Monterey Bay Aquarium

Seafood Watch®

Wahoo and Dolphinfish (Mahi mahi)

Acanthocybium solandri, Coryphaena hippurus

North Atlantic, South Atlantic

Floating object purse seine

July 11, 2016

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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 the associated (floating object) purse seine fishery in the Atlantic Ocean. The primary target species of this fishery are tuna, which have been covered in other published Seafood Watch reports. The target species for this report are secondary target species: mahi mahi *(Coryphaena hippurus)* and wahoo *(Acanthocybium solandri)*. These species are not typically captured in FAD-free purse seine sets.

Wahoo and mahi mahi are fast growing species that reach sexual maturity at a young age and produce a large number of young. Full assessments of mahi mahi and wahoo have not been conducted. There is some indication that mahi mahi populations are stable. Additional species included in this report as other "main species" include tuna and several bycatch species (sharks, finfish, and turtles). There is considerable concern over the status of silky and oceanic white tip sharks, along with sea turtles. Yellowfin and bigeye tuna populations are also of concern. Some measures have been put into place to protect sharks (prohibiting capture of several species) and there are data-reporting requirements. But overall, management of bycatch species caught in purse seine fisheries is considered ineffective.

The International Commission for the Conservation of Atlantic Tunas (ICCAT) manages these species in the Atlantic Ocean. Management measures are in place for most of these species and there are some purse seine specific measures in place as well.

Purse seine gears typically have little contact with bottom habitats, although fish aggregating devices (FADs) can be anchored to the bottom. The incidental capture of ecologically important species may be a concern, particularly in the associated fishery.

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
Wahoo North Atlantic, Floating object purse seine	Green (3.318)	Red (1.000)	Red (1.732)	Red (2.000)	**Avoid (1.841)**
Dolphinfish (Mahi Mahi) North Atlantic, Floating object purse seine	Green (3.831)	Red (1.000)	Red (1.732)	Red (2.000)	**Avoid (1.908)**
Dolphinfish (Mahi Mahi) South Atlantic, Floating object purse seine	Green (3.831)	Red (1.000)	Red (1.732)	Red (2.000)	**Avoid (1.908)**
Wahoo South Atlantic, Floating object purse seine	Green (3.318)	Red (1.000)	Red (1.732)	Red (2.000)	**Avoid (1.841)**

Summary

All species caught in the Atlantic associated purse seine fishery 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 the associated (floating object) purse seine fishery in the Atlantic Ocean. The primary target species of this fishery are tuna, which have been covered in other published Seafood Watch reports. The target species for this report are secondary target species: mahi mahi *(Coryphaena hippurus)* and wahoo *(Acanthocybium solandri)*. These species are not typically captured in FAD-free purse seine sets.

Species Overview

Mahi mahi is a highly migratory species found worldwide in tropical and subtropical waters. 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).

Wahoo is found in tropical and subtropical waters worldwide. It is an epipelagic species of fish that is typically found alone, although while small it may form small groups. Wahoo preys primarily on fish and squid (Froese and Pauly 2015).

All of these species are managed by the International Commission for the Conservation of Atlantic Tunas in international waters of the Atlantic Ocean.

Production Statistics

Catches of mahi mahi in the Atlantic (including the Mediterranean) have increased significantly since 2003. In 2003, 564 MT of mahi mahi were reported caught, followed by 2,632 MT in 2004. Catches peaked at 9,070 MT in 2010 and have since decreased to 2,607 MT in 2013 (ICCAT 2014). Catches of wahoo (Atlantic and Mediterranean) have fluctuated slightly over time, with peaks (≈3,000 MT) occurring during the mid-1990s. Catches were 2,346 MT in 2013 (ICCAT 2014).

Importance to the US/North American market.

The majority of mahi mahi imported to the United States comes from Ecuador (26%), Chinese Taipei (22%), and Peru (21%). (NMFS 2015). In 2010, U.S. landings made up less than 5% of the mahi mahi available in the U.S. marketplace that year (NMFS, 2010). Import statistics for wahoo are not available from the National Marine Fisheries Service.

Common and market names.

Wahoo is also known as ono, Pacific kingfish, tiger fish, ocean barracuda, Malata kingfish, queenfish, and kingfish. Mahi mahi is also known as dolphinfish.

Primary product forms

These species are sold fresh and frozen.

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**
North Atlantic Floating object purse seine	2.00: Medium	4.00: Low Concern	3.67: Low Concern	Green (3.831)
South Atlantic Floating object purse seine	2.00: Medium	4.00: Low Concern	3.67: Low Concern	Green (3.831)

WAHOO				
Region / Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
North Atlantic Floating object purse seine	2.00: Medium	3.00: Moderate Concern	3.67: Low Concern	Green (3.318)
South Atlantic Floating object purse seine	2.00: Medium	3.00: Moderate Concern	3.67: Low Concern	Green (3.318)

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

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Medium

FishBase assigned a moderate vulnerability score of 39 out of 100 (Froese and Pauly 2013). Mahi mahi reaches sexual maturity between 35 and 55 cm in length and within the first year of life. The maximum size and age reached is 210 cm and 4 years. It is a broadcast spawner and high-level predator (Froese and Pauly 2014).

Factor 1.2 - Abundance

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Low Concern

Mahi mahi is assessed along with 13 other “small tunas” in the Atlantic. Currently, there is not enough information to conduct a full assessment of this group (ICCAT 2012a). A separate preliminary attempt at a stock assessment for mahi mahi in the Caribbean and for the U.S. fishery was conducted in 2006. The results suggested that catch rates had been fairly stable over the 10-year study period and that the population was

likely near virgin levels in both areas (Parker et al. 2006). In addition, the International Union for Conservation of Nature (IUCN) considers mahi mahi a species of Least Concern with a stable population trend. We have awarded a "low" concern score due to the IUCN status and the results of the preliminary assessment indicating the population was likely near virgin levels.

Factor 1.3 - Fishing Mortality

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Low Concern

Mahi mahi make up a small proportion of "small tuna" catches in the Atlantic Ocean. No assessment has been conducted due to a lack of data (ICCAT 2012a). Mahi mahi are caught by a variety of gears (Collette et al. 2011d). In the Atlantic, catches have increased considerably since the 1950s but have begun to decrease in recent years (FAO 2013). Fisheries are not considered to be a major threat to this species (Collette et al. 2011d) but mahi mahi is a reported bycatch species in purse seine fisheries (Menard et al. 2000). For example, it made up around 3% of "other fish" species in French and Spanish purse seine fisheries between 2003 and 2007 (Amande et al. 2010). We have awarded a "low" concern score because it is a non-target species and fisheries are not considered to be a major threat.

WAHOO

Factor 1.1 - Inherent Vulnerability

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Medium

FishBase assigned a moderate to high vulnerability score of 46 out of 100. Wahoo reaches sexual maturity around 99 cm in length and 1 year of age. The maximum length attained is 250 cm and it can live to around 9 years of age. Wahoo is a broadcast spawner and considered a top predator (Froese and Pauly 2014). These life history characteristics also suggest a moderate level of vulnerability.

Factor 1.2 - Abundance

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Moderate Concern

In the Atlantic, wahoo is assessed along with 13 other "small tuna" species. Currently, there is not enough information to conduct a full assessment of this group (ICCAT 2012a). The International Union for Conservation of Nature (IUCN) considers the Atlantic population a population of Least Concern, indicating that there is no evidence to suggest populations are declining overall; although local decreases in abundance might have occurred (Collette et al. 2011f). An assessment conducted in the Caribbean suggested stable populations between 1996 and 2006 (Collette et al. 2011f). We have awarded a "moderate" concern score because a stock assessment has not been completed, although it is listed as Least Concern by the IUCN and has a moderate vulnerability level.

Factor 1.3 - Fishing Mortality

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Low Concern

Wahoo makes up a small proportion of "small tuna" catches in the Atlantic Ocean. No assessment has been conducted due to a lack of data (ICCAT 2012a). Catches of wahoo in the Atlantic have been variable over time. Wahoo is a reported bycatch species in purse seine fisheries (Menard et al. 2000), making up around 6% of

the “other fish” catch in the French and Spanish purse seine fisheries between 2003 and 2007 (Amande et al. 2010). In the European purse seine fishery, wahoo had a per set occurrence rate of 53% between 2006 and 2007 (Chassot et al. 2008). Fishing is not thought to have negatively affected wahoo populations in the Atlantic Ocean, although increased fishing on FADs has led to increased fishing and bycatch mortality rates (Collette et al. 2011f). We have awarded a “low” concern score because fishing mortality does not appear to adversely affect the population.

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) - NORTH ATLANTIC - FLOATING OBJECT PURSE SEINE					
Subscore:	**1.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.000**
Species	**Inherent Vulnerability**	**Abundance**		**Fishing Mortality**	**Subscore**
Oceanic whitetip shark	1.00:High	1.00:Very High Concern		1.00:High Concern	Red (1.000)
Bigeye tuna	2.00:Medium	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)
Blue marlin	2.00:Medium	2.00:High Concern		1.00:High Concern	Red (1.414)
Turtles	1.00:High	1.00:Very High Concern		3.67:Low Concern	Red (1.916)
Yellowfin tuna	2.00:Medium	2.00:High Concern		2.33:Moderate Concern	Red (2.159)
Rainbow runner	2.00:Medium	3.00:Moderate Concern		2.33:Moderate Concern	Yellow (2.644)
Blackfin tuna	2.00:Medium	3.00:Moderate Concern		2.33:Moderate Concern	Yellow (2.644)
Albacore tuna	2.00:Medium	2.00:High Concern		5.00:Very Low Concern	Yellow (3.162)
Wahoo	2.00:Medium	3.00:Moderate Concern		3.67:Low Concern	Green (3.318)
Skipjack tuna	2.00:Medium	4.00:Low Concern		3.67:Low Concern	Green (3.831)

DOLPHINFISH (MAHI MAHI) - SOUTH ATLANTIC - FLOATING OBJECT PURSE SEINE					
Subscore:	**1.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.000**
Species	**Inherent Vulnerability**	**Abundance**		**Fishing Mortality**	**Subscore**
Oceanic whitetip shark	1.00:High	1.00:Very High Concern		1.00:High Concern	Red (1.000)

Albacore tuna	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)
Bigeye tuna	2.00:Medium	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)
Blue marlin	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)
Turtles	1.00:High	1.00:Very High Concern	3.67:Low Concern	Red (1.916)
Yellowfin tuna	2.00:Medium	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Blackfin tuna	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Rainbow runner	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Triggerfish spp.	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Wahoo	2.00:Medium	3.00:Moderate Concern	3.67:Low Concern	Green (3.318)
Skipjack tuna	2.00:Medium	4.00:Low Concern	3.67:Low Concern	Green (3.831)

WAHOO - NORTH ATLANTIC - FLOATING OBJECT PURSE SEINE					
Subscore:	**1.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.000**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Oceanic whitetip shark	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.000)
Bigeye tuna	2.00:Medium	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)
Blue marlin	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)
Turtles	1.00:High	1.00:Very High Concern	3.67:Low Concern	Red (1.916)
Yellowfin tuna	2.00:Medium	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Rainbow runner	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Blackfin tuna	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Albacore tuna	2.00:Medium	2.00:High Concern	5.00:Very Low Concern	Yellow (3.162)
Skipjack tuna	2.00:Medium	4.00:Low Concern	3.67:Low Concern	Green (3.831)
Dolphinfish (Mahi Mahi)	2.00:Medium	4.00:Low Concern	3.67:Low Concern	Green (3.831)

WAHOO - SOUTH ATLANTIC - FLOATING OBJECT PURSE SEINE					
Subscore:	**1.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.000**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
Oceanic whitetip shark	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.000)
Albacore tuna	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)
Bigeye tuna	2.00:Medium	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)
Blue marlin	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)
Turtles	1.00:High	1.00:Very High Concern	3.67:Low Concern	Red (1.916)
Yellowfin tuna	2.00:Medium	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Blackfin tuna	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Rainbow runner	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Triggerfish spp.	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Skipjack tuna	2.00:Medium	4.00:Low Concern	3.67:Low Concern	Green (3.831)
Dolphinfish (Mahi Mahi)	2.00:Medium	4.00:Low Concern	3.67:Low Concern	Green (3.831)

Bycatch levels are typically larger in associated vs. unassociated (not assessed in this report) purse seine fisheries. The majority of information related to bycatch in Atlantic purse seine fisheries comes from European fleets {Hall and Martin 2013}. The total bycatch rates in 2008 and 2009 were 13.4% and 19.4%, respectively, on associated fish aggregating device (FAD) sets in the French and Spanish purse seine fisheries {Amande et al. 2011}. A variety of species, including billfish, sharks, and sea turtles, have been reported as caught in associated purse seine fisheries. Species that had high occurrence rates are included in this report as “main species,” as well as some species whose vulnerability status qualifies them for inclusion (based on Seafood Watch criteria) and target tuna species that have been assessed in other Seafood Watch reports. The worst scoring species in the associated fishery is the oceanic whitetip shark, based on its low abundance and high fishing mortality rates.

Floating object

Species	Justification	Source
Oceanic whitetip shark	>5% (3% occurrence per set) but depleted	Chassot et al. 2008
Silky shark	14% occurrence per set	Chassot et al. 2008
Rainbow runner	53% occurrence per set	Chassot et al. 2008
Triggerfish	17-22% occurance per set	Chassot et al. 2008

Turtles	2% occurrence per set	Chassot et al. 2008

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)

Oceanic whitetip shark

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC
SOUTH ATLANTIC

High

FishBase assigned a very high vulnerability score of 75 out of 100 (Froese and Pauly 2013). Oceanic whitetip sharks reaches sexual maturity between 180 and 200 cm in size. It can attain a maximum length of 400 cm and live up to 22 years. Oceanic whitetip shark gives birth to live young and is a top predator (Froese and Pauly 2015). These life history characteristics also suggest a “high” level of vulnerability to fishing.

Factor 2.2 - Abundance

NORTH ATLANTIC
SOUTH ATLANTIC

Very High Concern

Stock assessments for oceanic whitetip shark throughout the Atlantic Ocean have not been conducted. It has been assessed via an Ecological Risk Assessment in 2008 and 2012, at which point it ranked 13th out of 20 in terms of productivity, indicating that it is more productive than other species (ICCAT 2012h). But according to the International Union for Conservation of Nature (IUCN), oceanic whitetip shark is assessed as Critically Endangered, due to radical declines in population sizes over time (Baum et al. 2006). Published estimates of declines range from 70%–90% but the methods used in those studies have been questioned (Burgess et al. 2007). We have assigned a “very high” concern based on the IUCN assessment.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC
SOUTH ATLANTIC

High Concern

Information on fishing mortality rates for oceanic whitetip shark in the Atlantic Ocean is not available (Baum et al. 2006). This is due to a general lack of data, making stock assessments very difficult. An Ecological Risk Assessment was conducted in 2012, and oceanic whitetip shark ranked 6th out of 20 species in terms of susceptibility to longline capture (Cortes et al. 2012). We have awarded a “high concern” score because fishing mortality rates are unknown; even though purse seine fisheries do not catch the majority of oceanic whitetip, the contribution from the associated fishery is considered substantial due in part to the potential for ghost fishing mortality (e.g., (Filmalter et al. 2013)); and effective management is not fully implemented. Although

retention is prohibited, this does not ensure that post-release survival rates are high.

Factor 2.4 - Discard Rate

NORTH ATLANTIC
SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at 4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged from 0%–4% during 2007.

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
North Atlantic / Floating object purse seine	3.000	1.000	Red (1.732)
South Atlantic / Floating object purse seine	3.000	1.000	Red (1.732)

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**
North Atlantic / Floating object purse seine	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective
South Atlantic /	Moderately	Moderately	Moderately	Moderately	Moderately	Moderately	Highly

Floating object purse seine	Effective	Effective	Effective	Effective	Effective	Effective	Effective

The United Nations Law of the Sea agreement (1995) indicated that the management of straddling and highly migratory fish stocks should be carried out through Regional Fisheries Management Organizations (RFMOs). RFMOs are the only legally mandated fishery management body on the high seas and there are currently 18 RFMOs (www.fao.org) that cover nearly all of the world's high seas. Countries must abide by the management measures set forth by individual RFMOs in order to fish in their waters {Cullis-Suzuki and Pauly 2010}. Some RFMOs manage all marine living resources within their authority (e.g., General Fisheries Commission for the Mediterranean (GFCM)), while others manage a group of species such as tunas (e.g., International Commission for the Conservation of Atlantic Tunas (ICCAT)). This report focuses on purse seine fisheries in international waters within the Atlantic Ocean, which are managed by ICCAT (see below for member countries). For this report we are scoring ICCAT's management of these fisheries.

ICCAT Contracting Parties: United States, Japan, South Africa, Ghana, Canada, France, Brazil, Maroc, Republic of Korea, Côte d'Ivoire, Angola, Russia, Gabon, Cap-Vert, Uruguay, Sao Tome E Principe, Venezuela, Guinea Ecuatorial, Republic of Guinée, United Kingdom, Libya, China, European Union, Tunisie, Panama, Trinidad and Tobago, Namibia, Barbados, Honduras, Algérie, Mexico, Vanuatu, Iceland, Turkey, Philippines, Norway, Nicaragua, Guatemala, Senegal, Belize, Syria, St. Vincent and the Grenadines, Nigeria, Egypt, Albania, Sierra Leone, Mauritania, Curaçao, Liberia, and El Salvador.

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.

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Moderately Effective

There is an annual catch limit of 2,000 t for blue marlin. The catch limit is divided up between individual countries (ICCAT 2012j). There are no management measures in place for mahi mahi or wahoo.

There are no management measures specific to skipjack tuna, but the establishment of a time area closure in the surface fishery to protect juvenile bigeye tuna also provided some protection to skipjack and yellowfin tuna. In addition, area closures to fish aggregating device (FAD) fishing will likely have an impact on skipjack tuna (ICCAT 2012a). There is a total allowable catch (TAC) for yellowfin tuna, and there are limits on the number of vessels allowed to target it (ICCAT 2012a). Albacore tuna in the North Atlantic are managed through a TAC (28,000 t for 2012 and 2013) as well as effort restrictions from 1998 that limit the fishing capacity to the average from 1993 to 1997 (ICCAT 2012a). Bigeye tuna is managed through a TAC, which has been reduced from 85,000 t to 65,000 t for 2016–2018 (ICCAT 2015c). Albacore tuna in the North Atlantic is managed through a TAC (28,000 t for 2012 and 2013) as well as effort restrictions from 1998 that limit the fishing capacity to the average from 1993 to 1997 (ICCAT 2012a). There are no management measures in place for blackfin tuna, either domestically or internationally (NOAA 2012) (ICCAT 2012a).

ICCAT does not have formally accepted target reference points. There is a framework for harvest control rules, but none is currently used (ISSF 2013a). We have awarded a "moderate" concern score because ICCAT has implemented measures for some but not all of the target species in this report.

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.

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Moderately Effective

Within the Atlantic Ocean, yellowfin tuna and albacore are or are close to overfished. In addition, blue marlin is overfished. The current multi-year Atlantic tuna conservation and management program, which was initiated in 2009, was amended in 2011 to include yellowfin tuna. Included in this plan are capacity limitations, vessel authorization to fish, catch limits for bigeye, and a TAC for yellowfin (ICCAT 2011c) (ICCAT 2013c). North Atlantic albacore tuna is currently under a rebuilding program that was initiated in 2009 and last updated in 2013 (ICCAT 2011e) (ICCAT 2013c). According to the most recent assessment, there is a 53% probability that the population will be rebuild by 2019 (meeting Convention objectives) if the total allowable catch (TAC) is attained, and a 75% probability if catches are lower. In addition, the biomass has been increasing over time and fishing mortality rates are now below Convention objectives; however, fishing mortality rates are still above Convention objectives (ICCAT 2013a). Blue marlin has been under a rebuilding plan since 2000 (ICCAT 2012a). Bigeye tuna has recently been assessed as overfished and undergoing overfishing (ICCAT 2015b). ICCAT adopted new regulations during the 2015 Commission meeting to address the status of bigeye tuna, but these will not be put into place until 2016 (ICCAT 2015c). We have awarded a "moderately effective" score because recovery plans have not been in place long enough to judge their success for all species.

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.

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Moderately Effective

Stock assessments for albacore, bigeye, skipjack, and yellowfin tuna are conducted every 4–6 years, and include catch and effort data from both fishery-dependent and -independent sources, along with biological information and other data sets. Blue marlin is also assessed but mahi mahi, wahoo, and other species have not been assessed throughout the Atlantic (ICCAT 2012a). The last assessment of blackfin tuna was attempted in 2008 and there are no plans currently to update it. Some information on catch and effort and size data was included in the assessment (ICCAT 2012a). There is uncertainty surrounding the results of these assessments and there are issues with reporting catch data for some species. We have therefore awarded a "moderately 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.

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Moderately Effective

No specific management recommendations have recently been made for skipjack tuna, other than to keep catches below MSY (ICCAT 2014). It has been suggested that maintaining yellowfin tuna catches at current levels (110,000 t) should lead to the biomass being above B_{MSY} by 2016. The TAC was set at this level starting in 2012 (ICCAT 2012a). It was also advised that measures to reduce FAD-related mortality and other fishing mortality on small yellowfin tuna should be implemented, and this has not yet been done (ICCAT 2012a). The Commission has followed advice and set the TAC for albacore tuna in the North Atlantic at 28,000 t for 2012 and 2013. The current assessment indicates that if catches remain at the current TAC level, the population will rebuild (53% probability) by 2019, which abides by the 2011 recovery plan. If catches were lowered, recovery would occur more quickly. The current management measure for North Atlantic albacore tuna allows for potential overages by allowing excess catch (not included in the total TAC) (ICCAT 2013a). Bigeye tuna TAC should be reduced from the current level of 85,000 t, to allow the population to rebuild (ICCAT 2015d). The

Commission lowered the bigeye tuna TAC to 65,000 t from 2016 to 2018, which will allow a 49% probability of rebuilding by 2028 (ICCAT 2015c). The billfish working group advised that, at a minimum, current management measures for blue marlin should be continued. In addition, fishery information needs to be improved, including information on discards and survival, and mortality should be reduced (ICCAT 2012a). No scientific advice for blackfin tuna has been provided and there is currently no set TAC (ICCAT 2012a). Scientific advice for mahi mahi and wahoo is also lacking (ICCAT 2014). We have awarded a "moderately effective" score because advice is sometimes but not always followed.

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.

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Moderately Effective

In terms of compliance among member countries to management measures, ICCAT has one of the best practices of reviewing, assessing, and addressing compliance issues (Koehler 2013). Countries are required to provide information on catch, catch at size, location, and month of captures for other tuna species (ICCAT 2012a), and vessel monitoring systems are required on all vessels larger than 20 m in length (ICCAT 2003). A total allowable catch (TAC) for yellowfin tuna was implemented in 2012 but it is too early to determine if catches were below this level. There is the ability to subtract overages from subsequent years if catches of yellowfin tuna exceed TAC levels (ICCAT 2012a). Bigeye catches have been below TAC levels from 2005 to 2011; if they ever exceed the TAC, there are measures in place to adjust the following years' countries quotas (ICCAT 2012a). Overages or underages of the blue marlin catch limit are added or subtracted from subsequent years (ICCAT 2014) (ICCAT 2012j). There is no TAC for skipjack tuna, mahi mahi, or wahoo (ICCAT 2012a). We have awarded a "moderately effective" score because ICCAT has a good record of addressing compliance issues and TACs are not generally exceeded.

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.

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Moderately Effective

Management measures have been able to sustain or allow some species to recover (such as albacore tuna), while the success of other measures (for example, those in place to protect yellowfin tuna) is less certain (ICCAT 2014). Bigeye tuna has become overfished under current management measures, although updated measures have been adopted and will be put into place during 2016 (ICCAT 2015c) (ICCAT 2015d). We have awarded a "moderately effective" score because recovery plans have not always been successful for species included in this report.

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.

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Highly Effective

The International Commission for the Conservation of Atlantic Tunas (ICCAT) has attempted to include

stakeholder input in the management and conservation of some species (e.g., Atlantic bluefin) (ICCAT 2008b). Observers are allowed at scientific and commission meetings but may not vote on individual management measures. We have awarded a "highly effective" score to account for the inclusion of stakeholder input and transparency of management process through meeting reports and the ability of non-delegates to attend and participate in meetings.

Factor 3.2: Bycatch Strategy

FACTOR 3.2: BYCATCH STRATEGY						
Region / Method	**All Kept**	**Critical**	**Strategy**	**Research**	**Advice**	**Enforce**
North Atlantic / Floating object purse seine	No	No	Ineffective	Ineffective	Moderately Effective	Moderately Effective
South Atlantic / Floating object purse seine	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.).

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Ineffective

The International Commission for the Conservation of Atlantic Tunas (ICCAT) has implemented a few management measures specific to bycatch in the purse seine fishery. Member countries are required to collect information on bycatch and discards and to report that information to the Secretariat. Countries are also encouraged to provide identification guides for sharks, seabirds, sea turtles, and marine mammals to vessels fishing in the Convention area (ICCAT 2011g). Several species of sharks (silky, oceanic whitetip, and hammerhead) are prohibited from being retained if incidentally captured (ICCAT 2011i) (ICCAT 2010e) (ICCAT 2010f). In addition, purse seine vessels must avoid encircling sea turtles, release those incidentally caught, and report any interactions, and safe handling techniques must be used (ICCAT 2013c) (ICCAT 2010g). Management measures for other bycatch species, such as dolphinfish, wahoo, rainbow runner, and triggerfish, are not in place. Individual countries are required to report on the implementation and compliance with several of these measures, including for sea turtles and sharks (ICCAT 2010g) (ICCAT 2012i). There are no bycatch catch limits in place, and best practices for bycatch mitigation are not being employed (Gilman 2011). In addition, it is unknown if current measures have been sufficient in maintaining the health of bycatch species populations. The potential for population-level impacts of bycatch using associated purse seine is considerable, due to the potential for the FADs to entangle sharks and other species of concern as well as bycatch of juvenile bigeye and yellowfin tuna. The management in place to reduce bycatch is considered insufficient given these potential impacts of the fishery. We have therefore awarded an "ineffective" score.

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

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Ineffective

The International Commission for the Conservation of Atlantic Tunas (ICCAT) requires member countries to have observer programs in place that provide a minimum of 5% observer coverage, although the

implementation success of this measure by all countries is unknown. Observers record information on effort, total target and bycatch catches, size, and disposition, and they can collect biological samples (ICCAT 2010i). In addition, vessels 20 m in length or more must carry an observer while targeting bigeye or yellowfin tuna in the time/area closure designated to protect juvenile fish around Fish Aggregating Devices (FADs) (ICCAT 2013c). We have awarded an "ineffective" score because observer programs are in place but the required coverage rate is low.

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.

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Moderately Effective

See harvest strategy section 3.1.4

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.

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Moderately Effective

See harvest strategy section 3.1.5

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
North Atlantic / Floating object purse seine	4.00: Very Low Concern	0.00: Not Applicable	1.00: Very High Concern	Red (2.000)
South Atlantic / Floating object purse seine	4.00: Very Low Concern	0.00: Not Applicable	1.00: Very High Concern	Red (2.000)

Purse seine fisheries tend to have minimal contact with the bottom habitat, although FADs can be anchored to the bottom. However, they do incidentally capture some ecologically important species and the impact of this on the ecosystem is not known. In addition, the impact this fishery has on the ecosystem is not factored into current management efforts.

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

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Very Low Concern

Although purse seine fishing typically does not result in the nets coming in contact with the bottom, anchored FADs could result in contact with the bottom (Beverly et al. 2012) (Seafood Watch 2013).

Factor 4.2 - Mitigation of Gear Impacts

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Not Applicable

Although purse seines can come into contact with bottom habitats, their impact is minimal and therefore no mitigation measures are needed.

Factor 4.3 - Ecosystem-Based Fisheries Management

NORTH ATLANTIC, FLOATING OBJECT PURSE SEINE
SOUTH ATLANTIC, FLOATING OBJECT PURSE SEINE

Very High Concern

Purse seine fisheries in the Atlantic Ocean catch several ecologically important groups including other tunas and sharks. In particular, sharks are considered top predators in many ecosystems and play a critical role in how these ecosystems are structured and function (Piraino et al. 2002) (Stevens et al. 2000). The loss of these

predators can cause many changes (such as to prey abundances), which can lead to a cascade of other effects (Myers et al. 2007) (Duffy 2003) (Ferretti et al. 2010) (Schindler et al. 2002) and behavioral changes (Heithaus et al. 2007).

The use of FADs can also affect the surrounding ecosystems. Smaller tuna, specifically bigeye and yellowfin, are often associated with FADs and this could lead to growth and recruitment overfishing (Freon and Dagorn 2000). In addition, behavioral changes in tunas could be associated with the introduction of FADs into the Atlantic region. These include increases in the biomass of tunas under FADs, reduced free-school abundance, changes in school movement patterns and structure, and differences between the age and size of free and FAD-associated schools (Fonteneau 1991) (Menard et al. 2000a) (Menard et al. 2000b) (Josse et al. 1999) (Josse et al. 2000). The negative long-term impacts of FAD fishing are difficult to evaluate due to insufficient qualitative data (Fonteneau et al. 2000), so additional research should be undertaken to determine the potential effects of FADs on the ecosystem, including monitoring the number of FADs being used (Dagorn et al. 2012).

ICCAT has assessed several species of sharks and conducted ecological risk assessments for other bycatch species. Although ecosystem impacts are not currently included in management plans, ICCAT has adopted management measures to protect bycatch species and conducts ecological risk assessments. In addition, ICCAT has investigated prohibiting the use of FADs and currently requires the collection of some information on FAD fishing (deployment of FADs, visiting FADs, and loss of FADs) and requires the use of FAD logbooks (Morgan 2011) (ICCAT 2013c). In addition, there is a Sub-Committee on Ecosystems within ICCAT that is investigating the role of Ecosystem-Based Management within ICCAT fisheries (ICCAT 2013b).

We have awarded a “very high” concern score because there is a potential for negative ecological impacts from FADs and management is not designed to avoid these impacts.

Acknowledgements

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

Seafood Watch would like to thank one anonymous reviewer for graciously reviewing this report for scientific accuracy.

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Appendix A: Extra By Catch Species

Bigeye tuna

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC
SOUTH ATLANTIC

Medium

FishBase assigned a high to very high vulnerability of 72 out of 100 (Froese and Pauly 2013). However, bigeye tuna's life history characteristics suggest a medium vulnerability to fishing. For example, bigeye tuna reaches sexual maturity around 100–125 cm, reaches a maximum size of 200 cm, and lives around 11 years (Davies et al. 2011) (Froese et al. 2013). It is a broadcast spawner and top predator (Froese and Pauly 2013). Based on these life history characteristics, we have awarded a "medium" score.

Factor 2.2 - Abundance

NORTH ATLANTIC
SOUTH ATLANTIC

High Concern

Bigeye tuna in the Atlantic were last assessed in 2015. Several models were used in this assessment. The Stock Synthesis model indicates that the biomass has decreased over time and fell below levels necessary to produce the maximum sustainable yield (B_{MSY}) in 2010. The Age Structured Production Model indicated that the ratio of the biomass in 2014 to that needed to produce the maximum sustainable yield (B_{2014}/B_{MSY}) ranged between 0.554 and 1.225. The Virtual Population Analysis also indicated that the population is overfished (ICCAT 2015a). The current status is assessed to be overfished based on the most plausible model runs (0.48–1.20). We have awarded a "high" concern score because there is evidence that the population of bigeye tuna in the Atlantic is overfished.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC
SOUTH ATLANTIC

High Concern

According to the Age Structured Production model used in the 2015 assessment, the ratio of fishing mortality in 2014 to that needed to produce the maximum sustainable yield (F_{2014}/F_{MSY}) ranged from 0.576 to 1.436, indicating that overfishing may be occurring.

According to the stock synthesis model, the F_{2014}/F_{MSY} ratio appears to have decreased in recent years to below 1, indicating that overfishing is not occurring. The Virtual Population Analysis (VPA) base model indicated that overfishing is not occurring, although some model runs indicated that overfishing is occurring (the VPA results were sensitive to the values used for recruitment) (ICCAT 2015a). Based on the most plausible model runs (0.62–1.85), there is an indication that overfishing is occurring (ICCAT 2015a). Because some models indicate that overfishing is occurring, we have awarded a "high" concern score.

Factor 2.4 - Discard Rate

NORTH ATLANTIC
SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at 4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony

fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged from 0%–4% during 2007.

Skipjack tuna

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC
SOUTH ATLANTIC

Medium

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

Factor 2.2 - Abundance

NORTH ATLANTIC
SOUTH ATLANTIC

Low Concern

Stock assessments for skipjack tuna are difficult to conduct due to its biology and the fishery characteristics. In the Atlantic Ocean, eastern and western stocks of skipjack tuna are assessed. According to the most recent assessment conducted in 2014, the biomass in the eastern region is likely above target levels (B_{MSY}, biomass needed to produce the maximum sustainable yield) and the biomass in the western region is "probably" 30% above the level needed to produce the maximum sustainable yield (B_{2013}/B_{MSY} = 1.3). Both populations are not overfished (ICCAT 2014). We have awarded a "low" concern and not very low concern score due to the high level of uncertainty associated with this assessment.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC
SOUTH ATLANTIC

Low Concern

Stock assessments for skipjack tuna are difficult to conduct due to its life history and the fishery characteristics. The last assessment in the Atlantic was conducted in 2014 for the eastern and western populations. The assessment determined that the fishing mortality rate (F_{2013}) in the eastern Atlantic was likely below the level needed to produce the maximum sustainable yield (F_{MSY}), and in the western Atlantic was likely 30% below F_{MSY} (F_{2013}/F_{MSY} = 0.70) (ICCAT 2014). We have awarded a "low" concern and not very low concern score because the populations appear to be sustainably fished but there is some uncertainty surrounding the results.

Factor 2.4 - Discard Rate

NORTH ATLANTIC
SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at 4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony

fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged from 0%–4% during 2007.

Yellowfin tuna

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC
SOUTH ATLANTIC

Medium

FishBase assigned a moderate vulnerability score of 46 out of 100 (Froese and Pauly 2013). Yellowfin tuna reaches sexual maturity around 100 cm in size and 2–5 years in age. A maximum length of 140–150 cm in size can be attained and it can live 8-9 years. It is a broadcast spawner and high-level predator in the ecosystem (Froese and Pauly 2014) (ICCAT 2014). These life history characteristics also support a moderate level of vulnerability.

Factor 2.2 - Abundance

NORTH ATLANTIC
SOUTH ATLANTIC

High Concern

Yellowfin tuna in the Atlantic Ocean was last assessed in 2011. There was some degree of uncertainty with the different models, which indicated opposite results (i.e., one shows an increasing abundance trend and one shows a decreasing trend). The population is currently estimated to be 15% below Convention objectives (B_{2010}/B_{MSY} = 0.85 (0.61–1.12)) and therefore overfished (ICCAT 2011d). We have awarded a “high” concern score because the population is considered overfished.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC
SOUTH ATLANTIC

Moderate Concern

The current fishing mortality rate is estimated to be 13% below F_{MSY} ($F_{current}/F_{MSY}$ = 0.87 (0.68–1.40)) and the maximum sustainable yield (MSY) is estimated to be 144,600 t (ICCAT 2011d). This suggests that fishing mortality rates are sustainable. The assessment had some degree of uncertainty surrounding the results, with different models indicating opposite trends. Two models were used, with one model estimating that fishing mortality rates were not sustainable, while the other estimated that they were sustainable (ICCAT 2011d). In addition, the fishing mortality reference point used in the base case model (F_{max}, the fishing level that produces the largest yield per catch from the fishery) may not be suitable, because some studies have indicated that F_{max} is likely greater than F_{MSY} (Gabriel and Mace 1999). Therefore, a more conservative reference point may have actually indicated that overfishing is occurring (ICCAT 2011k). We have therefore awarded a “moderate” concern instead of low concern score.

Factor 2.4 - Discard Rate

NORTH ATLANTIC
SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at

4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged from 0%–4% during 2007.

Rainbow runner

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC
SOUTH ATLANTIC

Medium

FishBase assigned a moderate vulnerability score of 41 out of 100 (Froese and Pauly 2013). Rainbow runner reaches a maximum size of 180 cm. It is a broadcast spawner and top predator (Froese and Pauly 2015).

Factor 2.2 - Abundance

NORTH ATLANTIC
SOUTH ATLANTIC

Moderate Concern

No assessments have been conducted in the Atlantic Ocean, so its status is unknown. We have awarded a “moderate” concern score.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC
SOUTH ATLANTIC

Moderate Concern

Although information on fishing mortality rates is not available for this species in the Atlantic, it is reported to be one of the most common bycatch species in the European purse seine fishery, having a 53% occurrence rate per set (Chassot et al. 2008). Rainbow runner is also reported as common bycatch in other FAD purse seine fisheries in the Northeast Atlantic (Menard et al. 2000) and made up 18% of the total “other bony fish” catch between 2003 and 2005 in the French and Spanish purse seine fisheries (Amande et al. 2010). We have awarded a “moderate” concern score due to its unknown status and the high incidental capture rates in this fishery.

Factor 2.4 - Discard Rate

NORTH ATLANTIC
SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at 4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged

from 0%–4% during 2007.

Silky shark

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC
SOUTH ATLANTIC

High

FishBase assigned a very high vulnerability of 79 out of 100 (Froese and Pauly 2013). Silky shark reaches sexual maturity between 200 and 260 cm in size and 7–12 years of age. Silky shark gives birth to live young. It reaches a maximum size of 350 cm and lives at least 25 years (Froese and Pauly 2015). These life history characteristics also suggest a high vulnerability to fishing.

Factor 2.2 - Abundance

NORTH ATLANTIC
SOUTH ATLANTIC

High Concern

A stock wide population assessment of silky shark in the Atlantic Ocean has not been conducted. The International Union for Conservation of Nature (IUCN) has listed silky shark as Vulnerable in the Northwest Atlantic and Western Central Atlantic Ocean, and Near Threatened in the Southwest Atlantic Ocean. Some analyses of catch rate series in the Northwest and Central Atlantic Ocean have indicated large declines in population size (Baum et al. 2003) (Cortes et al. 2007). There are significant issues with species identification and an overall lack of reporting for this species (Bonfil et al. 2009). We have awarded a “high” concern score based on the IUCN status.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC
SOUTH ATLANTIC

High Concern

Silky shark is caught as bycatch in several fisheries in the Atlantic, particularly purse seine fisheries (Bonfil et al. 2009). It has been reported as one of the most common bycatch species in European purse seine fisheries on FADs (Menard et al. 2000) and made up 72% of all shark species observed caught between 2003 and 2007 in the Spanish and French fisheries (Amande et al. 2010). The incidental mortality from fisheries is thought to be a contributing factor to silky shark population declines (Bonfil et al. 2009). But in the Atlantic, silky shark is prohibited from being retained (ICCAT 2011i), so we have awarded a “high” concern and not critical concern score.

Factor 2.4 - Discard Rate

NORTH ATLANTIC
SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at 4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged

from 0%–4% during 2007.

Albacore tuna

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC
SOUTH ATLANTIC

Medium

FishBase assigned a high vulnerability score of 58 out of 100 (Froese and Pauly 2013). But the life history characteristics of albacore suggest only a medium vulnerability to fishing. For example, albacore reaches sexual maturity between 5 and 6 years of age and reaches a maximum age of 15 years (ISCAWG 2011). It is a broadcast spawner and top predator (Froese and Pauly 2013). Based on these life history characteristics, we have awarded a “medium” score.

Rationale:

Life history paramater	Value	Score
Age at maturity	5-10 years	2
Average maximum age	10-25 years	2
Reproductive strategy	Broadcast spawner	3
Trophic level	>3.25	1

Factor 2.2 - Abundance

NORTH ATLANTIC

High Concern

The population of albacore tuna in the North Atlantic has been below the level needed to produce the maximum sustainable yield (B_{MSY}) since the mid-1980s but has improved since the lowest levels in the late 1990s. There is considerable uncertainty surrounding the status of albacore tuna in the North Atlantic, as evidenced by the wide array of model results. The ratio of the current spawning stock biomass to that at the maximum sustainable yield ($SSB_{current}/SSB_{MSY}$) is estimated to be 0.94 (0.74–1.14). There is a 0.2% probability that the population is overfished and undergoing overfishing, a 27.4% probability that the population is neither overfished nor undergoing overfishing, and a 72.4% probability that the population is either overfished or overfishing is occurring, but not both (ICCAT 20013). So we have awarded a “high” concern score.

SOUTH ATLANTIC

High Concern

The 2013 assessment of albacore tuna in the South Atlantic provided a wide range of results. Based on all scenarios included in the assessment, there is a 57% probability that the population of albacore tuna is overfished and undergoing overfishing; a 13% probability that the population is overfished or undergoing overfishing, but not both; and a 30% probability that the biomass is above target levels and fishing mortality is below Convention objectives (ICCAT 2013a). The ratio of the current biomass to that that would produce the maximum sustainable yield (B/B_{MSY}) is 0.92 (0.71–1.26). We have awarded a “high” concern score because there is a large degree of uncertainty surrounding these results but it appears the population is overfished.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC

Very Low Concern

The maximum sustainable yield (MSY) of albacore tuna in the North Atlantic is estimated to be 31,680 t. Historically, fishing mortality rates were above the levels needed to produce the maximum sustainable yield (F_{MSY}) from the 1960s to the mid-2000s. Currently, F_{2012}/F_{MSY} = 0.72 (0.55–0.89) and the population is no longer undergoing overfishing (ICCAT 2013a). We have awarded a "very low" concern score because overfishing is not occurring.

SOUTH ATLANTIC

High Concern

According to the last assessment (2013) conducted for the South Atlantic population, the median maximum sustainable yield (MSY) value was 25,228 t (19,109–28,360 t) in 2012 and the median estimate of the ratio of current fishing mortality rates to those that produce the maximum sustainable yield (F/F_{MSY}) was 1.04 (0.38–1.32). Based on this large degree of uncertainty, the status is difficult to determine but it is likely that overfishing is occurring, with a 57% chance that the population is overfished and overfishing is occurring (ICCAT 2013a). There are management measures in place but they have failed to maintain the population in the South Atlantic. We have therefore awarded a "high" concern score.

Factor 2.4 - Discard Rate

NORTH ATLANTIC
SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at 4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged from 0%–4% during 2007.

Blue marlin

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC
SOUTH ATLANTIC

Medium

FishBase assigned a moderate vulnerability score of 52 out of 100 (Froese and Pauly 2013). Blue marlin reaches sexual maturity between 50 and 80 cm in length and can reach 500 cm in size. It is a broadcast spawner and top predator in the ecosystem (Froese and Pauly 2014). These life history characteristics suggest a moderate vulnerability to fishing according to the Seafood Watch productivity and susceptibility table (1.83).

Rationale:

Life history characteristic	Paramater	Score
Age at maturity	<5 years	3
Average size at maturity	>200 cm	1
Average maximum size	>300 cm	1
Average maximum age	10-25 years	2
Reproductive strategy	Broadcast spawner	3
Trophic level	>3.25	1

Factor 2.2 - Abundance

NORTH ATLANTIC
SOUTH ATLANTIC

High Concern

Blue marlin in the Atlantic was last assessed in 2011. According to the assessment, the current biomass is well below the biomass that produces the maximum sustainable yield (B_{MSY}). There was conflicting information on the biomass trend, with some indices showing biomass declines had stopped, while others indicated that the declines were continuing. The working group therefore suggested a possible stabilizing trend in abundance. Because of a lack of data, it was estimated that at least 4 or 5 years of additional data were needed to conduct another assessment (ICCAT 2011f). Blue marlin is also listed as Vulnerable by the International Union for the Conservation of Nature (IUCN) (Collette et al. 2011g). We have awarded a “high” concern score because of the low abundance size and IUCN status.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC
SOUTH ATLANTIC

High Concern

Catches of blue marlin in purse seine fisheries operating around moored FADs are known to be high but underreported (Chassot et al. 2008) (Menard et al. 2000) (Amande et al. 2010). The maximum sustainable yield (MSY) is estimated to be around 2,000 t (1,000 t to 2,400 t), and current fishing mortality rates are higher than F_{MSY} but possibly smaller than $F_{replacement}$, which is the level of fishing mortality that would keep the biomass constant between years (ICCAT 2011f). It is illegal to sell blue marlin in the United States. We have therefore awarded a “high” concern score due to the high fishing mortality rates.

Factor 2.4 - Discard Rate

NORTH ATLANTIC
SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at 4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged from 0%–4% during 2007.

Turtles

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC
SOUTH ATLANTIC

High

Sea turtles have a high level of vulnerability (Seafood Watch 2013). This classification is supported by sea turtle life history characteristics, which include a long life, late age at maturity, and low number of young.

Factor 2.2 - Abundance

NORTH ATLANTIC
SOUTH ATLANTIC

Very High Concern

Several species of sea turtles, green, Kemp's ridley, hawksbill, leatherback, loggerhead, and olive ridley, have been reported as incidentally captured in purse seine fisheries operating in the Atlantic Ocean. Several of these species are listed as Endangered by the International Union for Conservation of Nature (IUCN), have decreasing population sizes, and are listed on the U.S. Endangered Species Act (ESA) or on the Convention on International Trade in Endangered Species (CITES) Appendix I. We have therefore awarded a "very high" concern score.

Rationale:

Green: The IUCN has classified green sea turtle as Endangered with a decreasing population trend. Green sea turtle has been listed on CITES since 1975 and is currently listed on CITES Appendix I, meaning that it is threatened with extinction and that international trade is prohibited. The mean annual number of nesting turtles worldwide has decreased between 48% to 67% over the past 100 to 150 years (Seminoff 2004). In the Atlantic, 4 populations have shown declines of around 80%–90%, while 11 populations have shown increases up to 113%. The largest increases in population size have occurred in the Western Atlantic region (Masion et al. 2010).

Hawksbill: The IUCN has classified hawksbill turtle as Critically Endangered with a decreasing population trend (Mortimer and Donnelly 2008). Hawksbill turtle has been listed on CITES since 1977 and is currently listed on CITES Appendix I, meaning that it is threatened with extinction and that international trade is prohibited. In the Atlantic Ocean, there has been a population decrease of 80.5% over the past three generations (Mortimer and Donnelly 2008).

Leatherback: Leatherback sea turtle has been listed as Endangered by the Endangered Species Act (ESA) since 1970 (NMFS 2012). The International Union for Conservation of Nature (IUCN) classified leatherback turtle as Critically Endangered with a decreasing population trend in 2000 (Martinez 2000). Leatherback turtle has been listed on CITES since 1975 and is currently listed on CITES Appendix I, meaning that it is threatened with extinction and that international trade is prohibited. In the North Atlantic, the population size is estimated to be between 34,000 and 94,000 (TEWG 2007).

Loggerhead: The International Union for Conservation of Nature (IUCN) classified loggerhead turtle as Endangered in 1996, although it has been suggested that this needs to be updated (MTSG 2006). Loggerhead is listed on Appendix I of CITES. There are an estimated 2,280 to 2,787 loggerhead turtles nesting annually in the Mediterranean (Broderick et al. 2002). The majority of turtles nest in Greece and Turkey, which have decreasing trends (though Greece may be stable) (NMFS 2009).

Olive ridley: The IUCN considers olive ridley sea turtle to be Vulnerable with a decreasing population trend. Olive ridley has been listed as Threatened on the Endangered Species Act (ESA) since 1978 (NMFS 2012a) and is listed on CITES Appendix I. The arribada rookeries have decreased by 97%–99% while the non-arribada rookeries have increased 364% over time (Abreu-Grobois and Plotkin 2008).

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC
SOUTH ATLANTIC

Low Concern

Although capture rates of turtles in purse seine fisheries are small compared to those for longlines, gillnets, and trawls, bycatch also occurs in purse seine fisheries. There is evidence from other regions that the accidental entanglement of turtles in fish aggregating devices (FADs) is a major concern (Gilman 2011). There are some management measures in place in this region to protect incidentally captured sea turtles, and there are initiatives to design Ecological FADs that reduce incidental interactions (ICCAT 2013d), but

implementation of these measures may not be 100%. We have therefore awarded a “low concern and not very low concern score.

Rationale:

Green sea turtle: Only two occurrences of green sea turtle catch were reported in the Eastern Atlantic FAD fishery between 1991 and 1997 (Menard et al. 2000). Between 2003 and 2007, nine turtles were observed caught in the French and Spanish FAD fisheries (Amande et al. 2010). The occurrence rate per set in the French fishery (2005–2008) was 1.52 (Chassot et al. 2008). The observer rate for this cited study (Chassot et al. 2008) was around 3% of all fishing trips.

Kemp’s ridley: A total of three Kemp’s ridley turtles were observed caught in the French and Spanish FAD fisheries between 2003 and 2007 (Amande et al. 2010). The occurrence rate per set in the French FAD fishery was 1.52 between 2005 and 2008 (Chassot et al. 2008).

Leatherback: Five leatherback sea turtles were reported incidentally captured in the French and Spanish FAD fisheries between 2003 and 2007 (Amande et al. 2010).

Loggerhead: Between 1991 and 1997, three loggerhead turtles were observed caught in the Eastern Atlantic (Menard et al. 2000) and five were reported captured between 2003 and 2007 in the French and Spanish FAD fisheries (Amande et al. 2010).

Olive ridley: Only three olive ridley turtles were reported captured in the Spanish and French FAD fisheries between 2003 and 2007 (Amande et al. 2000) and their occurrence rate per set in the French FAD fishery was 1.52 between 2006 and 2007 (Chassot et al. 2008).

Factor 2.4 - Discard Rate

NORTH ATLANTIC
SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at 4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged from 0%–4% during 2007.

Blackfin tuna

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC
SOUTH ATLANTIC

Medium

FishBase assigned a moderate vulnerability score of 41 out of 100 (Froese and Pauly 2013). Blackfin tuna is a small tuna species that reaches sexual maturity by 50 cm and 3 years of age. The maximum length attained is around 108 cm and it lives to around 5 years of age. Blackfin tuna is a broadcast spawner and high-level predator in the ecosystem (Froese and Pauly 2014). These life history characteristics also suggest a moderate vulnerability level.

Factor 2.2 - Abundance

NORTH ATLANTIC
SOUTH ATLANTIC

Moderate Concern

In Atlantic waters, blackfin tuna is assessed along with 13 other “small tuna” species. Currently, there is not enough information to conduct a full assessment of this group (ICCAT 2012a). According to the International Union for Conservation of Nature (IUCN), blackfin tuna is a species of Least Concern with a stable population trend and is considered one of the most common tuna species in the Western Atlantic (Collette et al. 2011a). We have awarded a “moderate” concern score because information on its status is unknown and it has a moderate vulnerability to fishing pressure.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC
SOUTH ATLANTIC

Moderate Concern

Blackfin tuna makes up a small proportion of “small tuna” catches in the Atlantic Ocean. No assessment has been conducted due to a lack of data. Landings have been variable over the years, peaking in the early 1990s but showing no consistent trend over time (ICCAT 2012a). It is caught by a variety of gears but there is no indication that overfishing is occurring (Collette et al. 2011a). We have awarded a “moderate” concern score because information on fishing mortality is not available.

Factor 2.4 - Discard Rate

NORTH ATLANTIC
SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at 4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged from 0%–4% during 2007.

Triggerfish spp.

Factor 2.1 - Inherent Vulnerability

SOUTH ATLANTIC

Medium

Triggerfish have low to moderate vulnerability scores (32-44 out of 100) (Froese et al. 2013).

Factor 2.2 - Abundance

SOUTH ATLANTIC

Moderate Concern

Several species of triggerfish have been assessed by the International Union for Conservation of Nature (IUCN) and all have been assigned a Least Concern status (IUCN 2013). We have assigned a “moderate”

concern score because no assessment has been conducted but they are listed as Least Concern by the IUCN and they have a moderate level of vulnerability to fishing.

Factor 2.3 - Fishing Mortality

SOUTH ATLANTIC

Moderate Concern

Several species of triggerfish, including grey and bluespotted, are reported as common bycatch species in purse seine fisheries. They can make up as much as 12% of the total catch (Mendard et al. 2000) and 59% of "other fish" total catch (Amande et al. 2010). Other information suggests occurrence rates per set of 16% (Chassot et al. 2008). But fishing mortality rates are unknown for these species, so we have awarded a "moderate" concern score.

Factor 2.4 - Discard Rate

SOUTH ATLANTIC

< 20%

Purse seine fisheries have an average discard rate of 5%, although in the Atlantic this rate is slightly less at 4.1% (Kelleher 2005). Discard rates in the combined purse seine fisheries (associated and unassociated) for France and Spain are predominantly made up of tunas (79% and 83%, respectively), rays (89% and 90%), bony fish (47% and 26%), sharks (31% and 45%), and billfish (1% and 15%). In these purse seine fisheries, juvenile skipjack made up the majority of discarded tuna bycatch (Amande et al. 2011). Discard rates are typically higher in purse seine sets made on FADs compared to those in unassociated sets. In the French purse seine fishery, 97% of discards were made on FAD sets, with spotted tuna and skipjack making up 50% and 46%, respectively, of those discards (Chassot et al. 2008). In this fishery, tuna discard rates on FAD sets ranged from 0%–4% during 2007.