Monterey Bay Aquarium

Seafood Watch®

Blue swimming crab

Portunus pelagicus

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Philippines

Set gillnets, Pots

December 19, 2018

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 includes recommendations for Blue swimming crab (*Portunus pelagicus)*, a large-bodied, benthic crustacean caught by crab pot and bottom-set gillnet. The majority of the fishery occurs in the Visayan Sea, Philippines. The provinces bordering the Visayan Sea are Masbate (Region 5: Bicol Region), Iloilo and Negros Occidental, including Guimaras (Region 6: Western Visayas), Cebu (Region 7: Central Visayas), and Leyte (Region 8: Eastern Visayas). Palawan (located in the region of MIMAROPA) has its own recommendation, since Irrawaddy dolphins are endemic to this area only.

Recent stock assessments conducted in MIMAROPA, Bicol/Masbate, and the Western/Eastern/Central Visayan Sea indicated that the BSC catch was below MSY, and that CPUE has been steadily decreasing. SPR assessments from Bantayan Island and Danajon Bank (Central Visayas) indicate that SPR of the BSC stock in those areas is 26% and 27%, respectively, which is above the limit reference point (20% SPR), but slightly below the precautionary SPR of at least 30% for most stocks to remain sustainable, although the SPR assessment from the Western Visa indicated an SPR of only 10%. A Productivity-Susceptibility Analysis of BSC suggested a medium inherent vulnerability, lending to an overall score of "moderate" concern. Overfishing is also occurring as F/M > 1 in all assessed areas.

The Philippine BSC gillnet fishery is thought to have moderate to high levels of bycatch and interacts with some species of concern (e.g., sharks, rays, sea turtles, dugongs, and Irrawaddy dolphins [only found in Palawan]). Comparatively, crab pots incidentally catch relatively small amounts of bycatch, but have the potential to interact with mammals, corals, and other biogenic habitats. Sharks, rays, and sea turtles limit the Criterion 2 scores for the gillnet fishery, and marine mammals limit the score for the pot fishery.

The Fishery Management Plan has been in place since 2013, and lays out BSC-specific management measures, appropriate management goals (which are being met), and precautionary policies are based on scientific advice. However, the BSC stock has not been maintained at a sustainable level, is currently being overfished, and it is unclear if enforcement goals are successfully met; hence, management is considered "ineffective."

The Philippine BSC fishery has an overall low impact on ocean habitats and ecosystems. Although there are no gear-specific modifications to reduce impacts to the seafloor, there are a number of protected areas throughout the Philippines where commercial fishing is prohibited.

Overall, the gillnet and pot fisheries in the Visayan Sea and Palawan are rated "red" or "Avoid."

Final Seafood Recommendations

SPECIES/FISHERY	CRITERION 1: IMPACTS ON THE SPECIES	CRITERION 2: IMPACTS ON OTHER SPECIES	CRITERION 3: MANAGEMENT EFFECTIVENESS	CRITERION 4: HABITAT AND ECOSYSTEM	OVERALL RECOMMENDATION
Blue swimming crab Philippines Western Central Pacific, Pots, Philippines, Palawan	Red (1.526)	Red (1.732)	Red (1.000)	Green (3.240)	**Avoid (1.710)**
Blue swimming crab Philippines Western Central Pacific, Pots, Philippines, Visayan Sea	Red (1.526)	Red (1.732)	Red (1.000)	Green (3.240)	**Avoid (1.710)**
Blue swimming crab Philippines Western Central Pacific, Gillnets and entangling nets (unspecified), Philippines, Palawan	Red (1.526)	Red (1.000)	Red (1.000)	Green (3.240)	**Avoid (1.491)**
Blue swimming crab Philippines Western Central Pacific, Gillnets and entangling nets (unspecified), Philippines, Visayan Sea	Red (1.526)	Red (1.000)	Red (1.000)	Green (3.240)	**Avoid (1.491)**

Summary

The blue swimming crab (*Portunus pelagicus)* is a large-bodied, benthic crustacean common throughout the Indo-Pacific. This report covers BSC caught by collapsible crab pot and bottom-set gillnets in the Visayan Sea, Philippines: Masbate (Region 5: Bicol Region); Iloilo and Negros Occidental, including Guimaras (Region 6: Western Visayas); Cebu (Region 7: Central Visayas); and Leyte (Region 8: Eastern Visayas).

The "Avoid" rank for BSC in all localities is driven by high conservation concerns over stock status, impacts on ray and shark populations (and Irrawady dolphins in Palawan), and management of the fishery's impacts on crab populations.

Eco-Certification Information

The Philippine BSC fishery is engaged in a Fishery Improvement Project (FIP). Engagement in a FIP does not affect the Seafood Watch score, because we base our assessments on the current situation. Monterey Bay Aquarium is a member organization of the Conservation Alliance for Seafood Solutions. The Alliance has outlined guidelines for credible Fishery Improvement Projects. As such, Seafood Watch will support procurement from fisheries engaged in a FIP provided it can be verified by a third party that the FIP meets the Alliance guidelines. It is not the responsibility of Monterey Bay Aquarium to verify the credibility or progress of a FIP, or promote the fisheries engaged in improvement projects.

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 includes recommendations for blue swimming crab (*Portunus pelagicus)*, a large-bodied, benthic crustacean caught by crab pot and bottom-set gillnet. The majority of the fishery occurs in the Visayan Sea, Philippines. The provinces bordering the Visayan Sea are Masbate (Region 5: Bicol Region), Iloilo and Negros Occidental, including Guimaras (Region 6: Western Visayas), Cebu (Region 7: Central Visayas), and Leyte (Region 8: Eastern Visayas).

Species Overview

Species overview

Blue swimming crabs (BSC) are brachyuran crabs that belong to the Portunidae family. Crabs from this family are usually recognized by their flat, disc-shaped hind legs, used as paddles for swimming, and by the nine spikes (aka. horns) along their carapace, on either side of their eyes (GWA DOF 2011). Males are bright blue in color with white spots and with characteristically long chelipeds; the females are a duller green/brown, with a more rounded carapace (BFAR 2012). Spawning occurs year-round, with peak spawning seasons typically between May and October (Ihsan et al. 2014). Female blue crabs mate only during molting, with the male crabs carrying and protecting them until molting and mating occurs. BSC are common throughout the Indo-Pacific in inshore and continental shelf habitats, including sand, mud, algae and seagrass near reefs and mangrove areas, and are found from the intertidal up to depths of 70 m (Ingles 1988) (Germano et al. 2006). BSC are a focal point of fishery industries in the region, such as in Indonesia, Philippines, Vietnam, Cambodia, Malaysia, Thailand, India, and Sri Lanka ((Creech et al. 2016); Figure 1), and they are cosmopolitan in Philippine coastal waters (BFAR 2012). They mature quickly (about 1 year), have short lifespans (about 3 years), and are partial brooders (Josileen and Menon 2007) (Kangas 2000).

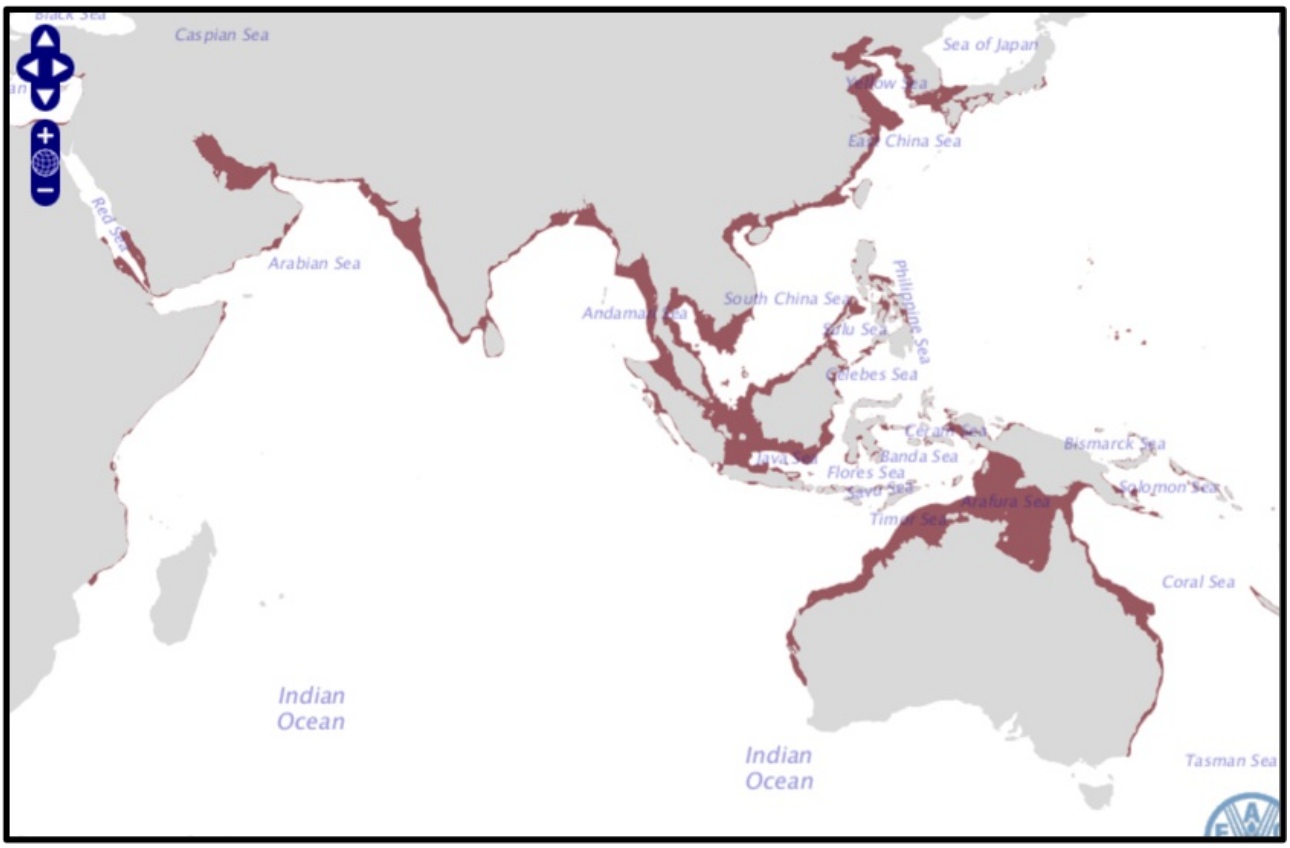

Figure 1 BSC distribution map (FAO 2016a).

Philippine BSC fishery locations and gear

BSC is a widespread species in the Philippines, with the major fishing grounds concentrated in the central geographical portion (Ingles 2004). The Visayan Sea, surrounded by the regions of Western Visayas (Iloilo and Negros Occidental), Bicol (Masbate), Central Visayas (Cebu) and Eastern Visayas (Leyte), is one of the major fishing grounds contributing to about 31% of the total catch volume (PSA 2018). Other major fishing grounds include Palawan (12%), Sorsogon Bay (8%), Samar (6%), Capiz (6%), Quezon (5%), Bataan (4%), Camarines Sur (4%), Zamboanga Sibugay (2%), and Camarines Norte (2%) (ibid). Several crab meat processing plants also exist in these areas, but the highest concentration is located in provinces surrounding the Visayan Sea due because of their proximity to a high supply of raw materials. The supply chain of BSC varies per location. Generally the chain starts with the crab fishers who sell their catch to consolidators (or middlemen), local market, or directly to consumers. In areas where picking plants are present, the majority of the consolidators sell the crabs there for picking. Picked crab meat is consequently bought by crab meat processing plants for canning and distribution. On the other hand, some consolidators sell the crabs to the local market or to other establishments, such as supermarkets and restaurants (PACPI-WWF 2018) (The World Bank 2012) (Nieves et al. 2013) (de la Cruz et al. 2015).

Initiatives to conserve BSC have been recognized in Negros Occidental since 2003, through the enactment of provincial ordinance regulating the catching, selling, possessing or buying of gravid BSC and crablets. Some municipalities in Northern Iloilo (Batad, Estancia and Ajuy) have also followed suit (BFAR 2013). In addition, in Danajon Bank, Bohol, initiatives to conserve BSC stocks have been ongoing since 2014. Tawi-Tawi, which belongs to the ARMM region, was not included in this report since it contributed to less than 2% of blue swimming crab production (PSA 2015). Here, and in other small fishing grounds covered under the FMP that are not included in the Visayan Sea, production volume is smaller, but crab fishing is still a primary livelihood. However, there is little presence of processors (sometimes due to military conflict, as in Tawi-Tawi) and most of the BSC landings end up in the local market, i.e., hotels, supermarkets, restaurants (pers. comm., J. Emlen J. Genio, 5 May 2016).

The stock structure of BSC in the Philippines is not completely understood. Romero found that there are two confirmed genetic populations of BSC in the Philippines, one in the Visayan Sea and adjoining seas, and the other in Tawi-Tawi waters (Romero 2009). However, Sienes *et al*. (2014) claims that there are potentially two distinct species in the Philippines that occur in sympatry.

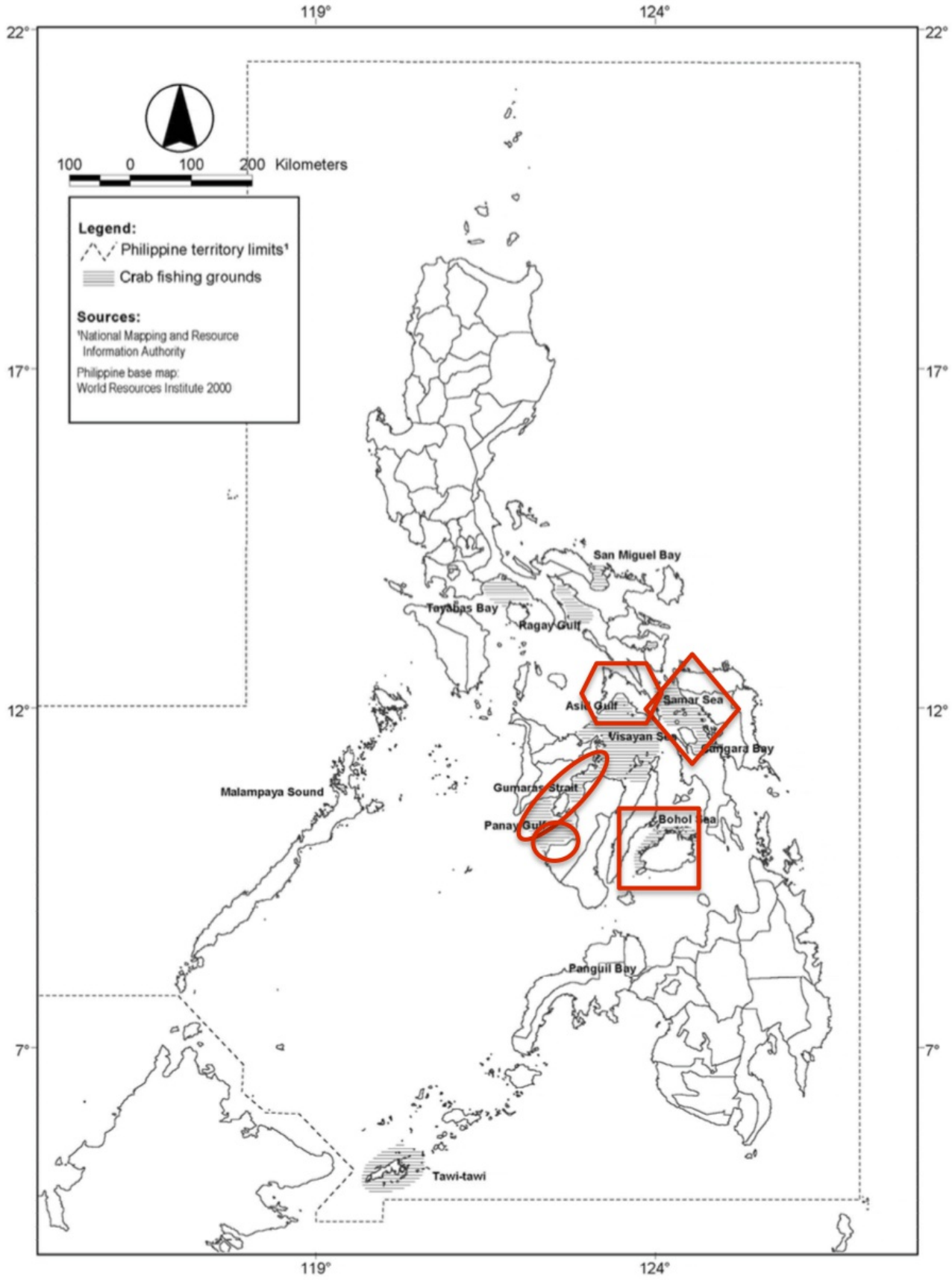

Figure 2 BSC fishing grounds in the Philippines covered under the Visayan Sea recommendation (from Ingles 2004). Ellipse: Western Visayas (Iloilo, Guimaras Strait), Circle: Negros Island, Square: Central Visayas (Cebu, Bohol), Diamond: Eastern Visayas, and Hexagon: Bicol (Masbate).

The Philippine BSC fishery is split into two sectors: municipal fisheries, which operate in coastal waters within 15 km from the coast, with or without vessels less than 3 tons gross, and commercial fisheries, which fish beyond 15 km from the coast (BFAR 2012). BSC is caught primarily by two gear types: entangling/gillnets (about 60%) (The World Bank 2012) and crab pots (about 30%; ibid), also known as "*palugdang*" and "*panggal,*" respectively (Ingles 2004) (BFAR 2012) (The World Bank 2012) (Nieves et al. 2013). Entangling/gillnets are 133 m-long, rectangular panels of nylon netting (0.30 mm twine size, 4 knots and 50 meshes deep) with large diamond-shaped mesh that sit vertically in the water column, and are anchored so they rest on the ocean floor (ibid; Figure 3). Nets are set in panels of 18, resulting in more than 2 km of gillnet per fishing operation (ibid). Crab pots (non-collapsible) are circular in shape, and are usually made of bamboo splits woven together with a non-return valve for easy entrance, but a difficult exit (Figure 4). They are tied to a groundline, roughly 4 m apart, usually 200 m in length (60 pots; (Ingles 1996)). Lost crab pots are less of an environmental hazard (ghost fishing) because they are biodegradable and decompose completely within 3 to 5 months (BFAR 2012).

Other, less predominant, gears used (not covered in this report) in commercial waters are trawls and Danish seines, and in municipal waters, crab lift nets, pushnets and fish corrals (Ingles and Flores 2000) (Ingles 2004) (BFAR 2012). Danish seines require commercial vessels for their operation; therefore, their use is limited to waters outside of municipal fishing areas (Ingles 1996).

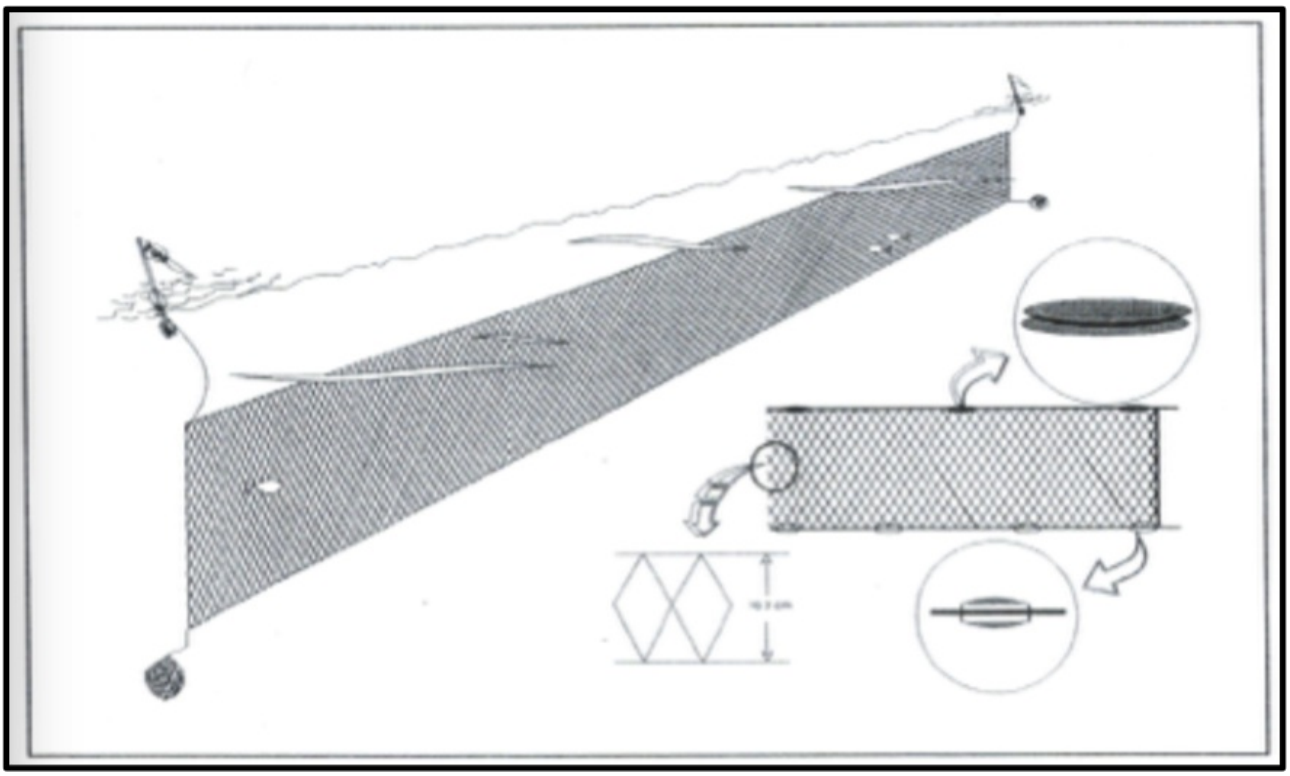

Figure 3 Entangling/gillnet (from Ingles 1996).

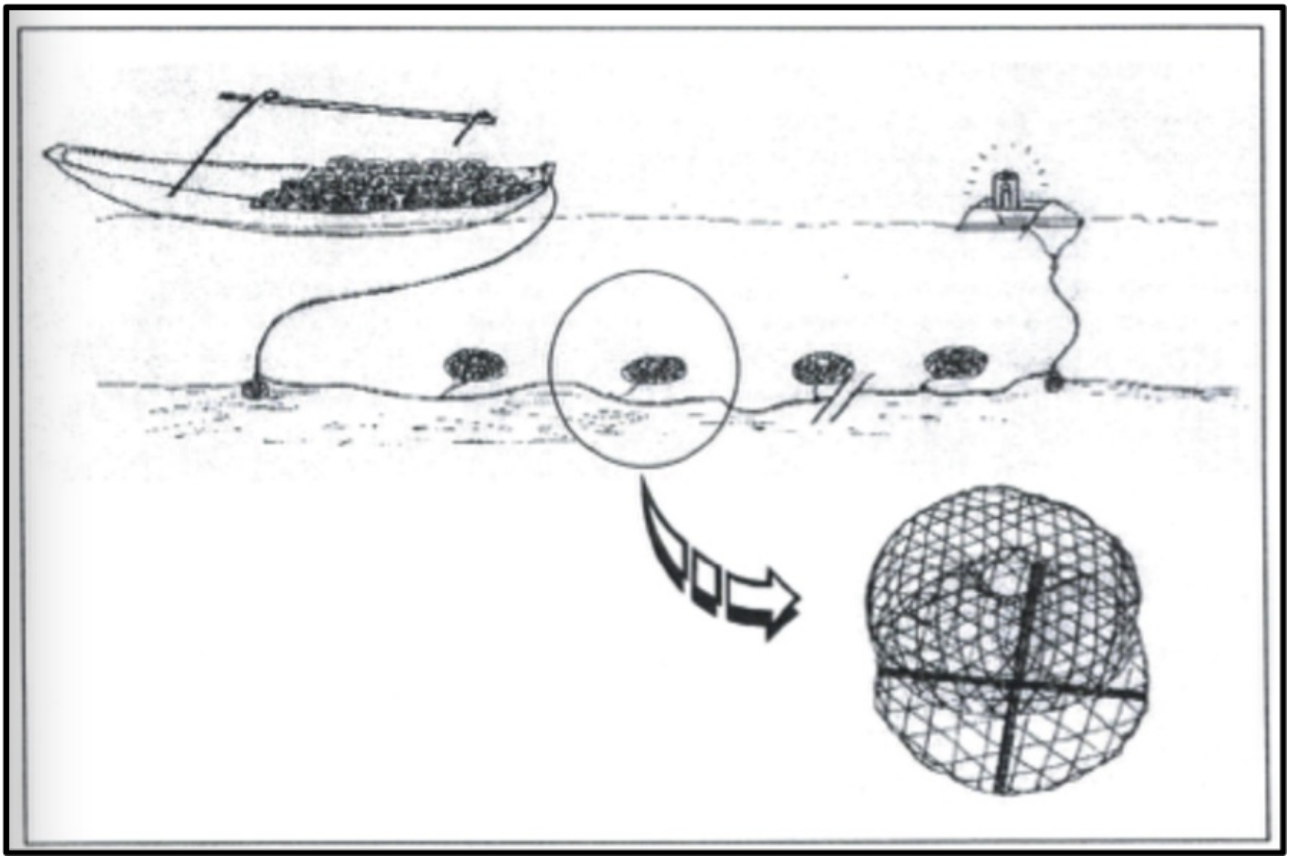
Figure 4 Schematic diagram of a unit of crab pots (from Ingles 1996).

History of Phil. BSC fishery

The BSC fishery in the Philippines was unregulated prior to the involvement of the Sustainable Fisheries Partnership (SFP) and the implementation of the Fisheries Improvement Project (FIP; (SFP 2016). Before the 1990s, BSC was caught only for local consumption and the price was very low, hence, the lack of regulation was not an issue. During the mid-90s however (starting in 1994), the export market for BSC developed once a major U.S. crab supplier discovered that white meat from the South East Asian BSC was the perfect substitute for the declining Chesapeake Bay blue crab (*Callinectes sapidus; ibid)*. Soon, other processors followed suit and demand for this product increased substantially, which in turn, increased fishing pressure. As a result, the Phil. BSC stock started to become overfished, and fishermen found it increasingly hard to catch large crab (*ibid*). Catch rates of Phil. BSC have been declining in recent years partially due to unregulated increased fishing efforts, and slow development of aquaculture technologies to wild-caught seeds for rearing BSC in captivity (Soundarapandian et al. 2007)(Sienes et al. 2014). Hatchery technology has already been established; the hurdle is determining a feasible grow-out technology (Marinelle Espino, August 17, 2018, pers. comm.). At present, PACPI is supporting two BSC hatcheries (Negros Occidental and Bohol), but the crab juveniles produced are used only for stock enhancement (*ibid*).

Management

There is no unified worldwide body that manages fisheries for BSC. Instead, each country has its own individual management system. In the Philippines, the Department of Agriculture-Bureau of Fisheries and Aquatic Resources (BFAR) is the agency responsible and has jurisdiction in the management, conservation, development, protection, utilization, and disposition of all fisheries and aquatic resources. In municipal waters, the local government units, particularly the municipal/city governments, have the jurisdiction over the abovementioned functions and/or responsibilities, while BFAR may coordinate and assist (RA 8550: Philippine

Fisheries Code of 1998, amended as RA 10654) (PFC 1998). In early 2013, the Bureau of Fisheries and Aquatic Resources (BFAR) finalized the Blue Swimming Crab Management Plan (BFAR 2012), followed by the approval of the Joint Department of Agriculture-Department of Interior and Local Government Administrative Order (JAO) in 2014 to enforce the management plan (ROP DOA 2014).

FIP

A fishery improvement project (FIP) led by the Philippine Association of Crab Processors, Inc. (PACPI), the premier trade association of Philippines Blue Swimmer Crab Processors, representing 90% of the Phil. BSC industry, was initiated in May 2009 (though actual work started in 2010). Their goal is to foster a good relationship within the crab-processing sector and to support initiatives aimed at promoting BSC sustainability in the country. The program includes projects aimed to: 1) intensify data collection on the status of BSC stocks, as well as the impact of the fishery on the environment; 2) promote and implement activities to revive the stock; 3) minimize environmental impacts of the fishery; 4) support the implementation of the BSC Management Plan; and 5) educate fisherfolks and communities (PACPI 2015). The FIP covers the Visayan Sea and nearby waters (Region 6), including Visayan Sea, Guimaras Strait, Iloilo Strait, and Panay Gulf, and is currently using the MSC sustainability platform as a basis for its improvement activities (NFICC 2016).

Production Statistics

The increasing global demand for BSC and their wide distribution throughout the Indo-Pacific make them an important species for a number of countries (Creech 2013) (FAO 2016a), and there has been a steady increase in global supply since the 1960s (Figure 5).

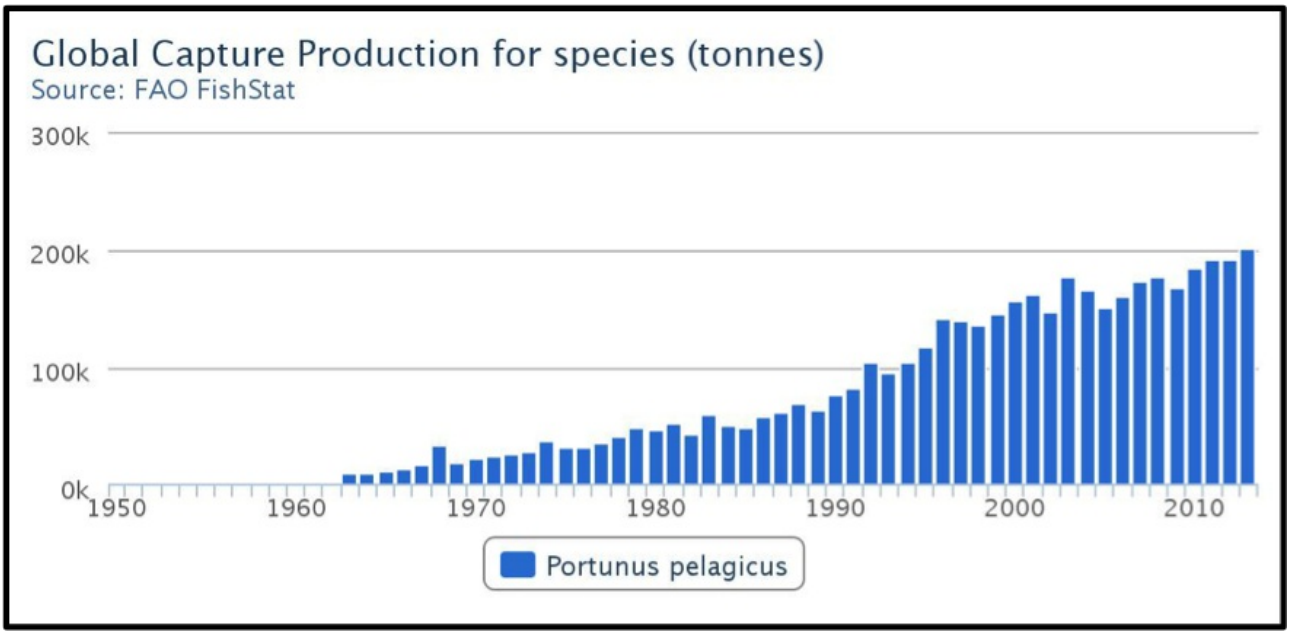

Figure 5 BSC global catch (FAO 2016a).

In 2014, the total global production of BSC was 212,571 tons (t), of which Asia contributed 208,816 t. Specifically, China contributed 83,877 t, Indonesia 52,437 t, Philippines 27,570 t, Thailand 26,635 t, Taiwan 7,084 t, and Australia 3,755 t (FAO 2016a). India, Vietnam and Sri Lankan catches are not accounted for in this data.

The municipal fishery sector dominates production in the Philippine BSC fishery. In 2017, it accounted for approximately 93.9% (29,453.19 mt) of BSC production; however, the commercial fishery only contributed 4.5% (1,397.24 mt; Figure 6, 7) (PSA 2017). In 2017, the major crab-producing regions were Western Visayas (11,022.24 mt; 35%), Bicol Region (6,043.01 mt; 19%), and MIMAROPA (2,993.01 mt; 10%) (PSA 2017). Based on the Philippine Statistics Authority (PSA) data from 2013 to 2017, the annual volume of BSC production has increased from 2013 (26,381.63 mt) to 2014 (27,570.34 mt), decreased in 2015 (26,251.87 mt), and has been increasing in 2016 (28,616.74 mt) and 2017 (31,327.61 mt) (PSA 2017).

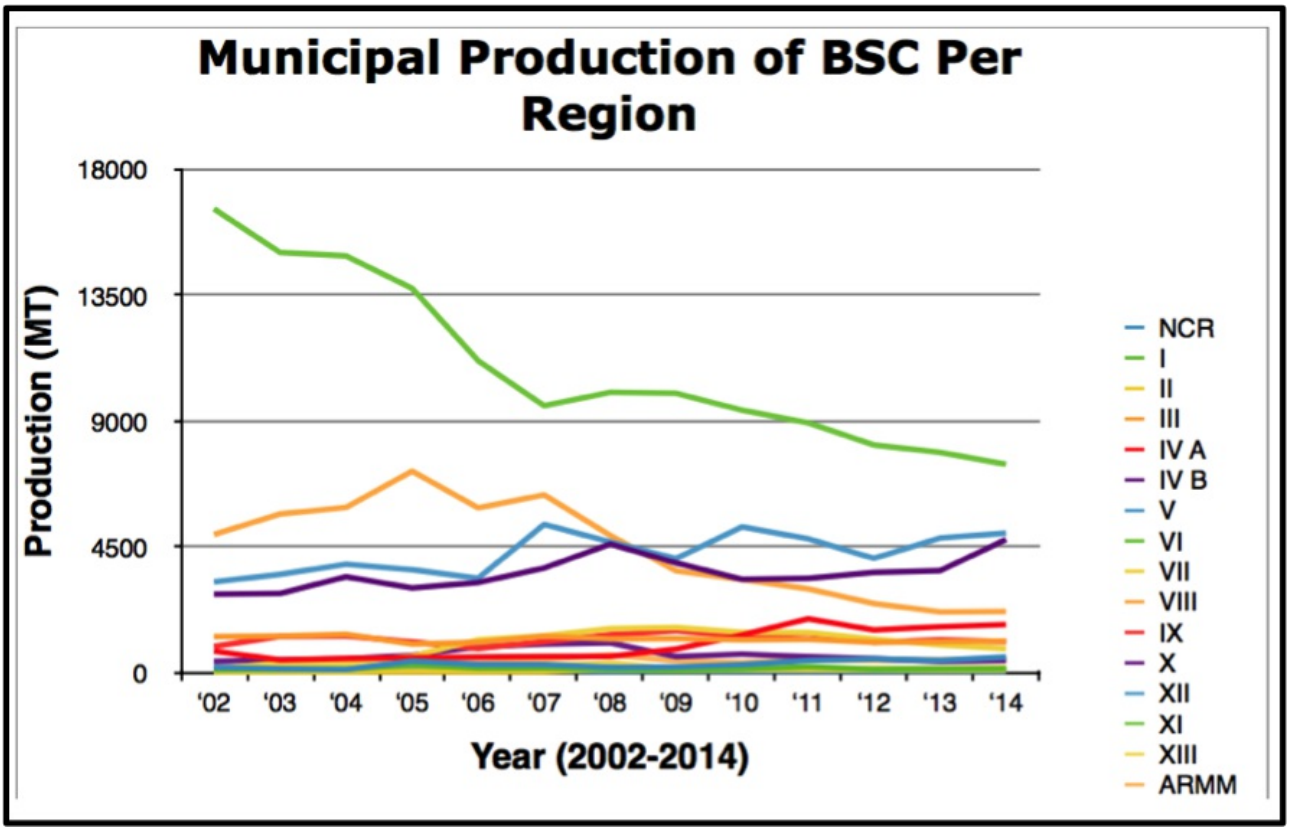

Figure 6 Municipal production of Phil. BSC per region from 2002-2014 (PSA 2017).

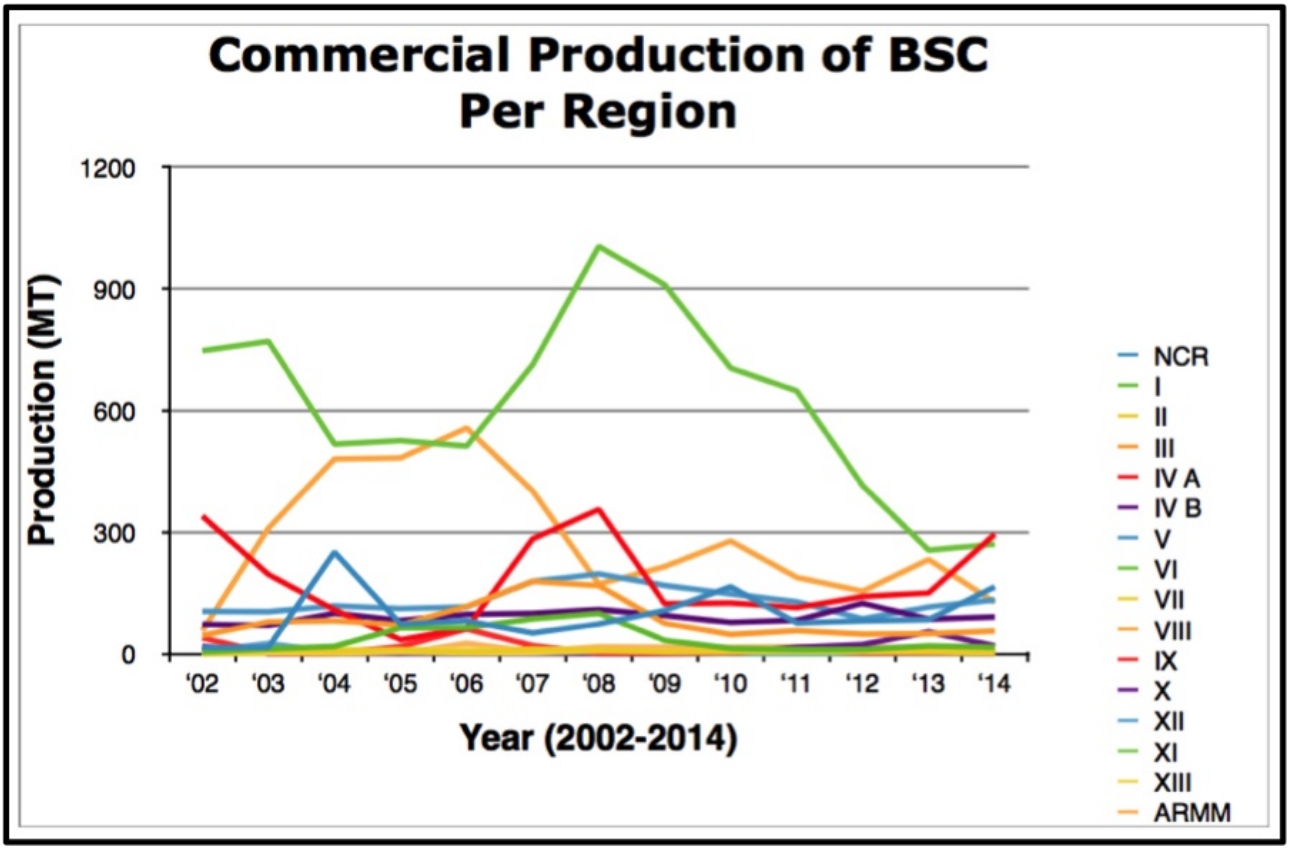

Figure 7 Commercial production of Phil. BSC per region from 2002-2014 (PSA 2017).

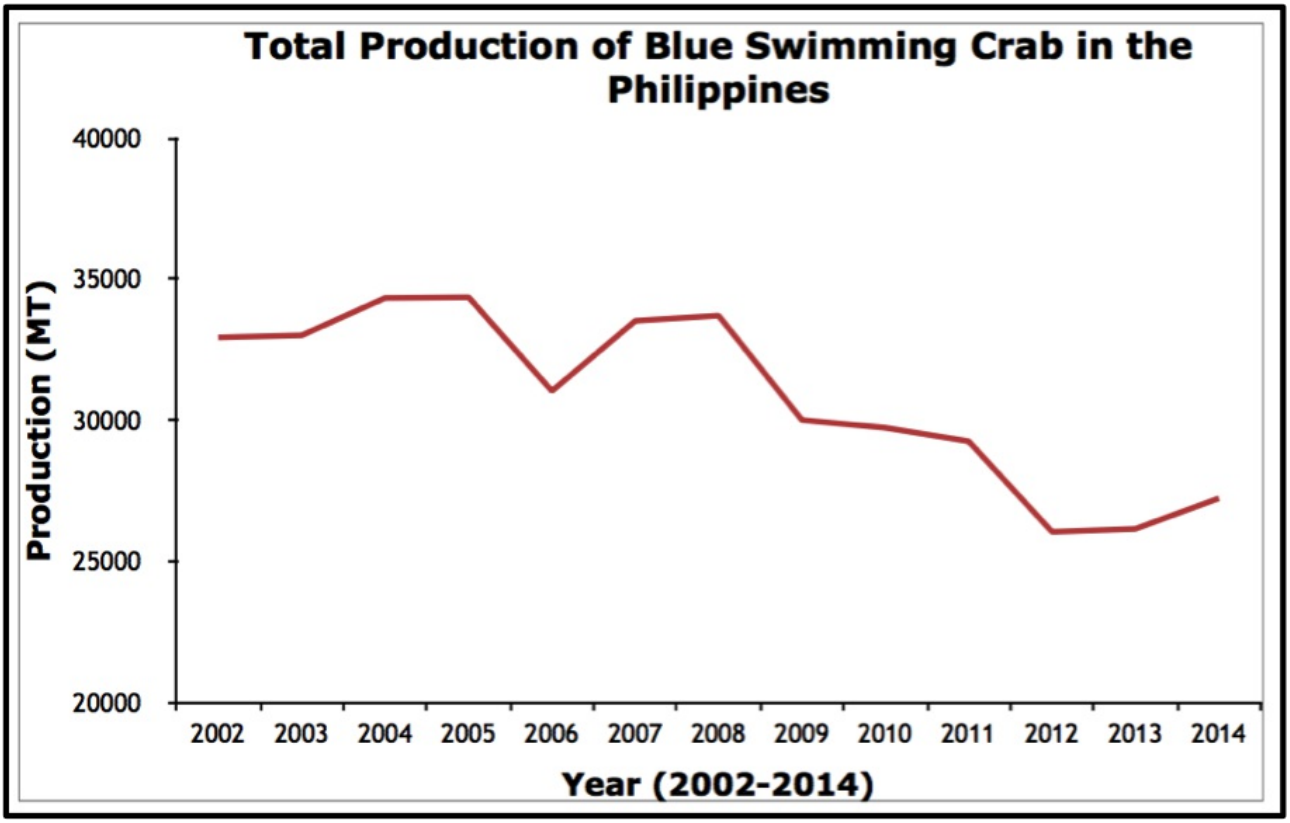

Figure 8 Total production of Phil. BSC from 2002-2014 (PSA 2017).

Importance to the US/North American market.

The United States is the major export destination for pasteurized crabmeat; hence, the US market drives global BSC demand (BFAR 2012). Imports of portunid crabs (species not identified) from the Philippines into the US have been rising since 2007 and peaked in 2015, at 12551.991 t (Figure 9), at a value of USD 28 million (NMFS 2016); Figure 11. The Philippines is the fourth major supplier of portunid crab imports to the US, with Indonesia, China, and Vietnam ranking in the top three (Figure 10). Five percent of crab and 12% of swimming crab (species unspecified) on the US market is from the Philippines (NMFS 2016).

As of 2009, the BSC industry ranks among the top 20 fishery commodities of the Philippines, comprising over 90% of crab landings, and is the fourth most important fishery export of the country (BFAR 2016) (FAO 2016b).

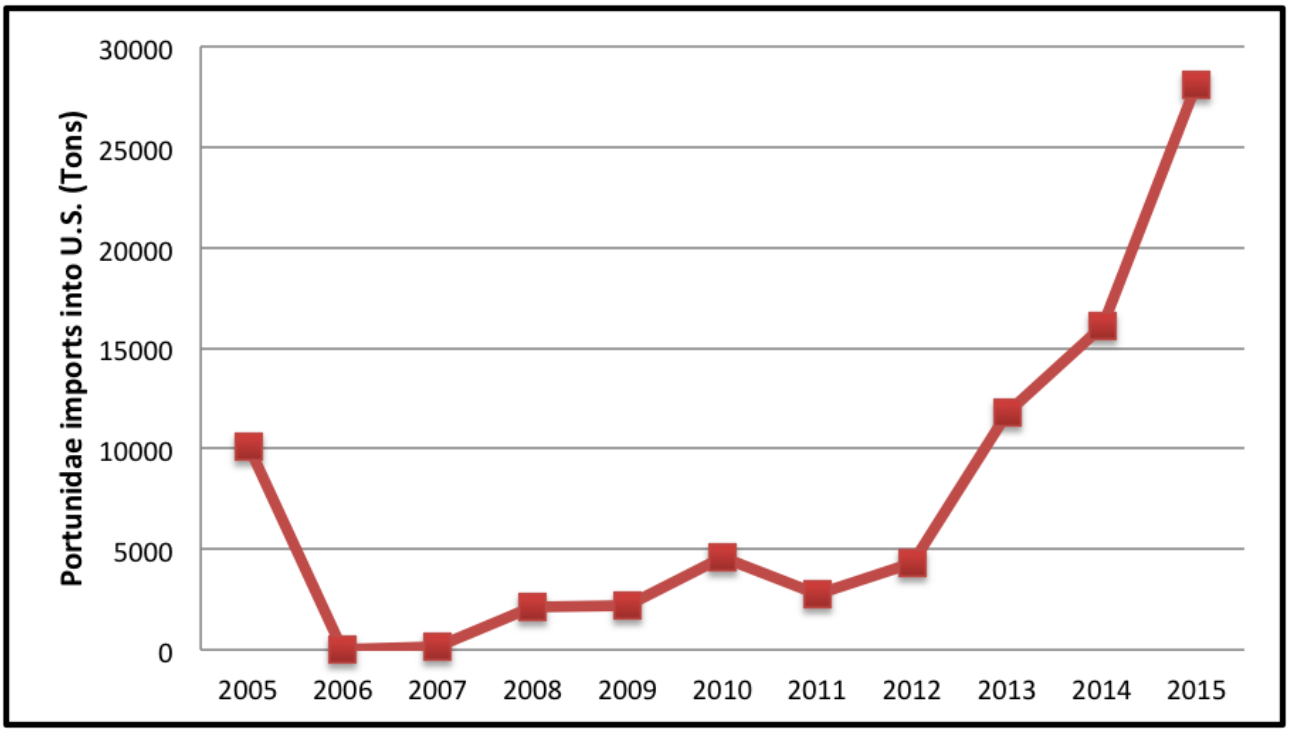

Figure 9 Imports of Portunidae (swimming crab) from the Philippines into the U.S. from 2005-2015 (data from NMFS 2016).

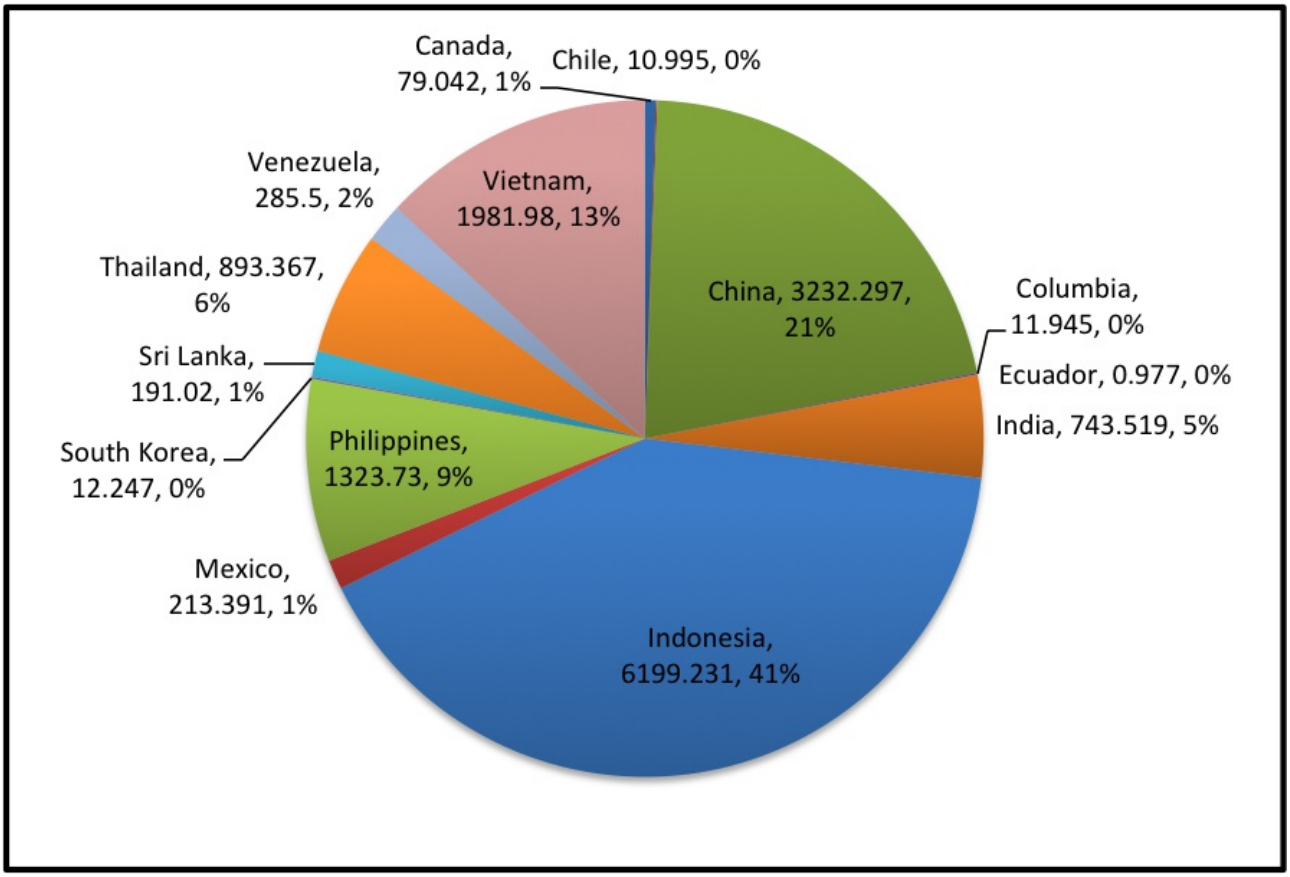

Figure 10 Portunid crab imports into the U.S. (by tons) in 2015 (data from NMFS 2016).

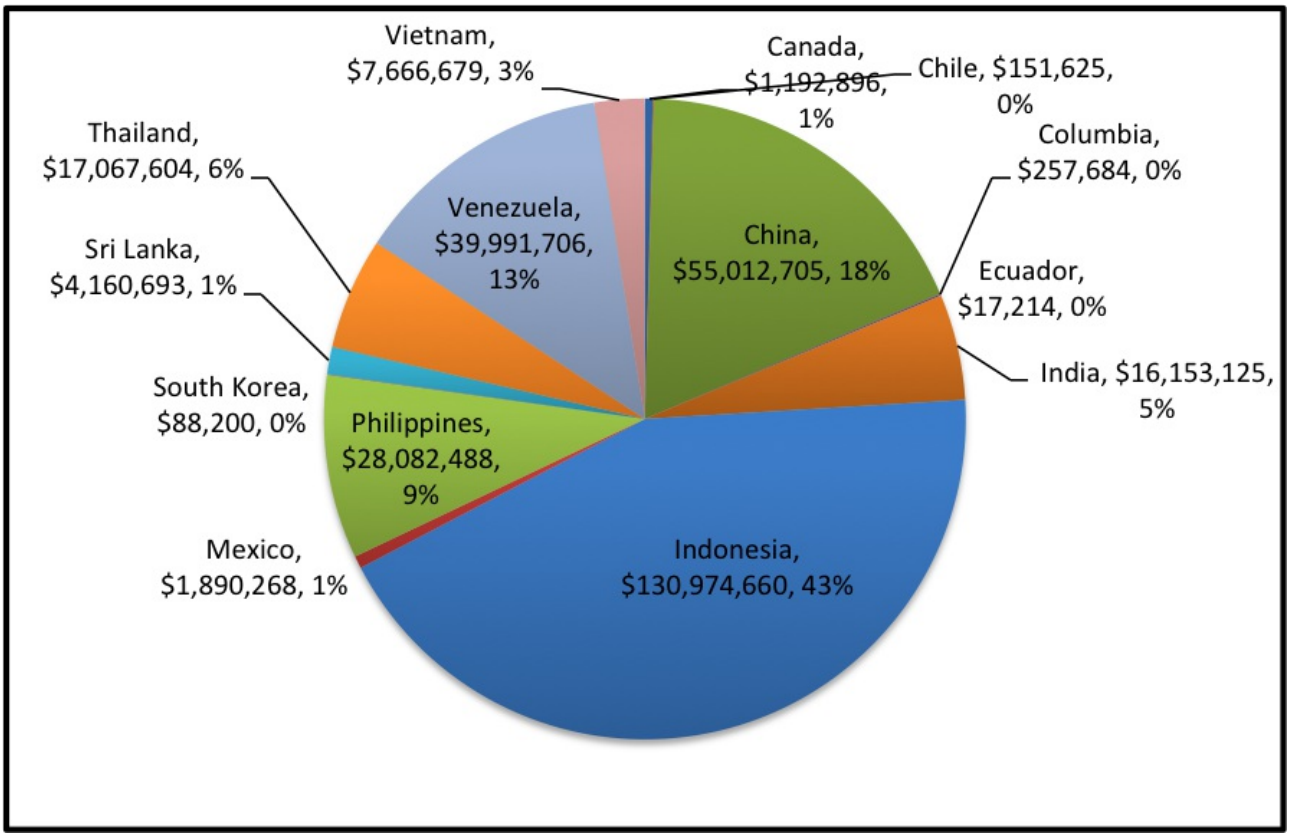

Figure 11 Portunid crab imports into the U.S. (by value) in 2015 (data from NMFS 2016).

Common and market names.

Blue swimming crab is also known as flower crab, blue crab, blue swimmer crab, blue manna crab, horse crab, sand crab, swimming crab (GWA DOF 2011) (FDA 2016) (FishSource 2016). Blue swimming crab is locally referred to as *alimasag* (Tagalog), *dariway*/ *bansaway* (Ilokano), *Galeway* (Pangasinan), *kasag* (Bicol and Hiligaynon), *lambay (*Bisaya), and *masag* (Waray) (ROP DOA 2014).

Primary product forms

Portunid crabs are sold interchangeably and these species can include RSC, BSC, and others, like *Portunis sanguinolentus* and *P. trituberculatus (*Lai et al. 2010) (Sea Fare Group 2011). BSC are exported by seafood companies as fresh, frozen, and canned products. Fresh crab is either exported as "head on" or "cut crab" products. Cut crabs are processed by removing the top shell, guts and gills, and then brushed clean and cut into two sections. Canned crab is a pasteurized product that involves picking the meat from boiled crabs. Crab meat is graded according to type and size. Grades include colossal, jumbo, B jumbo, flower, lump, special, claw, B claw and finger. Canned crab products include "fancy," "special," "jumbo lump," "back fin," "lump," "white," and "claw" (Creech 2013).

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

BLUE SWIMMING CRAB			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Philippines/Western Central Pacific | Pots | Philippines | Palawan	2.33: Moderate Concern	1.00: High Concern	Red (1.526)
Philippines/Western Central Pacific | Pots | Philippines | Visayan Sea	2.33: Moderate Concern	1.00: High Concern	Red (1.526)
Philippines/Western Central Pacific | Gillnets and entangling nets (unspecified) | Philippines | Palawan	2.33: Moderate Concern	1.00: High Concern	Red (1.526)
Philippines/Western Central Pacific | Gillnets and entangling nets (unspecified) | Philippines | Visayan Sea	2.33: Moderate Concern	1.00: High Concern	Red (1.526)

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.*

BLUE SWIMMING CRAB

Factor 1.1 - Abundance

PHILIPPINES/WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, PALAWAN
PHILIPPINES/WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN

Moderate Concern

The National Stock Assessment Program (NSAP) of the Bureau of Fisheries and Aquatic Resources (BFAR) recently conducted a comprehensive stock assessment of BSC in major landing areas all over the Philippines (Manila Bay, Ragay Gulf, MIMAROPA, Bicol region, Western Visayan Sea, Cebu, Negros, Leyte Gulf, Dipolog Bay, Basilan Strait, Sibuguey Bay, Hinatuan Bay) (BFAR-NSAP 2018). The results were presented in July 26, 2018 during the BSC Management Plan Review and Action Planning in Iloilo.

Length-based spawning potential ratio (SPR) was only calculated from the 2017 Western Visayan Sea stock assessment, and is well below both the target and limit thresholds at 10% (see figure for details; ibid). SPR assessments have also been used to estimate the status of the stock in the waters around Danajon Bank (in Bohol, 2014) and Bantayan Island (in 2016) (PACPI 2015) (PACPI 2017). The assessment for Danajon Bank found an SPR of 27% (PACPI 2015), though the assessment in Bantayan Island indicates that SPR of the Phil. BSC stock in that area is 26% (PACPI 2017). Both of these areas are above the suggested Limit Reference Point (20% SPR), but slightly below the precautionary SPR of at least 30% for most stocks to remain sustainable (Prince et al. 2014). In addition, catch rates (CPUE), which can be used as a proxy indicator for the status of the BSC population, have been generally declining, in MIMAROPA and Western/Central/Eastern Visayas, indicating over-exploitation of the species, and relatively steady in Bicol/Masbate (ibid).

A Productivity-Susceptibility Analysis (PSA) was calculated to determine the inherent vulnerability of BSC as there are mixed data-limited indicators (positive SPR in some areas and declining CPUE). The PSA score = 2.71 (detailed scoring of each PSA attribute is shown below), and BSC is deemed to have medium vulnerability. Due to the moderate vulnerability of blue swimming crab and the mixed data-limited indicators, Seafood Watch considers abundance to be a "moderate" concern.

Justification:

PACPI, in collaboration with the University of San Carlos and the University of the Philippines Visayas, will be conducting SPR assessments in Masbate and Iloilo areas starting August 2018. An academic partner is yet to be identified to conduct the SPR assessment in Negros Occidental in September 2018 (pers. comm., M. Espinio, 14 August 2018).

REGION	PROVINCE	SPR	F/M (LBAR)	CPUE TREND	PROPORTION OF LIFE STAGES IN CATCH	REFERENCE(S)
-	-	**>30%**	**F/M <= 1**	**Increasing**	**Juvenile (J)- < 10%, Adult (A)- <= 80%, Megaspawner (M)- < 10%**	**Target**
-	**-**	**20%**	**F/M =2M**	**Stable**	**J- 38%, A- 44%, M- 18%**	**Limit**
MIMAROPA	**Palawan**	None	1.48	Decreasing	J = 64%; A = 31%; M = 5%	(BFAR-NSAP 2018)
Bicol/Masbate	**San Miguel Bay**	None	F = 3, M = 1.87	Increasing; but bottom-set crab net is decreasing	J Female (F) = 55%, Male (M) = 11%; A F = 43%, 84%	(*ibid*)
	Sorsogon Bay	None	F = 2.02, M = 2	Increasing	J F = 50.6%, M = 20.3%; A F = 44%, A M = 76%	(*ibid*)
	Asid Gulf	None	F = 1.16, M = 1.41	Decreasing	J F = 19.6%, M = 3.9%; A F = 57%, A M = 75%	(*ibid*)
Western Visayan Sea		10%	2.64	Decreasing	J = 38%; A = 44%; M = 18%	(*ibid*)
Central Visayas	**Cebu**	None	1.1	Decreasing	J = 55.6%; A = 28%; M = 16%	(*ibid*)
Eastern Visayas	**Leyte Gulf**	None	1.17	Decreasing	J = 20%; A = 60%; M = 20%	(*ibid*)

Productivity-Susceptibility Analysis (if Applicable):

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)²*

Productivity Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Average age at maturity	Approx. 1 year (Josileen and Menon 2007) (Kangas 2000)	1
Average maximum age	Approx. 3 years (Josileen and Menon 2007) (Kangas 2000)	1
Fecundity	229,468 to 2,236,355 eggs/batch (Zairon et al. 2015)	1
Average maximum size (fish only)	-	-
Average size at maturity (fish only)	-	-
Reproductive strategy	Brooder	2
Trophic level	2.5 to 3.2 (First level carnivore) (de Lestang et al. 2000)	2
Density dependence (invertebrates only)	-	-
Total Productivity (average)		**1.4**

Susceptibility Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Areal overlap (Considers all fisheries)	SFW default; >30% overlap	3
Vertical overlap (Considers all fisheries)	High overlap w/fishing gear (target species)	3

Selectivity of fishery (Specific to fishery under assessment)	Targeted species, majority of catch in trap and net gear is mature.	2
Post-capture mortality (Specific to fishery under assessment)	Retained species	3
Total Susceptibility (multiplicative)		**2.33**

PSA score for BSC in Philippine Crab pot and Bottom-set gillnet fisheries is calculated as follows:

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

(V) = $\sqrt{(1.67^2 + 2.33)^2}$

V = 2.71

Factor 1.2 - Fishing Mortality

PHILIPPINES/WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, PALAWAN
PHILIPPINES/WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN

High Concern

Fishing mortality estimates from the 2017 stock assessments in MIMAROPA, Bicol/Masbate, western Visayan Sea, central Visayan Sea, and eastern Visayan Sea are below both target and limit thresholds, ranging from F/M = 1.1 to F/M = 2.64 (see figure in Criterion 1.1 for details) (BFAR-NSAP 2018). The SPR assessment from Bantayan Island showed that F/M was also high (1.83), which is a cause for concern when around 30% of the catch consists of immature individuals (PACPI 2017). Because the Philippine BSC stock is undergoing overfishing, fishing mortality is deemed "high" concern.

BLUE SWIMMING CRAB

Factor 1.1 - Abundance

PHILIPPINES/WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, VISAYAN SEA
PHILIPPINES/WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

Moderate Concern

The National Stock Assessment Program (NSAP) of the Bureau of Fisheries and Aquatic Resources (BFAR) recently conducted a comprehensive stock assessment of BSC in major landing areas all over the Philippines (Manila Bay, Ragay Gulf, MIMAROPA, Bicol region, Western Visayan Sea, Cebu, Negros, Leyte Gulf, Dipolog Bay, Basilan Strait, Sibuguey Bay, Hinatuan Bay) (BFAR-NSAP 2018). The results were presented in July 26, 2018 during the BSC Management Plan Review and Action Planning in Iloilo.

Length-based spawning potential ratio (SPR) was only calculated from the 2017 Western Visayan Sea stock assessment, and is well below both the target and limit thresholds at 10% (see figure for details; ibid). SPR assessments have also been used to estimate the status of the stock in the waters around Danajon Bank (in Bohol, 2014) and Bantayan Island (in 2016) (PACPI 2015) (PACPI 2017). The assessment for Danajon Bank found an SPR of 27% (PACPI 2015), though the assessment in Bantayan Island indicates that SPR of the Phil. BSC stock in that area is 26% (PACPI 2017). Both of these areas are above the suggested Limit Reference Point (20% SPR), but slightly below the precautionary SPR of at least 30% for most stocks to remain sustainable (Prince et al. 2014). In addition, catch rates (CPUE), which can be used as a proxy indicator for the status of the BSC population, have been generally declining, in MIMAROPA and Western/Central/Eastern Visayas, indicating over-exploitation of the species, and relatively steady in Bicol/Masbate (ibid).

A Productivity-Susceptibility Analysis (PSA) was calculated to determine the inherent vulnerability of BSC as there are mixed data-limited indicators (positive SPR in some areas and declining CPUE). The PSA score = 2.71 (detailed scoring of each PSA attribute is shown below), and BSC is deemed to have medium vulnerability. Due to the moderate vulnerability of blue swimming crab and the mixed data-limited indicators, Seafood Watch considers abundance to be a "moderate" concern.

Justification:

PACPI, in collaboration with the University of San Carlos and the University of the Philippines Visayas, will be conducting SPR assessments in Masbate and Iloilo areas starting August 2018. An academic partner is yet to be identified to conduct the SPR assessment in Negros Occidental in September 2018 (pers. comm., M. Espinio, 14 August 2018).

REGION	PROVINCE	SPR	F/M (LBAR)	CPUE TREND	PROPORTION OF LIFE STAGES IN CATCH	REFERENCE(S)
-	-	**>30%**	**F/M <= 1**	**Increasing**	**Juvenile (J)- < 10%, Adult (A)- <= 80%, Megaspawner (M)- < 10%**	**Target**
-	**-**	**20%**	**F/M =2M**	**Stable**	**J- 38%, A- 44%, M- 18%**	**Limit**
MIMAROPA	**Palawan**	None	1.48	Decreasing	J = 64%; A = 31%; M = 5%	(BFAR-NSAP 2018)
Bicol/Masbate	**San Miguel Bay**	None	F = 3, M = 1.87	Increasing; but bottom-set crab net is decreasing	J Female (F) = 55%, Male (M) = 11%; A F = 43%, 84%	(*ibid*)
	Sorsogon Bay	None	F = 2.02, M = 2	Increasing	J F = 50.6%, M = 20.3%; A F = 44%, A M = 76%	(*ibid*)

	Asid Gulf	None	F = 1.16, M = 1.41	Decreasing	J F = 19.6%, M = 3.9%; A F = 57%, A M = 75%	(*ibid*)
Western Visayan Sea		10%	2.64	Decreasing	J = 38%; A = 44%; M = 18%	(*ibid*)
Central Visayas	**Cebu**	None	1.1	Decreasing	J = 55.6%; A = 28%; M = 16%	(*ibid*)
Eastern Visayas	**Leyte Gulf**	None	1.17	Decreasing	J = 20%; A = 60%; M = 20%	(*ibid*)

Productivity-Susceptibility Analysis (if Applicable):

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)²*

Productivity Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Average age at maturity	Approx. 1 year (Josileen and Menon 2007) (Kangas 2000)	1
Average maximum age	Approx. 3 years (Josileen and Menon 2007) (Kangas 2000)	1
Fecundity	229,468 to 2,236,355 eggs/batch (Zairon et al. 2015)	1
Average maximum size (fish only)	-	-
Average size at maturity (fish only)	-	-
Reproductive strategy	Brooder	2

Trophic level	2.5 to 3.2 (First level carnivore) (de Lestang et al. 2000)	2
Density dependence (invertebrates only)	-	-
Total Productivity (average)		**1.4**

Susceptibility Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Areal overlap (Considers all fisheries)	SFW default; >30% overlap	3
Vertical overlap (Considers all fisheries)	High overlap w/fishing gear (target species)	3
Selectivity of fishery (Specific to fishery under assessment)	Targeted species, majority of catch in trap and net gear is mature.	2
Post-capture mortality (Specific to fishery under assessment)	Retained species	3
Total Susceptibility (multiplicative)		**2.33**

PSA score for BSC in Philippine Crab pot and Bottom-set gillnet fisheries is calculated as follows:

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

(V) = $\sqrt{(1.67^2 + 2.33)^2}$

V = 2.71

Factor 1.2 - Fishing Mortality

PHILIPPINES/WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, VISAYAN SEA
PHILIPPINES/WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

High Concern

Fishing mortality estimates from the 2017 stock assessments in MIMAROPA, Bicol/Masbate, western Visayan

Sea, central Visayan Sea, and eastern Visayan Sea are below both target and limit thresholds, ranging from F/M = 1.1 to F/M = 2.64 (see figure in Criterion 1.1 for details) (BFAR-NSAP 2018). The SPR assessment from Bantayan Island showed that F/M was also high (1.83), which is a cause for concern when around 30% of the catch consists of immature individuals (PACPI 2017). Because the Philippine BSC stock is undergoing overfishing, fishing mortality is deemed "high" concern.

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.

BLUE SWIMMING CRAB - PHILIPPINES/WESTERN CENTRAL PACIFIC - GILLNETS AND ENTANGLING NETS (UNSPECIFIED) - PHILIPPINES - PALAWAN					
Subscore:	**1.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.000**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Sharks	1.00:High Concern	1.00:High Concern	Red (1.000)		
Rays	1.00:High Concern	1.00:High Concern	Red (1.000)		
Irrawaddy dolphin	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		
Sea turtles	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		
True crabs	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)		

BLUE SWIMMING CRAB - PHILIPPINES/WESTERN CENTRAL PACIFIC - GILLNETS AND ENTANGLING NETS (UNSPECIFIED) - PHILIPPINES - VISAYAN SEA					
Subscore:	**1.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.000**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Sharks	1.00:High Concern	1.00:High Concern	Red (1.000)		

Rays	1.00:High Concern	1.00:High Concern	Red (1.000)
Sea turtles	1.00:High Concern	3.00:Moderate Concern	Red (1.732)
True crabs	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)

BLUE SWIMMING CRAB - PHILIPPINES/WESTERN CENTRAL PACIFIC - POTS - PHILIPPINES - PALAWAN					
Subscore:	**1.732**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.732**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Mammals	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		

BLUE SWIMMING CRAB - PHILIPPINES/WESTERN CENTRAL PACIFIC - POTS - PHILIPPINES - VISAYAN SEA					
Subscore:	**1.732**	**Discard Rate:**	**1.00**	**C2 Rate:**	**1.732**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Mammals	1.00:High Concern	3.00:Moderate Concern	Red (1.732)		

Ingles and Flores (2000) reported that bycatch in the Guimaras Strait and Visayan Sea BSC fishery (bottom-set gillnet) is 57.8% of the total catch. This includes 18 species of brachyurans (*Charybdis feriatus* and other crab species—51.87%), fish (3.81%) and cuttlefish (*Sepia* spp.—2.12%; ibid). Of the brachyuran (included in C2 as "true crabs"), six species are retained due to their marketability, including the Indo-Pacific crucifix crab, *Charybdis feriatus*. Several species of the crab genera Thalamita, Carcinoplax, Calappa, Parthenope, Camposia, and Majidae are discarded (ibid). Univalve molluscs (e.g., *Mirux tribulus* and *Melo boderipii*) are also reported to be discarded (ibid; (BFAR 2012). Additional bycatch species are rays, juvenile sharks, and sponges (BFAR 2012) (Peñol 2017) (Catalayban 2017) (Segurigan 2018) (pers. comm., J. Emlen J. Genio, 2 May 2016). Bycatch composition is not fully realized, since the completed studies have limited geographic coverage; however, they provide us with an indication of the species that are likely encountered in the region.

In the Danajan Bank (Bohol) pilot assessment (PACPI-USAID 2015), bycatch in crab gillnets accounted only for 6% of the total catch, and included fish (stingrays, flatfishes, and other species of reef- and seagrass-associated fish), other crab species (e.g., *Charybdis* spp., *Podophtalmus vigil*, *Scylla* spp., *Thalamita* spp.), and other invertebrates (including the slipper lobster, *Thenus orientalis*, some shells and cuttlefish). No single species accounted for more than 3% of the catch, and none were ETP species. Crab pots caught BSC almost exclusively (ibid).

Bycatch from bottom-set gillnets in the waters of Batad, Iloilo consisted of 14 families of fishes, two families of crustaceans, gastropods and elasmobranchs (Segurigan 2018). Dominant bycatch consisted of two species of flatfish, *Synaptura marginata* (29%) and *Pseudorhombus* sp. (20%; ibid). Other bycatch species included spotted filefish (15%), flathead (5%), other crustaceans, such as sentinel crab, crucifix crab, smooth shelled swimming crab and mantis shrimp (9%), gastropods, such as murex shells and crowned baler (5%), and elasmobranchs (carpet sharks and blue stingrays at 2%.; ibid). The remainder of bycatch identified included threadfin, parrotfish, lizardfish, and spotted stingerfish. All bycatch species, except murex shells and spotted stingerfish, were retained and utilized for human consumption (ibid).

In addition, bycatch from crab traps in Banate Bay consisted of 13 families, 15 genera, and 15 species (Peñol 2017). All fish and invertebrate bycatch were retained, except for mantis shrimp, and no ETP species were

caught (ibid). Crab pots in this area are highly selective in catching BSC, with *Charybdis feriatus* as the only bycatch (Catalayban 2017).

Specifically, ETP species have not been comprehensively identified or assessed at present (there are only data from a few of the major landing sites). Interactions between sea turtles—green, leatherback and hawksbill—and certain gears used to target BSC are reported to occur in the Visayan Sea (Eleserio and Mandreza 2010) and the Eastern Indian Ocean (fishing region within which the Philippines was situated for the study; Wallace, et al. 2010). Bycatch studies typically sample catch that is brought to shore, and it is uncertain whether large marine fauna, such as turtles, are brought back to shore; therefore, they may be under-represented in the data. We have included them as a precautionary measure. Other bycatch in gillnets are usually discarded in a manner that has a low survival rate (e.g., nets are brought onshore to the landing site and/or unwanted crabs are left onshore to ensure they are not caught again (Ingles and Flores 2000) (Romero 2009).

Interactions (accidental entanglement in crab gillnets and crab pot lines) with Irrawaddy dolphins (*Orcaella brevirostris*) in the MIMAROPA region of Malampaya Sound (Palawan) have been reported (Dolar et al. 2002) (Ingles 2003) (Smith et al. 2004) (Gonzales and Matillano 2008)(GMA 2017). The last reported incidental entrapment of an Irrawaddy dolphin occurred in September 2017 (GMA 2017). The local Government Unit, with the help of Kabang Kalikasan Ng Pilipinas (World Wildlife Fund – Philippines) and the Department of Environment and Natural Resources, Malampaya Sound (where the only subpopulation of Irawaddy dolphins in the Philippines reside) is a Land and Seascape Protected Area as per Presidential Proclamation Number 342 by virtue of the National Integrated and Protected Areas System (NIPAS) Act, since July 2000. BSC fished from the outer Malampaya Sound (no BSC fishing in the inner sound) account for a very small portion (<10%) of exported BSC (pers. comm., J. Emlen J. Genio, 17 Aug 2016).

Though it is unknown how many species of concern interact with the BSC fishery, turtles, sharks, and rays are included in this assessment since they are a high conservation concern, have low inherent resilience, lack regional information on stock health and have the potential to be caught in BSC gillnet fisheries. Marine mammals, and corals and sponges are also assessed in the BSC pot fishery for these reasons. Sea turtles, marine mammals, sharks, and rays limit the score for Criterion 2 due to their conservation status.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance

(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality

(same as Factor 1.2 above)

SHARKS

Factor 2.1 - Abundance

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

High Concern

According to the SFW Unknown Bycatch Matrices, sharks have a high stock status concern for bottom-set

gillnet fisheries. Sharks also have high inherent vulnerability according to the SFW criteria. For these reasons, their abundance is ranked "high" concern.

Factor 2.2 - Fishing Mortality

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

High Concern

According to the SFW Unknown Bycatch Matrices, sharks score a 2 out of 5, or "high" concern, for bottom-set gillnet fishing mortality.

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 / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

< 100%

Discards in the gillnet fishery have a lower chance of survival as they are only released after the net is untangled at the landing. Most fish and invertebrates (cephalopods and crustaceans) caught in gillnets are retained for human consumption (in households or sold in markets; (pers. comm., J. Emlen J. Genio, 17 August 2016). Bycatch with low commercial value are discarded in relatively small quantities (e.g., 15% of bycatch species—and murex shells—in Batad, Iloilo (Segurigan 2018), and 24.7% of bycatch species in Leyte Bay (Gonzales and Montecarlo 2017). Since discards appear to be relatively low, we have used a multiplying factor of 1, based on SFW criteria.

Discards from the pot fishery, of which there are significantly fewer, have higher survival rates because they are released at sea. Crab pots use small amounts of low value fishes as bait, e.g. *Apogon lineatus*, as well as squid and mussels. In a few areas, fishermen use pest snails (pers. comm., J. Emlen J. Genio, 16 Aug 2016). In a study from Banate Bay, crab traps caught only 15 bycatch species, of which all were retained for human consumption, except mantis shrimp (Peñol 2017). Due to the above, we have used a multiplying factor of 1, based on SFW criteria.

RAYS

Factor 2.1 - Abundance

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

High Concern

According to the SFW Unknown Bycatch Matrices, rays have a high stock status concern for bottom-set gillnet fisheries. Rays also have high inherent vulnerability according to the SFW criteria. For these reasons, their abundance is ranked "high" concern.

Factor 2.2 - Fishing Mortality

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

High Concern

According to the SFW Unknown Bycatch Matrices, rays score a 2 out of 5, or "high" concern, for bottom-set gillnet fishing mortality.

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 / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

< 100%

Discards in the gillnet fishery have a lower chance of survival as they are only released after the net is untangled at the landing. Most fish and invertebrates (cephalopods and crustaceans) caught in gillnets are retained for human consumption (in households or sold in markets; (pers. comm., J. Emlen J. Genio, 17 August 2016). Bycatch with low commercial value are discarded in relatively small quantities (e.g., 15% of bycatch species—and murex shells—in Batad, Iloilo (Segurigan 2018), and 24.7% of bycatch species in Leyte

Bay (Gonzales and Montecarlo 2017). Since discards appear to be relatively low, we have used a multiplying factor of 1, based on SFW criteria.

Discards from the pot fishery, of which there are significantly fewer, have higher survival rates because they are released at sea. Crab pots use small amounts of low value fishes as bait, e.g. *Apogon lineatus*, as well as squid and mussels. In a few areas, fishermen use pest snails (pers. comm., J. Emlen J. Genio, 16 Aug 2016). In a study from Banate Bay, crab traps caught only 15 bycatch species, of which all were retained for human consumption, except mantis shrimp (Peñol 2017). Due to the above, we have used a multiplying factor of 1, based on SFW criteria.

MAMMALS

Factor 2.1 - Abundance

PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, VISAYAN SEA

High Concern

Marine mammals are considered highly vulnerable according to the SFW criteria; therefore an abundance score of "high" concern is given.

Factor 2.2 - Fishing Mortality

PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, VISAYAN SEA

Moderate Concern

It is unlikely that marine mammals such as dugong are retained. Marine mammal fishing mortality is scored as a "moderate" concern, since there are no known interactions, as well as limited monitoring; however, there is insufficient evidence to support a "low" concern or to remove them from the report entirely.

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 / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, VISAYAN SEA

< 100%

Discards in the gillnet fishery have a lower chance of survival as they are only released after the net is

untangled at the landing. Most fish and invertebrates (cephalopods and crustaceans) caught in gillnets are retained for human consumption (in households or sold in markets; (pers. comm., J. Emlen J. Genio, 17 August 2016). Bycatch with low commercial value are discarded in relatively small quantities (e.g., 15% of bycatch species—and murex shells—in Batad, Iloilo (Segurigan 2018), and 24.7% of bycatch species in Leyte Bay (Gonzales and Montecarlo 2017). Since discards appear to be relatively low, we have used a multiplying factor of 1, based on SFW criteria.

Discards from the pot fishery, of which there are significantly fewer, have higher survival rates because they are released at sea. Crab pots use small amounts of low value fishes as bait, e.g. *Apogon lineatus*, as well as squid and mussels. In a few areas, fishermen use pest snails (pers. comm., J. Emlen J. Genio, 16 Aug 2016). In a study from Banate Bay, crab traps caught only 15 bycatch species, of which all were retained for human consumption, except mantis shrimp (Peñol 2017). Due to the above, we have used a multiplying factor of 1, based on SFW criteria.

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 / Western Central Pacific | Gillnets and entangling nets (unspecified) | Philippines | Palawan	Ineffective	Ineffective				Red (1.000)
Fishery 2: Philippines / Western Central Pacific | Gillnets and entangling nets (unspecified) | Philippines | Visayan Sea	Ineffective	Ineffective				Red (1.000)
Fishery 3: Philippines / Western Central Pacific | Pots | Philippines | Palawan	Ineffective	Moderately Effective	NA	NA	NA	Red (1.000)

Fishery 4: Philippines / Western Central Pacific | Pots | Philippines | Visayan Sea	Ineffective	Moderately Effective	NA	NA	NA	Red (1.000)

Criterion 3 Assessment

Factor 3.1 - Management Strategy and Implementation

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

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, VISAYAN SEA

Ineffective

The BSC Management Plan, officially adopted in 2013, is the framework of regulatory measures for the proper management of the BSC fisheries in the Philippines (BFAR 2012). It lists the long- and short-term objectives, details the management framework, presents information on the fishery, the processing sector, the legal and policy context, details and implementation framework, which includes information on research and development, monitoring, stock enhancement, and socio-economics, and introduces forthcoming regulations. Section 4 of the Management Plan defines the roles and responsibilities of the BFAR, BFAR Regional Field Offices, the National Fisheries Research and Development Institute (NFRDI), the Southeast Asian Fisheries Development Centre Aquaculture Department (SEAFDEC-AQD), Academe, LGUs, NGOs, PACPI and fishers (ibid).

There are rules and regulations implemented through the FAOs (by BFAR; management process summarized in Figure 15 and Justification section) for the proper utilization and conservation of Philippine BSC and judicial fines and penalties for violations of these rules. They are 1) a minimum carapace width of 10.2cm for catching, collecting and trading BSC; 2) a minimum mesh size for certain gears: crab entangling/gillnets and liftnets (11 cm and 3 cm stretch mesh, respectively) and crab pots/traps (5 cm minimum hole diameter); 3) closed seasons imposed by LGUs, in consultation with the FARMC (Fisheries and Aquatic Resources Management Council) based on scientific data collected from NFRDI (National Fisheries Research and Development Institute), BFAR/NSAP (National Stock Assessment Program) and other research institutions/agencies/academia; and, 4) prohibition on catching, possessing or trading berried BSC (ROP DOA 2014). Additionally, if required, the Secretaries of the DA and DILG may issue regulations on any or all of the following: 1) the number of registered crab fishers allowed to operate in the BSC fishery in any area of Philippine waters; 2) the number of crab pots/traps allowed per boat/banca; 3) the length/depth and number of nets a fisher could own and operate; and 4) specific closed fishing season for BSC by municipality (ibid). It is unlawful to transport BSC without a valid auxiliary invoice and LTP (local transport permit). Violation of the regulation is punishable with a fine amounting to $4.5 to $ 445.0 and imprisonment of six months to two

years, depending on the type and severity of violation (ibid). Fishing is prohibited in areas that are declared as overexploited, as well as during closed seasons. It is prohibited to catch species that are identified as threatened (as listed in CITES and determined by the Department) (Sections 88, RA 8550).

All persons, associations or corporations engaged in buying, selling, and processing BSC are required to keep a log sheet showing the daily transactions, consisting of: 1) the name/s and address/es of fishers, buyers, or sellers; 2) date of purchase; 3) size of BSC; 4) quantity (in kg); 5) fishing gear used; and 6) the place of origin (fishing ground) and market destination (ROP DOA 2014).

In January 2014, the DA published a Joint Administrative Order (JAO) "Regulation for the conservation of blue swimming crab (*Portunus pelagicus*)" (ROP DOA 2014). This JAO took effect on February 18, 2014 and provides the legal framework with which to implement the rules and regulations of the BSC Management Plan. In addition to the JAO, a Technical Working Group (TWG) was established in 2014, in support of the implementation of Joint Administrative Order No. 1 Series of 2014 on the Regulation for the Conservation of BSC (now amended as Fisheries Office Order No. 166 Series of 2018; (pers. comm., Marinelle XX, 17 August 2018).

Palawan, in particular, recently revised the TayTay Fishery Ordinance in order to update rules and regulations for the fishery commodities. During this revision, the BSC Administrative Order was incorporated. The policies in the draft Fishery Code include: 1) minimum catch/processable size of 11 cm CW; 2) no collection or trading of berried/gravid crabs; 3) minimum mesh size of 5 cm for crab pots, but no minimum valve diameter; 4) minimum mesh size of 10 cm for gillnets (must be single-layered) with a maximum length of 500 m (Fisheries Code of Taytay, Palawan, 2017, Section 3.19).

A recent stock assessment around Bantayan Island found that the measures set forth in the national management plan were not being implemented effectively; ensuring effective implementation of the management plan was identified as one of the major recommendations by the assessment group (PACPI 2017). One of the measures that appears to be poorly enforced or implemented is the minimum landing size (MLS); in Bantayan all gears were found to catch and land crab below the minimum landing size with most undersized crab landed in the hand collection fishery (PACPI 2017). It is concerning that, although a management plan has been drafted and adopted, it does not appear to be implemented effectively.

Although BSC-specific management measures are in place, there is uncertainty regarding the effective implementation of the management measures. The BSC stock has not been maintained at a sustainable level and is currently being overfished; hence, we have deemed this factor "ineffective."

Justification:

The management and institutional framework of fisheries in the Philippines exists at both the national and local levels, which includes provincial, municipal, and village, or "*barangay,*" sub-levels. The Department of Agriculture (DA) and the Department of Environment and Natural Resources (DENR) are the two main national governmental agencies (NGAs) that take part in fisheries management (FAO 2016b). The Bureau of Fisheries and Aquatic Resources (BFAR), which is an agency within the DA, is the chief agency mandated to manage the Philippine's fisheries sector, and in collaboration with other NGAs, has overall jurisdiction over fisheries and aquatic resources management at the national, regional, and provincial level (BFAR 2012); see Figure 15).

The management measures to be implemented by the BFAR through Fishing Administrative Orders (FAOs) apply to National waters, but in municipal waters, the measures provide assistance (technical/financial) to the Local Government Units (LGUs; (BFAR 2012); see Figure 15). LGUs are mandated to enact ordinances; to enforce fishery laws, rules, regulations, and ordinances; to maintain a registry of municipal fishers, to limit entry into municipal water, and to monitor fishing activities. If a LGU or the DA determines that certain municipal waters are overfished or are in danger of being overfished, the LGU can prohibit and limit fishing

activities (ibid). The LGU is under the Department of Interior and Local Government (DILG); hence, the legal framework is called Joint DA-DILG Administrative Order. At default, the LGU has the sole jurisdiction and authority on municipal waters and BFAR (under DA) over commercial waters. However, since it is a Joint Administrative Order, it gives BFAR the power to enforce regulations even in municipal scale; in this case, they can police fishermen, buyers, processors, wet market vendors, etc.

Small-scale fisheries are managed by LGUs through three organizational entities: village (barangay), municipality/city, and the province at the highest level. The municipal (and city) governments have the mandate to manage "municipal waters" and resources within the territorial boundaries of these municipalities or cities (Perez et al. 2012). The creation of Fisheries and Aquatic Resources Management Councils (FARMCs) for the provincial, municipal, and village levels, established under FAO No. 196, s. of 2000, institutes a legal commitment by the government to involve stakeholders (fishers and other resource users) in the development and management of the fisheries industry (REF).

The Philippine BSC fisheries operate under the Philippine Fisheries Code (Republic Act 8550) of 1989, the Agriculture and Fisheries Modernization Act (AFMA) (RA 8435) of 1989, and the Local Government Code (LGC) (RA 7160) of 1991. To ensure the detailed implementation of the Fisheries Code (see Sec. 2, RA 8550), BFAR issues FAOs. FAOs that are relevant to BSC fisheries as identified by BFAR (2012) are as follows:

FOO 233. Creation of a National Technical Working Group (TWG) for the Blue Swimming Crab Industry. 06/02/2009

FAO 155. Regulating the use of fine-meshed nets in fishing. 06/23/1986

FAO 155-1. Amending Section 2 of Fisheries Administrative Order (FAO) No. 155, regulating the use of fine meshed nets in fishing. 06/23/1994

FAO 222. Regulations on the operation of Modified Danish seine. 10/30/03

FAO 201. Ban of fishing with active gear. 01/23/2000

FAO 233. Aquatic Wildlife Conservation. 04/16/2010 Department of Agriculture Administrative Order No. 1, 2004. Guidelines on the delineation of municipal waters.

Republic Act No. 7160 – Local Government Code of 1991 further devolves the management of the municipal fisheries waters (within the 15 km radius from the shoreline) to the local government units covering the area.

Executive Order No. 305 – Devolving to Municipal and City Governments the Registration of Fishing Vessels Three (3) Gross Tonnage Below

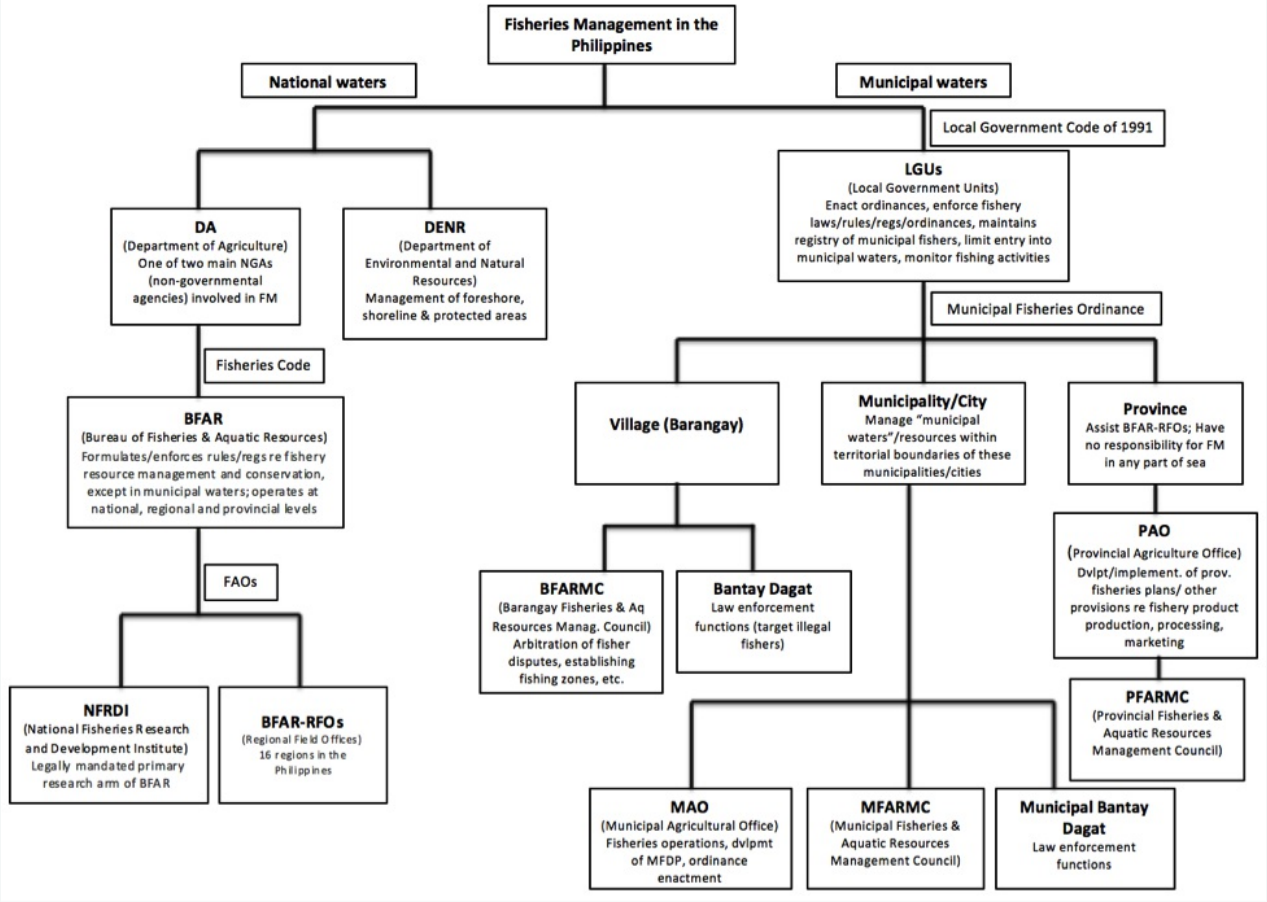

Figure 12 Flow chart of fisheries management in the Philippines.

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 / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

Ineffective

There are general BSC regulations that indirectly apply to bycatch (such as mesh size specifications and closed seasons/areas), but at this time, there are only a few bycatch-specific management measures in place for the Philippine BSC fishery.

Because crab pots usually have a bycatch rate of <8%, compared to other gears, which tend to have bycatch rates >40%, crab pots are being incentivized in one area (Danajon Bank) as a pilot project to reduce overall bycatch in the BSC fisheries (PACPI 2017b). Liftnets, which only account for 1% of bycatch relative to total catch (consisting primarily of other crab species), but are exploitative of juvenile BSC because of where they are fished, have also been eliminated (PACPI 2015). There was a piloted gear-swap program, liftnets for crab

pots in Danajon Bank, Bohol in 2015, but this attempt was not successful because fishers reported very low or no catch at all (pers. comm., M. Espino, 17 August 2018). A second trial gear-swap was attempted in 2017 using modified crab pots (reduced mesh size) and collapsible traps. The data are yet to be analyzed (PACPI 2017b). The plan is to extend this gear swap and liftnet removal into the more critical fishing areas, e.g., Cebu in the Visayan Sea (ibid).

To address the issue of Irrawaddy dolphin interactions with Phil. BSC fishery gear in Palawan, the local Government Unit, with the help of Kabang Kalikasan ng Pilipinas (World Wildlife Fund – Philippines) and the Department of Environmental and Natural Resources, Malampaya Sound (where the only subpopulation of Irrawaddy dolphins in the Philippines reside) is a Land and Seascape Protected Area as per Presidential Proclamation Number 342 by virtue of the National Integrated and Protected Areas System (NIPAS) Act (ROP 2000). However, the protected area management plan for MSPLS was only drafted and updated in 2012. It will be amended to update marine zones (Mancio 2017). To address concerns associated with the capture of dolphins in the area, a collaborative project between PACPI, DENR-CENRO (Department of Environment and Natural Resources -Community Environment and Natural Resources Office Taytay, Palawan), and WWF-Philippines aims to train fishers in the region on effective rescue and response for entangled and standed dolphins (pers. comm., M. Espino, 9th December 2018). Other protected areas declared as NIPAS sites where BSC are fished, include the Turtle Islands of Tawi-Tawi (not included in this report) and Bantayan Island (ROP 1994).

It has been reported that gillnets (most commonly) are discarded along beaches and lost offshore. Ingles and Flores (2000) found that 24% of gillnets used in the BSC fishery off the northwestern coast of the island of Negros in the Guimaras Strait and Visayan Sea are lost each year. The lost gear continues to catch a range of species and can cause incidental mortality of marine mammals and marine turtles, accumulation on/damage to the seabed and coral reefs, and the contamination of beaches. To address gillnet ghost fishing, the Zoological Society of London (ZSL) is implementing a project called Net-Works, where discarded gillnets are collected and converted into carpet tiles to provide supplemental income. ZSL's study areas include Danajon Reef (Bohol) and the Visayan Sea (Bantayan Island, 2 municipalities in Northern Iloilo and now expanding to 1 area in Negros; ZSL 2015). Gillnets in these areas target primarily BSC, as it is along municipal waters. This project is carried out independently by ZSL, although PACPI is in discussions with ZSL to partner in order to specifically address the BSC fishery (pers. comm., J. Emlen J. Genio, 10 August 2016). Lost crab pots, on the other hand, are less of an environmental hazard because they are made of biodegradable bamboo and decompose completely within 3 to 5 months (BFAR 2012). An amendment to the blue swimming crab management plan and JAO to address ghost fishing is expected in the near future (pers. comm., M. Espino, 9th December 2018).

In addition, it is unclear as to whether sea turtles, which are ETP species, are commonly caught as bycatch in the gillnet fishery. Because there are measures in place to address ghost fishing by gillnets, but bycatch information/management regarding sharks, rays and sea turtles is unknown, this factor is scored as "ineffective" for the gillnet fishery.

PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, VISAYAN SEA

Moderately Effective

There are general BSC regulations that indirectly apply to bycatch (such as mesh size specifications and closed seasons/areas), but at this time, there are only a few bycatch-specific management measures in place for the Philippine BSC fishery.

Because crab pots usually have a bycatch rate of <8%, compared to other gears, which tend to have bycatch

rates >40%, crab pots are being incentivized in one area (Danajon Bank) as a pilot project to reduce overall bycatch in the BSC fisheries (PACPI 2017b). Liftnets, which only account for 1% of bycatch relative to total catch (consisting primarily of other crab species) but are exploitative of juvenile BSC because of where they are fished, have also been eliminated (PACPI 2015). There was a piloted gear-swap program, liftnets for crab pots in Danajon Bank, Bohol in 2015, but this attempt was not successful because fishers reported very low or no catch at all (pers. comm., M. Espino, 17 August 2018). A second trial gear-swap was attempted in 2017 using modified crab pots (reduced mesh size) and collapsible traps. The data are yet to be analyzed (PACPI 2017b). The plan is to extend this gear swap and liftnet removal into the more critical fishing areas, e.g., Cebu in the Visayan Sea (ibid).

To address the issue of Irrawaddy dolphin interactions with Philippine BSC fishery gear in Palawan, the local Government Unit, with the help of Kabang Kalikasan Ng Pilipinas (World Wildlife Fund – Philippines) and the Department of Environmental and Natural Resources, Malampaya Sound (where the only subpopulation of Irrawaddy dolphins in the Philippines reside) is a Land and Seascape Protected Area as per Presidential Proclamation Number 342 by virtue of the National Integrated and Protected Areas System (NIPAS) Act (ROP 2000). However, the protected area management plan for MSPLS was only drafted and updated in 2012. It will be amended to update marine zones (Mancio 2017). Other protected areas declared as NIPAS sites where BSC are fished, include the Turtle Islands of Tawi-Tawi (not included in this report) and Bantayan Island (ROP 1994).

With respect to ghost fishing, lost crab pots are less of an environmental hazard (than gillnets, for example) because they are made of biodegradable bamboo and decompose completely within 3 to 5 months (BFAR 2012).

Bycatch management for the crab pot fishery is scored as "moderately effective." No mitigation measures are needed for ghost fishing, and no ETP species are caught as bycatch. However, though there is only a small amount of bycatch (<8%), it is not sufficiently low enough to consider it a highly selective fishery, retained finfish or invertebrates are likely unmanaged, and the effectiveness of the protections in place in Malampaya Sound are uncertain (and fishing activity is just limited to certain gears).

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 / Western Central Pacific / Pots / Philippines / Palawan	3	+0.5	Moderate Concern	Green (3.240)
Philippines / Western Central Pacific / Pots / Philippines / Visayan Sea	3	+0.5	Moderate Concern	Green (3.240)
Philippines / Western Central Pacific / Gillnets and entangling nets (unspecified) / Philippines / Palawan	3	+0.5	Moderate Concern	Green (3.240)
Philippines / Western Central Pacific / Gillnets and entangling nets (unspecified) / Philippines / Visayan Sea	3	+0.5	Moderate Concern	Green (3.240)

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 / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, VISAYAN SEA

3

Most BSC fishing for crab pots and bottom-set gillnets is reported to be across sandy and muddy substrates, since mature crabs are most commonly found in these habitats (BFAR 2012) (PACPI 2015). According to the SFW criteria, crab pots and bottom-set gillnets fished over sand/mud (not on rocky reef/boulder and corals) are scored a 3 out of 5.

Justification:

Some gears, such as liftnets (not included in this report), are operated in relatively nearshore and shallow waters—often near rivermouths or in shallow muddy and seagrass beds. Although vulnerable habitats, such as mangrove areas and coral reefs, are found in the region they are not fished, as BSC are found on muddy/sandy habitats.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, VISAYAN SEA

+0.5

There are no gear-specific modifications to reduce impacts to the seafloor; however there are a number of protected areas throughout the Philippines. Under the NIPAS Act, there are 22 protected landscape/seascape areas, 3 protected seascape areas, and 2 marine reserves (not under NIPAS; (La Vina et al. 2010)). Among these are Malampaya Sound (in Palawan), the Turtle Islands of Tawi-Tawi, and Bantanyan Island, where BSC fishing takes place. The Fisheries Code (not the NIPAS Act) provides the framework for local legislation to establish marine protected areas and sanctuaries. It mandates that 25%, but not more than 40% of bays, foreshore lands, continental shelves, or any fishing ground shall be set aside for the cultivation of mangroves to strengthen the habitat and spawning grounds of fish. Commercial fishing is not allowed in these areas. In addition, LGUs (in consultation with the FARMCs) are given the mandate to designate at least 15% of its coastal areas as fish sanctuaries and refuges (Sec. 81, RA 8550). For these reasons, we have deemed this factor "moderate mitigation."

Factor 4.3 - Ecosystem-Based Fisheries Management

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, POTS, PHILIPPINES, VISAYAN SEA

Moderate Concern

BSC are often considered opportunistic, bottom-feeding carnivores and scavengers. They primarily consume various sessile and slow-moving prey such as, worms, mollusks, and crustaceans (Batoy et al.1987), as well as smaller fish, but not much is known about the role of BSC as prey in Philippine waters. In Australia, BSC are prey to turtles, sharks, rays, large fish, birds and other BSC (GWA DOF 2011). Intense fishing pressure on BSC could alter the trophic structure and species composition by reducing predation on crab prey, and/or by reducing food for higher-level predators.

The full extent of the BSC fishery impacts on the ecosystem is also not well known. Effects of the fishery on the ecosystem are thought to include ghost fishing (gillnets in particular), and traps without escape vents (which could allow small incidental species and juvenile crabs to escape if utilized). In addition, it is unclear whether ETP species such as sea turtles are commonly caught in the gillnet fishery.

However, the USAID/ECOFISH Project however**,** seeks to increase BSC fisheries biomass and employment primarily through the promotion and institutionalization of an Ecosystem Approach to Fisheries Management (EAFM) under a Growth-Control-Maintenance framework (PACPI 2015). Specifically, ECOFISH will facilitate the right-sizing of fishing efforts through scientific assessments, policy support, and livelihood support (ibid).

Because the Philippine BSC fishery's impact on the ecosystem is unknown (but currently being studied), the likelihood of trophic cascades is a possibility, and there are currently no measures in place for the fishery to ensure that serious or irreversible harm is not caused to ecosystem structure and function; therefore, we have deemed this factor "moderate" concern.

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Appendix A: Extra By Catch Species

IRRAWADDY DOLPHIN

Factor 2.1 - Abundance

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN

High Concern

Irrawaddy dolphins in the Malampaya Sound are listed as "Critically Endangered" on the IUCN Redlist (IUCN 2016), due to their low numbers, limited ranges, and decreasing population trend. Therefore, their abundance is of "high" concern.

Justification:

Irrawaddy dolphins inhabit the inner sound of Malampaya, where over 100 crab fishers are reported to fish (PACPI 2016a). The last recorded interaction with Irrawaddy dolphins was in September 2017 (GMA 2017). There is a growing awareness of the communities around Malampaya on the importance of the Irrawaddy (pers. comm., J. J. Emlen Genio, 5 December 2016). There are also ongoing awareness campaigns, and the month of July was declared Irrawaddy Dolphin Celebration Month by the virtue of the Malampaya Sound Protected Landscape and Seascape (MSPLS) PAMB (Protected Area Management Board) Resolution no. 13, series of 2013 (ROP DENR 2016).

Factor 2.2 - Fishing Mortality

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN

Moderate Concern

Fishing mortality of Irrawaddy dolphins is low in Malampaya Sound, and the number of dolphin entanglement incidents have been declining as compared to incidents before 2011. The last recorded interaction with BSC fishing gear was in 2017 (one individual) (GMA 2017). There is a high level of overlap of BSC and Irrawaddy dolphin habitat, and reporting is reliant on fishers self-reporting, as well as the Protected Area Office, which monitors dolphin bycatch (Mancio 2017). Therefore, we have rated this factor "moderate" concern.

Justification:

Various conservation efforts have been initiated by WWF-Philippines, Local Government Units, and the Department of Environment and Natural Resources (DENR). Conservation efforts of WWF include communication campaigns, collaborative work to reduce use of fishing gears and regular monitoring and reporting of dolphin bycatch. Though the later was not sustained due to financial constraints, the activity is being continued by the Protected Area Office, even with limited funds (Mancio 2017). The Malampaya Sound Protected Landscape and Seascape (MSPLS) was proclaimed as a protected area in July 2000 under the National Integrated Protected Areas System (NIPAS; Republic Act 7586) (Proclamation No. 342). The inner Malampaya Sound was identified as a critical habitat for Irrawaddy dolphins. However, this is yet to be incorporated in marine zoning into the MSPLS management plan (Mancio 2017). Also, the zoning for resource use, especially fisheries vis-à-vis dolphin habitat range, still needs to be addressed (Matillano 2013).

Factor 2.3 - Discard Rate

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN

< 100%

Discards in the gillnet fishery have a lower chance of survival as they are only released after the net is untangled at the landing. Most fish and invertebrates (cephalopods and crustaceans) caught in gillnets are retained for human consumption (in households or sold in markets; (pers. comm., J. Emlen J. Genio, 17 August 2016). Bycatch with low commercial value are discarded in relatively small quantities (e.g., 15% of bycatch species—and murex shells—in Batad, Iloilo (Segurigan 2018), and 24.7% of bycatch species in Leyte Bay (Gonzales and Montecarlo 2017). Since discards appear to be relatively low, we have used a multiplying factor of 1, based on SFW criteria.

Discards from the pot fishery, of which there are significantly fewer, have higher survival rates because they are released at sea. Crab pots use small amounts of low value fishes as bait, e.g. *Apogon lineatus*, as well as squid and mussels. In a few areas, fishermen use pest snails (pers. comm., J. Emlen J. Genio, 16 Aug 2016). In a study from Banate Bay, crab traps caught only 15 bycatch species, of which all were retained for human consumption, except mantis shrimp (Peñol 2017). Due to the above, we have used a multiplying factor of 1, based on SFW criteria.

SEA TURTLES

Factor 2.1 - Abundance

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

High Concern

Sea turtles are listed as endangered or threatened throughout the world (NOAA 2016), and are therefore scored as "high" concern using the SFW criteria.

Justification:

Six of the seven worldwide sea turtle species are found in BSC fishing regions (SWOT 2016). A review by Wallace, et al. (2010) found that sea turtles are caught as bycatch in longlines, gillnets, and trawls in BSC fishing regions. It is unknown how many sea turtles are actually caught as bycatch in the gillnet fisheries, but their vulnerability and the potential for them to be caught includes them in this analysis.

Factor 2.2 - Fishing Mortality

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

Moderate Concern

According to the SFW Unknown Bycatch Matrices, bottom-set gillnet fisheries in Southeast Asia, sea turtles are scored as 1 out of 5, or "high" concern, for fishing mortality. However, since bottom-set crab nets are

fished close to the bottom, as opposed to horizontally, moderate concern is appropriate here (we do not know the impact, as studies may not fully capture the risk to turtles as described in the sythesis above).

Justification:

Of the Philippine BSC bycatch studies completed to date, none had sea turtle bycatch (Peñol 2017) (Catalayban 2017) (Segurigan 2018).

Factor 2.3 - Discard Rate

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

< 100%

Discards in the gillnet fishery have a lower chance of survival as they are only released after the net is untangled at the landing. Most fish and invertebrates (cephalopods and crustaceans) caught in gillnets are retained for human consumption (in households or sold in markets; (pers. comm., J. Emlen J. Genio, 17 August 2016). Bycatch with low commercial value are discarded in relatively small quantities (e.g., 15% of bycatch species—and murex shells—in Batad, Iloilo (Segurigan 2018), and 24.7% of bycatch species in Leyte Bay (Gonzales and Montecarlo 2017). Since discards appear to be relatively low, we have used a multiplying factor of 1, based on SFW criteria.

Discards from the pot fishery, of which there are significantly fewer, have higher survival rates because they are released at sea. Crab pots use small amounts of low value fishes as bait, e.g. *Apogon lineatus*, as well as squid and mussels. In a few areas, fishermen use pest snails (pers. comm., J. Emlen J. Genio, 16 Aug 2016). In a study from Banate Bay, crab traps caught only 15 bycatch species, of which all were retained for human consumption, except mantis shrimp (Peñol 2017). Due to the above, we have used a multiplying factor of 1, based on SFW criteria.

TRUE CRABS

Factor 2.1 - Abundance

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

Moderate Concern

Benthic invertebrates are ranked as "moderate" concern for abundance based on SFW criteria.

Justification:

Eighteen different species of brachyuran crabs are caught with BSC; several species of the crab genera Thalamita, Carcinoplax, Calappa, Parthenope, Camposia, and Majidae are discarded. Crucifix crab, *Charybdis feriatus*, comprise >5% of total BSC catch and are retained. The most recent stock assessment of the crucifix crab, *Charybdis feriatus*, in San Miguel Bay in the Philippines (data from 2011 to 2013) implies that *C. feriatus* is currently overfished (Nieves et al. 2015).

Factor 2.2 - Fishing Mortality

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

Moderate Concern

Benthic invertebrates are ranked as 3 out of 5, or "moderate" concern for bottom gillnets, and a 3.5 out of 5 for traps, or "low" concern, according to the SFW Unknown Bycatch Matrices.

Justification:

The 2015 stock assessment of crucifix crab indicated that population parameters showed exploitation rate (E) for *C. feriatus* exceeded the optimum exploitation of E = 0.5 (0.69), implying excessive fishing effort and heavily exploited stocks (Nieves et al. 2015). Approx. 14% of gravid females are harvested monthly, which may contribute to recruitment overfishing (ibid).

Factor 2.3 - Discard Rate

PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, PALAWAN
PHILIPPINES / WESTERN CENTRAL PACIFIC, GILLNETS AND ENTANGLING NETS (UNSPECIFIED), PHILIPPINES, VISAYAN SEA

< 100%

Discards in the gillnet fishery have a lower chance of survival as they are only released after the net is untangled at the landing. Most fish and invertebrates (cephalopods and crustaceans) caught in gillnets are retained for human consumption (in households or sold in markets; (pers. comm., J. Emlen J. Genio, 17 August 2016). Bycatch with low commercial value are discarded in relatively small quantities (e.g., 15% of bycatch species—and murex shells—in Batad, Iloilo (Segurigan 2018), and 24.7% of bycatch species in Leyte Bay (Gonzales and Montecarlo 2017). Since discards appear to be relatively low, we have used a multiplying factor of 1, based on SFW criteria.

Discards from the pot fishery, of which there are significantly fewer, have higher survival rates because they are released at sea. Crab pots use small amounts of low value fishes as bait, e.g. *Apogon lineatus*, as well as squid and mussels. In a few areas, fishermen use pest snails (pers. comm., J. Emlen J. Genio, 16 Aug 2016). In a study from Banate Bay, crab traps caught only 15 bycatch species, of which all were retained for human consumption, except mantis shrimp (Peñol 2017). Due to the above, we have used a multiplying factor of 1, based on SFW criteria.