# Day Octopus

*Octopus cyanea*

Image © Monterey Bay Aquarium

# Indonesia

Handline, Trap, Spear

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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 wild-catch fisheries for consumers and businesses. These criteria are:

- How does fishing affect the species under assessment?
- How does the fishing affect other, target and non-target species?
- How effective is the fishery's management?
- How does the fishing affect habitats and the stability of the ecosystem?

Each criterion includes:

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

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

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

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

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

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

# Summary

The following Seafood Watch report provides recommendations for the commercial octopus fishery in Indonesian waters whose catch is dominated by *Octopus cyanea*, or day octopus (also referred as reef octopus). This is an open access (unregulated) nearshore fishery that occurs mainly on reef areas of the archipelago. As no stock assessment exists for this species, it is difficult to assess the sustainability of the growing commercial fishery, nor the potentially larger but undocumented subsistence catch.

Day octopus is a medium sized, diurnally active octopus that is thought to be the most common octopus species on reefs worldwide and it is the dominant octopus in tropical subtidal and intertidal reefs in the Indian Ocean region (Herwig et al. 2012). Its migratory behavior and spawning spikes impart a certain level of vulnerability to the species, but its high fecundity, low age at maturity, relatively short lifespan, and rapid growth rate cause *O. cyanea* to be considered a naturally resilient organism that has a low vulnerability to fishing pressure.

A wide range of fishing gear is used to catch octopus in the country. However, the majority of day octopus is caught using spearguns, handlines and to a lesser extent traps, which are the gears assessed in this report.

The combination of individual criteria results in an overall rating of “Avoid” for all day octopus fisheries in Indonesia. Criterion 1, "Impacts of the Fishery on the Stock," ranks as Red for the species due to the combination of a Moderate Concern for stock status and a High Concern for fishing mortality. Criterion 2, "Impacts of the Fishery on Bycatch and Other Retained Species," is not a contributing factor to the overall ranking because all these fisheries have no or very low levels of bycatch because capture methods are non-lethal. Criterion 3, "Effectiveness of Fishery Management," is considered Ineffective due to the lack of recommendations for controlling catches and effort in nearshore fisheries in the country. Criterion 4, "Impacts on Habitat and Ecosystem," scores as Green for handlines due to the minimal impact of the gear on the habitat, and Yellow for traps and spearguns due to the physical damage of both fishing methods on reef-forming species.

**Table of Conservation Concerns and Overall Recommendations**

| Stock / Fishery | Impacts on the Stock | Impacts on other Spp. | Management | Habitat and Ecosystem | Overall Recommendation |
|---|---|---|---|---|---|
| **Day Octopus Indonesia Indian Ocean–Handline** | Red (1.73) | Green (5.00) | Red (1.00) | Green (4.00) | **Avoid (2.426)** |

| | | | | | |
|---|---|---|---|---|---|
| **Day Octopus Indonesia Indian Ocean–Spear** | Red (1.73) | Green (5.00) | Red (1.00) | Yellow (2.83) | **Avoid (2.225)** |
| **Day Octopus Indonesia Indian Ocean–Trap** | Red (1.73) | Green (5.00) | Red (1.00) | Yellow (2.83) | **Avoid (2.225)** |

*Scoring Guide*

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

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

- **Best Choice/Green** = Final Score >3.2, **and** no Red Criteria, **and** no Critical scores

- **Good Alternative/Yellow** = Final score >2.2-3.2, **and** neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern[2], **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).

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# Introduction

### Scope of the Analysis and Ensuing Recommendation

The following Seafood Watch report provides recommendations for the day octopus or reef octopus (*Octopus cyanea*) fishery located in Indonesian waters. Octopuses are caught in Indonesia using a wide range of fishing gears: spearguns and harpoons (Evayani 2014), handlines (Ferse et al. 2014)(Adhawati & Nuryanti 0000), traps (WWF Indonesia pers. Comm.), scoop nets (Evayani 2014), and even gleaning (using the low tides to search for octopus holes).

In particular, day octopus are caught mainly using spears and harpoons (Evayani 2014) and handlines (Ferse et al. 2014). Traps and pots (clay pots and natural shells) are also employed in some regions, but they are not widely used by fishermen in the country due to their lower efficiency in catching octopus and the complexity in the hauling operations (IPB 2010). These gears are used by fishermen working aboard small-scale vessels, as well as by divers and by fishermen walking on the reef flats.

Recommendations are therefore provided for these three fishing gears, which are thought to catch a significant volume of day octopus, which is exported to foreign markets.

### Overview of the Species and Management Bodies

Indonesia is the largest archipelagic country in the world comprising 17,504 islands and a coastline of 104,000 km. Its Exclusive Economic Zone covers 2,981,211 $km^2$ and its inlands waters 5,400 $km^2$ (OECD 2013)(MMAF 2011). Indonesia is the world's second largest producer of fisheries products with a production in 2011 of 12,385,850 mt; 41% of this production corresponds to marine captured fish and 56% to cultured finfish, seaweed, algae and other cultured aquatic animals (OECD 2013). Indonesia also has the world's second highest number of fishers (more than 2,500,000) as well as the world's second highest number of powered and non-powered vessels (more than 550,000) (OECD 2013).

Indonesian fisheries are very complex and diverse, reflecting the country's extraordinarily diverse bio-geographic characteristics (Buchary et al. 2007). In the western part of the archipelago, where waters are shallow and relatively rich, small-scale inshore fisheries operate on coral reefs and reef flats using a wide range of gears, such as lines, traps, scoop nets, and even gleaning without any gear (Buchary et al. 2007)(Resosudarmo 2005)(Ramu). This area produces about two-thirds of the total fish catch and suffers a large amount of fishing effort. In contrast, in eastern Indonesia, waters are deeper and large-scale purse seines and artisanal

fleets (pole-and-line, seines, etc) catch small pelagics such as anchovies and herring, and tuna-like fishes(Buchary et al. 2007).

Analysis of small-scale fisheries in Indonesia is difficult due to the high degree of spatial and temporal variability, as well as the diversity of fishing methods and target species (Ferse et al. 2014). For example, local fishing methods employed in the waters surrounding the Wakatobi Marine National Park (WMNP), (the second largest Marine National Park in the country (May, 2005)), include 12 types of handline, 12 different nets, 6 traps, gleaning and spear fishing (May 2004)((Exton 2010)(Pilgrim 2006).

Octopus reported in the region include day octopus, *Octopus cyanea*, a medium sized, diurnally active octopus, thought to be the most common octopus species on reefs worldwide (Herwig et al. 2012); *Callistoctopus nocturnus* (incorrectly identified in many reports as *Octopus macropus*, a European member of this group (FAO 2014)), a night active intertidal species which is caught using scoop nets and torches at night (Evayani 2014)(FAO 2014). Also included are *Amphioctopus aegina*, a species commonly sold as "baby octopus," which is harvested by Thai trawlers mainly in the Gulf of Thailand; and common octopus (*Octopus vulgaris*), a species frequently offered by some Indonesian suppliers on their websites but probably misidentified since (according to FAO 2014) this species is not present in the area. Finally, other minor species also caught in the country are *Cistopus indicus,* a shallow subtidal species that occurs on soft-sediment substrates, and *Octopus membranaceus* (probably *Enteroctopus dofleini*), the "North Pacific giant octopus" which is caught as bycatch by trawlers in some areas of the Indian Ocean (Yedukondala Rao & Mohana Rao 2013).

After collecting and contrasting the information provided by scientists, international octopus experts and local NGOs for the octopus fishery in Indonesia; the day octopus, *Octopus cyanea*, was the only species selected for this report since it seems to be the unique octopus species that is exported from Indonesia to international markets such as the U.S.

Controlled by the local governments, the Ministry of Marine Affairs and Fisheries (MMAF), along with its counterparts, the fisheries services at the provincial and district levels, are the main government agencies responsible for the administration and management of capture and culture fisheries in Indonesia (OECD 2013). The Ministry of Marine Affairs and Fisheries (MMAF) has committed itself to ensuring the sustainable used of marine resources, while increasing the value of the marine and fisheries sector in the country (Huffard et al. 2012).

In accordance with Presidential Decree No. 9 of 2005, the organizational structure of the Ministry of Marine Affairs and Fisheries consists of the Secretariat-General, the Inspectorate-General, five Directorates-General (Capture Fisheries; Aquaculture; Marine, Coastal and Small-islands; Fisheries Products Processing and Marketing and Monitoring and Control of Marine

Resources and Fisheries) and two agencies (Agency for Marine and Fisheries Research; and Human Resources Development Agency of Marine and Fisheries) (MMAF 2015).

The main laws regulating fisheries in Indonesia are Law 31/2004 and its amendment, Law 45/2009. These laws provide a legal basis for a range of fishery management measures in marine, brackish and public inland waters, including effort control through licensing and quota, gear restrictions, etc. Law 31/2004 defined fishery management for the first time in Indonesia and set out requirements for fishery management areas and fishery management plans (Dudley & Ghofar 2007). It specifically stated the responsibility of the minister in allocating catches that are based on the fisheries' potential and sustainability issues. Marine protected areas in Indonesia have also been established under conservation law 5/1990 and are managed by the Ministry of Forestry (OECD 2013).

Other management measures in Indonesia include protected species or periods where fishing is limited and technical measures for fishing gears such as auxiliary gears and fishing vessels. Banned fishing methods include blast or cyanide fishing. Compliance with fisheries regulations is monitored by the Directorate General of Control and Surveillance in cooperation with the marine police, the Indonesian navy and a network of community-based surveillance groups, known as POKMASWAS (OECD 2013).

Finally, Indonesia has the largest number of and longest enduring traditional community-based coastal resource management systems in Southeast Asia (Buchary et al. 2007)(OECD 2013). Some of these traditional management systems, such as Sasi (in Maluku and Irian) and Awiq-awiq (in West Nusatenggara and Bali), which focus mainly in a small range of species and in restricted areas, have been incorporated into local regulation (Dudley & Ghofar 2007).

**Production Statistics**

The importance of cephalopods as a worldwide fisheries resource continues to increase. Cephalopods were historically important, equally as target species and bycatch, in the coastal hand-fisheries of numerous countries, but now have major international fisheries directly focused on them (Guerra et al. 1994).

Official landings for octopodidae species, from 2003 to 2012, for the four main fishing countries in Southern Asia (Indonesia, Malaysia, Thailand and Philipines) are shown in the table below (Image 1) (adapted from FAO FishStatJ 2013)(FAO capture and aquaculture databases 2013). Thailand showed the highest catch of octopodidae species in the area from 2003 to 2010. Total annual catch ranged between 21,256 mt in 2004 to 7,608 mt in 2012. A decreasing trend occurred in the country until 2012. Indonesia, in contrast, shows an increasing trend in octopuses catches since 2004. Total annual catches ranged between 4,505 mt in 2004 to 8,668

mt in 2012 with a peak in 2010 of 10,860 mt. Since 2010, Indonesia shows the highest catch of octopodidae species in the area, surpasing Thailand. The Philippines and Malaysia rank 3rd and 4th in octopuses total annual catches, respectively.

As also can be seen in the table below, between 70% and 90% of the octopuses caught in Indonesia come from the Western Central Pacific (FAO statistical area 71) (Image 1) (FAO capture and aquaculture databases 2013).

| Fishing area | Country | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Eastern Indian Ocean (FAO 57) | Indonesia | 352 | 424 | 323 | 352 | 512 | 573 | 1006 | 982 | 1626 | 2637 |
| Western Central Pacific (FAO 71) | | 6147 | 4081 | 2673 | 6063 | 6462 | 7806 | 5007 | 9878 | 6048 | 6031 |
| Total | | **6499** | **4505** | **2996** | **6415** | **6974** | **8379** | **6013** | **10860** | **7674** | **8668** |
| Eastern Indian Ocean (FAO 57) | Malaysia | 750 | 766 | 523 | 727 | 707 | 1057 | 1325 | 971 | 1026 | 1115 |
| Western Central Pacific (FAO 71) | | 569 | 603 | 926 | 911 | 1454 | 1423 | 1146 | 965 | 1066 | 918 |
| Total | | 1319 | 1369 | 1449 | 1638 | 2161 | 2480 | 2471 | 1936 | 2092 | 2033 |
| Eastern Indian Ocean (FAO 57) | Thailand | 10249 | 11028 | 5960 | 4983 | 4750 | 4766 | 4007 | 2776 | 2352 | 2149 |
| Western Central Pacific (FAO 71) | | 9449 | 10228 | 14000 | 11124 | 8957 | 6013 | 5842 | 5631 | 5338 | 5459 |
| Total | | 19698 | 21256 | 19960 | 16107 | 13707 | 10779 | 9849 | 8407 | 7690 | 7608 |
| Western Central Pacific (FAO 71) | Philippines | 6205 | 3978 | 2776 | 3052 | 3496 | 3997 | 4987 | 5506 | 5158 | 4737 |
| Total | | 6205 | 3978 | 2776 | 3052 | 3496 | 3997 | 4987 | 5506 | 5158 | 4737 |

Table 1. Octopus landings in Indonesia from 2003 to 2012 (adapted from FAO capture fisheries database FishStatJ 2013).

**Importance to the US/North American Market**

The top five nations exporting octopus into the United States are Spain (23%), China (19%), Philippines (18%), Indonesia (10%), and Thailand (7%) (NMFS 2014). The database documenting U.S. imports does not differentiate between species or between frozen, dried, or brined octopus, and so it is difficult to determine how much of each octopus species is imported.

Octopus imports from Indonesia between 2010 and 2014 are shown in the table below (adapted from NFMS). Given that the major octopus species fished in the country are day octopus, O. cyanea, and baby octopus, Amphioctopus sp., it is assumed that the majority of the octopus imported into the U.S. from these countries are these species.

Imports from Indonesia have been variable in the last 5 years, from 1,439,987 kilos in 2011 to 2,628,923 kilos in 2012. The average quantity for the last 5 years has been 2,068,796 kilos. The total amount of octopus imported from the country for the last 5 years was 10,343,979 kilos, which was valued at in $47.1 million.

| | | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Country | Product Name | Month | Kilos | Dollars | Kilos | Dollars | Kilos | Dollars | Kilos | Dollars | Kilos | Dollars |
| Indonesia | OCTOPUS FROZEN/ DRIED/SALTED/BRINE | January | 226,367 | 710,889 | 105,844 | 370,202 | 202,671 | 1,422,943 | 194,037 | 742,122 | 171,435 | 692,805 |
| | | February | 183,287 | 562,101 | 123,034 | 438,297 | 247,510 | 1,640,142 | 85,981 | 409,850 | 164,698 | 635,614 |
| | | March | 243,414 | 739,879 | 158,853 | 605,637 | 193,759 | 1,269,691 | 127,188 | 558,990 | 201,882 | 738,768 |
| | | April | 198,467 | 575,316 | 147,077 | 573,469 | 169,521 | 1,096,482 | 172,189 | 756,806 | 233,038 | 920,129 |
| | | May | 215,593 | 656,004 | 114,122 | 513,931 | 335,493 | 2,052,442 | 144,748 | 577,748 | 213,910 | 881,840 |
| | | June | 255,415 | 720,796 | 101,794 | 538,938 | 328,806 | 1,984,979 | 246,656 | 975,376 | 261,819 | 1,049,028 |
| | | July | 203,957 | 622,699 | 136,989 | 723,668 | 307,644 | 1,856,571 | 119,399 | 464,990 | 215,565 | 864,119 |
| | | August | 168,847 | 514,037 | 101,306 | 606,863 | 278,165 | 1,600,126 | 63,086 | 274,847 | 142,910 | 557,276 |
| | | September | 165,666 | 502,452 | 89,270 | 546,895 | 163,806 | 1,069,865 | 71,789 | 287,490 | 97,940 | 377,564 |
| | | October | 54,593 | 176,350 | 63,939 | 438,210 | 143,227 | 839,735 | 80,392 | 295,130 | 237,428 | 1,020,042 |
| | | November | 109,926 | 367,837 | 194,576 | 1,284,495 | 95,334 | 457,531 | 168,394 | 664,192 | 197,944 | 895,541 |
| | | December | 133,691 | 489,250 | 103,183 | 743,057 | 162,987 | 816,743 | 126,893 | 520,649 | 376,525 | 1,830,953 |
| | | Total | 2,159,223 | 6,637,610 | 1,439,987 | 7,383,662 | 2,628,923 | 16,107,250 | 1,600,752 | 6,528,190 | 2,515,094 | 10,463,679 |

Table 2. Octopus imports from Indonesia to U.S. (adapted from NOAA commercial fisheries statistics 2013).

**Common and Market Names**

The commercial name used in the U.S. for day octopus (*Octopus cyanea)* is thought to be common octopus although really this name corresponds to O. vulgaris which is not distributed in Indonesia (FAO 2014). No other commercial names have been reported.

**Primary Product Forms**

Octopus is available in seafood markets or specialty grocery stores in a myriad of forms. Live, fresh, dried, frozen, cured, salted, and brined octopus are all available to the public. However, day octopus and baby octopus imported from Southeast Asia are sold primarily frozen. Other products identified in U.S. supermarkets are whole cooked octopus and canned octopus in sauce (olive oil, soybean sauce, garlic sauce, etc.).

# Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Criteria for Fisheries, available at http://www.seafoodwatch.org.

# Criterion 1: Stock for which you want a recommendation

*This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:*

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and <=3.2=Yellow or Moderate Concern*
- *Score <=2.2=Red or High Concern*
  *Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.*

**Criterion 1 Summary**

| DAY OCTOPUS | | | | |
|---|---|---|---|---|
| **Region / Method** | **Inherent Vulnerability** | **Stock Status** | **Fishing Mortality** | **Subscore** |
| **Indonesia Indian Ocean Handline** | 3.00:Low | 3.00:Moderate Concern | 1.00:High Concern | **Red (1.732)** |
| **Indonesia Indian Ocean Spear** | 3.00:Low | 3.00:Moderate Concern | 1.00:High Concern | **Red (1.732)** |
| **Indonesia Indian Ocean Trap** | 3.00:Low | 3.00:Moderate Concern | 1.00:High Concern | **Red (1.732)** |

**Criterion 1 Assessment**

**DAY OCTOPUS**

**Factor 1.1–Inherent Vulnerability**

*Scoring Guidelines*

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

- *High—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator). Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**Low**

The day octopus or reef octopus, *Octopus cyanea*, is a medium sized, diurnally active octopus that is thought to be the most common octopus species on reefs worldwide and is the dominant octopus in tropical, subtidal and intertidal reefs in the Indian Ocean region (Herwig et al. 2012). However, despite its abundance, studies of the reproductive cycle of *O. cyanea*in the Indian Ocean are very scarce (Guard & Mgaya 2002)(Caveriviere 2006). Growth rate and maturity of *O. cyanea* seem to be correlated to water temperature. In Madagascar waters, maturity normally occurs at a minimum mean weight of 2246 g for females and 643 g for males (Raberinary & Benbow 2012). In Australian waters, males mature at 155 days of age and/or 0.35 kg and females mature at around 225 days and/or 1.35 kg. This species has a maximum lifespan of approximately 1.5 years (Herwig et al. 2012) and is known to be a simultaneous terminal spawner (Van Heukelem 1983). The total number of eggs laid by a female in a single clutch varies from 150,000 to 700,000 eggs (Caveriviere 2006)(Van Heukelem 1973). Mature female individuals often migrate from shallow reef flats into deeper subtidal areas for spawning (Raberinry & Benbow 2012). Upon hatching, planktonic larvae move into the water column for one to two months, and dispersal is thought to be wide ranging with larvae travelling up to several hundred kilometres in ocean currents (Casu et al. 2002)(Murphy et al. 2002). Reproduction of O. cyanea has been documented to occur throughout the year in both Tanzania and Madagascar with reproductive peaks in June and December (Guard & Mgaya 2002)( Caveriviere, 2006), suggesting this species utilizes an intermittent spawning strategy occurring over an extended period of time. In Madagascar waters, the timing of the spawning is likely related to a combination of environmental and biological factors including climate and habitat availability as shown in studies related to other octopus species (Leporati et al. 2007)(Raberinary & Benbow 2012).The Productivity-Susceptibility Analysis (PSA) is a semi-quantitative assessment tool that relies on the life history characteristics of a stock, and it is used to assess the susceptibility of the stock to the fishery in question. For invertebrate species, Seafood Watch uses a PSA to assess their inherent vulnerability. The PSA score for day octopus is 2.5 (average age at maturity <5 years, average maximum age <10 years, reproductive strategy = demersal egg layer, density

dependence = no depensatory or compensatory dynamics demonstrated or likely), corresponding to a Low Vulnerability. Its migratory behavior and spawning spikes impart a certain level of vulnerability, but its high fecundity, low age at maturity, relatively short lifespan, and rapid growth rate cause *O. cyanea* to be considered a naturally resilient organism.

**Rationale:**

| Vulnerability attribute | Category | Score |
|---|---|---|
| Average age at maturity | < 5 years | 3 |
| Average maximum age | < 10 years | 3 |
| Fecundity | n/a | n/a |
| Reproductive strategy | Demersal egg layer | 2 |
| Density dependance | No depensatory or compensatory dynamics demostrated or likely | 2 |
| Average overall score | Low vulnerability | 2.5 |

Table 3. Results from the Seafood Watch inherent vulnerability rubric for invertebrate species (referred to as a Productivity-Susceptibility Analysis (PSA) in the text) for *Octopus cyanea* (SFW criteria document, pg. 4). Attribute scores can range from 1 to 3 with higher scores signifying more resilient life history attributes. Invertebrate species with average attribute scores between 2.46 and 3 are deemed to have a Low Vulnerability.

### Factor 1.2–Stock Status

*Scoring Guidelines*

- *5 (Very Low Concern)—Strong evidence exists that the population is above target abundance level (e.g., biomass at maximum sustainable yield, BMSY) or near virgin biomass.*
- *4 (Low Concern)—Population may be below target abundance level, but it is considered not overfished.*
- *3 (Moderate Concern) —Abundance level is unknown and the species has a low or medium inherent vulnerability to fishing.*
- *2 (High Concern)—Population is overfished, depleted, or a species of concern, OR abundance is unknown and the species has a high inherent vulnerability to fishing.*
- *1 (Very High Concern)—Population is listed as threatened or endangered.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**Moderate Concern**

The day octopus (*Octopus cyanea*) is one of the most common octopus species on reefs worldwide and it is the dominant octopus in many coral reef habitats in the Indian Ocean region (Herwig et al.

2012)(Raberinary & Benbow 2012). However, there is no formal stock assessment for this species in Indonesia, so neither TACs nor reference points have been set. Knowledge of main population features are still scarce.

Regional assessments of fisheries in Southeast Asia indicates that in general, high fishing pressure on a range of species, including octopus species, in coastal waters has led to declining catches across the region, with many species of octopus now overfished (Australia's Sustainable Seafood Guide Website 0000). As an example, fishermen from the Southeast Sulawesi region (West of Indonesia), where about 30% of total catch of octopus in Indonesia is landed (MMAF 2012), have complained that fishing for octopus in the area is getting harder and they need to travel long distances to the Maluku Sea and even to the Flores Sea to catch the species (Antara news 2011). WWF Indonesia publishes a seafood guide where it recommends, via a traffic light system, which fish consumers should avoid (red), choose as an alternative (amber), and which are the best choices (green). The octopus fishery is currently classified as amber due to concerns about the stock status (WWF Seafood Guide 2011).There is no evidence to suggest that stock is either above or below reference points, and stock inherent vulnerability is low. Stock status is assessed as Moderate Concern.

**Factor 1.3–Fishing Mortality**

*Scoring Guidelines*

- *5 (Very Low Concern)—Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY), OR fishery does not target species and its contribution to the mortality of species is negligible (≤ 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.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**High Concern**

Octopus landing data for Indonesia from 2003 to 2012 is shown in the figure below (Table 1, adapted from FAO capture and aquaculture databases 2013)).There is no formal stock assessment for day octopus in Indonesian waters, so neither TACs nor reference points (such as fishing mortality at maximum sustainable yield: $F_{MSY}$) have been set. Fishing mortality is unknown, but despite the increasing trends in the total catches reported from this region, there is a general perception that marine living resources are overexploited and critical habitats are becoming degraded (FAO 2011)(Australia's Sustainable Seafood Guide Website 0000). Key factors that contribute to this situation are socio-economic, such as those resulting from population growth and increased migration to the coast, and a lack of alternatives for securing food, with impacts on livelihoods and shelter in the poor rural coastal communities. Other factors are largely institutional, such as poor enforcement of policies, laws and regulations (FAO 2011). The Fishery Act no. 9/1985 and the Fishery Act no. 31/2004 do not require subsistence or traditional fishing vessels (i.e., fishing fleets ≤5 gross tonnage (GT) or boats without engines or with engine size ≤15 HP) to have fishing permits. As a result, small-scale fishing, which accounts for a large proportion of all fishing activities in Indonesia, remains largely unreported (Varkey et al. 2010)(Buchary et al. 2007). So, the effectiveness of management measures to control fishing effort are uncertain. Overfishing appears to be occurring and reasonable management to reduce fishing mortality/curtail overfishing is not in place. Therefore, fishing mortality is assessed as High Concern.

**Rationale:**

| Fishing area | Country | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Eastern Indian Ocean (FAO 57) | Indonesia | 352 | 424 | 323 | 352 | 512 | 573 | 1006 | 982 | 1626 | 2637 |
| Western Central Pacific (FAO 71) | | 6147 | 4081 | 2673 | 6063 | 6462 | 7806 | 5007 | 9878 | 6048 | 6031 |
| Total | | **6499** | **4505** | **2996** | **6415** | **6974** | **8379** | **6013** | **10860** | **7674** | **8668** |
| Eastern Indian Ocean (FAO 57) | Malaysia | 750 | 766 | 523 | 727 | 707 | 1057 | 1325 | 971 | 1026 | 1115 |
| Western Central Pacific (FAO 71) | | 569 | 603 | 926 | 911 | 1454 | 1423 | 1146 | 965 | 1066 | 918 |
| Total | | 1319 | 1369 | 1449 | 1638 | 2161 | 2480 | 2471 | 1936 | 2092 | 2033 |
| Eastern Indian Ocean (FAO 57) | Thailand | 10249 | 11028 | 5960 | 4983 | 4750 | 4766 | 4007 | 2776 | 2352 | 2149 |
| Western Central Pacific (FAO 71) | | 9449 | 10228 | 14000 | 11124 | 8957 | 6013 | 5842 | 5631 | 5338 | 5459 |
| Total | | 19698 | 21256 | 19960 | 16107 | 13707 | 10779 | 9849 | 8407 | 7690 | 7608 |
| Western Central Pacific (FAO 71) | Philippines | 6205 | 3978 | 2776 | 3052 | 3496 | 3997 | 4987 | 5506 | 5158 | 4737 |
| Total | | 6205 | 3978 | 2776 | 3052 | 3496 | 3997 | 4987 | 5506 | 5158 | 4737 |

Table 1. Octopus landings in Indonesia from 2003 to 2012 (adapted from FAO capture fisheries database FishStatJ 2013).

# Criterion 2: Impacts on Other Species

*All main retained and bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. Seafood Watch® defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghostfishing. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch. The Criterion 2 rating is determined as follows:*

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and <=3.2=Yellow or Moderate Concern*
- *Score <=2.2=Red or High Concern*
  *Rating is Critical if Factor 2.3 (Fishing Mortality) is Critical.*

**Criterion 2 Summary**

| Day Octopus: Indonesia Indian Ocean, Handline | | | | | |
|---|---|---|---|---|---|
| **Subscore:** | **5.000** | **Discard Rate:** | **1.00** | **C2 Rate:** | **5.000** |

| Species | Inherent Vulnerability | Stock Status | Fishing Mortality | Subscore |
|---|---|---|---|---|
| **DAY OCTOPUS** | Low | 3.00: Moderate Concern | 1.00: High Concern | **1.732** |

| Day Octopus: Indonesia Indian Ocean, Spear | | | | | |
|---|---|---|---|---|---|
| **Subscore:** | **5.000** | **Discard Rate:** | **1.00** | **C2 Rate:** | **5.000** |

| Species | Inherent Vulnerability | Stock Status | Fishing Mortality | Subscore |
|---|---|---|---|---|
| **DAY OCTOPUS** | Low | 3.00: Moderate Concern | 1.00: High Concern | **1.732** |

| Day Octopus: Indonesia Indian Ocean, Trap | | | | |
|---|---|---|---|---|
| **Subscore:** | **5.000** | **Discard Rate:** | **1.00** | **C2 Rate:** | **5.000** |

| Species | Inherent Vulnerability | Stock Status | Fishing Mortality | Subscore |
|---|---|---|---|---|
| **DAY OCTOPUS** | Low | 3.00: Moderate Concern | 1.00: High Concern | **1.732** |

Indonesia is the largest archipelagic country in the world, encompassing more than 17,000 islands, and nearly 230 million people who are increasingly dependent on marine resources both as a food supply and income. Artisanal fisheries in the country can be subsistence or commercial and provide for both local consumption and export, but catches are generally used or marketed locally {Huffard et al. 2012}.

In the western part of the archipelago, where between 70% and 90% of the octopus catch comes from waters that are shallow and relatively rich (FAO capture and aquaculture databases 2013), small-scale fisheries operate on coral reefs and reef flats using a wide range of gears such as lines, traps, scoop nets, spearguns, etc. (Buchary et al. 2007). Octopus fisheries on the coral reef are, in many cases, subsistence fisheries where the catch is rarely discarded and fully utilized, and most the catches are used or marketed locally. Octopuses are caught by small-scale vessels, divers and fishers that walk along the reef flat using three principal fishing gears—handlines, spearguns and harpoons and traps—or even gleaning (using the low tides to search for octopus holes) (Evayani 2014)(Ferse et al. 2014)(Adhawati & Nuryanti 0000)(WWF Indonesia pers. comm.).

Handlining in Indonesia covers a broad range of techniques to attract the prey using a line and a bait. The most recent innovations include the use of artificial bait (pocong-pocong or kulepa) to catch octopus, which has spread among fishers on the islands within the past few years (Ferse et al. 2014). When the prey takes the bait, it is hauled by hand (Bjamason 1992) or using a hook (Adhawati & Nuryanti 0000). In the case of an unwanted species trapped in the bait, handliners can easily release the catch. This targeted method of fishing has therefore low levels of bycatch, making it an environmentally responsible fishing method (SFW 2015).

Harpooning is a traditional method used by skilled fishermen to catch octopus and other species. When a harpooner spots an octopus, he thrusts or shoots a long aluminium or wooden harpoon into the animal and hauls it aboard. “Spearing" is the use of a handheld spear or similar device and the use of a weapon, other than a firearm, which propels a projectile to which a line, to recover the projectile, is attached and secured to the weapon or the person using the weapon (Georgia department of natural resources 2015).

Harpooning and spearfishing are highly efficient harvesting gear that selectively target larger prey. Harpooning and spearfishing are both environmentally responsible fishing methods where bycatch of unwanted marine life is not a concern because fishermen visually identify the species and size of the targeted prey before killing it (SFW 2015).

Conflicting information exists about the use of traps and pots to catch octopus in Indonesia. It seems that many fishermen in the country do not like to use this gear because the species may escape from it (IPB 2010). When used they are often in the form of clay pots, natural shells or other low cost materials such as gastropod shells, concrete blocks, bottles, etc. (Nabhitabhata J. 2014). This method used the homing behavior of octopuses to catch them without a net or other device to retain the species caught. This fishing gear does not use any bait as an attractant. Therefore, pots are a highly selective gear and no bycatch exists (Silva et al. 2002).

Due to the nature of subsistence of coral reef fisheries in Indonesia and the high selectivity of the fishing methods used to catch octopus, very little or no bycatch exists in the fishery and no species are included in this criterion.

**Criterion 2 Assessment**

**Factor 2.4–Discard Rate**

**Indonesia/Indian Ocean, Handline**

**< 20%**

Handlining in Indonesia covers a broad range of techniques to attract the prey using a line and a bait. The most recent innovations include the use of artificial bait (pocong-pocong or kulepa) (Image 1, adapted from (Adhawati, S.S., & Nuryanti, D.M. 0000)) to catch octopus, which has spread among fishers on the islands within the past few years (Ferse et al. 2014). When the prey takes the bait, it is hauled by hand (Bjamason 1992) or using a hook (Adhawati & Nuryanti 0000). In the case of an unwanted species trapped in the bait, handliners can easily release the catch.

This targeted method of fishing has very low levels of bycatch, making it an environmentally responsible fishing method (SFW 2015). Therefore, this section is assessed as <20%.

**Rationale**


Image 1. Handline methods used in Indonesia (Pocong–pocong and kulepa). From (Adhawati & Nuryanti 0000).

## Factor 2.4–Discard Rate

**Indonesia/Indian Ocean, Spear**

**< 20%**

Harpooning and spearfishing are highly efficient harvesting gears that selectively target larger prey. Harpooning and spearfishing are both environmentally responsible fishing methods where bycatch of unwanted marine life is not a concern because fishermen visually identify the species and size of the targeted prey before killing it (SFW 2015). Therefore, this section is assessed as <20%.

**Indonesia/Indian Ocean, Trap**

**< 20%**

Traps and pots used the homing behavior of octopuses to catch them without any net or other devices to retain the species caught. These fishing gears do not use any bait as an attractant. Therefore, pots are highly selective gears and no bycatch exists, <20%.

# Criterion 3: Management effectiveness

*Management is separated into management of retained species (harvest strategy) and management of non-retained species (bycatch strategy).*

*The final score for this criterion is the geometric mean of the two scores. The Criterion 3 rating is determined as follows:*

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and <=3.2=Yellow or Moderate Concern*
- *Score <=2.2 or either the Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern = Red or High Concern*
  *Rating is Critical if either or both of Harvest Strategy (Factor 3.1) and Bycatch Management Strategy (Factor 3.2) ratings are Critical.*

**Criterion 3 Summary**

| Region / Method | Management of Retained Species | Management of Non-Retained Species | Overall Recommendation |
|---|---|---|---|
| **Indonesia Indian Ocean Handline** | 1.000 | All Species Retained | Red(1.000) |
| **Indonesia Indian Ocean Spear** | 1.000 | All Species Retained | Red(1.000) |
| **Indonesia Indian Ocean Trap** | 1.000 | All Species Retained | Red(1.000) |

**Factor 3.1: Harvest Strategy**

Scoring Guidelines

*Seven subfactors are evaluated: Management Strategy, Recovery of Species of Concern, Scientific Research/Monitoring, Following of Scientific Advice, Enforcement of Regulations, Management Track Record, and Inclusion of Stakeholders. Each is rated as Ineffective, Moderately Effective, or Highly Effective.*

- *5 (Very Low Concern)—Rated as Highly Effective for all seven subfactors considered.*
- *4 (Low Concern)—Management Strategy and Recovery of Species of Concern rated Highly Effective and all other subfactors rated at least Moderately Effective.*
- *3 (Moderate Concern)—All subfactors rated at least Moderately Effective.*

- *2 (High Concern)—At minimum, meets standards for Moderately Effective' for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated Ineffective.*
- *1 (Very High Concern)—Management exists, but Management Strategy and/or Recovery of Species of Concern rated Ineffective.*
- *0 (Critical)—No management exists when there is a clear need for management (i.e., fishery catches threatened, endangered, or high concern species), OR there is a high level of Illegal, unregulated, and unreported fishing occurring.*

**Factor 3.1 Summary**

| Factor 3.1: Management of fishing impacts on retained species | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Region / Method** | **Strategy** | **Recovery** | **Research** | **Advice** | **Enforce** | **Track** | **Inclusion** |
| **Indonesia Indian Ocean Handline** | Ineffective | N/A | Moderately Effective | Moderately Effective | Ineffective | Ineffective | Moderately Effective |
| **Indonesia Indian Ocean Spear** | Ineffective | N/A | Moderately Effective | Moderately Effective | Ineffective | Ineffective | Moderately Effective |
| **Indonesia Indian Ocean Trap** | Ineffective | N/A | Moderately Effective | Moderately Effective | Ineffective | Ineffective | Moderately Effective |

**Subfactor 3.1.1 – Management Strategy and Implementation**

*Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? To achieve a Highly Effective rating, there must be appropriate management goals, and evidence that the measures in place have been successful at maintaining/rebuilding species.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**Ineffective**

The Ministry of Marine Affairs and Fisheries (MMAF), along with its counterparts, the fisheries services at the provincial and district levels, which are controlled by local governments, are the main government agencies responsible for the administration and management of capture and culture fisheries in Indonesia (OECD 2013). Fishing management in Indonesia is established according to the distance to the coast: fishing area I, which covers coastal waters to four nautical miles and is managed by municipalities; fishing area II, which covers coastal waters up to twelve nautical miles and is controlled by provinces; and fishing area III, which covers the whole of the exclusive economic zone and

it is managed by the national government. However, some jurisdictional overlap exists with the nearshore fisheries and marine resources, particularly between subnational governments and the Ministry of Marine Affairs and Fisheries (CCIF 2013)(Nurhidayah 2010). The main laws regulating fisheries in Indonesia are Law 31/2004 and its amendment law 45/2009. These laws provide a legal basis for a range of fishery management measures in marine, brackish and public inland waters, including effort control through licensing and quota, gear restrictions, etc. (OECD 2013)(CCIF 2013). Law 31/2004 defined fishery management for the first time in Indonesia and set out the requirement for fishery management areas and fishery management plans. It specifically stated the responsibility of the Minister in allocating catches based on fisheries' potential and sustainability issues (Dudley & Ghofar 2007). Marine protected areas in Indonesia have also been established under conservation law 5/1990 and are managed by the Ministry of Forestry (OECD 2013). Many other regulations apply to the fishing activity in the country, among which include the regulation number PER.02/MEN/2011 of the Ministry of Marine Affairs and Fisheries (FAOLEX 2012). This regulation defines fishing areas and regulates the type of fishing gears permitted in each area. It also specifies technical measures for fishing gears, auxiliary gears and fishing vessels; and designates zones and periods where fishing is limited (fishery management areas)(Image 2 (SPF 0000)). The regulation further provides a framework for monitoring and evaluation of fishing activities and contains provisions relating to sanctions for offences of the fishing regulations (FAOLEX 2012)(CCIF 2013). However, a number of constraints affect fisheries management in Indonesia, including overlapping and conflicting laws regarding marine and coastal management, unclear roles and responsibilities of institutions managing marine and coastal resources, lack of coordination and capacity of local governments, lack of financial support, weak fisheries management (particularly concerning monitoring), surveillance and enforcement (MCS), lack of public participation, low income and standard of living for fishers and fish farmers, etc. (FAO 2011)(Nurhidayah 2010)(CCIF 2013). In addition to these general problems, nearshore fisheries undertaken within 4 nautical miles (nm) of the coast, where the day octopus fishery occurs, have been traditionally treated as open access (CCIF 2013), which have resulted in an overfishing in both marine and inland nearshore fishing resources (Nurhidayah 2010). Therefore, although management measures are in place in the country, few catch limits, controls or effort restrictions are used in nearshore waters (CCIF 2013) and the open access regime has created a race for fishing where there is no incentive to fish sustainably (Exton 2010). Therefore, management strategy for the octopus fishery is considered as Ineffective.

**Rationale:**

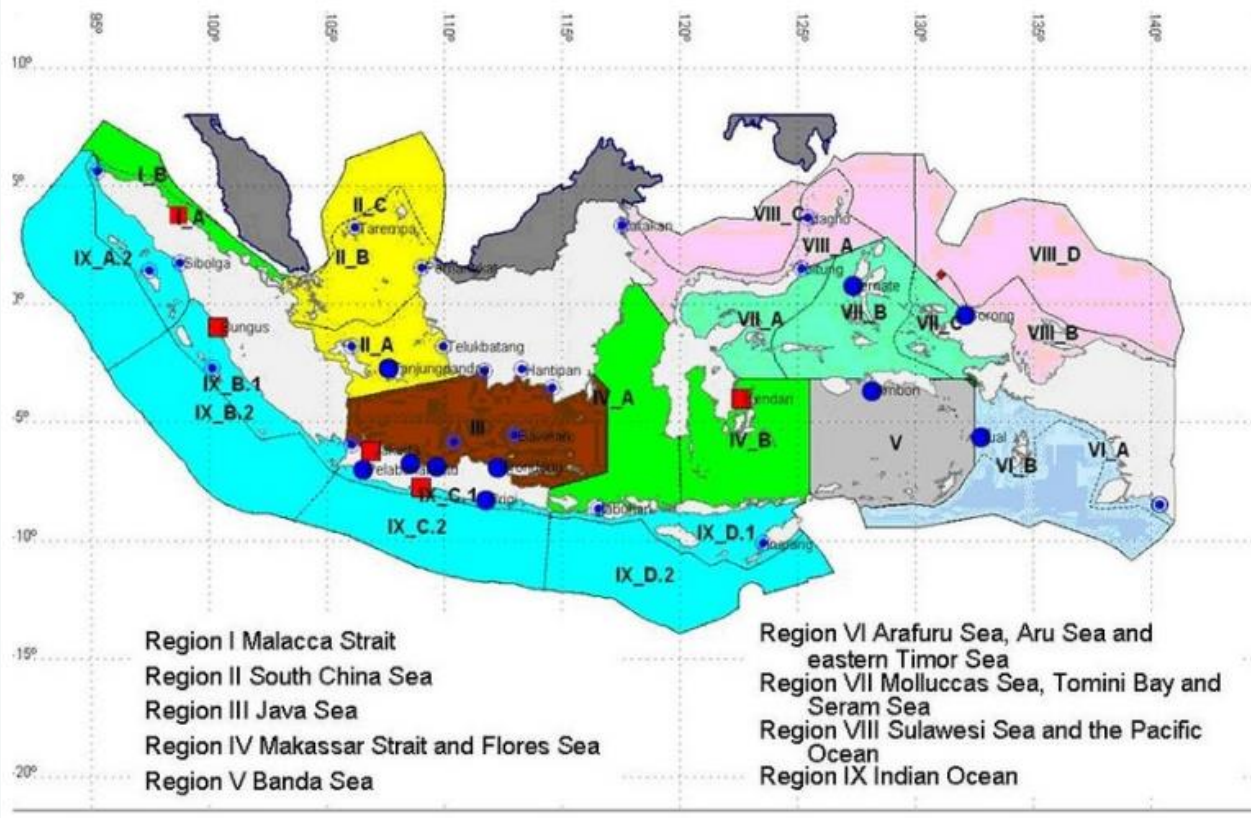


Image 2. Fishery management areas in Indonesia (SPF 0000).

### 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.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**N/A**

Since it is unknown if octopus or other target species caught in this fishery are overfished, this section is classified as "N/A".

### 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.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**Moderately Effective**

In Indonesia, the fisheries sampling program was started in 1973 and although newer programs are constantly initiated, the sampling design has been changed only once since then (BOLBME 2012). The system is based on a sampling scheme that collects data by species and fishing gear (FAO 2011). Monitoring of fish landings is undertaken at landing sites and fishing villages by district officers using census data and interviews (BOBLME 2012). This data is posteriorly sent to the Directorate General of Fisheries in Jakarta, which published it by province and statistical area (there are eleven statistical areas, also called "fisheries management areas") (FAO 2011). A comparative study of these publications shows large differences between provinces in the detail of sampling and reporting (Ahda et al. 1997), which make it difficult to compare different statistical areas. In addition, a log-book program was also initiated in 2010 (BOLBME 2012).

The Agency for Research and Development is responsible for fisheries research activities in Indonesia. In addition, two research institutes, the Central Research Institute for Oceanography, under the Indonesia Institute of Science, and the Research Institute for Limnology, are also providing research support for marine life and oceanography and freshwater environment respectively. They both support the Fisheries Research Agency (FAO 2011). The MMAF also established a national committee for fish stock assessment in 2005, with the principal task of assessing the impact of fishing on marine resources. A marine resources status report was produced in 2006 and an updated version was being finalized by the committee in late 2010 (FAO 2011). However, Indonesia is one of the world's most highly populated countries, where over 60% of the population live within the coastal zone (Elliott et al. 2001) and reef fishing provides nearly 70% of the nation's protein requirements (Cesar et al. 1997)(Resosudarmo 2005)(Exton & Smith 2011). It is predominantly small-scale fisheries for some species in the country and, in particular, for octopus. The landings from these species are probably large but due to the nature of subsistence fishing in these kind of fisheries, many landings go unrecorded (Exton & Smith 2011). The sampling coverage from small-scale fisheries is low, and the reliability is questionable, as often interview-based methods are used. There is a need to get better information from the small-scale sector to improve the management in the region. Many international NGOs, such as the Operation Wallacea

Trust, WWF, Global Environment Facility (GEF) or sustainable fisheries partnership (SPF) are working to improve knowledge of these fisheries (Darwin Initiative 2010)(FAO 2011). However, some of these initiatives are local or region-based and the results are not always scalable to other fishing areas (Nurhidyah 2009).

Because there is some data collection, monitoring is considered as Moderately Effective.

### 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.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**Moderately Effective**

There are no reliable assessments for some Indonesian stocks, including cephalopod species. The available scientific information is scarce and cannot be embodied in proper management measures. Cephalopod stocks are not presently subject to quota management and a viable method of assessment for these species is not available. Therefore, since there is little scientific advice available for this fishery to inform management, this sub-criterion is not applicable to this fishery and scores as Moderately Effective. The lack of scientific advice available to inform management is addressed under Criteria 3.1.

**Rationale**

The Agency for Research and Development of Marine Affairs and Fisheries, which is part of the Ministry of Marine Affairs and Fisheries, houses several research institutions such as the Marine Fisheries Research Institute (in Jakarta), the Inland Fisheries Research Institute (in Palembang) and the Freshwater Research Institute (in Bogor), while aquaculture research is handled by the Research Institute for Freshwater Aquaculture, Brackishwater Aquaculture and Mariculture (FAO 2011). They all work with the Indonesian Institute of Sciences (LIPI); the Agency for the assessment and application of technology (BPPT), a non-departmental government agency under the coordination of the Ministry of Research and Technology; and some Indonesian universities assessing marine resources (Dudley & Ghofar 2007). In addition to these institutes, special institutes have been established such as the “Research Institute for Post Harvest Technology” and the “Research Institute for Socio-economics” (FAO 2011). There are also other regional research institutions, including both governmental bodies as well as trans-sectoral, and semi-independent units (Dudley & Ghofar 2007).

Most fish stock assessment activities are carried out by the Research Center for Capture Fisheries, within the Agency for Marine and Fisheries Research. For each fishery management area, information is summarized for several fishery types; usually large pelagic, small pelagic, demersal fishes, shrimp, squid and cuttlefish, coral fish for consumption, ornamental fish and deep-sea resources (Dudley & Ghofar 2007). Most assessments of Indonesian fish stocks are made on the basis of surplus production models and through the use of the Gulland formula supplemented by limited acoustic surveys (in the case of demersal and small pelagic fisheries) (Dudley & Ghofar 2007)(Buchary et al. 2007). These simple, single-species methods have been used to estimate the total potential estimate of the fish catch from the whole of the Indonesian archipelago (Widodo et al. 1998)(Buchary et al. 2007). Research tends to focus on determination of the maximum sustained yield (MSY) for each fishery grouping in each of the Indonesia's eleven fishery management areas (Dudley & Ghofar 2007)(CCIF 2013). MSY calculations using the surplus production model require estimates of fishing effort and landings data over time. However, small-scale fisheries are the primary fishing method for some species in the country, including octopus and, due to the special characteristics of these kind of fisheries (multi-gear, multi-species, open access regime, etc.), the available scientific information (landings, total catches, effort, CPUE) is scarce and unreliable (CCIF 2013)(Exton 2010)(Exton & Smith 2011). Moreover, most of the MSY estimates have been made largely as a one-time exercise and generally quantitative assessments for Indonesian fisheries are not updated regularly (Buchary et al. 2007). The national policy for capture fisheries is to achieve a catch amounting to 80% of the maximum sustainable yield (MSY), which was estimated in 1990 as being 6.4 million mt per year. As this amount has never been officially reached, even though ministerial regulation 29 of 2012 stipulates that fishery management plans must be based on TACs (CCIF 2013), TACs are still not implemented in the country (OECD 2013).

### 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.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**Ineffective**

The Ministry of Marine Affairs and Fisheries (MMAF), along with its counterparts, the fisheries services at the provincial and district levels, are the main government agencies responsible for the administration and management of capture and culture fisheries in Indonesia (OECD 2013). The MMAF comprises five directorates and several agencies. The Directorate General of Capture Fisheries and its

units—the directorate of resources management and the directorate of fishing license—together with some units in the Directorate General of Control and Surveillance are in charge of capture fisheries management in the country. In addition, they cooperate with the marine police and the Indonesian navy in enforcement operations (FAO 2011). The province and district level fisheries services also rely on a network of community-based surveillance groups, known as POKMASWAS, which report any violations of fisheries regulations to law enforcement agencies (OECD 2013). A wide range of fishery management instruments are set in the country to manage capture fisheries. The main instrument currently in place is licensing fishing vessels, which is mandatory for all the fishing vessel > 5 GT (OECD 2013). Since 2002, all Indonesian flag vessels over 60 GT are also obligated by law to install a transmitter of a satellite-based vessel monitoring system (VMS). An off-line VMS, which transmits position data when the vessel returns to harbor, is also operated by the MMAF for vessels between 30 and 60 GT (OECD 2013). Additionally, fisheries management areas (created to guide interventions (e.g., governance, licensing systems, and gear restrictions)) and marine protected areas (developed to protect marine resources) have been designated in the country (CCIF 2013). Furthermore, Indonesia has a network of fisheries courts where violations of fisheries regulations are judged (OECD 2013). However, fisheries and marine resources in Indonesia, especially within 4 nautical miles (nm) of the coast, have been traditionally treated as open access. Whereas Indonesia does have regulations and procedures to regulate spatial distribution of fishing effort, few catch limits or effort restrictions are used in nearshore waters (CCIF 2013) and the open access regime creates a race for fishing where there is no incentive to fish sustainably (Exton 2010). Jurisdictional overlap over nearshore fisheries and marine resources also exists, particularly between subnational governments and the Ministry of Marine Affairs and Fisheries (MMAF), which adds confusion and uncertainty to management regulations. Furthermore, enforcement is limited at all levels due to a lack of resources, limited coordination and inadequate understanding of laws (CCIF 2013). Current regulations in the country have not yet resulted in control of the overall level of effort in nearshore waters, nor have they been effective in abating overfishing. Therefore, enforcement in the country is considered as Ineffective.

### 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.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**Ineffective**

Indonesia is the largest archipelagic country in the world, encompassing more than 17,000 islands, and nearly 230 million people (Huffard et al. 2012). Indonesia is therefore one of the world's most highly populated countries, where over 60% of the population live within the coastal zone (Elliott et al. 2001) and where reef fishing provides nearly 70% of the nation's protein requirements (90% in coastal communities) (Cesar et al. 1997)(Resosudarmo 2005)(Exton & Smith 2011)(Huffard et al. 2012). Indonesian fisheries have developed rapidly in recent years from a formerly traditional and subsistence fishery into an export driven collection fishery. Indonesia estimates that the number of coastal fishers increased by more than 40% over the last 10 years (Huffard et al. 2012). Rapidly rising levels of effort across Indonesia—with expanding fishing fleets and overall fishing power—are yielding steady declines in productivity per vessel and per unit of fishing effort (Kelleher 2012). Several of Indonesia's most economically valuable fisheries are overfished, including shrimp fisheries, many demersal fisheries, bigeye tuna, and bluefin tuna (CCIF 2013). Although there is not specific information about the state of the octopus stock, there is evidence that many reef resources are being extracted at a rate exceeding maximum sustainable yield (MSY) and that catch per unit effort is rapidly declining (Exton 2010). Some species, such as sea cucumbers or snappers/groupers, have largely declined or have become depleted in some areas (Ferse et al. 2014)(Pet-Soede & Erdmann 1998)(Unsworth et al. 2007) and many fishermen complain of declining yields, smaller average size of their fish, and longer trips to catch fewer fish; all signs of overfishing (Antara news 2011). Although Indonesia does have regulations and procedures to regulate spatial distribution of fishing effort, an increasing human population coupled with a heavy reliance on marine resources have put huge pressure on fish and invertebrate resources inhabiting reef habitats in the country. Unsustainable fishing pressure and habitat destruction via destructive fisheries and coastal development have contributed to the plummeting decline in Indonesia's fishery stocks. Therefore, this section is considered as Ineffective.

### 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.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**Moderately Effective**

The Ministry of Marine Affairs and Fisheries (MMAF) considers it essential to collaborate with stakeholders in fisheries management (FAO 2011). This collaboration is done through fishery or fishing

industry associations such as the Association of Indonesian Tuna Fisheries (ASTUIN), the Association of Indonesian Tuna Longliners (ATLI), and the Association of Shrimp Trawlers in Indonesia (HPPI); all of which represent fishing groups. The MMAP also collaborates with the association of canning industries (APIKI) and the association of cold storage owners (APCI), which represent fishing industries (FAO 2011). All of these associations coordinate their activities through an apex association called GAPPINDO (Federation of Indonesian Fisheries Associations) (FAO 2011).The government also encourages continuous communication with stakeholders through national committees that have been established for the main targeted seafood species (FAO 2011). The principal committees established in the country are the National Tuna Committee (KTI), the National Shrimp Committee (KUI), the National Seaweed Committee (KRL) and the National Committee for Aquarium fish (KIHI). They are all headed by an independent chairman and have members representing both the government and the private sector (FAO 2011). Also, Indonesia has the largest number of and longest enduring traditional community-based coastal resource management systems in Southeast Asia (Buchary et al. 2007). Fisheries laws 31 of 2004 and 45 of 2009 acknowledge the importance of traditional fisheries management systems that are based in unwritten agreement among coastal people in rural areas (OECD 2013). Some of these traditional management systems, such as “Sasi” (in Maluku and Irian) and “Awig-awig” (in West Nusatenggara and Bali) have been incorporated into local regulation (Dudley & Ghofar 2007)(OECD 2013). Recently, many coastal management initiatives in Indonesia have been promoted by international and bilateral donor agencies through pilot projects (COREMAP, CTI) whose goals are to improve coastal protection introducing best practices and improving capacity building in local governments and communities (Nurhidayah 2010). However, these traditional management systems normally focus on a specific area or on specific fisheries (for example “sasi” focuses on fisheries for lobster, mother-of-pearl or sea cucumbers (OECD 2013)) and they are not common or scalable models (CCIF 2013). Moreover, the community-based fisheries management introduced by some international projects in the past have been mostly on an ad-hoc and project basis (Nurhidayah 2010)(Dudley & Ghofar 2007). There is therefore a need to develop nested management systems, incorporating them into fishery management planning and law, and defining clear roles of stakeholders on a national, provincial, district and local basis (Dudley & Ghofar 2007). Full participation of stakeholders in developing co-management programs is one of the major opportunities of decentralization in Indonesia. Stakeholder involvement in fisheries management is being promoted by both government and international agencies in Indonesia. However, there is still a need to develop and improve locally-based management systems (including traditional ones), and encourage local participation in larger management systems, without creating unnecessary dependence on government or external funding (Dudley & Ghofar 2007)(CCIF 2013). This section is therefore considered as Moderately Effective.

# Bycatch Strategy

| Factor 3.2: Management of fishing impacts on bycatch species | | | | | | |
|---|---|---|---|---|---|---|
| **Region / Method** | **All Kept** | **Critical** | **Strategy** | **Research** | **Advice** | **Enforce** |
| **Indonesia Indian Ocean Handline** | Yes | N/A | N/A | N/A | N/A | N/A |
| **Indonesia Indian Ocean Spear** | Yes | N/A | N/A | N/A | N/A | N/A |
| **Indonesia Indian Ocean Trap** | Yes | N/A | N/A | N/A | N/A | N/A |

Handlining is a fishing method in which a line with a hook, usually baited, is lowered into the water from a drifting, anchored or moving boat or jetty, pier or rock on the shore overlooking the water. Handlining is just as its name implies—holding a line in the hand while waiting (either actively or passively) for a fish to take the bait. If there is a bite and a fish takes the hook, it can then be hauled in by hand (Bjamason 1992).

This targeted method of fishing has low levels of bycatch, making it an environmentally responsible fishing method (SFW 2015). Discard rates of dead fish from hook-and-line fishers is low (around 1% of their catch); three times lower than discard rates for spearfishers (Frisch et al. 2008).

# 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 | Overall Recomm. |
|---|---|---|---|---|
| **Indonesia Indian Ocean Handline** | 4.00:Very Low Concern | 0.00:No Effective Mitigation | 4.00:Low Concern | **Green (4.000)** |
| **Indonesia Indian Ocean Spear** | 2.00:Moderate Concern | 0.00:No Effective Mitigation | 4.00:Low Concern | **Yellow (2.828)** |
| **Indonesia Indian Ocean Trap** | 2.00:Moderate Concern | 0.00:No Effective Mitigation | 4.00:Low Concern | **Yellow (2.828)** |

**Justification of Ranking**

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

*Scoring Guidelines*

- *5 (None)—Fishing gear does not contact the bottom*
- *4 (Very Low)—Vertical line gear*
- *3 (Low)—Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Bottom seine on resilient mud/sand habitats. Midwater trawl that is known to contact bottom occasionally)*

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

**Indonesia Indian Ocean, Handline**

**Very Low Concern**

In hook-and-line fishing, individual lines with baited hooks or lures are deployed from a vessel. Hooks are often suspended in the water column and usually do not touch the seafloor. If they are set on or near the seafloor, damage can occur from entanglement, breakage, or minor degradation of seafloor organisms such as invertebrates (corals, sponges, or gorgonians), and lines and sinkers may cause abrasions (Morgan, L. & Chuenpagdee, R. 2003). The impact of hook-and-line fisheries on the seafloor is considered as Very Low Concern.

**Indonesia Indian Ocean, Spear**

**Moderate Concern**

Spears and harpoons are one of the most common gears used to catch octopus in tropical countries. These tools are used to pry the octopus out of its hole and then kill it with a quick strike to the head with a wooden club or by inverting their head (Livewiththesea.org 2015)(Dan Exton pers. Comm.). Octopus fishing is usually done by divers or fishers who walk along the reef flat, although pirogues are often used to transport people to off-shore reef areas. There is very little information about the octopus fishery in Indonesia, although octopus are normally hunted in other tropical countries using gleaning (fishermen walk along reef flats with a spear at low tide searching for octopus holes) and diving (fishermen dive deeper areas of reef flats or hunt for octopus at high tide using a mask and snorkel and a spear or harpoon (livewithesea.org 2015)), or they catch them using their bare hands (Dan Exton pers. comm.). Fishers normally look for octopus dens in the reef flat. The holes are prodded with a spear to see if there is an octopus present and it is then removed with the octopus attached. A second spear or a pick is used to break up the coral around the hole to extract octopus that will not come out easily (Saleh Hanan 2009). These traditional fishing techniques for octopus are very destructive to coral reef habitats as people crush coral as they walk over the reef. Using a pick or spear to break apart octopus holes destroys future octopus habitat and also kills corals that may be adjacent to octopus holes. Therefore,

habitat damage is considered as Moderate Concern.

**Indonesia Indian Ocean, Trap**

**Moderate Concern**

Traps used by fishermen in Southern Asia to catch octopus are made of clay and other low cost materials such as gastropod shells (*Cymbiola nobilis*), concrete blocks or soft-drink bottles (Nabhitabhata J. 2014). Pots are normally rigged to longlines and lifted every 2 days (Exton 2010). Traps are therefore an entrapment device with its effectiveness based on the octopus' behavior: territorial, "hermitlike." Thus, the day octopus voluntarily enters the pot seeking shelter and can leave it at any moment. This is, therefore, a passive, lightweight fishing gear that has a negligible impact on the habitat when the fishery is undertaken on rocky, sandy, or muddy bottoms. However, one of the main objections to the use of these small traps on coral reefs is the physical destruction that often accompanies them as fishers use coral from the surrounding reef to weight their traps to the benthos (Exton 2010). Moreover, it is known that when fishermen haul the gear up, the lines of pots can entangle corals and damage them. The discarded lines also entangle corals and abrade their polyps and upper tissue layers. Therefore, the impact of the gear on the substrate is considered as Moderate Concern.

### Factor 4.2 – Mitigation of Gear Impacts

*Scoring Guidelines*

- *+1 (Strong Mitigation)—Examples include large proportion of habitat protected from fishing (>50%) with gear, fishing intensity low/limited, gear specifically modified to reduce damage to seafloor and modifications shown to be effective at reducing damage, or an effective combination of 'moderate' mitigation measures.*
- *+0.5 (Moderate Mitigation)—20% of habitat protected from fishing with gear or other measures in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.*
- *+0.25 (Low Mitigation)—A few measures are in place (e.g., vulnerable habitats protected but other habitats not protected); there are some limits on fishing effort/intensity, but not actively being reduced.*
- *0 (No Mitigation)—No effective measures are in place to limit gear impacts on habitats.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**No Effective Mitigation**

The Ministry of Marine Affairs and Fisheries (MMAF) in Indonesia has committed itself to ensure the sustainable use of marine resources and to protect marine habitats and species in the country. Marine protected areas (MPAs) are the key tool used by the government to achieve these aims (Huffard 2012). The objective is to reach 20 million hectares of MPAs by 2020. This commitment has resulted in a considerable progress over the past years to identify potential sites for both national and district MPAs. In July 2012, the total area of protected marine and coastal ecosystems in Indonesia was 15.5 million hectares (Huffard 2012) (Yulianto et al., 2013), 5% of territorial waters. The Indonesian legislation also regulates fishing intensity and protects marine habitats through limits on the number of licenses, bycatch limits, fishing area and gear restriction, the designation of protected species and a zoning system for allocation of management responsibility to administrative levels (OECD 2013)(CCIF 2013). Recreational fisheries are also regulated by MMAF regulation 15 of 2005, which bans recreational fishing in spawning grounds and fisheries conservation areas. Recreational fisheries must also comply with fishing regulations on gear restrictions and protected species (OECD 2013). However, as stated before, fisheries and marine resources in Indonesia, especially within 4 nautical miles (nm) of the coast, have been traditionally open access (Exton 2010)(CCIF 2013). Whereas Indonesia does have regulations and procedures to regulate spatial distribution of fishing effort, the current regulations in the country have not yet resulted in control of the overall level of effort, nor have they been effective in abating overfishing (CCIF 2013). Information about vulnerable marine ecosystems (VME) in the area and the management measures particularly defined to protect benthic habitats is improving but it is still scarce and very local. Moreover, compliance with management measures is not correctly monitored, resulting in massive illegal, unreported, and unregulated (IUU) fishing in some protected areas (Buchary et al. 2007)(OECD 2013). No effective controls on fishing intensity are in place and few efforts exist to limit the spatial extent of fishing. Therefore, mitigation of gear impacts for the Indonesian coastal fishery is assessed as No Effective Mitigation.

### Factor 4.3 – Ecosystem-Based Fisheries Management

*Scoring Guidelines*

- *5 (Very Low Concern)—Substantial efforts have been made to protect species' ecological roles and ensure fishing practices do not have negative ecological effects (e.g., large proportion of fishery area is protected with marine reserves, and abundance is maintained at sufficient levels to provide food to predators).*
- *4 (Low Concern)—Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. Measures are in place to minimize potentially*

*negative ecological effect if hatchery supplementation or fish aggregating devices (FADs) are used.*

- *3 (Moderate Concern)—Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species, OR negative ecological effects from hatchery supplementation or FADs are possible and management is not place to mitigate these impacts.*
- *2 (High Concern)—Fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.*
- *1 (Very High Concern)—Use of hatchery supplementation or fish aggregating devices (FADs) in the fishery is having serious negative ecological or genetic consequences, OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.*

**Indonesia Indian Ocean, Handline**

**Indonesia Indian Ocean, Spear**

**Indonesia Indian Ocean, Trap**

**Low Concern**

In 2007, the governments of Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor-Leste came together to form the Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF), a multi-government partnership aiming to safeguard the region's marine and coastal resources and the services they provide to society (Pomeroy et al. 2013). Under the CTI-CFF, the six Coral Triangle countries (CT6) adopted a regional plan of action (RPOA) with five overarching goals: 1) strengthening management of seascapes, 2) applying an ecosystem approach to fisheries management (EAFM), 3) developing and strengthening the management of marine protected areas, 4) implementing climate change adaptation measures, and 5) protecting threatened marine species. Specifically, the CTI-CFF agreed to work collaboratively to "develop a common regional framework for legislation and policy that would support EAFM and strengthen regional and national legislation, policies, and regulations." (Pomeroy et al. 2013).The government of Indonesia, with the National Working Group 2 of the Coral Triangle Initiative, is implementing a roadmap toward EAFM. Progress is supported by key stakeholders including the Ministry of Marine Affairs and Fisheries, Marine and Fisheries Research Agency, District and Provincial Fisheries Agencies, universities, NGOs, and CTSP-USAID (Image 3 adapted from (Coral Triangle Initiative)). A suite of indicators was already developed in consultation with key stakeholders in fishery management. Indicators spanned six fishery domains: habitat, fish resource, fishery, social, economic and institutional. Established indicators were used to conduct a preliminary assessment of EAFM implementation in Indonesian Fisheries Management Areas. Building on this success, assessments were expanded to examine other management scenarios, namely marine protected areas and species-based fisheries. Follow-up activities include the development of training modules on data collection and analysis for EAFM indicators. Initial training in selected fisheries will provide a pilot toward full adoption

of EAFM indicators in Indonesia (Coral Triangle Initiative 2013). Scientific assessments and management efforts to account for ecological roles are underway. However, it seems that regulations to support the adoption and implementation of an EBFM have not been yet implemented.

**Rationale:**


Image 3. EAFM roadmap (adapted from Coral Triangle initiative)

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