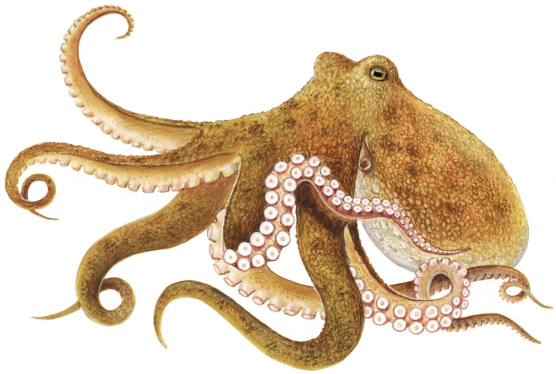
Monterey Bay Aquarium

Seafood Watch®

Common octopus and Big blue octopus

Octopus vulgaris and *Octopus cyanea*



Philippines

Hand Implements and Vertical Lines

June 14, 2017

Seafood Watch Consulting Researcher

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

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About Seafood Watch

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

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

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Watch assessments in any way they find useful.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

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

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

These guiding principles are operationalized in the four criteria in this standard. Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and rating

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guide and online guide:

Best Choice/Green: Are well managed and caught in ways that cause little harm to habitats or other wildlife.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught.

Avoid/Red Take a pass on these for now. These items are overfished or caught in ways that harm other marine life or the environment.

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

Summary

This report focuses on fisheries for common octopus (*Octopus vulgaris*) and big blue octopus (*Octopus cyanea*) in the Republic of the Philippines (hereafter referred to as the Philippines). These species are among the six to seven octopus species commonly harvested in the Philippines, and they are known to be traded internationally. Most harvest (an estimated 90%) is accomplished with gear classified here as "hand implements" (specifically, short metal pipes with hooks at one end that are used by wading and free-diving fishermen at low tide to extract octopus from their shelters). Another 5 to 10% of the harvest is accounted for by vertical line fisheries from small boats. The remaining minority share of harvest is accounted for by traps, divers with spear guns, and bottom trawls.

Much regarding the status of octopus stocks in the Philippines is unknown. Because stock assessments are not conducted, biomass and fishing mortality are not known, and there are no reference points in place for these parameters. Surveys conducted annually at processing plants give an idea of landings, current size, and age distribution. Export statistics are also available, but without details on species composition or gear type.

Assuming hand implements and vertical lines are the primary gears, the quantity of bycatch for the octopus fisheries is presumed low. However, some non-target catch, particularly of non-commercial species of octopus, is presumed. As for impacts to bottom habitat, vertical lines are categorized as "low impact," but the use of hand implements may involve trampling of coral reef habitats of low resilience and high vulnerability, resulting in a "medium conservation" concern ecosystem impact rating for that gear type.

The fishery is not managed to achieve specific reference points, and in this respect is inadequately managed. Permits are required for entry into the fishery and some general regulations are in place to protect corals, *Sargassum*, and other sensitive species from the impacts of this and other commercial fisheries in the Philippines.

The overall rating of "avoid" for both the hand implement and vertical line fisheries reflects the lack of information on the status of target and bycatch species, as well as their high susceptibility to fishing pressure (the target and bycatch species, including squid and cuttlefish species, are all presumed semelparous, and thus susceptible to harvest before their single spawning event). The rating also reflects the current inadequacy of fishery management.

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
Big blue octopus Philippines, Vertical lines, Philippines	Red (1.73)	Red (1.73)	Red (1.00)	Green (3.46)	**Avoid (1.79)**
Common octopus Philippines, Vertical lines, Philippines	Red (1.73)	Red (1.73)	Red (1.00)	Green (3.46)	**Avoid (1.79)**
Big blue octopus Philippines, Hand implements	Red (1.73)	Red (1.73)	Red (1.00)	Yellow (2.45)	**Avoid (1.65)**
Common octopus Philippines, Hand implements	Red (1.73)	Red (1.73)	Red (1.00)	Yellow (2.45)	**Avoid (1.65)**

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

- **Best Choice/Green** = Final Score >3.2, and no Red Criteria, and no Critical scores
- **Good Alternative/Yellow** = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern2, and no more than one Red Criterion, and no Critical scores
- **Avoid/Red** = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

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

Introduction

Scope of the analysis and ensuing recommendation

This report focuses on commercial fisheries for the common octopus (*Octopus vulgaris*) and big blue octopus (*Octopus cyanea*) harvested by vertical lines and hand implements (includes diving/free diving) in the Philippines. It also extends to all octopus species from the Philippines, regardless of gear type. This includes *Amphioctopus aegina* ("baby octopus"), *Cistopus indicus*, *Octopus aculeatus*, *Octopus nocturnus*, *Octopus ornatus*, and *Octopus luteus*. According to local stakeholders, *O. vulgaris* and *A. aegina* are the most abundant species, but *aegina* is not exported to Western markets. Octopus fisheries take place throughout the Philippines in all months of the year; December through February is the height of the season, and Cebu and Northern Mindanao are key locations.

Species Overview

Also known as the day octopus, and less commonly referred to as Cyane's octopus or the big blue octopus, *Octopus cyanea* is a cephalopod in the family Octopodidae and occurs in the Pacific and Indian oceans, from East Africa to Hawaii to the Tuamotu Archipelago (Van Heukelem 1973); (Norman and Sweeney 1997). These octopuses live in shallow subtidal waters up to 100 m depth and are commonly associated with coral reefs. They can grow up to 160 mm in mantle length, and weigh up to 6 kg. They range in color from cream to mottled to dark chocolate brown, and have ocelli (black spots surrounded by a pale ring and outer dark ring) underneath each eye, zebra bars on their ventral surfaces, and dorsal and frontal white spots (Norman and Sweeney 1997). These octopuses mature within 1 to 1.5 years, at which point females lay eggs in strings each containing 600 to 1200 eggs per string, and die shortly thereafter. Male octopuses have a lifespan similar to females. Eggs hatch after 3 to 5 weeks of incubation, after which the pelagic larval duration lasts approximately 30 days before larvae settle out of the water column (Van Heukelem 1973). Thus the day octopus is a fast-growing, short-lived, highly fecund species.

The common octopus (*Octopus vulgaris*) shares many characteristics with the day octopus: wide distribution (common octopus is found in temperate and tropical waters around the world), short lifespans, and high fecundity (Belcari et al. 2002). In contrast to day octopus' preference for coastal waters and association with coral habitats, common octopus are found on rocky, sandy, and muddy bottoms extending from coastlines to the edge of the continental shelf (Mangold 1983).

Production Statistics

Octopus landings are not monitored and reported individually by the Philippines. Rather, octopus are among species for which landings are reported cumulatively as "other species" by the Bureau of Fisheries and Aquatic Resources (BFAR), because octopus are not among the highest volume contributors to the Philippines' overall harvest of aquatic resources (Lizarondo 2011). Exports of octopus are reported by volume and by value (but not broken out by species) in BFAR's annual Philippine Fisheries Profile reports (BFAR 1991-2015). These data are taken from the Port of Manila records (pers. comm., Jake Piscano, BFAR 2017). Meanwhile, the Philippines also reports harvest data for *octopuses nei* to the Food and Agriculture Organization (FAO) of the United Nations. It is unclear how the export and harvest datasets relate to one another, as it does not appear that a steady processing coefficient is applied to the export volumes in order to yield the harvest volumes. In fact, in most years processing volumes exceed harvest volumes, suggesting inaccuracies or the entry of illegal product into processing plants. Illegal fishing is an identified problem in Filipino fisheries (Oceana 2015).

Harvest and exports have exhibited declining trends over the last five years for which data is available (Figure 1). In 2013, exports hit their lowest recorded volume, and were similarly low in 2015.

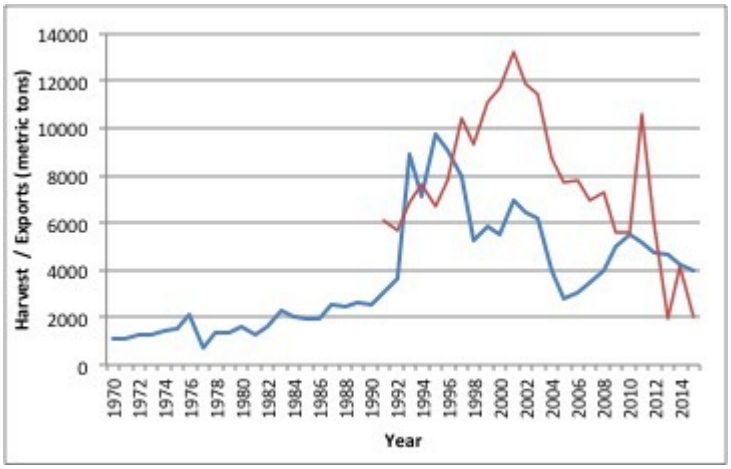

Figure 1 Harvest (blue) and exports (red) of Filipino octopus, 1991–2015 (FAO 2017); (BFAR 1991–2015).

Importance to the US/North American market.

In 2016, according to US trade statistics, the Philippines was the second-largest exporter of octopus to the United States in terms of volume (3,186,602 kg exported), trailing only Spain, and third-largest exporter in terms of value ($11,531,220 worth of product exported). In the first half of 2017, Philippines stands fourth in export volume to the US, behind Spain, China, and Indonesia (NOAA 2017).

Generally, the Philippines' importance for the US market has declined over the past decade. The Philippines was the #1 exporter of octopus to the US in 1989 to 2007, but subsequently Spanish imports have surged, particularly in the last five years, in response to increased demand in the US market (Figure 2). The increased demand has been driven by growth in the restaurant industry, which is expanding its offerings to appeal to a more ethnically diverse population, and by popularity with millennials (Seafood News 2014) (Undercurrent News 2017). The Philippines has not been able to respond to the increased American demand due to supply shortages. According to Undercurrent News, "Filipino production [has been] particularly short on octopus 4 to 6 lb and smaller, which are the preferred sizes for US buyers. These items are currently commanding premium levels over 8 lb and up sized items, which is unusual for [the US] market" (Undercurrent News 2017).

Octopus is also sold in the Philippines' domestic markets for local consumption, although data indicating volumes consumed domestically are lacking.

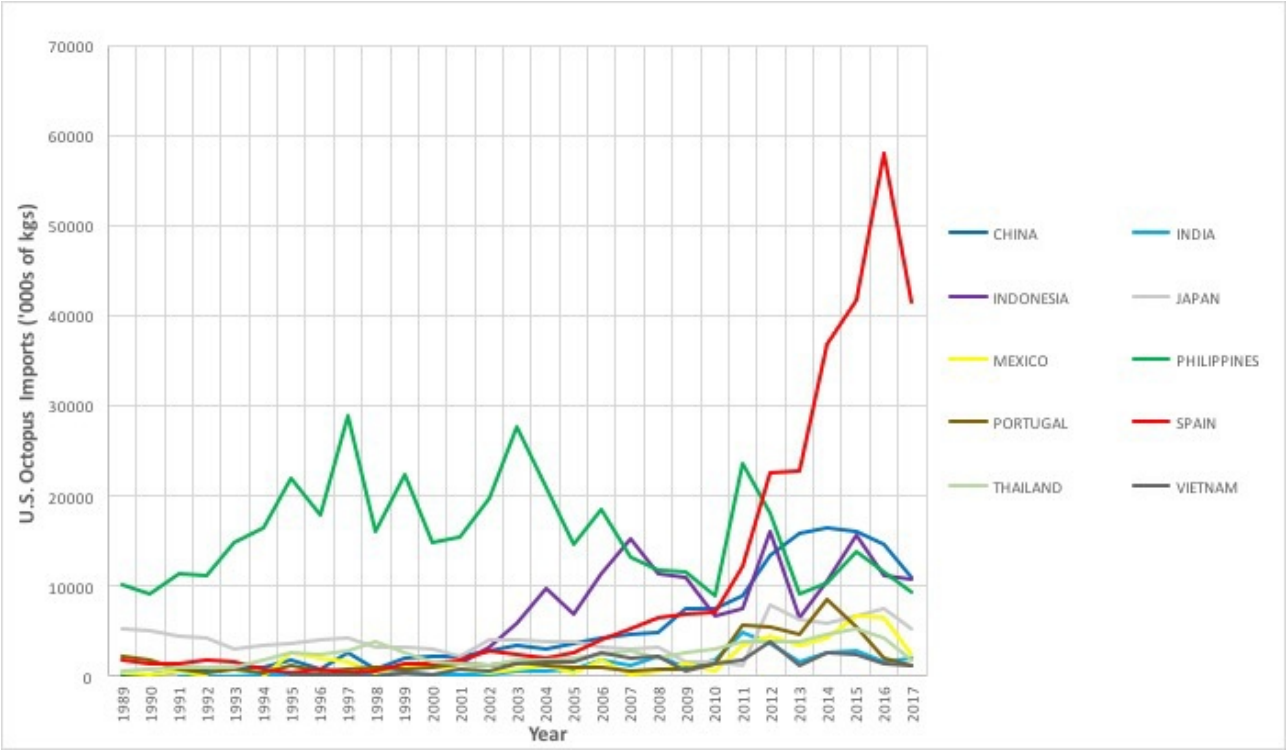

Figure 2 U.S. imports of octopus by year and by country of origin, 1989–2017 (first half of 2017 only) (NOAA 2017).
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Common and market names.

Day octopus (*Octopus cyanea*) is also known as big blue octopus, and on the market can be grouped with *Octopus vulgaris* under the name "common octopus." No commercial names other than "common octopus" have been reported for *O. vulgaris*.

Primary product forms

Octopus is available in seafood markets or specialty grocery stores in a myriad of forms, including live, fresh, dried, frozen, cured, salted, and brined. According to a Manila-based seafood processor, the predominant product type sold to the US is fresh-frozen. That particular processor freezes octopus into a variety of forms—blocks, pinwheels, bows, and balls—for purchase (pers. comm., Emerald Uy, Millennium Ocean Star Corp. 2017).

While the US purchases predominantly frozen octopus from the Philippines, cooked product is also exported in large quantities to the Japanese market.

Assessment

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

Criterion 1: Impacts on the Species Under Assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical

Guiding Principles

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

Criterion 1 Summary

BIG BLUE OCTOPUS			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Philippines | Vertical lines | Philippines	1.00: High Concern	3.00: Moderate Concern	Red (1.73)
Philippines | Hand implements	1.00: High Concern	3.00: Moderate Concern	Red (1.73)

COMMON OCTOPUS			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Philippines | Vertical lines | Philippines	1.00: High Concern	3.00: Moderate Concern	Red (1.73)
Philippines | Hand implements	1.00: High Concern	3.00: Moderate Concern	Red (1.73)

Stock assessments are not conducted for common or day octopus in the Philippines, so biomass and fishing mortality are unknown and there are no reference points in place for these parameters. Based on the results of the PSA, the target species have high susceptibility to fishing pressure due to their inherent life history characteristics (particularly their semelparity), resulting in ratings of "high" concern for stock status.

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Abundance

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

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

Factor 1.2 - Fishing Mortality

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

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

BIG BLUE OCTOPUS

Factor 1.1 - Abundance

PHILIPPINES, VERTICAL LINES, PHILIPPINES

High Concern

Biomass of the stock is unknown because stock assessments are not conducted. A rating of "high" concern is awarded on the basis of a Productivity Susceptibility Analysis (PSA). In the PSA, the fishery was rated "highly selective" due to the semelparous nature of the species (spawns only once in a lifetime), which was a motivating factor in the "high" score for susceptibility.

Justification:

Productivity-Susceptibility Analysis:

Scoring Guidelines

1.) Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

2.) Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows: ⬚⬚ = [(⬚⬚1 ∗ ⬚⬚2 ∗ ⬚⬚3 ∗ ⬚⬚4) − 1/ 40] + 1 .

3.) Vulnerability score (V) = the Euclidean distance of P and S using the following formula: ⬚⬚ = √(P² + S)

Productivity-Susceptibility Analysis for Day octopus:

Table 4

PRODUCTIVITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = LOW RISK, 2 = MEDIUM RISK, 3 = HIGH RISK)	CITATION
Avg age at maturity	0.5 years	1	Herzig et al. 2012
Avg max age	1.5 years	1	Herzig et al. 2012
Density dependence	Unlikely (highly mobile species)	2	Mather and Scheel 2014
Fecundity	>20,000 eggs per year	1	Belazis 2011
Reproductive strategy	demersal egg layer	2	Belazis 2011
Trophic strategy	3.5	3	Sealife Base 2017
SUSCEPTIBILITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = low risk, 2 = medium risk, 3 = high risk)	CITATION
Aereal overlap (considers all fisheries)	≥30% fished	3	Default
Vertical overlap (considers all fisheries)	high overlap	3	Default
Selectivity of fishery (specific to fishery under assessment)	high selectivity	3 (semelparous species)	Default
Post-capture mortality (specific to fishery under assessment)	retained species	3	Default
PSA Score		**3.52, high**	

Factor 1.2 - Fishing Mortality

PHILIPPINES, VERTICAL LINES, PHILIPPINES

Moderate Concern

Fishing mortality reference points have not been set for the octopus fishery in the Philippines, and stock assessments are not conducted. Estimates of fishing mortality are not available.

The factor is scored a "moderate" concern because fishing mortality is unknown.

BIG BLUE OCTOPUS

Factor 1.1 - Abundance

PHILIPPINES, HAND IMPLEMENTS

High Concern

Biomass of the stock is unknown because stock assessments are not conducted. A rating of "high" concern is awarded on the basis of a Productivity Susceptibility Analysis (PSA). In the PSA, the fishery was rated "highly selective" due to the semelparous nature of the species (spawns only once in a lifetime), which was a motivating factor in the "high" score for susceptibility.

Justification:

Productivity-Susceptibility Analysis:

Scoring Guidelines

1.) Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

*2.) Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows: ** = [(**1 ∗ **2 ∗ **3 ∗ **4) − 1/ 40] + 1 .*

*3.) Vulnerability score (V) = the Euclidean distance of P and S using the following formula: ** = √(P² + S)*

Productivity-Susceptibility Analysis for Day octopus:

Table 4

PRODUCTIVITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = LOW RISK, 2 = MEDIUM RISK, 3 = HIGH RISK)	CITATION
Avg age at maturity	0.5 years	1	Herzig et al. 2012
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Reproductive strategy	demersal egg layer	2	Belazis 2011
Trophic strategy	3.5	3	Sealife Base 2017

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Aereal overlap (considers all fisheries)	≥30% fished	3	Default
Vertical overlap (considers all fisheries)	high overlap	3	Default
Selectivity of fishery (specific to fishery under assessment)	high selectivity	3 (semelparous species)	Default
Post-capture mortality (specific to fishery under assessment)	retained species	3	Default
PSA Score		**3.52, high**	

Factor 1.2 - Fishing Mortality

PHILIPPINES, HAND IMPLEMENTS

Moderate Concern

Fishing mortality reference points have not been set for the octopus fishery in the Philippines, and stock assessments are not conducted. Estimates of fishing mortality are not available.

The factor is scored a "moderate" concern because fishing mortality is unknown.

COMMON OCTOPUS

Factor 1.1 - Abundance

PHILIPPINES, VERTICAL LINES, PHILIPPINES

High Concern

Biomass of the stock is unknown because stock assessments are not conducted. A rating of "high" concern is awarded on the basis of a Productivity Susceptibility Analysis (PSA). In the PSA, the fishery was rated "highly selective" due to the semelparous nature of the species (spawns only once in a lifetime), which was a motivating factor in the "high" score for susceptibility.

Justification:

Productivity-Susceptibility Analysis:

Scoring Guidelines

1.) Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

*2.) Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows: ** = [(**1 ∗ **2 ∗ **3 ∗ **4) − 1/ 40] + 1 .*

*3.) Vulnerability score (V) = the Euclidean distance of P and S using the following formula: ** = √(P² + S)*

Productivity-Susceptibility Analysis for Common octopus:

Table 1

PRODUCTIVITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = LOW RISK, 2 = MEDIUM RISK, 3 = HIGH RISK)	CITATION
Avg age at maturity	0.3 years	1	Cuccu et al. 2013
Avg max age	1.5 years	1	Octopus Worlds 2017
Density dependency	Unlikely (highly mobile species)	2	Mather and Scheel 2014
Fecundity	280,000	1	FAO 2000
Reproductive strategy	demersal egg layer	2	Sealife Base 2017
Trophic level	3	2	Idrissi et al. 2016
SUSCEPTIBILITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = low risk, 2 = medium risk, 3 = high risk)	CITATION
Aereal overlap (considers all fisheries)	>30% fished	3	Default
Vertical overlap (considers all fisheries)	High overlap	3	Default
Selectivity of fishery (specific to fishery under assessment)	High selectivity	3 (semelparous)	Sealife Base 2017
Post-capture mortality (specific to fishery under assessment)	Retained species	3	Default
PSA SCORE:		**3.35, high**	

Factor 1.2 - Fishing Mortality

PHILIPPINES, VERTICAL LINES, PHILIPPINES

Moderate Concern

Fishing mortality reference points have not been set for the octopus fishery in the Philippines, despite the fact that the Filipino Fisheries Code as of 2015 calls for Local Government Units, the main managing bodies of octopus fisheries, to set harvest control rules for fisheries occurring in their waters (see Criterion 3.1 below). As stock assessments are not conducted for octopus in the Philippines at this time, estimates of fishing mortality are also not available. In the absence of stock assessments, it is difficult for LGUs to follow through on their mandate to set harvest control rules for octopus.

The factor is scored a "moderate" concern because fishing mortality is unknown.

COMMON OCTOPUS

Factor 1.1 - Abundance

PHILIPPINES, HAND IMPLEMENTS

High Concern

Biomass of the stock is unknown because stock assessments are not conducted. A rating of "high" concern is awarded on the basis of a Productivity Susceptibility Analysis (PSA). In the PSA, the fishery was rated "highly selective" due to the semelparous nature of the species (spawns only once in a lifetime), which was a motivating factor in the "high" score for susceptibility.

Justification:

Productivity-Susceptibility Analysis:

Scoring Guidelines

1.) Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

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*3.) Vulnerability score (V) = the Euclidean distance of P and S using the following formula: ** = √(P² + S)*

Productivity-Susceptibility Analysis for Common octopus:

Table 1

PRODUCTIVITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = LOW RISK, 2 = MEDIUM RISK, 3 = HIGH RISK)	CITATION
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Fecundity	280,000	1	FAO 2000
Reproductive strategy	demersal egg layer	2	Sealife Base 2017
Trophic level	3	2	Idrissi et al. 2016
SUSCEPTIBILITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = low risk, 2 = medium risk, 3 = high risk)	CITATION
Aereal overlap (considers all fisheries)	>30% fished	3	Default
Vertical overlap (considers all fisheries)	High overlap	3	Default
Selectivity of fishery (specific to fishery under assessment)	High selectivity	3 (semelparous)	Sealife Base 2017
Post-capture mortality (specific to fishery under assessment)	Retained species	3	Default
PSA SCORE:		**3.35, high**	

Factor 1.2 - Fishing Mortality

PHILIPPINES, HAND IMPLEMENTS

Moderate Concern

Fishing mortality reference points have not been set for the octopus fishery in the Philippines, despite the fact that the Filipino Fisheries Code as of 2015 calls for Local Government Units, the main managing bodies of octopus fisheries, to set harvest control rules for fisheries occurring in their waters (see Criterion 3.1 below). As stock assessments are not conducted for octopus in the Philippines at this time, estimates of fishing mortality are also not available. In the absence of stock assessments, it is difficult for LGUs to follow through on their mandate to set harvest control rules for octopus.

The factor is scored a "moderate" concern because fishing mortality is unknown.

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤=3.2=Yellow or Moderate Concern*
- *Score ≤=2.2=Red or High Concern*

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding Principles

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

Criterion 2 Summary

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

BIG BLUE OCTOPUS - PHILIPPINES - HAND IMPLEMENTS					
Subscore:	**1.73**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.73**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Common octopus	1.00:High Concern	3.00:Moderate Concern	Red (1.73)		
Octopus	1.00:High Concern	3.00:Moderate Concern	Red (1.73)		

BIG BLUE OCTOPUS - PHILIPPINES - VERTICAL LINES - PHILIPPINES					
Subscore:	**1.73**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.73**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Common octopus	1.00:High Concern	3.00:Moderate Concern	Red (1.73)		
Octopus	1.00:High Concern	3.00:Moderate Concern	Red (1.73)		
Common cuttlefish	1.00:High Concern	3.00:Moderate Concern	Red (1.73)		
Squid	1.00:High Concern	3.00:Moderate Concern	Red (1.73)		

COMMON OCTOPUS - PHILIPPINES - HAND IMPLEMENTS					
Subscore:	**1.73**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.73**

Species	Abundance	Fishing Mortality	Subscore
Big blue octopus	1.00:High Concern	3.00:Moderate Concern	Red (1.73)
Octopus	1.00:High Concern	3.00:Moderate Concern	Red (1.73)

COMMON OCTOPUS - PHILIPPINES - VERTICAL LINES - PHILIPPINES					
Subscore:	**1.73**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.73**

Species	Abundance	Fishing Mortality	Subscore
Big blue octopus	1.00:High Concern	3.00:Moderate Concern	Red (1.73)
Octopus	1.00:High Concern	3.00:Moderate Concern	Red (1.73)
Common cuttlefish	1.00:High Concern	3.00:Moderate Concern	Red (1.73)
Squid	1.00:High Concern	3.00:Moderate Concern	Red (1.73)

Octopus in the Philippines are harvested using fairly selective, small-scale, artisanal methods. Hard data on the proportions of harvest accounted for by different gear types are not available, but local stakeholder reviewers of this report estimated that hand implements account for 90% of the catch, vertical lines comprise 5 to 10%, and a variety of gears (traps, dive spearfishing, bottom trawls) comprise the remainder.

"Vertical lines" covers a broad range of techniques to attract the prey using a line and bait. Natural and artificial baits can be used, as can jigs, and catch may be hauled by hand or using a hook. In the case of an unwanted species trapped in the bait, handliners can easily release the catch. Squid are a significant portion of the catch when squid/octopus jigs are used, and thus *Sepia* and *Loligo* spp. are included as main species in this analysis.

"Hand implements" refers to use of a metal projectile instrument to thrust into the animal and subsequently haul it aboard or to shore. Hand implements are considered a highly selective gear because fishermen can identify the target as an octopus before harvesting it.

It is presumed that the catch in the Filipino octopus fishery is rarely discarded and almost fully utilized, with species that are not exported to Western markets and Japan used or marketed locally. However, since the gear composition of the fishery is not definitively known and local stakeholders during outreach referred to some species of octopus as "bycatch" (specifically, a species known locally as "white octopus" that is five-sixths water by weight and therefore not valued on the market), *octopus* spp. were also included as a bycatch species assessed in Criterion 2 of this report (pers. comm., Millennium Ocean Star Corporation 2017).

Ratings of "high" concern were awarded due to unknown stock status of the bycatch species (octopus, cuttlefish, and squid) combined with high susceptibility scores (i.e., on the basis of Productivity Susceptibility Analysis).

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

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

OCTOPUS

Factor 2.1 - Abundance

PHILIPPINES, VERTICAL LINES, PHILIPPINES
PHILIPPINES, HAND IMPLEMENTS

High Concern

A rating of "high" concern is awarded because stock status of octopus bycatch species is unknown, and the species are presumed to be highly susceptible to fishing pressure (based on the Productivity Susceptibility Analyses for the two target species). Although the exact bycatch species are unknown, the octopus species that are known to occur in the catch besides common and day octopus are known or presumed to be semelparous (this fishery is a coastal one, and most shallow-water octopuses are small-egged species laying eggs in festoons or small clusters of a single spawning event) (Rocha et al. 2001). Thus, these species (A*mphioctopus aegina, Cistopus indicus, Octopus aculeatus, Octopus nocturnus, Octopus ornatus, Octopus luteus,* and others) would likewise score "high" on a Productivity Susceptibility Analysis because the target species have yielded the rating of "high" concern.

Factor 2.2 - Fishing Mortality

PHILIPPINES, VERTICAL LINES, PHILIPPINES
PHILIPPINES, HAND IMPLEMENTS

Moderate Concern

Fishing mortality reference points have not been set for either target or bycatch octopus species in the Philippines. Estimates of fishing mortality are not available, resulting in the score of "moderate" concern.

Factor 2.3 - Modifying Factor: Discards and Bait Use

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

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

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

PHILIPPINES, VERTICAL LINES, PHILIPPINES

< 100%

Vertical lines, if used with cephalopod jigs or octopus lures, are highly selective. It is presumed that there is local market demand for species of octopus and squid for which there is insufficient international demand to encourage exporting. However, when queried a local processor did refer to a couple of octopus species considered bycatch due to undesirable characteristics (e.g., high water content) (pers. comm., Emerald Uy, Millenium Ocean Star Corp 2017). It is presumed that these species comprise a small portion of the catch.

PHILIPPINES, HAND IMPLEMENTS

< 100%

The hand implement method of harvesting octopus is highly selective, and it is also presumed that there is local market demand for species of octopus for which there is insufficient international demand to encourage exporting. However, when queried a local processor did refer to a couple of octopus species considered bycatch due to undesirable characteristics (e.g., high water content) (pers. comm., Emerald Uy, Millenium Ocean Star Corp. 2017). It is presumed that these species comprise a small portion of the catch.

COMMON CUTTLEFISH

Factor 2.1 - Abundance

PHILIPPINES, VERTICAL LINES, PHILIPPINES

High Concern

According to (ANCORS et al. 2011), 34% of the catch of jig fisheries in Bicol, Philippines (Luzon Island) is composed of octopus species, with squids and cuttlefish accounting for the remainder—among them, *Sepia* spp. (of which *Sepia esculenta* and *Sepia pharaonis* are known to be among the most abundant species in the region) accounted for 27% of the catch and *Loligo* species (of which *Loligo duvauceli* and *Loligo edulis* are known to be among the most abundant species in the region) accounted for 37% (Hernando and Flores 1981).

Biomass of *Sepia* species in the Philippines is unknown because stock assessments are not conducted. A rating of "high" concern is awarded on the basis of a Productivity Susceptibility Analysis.

Justification:

Productivity-Susceptibility Analysis for *Sepia* spp.:

Scoring Guidelines

1.) Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

2.) Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows: ⬚⬚ = [(⬚⬚1 ∗ ⬚⬚2 ∗ ⬚⬚3 ∗ ⬚⬚4) − 1/ 40] + 1 .

3.) Vulnerability score (V) = the Euclidean distance of P and S using the following formula: ⬚⬚ = √(P² + S)

Generalized Productivity-Susceptibility Analysis for *Sepia* spp.:

PRODUCTIVITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = LOW RISK, 2 = MEDIUM RISK, 3 = HIGH RISK)	CITATION
Avg age at maturity	0.3 yo	1	cephalopodpage, 2017 (for *Sepia pharaonis)*
Avg max age	2.2 yo	1	Sasikumarl et al. 2013 (for *S. pharaonis)*
Density dependence	Unlikely (highly mobile species)	2	Mather and Scheel 2014
Fecundity	1500 eggs	2	cephalopodpage, 2017 (for *S. pharaonis)*
Reproductive strategy	demersal egg layers	2	FAO 2014 (for *Sepia* spp.)
Trophic level	3.56	3	Babouri et al. 2014 (for *S. officinalis*)
SUSCEPTIBILITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = low risk, 2 = medium risk, 3 = high risk)	CITATION
Aereal overlap (considers all fisheries)	>30% fished	3	Default
Vertical overlap (considers all fisheries)	High overlap	3	Default
Selectivity of fishery (specific to fishery under assessment)	High selectivity	3 (semelparous species)	Hanlon and Messenger 1998
Post-capture mortality (specific to fishery under assessment)	Retained species	3	Default
PSA SCORE:		**3.39 (high)**	

Factor 2.2 - Fishing Mortality

PHILIPPINES, VERTICAL LINES, PHILIPPINES

Moderate Concern

As with octopus, fishing mortality reference points have not been set for squid in the Philippines. The factor is scored a "moderate" concern because fishing mortality is unknown.

Factor 2.3 - Modifying Factor: Discards and Bait Use

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

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

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

PHILIPPINES, VERTICAL LINES, PHILIPPINES

< 100%

Vertical lines, if used with cephalopod jigs or octopus lures, are highly selective. It is presumed that there is local market demand for species of octopus and squid for which there is insufficient international demand to encourage exporting. However, when queried a local processor did refer to a couple of octopus species considered bycatch due to undesirable characteristics (e.g., high water content) (pers. comm., Emerald Uy, Millenium Ocean Star Corp 2017). It is presumed that these species comprise a small portion of the catch.

SQUID

Factor 2.1 - Abundance

PHILIPPINES, VERTICAL LINES, PHILIPPINES

High Concern

According to (ANCORS et al. 2011), 34% of the catch of jig fisheries in Bicol, Philippines (Luzon Island) is composed of octopus species, with squids and cuttlefish accounting for the remainder—among them, *Sepia* spp (of which *Sepia esculenta* and *Sepia pharaonis* are known to be among the most abundant species in the region) accounted for 27% of the catch and *Loligo* species (of which *Loligo duvauceli* and *Loligo edulis* are known to be among the most abundant species in the region) accounted for 37% (Hernando and Flores 1981).

Biomass of *Loligo* species in the Philippines is unknown because stock assessments are not conducted. A rating of "high" concern is awarded on the basis of a Productivity Susceptibility Analysis.

Justification:

Productivity-Susceptibility Analysis for *Loligo spp.*:

Scoring Guidelines

1.) Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

*2.) Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows: ** = [(**1 ∗ **2 ∗ **3 ∗ **4) − 1/ 40] + 1 .*

*3.) Vulnerability score (V) = the Euclidean distance of P and S using the following formula: ** = √(P^2 + S)*

PRODUCTIVITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = LOW RISK, 2 = MEDIUM RISK, 3 = HIGH RISK)	CITATION
Avg. age at maturity	1.5 yo	1	Petsut and Kublatong 2013 (for *L. duvaucelii*)
Avg. max. age	3 yo	1	Sabrah et al. 2015 (for *L. duvaucelii*)
Density dependence	Unlikely (highly mobile species)	2	Mather and Scheel 2014
Fecundity	7,000 eggs	2	Naik et al. 2017 (for *L. duvaucelii*)
Reproductive strategy	demersal egg layers	2	FAO 2014 (for *Loligo* spp.)
Trophic level	3.2	2	Jin et al. 2017 (for *Loligo* spp.)
SUSCEPTIBILITY ATTRIBUTE	RELEVANT INFORMATION	SCORE (1 = low risk, 2 = medium risk, 3 = high risk)	CITATION
Aereal overlap (considers all fisheries)	>30% fished	3	Default
Vertical overlap (considers all fisheries)	High overlap	3	Default
Selectivity of fishery (specific to fishery under assessment)	High selectivity	3 (semelparous species)	Hanlon and Messenger 1998
Post-capture mortality (specific to fishery under assessment)	Retained species	3	Default
PSA SCORE:		**3.52 (high)**	

Factor 2.2 - Fishing Mortality

PHILIPPINES, VERTICAL LINES, PHILIPPINES

Moderate Concern

As with octopus, fishing mortality reference points have not been set for squid in the Philippines. The factor is scored a "moderate" concern because fishing mortality is unknown.

Factor 2.3 - Modifying Factor: Discards and Bait Use

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

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

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

PHILIPPINES, VERTICAL LINES, PHILIPPINES

< 100%

Vertical lines, if used with cephalopod jigs or octopus lures, are highly selective. It is presumed that there is local market demand for species of octopus and squid for which there is insufficient international demand to encourage exporting. However, when queried a local processor did refer to a couple of octopus species considered bycatch due to undesirable characteristics (e.g., high water content) (pers. comm., Emerald Uy, Millenium Ocean Star Corp 2017). It is presumed that these species comprise a small portion of the catch.

Criterion 3: Management Effectiveness

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

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

The Criterion 3 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2 = Red or High Concern*

Rating is Critical if Management Strategy and Implementation is Critical.

GUIDING PRINCIPLE

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

Criterion 3 Summary

Fishery	Management Strategy	Bycatch Strategy	Research and Monitoring	Enforcement	Stakeholder Inclusion	Score
Fishery 1: Philippines | Hand implements	Ineffective	Highly Effective				Red (1.00)
Fishery 2: Philippines | Vertical lines | Philippines	Ineffective	Moderately Effective				Red (1.00)

Criterion 3 Assessment

Factor 3.1 - Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

PHILIPPINES, HAND IMPLEMENTS
PHILIPPINES, VERTICAL LINES, PHILIPPINES

Ineffective

As of Spring 2017 there are plans to introduce management measures specific to octopus in the future: seasonal closures and abundance limits based on historic catch data (Jake Piscano, BFRA, 2017, pers. comm.). However, at this time, there are no management measures specific to the octopus fishery. Some conservation measures are in place for all commercial fisheries including octopus: 1) the use of compressors (known as "hookahs") to allow divers to stay underwater for extended periods of time is outlawed; 2) night fishing is illegal; 3) permits are required; 4) fishers cannot touch *Seagassum* while fishing (Jake Piscano, BFRA, 2017, pers. comm.). Although the hookah is illegal, according to a local stakeholder who reviewed this report, they are still commonly used in the hand implement fishery.

Because there is practically no management of the target species but it is unlikely that the fishery is having serious, negative impacts on retained populations (e.g., population status is not scored red), a rating of "ineffective" is awarded.

Justification:

The national governing agency is the Bureau of Fisheries and Aquatic Resources (BFAR) which is part of the Department of Agriculture. BFAR classifies octopus fisheries as "municipal fisheries," which include fishing done in coastal and inland waters with or without the use of boats of 3 gross tons or less (Oceana 2015). The Republic Act 7160 (Local Government Code of 1991) specified that management and protection of all fisheries resources and habitat between 0 and 15 km from shore (known as municipal waters), are under the jurisdiction of the Local Government Units (LGUs) that operate at the municipal/city level (Code 1991). Thus the primary management agencies for the octopus fishery in the Philippines consist of all LGUs with jurisdiction over coastal municipal waters; national agencies including BFAR are rarely involved.

Although management of this fishery is the responsibility of LGUs, management of the octopus fishery (like all Filipino fisheries) must also comply with the Republic Act 8550 (a.k.a. the Philippine Fisheries Code of 1998) which consolidated all laws pertaining to the fisheries sector and superseded previous statutes (Code 1998). This code declared achieving food security as the main consideration in the development, management, and conservation of fishery resources. It recognized the importance of protecting the rights of fishers, supporting the fishery sector as a state, and managing for long-term conservation of fishery resources. This Act also established government jurisdiction over issuing licenses and permits, prescribing quotas, and closing any fishery it deems necessary. The Fisheries Code furthermore created the National Fisheries Research and Development Institute (NFRDI) which is a research institute that supports the development of sustainable and competitive fisheries. The major project of the NFRDI is the National Stock Assessment Project (NSAP). However, the NSAP has so far been focused on fin fishes due to their national commercial importance. As of 2011, no stock assessment of the octopus fishery had been conducted or was planned due to its low volume of capture (Ji-Yih Yau 2011). Stakeholders queried in 2017 indicated that the situation had not changed in the six years that have followed.

The Philippine Fisheries Code of 1998 provided for the creation of three levels of management councils. The first is the National Fisheries and Aquatic Resource Management Council (NFARMC) which forms national-level fisheries policy and is composed of the Undersecretary of Agriculture, the Undersecretary of Interior and Local Government, and members representing fishers, commercial fishing and aquaculture, academics, and non-governmental organizations. The second is the Municipal/City Fisheries and Aquatic Resource Management Council (M/CFARMC), which advises LGUs on fisheries policy within their jurisdiction of 15 km from the coastline. The third is the Integrated Fisheries and Aquatic Resource Management Council (IFARMC) which assists with fisheries policy for bodies of water that span two or more municipalities and/or cities. The

octopus fishery is not currently managed as its own entity or jointly with others by any LGU due to the low volume of capture (Ji-Yih Yau 2011).

The Philippine Fisheries Code was most recently updated in 2015, with revisions mostly focusing on combating IUU fisheries. In addition to the entities described above that take their mandates from the Code, some other contents of the Code that are relevant for municipal octopus fisheries include:

- LGUs issue licenses and determine license fees for fisheries within municipal waters. License fees are determined in consultation with the M/CFARMC.

- LGUs are required to establish Harvest Control Rules within their waters per a 2015 amendment to the Fisheries Code.

- The Secretary of the Department of Agriculture can declare fishery-wide/nationwide closed seasons, while LGUs in consultation with the appropriate M/CFARMC can put into place seasonal closures and other conservation measures (e.g., net mesh size limits, thresholds on the number of license holders) into place (Oceana 2015).

Factor 3.2 - Bycatch Strategy

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

PHILIPPINES, HAND IMPLEMENTS

Highly Effective

While data are lacking, the hand implement method of fishing is presumed to be quite selective, with very rare take of non-octopus species . Because the bycatch is likely below 5% of the catch and there is no significant bycatch of species of concern, this factor is rated "highly effective."

PHILIPPINES, VERTICAL LINES, PHILIPPINES

Moderately Effective

Unlike the hand implement method, harvest by vertical line, depending on the type of lines used, may entail significant harvest of non-octopus species. Three reviews of the gears used in vertical line fisheries in various regions of the Luzon and Samar islands indicated that octopus are harvested in some areas using octopus-specific lures, in others using jigs that simultaneously target squid; in other areas they are not targeted at all, but may appear in the bycatch of non-jig or non-lure vertical line fisheries that target other species (ANCORS et al. 2011) (Galenzoga and Quiñones 2014) (Baleta et al. 2017). ANCORS et al. (2011) indicate that, in Bicol, jigs target squid and octopus, with 66% of the catch comprised of squid and the remainder of octopus. While it is unclear whether or not these jigs account for the majority of vertical line octopus harvest across the country, their significant contribution to catch was presumed in rating this fishery "moderately effective" for bycatch strategy. There are no bycatch management measures in place and the fishery is not highly selective per se because squid account for more than 5% of the catch, but the jig method does appear to be highly selective for cephalopods and is not known to harvest species of concern (ANCORS et al. 2011). The "moderately effective" rating balances the absence of management measures with the moderately selective gear.

Factor 3.3 - Scientific Research and Monitoring

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

Factor 3.4 - Enforcement of Management Regulations

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

Factor 3.5 - Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

GUIDING PRINCIPLES

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

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Philippines / Vertical lines / Philippines	4	0	Moderate Concern	Green (3.46)
Philippines / Hand implements	2	0	Moderate Concern	Yellow (2.45)

Criterion 4 Assessment

SCORING GUIDELINES

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

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

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*

- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

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

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

Factor 4.3 - Ecosystem-Based Fisheries Management

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

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

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

PHILIPPINES, HAND IMPLEMENTS

2

Hand implements are unlikely to contact the bottom during fishing, but trampling of coral reefs may occur when fishermen walk along reef flats at low tide looking for octopus holes (Emerald Uy, Millenium Ocean Star Corp., pers. comm., 2017).

Justification:

Octopus fishing by hand implement can entail "gleaning," whereby fishermen walk along reef flats at low tide searching for octopus holes. When found, the holes are prodded to see if there is an octopus present. The implements, described variously by local stakeholders as "hooks with long handles" or "galvanized iron pipes with a hook at the end" are used to extract the octopus. A second, similar implement may be used to break up the coral around the hole to extract octopus that will not come out easily (Saleh Hanan 2009).

Hand implement fishers may also dive to catch octopus, some using hookahs (compressors to provide oxygen). Hookahs are illegal in Filipino fisheries but still widely used.

PHILIPPINES, VERTICAL LINES, PHILIPPINES

4

Fishing using handline is presumed to cause minimal habitat damage, as handlines are deployed from a vessel with hooks suspended in the water column and not touching the seafloor.

Justification:

Handline gear consists of long lines with a small series of baited hooks requiring constant attention. There are different types of handlines in use in the Philippines, including a) simple handlines or drop lines; b) multiple handlines; c) jiggers, and d) troll lines. A simple handline or drop line is defined as a single vertical line carrying one of two barbed hooks and works by simply dropping it into the water and waiting for fish to bite. A multiple handline or multiple hook and line is a handline gear with a single vertical line and a small series of barbed hooks attached by spreaders at regular intervals. Jiggers are lines, each bearing a multiple hook device, which works by jerking it up and down under a bright light, making the hook lures attractive primarily to squids. Lastly, troll lines are long handlines, fixed horizontally with a hook or hooks at the free end, baited either with a natural bait or an artificial lure, and the whole arrangement drawn or towed behind a boat underway (Galenzoga and Quiñones 2014).

A 2011 survey of fishers in the Bicol region of Luzon Island in the Philippines found that simple handline or drop line accounted for the majority of fisheries harvest in the region (82%), followed by jigger (9%), multiple hook and line (5%), and troll line (4%). However, jigger handlines were the most common handline used for harvest of octopus, as well as squid species, in Bicol (ANCORS et al. 2011). Meanwhile, a study conducted in the city of Isabela, also located on Luzon Island, indicated that fishers use two different types of jigs/lures to target squid and octopus, respectively, there (Baleta et al. 2017). Finally, a study covering the northern region of Samar Island indicated that octopus and squid jigs are rarely used in that area (Galenzoga,and Quiñones 2014). The three studies collectively indicate that there are regional differences among vertical line gears and a lack of a collective understanding regarding what proportion of the Philippines' octopus harvest is accounted for by each type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

PHILIPPINES, HAND IMPLEMENTS

0

There are general regulations in place to limit fishery gear impacts on habitat: e.g., cyanide and dynamite fishing are illegal and compressors cannot be used. According to BFAR staff, a policy is also being considered that would require broken coral to be replanted by the perpetrator (Jake Piscano, BFAR, 2017, pers. comm.). However, there are no measures in place specific to the octopus fishery and its gears.

PHILIPPINES, VERTICAL LINES, PHILIPPINES

0

There are general regulations in place to limit fishery gear impacts on habitat: e.g., cyanide and dynamite fishing are illegal and compressors cannot be used. According to BFAR staff, a policy is also being considered that would require broken coral to be replanted by the perpetrator (Jake Piscano, BFAR, 2017, pers. comm.). However, there are no measures in place specific to the octopus fishery and its gears.

Factor 4.3 - Ecosystem-Based Fisheries Management

PHILIPPINES, HAND IMPLEMENTS
PHILIPPINES, VERTICAL LINES, PHILIPPINES

Moderate Concern

There have been efforts at encouraging Ecosystem Based Fisheries Management (EBFM) in the Philippines, most notably the Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF) that was most active in 2007 to 2013 and worked in Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor-Leste (CTI 2013). Yet, despite the efforts of CTI-CFF to develop and follow road-maps toward EBFM, there is still no EBFM-specific legislation in the Philippines. There are, however, policies and programs that have pursued specific management strategies and designated conservation areas in the coastal zone where the EBFM approach can and has been operationalized (Eisma Osorio et al. 2009) (Sparks 2012).

Despite the the fishery's lack of spatial management or other policies to protect ecosystem functioning and account for capture species' ecological role, detrimental food web impacts are deemed to be unlikely, and a rating of "moderate concern" is awarded. The fishery does not target primary producers or the main apex predators in the ecosystem in which it takes place, and is therefore unlikely to set off a trophic cascade.

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

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Appendix A: Criterion 3

Below are scores and supporting information for Factors 3.3, 3.4, and 3.5. These scores do not factor into the overall score for the fisheries because scores for Factors 3.1 and 3.2 automatically yield "Ineffective" scores for Criterion 3.

Factor 3.3: Scientific Research and Monitoring: Ineffective

Little scientific information on octopus is collected or analyzed by management authorities in the Philippines, nor are appropriate data-limited assessment and management methods used, resulting in a score of "ineffective." Fishery catch data are the one multi-year data set that is available for octopus and many of the other commercially-targeted species in Philippines. However, in the case of octopus catch, volumes are not broken out by species, rendering it difficult to draw conclusions about species status and inform management of the fishery on that basis. Moreover, according to Anticamara and Go (2016), national catch statistics have other shortcomings that prevent their use in management: they do not take IUU harvest into account; they inadequately account for overlaps between catches of municipal and commercial fishers; and they do not capture the mobility of fishers and their landings, "preventing analysis of spatial serial fisheries depletion or geographical expansions."

Factor 3.4: Enforcement of Management Regulations: Moderately effective

Illegal fishing is known to be a problem in the Western Central Pacific, including the Philippines, where it comprised 34 to 38% of legal harvest from 1980 to 2003 (Agnew et al. 2009). Types of illegal fishing known to be problematic include divers' use of compressors ("hookahs") to stay underwater for long periods of time, and incursion of bottom trawlers within the 15 km coastal border zone. In 2014, the European Union issued a yellow card to the Philippines, signifying that the EU could stop importing Filipino seafood if action was not taken to combat illegal fishing (Seafood Source 2014). In response, the Philippines modified its national Fisheries Code to put measures into place combating illegal fishing and ensuring their enforcement. Among the changes were new requirements that fishers use daily logbooks to report catch and activate VMS on board some vessels. Fines for illegal fishing were also raised sharply (Oceana 2015). In 2015, the European Union yellow card for Philippines was rescinded. A score of "moderately effective" is awarded because enforcement and monitoring are in place, but effectiveness of the enforcement and monitoring is uncertain. While fines for illegal fishing have increased, as of 2017 the Bureau of Fisheries and Aquatic Resources had not imposed many such penalties, as it was still in the process of hiring control officers tasked with enforcing the new measures (Philstar 2017).

Factor 3.5: Stakeholder inclusion: Moderately effective

Public participation in fisheries management is provided for in the Philippine Fisheries Code. The Code mandates the creation of Fisheries and Aquatic Resources Management Councils (FARMCs) at municipal scale, which takes the input of local fishermen into consideration when developing advice for the city, municipality, and/or Bureau of Fisheries and Aquatic Resources regarding changes to fishery regulations. The Fisheries Code also provides a means by which members of local fisherfolk associations can be deputized as wardens to enforce the Fisheries Code (Gera 2016).

Updates to the Code made in 2015 also provide the mechanisms of civil suit and calling out the government for a SLAPP (Strategic Lawsuit Against Public Participation) in cases where stakeholder input is being ignored or the government is persecuting citizens for providing input (Oceana 2015).

A score of "moderately effective" is awarded because mechanisms are in place for consideration of stakeholder input, but it is not clear how well the FARMC process works at receiving stakeholder input and successfully

convincing government to put regulations into place.