



Monterey Bay Aquarium Seafood Watch

Blue swimming crab

Portunus pelagicus



© R. Swainston/www.anima.net.au

Thailand: Andaman Sea and Gulf of Thailand

Set gillnets, Pots

Report ID 27944

August 7, 2023

Seafood Watch Standard used in this assessment: Fisheries Standard v3

Disclaimer

All Seafood Watch fishery assessments are reviewed for accuracy by external experts in ecology, fisheries science, and aquaculture. Scientific review does not constitute an endorsement of the Seafood Watch program or its ratings on the part of the reviewing scientists. Seafood Watch is solely responsible for the conclusions reached in this assessment.

Table of Contents

Table of Contents	2
About Seafood Watch	3
Guiding Principles	4
Summary	5
Final Seafood Recommendations	6
Introduction	8
Criterion 1: Impacts on the species under assessment	15
Criterion 1 Summary	15
Criterion 1 Assessments	15
Criterion 2: Impacts on Other Species	19
Criterion 2 Summary	20
Criterion 2 Assessment	23
Criterion 3: Management Effectiveness	29
Criterion 3 Summary	29
Criterion 3 Assessment	30
Criterion 4: Impacts on the Habitat and Ecosystem	36
Criterion 4 Summary	36
Criterion 4 Assessment	36
Acknowledgements	42
References	43
Appendix A: Review Schedule	46
Appendix B: 2023 Update Summary	47
Criterion 1	47
Criterion 2	47
Criterion 3	48

About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental 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. 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.

Seafood Watch's science-based ratings are available at www.SeafoodWatch.org. Each rating is supported by a Seafood Watch assessment, in which the fishery or aquaculture operation is evaluated using the Seafood Watch standard.

Seafood Watch standards are built on our guiding principles, which outline the necessary environmental sustainability elements for fisheries and aquaculture operations. The guiding principles differ across standards, reflecting the different impacts of fisheries and aquaculture.

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.
- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.
- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

Each assessment follows an eight-step process, which prioritizes rigor, impartiality, transparency and accessibility. They are conducted by Seafood Watch scientists, in collaboration with scientific, government, industry and conservation experts and are open for public comment prior to publication. Conditions in wild capture fisheries and aquaculture operations can change over time; as such assessments and ratings are updated regularly to reflect current practice.

More information on Seafood Watch guiding principles, standards, assessments and ratings are available at www.SeafoodWatch.org.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished¹ 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, Seafood Watch develops an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guides and online guide:

Best Choice/Green: Buy first; they're well managed and caught or farmed responsibly.

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

Avoid/Red: Take a pass on these for now; they're caught or farmed 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 ratings for blue swimming crab (*Portunus pelagicus*), which is a large-bodied, benthic crustacean caught by collapsible crab pots and bottom-set gillnets. The Thai blue swimming crab fishery occurs in the Gulf of Thailand and the Andaman Sea.

A recent blue swimming crab stock assessment has been conducted in the Gulf of Thailand, and indicates that the stock in this region is at the target level for management purposes. No recent blue swimming crab stock assessment has been conducted along the Andaman coast—the last assessment was conducted more than 10 years ago and indicated that the stock was not maintained at a level consistent with B_{MSY} , with stock status likely overexploited for the fishery as a whole, and heavily overexploited in coastal areas. The stock is also undergoing overfishing in both the Gulf of Thailand and the Andaman Sea.

Gillnet and pot fisheries retain all bycatch and interact with some species of concern (e.g., sharks, rays, sea turtles, dugongs, mammals, corals, and other biogenic habitats). Several crab species (mud, musk/crucifix, etc.) are also included, because they compose more than 5% of the total catch for pots. Sharks, rays, and sea turtles limit the Criterion 2 score for the gillnet fishery, and marine mammals limit the score for the pot fishery.

There is currently a draft Fishery Management Plan in place for the Thai blue swimming crab fishery, but no limit and target reference points have been defined. Although there are some regulations in place, there are no harvest control rules. Because there are few management measures in place, and those that are in place are not well enforced, management is considered ineffective.

The Thai blue swimming crab fishery has an overall moderate impact on ocean habitats and ecosystems; however, the gillnet and pot fisheries in the Andaman Sea are fished over more-sensitive mixed ground, so they score lower than the fisheries in the Gulf of Thailand. Overall, the gillnet and pot fisheries in the Gulf of Thailand and the Andaman Sea are rated Red.

Final Seafood Recommendations

SPECIES FISHERY	C 1 TARGET SPECIES	C 2 OTHER SPECIES	C 3 MANAGEMENT	C 4 HABITAT	OVERALL	VOLUME (MT) YEAR
Blue swimming crab Andaman Sea or Burma Sea Indian Ocean, Eastern Gillnets and entangling nets Thailand	1.000	1.000	1.000	2.449	Avoid (1.251)	Unknown
Blue swimming crab Gulf of Siam (Gulf of Thailand) Pacific, Western Central Gillnets and entangling nets	1.526	1.000	1.000	3.000	Avoid (1.463)	Unknown
Blue swimming crab Andaman Sea or Burma Sea Indian Ocean, Eastern Pots Thailand	1.000	1.732	1.000	2.449	Avoid (1.435)	Unknown
Blue swimming crab Gulf of Siam (Gulf of Thailand) Pacific, Western Central Pots	1.526	1.732	1.000	3.000	Avoid (1.678)	Unknown

Summary

Blue swimming crab (*Portunus pelagicus*) is a large-bodied, benthic crustacean common throughout the Indo-Pacific. This report covers blue swimming crab caught by collapsible crab pots and bottom-set gillnets in the Gulf of Thailand and the Andaman Sea.

The Red rating for blue swimming crab in both localities is driven by high conservation concerns over stock status; by the impacts on rays, sea turtles, and shark populations (dugongs for bottom-set gillnets); and by management of the fisheries' impacts on crab populations.

Scoring Guide

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

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

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

Good Alternative/Yellow = Final score $>2.2-3.2$, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern², and no more than one Red Criterion, and no Critical scores

Avoid/Red = Final Score ≤ 2.2 , or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

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

Introduction

Scope of the analysis and ensuing recommendation

This report includes recommendations for blue swimming crab (*Portunus pelagicus*), a large-bodied, benthic crustacean caught by collapsible crab traps and bottom-set gillnets. The fisheries occur in the Gulf of Thailand (key recruitment areas are Chanthaburi and Surat Thani; east) and the Andaman Sea (Ranong and Krabi; west).

Species Overview

Blue swimming crab is a brachyuran crab in the Portunidae family. Crabs from this family are usually recognized by their flat, disc-shaped hind legs, which are 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 in Thailand typically between October and December (Banks and Trumble 2012). Female blue crabs mate only during molting, and the male crabs carry and protect them until molting and mating occurs. Blue swimming crab is common throughout the Indo-Pacific in inshore and continental shelf habitats, including sand, mud, algae, and seagrass near reefs and mangrove areas, and is found from the intertidal zone to depths of 70 m (Ingles 1988)(Germano et al. 2006). Blue swimming crab is a focal point of fishery industries in the region, such as in Indonesia, the Philippines, Vietnam, Cambodia, Malaysia, Thailand, India, and Sri Lanka (Figure 1) (Crech et al. 2016), and it is widely found in Thai coastal waters. Blue swimming crab is fished year-round in Thailand, with the peak fishing season from May to September (Banks and Trumble 2012). It matures quickly (in about 1 year), has a short lifespan (about 3 years), and is a partial brooder (Josileen and Menon 2007)(Kangas 2000).

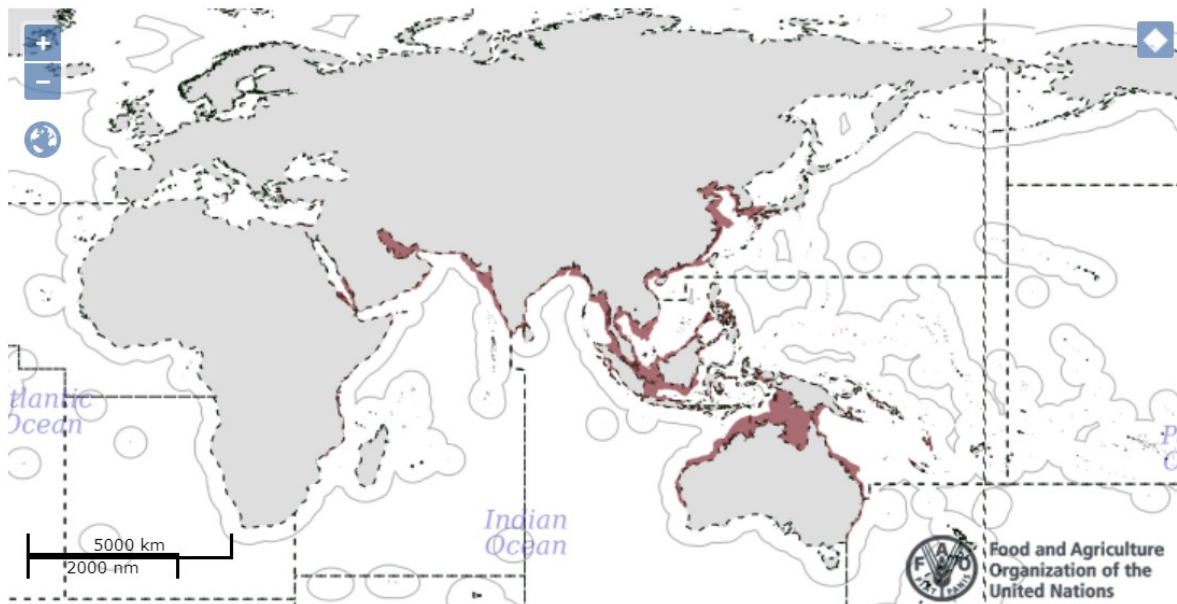


Figure 1: Global distribution of blue swimming crab. Taken from (FAO 2022).

Thai blue swimming crab fishery locations and gear

The major commercial fishing grounds in the Gulf of Thailand are Pattani, Prachuab-Kirikhan, Phetchaburi, Rayong, Surat Thani, Chonburi, Chanthaburi, Chumphon, Nakohn Si Thammarat, Narathiwat, Trat, and Songkhla; coastal activities take place from almost all the Gulf of Thailand provinces, as well as Krabi, Phang Nga, Phuket, Trang, Satun, and Ranong on the Andaman Sea (Figure 2) (Banks and Trumble 2012).



Figure 2: Distribution of blue swimming crab in Thailand. The red asterisk indicates Ban Don Bay (the FIP region). From (MRAG 2018).

The major gears used by Thai fishers are bottom-set gillnets (Figure 3) and crab traps (Figure 4) that are fished using a range of boat sizes, from small coastal boats to larger commercial fleets (Banks and Trumble 2012). Depending on the size of the vessel, gillnets may comprise several tiers of approximately 180 m per tier and 1 to 2 m in depth (Banks and Trumble 2012). For coastal fishers, maximum lengths range from 400 to 2,000 m, and up to eight nets can be deployed at any one time for a soakage period of up to 24 hours. Commercial fishers, on the other hand, deploy one net, which can be up to 5 km in length, over the course of around 40 hours (setting and retrieving). Gillnet mesh size is typically around 6.4 cm (2.5 in) for inshore netters and 8 cm (3.2 in) for offshore commercial vessels (Banks and Trumble 2012). Because the gillnets used closely resemble entangling nets, they have been categorized as “gillnets and entangling nets” in this assessment.

The collapsible crab traps are 30 × 60 × 20 cm and are made of aluminium wire and green nylon net with a mesh size of 1.4 cm. The minimum mesh size limit for trap floors is 2.5 in, but there are no escape vents. Traps are attached to a main rope, which can be up to 1 km in length and has trap intervals of 20 m. During each trip, fishers deploy up to 300 traps in coastal waters and up to 3,500 traps using longboats and up to 4,500 traps using larger commercial vessels in offshore commercial waters (Banks and Trumble 2012). Coastal fishers use bait taken from fish caught in baitfish gillnets, whereas commercial vessels buy Indian mackerel and sometimes mussels (Banks and Trumble 2012). Coastal fishers set traps at depths of 2 to 5 m, usually 3 km from shore, whereas offshore fishers lay traps at depths of 30 to 50 m and distances of 5 to 7 km from shore (Banks and Trumble 2012). Other gears that may be used (but are not included in this report) are otter trawl, pair trawl, shrimp trammel net, and push net; however, trawling is banned in coastal waters.

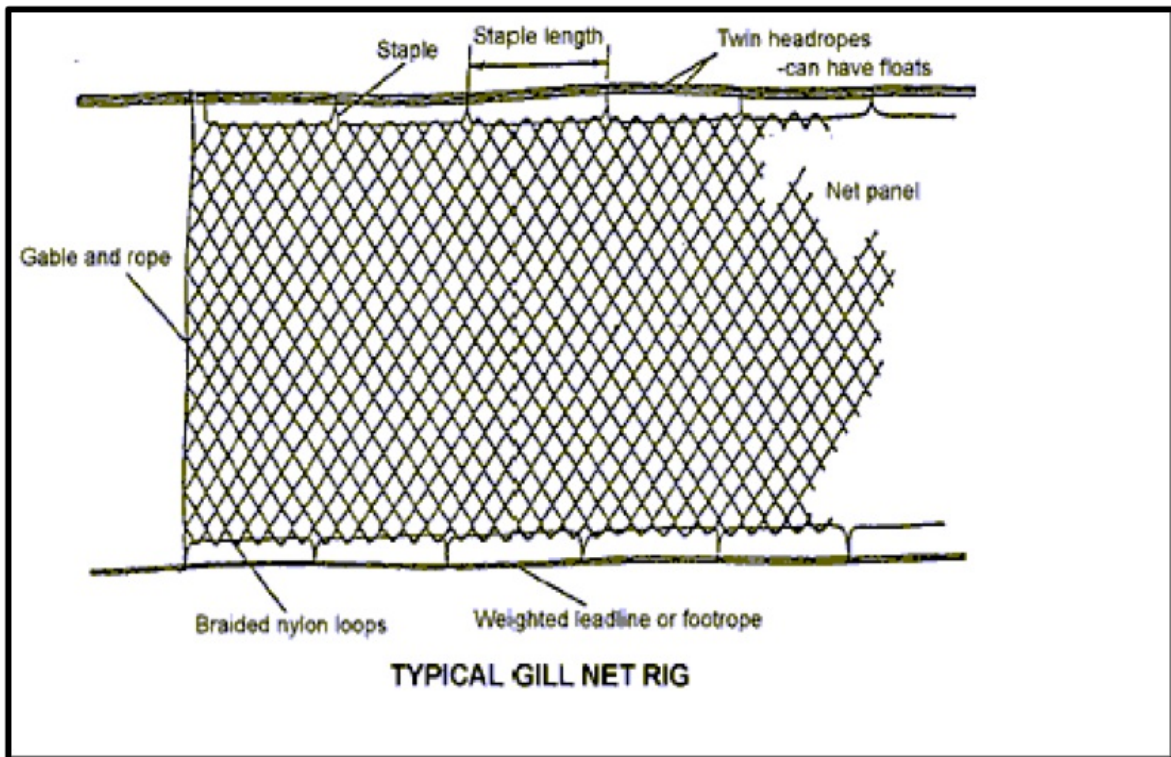


Figure 3: Bottom-set gillnet rig used in the blue swimming crab fisheries. From (Banks and Trumble 2012).



Figure 4: Collapsible trap used in the blue swimming crab fisheries. From (Banks and Trumble 2012).

History of Thai blue swimming crab fishery

In Thailand, when pot gear was introduced from Japan in 1981, fishing for blue swimming crab increased and resulted in decreases in catch per unit effort and crab size, with an increase in sub-adult crab catch {Boutson et al. 2009}. There appear to be two distinct stocks in the Andaman Sea and the Gulf of Thailand, with potentially other genetic distinctions within the Gulf of Thailand (Banks and Trumble 2012).

Management

There is no unified worldwide body that manages fisheries for blue swimming crab. Instead, each country has an individual management system. At the national level in Thailand, the Department of Fisheries (DOF) leads fisheries management (Banks and Trumble 2012). The national government appoints provincial governors and district officers at the provincial and local government levels, respectively, to act as representatives of the DOF. The DOF then delegates to the local authority regarding responsibility for monitoring, control, and enforcement (Banks and Trumble 2012).

Fishery improvement plan (FIP)

The blue swimming crab FIP in Thailand is managed by the Thai Crab Product Group (TCPG), which was formed under the umbrella of the Thai Frozen Foods Association in 2012. TCPG is the industry lead for the Thai blue swimming crab sustainability initiative (NFICC 2016). A Marine Stewardship Council (MSC) pre-assessment was conducted in 2012, and the FIP was initiated in 2013; since then, it has sparked numerous meetings between the Thai Department of Fisheries and the World Wildlife Fund (WWF) on the best ways to address the issues brought forth. A revised action plan to facilitate the FIP implementation has been completed and comprises four strategies: improving information on blue swimming crab fisheries and relevant resources; establishing the direction on blue swimming crab restoration; controlling

inputs to blue swimming crab fisheries; and promoting local participation and responsible blue swimming crab fishing (NFICC 2016). The Thai FIP, in partnership with the WWF, will focus on Ban Don Bay in Surat Thani Province, which is the biggest landing site in Thailand for blue swimming crab (NFICC 2016).

Production Statistics

The increasing global demand for blue swimming crab and its wide distribution throughout the Indo-Pacific makes it 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 until 2018, after which global production has slightly declined (Figure 5) {FAO 2022b}. In 2020, the total global production of blue swimming crab was 251,915 tonnes, of which Thailand contributed about 38,318 tonnes (FAO 2022).

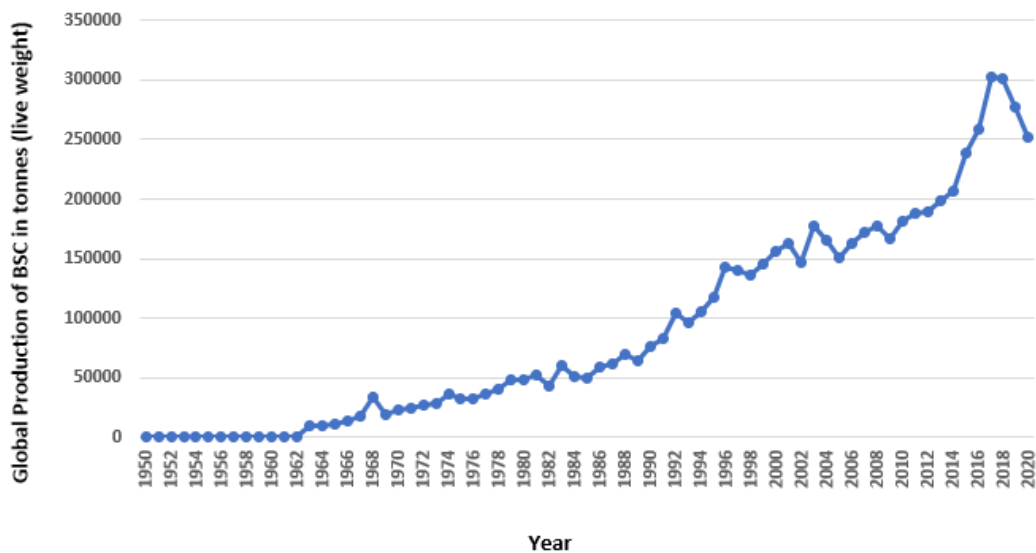


Figure 5: Global production of blue swimming crab in tonnes (live weight). Taken from (FAO 2022).

Importance to the US/North American market.

The United States is an important export destination for pasteurized crabmeat, so the U.S. market drives global blue swimming crab demand (BFAR 2012). Imports of portunid crabs (species not identified) from Thailand into the United States were high in 2008, but have steadily declined since (Figure 6). Thailand is the seventh-ranked major supplier of portunid crab imports to the United States, with Indonesia, the Philippines, China, Vietnam, and India ranking in the top five (Figure 7).

In 2021, 531.08 tonnes of portunid crab (species not identified) were imported into the United States from Thailand (Figure 7), with a value of about USD11.4 million (Figure 8) (NMFS 2022)(NMFS 2022b), which represent 2% of portunid crab U.S. imports by both volume and value (NMFS 2022)(NMFS 2022b).

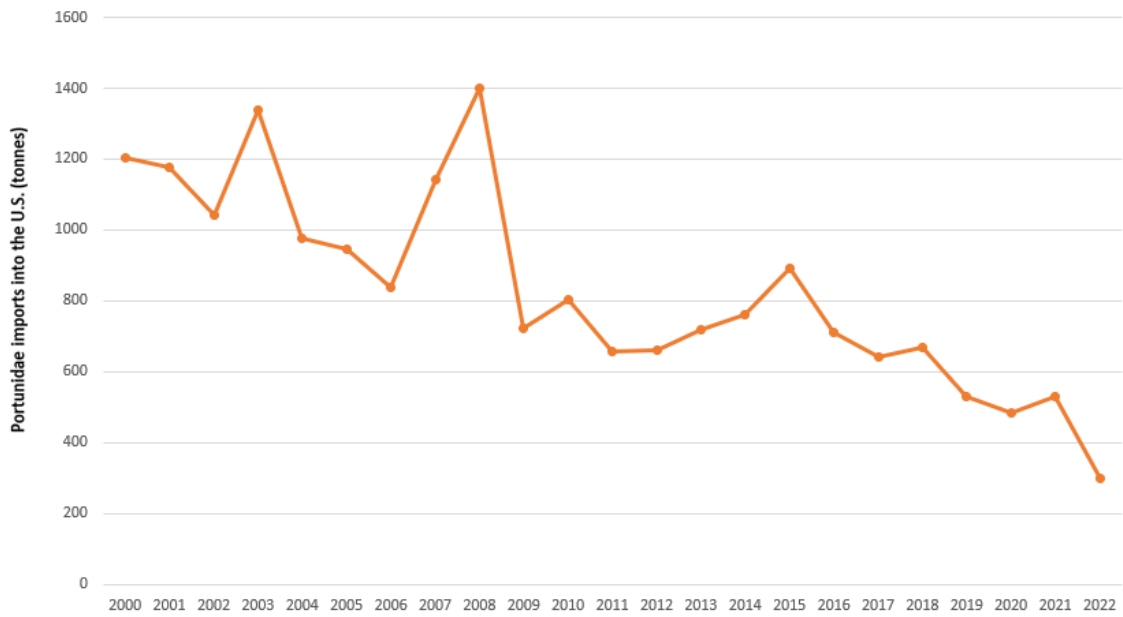


Figure 6: Portunidae (swimming crab) imports into the United States from Thailand by weight (tonnes), from 2000 to 2022. Data from (NMFS 2022b).

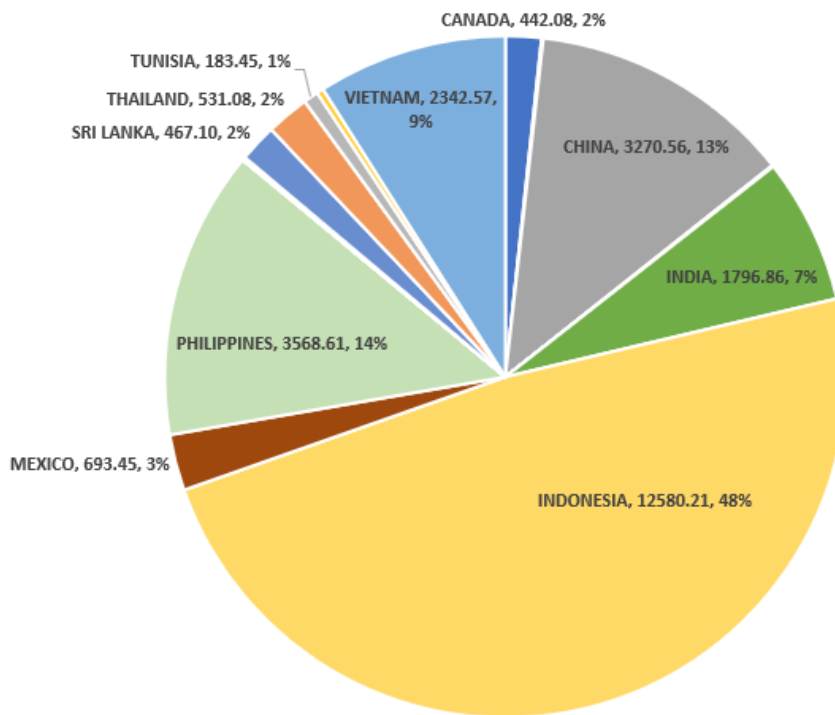


Figure 7: Global portunid crab imports into the United States by weight (tonnes) in 2021. Data from (NMFS 2022).

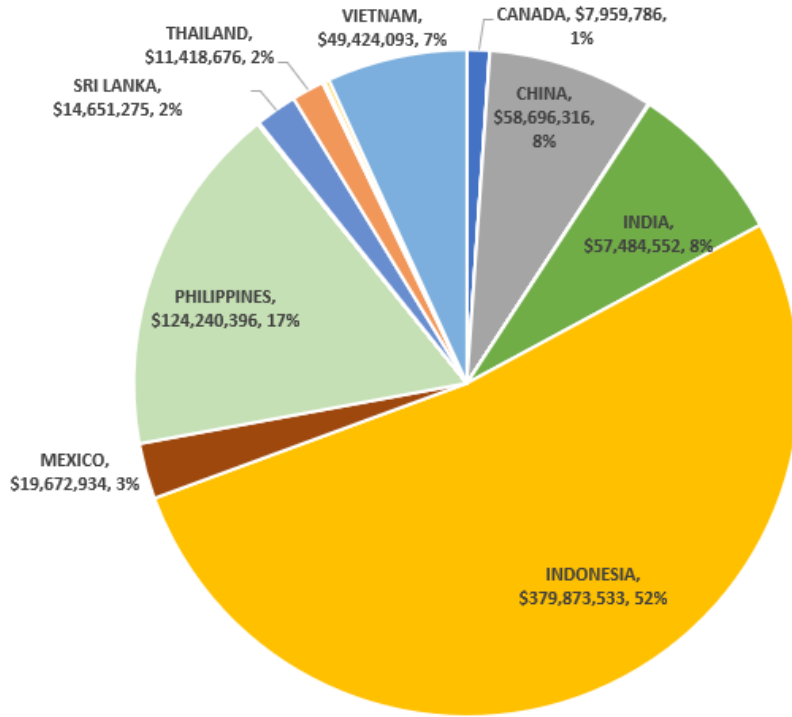


Figure 8: Global portunid crab imports into the United States by value (USD) in 2021. Data from (NMFS 2022).

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, and swimming crab (GWA DOF 2011)(FDA 2016){Fishsource 2016}.

Primary product forms

Portunid crabs are sold interchangeably, and these species can include red swimming crab, blue swimming crab, and others, such as *Portunis sanguinolentus* and *P. trituberculatus* (Lai et al. 2010)(Sea Fare Group 2011). Swimming crab is 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, then brushed clean and cut into two sections. Canned crab is a pasteurized product that involves picking the meat from boiled crabs. Crabmeat 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 the designations 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
Andaman Sea or Burma Sea Indian Ocean, Eastern Gillnets and entangling nets Thailand	1.000: High Concern	1.000: High Concern	Red (1.000)
Gulf of Siam (Gulf of Thailand) Pacific, Western Central Gillnets and entangling nets	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Andaman Sea or Burma Sea Indian Ocean, Eastern Pots Thailand	1.000: High Concern	1.000: High Concern	Red (1.000)
Gulf of Siam (Gulf of Thailand) Pacific, Western Central Pots	2.330: Moderate Concern	1.000: High Concern	Red (1.526)

Criterion 1 Assessments

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

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

High Concern

No updated stock assessment has been conducted from Trang Province on the Andaman Sea coast of Thailand where blue swimming crab is harvested. The last stock assessment from this region was conducted more than 10 years ago (Songrak and Choopunth 2011). Because the stock was previously overfished and there is no updated stock assessment, it is still considered overfished (Banks and Trumble 2012). Hence, abundance has been scored a high concern.

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Moderate Concern

According to the most recent data-limited stock assessments conducted from Surat Thani Province in the Gulf of Thailand, the length-based spawning potential ratio (LB SPR) of the blue swimming crab stock from Ban Don Bay was 37% from data collected in 2020, 46% from data collected in 2021, and 50% from data collected in 2022 (STBSCFIP 2020)(STBSCFIP 2021)(STBSCFIP 2022) (FishChoice 2021). An SPR of 30–40% may be considered a target level for management purposes (Prince et al. 2020), which would warrant a Seafood Watch score of low concern. But, it has been noted that the LB SPR was based on uncertain estimates of natural mortality, and there were uncertainties in the data collected (FishChoice 2021)(Anonymous 2022); hence, the abundance estimate is likely over-optimistic. Further, there is a possibility that the stock has been artificially enhanced by crab banks (FishChoice 2021). For these reasons, an abundance score of moderate concern is given.

Factor 1.2 - Fishing Mortality

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

High Concern

There has been no recent stock assessment in the past 10 years, but because the previous stock assessment of blue swimming crab in Sikao Bay Trang Province (Andaman Sea) indicated that fishing mortality was high at 5.38, with an exploitation rate of 0.77 and an optimum exploitation rate of 0.5 (Songrak and Choopunth 2011), it is assumed that overfishing is still taking place. Thus, fishing mortality is deemed a high concern.

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

High Concern

A recent update from Surat Thani Province in the Gulf of Thailand indicates that the fishing mortality was 3.75/year (STBSCFIP 2020b). Results of the Thompson and Bell analysis from FISAT-II of blue swimming crab from Ban Don Bay showed that the current fishing level (at f-factor = 1) had slightly exceeded the level of maximum sustainable yield (at f-factor = 0.9) (Figure 9) (STBSCFIP 2020b), which indicates that the fishery is experiencing overfishing. Hence, fishing mortality has been scored a high concern.

Justification:

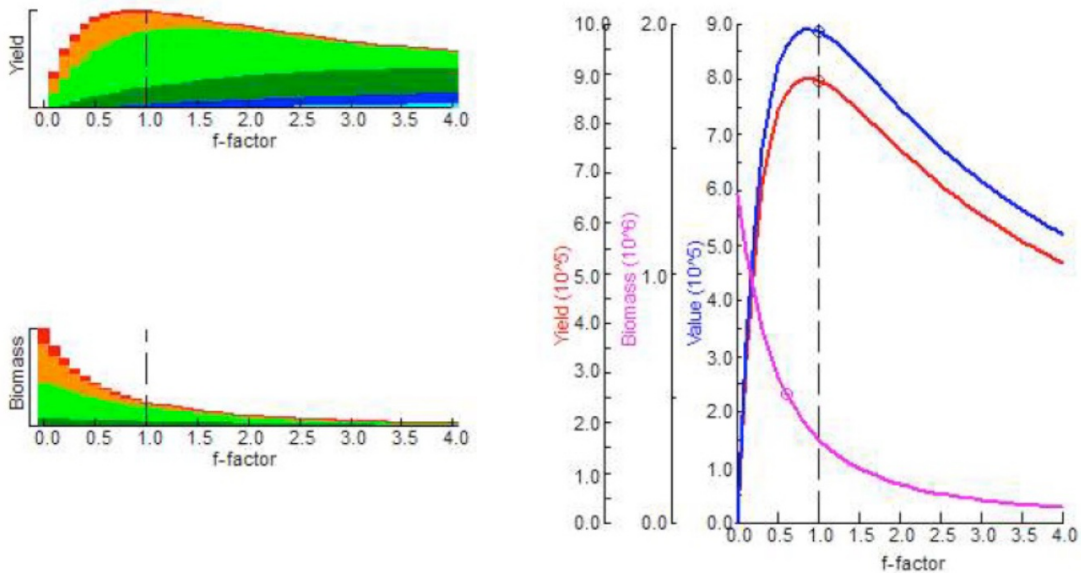


Figure 9: Graph of Thompson and Bell analysis from FISAT of blue swimming crab in Ban Don Bay. Taken from (STBSCFIP 2020b).

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 Critical

Guiding principles

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

Criterion 2 Summary

Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

BLUE SWIMMING CRAB			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Andaman Sea or Burma Sea Indian Ocean, Eastern Gillnets and entangling nets Thailand	1.000	1.000: < 100%	Red (1.000)
Gulf of Siam (Gulf of Thailand) Pacific, Western Central Gillnets and entangling nets	1.000	1.000: < 100%	Red (1.000)
Andaman Sea or Burma Sea Indian Ocean, Eastern Pots Thailand	1.732	1.000: < 100%	Red (1.732)
Gulf of Siam (Gulf of Thailand) Pacific, Western Central Pots	1.732	1.000: < 100%	Red (1.732)

Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

ANDAMAN SEA OR BURMA SEA INDIAN OCEAN, EASTERN GILLNETS AND ENTANGLING NETS THAILAND			
SUB SCORE: 1.000		DISCARD RATE: 1.000	SCORE: 1.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Blue swimming crab	1.000: High Concern	1.000: High Concern	Red (1.000)
Rays	1.000: High Concern	1.000: High Concern	Red (1.000)
Sea turtles	1.000: High Concern	1.000: High Concern	Red (1.000)
Sharks	1.000: High Concern	1.000: High Concern	Red (1.000)
Marine mammals	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

ANDAMAN SEA OR BURMA SEA INDIAN OCEAN, EASTERN POTS THAILAND			
SUB SCORE: 1.732		DISCARD RATE: 1.000	SCORE: 1.732
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Blue swimming crab	1.000: High Concern	1.000: High Concern	Red (1.000)
Marine mammals	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
True crabs	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

GULF OF SIAM (GULF OF THAILAND) | PACIFIC, WESTERN CENTRAL | GILLNETS AND ENTANGLING NETS

SUB SCORE: 1.000		DISCARD RATE: 1.000		SCORE: 1.000
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE	
Rays	1.000: High Concern	1.000: High Concern	Red (1.000)	
Sea turtles	1.000: High Concern	1.000: High Concern	Red (1.000)	
Sharks	1.000: High Concern	1.000: High Concern	Red (1.000)	
Blue swimming crab	2.330: Moderate Concern	1.000: High Concern	Red (1.526)	
Marine mammals	1.000: High Concern	3.000: Moderate Concern	Red (1.732)	

GULF OF SIAM (GULF OF THAILAND) | PACIFIC, WESTERN CENTRAL | POTS

SUB SCORE: 1.732		DISCARD RATE: 1.000		SCORE: 1.732
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE	
Blue swimming crab	2.330: Moderate Concern	1.000: High Concern	Red (1.526)	
Marine mammals	1.000: High Concern	3.000: Moderate Concern	Red (1.732)	
True crabs	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)	

All bycatch in the Thai blue swimming crab fishery is retained. Species that are commonly caught in gillnets and/or traps are unidentified sharks and rays, several crab species (mud, musk/crucifix, etc.), shrimp, and prawns (Table 1). Some sea turtle interactions have been confirmed in interviews with fishing communities and are not always reported (e.g., turtles that are released alive, or keeping dead turtles for their shells) (Banks and Trumble 2012). There have also been reports of dugongs in the same area as crab fishers, but dugongs are confined to seagrass beds, which are largely protected (Adulyanukosol and Sombat 2006), and only one interaction between dugongs and crab fishers was reported between 1979 and 1999 (Adulyanukosol 1999).

Sharks, rays, sea turtles, and dugong are included as Criterion 2 species because of their high conservation concern, because sharks and rays are predominant in the retained catch, and because all interactions with sea turtles are recorded. Marine mammals, corals, and sponges are also assessed in the blue swimming crab pot fishery. Other species that composed more than 5% of the total catch and were considered under Criterion 2 as “true crabs” are blue spot crab (sp. unidentified), three-spotted crab (*Portunus sanguinolentus*), mud crab (*Scylla serrata*), and the musk/crucifix crab (*Charybdis cruciate/feriatus*).

For the gillnet fishery, sharks, sea turtles, and rays limit the score for Criterion 2 because of their high vulnerability, high conservation concern, and high potential to interact with this gear type. For the pot fishery, marine mammals limit the score.

Table 1. Retained species caught in bottom-set gillnets and crab traps. From (Banks and Trumble 2012).

Bottom-set gillnet				
Gulf of Thailand			Andaman Sea	
Species	Tons	% total catch	Tons	% total catch
Blue swimming crab	9,539	83.6%	5,720	95%
Tiger shrimp (<i>Panaeus monodon</i>)	251	2.2%		0%
White banana shrimp (<i>Panaeus indicus</i>)	61	0.5%		0%
Mantis shrimp (<i>Odontodactylus scyllarus</i>)	188	1.6%		0%
Mangrove crab (<i>Aratus pisonii</i>)	308	2.7%		0%
Blue spot crab (sp. unidentified)	652	5.7%		0%
Squid	11	0.1%	3	0%
Sharks	77	0.7%		0%
Rays	42	0.4%	64	1%
Sea catfish	12	0.1%		0%
Croaker	4	0.0%		0%
Eel-tailed catfish (<i>Tandanus tandanus</i>)	2	0.0%		0%
Other food fish	249	2.2%	242	4%
Mackerels	11	0.1%	11	0%

Trap				
Gulf of Thailand			Andaman Sea	
Species	Tons	% total catch	Tons	% total catch
Blue swimming crab	3,353		717	50%
Three-spotted crab (<i>Portunus sanguinolentus</i>)		25–50%, depending on season	215	15%
Mud crab (<i>Scylla serrata</i>)	496		400	28%
Other crab; includes musk/crucifix crab (<i>Charybdis cruciate/feriatus</i>) and other <i>Charybdis</i> spp.	21		102	7%

Kindly refer to Appendix B for updated catch composition analysis.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

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

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

Marine mammals

Factor 2.1 - Abundance

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

High Concern

Marine mammals are at risk of entanglement in pot lines and gillnets. They are considered highly vulnerable according to the SFW criteria; therefore, an abundance score of high concern is given.

Factor 2.2 - Fishing Mortality

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Moderate Concern

It is unlikely that marine mammals such as dugong are retained. There have been reports of dugongs in the same area as crab fishers, but dugongs are confined to seagrass beds, which are largely protected (Adulyanukosol and Sombat 2006), and only one interaction between dugongs and crab fishers was reported from 1979 to 1999 (Adulyanukosol 1999).

Marine mammal fishing mortality is scored a moderate concern, because the last known interaction was over 10 years ago; however, as a result of limited monitoring, there is insufficient evidence to support a score of low concern or to remove them from the report entirely.

Rays

Factor 2.1 - Abundance

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

High Concern

Most pelagic rays are inherently highly vulnerable and are classified as "Near Threatened" {Dulvy et al. 2008}. According to the SFW criteria, rays are rated a high concern for abundance.

Factor 2.2 - Fishing Mortality

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

High Concern

Rays are not specifically included in the SFW Unknown Bycatch Matrices, but finfish receive a fishing mortality score of 2 for bottom-set gillnets. Thus, we have scored rays 2 out of 5, or a high concern.

Sea turtles

Factor 2.1 - Abundance

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

High Concern

Sea turtles are listed as endangered or threatened throughout the world {NOAA 2016}, so they are scored a "high" concern under the SFW criteria.

Justification:

There are two species of turtle in the Gulf of Thailand: green sea turtle (*Chelonia mydas*) and hawksbill turtle (*Eretmochelys imbricate*), and four species in the Andaman Sea: green sea turtle, hawksbill turtle, olive ridley turtle (*Lepidochelys olivacea*), and leatherback turtle (*Dermochelys coriacea*). Declines in the Gulf of Thailand and Andaman Sea turtle populations have been attributed mostly to interactions with trawlers, and until the 1980s, from direct targeting by fishers (Shanker and Pilcher 2003). The Department of Marine and Coastal Resources has recorded some crab gillnet interactions; however, the scale of these interactions relative to the total population size is not clear because live releases are not reported (Banks and Trumble 2012).

Factor 2.2 - Fishing Mortality

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

High Concern

For bottom-set gillnet fisheries in Southeast Asia, sea turtles are scored 1 out of 5 or a high concern for fishing mortality, under the SFW Unknown Bycatch Matrix.

Sharks

Factor 2.1 - Abundance

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

High Concern

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

Justification:

In Kung Krabaen Bay (in the eastern Gulf of Thailand), the ridgebacked bamboo shark (*Chiloscyllium indicum*) was the dominant bycatch species found in crab gillnets (pers. comm., C. Kunsook September 3, 2017). The IUCN considers ridgebacked bamboo shark as "Near Threatened," with an unknown population status (Barratt et al. 2003).

Factor 2.2 - Fishing Mortality

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

High Concern

According to the SFW Unknown Bycatch Matrices, sharks score 2 or a high concern for bottom-set gillnet fisheries.

True crabs

Factor 2.1 - Abundance

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Moderate Concern

Benthic invertebrates are ranked a moderate concern for abundance, based on the SFW criteria.

Justification:

Blue spot crab (sp. unidentified), three-spotted crab (*Portunus sanguinolentus*), mud crab (*Scylla serrata*), and crucifix crab (*Charybdis cruciate/feriatus*) all compose >5% of the total blue swimming crab catch from pots and are retained. Kunsook and Dumrongrojwattana (2017) found that 17 species of crab were caught alongside blue swimming crab in traps set in Kung Krabaen Bay and represented the majority of the bycatch. There are no stock assessments for these species in Thai waters.

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Moderate Concern

Benthic invertebrates are ranked a moderate concern for abundance, per the SFW criteria.

Justification:

Blue spot crab (sp. unidentified), three-spotted crab (*Portunus sanguinolentus*), mud crab (*Scylla serrata*), and crucifix crab (*Charybdis cruciate/feriatus*) all compose >5% of the total blue swimming crab catch from pots and are retained.

During a study at the Kung Krabaen Bay fishery (Gulf of Thailand), the diversity and abundance of marine crabs were observed using 10 sampling stations. The results showed that there were 7 families, 11 genera, and 17 species (2 anomuran and 15 brachyuran crabs). For brachyuran crabs, Portunidae was the most common family (10 species); the dominant species included mangrove swimming crab (*Thalamita crenata*), blue swimming crab (*Portunus pelagicus*), smooth-shelled swimming crab (*Charybdis affinis*), *Scylla* spp. (201 individuals), and two-spined arm swimming crab (*Charybdis anisodon*) {Kunsook and Dumrongrojwattana 2017}. There are no stock assessments for these species in Thai waters.

Factor 2.2 - Fishing Mortality

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Low Concern

Using the SFW Unknown Bycatch Matrices, benthic invertebrates receive a fishing mortality score of 3.5 out of 5, or low concern, for traps.

Factor 2.3 - Discard Rate/Landings

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

< 100%

Some low-value species, such as *Murex trapa* and *Telescopium telescopium*, which are caught as bycatch in crab gillnets and discarded (pers. comm., C. Kunsook September 3, 2017), may or may not survive; however, the majority of the catch is landed (dead or alive). Because there is no bait used in bottom-set gillnets and most bycatch species are retained, a modifying factor of 1 is used.

**Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand
Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots**

< 100%

Some low-value species, such as mollusks, undersized fish, and hermit crab, which are caught as bycatch in crab traps and discarded (pers. comm., C. Kunsook, September 3, 2017), may or may not survive; however, the majority of catch is landed (dead or alive). Therefore, there is likely less than a 100% discard rate, so a modifying factor of 1 is used.

Justification:

Fishing vessel owners and small-scale fishers stated that Indian mackerels and small pelagic species are used as baitfish in traps, but the amount of bait/trap has not been quantified.

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.

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:

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	RESEARCH AND MONITORING	ENFORCEMENT	INCLUSION	SCORE
Andaman Sea or Burma Sea Indian Ocean, Eastern Gillnets and entangling nets Thailand	Ineffective	Ineffective	Ineffective	Moderately Effective	Highly effective	Red (1.000)
Andaman Sea or Burma Sea Indian Ocean, Eastern Pots Thailand	Ineffective	Ineffective	Ineffective	Moderately Effective	Highly effective	Red (1.000)

Gulf of Siam (Gulf of Thailand) Pacific, Western Central Gillnets and entangling nets	Ineffective	Ineffective	Moderately Effective	Moderately Effective	Highly effective	Red (1.000)
Gulf of Siam (Gulf of Thailand) Pacific, Western Central Pots	Ineffective	Ineffective	Moderately Effective	Moderately Effective	Highly effective	Red (1.000)

Criterion 3 Assessment

SCORING GUIDELINES

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 managers 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.

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.

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 is a mechanism to effectively address user conflicts.

Factor 3.1 - Management Strategy And Implementation

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Ineffective

A draft fishery management plan (FMP) was presented at the 2018 FIP review meeting, and it included a precautionary approach and clearly defined long-term objectives for the fisheries sector (MRAG 2018). Following this development in 2018, a series of consultations with fishers were held to obtain their inputs (STBSCFIP 2021b); then, the Department of Fisheries gathered feedback from their experts, and the next steps were outlined in May 2021 (STBSCFIP 2021b). The second National Marine Fishery Management Plan 2020–22 was developed after the first one; currently, the Department of Fisheries is considering making the blue swimming crab FMP part of the National Marine FMP, pending approval by the Cabinet (STBSCFIP 2021b).

The Thai blue swimming crab fishery is open-access (both commercial and coastal fisheries) and has had an expansion in effort with respect to both boat numbers and gear (Banks and Trumble 2012). Limit and target reference points have not yet been set or incorporated into management, and there are not many widespread fishery-specific harvest strategies, or rules, in place. There is a closed season to protect spawning crabs (October to December), which has not been enforced, and some localized management measures in place, with evidence to suggest that initiatives are being encouraged, including crab banks, voluntary no-take zones (0 to 1 km from the shore), and the preservation of crab habitat (seagrass beds), but they are not pervasive in the coastal communities (Banks and Trumble 2012). There are also various marine protected areas (MPAs) that exclude access to all fishers. These management measures are issued as Notifications. Commercial vessels are required to complete logbooks, but this does not specifically pertain to the crab fleet.

The existing regulations for collapsible crab traps that operate within the coastal zone in vessels lower than 9.9 GT include a prohibition on the mesh size being less than 2.5 in on all sides, and the maximum number of traps is 300 units/vessel (FishChoice 2021)(STBSCFIP 2021b). For collapsible traps that operate in offshore regions and in vessels of 10 GT and over, the mesh size must be greater than 2.5 in from the bottom side only, the maximum number of units per vessel up to 29.9 GT is 3,500, and the maximum for vessels 30 GT and over is 4,500 units/vessel (FishChoice 2021)(STBSCFIP 2021b).

For gillnets, for vessels operating in the coastal zone that are less than 9.9 GT, the maximum length is 3,000 m/vessel (FishChoice 2021)(STBSCFIP 2021b). For gillnets set in offshore waters in vessels from 10 GT up to 29.9 GT, the maximum length is 20,000 m/vessel, and for vessels 30 GT and over, the maximum length is 30,000 m/vessel (FishChoice 2021)(STBSCFIP 2021b). A complete ban on trawling in coastal zones is being maintained; for offshore trawlers greater than 10 GT, the cod end mesh size must be 4 cm, the ground rope in a pair trawl cannot be over 100

m, and the ground rope in an otter trawl cannot be over 60 m (The Government Gazette 2017). Per an official notification by the Ministry of Agriculture and Cooperatives, there is also a prohibition on fishing berried female crabs, from October to December every year (FishChoice 2021); however, this regulation is not implemented and enforced (FishChoice 2021).

Based on regulations implemented since mid-November 2015, in each province, provincial fisheries committees are encouraged to organize consultations to regulate fisheries with management measures (including gear limitations) within their provinces. The existing blue swimming crab FMP aims to implement a minimum landing size within 5 years (pers comm., Osmond M. 2023). In a recent meeting including the industry and managers, the use of indicators including the spawning potential ratio, the proportion of mature blue swimming crab in the catch, and the exploitation rate were discussed, in addition to setting target and limit reference points for the same and designing harvest control rules (pers comm., Osmond M. 2023). But, these measures have not been currently implemented. Nevertheless, some communities have implemented their own regulations to address the same (FishChoice 2021)(STBSCFIP 2021b).

Efforts to develop the FMP have been initiated and progressed, but there is no law in place at present (STBSCFIP 2021b). Processors have implemented a voluntary minimum size for blue swimming crab for buying and processing. Issues that should be addressed in the FMP are: 1) the need for limited licensing; 2) setting indicators with appropriate target and limit reference points; 3) enforcing the prohibition on taking berried females; 4) implementing trap escape vents; and 5) implementing harvest control rules. Although there is a clear need to develop a national management strategy for blue swimming crab fisheries in Thailand, it is important that the plan is flexible to support the differing needs of communities that rely on these fisheries (pers. comm., C. Kunsook, September 23, 2017).

Because there are few management measures currently in place, and those that are in place are not well enforced, management is scored as ineffective.

Factor 3.2 - Bycatch Strategy

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Ineffective

There are general blue swimming crab regulations that indirectly apply to bycatch (such as crab trap mesh size specifications and closed seasons/areas), but at this time, there are no bycatch-specific management measures in place for the Thai blue swimming crab fishery. In terms of endangered, threatened, and protected (ETP) species, there are numerous community conservation groups (especially sea turtle and seagrass conservation groups) in many of the coastal fishing

villages. Organizations are also involved in sea turtle protection and conservation, including the Thai Navy, some nongovernmental organization (NGO) groups, and the DMCR, through informational brochures and workshops on ETP awareness and the establishment of reporting systems (Banks and Trumble 2012). All seagrass beds, where dugong resides, are mapped and protected by law under the Enhancement and Conservation of the National Environmental Quality Act B.E. 1992 (DMCR 2011); fishing in these areas is rare (DMCR 2011). During the 2020 blue swimming crab FIP review meeting, local stakeholder consultations revealed that the strandings of turtles and cetaceans were an issue (FishChoice 2021).

Recent research indicates that ghost gear from the blue swimming crab fishery is an issue, but no mitigation measures are in place to address it (Koolkalya et al. 2022), and the extent to which sea turtles and marine mammals, which are ETP species, are entangled in both traps and gillnets is unknown. For these reasons, this factor is scored ineffective.

Justification:

In Kung Krabaen Bay specifically, a 20% harvest reduction of blue swimming crab has been proposed for collapsible crab traps (pers. comm., C. Kunsook, September 3, 2017).

Factor 3.3 - Scientific Research And Monitoring

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Ineffective

In Trang Province on the Andaman Sea coast of Thailand, catch composition data are collected for all species on a monthly basis by the Department of Fisheries, but there appears to be no regular monitoring of the blue swimming crab stock or the bycatch in the blue swimming crab fisheries. For this reason, a score of ineffective is given (DoF 2022).

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Moderately Effective

In the Surat Thani Province on the Gulf of Thailand, data-limited stock assessments are conducted to maintain and monitor the blue swimming crab stock (STBSCFIP 2020)(STBSCFIP 2021) (STBSCFIP 2022)(FishChoice 2021). Qualitative bycatch data are also collected, along with proportions of various categories of species found in the catch (Sawusdee 2021); thus, bycatch is monitored, but the data are incomplete. Because some data are collected, but there are gaps in the collected data and the stock assessment is data limited, a score of moderately effective is given.

Factor 3.4 - Enforcement Of Management Regulations

Factor 3.4 - Enforcement Of Management Regulations

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Moderately Effective

In the 2020 Three-Year FIP Review of the blue swimming crab fishery in Surat Thani Province in the Gulf of Thailand, information was provided on the number of allegations, prosecutions, and results of illegal activity in the blue swimming crab fishery in 2019 and 2020 (FishChoice 2021). During this time, the most common offense appeared to be the use of inappropriate gear (a mesh size less than 2.5 in), and fishing in prohibited zones (FishChoice 2021). Data on vessel size category were missing in the 2020 dataset (FishChoice 2021). There is also evidence that fines were charged for offenses, but there is no information on whether the fines were enough to ensure adequate compliance (FishChoice 2021). In 2020, only two incidents of noncompliance were reported, but this could also be due to the Covid-19 pandemic (FishChoice 2021).

Although small inshore vessels must be registered, they do not yet need to have a license. Smaller vessels may have paper-based logbooks, but this is currently voluntary (FishChoice 2021). Larger offshore vessels must be registered and must have a license, are required to have e-log books, and must have a vessel monitoring system (VMS) onboard (FishChoice 2021). Patrolling takes place four times a month, for 5 days at a stretch (FishChoice 2021). Local fishing volunteers have also been trained to monitor illegal fishing activity and good practice within the fishery (FishChoice 2021). The enforcement of regulations is key to the success of this fishery, but the fisheries agency lacks the capacity to effectively enforce regulations in such a widely dispersed fishery (pers comm., Osmond M. 2023). Despite there being some enforcement in place, its effectiveness is unknown because the catch of juveniles is known to occur, which suggests that systematic noncompliance exists.

Regarding the blue swimming crab fishery in Trang Province on the Andaman Sea coast of Thailand, enforcement does exist and penalties are charged for fishing infractions (DoF 2022). But, the list of infractions that was provided was low in number, which suggests that compliance could be weak.

Because enforcement of fisheries regulations exists, but its effectiveness and the extent of compliance are unknown along both coasts of Thailand, this factor has been scored moderately effective.

Factor 3.5 - Stakeholder Inclusion

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Highly effective

At the national level, management of marine systems is the responsibility of the Department of Marine and Coastal Resources (FishChoice 2021)(Anonymous 2022b). Fisheries are also managed at the provincial and local levels (FishChoice 2021)(Anonymous 2022b). The provincial fisheries committee is appointed by the national government, and is made of representatives from local fishing communities; these committees have the authority to compile and propose policy recommendations on the management and conservation of marine resources (FishChoice 2021)(Anonymous 2022b). During emergencies, these committees have the authority to issue notifications that may be implemented immediately (FishChoice 2021)(Anonymous 2022b). The draft blue swimming crab FMP clearly defines the responsibilities of stakeholders involved in the management of blue swimming crab in Surat Thani Province along the Gulf of Thailand (FishChoice 2021)(Anonymous 2022b). When there is new fisheries legislation, fishers are invited for consultations (FishChoice 2021)(Anonymous 2022b). The Management Advisory Committee, which includes members of the blue swimming crab fishing community, was formulated to ensure that appropriate consultation occurs among all relevant stakeholders at the national level, for all blue swimming crab fisheries (FishChoice 2021)(Anonymous 2022b). Local universities have also been tasked to provide academic support and advice on the blue swimming crab fishery (FishChoice 2021)(Anonymous 2022b).

Along the Andaman Sea coast, the Department of Fisheries has encouraged inclusion of 60 fisher communities through the establishment of locally managed crab banks. Local fishers have set up committees to manage the crab bank activities and the associated blue swimming crab nursery grounds, with a clear division of responsibilities (DoF 2022). The DoF has also generated awareness about the conservation of blue swimming crab (DoF 2022). Fishers are also drafted to collect catch data on blue swimming crab (DoF 2022).

Because there is a high degree of transparency, participation, and inclusion in the blue swimming crab fisheries along the Gulf of Thailand and the Andaman Sea coast, this factor has been scored highly effective.

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

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	SCORE
Andaman Sea or Burma Sea Indian Ocean, Eastern Gillnets and entangling nets Thailand	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)
Andaman Sea or Burma Sea Indian Ocean, Eastern Pots Thailand	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)
Gulf of Siam (Gulf of Thailand) Pacific, Western Central Gillnets and entangling nets	Score: 3	Score: 0	Moderate Concern	Yellow (3.000)
Gulf of Siam (Gulf of Thailand) Pacific, Western Central Pots	Score: 3	Score: 0	Moderate Concern	Yellow (3.000)

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 - Impact of Fishing Gear on the Habitat/Substrate

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Score: 2

In some parts of the Andaman Sea (west coast), fishing was observed on mixed ground, rock, and sand (Banks and Trumble 2012), interacting with benthic assemblages such as corals, giant mussel, skate, and sponges. In other areas, such as Ban Nam Rab, Trang Province, fishing was on sand, with limited signs of benthic assemblages caught in the net. According to the SFW criteria, crab traps and bottom-set gillnets fished over sand/mud (not on rocky reef/boulder and corals) are scored 3 out of 5, whereas fishing over rocky reef/boulders is scored 2. Hence, the more conservative score of 2 is given.

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Score: 3

Banks and Trumble (2012) reported that most fishing on the east coast of Thailand (in the Gulf of Thailand) is reported to be across soft sand/mud. According to the SFW criteria, crab traps and bottom-set gillnets fished over sand/mud (not on rocky reef/boulder and corals) are scored 3 out of 5.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Score: 0

There are no gear-specific modifications to reduce impacts to the seafloor; however, there are voluntary no-take zones (0 to 1 km from the shore) that are set up by some fishers, and a prohibition on fishing in seagrass beds (Banks and Trumble 2012). In addition, there are various marine protected areas, which exclude access to all fishers, and the DMCR has established a network of moorings on all coral reefs, to reduce coral reef damage (Banks and Trumble 2012). Although some voluntary closures are in place, they are not widespread, and it is uncertain whether there is a high level of compliance. Therefore, this factor is scored with no mitigation.

Justification:

With the support of DoF, groups for community monitoring, control, and surveillance (MCS) have been set up in certain coastal villages, to protect their fishing zones from commercial trawlers and to monitor compliance by their own communities, thereby ensuring protection of seagrass beds and other no-take zones (Banks and Trumble 2012). Participation in these activities is thought to be effective, but these measures are not yet widespread in the coastal communities (Banks and Trumble 2012).

Factor 4.3 - Ecosystem-based Fisheries Management

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Gillnets and entangling nets | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Gillnets and entangling nets

Andaman Sea or Burma Sea | Indian Ocean, Eastern | Pots | Thailand

Gulf of Siam (Gulf of Thailand) | Pacific, Western Central | Pots

Moderate Concern

Blue swimming crab is often considered an opportunistic, bottom-feeding carnivore and scavenger. It primarily consumes various sessile and slow-moving prey such as worms, mollusks, and crustaceans {Batooy et al. 1987}, as well as smaller fish, but not much is known about the role of blue swimming crab as prey in Thai waters. In Australia, blue swimming crab is prey to turtles, sharks, rays, large fish, birds, and other blue swimming crabs (GWA DOF 2011). Intense fishing pressure on blue swimming crab could alter the trophic structure and species composition by reducing predation on crab prey, and/or by reducing food for higher-level predators.

The development of a new Fisheries Act is in progress, which will promote the application of the precautionary principle and the ecosystem approach to fisheries management (Banks and Trumble 2012). These have yet to be adopted in practice, so the full extent of the blue swimming crab fishery's impacts on the ecosystem is not well known. The effects of this fishery on the ecosystem are thought to include ghost fishing and traps without escape vents or biodegradable panels (which could allow small incidental species and juvenile crabs to escape). Crab traps catch a large amount of juvenile crabs, which could also affect ecosystem structure by reducing the size composition and the rate of recovery for all crab species caught.

Bycatch from gillnets includes top predators (sharks and rays), which are considered highly vulnerable, and their capture could potentially cause trophic cascades. Along with the primary bycatch of other crab species in traps, there are no measures in place to maintain retained species at levels that are likely to be within biologically based limits. In addition, it is unclear whether ETP species such as sea turtles and dugong are commonly caught in the gillnet fishery. There are numerous community conservation groups (especially sea turtle and seagrass conservation groups) in many of the coastal fishing villages; organizations have also become involved in sea turtle protection and conservation, including the Thai Navy, some nongovernmental organizations, and the DMCR, through informational brochures and workshops on ETP awareness and the establishment of reporting systems (Banks and Trumble 2012). All seagrass beds are mapped and

protected by law under the Enhancement and Conservation of the National Environmental Quality Act B.E. 1992 (DMCR 2011); fishing in these areas is rare (DMCR 2011).

Ecosystem-based fishery management is not in place at present, but trophic cascades—though possible—are considered not likely; therefore, we have deemed this factor a moderate concern.

Justification:

Some communities are looking at rehabilitating local habitats. For example, stakeholders in Kung Krabaen Bay and Chaoloa Beach are planting seagrass beds (*Halodule pinifolia*) to aid in the conservation of the megalopa (larval) and juvenile crab stages (pers. comm., C. Kunsook, September 3, 2017).

Acknowledgements

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

Seafood Watch would like to thank Michael Osmond from World Wildlife Fund for graciously reviewing this report for scientific accuracy.

References

Adulyanukosol, K., Poovachiranon, S. 2006. Dugong (*Dugong dugon*) and Seagrass in Thailand: Present Status and Future Challenges. In: Proceedings of the 3rd international Symposium on SEASTAR2000 and Asian Bio-logging Science (The 7th SEASTAR2000 Workshop). Kyoto: Kyoto University, 41–50. Dugong dugon feeding in tropical Australian seagrass meadows: Implications for conservation planning. Available from:

https://www.researchgate.net/publication/305000964_Dugong_dugon_feeding_in_tropical_Australian_seagrass_meadows_Implications_for_conservation_planning [accessed May 7, 2017].

Adulyanukosol, K. 1999. Dolphin, Dugong and Whale in Thai Waters. In: Proceedings of the 1st Korea-Thailand Joint Workshop on Comparison of Coastal Environment: Korea-Thailand, Seoul: Hoam Convention Center, Seoul National University.

Anonymous 2022. Milestone 57: Limitation and gaps of Length-based Thompson and Bell model on blue swimming crab in 2020.

Anonymous 2022b. Milestone 43: Establish a network system of BSC fishery information.

Banks, R., R.J. Trumble. 2012. Pre-Assessment of the Thailand Blue Swimming Crab (*Portunus pelagicus*) Fishery. May. 81pp.

Barratt, P., R.D. Cavanagh, P.M. Kyne. (SSG Australia & Oceania Regional Workshop, March 2003). 2003. *Chiloscylidium indicum*. The IUCN Red List of Threatened Species 2003: e.T41791A10547620. <http://dx.doi.org/10.2305/IUCN.UK.2003.RLTS.T41791A10547620.en>. Downloaded on 31 March 2018. Available at: <http://www.iucnredlist.org/details/41791/0>.

BFAR (Bureau of Fisheries and Aquatic Resources, Department of Aquaculture). 2012. The Philippine Blue Swimming Crab Management Plan. 31pp. Available at: http://www.bfar.da.gov.ph/new/announcement_archive/1Final%20Approved%20Version%20BSCMP%20January%2024%202013.pdf.

complete.

Creech, S. 2013. Final Report: Sri Lanka Blue Swimming Crab Fishery Assessment. Submitted to Seafood Exporters' Association of Sri Lanka. Revised on May 28, 2014. 81 pp.

Creech, S., J. Bandara, D. de Silva. 2016. Project Proposal: An Assessment of the Ecological Impact (Habitats & Ecosystem) of the Blue Swimming Crab (*Portunus pelagicus*) Fishery in the Palk Bay (Bay of Bengal), Sri Lanka. Sri Lankan Blue Swimming Crab Fishery Improvement Project. 11pp.

Department of Fisheries. 2022. Blue Swimming Crab Resources Management Information and BSC Fishing in the Andaman Coastal for the evaluation of BSC products of Thailand under Seafood Watch Program.

DMCR (Department of Marine and Coastal Resources). 2011. Status Report on Endangered Marine

Species, DMCR, Chumporn Research.

FAO (Fisheries and Aquaculture Organization). 2016a. Species Fact Sheet: *Portunus pelagicus*. Available at: <http://www.fao.org/fishery/species/2629/en>.

FishChoice 2021. Three-Year Audit: Blue swimming crab, Surat Thani province, Thailand. pp, 55.

Food and Agriculture Organization 2022. FishStatJ v4.02.07. Accessed from: <https://www.fao.org/fishery/en/statistics/software/fishstatj/en>

Germano, B. P., J.L.F. Melgo, J.C. Evangelio. 2006. Population, Reproduction and Fishery Biology of the Blue Crab *Portunus pelagicus* (Linnaeus 1758) in Eastern Visayas. Terminal Report, Volume 3. AFMA – Invertebrate Project of Leyte State University (LSU) and the Department of Agriculture – Bureau of Agriculture Research (DA-BAR). 116 pp.

GWA DOF (Government of Western Australia, Department of Fisheries). 2011. Fisheries Fact Sheet: Blue Swimmer Crab. Available at: http://www.fish.wa.gov.au/Documents/recreational_fishing/fact_sheets/fact_sheet_blue_swimmer.pdf.

Ingles, J.A. 1988. Management strategies for *Portunus pelagicus* fishery in Ragay Gulf, Philippines. Fisheries Research Journal of the Philippines 13:15-22.

Jindalikit, J., P. Chakaphan, S. Kanitha, W. Suwarak. 2008. Biological and Stock Assessment of Blue Swimming Crab in the Upper Gulf of Thailand. MFRDB, Technical Paper No 3.

Josileen J., N. G. Menon. 2007. Fishery and Growth Parameters of the Blue Swimmer Crab *Portunus pelagicus* (Linnaeus, 1758) Along the Mandapam Coast, India. Journal Marine Biological Association of India 49:2, 159-165.

Kangas, M. I. 2000. Synopsis of the Biology and Exploitation of the Blue Swimmer Crab, *Portunus pelagicus* Linnaeus, in Western Australia. Fisheries Research Report 121: 1-22.

Koolkalya, S., T. Jutagate, A. Sawusdee, and S. Sichum. 2022. Milestone 59 Impact of ghost gear on the fishery from trap and gillnets: Study on the effect of ghost fishing on uncountable mortality of BSC in Surat Thani Province.

Lai, J. C. Y, P. K. L Ng, and P. J. F Davie. 2010. A revision of the *Portunus pelagicus* (Linnaeus, 1758) species complex (Crustacea: Brachyura: Portunidae), with the recognition of four species. The Raffles Bulletin of Zoology 58:2, 199-237.

MRAG. 2018. Review of Surat Thani Blue Swimming Crab Fishery Improvement Project 2018. Department of Fisheries, Bangkok, Thailand. April 19-20. Prepared by Dr Robert Wakeford, MRAG Ltd.

National Marine Fisheries Service 2022. US foreign trade data. Accessed from: <https://www.fisheries.noaa.gov/foss/f?p=215:2:6457053285692::NO:::>

National Marine Fisheries Service. 2022b. US foreign trade data: Portunid imports from Thailand into the US. Accessed from <https://www.fisheries.noaa.gov/foss/f?p=215:2:6457053285692::NO::>

NFICC (National Fisheries Institute Crab Council). 2016. Vietnam FIP Background. Available at: <http://www.committedtocrab.org/projects/thailand/>.

Personal Communication. 2023. Osmond, Michael. Senior Program Officer, Fisheries, WWF-US. 04/17/2023.

Prince, J., S. Creech, H. Maduduppa, and A. Hordyk. 2020. Length based assessment of spawning potential ratio in data-poor fisheries for blue swimming crab (*Portunus* spp.) in Sri Lanka and Indonesia: Implications for sustainable management. *Regional Studies in Marine Science*. 36:1-12.

Sawusdee, A. 2021. Milestone 33b: Final report of bycatch research.

Sawusdee, A., A. Songrak. 2009. Population Dynamics and Stock Assessment of Blue Swimming Crab (*Portunus pelagicus* Linnaeus, 1758) in the Coastal Area of Trang Province, Thailand. *Walailak Journal of Science & Technology*. 6:2, 189-202.

Sea Fare Group. 2011. Quantification and Market Analysis of the Top 30 Seafood Species/Categories Consumed in the U.S. Prepared by Sea Fare Group for Monterey Aquarium Seafood Watch®, March 15, 2011.

Shanker, K., N.J. Pilcher (2003). Marine turtle conservation in South and Southeast Asia: hopeless cause or cause of hope? *Marine Turtle Newsletter* 100, 43–51. Available at: <http://www.seaturtle.org/mtn/archives/mtn100/mtn100p43.shtml?nocount>.

Songrak, A., P. Choopunth, 2011. Stock assessment of blue swimming crab (*Portunus pelagicus* Linnaeus) in Sikao Bay, Trang, Trang Province, Southern Thailand. Thailand Research Fund and the Faculty of Science and Fisheries Technology. Rajamangala University of Technology Srivijaya.

Surat Thani Blue Swimming Crab Fishery Improvement Project. 2020. Milestone 19: Report of LB-SPR analysis (update October 2020).

Surat Thani Blue Swimming Crab Fishery Improvement Project. 2020b. Milestone 30: Stock assessment of the blue swimming crab in Ban Don Bay, Surattani Province.

Surat Thani Blue Swimming Crab Fishery Improvement Project. 2021. Milestone 19: Report of LB-SPR analysis (Data from year 2021 - data collection).

Surat Thani Blue Swimming Crab Fishery Improvement Project. 2021b. Milestone 47: Draft blue swimming crab fishery management plan.

Surat Thani Blue Swimming Crab Fishery Improvement Project. 2022. Milestone 19: Report of LB-SPR

analysis.

The Government Gazette 2017. Announcement of the Ministry of Agriculture and Cooperatives. Subject: Specifying fishing equipment, fishing method and fishing areas that are prohibited from fishing in coastal area, B.E. 2017

Appendix A: Review Schedule

Appendix B: 2023 Update Summary

Updates to the Blue Swimming Crab Thailand report:

Updates to the December 19, 2018 Blue Swimming Crab report were made from March 24, 2022 to February 28 2023. The report was updated in version 3 of the Seafood Watch Fisheries Standard. **The overall ratings for the blue swimming crab gillnet and pot fisheries in Thailand are still Red.** Additional updates, if any, are described below.

Criterion 1

Blue swimming crab remained Red for Criterion 1. A new stock assessment was conducted on blue swimming crab in the Gulf of Thailand, so abundance (Factor 1.1) of crabs in that region was upgraded from high concern to moderate concern. But, no new stock assessment has been conducted along the Andaman coast, so abundance of crabs along that coast remained a high concern. By contrast, fishing mortality (Factor 1.2) remained rated at high concern in both regions, which indicates that overfishing is occurring.

Criterion 2

Although recent catch composition data were available, the new information has not been incorporated into the text of this assessment because it does not change the rating of Criterion 2, which remains Red. For the Gulf of Thailand stock, catch composition data were analyzed from Sawusdee 2021; however, the data are incomplete, so the Seafood Watch Unknown Bycatch Matrix was also applied to the analysis. The following species qualify as main species, following the SFW standard:

Pots: *Hippocampus* spp. (*Hippocampus trimaculatus*, *H. spinosissimus*, *H. kelloggi*, *H. kuda*, *H. histrix*), which are listed as "Vulnerable" on the IUCN Red List; sea cucumber (*Holothuria fuscogilva*), which is "Vulnerable" on the IUCN Red List; as well as *Maculabatis gerrardi*, *Scomberomorus commerson*, brachyuran crabs, benthic invertebrates, corals and other biogenic habitats, finfish, and marine mammals.

Gillnets: Sea cucumber (*Holothuria fuscogilva*), which is "Vulnerable" on the IUCN Red List; as well as *Himantura imbricata*, brachyuran crabs, horseshoe crabs, finfish, forage fish, marine mammals, sea turtles, seabirds, and sharks.

For the Andaman coast stock, broad categories of bycatch species were provided to Seafood Watch (DoF 2022). Because these data were incomplete, the SFW Unknown Bycatch Matrix was also applied. Species included are:

Pots: Brachyuran crabs (including *Charybdis feriatus*, *Portunus sanguinolentus*, and *Portunus gladiator*), which compose >5% of the catch; benthic invertebrates (including *Babylonia areolata*), which form >5% of the catch; as well as corals and other biogenic habitats, finfish, and marine mammals.

Gillnets: Brachyuran crabs (including *Portunus gladiator*, *Portunus sanguinolentus*, and *Calappa philargius*), which compose >5% of the catch; benthic invertebrates (including *Murex* spp.), which form >5% of the catch; as well as finfish, forage fish, marine mammals, sea turtles, seabirds, and sharks.

The final updated Criterion 2 score is given in the following table:

Fishery	lowest C2.1	lowest C2.2	C2.3	C2 score
Gulf of Thailand gillnets	1.000	1.000	1	1.000
Gulf of Thailand pots	1.000	1.000	1	1.000
Andaman coast gillnets	1.000	1.000	1	1.000
Andaman coast pots	1.000	1,000	1	1.000

Criterion 3

There was no improvement in the overall Criterion 3 score, which remained Red. But, new information was added to the texts in Management Strategy and Implementation (Factor 3.1) and Bycatch Strategy (Factor 3.2). An ineffective rating was assigned to Research and Monitoring (Factor 3.3), a rating of moderately effective was assigned to Enforcement (Factor 3.4), and a rating of highly effective was assigned to Stakeholder Inclusion (Factor 3.5).

Rating review summary table:

Report:		
Blue swimming crab (Thailand)		
Criteria	Previous report (2018)	Current report (2022)
Who conducted the stock assessment? When was it conducted?	Andaman Sea: (Sawusdee and Songrak 2009) (Songrak and Choopunth 2011) Gulf of Thailand: (Jindalikit et al. 2008) {Kunsook et al. 2017} (Banks and Trumble 2012)	Andaman Sea: No updated stock assessment Gulf of Thailand: Surat Thani blue swimming crab fishery improvement project 2020, 2020b, 2021 & 2022.
Where/what are the catch composition data source(s)?	(Banks and Trumble 2012)	(Sawusdee 2021)(DoF 2022)
Who manages the fishery?	Department of Fisheries at the national level; provincial governors and district officers at the regional and local levels, respectively.	Department of Fisheries at the national level; provincial governors and district officers at the regional and local levels, respectively.
What is the date of the published management plan?	N/A	A draft FMP was presented in 2018. This was later incorporated into the Marine Fisheries Management Plan of Thailand 2020–22, which is pending cabinet approval.

<p>Are there any updates or amendments?</p>	<p>N/A</p>	<ul style="list-style-type: none"> • The Department of Fisheries is considering making the draft blue swimming crab FMP part of the National Marine FMP, pending cabinet approval. • Regulations on minimum mesh size and maximum number of traps per vessel size category have been updated. • For gillnets, regulations on length of the net per vessel size category have been updated. • Trawling has been banned in coastal waters, and offshore trawl nets have restrictions on the cod end mesh size and ground rope length. • There is a prohibition on harvesting berried females from October to December.
---	------------	---