, Mexico. in press In: Advances in Research and Conservation. University of Arizona Press, Tucson. Seminoff JA, Wallace BP (eds) Sea Turtles of the Eastern Pacific. 386 pp.

DIPESCA. 2002. Ley General de Pesca y Acuicultura [Decreto 80-2002] \y su Reglamento [Acuerdo Gubernativo 223-2005]. Ministerio De Agricultura, Ganaderia Y Alimentacion.

FAO. 2017. Global production: Fishery statistical collections. Food and Agriculture Organization. Available at: http://www.fao.org/fishery/statistics/global-production/en

Fonteneau, A., Chassot, E. and Bodin, N. 2013. Global spatio-temporal patterns in tropical tuna purse seine fisheries on drifting fish aggregating devices (DFADs): Taking historical perspective to inform current challenges. Aquatic Living Resources 26:37-48. Available at: https://www.cambridge.org/core/journals/aquatic-living-resources/article/global-spatio-temporal-patterns-in-tropical-tuna-purse-seine-fisheries-on-drifting-fish-aggregating-devices-dfads-taking-a-historical-perspective-to-inform-current-challenges/0A00E8E2AA3D636D1F5F48577AB6DF7A

FR. 2015. Endangered and threatened wildlife; 90-day finding on a petition to list the common thresher shark as Threatened or Endangered under the Endangered Species Act. Federal Register 80 FR 11379. https://www.federalregister.gov/documents/2015/08/11/2015-19551/endangered-and-threatened-wildlife-90-day-finding-on-a-petition-to-list-the-bigeye-thresher-shark-as

Froese, R. and D. Pauly. Editors. 2017.FishBase. World Wide Web electronic publication. www.fishbase.org, (

10/2017)

Gallagher, A.J., Serafy, J.E., Cooke, S.J. and Hammerschlag, N. 2014. Physiological stress response, reflect impairment, and survival of five sympatric shark species following experimental capture and release. Marine Ecology Progress Series 496:207-218. https://www.researchgate.net/publication/260079171_Physiological_stress_response_reflex_impairment_and_su

Goldman, K.J., Baum, J., Cailliet, G.M., Cortés, E., Kohin, S., Macías, D., Megalofonou, P., Perez, M., Soldo, A. & Trejo, T. 2009. Alopias vulpinus. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1. http://www.iucnredlist.org/details/39339/0

IAC. 2013. Guatemala annual report 2013. Inter-American Convention for the Protection and Conservation of Sea Turtles. http://www.iacseaturtle.org/docs/informes-anuales/2013/Informe_Anual_Guatemala_2013.pdf

IAC. 2015. Guatemala Informe Anual 2015-2015. Convencion Interamericana para la Proteccion y Conservacion de las Tortugas Marinas.

IAC. 2017. Conservation status and habitat use of sea turtles in the Eastern Pacific Ocean. Eighth Meeting of the Scientific Advisory Committee, 15-18 May, 2012, La Jolla, CA. CIT-CC8-2011-Tec.1.

IATTC. 2013. Preliminary results from mahimahi (dorado) collaborative research with IATTC member countries. 4th Meeting of the IATTC Scientific Advisory Meeting, 29 April - 3 May, 2013, La Jolla, CA. https://www.iattc.org/Meetings/Meetings2013/May/_English/SAC-04-MAHI-SAC4-presentation.pdf

IATTC. 2013b. Stock status of the silky shark in the Eastern Pacific Ocean. 4th Meeting of the IATTC Scientific Advisory Meeting, 29 April - 3 May, 2013, La Jolla, Ca.

Inter-American Tropical Tuna Commission (IATTC). 2013c. Bycatch management. 4th Meeting of the Scientific Committee, 29 April - 3 May, 2013, La Jolla, CA.

IATTC 2013d. 4th Meeting of the Scientific Advisory Committee Report. May 2013.

IATTC. 2014. A collaborative attempt to conduct a stock assessment for the silky shark in the eastern Pacific Ocean (1993-2010): Update report. Inter-American Tropical Tuna Commission Scientific Advisory Committee Fifth Meeting Document SAC-05 INF-F. https://www.iattc.org/Meetings/Meetings2014/MAYSAC/PDFs/SAC-05-INF-F-Assessment-of-silky-sharks.pdf

IATTC. 2015. Updated stock status indicators for silky sharks in the eastern Pacific Ocean (1994-2014). IATTC Document SAC-06-08b.

IATTC. 2016. Updated stock status indicators for silky sharks in the eastern Pacific Ocean (1994-2015). Document SAC-07-06bi. Available at: http://www.iattc.org/Meetings/Meetings2016/SAC7/PDFfiles/SAC-07-06b(i)-Indicators-for-silky-shark.pdf

ISC. 2017. Stock assessment and future projections of blue shark in the north Pacific Ocean through 2015. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean. Available at: https://www.wcpfc.int/system/files/SC13-SA-WP-10%20Stock%20Assessment%20and%20Projections%20Blue%20Shark.pdf

ISCSWG. 2014. Stock assessment and future projections of blue shark in the North Pacific Ocean. Report of the Shark Working Group. International Scientific Committee for Tuna and Tuna-like species in the North Pacific

Ocean. 16-21 July 2014 Taipei, Chinese- Taipei.

Ixquiac and Juarez. 2014. Estado de la pesqueria del Dorado en el Pacifico de Guatemala. DIPESCA, CEMA, FUNDAECO, Manta, Ecuadro, 2014.

Jolon, R. 2005. Guatemala en la Protection y Conservacion de Tortugas Marinas. Nueva Guatemala de la Asuncion.

Jones, T.T., Bostrom, B.L., Hastings, M.D., Van Houtan, K.S., Pauly, D. and Jones, D.R. 2012. Resource requirements of the Pacific leatherback turtle population. PLoS ONE 7:e45447/dpi:10.1371/journal.pone.0045447.

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

Lemus-Guzman J.A. 2012. The Commanders Respond: Guatemalan Navy. Proceedings Magazine--United States Naval Institute. March 42 2012. https://www.usni.org/magazines/proceedings/archive/2012

Lewison, R., Crowder, L.B., Read, A.J. and Freeman, S.A. 2004. Understanding impacts of fisheries bycatch on marine megafauna. Trends in Ecology and Evolution 19:598-607. https://www.sciencedirect.com/science/article/pii/S0169534704002642

MAGNA-CONAP. 2016. Informe sobre recopilacion de informacion bilogica y de aprovechamiento de tiburon a pequena escala para la subsistencia de las comunidades pesqueras y Aplicacion de la Guia practica sobra la CITES y los medios de subsistencia. Ministerio de Agricultura Ganaderia y Alimentacion CONAP

McBride, R. S., Snodgrass, D. J., Adams, D. H., Rider, S. J., & Colvocoresses, J. A. (2012). An indeterminate model to estimate egg production of the highly iteroparous and fecund fish, dolphinfish (Coryphaena hippurus). Bulletin of Marine Science, 88, 283–303. https://doi.org/10.5343/bms.2011.1096

Mortimer, J.A & Donnelly, M. (IUCN SSC Marine Turtle Specialist Group). 2008. Eretmochelys imbricata. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. http://www.iucnredlist.org/details/8005/0

Musyl, M.K., Brill, R.W., Curran, D.S., Fragoso, N.M., McNaughton, L.M., Nielsen, A., Kikkawa, B and Moyes, C. 2011. Post release survival, vertical and horizontal movements, and thermal habitats of five species of pelagic sharks in the central Pacific Ocean. Fisheries Bulletin 109:341-368. http://aquaticcommons.org/8696/1/musyl_Fish_Bull_2011.pdf

National Marine Fisheries Service (NMFS). 2010. Highly migratory species management team report on Fishery Management Plan Amendment 2, annual catch limits and accountability measures. Supplement HMSMT Report June 2010. https://www.pcouncil.org/highly-migratory-species/fishery-management-plan-and-amendments/amendment-2/

National Marine Fisheries Service (NMFS). 2012. Endangered Species Act - Section 7 Consultation Biological Opinion. National Marine Fisheries Service, Pacific Islands Region, Protected Resources Division. 162 pg. http://www.fpir.noaa.gov/PRD/prd_esa_section_7.html

NMFS. 2015b. Annual trade data by product, country/association. National Marine Fisheries Service

National Marine Fisheries Service (NMFS). 2015. Summary of stock status for FSSI stocks. National Marine Fisheries Service.

http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/archive/stock_status_archive.html#acc2015

NMFS. 2017. Annual trade data by product, country/association. National Marine Fisheries Service Fisheries Statistics and Economics Division

NRPP. 2012. Central America and Dominican Republic outlaw shark finning. Natural Resources Policy and Practice. http://www.sharksavers.org/en/our-programs/shark-sanctuaries/learn-more/laws-protecting-sharks

Oxenford, H.A. 1999. Biology of the dolphinfish (Coryphaena hippurus) in the western central Atlantic: a review.: Sci. Mar. 63(3/4):277-301.
http://scientiamarina.revistas.csic.es/index.php/scientiamarina/article/viewArticle/864

Parga, M. L. 2012. Hooks and sea turtles: a veterinarian's perspective. Bulletin of Marine Science 88:731–741.

Parga, M.L, Pons, M., Andraka, S., Rendon, L., Mituhasi, T., Hall, M., Pacheco, L., Segura, A., Osmond, M. and Vogel, N. 2015. Hooking locations in sea turtles incidentally captured by artisanal longline fisheries in the eastern Pacific Ocean. Fisheries Research 164:231- 237.
https://www.sciencedirect.com/science/article/pii/S0165783614003385

Pacific Fishery Management Council (PFMC). 2013. Stock Assessment and Fishery Evaluation (SAFE) documents: current HMS SAFE report. Pacific Fishery Management Council, Portland, OR.
http://www.pcouncil.org/wp-content/uploads/2014_HMS_SAFE_Report_archive_copy.pdf

Polovina, J.J., M. Abecassis, E.A. Howell, P. Woodworth. 2009. Increases in the relative abundance of mid-trophic level fishes concurrent with declines in apex predators in the subtropical North Pacific , 1996 – 2006. Fishery Bulletin: 523-531.
https://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/6777/Increases%20in%20the%20relative%20abundance
sequence=1

Reardon, M., Márquez, F., Trejo, T. & Clarke, S.C. 2009. Alopias pelagicus. The IUCN Red List of Threatened Species 2009: e.T161597A5460720. http://dx.doi.org/10.2305/IUCN.UK.2009-2.RLTS.T161597A5460720.en .

Rigby, C.L., Sherman, C.S., Chin, A. & Simpfendorfer, C. 2016. Carcharhinus falciformis. The IUCN Red List of Threatened Species 2016: e.T39370A2909465. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T39370A2909465.en

Rosa, R.S., Castro, A.L.F., Furtado, M., Monzini, J. & Grubbs, R.D. 2006. Ginglymostoma cirratum. The IUCN Red List of Threatened Species 2006: e.T60223A12325895.
http://dx.doi.org/10.2305/IUCN.UK.2006.RLTS.T60223A12325895.en.

Schwenke, K.L. and Buckel, J.A. 2008. Age, growth, and reproduction of dolphinfish (Coryphaena hippurus) caught off the coast of North Carolina. Fish. Bull. 106: 82-92. http://aquaticcommons.org/8858/

Secretaría CIT (2006). Pesquerías y Tortugas Marinas. Mayo 2006, San José, Costa Rica.
http://www.iacseaturtle.org/docs/publicaciones/8-Pesquerias-FINAL-ESP.pdf

Seminoff, J.A. 2004. Chelonia mydas. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2

Simpfendorfer, C. & Burgess, G.H. 2009. Carcharhinus leucas. The IUCN Red List of Threatened Species 2009: e.T39372A10187195. http://dx.doi.org/10.2305/IUCN.UK.2009-2.RLTS.T39372A10187195.en

Spotila, J.R., Dunham, A.E., Leslie, A.J., Steyermark, A.C., Plotkin, P.T. and Paladino, F.V. 1996. Worldwide population decline of Dermochelys coriacea: are leatherback turtles going extinct? Chelonian Conservation and Biology 2:209-222

Torrejon-Magallanes and Oliveros-Ramos. 2015b. Una vision a la evaluacion de stocks del Perico/Dorado (Coryphaena hippurus) a partir de la informacion de la pesqueria en Peru. Peru Ministerio de la Produccion. https://www.iattc.org/Meetings/Meetings2015/DOR-02/pdfs/presentations/_Spanish/DOR-02_Evaluacion-de-stocks-del-perico-a-partir-de-la-informacion-de-la-pesqueria-en-Peru.pdf

Uchiyama JH, Boggs CH (2006) Length-weight relationships of dolphinfish,Coryphaena hippurus, and wahoo,Acanthocybiumsolandri: seasonal effects of spawning and possible migration in the central North Pacific. Mar Fish Rev 68(1–4):19–29. http://agris.fao.org/agris-search/search.do?recordID=AV2012094725

Uchiyama, J.H., R.K. Burch and S.A. Kraul Jr., 1986. Growth of dolphins, Coryphaena hippurus and C. equiselis in Hawaiian waters as determined by daily increments on otoliths. Fish. Bull. 84(1):186-191.

UNDP. 2017. Construyen Estrategia Nacional de Investigacion Marino Costera (ENIMC) en Guatemala. United Nations Development Program.

UNDP. 2018. Una herramienta innovadora se lanza para conservar los territorios marinos de Guatemala. United Nations Development Program.

Vega, A.A., 2018. Abundancia, distribucion y estructura poblacional de tiburon martillo (Sphyrna lewini) en zonas de pesca artesanal en el Pacifico de Guatemala sistematizacion de practica profesional. Guatemala de la Asuncision.

Villagran et al. 2012. International Symposium on circle hooks in research, management and conservation - abstracts. Bulletin of Marine Science 88:791-815.

Wallace, B.P., Kot, C.Y., MiMatteo, A.D., Lee, T., Crowder, L.B. and Lewison, R.L. 2013. Impacts of fisheries bycatch on marine turtle populations worldwide: toward conservation and research priorities. Ecosphere 4:40.http://dx.doi.org/10.1980/ES12-00388.1

Wallace, B.P., Tiwari, M. & Girondot, M. 2013b. Dermochelys coriacea. The IUCN Red List of Threatened Species 2013: e.T6494A43526147. http://dx.doi.org/10.2305/IUCN.UK.2013-2.RLTS.T6494A43526147.en.

Whoriskey, S., Arauz, R. and Baum, J.K. 2011. Potential impacts of emerging mahi-mahi fisheries on sea turtle and elasmobranch bycatch species. Biological Conservation 144;1841-1849. Available at: http://www.seaturtle.org/pdf/WhoriskeyS_2011_BiolConserv.pdf

Zhu, J. and Dai, X. 2014. CPC observer annual report for the year 2013 in the IATTC convention area. Document SAC-05 INF-C.

Appendix A: Extra By Catch Species

LEATHERBACK TURTLE

Factor 2.1 - Abundance

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

High Concern

Leatherback sea turtles have been listed as "Endangered" under the U.S. Endangered Species Act (ESA) since 1970 (NMFS 2012). In 2000, the IUCN classified leatherback turtles as "Critically Endangered," with a decreasing population trend (Wallace et al. 2013b). Leatherback turtles have been listed in the Convention on International Trade in Endangered Species (CITES) since 1975 and are currently listed under CITES Appendix 1 (NMFS 2012), meaning that they are threatened with extinction and international trade is prohibited. Over the past 25 years, the population of leatherbacks in the Pacific Ocean has decreased significantly (Spotila et al. 1996). Recent estimates from the Pacific Ocean suggest a population size of 294,068 turtles, and out of these, 6,199 are adults (Jones et al. 2012). We have awarded a score of "high" concern based on the ESA, IUCN, and CITES listings.

Factor 2.2 - Fishing Mortality

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Moderate Concern

Fishing mortality is believed to be a major threat to leatherback turtles, especially for juveniles, and adults that can be incidentally captured in fisheries along their migration routes (Wallace et al. 2013b). In the eastern Pacific Ocean, bycatch in longline fisheries is thought to be low impact, but interactions are a high risk to the population size overall (Wallace 2013). The Guatemalan fleet uses only circle hooks, which have been shown to reduce mortality in sea turtles (CeDePesca 2013) (Andraka et al. 2013) (Parga et al. 2015). We have awarded a score of "moderate" concern because circle hooks are used and have been shown to reduce sea turtle bycatch and associated mortality.

Justification:

There have been issues with compliance in other regions of the Pacific Ocean (Clarke 2013). According to Andraka et al., 99% of individual sea turtles caught in surface longlines in the EPO are alive (Andraka et al. 2013). However, the severity of the interaction and chances of post-release survival depend on the type of interaction, the manipulation of the individual, and release techniques (Parga et al. 2015) (Parga 2012). For example, entanglements in the line can increase the mortality rate in some cases (Parga 2012).

Factor 2.3 - Discard Rate

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

< 100%

Discard rates are unknown for the mahi mahi fisheries in Guatemala. Small-scale operators typically have lower discard rates than industrial scale vessels (Kelleher 2005), because artisanal fishers are able to utilize more of the incidental catch. Kelleher assumed a discard rate of <1 to 5% for artisanal fisheries (Kelleher 2005), which land the majority of mahi mahi in Guatemala (Arenales et al. 2009). Kelleher also found that industrial-scale longliners targeting tuna averaged a discard rate of 28.5% (Kelleher 2005). We have awarded the lowest discard rate of <100% because the majority of mahi mahi in Guatemala are caught by small-scale

vessels, which have lower discard rates.

HAWKSBILL TURTLE

Factor 2.1 - Abundance

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

High Concern

The IUCN has classified hawksbill turtles as "Critically Endangered," with a decreasing population trend (Mortimer and Donnelly 2008). Hawksbill turtles have been listed in the Convention on International Trade in Endangered Species (CITES) since 1977 and are currently listed in CITES Appendix 1, meaning they are threatened with extinction and international trade is prohibited (Mortimer and Donnelly 2008). It has been estimated that populations in the Pacific Ocean have declined by over 75% over three generations (Mortimer and Donnelly 2008). We have awarded a score of "high" concern based on the IUCN listing and evidence of declining population size.

Factor 2.2 - Fishing Mortality

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Moderate Concern

Incidental capture of hawksbill turtles has been identified as adversely affecting their recovery worldwide, although declines in the population of hawksbill turtles is mainly a factor of historical targeting (Mortimer and Donnelly 2008). Hawksbill sea turtles are reported as incidentally captured in longline fisheries in the eastern Pacific Ocean (IAC 2012). The bycatch impacts in this region are considered low, but a high risk to the population size (Wallace et al. 2013). The Guatemalan fleet uses only circle hooks, which have been shown to reduce mortality in sea turtles (CeDePesca 2013) (Andraka et al. 2013) (Parga et al. 2015). We have awarded a score of "moderate" concern because circle hooks are used and are known to reduce sea turtle bycatch and associated mortality.

Justification:

There have been issues with compliance in other regions of the Pacific Ocean (Clarke 2013). According to Andraka et al., 99% of individual sea turtles caught in surface longlines in the EPO are alive (Andraka et al. 2013). However, the severity of the interaction and chances of post-release survival depend on the type of interaction, the manipulation of the individual, and release techniques (Parga et al. 2015) (Parga 2012). For example, entanglements in the line can increase the mortality rate in some cases (Parga 2012).

Factor 2.3 - Discard Rate

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

< 100%

Discard rates are unknown for the mahi mahi fisheries in Guatemala. Small-scale operators typically have lower discard rates than industrial scale vessels (Kelleher 2005), because artisanal fishers are able to utilize more of the incidental catch. Kelleher assumed a discard rate of <1 to 5% for artisanal fisheries (Kelleher 2005), which land the majority of mahi mahi in Guatemala (Arenales et al. 2009). Kelleher also found that industrial-scale longliners targeting tuna averaged a discard rate of 28.5% (Kelleher 2005). We have awarded the lowest discard rate of <100% because the majority of mahi mahi in Guatemala are caught by small-scale

vessels, which have lower discard rates.

GREEN SEA TURTLE

Factor 2.1 - Abundance

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

High Concern

The IUCN has classified green sea turtles as "Endangered," with a decreasing population trend (Seminoff 2004). Green sea turtles have been listed in the Convention on International Trade in Endangered Species (CITES) since 1975 and are currently listed on CITES Appendix 1, meaning that they are threatened with extinction and international trade is prohibited (Seminoff 2004). However, this assessment is ten years old and more recent information suggests that populations in Mexico have been increasing over the past ten years (Delgado-Trejo and Alvarado-Diaz 2012). A recent analysis of the Eastern Pacific Distinct Population Segment by the US Endangered Species Act found the DPS should be considered "threatened" and not "endangered" (FR 2015). We have awarded a score of "high" concern due to their threatened status.

Factor 2.2 - Fishing Mortality

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Moderate Concern

Incidental capture in fisheries is considered a major threat to green sea turtles worldwide (Seminoff 2004), but there are regional differences. Green sea turtles are reported as incidentally captured in longline fisheries in the eastern Pacific Ocean (IAC 2017). The bycatch impacts in this region are considered low, but a high risk to the population size (Wallace et al. 2013). The Guatemalan fleet uses only circle hooks, which have been shown to reduce mortality in sea turtles (CeDePesca 2013) (Andraka et al. 2013) (Parga et al. 2015). We have awarded a score of "moderate" concern because circle hooks are used and known to effectively reduce sea turtle bycatch.

Justification:

There have been issues with compliance in other regions of the Pacific Ocean (Clarke 2013). According to Andraka et al., 99% of individual sea turtles caught in surface longlines in the EPO are alive (Andraka et al. 2013). However, the severity of the interaction and chances of post-release survival depend on the type of interaction, the manipulation of the individual, and release techniques (Parga et al. 2015) (Parga 2012). For example, entanglements in the line or ingestion of the hook can increase the mortality rate in some cases (Parga 2012).

Factor 2.3 - Discard Rate

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

< 100%

Discard rates are unknown for the mahi mahi fisheries in Guatemala. Small-scale operators typically have lower discard rates than industrial scale vessels (Kelleher 2005), because artisanal fishers are able to utilize more of the incidental catch. Kelleher assumed a discard rate of <1 to 5% for artisanal fisheries (Kelleher 2005), which land the majority of mahi mahi in Guatemala (Arenales et al. 2009). Kelleher also found that industrial-scale longliners targeting tuna averaged a discard rate of 28.5% (Kelleher 2005). We have awarded the lowest discard rate of <100% because the majority of mahi mahi in Guatemala are caught by small-scale

vessels, which have lower discard rates.

OLIVE RIDLEY TURTLE

Factor 2.1 - Abundance

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

High Concern

The IUCN considers the population of olive ridley sea turtles to be "Vulnerable" (Abreu-Grobois and Plotkin 2008). In the eastern Pacific Ocean, estimates of the total number of nests range from 608 protected nests in Mexico to 33,530 to 68,753 nests in Nicaragua (Abreu-Grobois and Plotkin 2008). Female population size ranges from 8,768 in Panama to 1,013,034 in Mexico (Abreu-Grobois and Plotkin 2008). The annual nesting female sub-population size has decreased by 99% in some regions in Mexico, increased substantially in others, and not changed at all in areas such as Nicaragua (Abreu-Grobois and Plotkin 2008). Overall, the annual nesting female sub-population size in the eastern Pacific Ocean has declined to around 35% over time (Abreu-Grobois and Plotkin 2008), but the risk to populations from longline fishing in this region is considered low (Wallace et al. 2013). A score of "high" concern is awarded based on the IUCN classification.

Factor 2.2 - Fishing Mortality

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Moderate Concern

Incidental capture of olive ridley sea turtles occurs worldwide. Impacts from other fisheries, such as trawl and gillnets, appear to have a larger negative impact in many areas compared to longlines, except for the Eastern Pacific Ocean (EPO) (Abreu-Grobois and Plotkin 2008) (Wallace et al. 2013). Within this region, the impact from incidental captures in longline fisheries is considered high (Wallace et al. 2013). For example, during 2000, the Japanese reported the incidental capture of 6,000 sea turtles, the majority of which were olive ridleys (exact number not provided) (IATTC 2013c). The Guatemalan fleet uses only circle hooks, which have been shown to reduce mortality in sea turtles (CeDePesca 2013) (Andraka et al. 2013) (Parga et al. 2015). Olive ridley are the most commonly captured turtle in this fishery (Villagran et al. 2012). We have awarded a score of "moderate" concern because circle hooks are used and have been shown to reduce sea turtle bycatch and associated mortality.

Justification:

There have been issues with compliance in other regions of the Pacific Ocean (Clarke 2013). According to Andraka et al., 99% of individual sea turtles caught in surface longlines in the EPO are alive (Andraka et al. 2013). However, the severity of the interaction and chances of post-release survival depend on the type of interaction, the manipulation of the individual, and release techniques (Parga et al. 2015) (Parga 2012). For example, entanglements in the line can increase the mortality rate in some cases (Parga 2012).

Factor 2.3 - Discard Rate

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

< 100%

Discard rates are unknown for the mahi mahi fisheries in Guatemala. Small-scale operators typically have lower discard rates than industrial scale vessels (Kelleher 2005), because artisanal fishers are able to utilize

more of the incidental catch. Kelleher assumed a discard rate of <1 to 5% for artisanal fisheries (Kelleher 2005), which land the majority of mahi mahi in Guatemala (Arenales et al. 2009). Kelleher also found that industrial-scale longliners targeting tuna averaged a discard rate of 28.5% (Kelleher 2005). We have awarded the lowest discard rate of <100% because the majority of mahi mahi in Guatemala are caught by small-scale vessels, which have lower discard rates.

SILKY_SHARK

Factor 2.1 - Abundance

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

High Concern

Silky sharks are assessed as "Vulnerable" with a decreasing population trend by the International Union for Conservation of Nature (IUCN) (Rigby et al. 2016). We have awarded a score of "high" concern based on the IUCN status combined with their high vulnerability to fishing and unknown population status.

Justification:

The Inter-American Tropical Tuna Commission has begun conducting an assessment of silky sharks in the eastern Pacific Ocean (EPO). Preliminary results were presented in early 2013 (IATTC 2013g). According to these results, the abundance of silky sharks caught in purse seine sets made on floating objects in the southern region decreased dramatically in the late 1990s and remained stable thereafter, but has been increasing slightly in more recent years. In the southern region, declines occurred into the early 2000s and have been stable, although increasing slightly in 2008 to 2010. Abundance of silky sharks caught in the northern region on both dolphin and unassociated sets have varied from the early to mid 2000s and increased dramatically in 2010. In the southern region, abundance in dolphin sets has been variable with no real trend, and on unassociated sets have been fairly low since the late 1990s, although an increase in 2010 is evident (IATTC 2013g). Purse seine indices of abundance were updated in 2015, which indicated an increase in silky sharks (index) during 2015, compared to 2014, in the northern area (IATTC 2016g). However, environmental variables such as El Niño may have contributed to this increase and it may not be the result of actual population increases (IATTC 2016g).

Factor 2.2 - Fishing Mortality

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Moderate Concern

Silky sharks are caught as bycatch in purse seine and longline fisheries operating in the Eastern Pacific Ocean, but are also targeted, in small amounts, in some longline fisheries (IATTC 2013b) (IATTC 2016). The most recent attempt at an assessment for this species indicated that the current fishing mortality rates are unknown (IATTC 2016). We have awarded a score of "moderate" concern because there is a stock assessment available, but fishing mortality rates are unknown.

Factor 2.3 - Discard Rate

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

< 100%

Discard rates are unknown for the mahi mahi fisheries in Guatemala. Small-scale operators typically have lower discard rates than industrial scale vessels (Kelleher 2005), because artisanal fishers are able to utilize

more of the incidental catch. Kelleher assumed a discard rate of <1 to 5% for artisanal fisheries (Kelleher 2005), which land the majority of mahi mahi in Guatemala (Arenales et al. 2009). Kelleher also found that industrial-scale longliners targeting tuna averaged a discard rate of 28.5% (Kelleher 2005). We have awarded the lowest discard rate of <100% because the majority of mahi mahi in Guatemala are caught by small-scale vessels, which have lower discard rates.

BLUE SHARK

Factor 2.1 - Abundance

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Low Concern

The north Pacific stock of blue shark was assessed in 2017. According to the assessment, the biomass has remained near an all time high since 2005. The female spawning biomass in 2015 was 71% above levels needed to produce the maximum sustainable yield (SB_{2015}/SB_{MSY}) (ISC 2017). The population of blue shark in the north Pacific is therefore not overfished. We have awarded a score of "low" concern based on the current assessment results."

Factor 2.2 - Fishing Mortality

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

Low Concern

Blue sharks are widely distributed throughout the North Pacific and dominate shark catches in that region. The last assessment of this species in the North Pacific was conduced in 2017. Current fishing mortality rates are estimated to be well below levels needed to produce the maximum sustainable yield ($F_{2012\text{-}2014}/F_{MSY}$) (ISC 2017). Overfishing is therefore not occurring and we have awarded a score of "low" concern.

Factor 2.3 - Discard Rate

GUATEMALA / EASTERN CENTRAL PACIFIC, DRIFTING LONGLINES, GUATEMALA

< 100%

Discard rates are unknown for the mahi mahi fisheries in Guatemala. Small-scale operators typically have lower discard rates than industrial scale vessels (Kelleher 2005), because artisanal fishers are able to utilize more of the incidental catch. Kelleher assumed a discard rate of <1 to 5% for artisanal fisheries (Kelleher 2005), which land the majority of mahi mahi in Guatemala (Arenales et al. 2009). Kelleher also found that industrial-scale longliners targeting tuna averaged a discard rate of 28.5% (Kelleher 2005). We have awarded the lowest discard rate of <100% because the majority of mahi mahi in Guatemala are caught by small-scale vessels, which have lower discard rates.