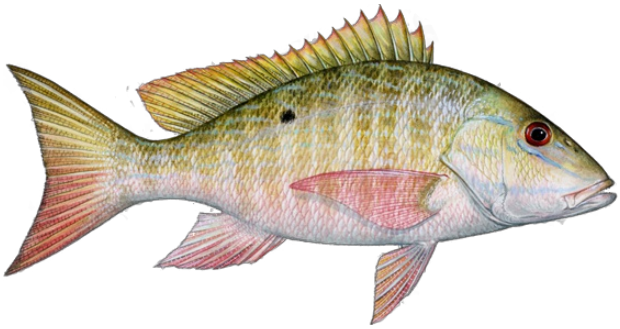
Snapper

Lutjanus purpureus, Lutjanus synagris, *Ocyurus chrysurus*, *Lutjanus jocu*, *Lutjanus analis* and *Rhomboplites aurorubens*



Brazil: Southwest Atlantic

Handlines and Vertical lines, Traps (unspecified)

Report ID 27862

August 1, 2022

Seafood Watch Standard used in this assessment: Fisheries Standard v4

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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 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, 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.

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

Summary

This report evaluates the main commercial snapper species that are exported from Brazil to the U.S. market: Caribbean red snapper (*Lutjanus purpureus*) is the main snapper species exported to the U.S. market, but other species such as lane snapper (*Lutjanus synagris*), yellowtail snapper (*Ocyurus chrysurus*), dog snapper (*Lutjanus jocu*), mutton snapper (*Lutjanus analis*), and vermilion snapper (*Rhomboplites aurorubens*) are also exported, at a lower volume. These species are mainly caught using handlines, traps, and vertical lines from the North to the Southeast Regions of Brazil.

Currently, there are no continuous catch or landings data for these fisheries at the country level, or since 2011. Caribbean red snapper is the only snapper species with recent catch data, as part of a management plan published in 2018. The species is the main component in the snapper exports from Brazil to the U.S. market. Stock assessments are not available for any of the assessed species. Limited information on catches for other snappers places the species in broader categories (i.e., labeling as "snappers" instead of species names), which restricts the reliability of these data.

Fishing gears evaluated in this assessment have significant differences related to by-catch and their impact on the seafloor. Handline is considered a low by-catch fishery and does not affect the seafloor. No by-catch is listed for this fishery. Trap fisheries are more common in the North and Northeast Regions of Brazil and, unlike handlines, this gear type may contact the seafloor and biogenic structures. Information on the by-catch of the trap fishery includes critically endangered goliath grouper and other nontarget species (which are usually sold at local markets, used as baits, and/or consumed [subsistence]). The vertical line fishery targeting Lutjanidae in the Southeast Region of Brazil may catch elasmobranchs incidentally.

Management of these fisheries are at very distinct stages. The fisheries with the best management scores are the trap/pot and vertical line fisheries that target Caribbean red snapper. This is a result of the management plan that is specific to the target species and in place since 2018, and the fishery improvement project (FIP) for the trap fishery, which is implementing many of the much-needed developments, such as continuous monitoring/surveys, stakeholder inclusion, and enforcement. The fishery with the lowest management score is the trap fishery in the Northeast, which targets lane snapper and other species. This fishery has no specific management strategy and has shifted target species (originally spotted goatfish) because of species overfishing, and it lacks continuous data collection.

Impacts on the ecosystem from these fisheries are diverse. Fisheries targeting Caribbean red snapper are in more advanced stages for gear impact mitigation and ecosystem-based management (EBFM). Other fisheries do not have specific regulations to address such impacts, and may benefit from other local initiatives such as marine protected areas (MPAs) (although most of them do not have specific fisheries regulations).

Because of these factors, and more that are detailed in the report, Seafood Watch categorizes snappers caught in Brazil on the Avoid list.

Final Seafood Recommendations

SPECIES | FISHERY	CRITERION 1 TARGET SPECIES	CRITERION 2 OTHER SPECIES	CRITERION 3 MANAGEMENT	CRITERION 4 HABITAT	OVERALL RECOMMENDATION
Caribbean red snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)	1.732	1.000	3.000	2.739	**Avoid (1.942)**
Caribbean red snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)	1.732	1.000	3.000	3.674	**Avoid (2.090)**
Caribbean red snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.732	1.000	1.000	2.828	**Avoid (1.488)**
Dog snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000	1.000	2.828	**Avoid (1.297)**
Dog snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000	1.000	1.000	2.828	**Avoid (1.297)**
Lane snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000	1.000	2.828	**Avoid (1.297)**
Lane snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000	0.000	2.000	**Avoid (0.000)**
Lane snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000	1.000	1.000	2.828	**Avoid (1.297)**
Mutton snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000	1.000	2.828	**Avoid (1.297)**
Mutton snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000	0.000	2.000	**Avoid (0.000)**
Vermilion snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.732	1.000	1.000	2.828	**Avoid (1.488)**
Vermilion snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.732	1.000	1.000	2.828	**Avoid (1.488)**

Yellowtail snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000	1.000	2.828	**Avoid (1.297)**
Yellowtail snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000	0.000	2.000	**Avoid (0.000)**
Yellowtail snapper | Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000	1.000	1.000	2.828	**Avoid (1.297)**

Summary

Snapper caught with handlines, vertical lines, and traps in Brazil has an Avoid rating. The Avoid recommendation is a direct result of target species listed as "Near Threatened" or "Vulnerable" by the national Red List. Secondary species/by-catch also include Red List species and, except for the fisheries targeting Caribbean red snapper in the North Region, all fisheries have quite poor management.

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 covers handline, vertical line, and trap fisheries catching snapper in Brazil. The most important species relevant to the U.S. market is Caribbean red snapper (*Lutjanus purpureus*). Other important commercial species relative to this market—lane snapper (*Lutjanus synagris*), yellowtail snapper (*Ocyurus chrysurus*), vermilion snapper (*Rhomboplites aurorubens*), dog snapper (*Lutjanus jocu*), and mutton snapper (*Lutjanus analis*)—were also assessed here. The fishing areas covered in this assessment are in the North, Northeast, and Southeast Regions of Brazil.

A total of five different fisheries were included in this assessment (see Production Statistics for maps):

Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4):

1. Handline – This multispecies fishery targets Lutjanidae, Scombridae, Serranidae and Carangidae.

2. Trap/pot – this multispecies fishery targeted originally only spotted goatfish, but in the past years it has expanded to target Lujanidae and Hamulidae species as well.

North (Amapá and Pará): FAO 41 (1.1, 1.2)

3. Trap/pot – this fishery targets Caribbean red snapper, particularly in the state of Pará.

4. Vertical line – this fishery targets Caribbean red snapper, particularly in the state of Pará.

Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

5. Vertical lines – this fishery targets several Lutjanidae species in this portion of Brazil

Species Overview

Caribbean red snapper is a demersal species found in coastal waters along the Atlantic Ocean, ranging from the Caribbean to Brazil, where it is most abundant in the Amazon River mouth (Moura et al. 2016). Oceanic banks (between 30 and 140 m) along the Northeast coast in Brazil are believed to be spawning areas for the species. Eggs and larvae would follow the currents to the Amazon River mouth and other coastal areas (Ivo and Hanson 1982). It is considered a generalist carnivore, feeding on fish, crustacean, mollusks, and other organisms (Pinheiro et al. 2018). It is a target species, with specific fisheries in the North Region of Brazil.

Lane snapper is silvery-pink to reddish in color, with short, irregular pink and yellow lines on its side with a diffuse black spot. Juvenile fish are found inshore over shallow reefs and adults are found offshore, where they form large spawning aggregations (Froese and Pauly 2015)(Leite et al. 2005). Lane snapper has been reported from the Western Atlantic (Bermuda, and North Carolina, United States) to southeastern Brazil, including the Gulf of Mexico and the Caribbean Sea (Cervigón 1993). It becomes sexually mature at 15 cm total body length at 1 year of age; it is a generalist carnivore and a trophic opportunistic fish, preying on a wide range of resources (Duarte and Garcia 1999)(Lessa et al. 2004). It is an important fishery resource and is highly esteemed for its tasty white meat (Cavalcanti et al. 2010).

Yellowtail snapper is a common reef-associated species in coastal waters, ranging in the Western Atlantic from Massachusetts, United States to southeastern Brazil (Froese and Pauly 2015). Growth rates for yellowtail snapper vary by location (Araujo et al. 2002)(de Mattos and Maynou 2009), as does maturity (from 20 to 24.5 cm) (Fredou et al. 2009)(Freitas et al. 2011a).

The species usually feeds at night on plankton, fish, and benthic animals (crustaceans, worms, and gastropods) (Ferreira et al. 2004)(Froese and Pauly 2015). Juveniles are generally found over seagrass beds, feeding on plankton (Froese and Pauly 2015), and have been reported to dwell among coral branches in Brazil (Coni et al. 2013). It is known to form spawning aggregations in many fishing grounds along the coast (Costa et al. 2003)(Francini-Filho et al. 2004), and to spawn many times a year with different spawning peaks in different locations (Diehdhiou 2000)(Freitas et al. 2011a)(Begossi et al. 2011). It is reported to hybridize with lane snapper (Batista et al. 2012). This species is one of the main resources in coastal artisanal fisheries, especially in the Northeast Region of Brazil (Teixeira 2004). Some studies suggest that the population in Brazil is highly connected (da Silva et al. 2015); therefore, management initiatives should consider the entire stock as one.

Vermilion snapper is distributed along the Western Atlantic from North Carolina, United States to São Paulo, Brazil (Floeter et al. 2003), and commonly found in large schools near the continental edge, whereas juveniles are also found in schools in shallower waters. The species feeds on fish, shrimps, mollusks, and other invertebrates (Pinheiro et al. 2018). In some parts of Brazil, fishing pressure overlaps with spawning season, when the species creates aggregations, thus increasing species vulnerability to fishing (Padilha 2016).

Dog snapper is a demersal fish widely distributed in tropical waters of Brazil, inhabiting estuaries, coastal reefs to the outer continental shelf, and upper-slope mesophotic reefs deeper than 100 m (França and Olavo 2015). The species is highly targeted by the artisanal fleet in many coastal states of the Northeast Region (Rezende and Ferreira 2004). The species is targeted by handlines, longlines, and traps, and historical fishing pressure has shown a decline in abundance for many years (Fredou et al. 2009).

Mutton snapper is distributed in the Western Atlantic from Massachusetts, United States to southeastern Brazil (Menezes and Figueiredo 1980). It occurs in a variety of habitats, such as sand bottoms, seaweed-dominated reefs, bays, mangroves, and estuaries (Allen 1985). In Brazil, it is commonly found over hard substrates and reefs in the Northeastern and Southeastern Regions' coast {Frédou and Ferreira 2005}. This species usually exhibits a diurnal feeding pattern (Watanabe 2001), which includes decapod crustaceans and fishes as the most important food items (Pimentel and Joyeux 2010)(Freitas et al. 2011b). The species displays two reproductive spawning seasons: the first between November and April, and the second between June and July (Teixeira et al. 2010). In Brazil, this species is mainly caught by handline artisanal fisheries {Frédou and Ferreira 2005} and traps (Ribeiro 2004), especially in the Northeast Region, representing a great economic resource.

The Aquaculture and Fisheries Secretariat, under the Ministry of Agriculture, Livestock and Supply, is responsible for managing fisheries in Brazil. Other federal agencies are also involved, particularly the Ministry of Environment, which sets the agenda for endangered, threatened, and protected (ETP) species and protected areas (which include Territorial Use Rights for Fisheries, or Extractive Marine Reserves). The managements of the fisheries assessed in this report are at very distinct stages, ranging from an almost complete lack of regulations to a specific management plan to the target species with recent continuous enforcement.

Production Statistics

Catch statistics of marine fisheries along the Brazilian coast were available until 2011. The Northeast Region was historically one of the main producers of snappers (see figure). Since then, national fisheries statistics have not been produced.

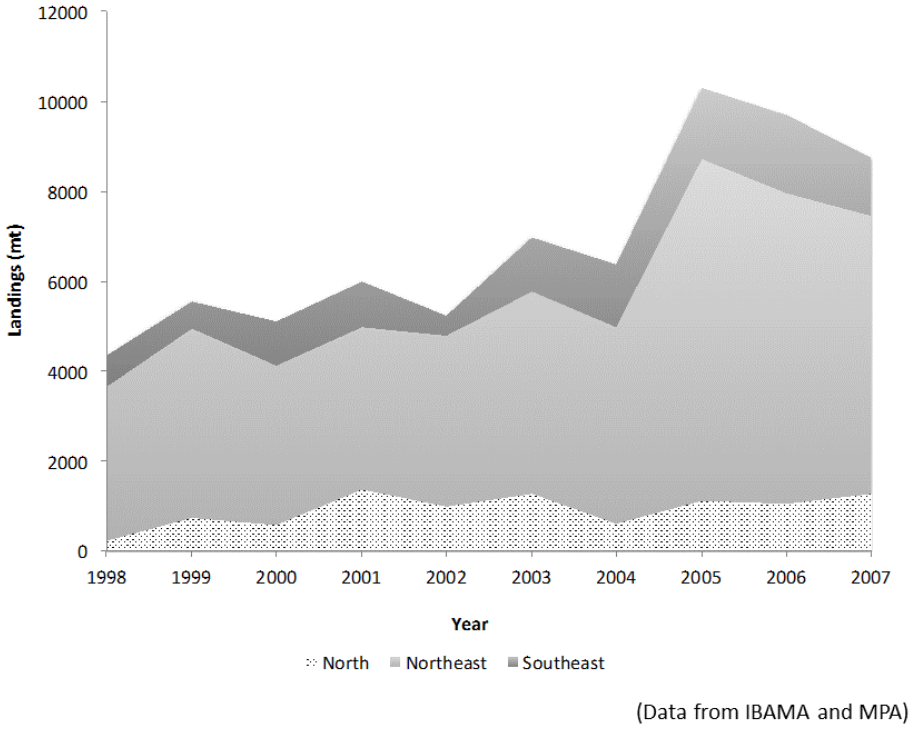

Figure 1: Commercial snapper landings by region, 1998–2007 (Data from IBAMA).

Nowadays, only Caribbean red snapper has production statistics since the publication of its management plan (data available are from the 2019–2021 seasons) at around 2,210 t/year. From 2007 onward, the national trade database has included Caribbean red snapper as a distinct category for export products (NCM codes 0302.89.10, 0302.89.12, 0303.89.32, 0304.29.20, 0304.89.10), and this may be one of the only means for inferring historical national production of the species. Other snapper species, because they are exported at a much lower volume than Caribbean red snapper, are grouped in multiple categories with other families (e.g., Sparidae, NCM codes 0303.79.33, 0302.69.23, 0302.85.00) in the national trade database (http://comexstat.mdic.gov.br/pt/geral), so their production could not be presented.

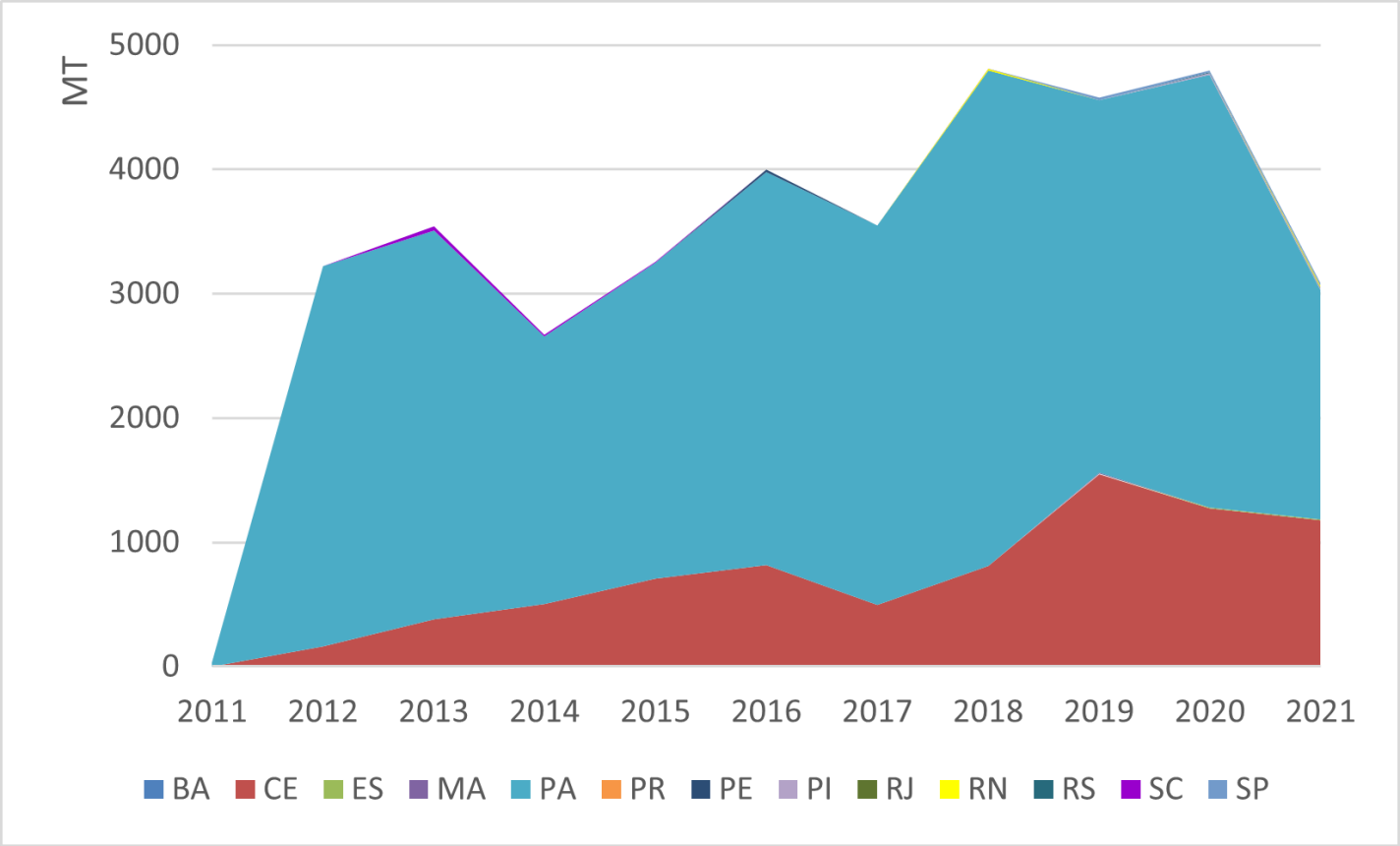

Figure 2: Contribution by Brazilian states to the export volume (in metric tons) of Caribbean red snapper. States: BA = Bahia, CE = Ceará, ES = Espírito Santo, MA = Maranhão, PA = Pará, PR = Paraná, PE = Pernambuco, PI = Piauí, RJ = Rio de Janeiro, RN = Rio Grande do Norte, RS = Rio Grande do Sul, SC = Santa Catarina, SP = São Paulo. Data extracted from COMEXSTAT 2021.

The state of Pará is the largest producer and exporter of Caribbean red snapper in Brazil. The Fishery Improvement Project for the Caribbean red snapper trap fishery in Brazil is also being developed in the state of Pará. This FIP is responsible for approximately 70% of the national production of the species.

Figure 3: Regions and states of Brazil (from Wikipedia)

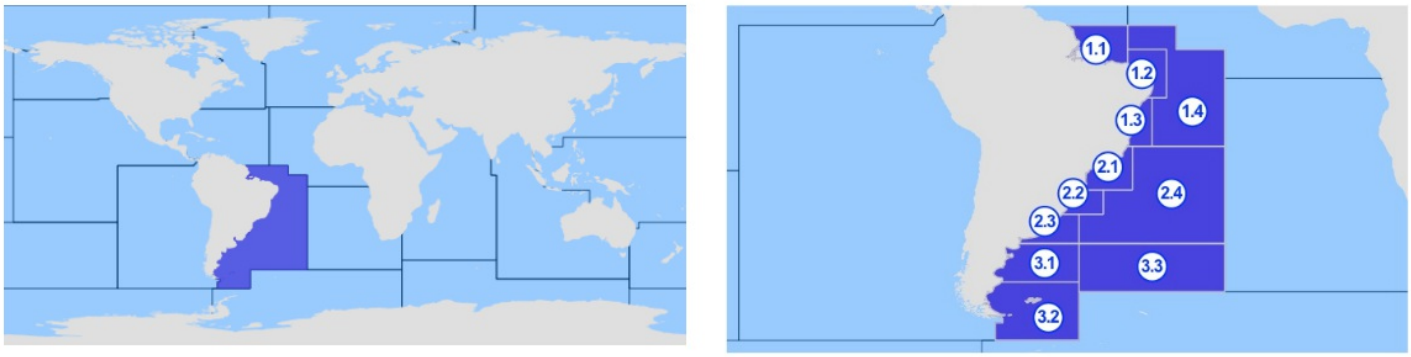

Figure 4: FAO Area 41 – Atlantic, Southwest (from FAO)

Importance to the US/North American market.

United States imports of snapper products in 2020 were valued at $155,305,596 and measured almost 22,000 metric tons (NMFS 2021). The main snapper supplier markets are: South America, North America (Mexico only), and Central America, comprising 41%, 30%, and 24% of the total volume imported, respectively. In South America, Brazil represents the first position among the snapper supplier market to the United States (NMFS 2021).

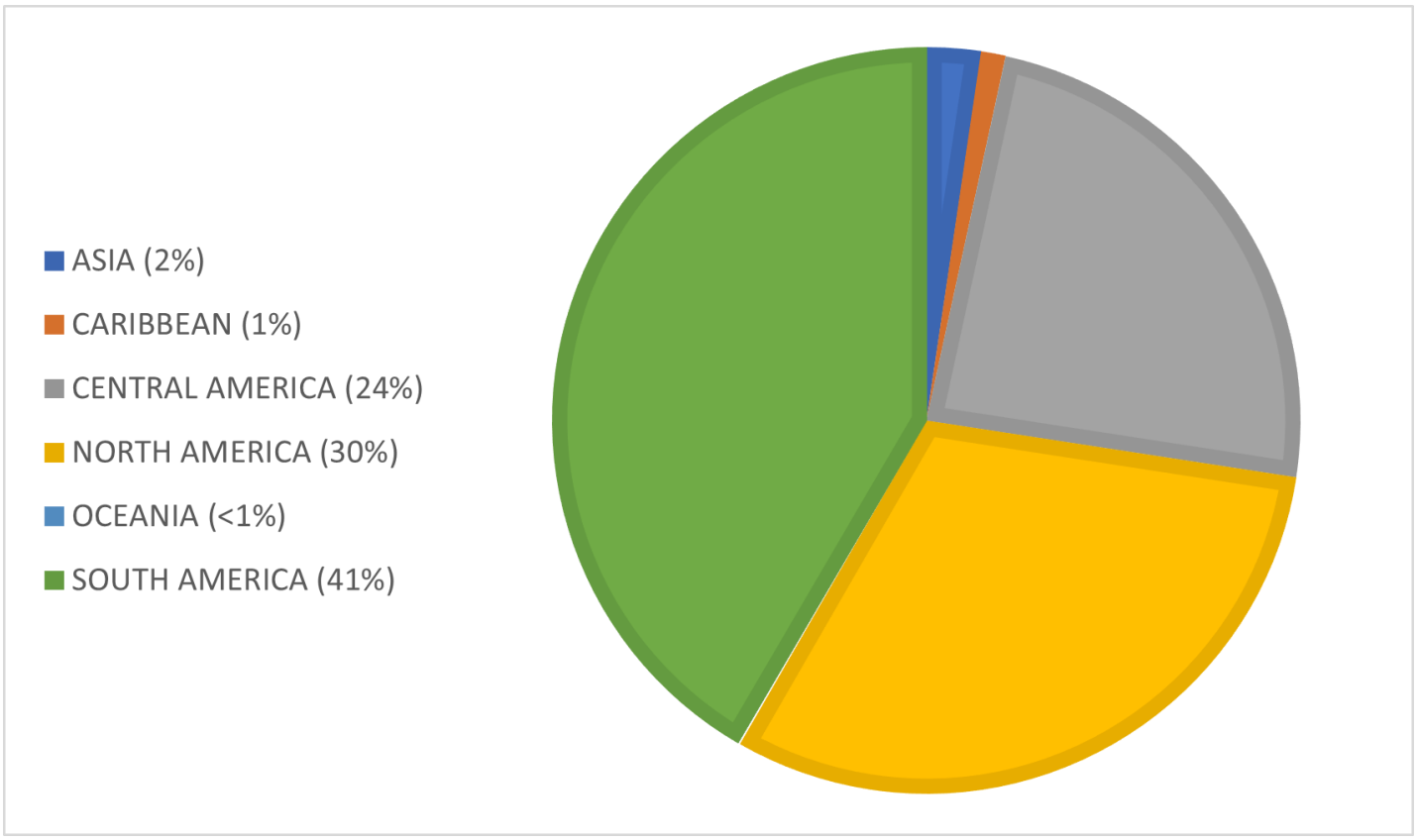

Figure 5: Total of snapper imports from global regions to the U.S. in 2020. Extracted from NOAA's U.S. trade in fishery products online database.

Between 2001 and 2021, the United States imported from Brazil a total of 79,763,376 kg of snapper, either frozen or fresh (NMFS 2021). Frozen snapper imported from Brazil has increased over the years, peaking in 2016 (4,261 mt), whereas fresh snapper has decreased in volume after peaking in 2003 at 3,684 mt (NMFS 2021). Over the most recent 5 years, there has been a new increase in fresh snapper imports, while frozen snapper has oscillated in volume (NMFS 2021).

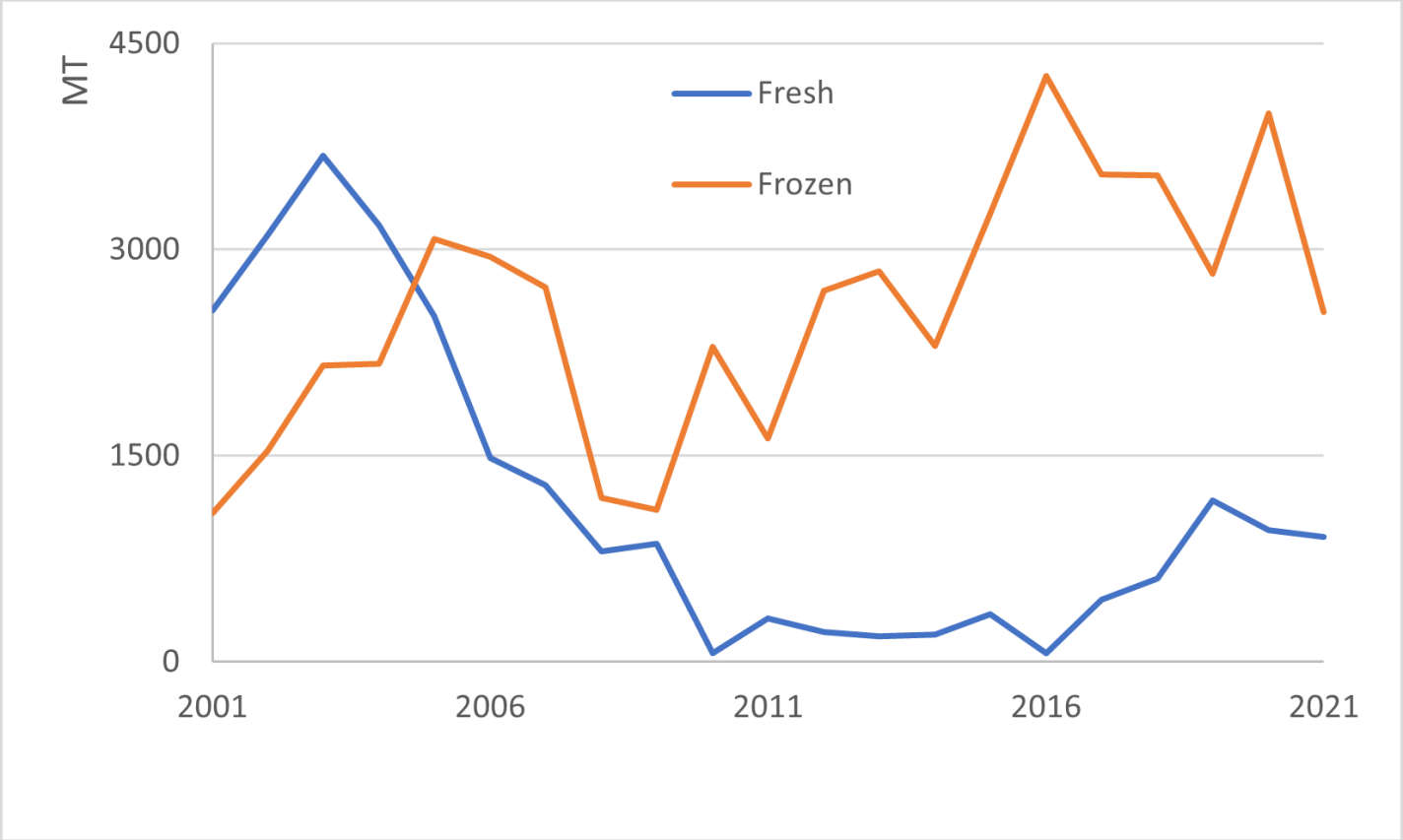

Figure 6: Total snapper production imported by the United States from Brazil, 2001–2021 (NMFS 2021).

Common and market names.

Lutjanus purpureus
Common names: Caribbean red snapper, southern red snapper

Ocyurus chrysurus
Common name: yellowtail snapper

Lutjanus synagris
Common name: lane snapper

Lutjanus analis
Common name: mutton snapper

Lutjanus jocu
Common name: dog snapper

Rhomboplites aurorubens
Common name: vermilion snapper

Primary product forms

Snapper is exported to the U.S. market both fresh (whole and gutted) and frozen (whole and gutted) (Cunha et al. 2012). Fillets of snapper are also exported from Brazil, but are less common.

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

CARIBBEAN RED SNAPPER			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

DOG SNAPPER			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000: High Concern	1.000: High Concern	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000: High Concern	1.000: High Concern	Red (1.000)

LANE SNAPPER			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000: High Concern	1.000: High Concern	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000: High Concern	1.000: High Concern	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000: High Concern	1.000: High Concern	Red (1.000)

MUTTON SNAPPER			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000: High Concern	1.000: High Concern	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000: High Concern	1.000: High Concern	Red (1.000)

VERMILION SNAPPER			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

YELLOWTAIL SNAPPER			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000: High Concern	1.000: High Concern	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000: High Concern	1.000: High Concern	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000: High Concern	1.000: High Concern	Red (1.000)

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.*

Caribbean red snapper

Factor 1.1 - Abundance

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

High Concern
A recent stock assessment is not available for Caribbean red snapper, but there is a recent Management Strategy Evaluation (MSE), which assessed multiple Management Procedures within a data-limited approach. The study did not bring out a stock diagnosis (Feltrim and Dias 2019). Caribbean red snapper is listed as "Vulnerable" by the Brazilian national Red List (criteria A2bcd) (ICMBio 2020)(SiBBr 2020). The main reason to list this species as "Vulnerable" is a population decrease of 45% within three generations (ICMBio 2014). Because it is considered a species of concern by the Brazilian government, we scored Caribbean red snapper a high concern.

Factor 1.2 - Fishing Mortality

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

Moderate Concern
A stock assessment is not available for the species. Catches of Caribbean red snapper have been reported to be decreasing since the late 1980s. The species is currently only exploited in the northern coast of Brazil, with signs of decline (about 30%) after intense fishing depleted the stock in other parts where it was once abundant (ICMBio 2014). The species was listed as fully exploited in a recent study (Verba et al. 2019). Caribbean red snapper is targeted in a specific fishery that is currently part of a Fishery Improvement Project (Fishery Progress 2021). The FIP preliminary assessment indicated an overfishing status (E = 0.71; F = 0.82); however, because data came from a small time series, there might be other driving factors, such as local recruitment rate or oceanographic and climatic phenomena (Fishery Progress 2021). A management strategy evaluation prepared in 2019 demonstrated that, if the stock were harvested at 4,500 t/year, it would have a 75% probability of being sustainable and an 82% probability of not promoting overfishing (Feltrim and Dias 2019)(Feltrim 2019). Such probabilities are above 90% if the stock were harvested at 3,500 t/year (Feltrim and Dias 2019). The current national production of the species is around 2,210 t/year (data from the 2020 season) (MAPA 2021). Indications of illegal fishing by vessels not originally registered for this specific fishery led to the cancellation of at least 72 permits in 2021. The previous illegal fishing likely resulted in a larger catch than what had been officially recorded (Freire JL 2019)(SAP/MAPA 2021). Because current production is below the levels expected to keep the stock at sustainable levels, but with uncertainties about the official records, this factor is scored a moderate concern.

Dog snapper

Factor 1.1 - Abundance

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

High Concern
In the past, the biomass of dog snapper was estimated at 2,604 t and approximately 400,000 recruits (Klippel et al. 2005), suggesting that the stock was in decline. Another study (Fredou et al. 2009) came to a similar conclusion of population decline. A more recent study also indicates population decline and an overfished status in southern Bahia (Previero 2018). The species is listed as "Near Threatened" by the latest nationwide assessment, which was updated in 2018 (ICMBio 2020)(SiBBr 2020). We assign this species a score of high concern for abundance because of its "Near Threatened" status.

Factor 1.2 - Fishing Mortality

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

High Concern
In previous years, estimates of fishing mortality for dog snapper would vary from 0.002 to 1.042 in different scenarios (Fredou et al. 2009). The same study considered the calculated natural mortality M = 0.12, indicating that the stock of dog snapper was overexploited or fully exploited in Northeast Brazil (Fredou et al. 2009). A more recent assessment in southern Bahia has identified overfishing (Z: 0.34, M: 0.13, F: 0.21, F/M: 1.62, SPR: 0.46) (Previero 2018). In 2019, another study classified the species as being fully exploited (Verba et al. 2019). Dog snapper is also evaluated as "Near Threatened" by the Brazilian government due to low abundance and high fishing pressure (ICMBio 2014)(ICMBio 2020) (SiBBr 2020). Because overfishing is likely occurring, we assign this species a fishing mortality score of high concern.

Lane snapper

Factor 1.1 - Abundance

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

High Concern
In 2005, lane snapper biomass estimated for the states of Bahia and Espirito Santo was 608 t, and in 2006 the biomass estimated for Northeastern Brazil was 7,200 t (Klippel et al. 2005)(MMA 2006). More recently, no abundance decline was reported in an important region of its range where fishing pressure is significant but the species is not overfished (Previero 2018). The species is listed as "Near Threatened" by the latest nationwide assessment, which was updated in 2018 (ICMBio 2020)(SiBBr 2020). We assign this species a score of high concern for abundance because of its "Near Threatened" status.

Factor 1.2 - Fishing Mortality

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

High Concern
Fishing mortality data have been estimated in assessments with restricted range over the years. According to Lessa et al. 2004, lane snapper fishing mortality is high: 0.197 (Lessa et al. 2004). In another study, the estimates of fishing mortality varied from 0.056 to 0.2980, depending on the scenario considered (Fredou et al. 2009). More recently, fishing parameters were calculated in a significant portion of the species' range and indicated overfishing (Z: 0.44, M: 0.22, F: 0.22, F/M: 0.98, SPR: 0.41) (Previero 2018), and that most individuals caught are smaller than the l_{50} ("growth overfishing," Haddon 2011 cited in Previero 2018). Another recent regional study indicates the exploitation status for lane snapper as "developing" (Verba et al. 2019). Because overfishing is likely occurring, we assign this species a fishing mortality score of high concern.

Mutton snapper

Factor 1.1 - Abundance

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

High Concern
In the past, estimates of biomass for mutton snapper were calculated from cohort analysis, and ranged from 1,568 to 90,720 t (Fredou et al. 2009). The Brazilian Ministry of Environment (MMA 2004) had previously classified mutton snapper as a "Threatened" species; however, because of pressure from the fishing industry, this species was reclassified to Appendix II as overexploited (MMA 2005). The species is currently listed as "Near Threatened" by the latest nationwide assessment, which was updated in 2018 (ICMBio 2020)(SiBBr 2020). We assign this species a score of high concern for abundance because of its "Near Threatened" status.

Factor 1.2 - Fishing Mortality

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

High Concern
Fishing parameters for mutton snapper have been estimated over the years, but recent values are not available. According to Klippel et al. (2005), an increasing trend of exploitation rates was observed for mutton snapper using virtual population analysis, with the fishing mortality rates exceeding the natural mortality rate ($F/Z > 0.5$), mainly for individuals > 65 cm fork length (FL) (Klippel et al. 2005). In 2009, using different scenarios for assessing snapper stocks, Fredou et al. (2009) estimated $F_{CURRENT}$ for mutton snapper as ranging from 20% to 40% above F_{MAX} when $M = 0.1$, indicating that the stock was overexploited (Fredou et al. 2009). In 2019, another study assigned mutton snapper status as fully exploited (Verba et al. 2019). In southern Bahia, a 3-year monitoring identified most catches as above the catch limit size (ICMBio 2020a). Considering the uncertainty of the current F value but the likelihood that overfishing is occurring, fishing mortality is scored a high concern.

Vermilion snapper

Factor 1.1 - Abundance

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

High Concern
The biomass of vermilion snapper was previously estimated at 1,314 t, with approximately 5,100,000 recruits for the central coast of Brazil (Klippel et al. 2005). The study also indicated that the stock was in decline. The stock of vermilion snapper has not been quantitatively estimated in Brazil in recent years (Zamboni 2020), but the species is listed as "Near Threatened" by the national Red List (SiBBr 2020). Because of the "Near Threatened" status, the species receives a score of high concern.

Factor 1.2 - Fishing Mortality

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

Moderate Concern
In previous years, the species was regarded as overexploited by cumulative fishing pressure, especially in the central coastal region of Brazil (Klippel et al. 2005). A stock assessment published in the last 5 years is not available for vermilion snapper; therefore, it is not possible to infer whether overfishing is currently occurring (Zamboni 2020). More recently, a study based on reconstructed data suggests the exploitation status for vermilion snapper as "developing" (Verba et al. 2019). Fishing mortality of the species is currently unknown. Because F is unknown, we assign this species a fishing mortality score of moderate concern.

Yellowtail snapper

Factor 1.1 - Abundance

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

High Concern
The importance of yellowtail snapper to local fisheries and its current abundance (compared to other species) may mask its overexploited status (Bender et al. 2013). Overall, yellowtail snapper is broadly fished in Brazil, with overexploited populations reported in the past (Costa et al. 2003)(Floeter et al. 2006)(IBAMA 2006)(Mariano and Rosa 2010), especially in the central coastal region (Klippel et al. 2005). Biomass values for yellowtail snapper were estimated in the past in studies that indicated that the species abundance was declining (Klippel et al. 2005)(Fredou et al. 2009). The species is listed as "Near Threatened" by the latest nationwide assessment, which was updated in 2018 (ICMBio 2020) (SiBBr 2020). A full stock assessment is not available for the species. We assign yellowtail snapper a score of high concern for abundance because of its "Near Threatened" status.

Factor 1.2 - Fishing Mortality

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

High Concern
Cumulative fishing pressure on yellowtail snapper in Brazil is quite high. Yellowtail snapper was classified as overexploited in a study using local ecological knowledge in the northeast coast of Brazil (Bender et al. 2013); a recent study in southern Bahia has identified overfishing (Z: 0.43, M: 0.20, F: 0.22, F/M: 1.09, SPR: 0.43) (Previero 2018). F values throughout its entire distribution are not available. Because the species is experiencing local overfishing according to available information, but for other regions such information is unavailable (but overfishing is likely occurring), we assign this species a fishing mortality score of 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

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.

CARIBBEAN RED SNAPPER			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)	1.000	1.000: < 100%	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)	1.000	1.000: < 100%	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000	1.000: < 100%	Red (1.000)

DOG SNAPPER			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000: < 100%	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000	1.000: < 100%	Red (1.000)

LANE SNAPPER			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000: < 100%	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000: < 100%	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000	1.000: < 100%	Red (1.000)

MUTTON SNAPPER			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000: < 100%	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000: < 100%	Red (1.000)

VERMILION SNAPPER			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000: < 100%	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000	1.000: < 100%	Red (1.000)

YELLOWTAIL SNAPPER			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000: < 100%	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	1.000	1.000: < 100%	Red (1.000)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	1.000	1.000: < 100%	Red (1.000)

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.

SOUTHWEST ATLANTIC | ATLANTIC, SOUTHWEST / 41.1.1 | ATLANTIC, SOUTHWEST / 41.1.2 | TRAPS | BRAZIL | NORTH (AMAPÁ AND PARÁ): FAO 41 (1.1, 1.2)			
SUB SCORE: 1.000	DISCARD RATE: 1.000	**SCORE: 1.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Goliath	1.000: High Concern	1.000: High Concern	Red (1.000)
Finfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Caribbean red snapper	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

SOUTHWEST ATLANTIC | ATLANTIC, SOUTHWEST / 41.1.1 | ATLANTIC, SOUTHWEST / 41.1.2 | VERTICAL LINES | BRAZIL | NORTH (AMAPÁ AND PARÁ): FAO 41 (1.1, 1.2)			
SUB SCORE: 1.000	DISCARD RATE: 1.000	**SCORE: 1.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Goliath	1.000: High Concern	1.000: High Concern	Red (1.000)
Finfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Caribbean red snapper	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

SOUTHWEST ATLANTIC | ATLANTIC, SOUTHWEST / 41.1.2 | ATLANTIC, SOUTHWEST / 41.1.3 | ATLANTIC, SOUTHWEST / 41.1.4 | HANDLINES | BRAZIL | NORTHEAST (MARANHÃO, PIAUÍ, CEARÁ, RIO GRANDE DO NORTE, PARAÍBA, PERNAMBUCO, ALAGOAS, SERGIPE, BAHIA): FAO 41 (1.2, 1.3, 1.4)

SUB SCORE: 1.000 | DISCARD RATE: 1.000 | **SCORE: 1.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Dog snapper	1.000: High Concern	1.000: High Concern	Red (1.000)
Finfish	1.000: High Concern	1.000: High Concern	Red (1.000)
Lane snapper	1.000: High Concern	1.000: High Concern	Red (1.000)
Mutton snapper	1.000: High Concern	1.000: High Concern	Red (1.000)
Yellowtail snapper	1.000: High Concern	1.000: High Concern	Red (1.000)
Vermilion snapper	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

SOUTHWEST ATLANTIC | ATLANTIC, SOUTHWEST / 41.1.2 | ATLANTIC, SOUTHWEST / 41.1.3 | ATLANTIC, SOUTHWEST / 41.1.4 | TRAPS | BRAZIL | NORTHEAST (MARANHÃO, PIAUÍ, CEARÁ, RIO GRANDE DO NORTE, PARAÍBA, PERNAMBUCO, ALAGOAS, SERGIPE, BAHIA): FAO 41 (1.2, 1.3, 1.4)

SUB SCORE: 1.000 | DISCARD RATE: 1.000 | **SCORE: 1.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lane snapper	1.000: High Concern	1.000: High Concern	Red (1.000)
Mutton snapper	1.000: High Concern	1.000: High Concern	Red (1.000)
Yellowtail snapper	1.000: High Concern	1.000: High Concern	Red (1.000)
Finfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

SOUTHWEST ATLANTIC | ATLANTIC, SOUTHWEST / 41.1.3 | ATLANTIC, SOUTHWEST / 41.2.1 | VERTICAL LINES | BRAZIL | SOUTHEAST REGION (ESPÍRITO SANTO, RIO DE JANEIRO, SÃO PAULO, DISTRITO FEDERAL): FAO 41 (1.3, 2.1)

SUB SCORE: 1.000 | DISCARD RATE: 1.000 | **SCORE: 1.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Dog snapper	1.000: High Concern	1.000: High Concern	Red (1.000)
Lane snapper	1.000: High Concern	1.000: High Concern	Red (1.000)
Yellowtail snapper	1.000: High Concern	1.000: High Concern	Red (1.000)
Caribbean red snapper	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Sharks	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Vermilion snapper	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Wreckfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

The fish species assessed under Criterion 2 include those listed in the official list of incidental/by-catch species for each fishery assessed (Brasil 2011). The only exceptions are the trap/pot and vertical line fisheries that target Caribbean red snapper, because there are more specific studies and updated catch information on nontarget/secondary species, following a Fisheries Improvement Project (da Silva et al. 2017). The previous assessment included Criterion 2 species based on old (10+ years) catch information. In addition, many of the species assessed in Criterion 2 are considered target species in some of the fisheries (which may include over 30 species as target), so they were grouped as "finfish."

1. Handline fishery targeting Lutjanidae, Scombridae, Serranidae, and Carangidae

Although no by-catch is officially listed for this multispecies fishery, we assessed other target species that are not Lutjanidae. Bigeye tuna limits the score because the species is overfished and overfishing is occurring. Overfishing is also likely occurring

for yellowfin tuna. Black grouper and red grouper are listed as "Vulnerable" by the latest national Red List.

2. Trap/pot fishery targeting spotted goatfish (with recent expansion to Lutjanidae and Haemulidae spp)

Although no by-catch is officially listed for this multispecies fishery, we assessed spotted goatfish and tomtate grunt. These species scored with moderate concern because of their "Least Concern" conservation status and unknown fishing mortality.

3. Trap/pots fishery targeting Caribbean red snapper

The species that limits the score for Criterion 2 is goliath grouper, which is currently listed as "Critically Endangered" by the national Red List and is in moratorium until 2023, and catches in this fishery, although not frequent, may still occur.

4. Vertical lines targeting Caribbean red snapper

The species that limits the score for Criterion 2 is goliath grouper, which is currently listed as "Critically Endangered" by the national Red List and is in moratorium until 2023, and catches in this fishery, although not frequent, may still occur.

5. Vertical lines targeting Lutjanidae

Nine shark species are limiting the score for Criterion 2 in this fishery (bigeye thresher shark, tope shark, narrownose smooth-hound shark, basking shark, nurse shark, whale shark, angular angelshark, hidden angelshark, and daggernose shark) because they are all on the Red List.

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

Finfish

Factor 2.1 - Abundance

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

High Concern
The main secondary species captured in the fisheries targeting Caribbean red snapper are vermilion snapper (≈22% of landings), king mackerel (≈12%), greater amberjack (≈37%), and other Carangidae species (crevalle jack, blue runner, horse-eye jack) that are usually grouped together (≈10%) (da Silva et al. 2017). None of these species have stock assessments, and/or they are listed as "Least Concern" by the latest national Red List (ICMBio 2020)(SiBBr 2020). The only exception is vermilion snapper, which is listed as "Near Threatened" by the same Red List (ICMBio 2020)(SiBBr 2020). This factor receives a score of high concern because of vermilion snapper's "Near Threatened" status.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

High Concern
This multispecies fishery targets Scombridae, Lutjanidae, Serranidae/Epinephelidae, and Carangidae (Brasil 2011)(Zamboni 2020). We will discuss stock status by family group (except Lutjanidae).

Scombridae

Scombridae listed in the Northeast handline fishery include skipjack tuna, little tunny, frigate tuna, bigeye tuna, blackfin tuna, yellowfin tuna, albacore, Spanish mackerel, and chub mackerel. Most of these species do not have stock assessments; however, bigeye tuna has a stock assessment from 2018 indicating that the species is overfished (SSB_{2017}/SSB_{MSY} = 0.59, target reference point [TRP] between 0.42 and 0.80) (ICCAT 2019)(Zamboni 2020b).

Serranidae

Serranidae listed in the Northeast handline fishery include snowy grouper, red grouper, black grouper, comb grouper, and gag grouper. None of these species have available stock assessments. Black grouper and red grouper are currently included as "Vulnerable" in the national Red List (ICMBio 2020)(SiBBr 2020) and have been part of an ongoing Recovery Plan for Endangered Reef Species since 2018 (MMA 2018).

Carangidae

Carangidae listed in the Northeast handline fishery include horse-eye jack, crevalle jack, greater amberjack, lesser amberjack, blue runner, yellow jack, Atlantic bumper, rainbow runner, castin leatherjack, Atlantic moonfish, lookdown, African pompano, rough scad, yellowtail lamberjack, Florida pompano, great pompano, and plata pompano. None of these species have available stock assessments; however, except for lesser amberjack (listed as "data deficient"), all species are listed as "Least Concern" by the latest national Red List assessment (ICMBio 2020)(SiBBr 2020).

This factor receives a score of high concern because of bigeye tuna's overfished status, and black grouper and red

grouper's "Vulnerable" status on the national Red List.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Moderate Concern
According to Brazil's federal list of onboard fisheries (Brasil 2011), the multispecies trap fishery in the Northeast Region targeted spotted goatfish (*Pseudupeneus maculatus*) but, more recently, because of the species' population decline, the fishery has been targeting multiple species, with tomtate grunt (*Haemulon aurolineatum*) and lane snapper being the most abundant landed species (Souza Jr 2018). Tomtate grunt has no recent stock assessment; however, the species is listed as "Least Concern" by the latest national assessment (ICMBio 2020)(SiBBr 2020). Spotted goatfish also does not have a recent stock assessment. In 2006, the species biomass was estimated at 2,000 t for the Northeast Region. The species is listed as "Least Concern" from the latest national assessment (ICMBio 2020)(SiBBr 2020). Because of the "Least Concern" status of both species, this factor receives a score of moderate concern.

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

Moderate Concern
Because stock assessments are not available for any of the species (vermilion snapper, king mackerel, greater amberjack, and other Carangidae species), fishing mortality is currently unknown. Therefore, we assign this species a fishing mortality score of moderate concern.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

High Concern
Scombridae

Overfishing is currently occurring for bigeye tuna (F_{2017}/F_{MSY} = 1.63) (CI 1.14–2.12) (ICCAT 2019)(Zamboni 2020b).

There are total allowable catches (TAC) established by ICAAT based on the stock assessments; however, the likelihood of stock recovery by 2033 is 44%, which does not meet ICAAT's targets (ICCAT 2019)(Zamboni 2020b). For yellowfin tuna, there is a 43% probability that overfishing might be occurring, particularly among younger individuals, according to the 2019 stock assessment (ICCAT 2019b)(Zamboni 2020b). In other species with stock assessments (skipjack tuna and albacore), overfishing is not occurring. For the remaining species (little tunny, frigate tuna, blackfin tuna, king mackerel, Spanish mackerel, and chub mackerel), stock assessments are not available.

Serranidae

Because stock assessments are not available for any of the Serranidae species (snowy grouper, red grouper, black

grouper, comb grouper, and gag grouper), overfishing cannot be confirmed. But, both black and red grouper have been part of a national recovery plan since 2018 because of population declines as a result of overexploitation (MMA 2018). There has been a minimum size catch regulation for gag grouper since 2005 (Zamboni 2020b).

Carangidae

Although stock assessments are not available for any of these species (horse-eye jack, crevalle jack, greater amberjack, lesser amberjack, blue runner, yellow jack, Atlantic bumper, rainbow runner, castin leatherjack, Atlantic moonfish, lookdown, African pompano, rough scad, yellowtail lamberjack, Florida pompano, great pompano, and plata pompano), a few isolated studies have identified potential overfishing status in the past for castin leatherjack (Murad 2010), Atlantic moonfish (Bastos et al. 2005), and rough scad (Haimovici et al. 2009).

This factor receives a score of high concern because overfishing is occurring for bigeye tuna and likely for yellowfin tuna.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Moderate Concern

This section covers fishing mortality for spotted goatfish and tomtate grunt. Tomtate grunt is usually caught by multispecies fisheries using handline, pots, and gillnets (Melo CC 2019), and it is one of the most abundant species in pot gear (Souza-Junior 2018). But, fishing mortality for the species is unknown. Spotted goatfish was targeted as the main species in pot fisheries in the Northeast Region of Brazil, but population declines have been observed in the past decades (Lessa et al. 2009), including catches of significantly smaller individuals than in previous records (Souza-Junior 2018). Because fishing mortality is not available for the species, overfishing cannot be confirmed from the changes of target species from spotted goatfish to tomtate grunt and lane snapper in this fishery. Therefore, this factor receives a score of moderate concern.

Goliath

Factor 2.1 - Abundance

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

High Concern
Goliath grouper is listed as "Vulnerable" by the International Union for the Conservation of Nature (IUCN) Red List (criteria A2bcd) (Bertoncini et al. 2018) and it is listed as "Critically Endangered" by the Brazilian national Red List, which was updated in 2018 (criteria A2bcd) (ICMBio 2020)(SiBBr 2020) but using data from up to 2012. Goliath grouper receives a score of high concern based on its status from the IUCN Red List, which contains a more updated assessment.

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

High Concern
The fishing mortality rate, F, is unknown for goliath grouper, and the species has been protected in Brazil since 2002 through a fishing moratorium (BRASIL 2015b). In the vertical line and trap/pot fisheries where this species is officially listed as "bycatch" (Brasil 2011), illegal catches of goliath grouper are rare but still occur after recent years of monitoring (da Silva et al. 2017), and it is even sold in local markets (Freire JL 2019)(Pereira et al. 2021). Considering that the current F is unknown and that the species is still caught and sold despite the moratorium, this factor receives a score of high concern.

Sharks

Factor 2.1 - Abundance

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

High Concern
Shark by-catch in longline fisheries is quite common throughout the world, contributing to declines of several species over the years and causing many elasmobranchs to be included on red lists (Dulvy et al. 2021). The vertical line fishery that targets Lutjanidae in Southeast Brazil has nine shark species officially listed as by-catch (Brasil 2011) (although other shark species may be caught, but likely less frequently): bigeye thresher, tope shark, narrownose smooth-hound, basking shark, nurse shark, whale shark, angular angelshark, hidden angelshark, and daggernose shark. Six of these species are currently listed as "Critically Endangered" by the national Red List (tope shark, narrownose smooth-hound, basking shark, angular angelshark, hidden angelshark, and daggernose shark) and three are listed as "Vulnerable" (bigeye thresher, nurse shark, and whale shark) (ICMBio 2020)(SiBBr 2020). Because all species are on a red list, this factor receives a score of high concern.

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

Moderate Concern
Fishing mortality for all nine of these shark species (bigeye thresher, tope shark, narrownose smooth-hound, basking shark, nurse shark, whale shark, angular angelshark, hidden angelshark, and daggernose shark) is unknown. Because F is unknown, this factor receives a score of moderate concern.

Wreckfish

Factor 2.1 - Abundance

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

High Concern
Atlantic wreckfish was historically one of the most abundant species in the Southeast and South Regions of Brazil, being among the most captured species in the deepset longline fishery (Zamboni 2020). But, because of a massive decline in catches, the species was listed in the National List of Overexploited Marine Resources. The species is in a moratorium (any catch is forbidden) until 2023 (Brasil 2015c). Atlantic wreckfish is listed as "Critically Endangered" by both the Brazil national Red List and the IUCN Red List (SiBBr 2020)(ICMBio 2020). Because of its listing status, Atlantic wreckfish receives a score of high concern.

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

Moderate Concern
Available information on catches and landings of the species is scarce, particularly because data historically were combined with similar species (Zamboni 2020). Because fishing mortality is unknown and catches have been forbidden since 2005 (Brasil 2015c), this factor receives a score of moderate concern.

Factor 2.3 - Discard Rate/Landings

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

< 100%
The trap/pot fishery targeting Caribbean red snapper uses small "bait baskets" made from PVC tubes with holes (da Silva et al. 2017). Their interior is filled with macerated sardine-like fish (Egraulidae, Clupleidae) and carcasses of tuna (*Katsuwonus* sp.) tied to the bait basket (da Silva et al. 2017).

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

< 100%
Vertical lines targeting Caribbean red snapper use pieces of sardine-like species or other caught species of lesser commercial value and, eventually, Caribbean red snapper individuals that are damaged and not commercially viable (da Silva et al. 2017).

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba,

Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

< 100%
Live bait is captured before fishing trips and dead bait is bought in local markets. The main bait species used are the Atlantic thread herring (*Opisthonema oglinum*), bigeye scad (akule) (*Selar crumenophthalmus*), and fourwing flyingfish (*Hirundichthys affinis*) (de Mattos 2004). In Brazil, most handline fisheries target multiple species, with all catch generally kept/landed (not discarded).

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

< 100%
Part of the catch that is not sold or consumed (subsistence) may be used as bait in this fishery (Souza Jr 2018).

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

< 100%
For this fishery, shrimps are usually used as bait (but fish may also be used, less frequently) (Netto and di Beneditto 2007).

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	DATA COLLECTION AND ANALYSIS	ENFORCEMENT	INCLUSION	SCORE
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	**Yellow (3.000)**
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	**Yellow (3.000)**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	Ineffective	Highly effective	Ineffective	Ineffective	Moderately Effective	**Red (1.000)**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	Critical	Highly effective	Ineffective	Ineffective	Moderately Effective	**Black (0.000)**
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	Ineffective	Ineffective	Ineffective	Moderately Effective	Moderately 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 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.

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 a mechanism to effectively address user conflicts.

Factor 3.1 - Management Strategy And Implementation

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

Moderately Effective
Caribbean red snapper in Brazil has specific regulations for the management of the species. The Caribbean red snapper recovery plan (MMA 2018b) and the Ordinance No. 42/2018 (BRASIL 2018) define rules for the sustainable use and recovery of stocks of Caribbean red snapper, including delimitation of the fleet's operating area, the fishing depth at above 50 m, the annual closed season from December 15 to April 30, the limitation of the fleet to 150 vessels, and the specifications of gears authorized for fishing activities (BRASIL 2018)(Zamboni 2020b). This recovery/management plan was published in 2018 after several discussions with the stakeholders, because the species was first listed as "Vulnerable" in the 2014 national Red List and its catch was suspended for a period (MMA 2014)(IBAMA 2018)(MMA 2018c). The plan was due for regular updates and enforcement, and between 2018 and 2019, four emergency actions

were expected to be implemented (Oceana 2020):

(1) Re-registration and regularization of all vessels engaged in the Caribbean red snapper fishery in the North and Northeast Regions;

(2) Implementation of a continuous monitoring program for the Caribbean snapper fishery;

(3) Assess the relevance and feasibility of establishing (i) a preventive annual catch limit for the 2019 harvest, compatible with the catch history, and (ii) a maximum fleet size, based on the re-registration of vessels and stock support capacity; and

(4) Ensure the functioning of the Permanent Committee for the Management of Demersal Resources in the North/Northeast Regions, including its respective Scientific Subcommittee.

These four actions were all included as prerequisites for altering Ordinance No. 42 and reopening the Caribbean red snapper fishery; however, they were not implemented right away (Fishery Progress 2021). The 2018–2019 harvest seasons still occurred without any measures foreseen in the plan being discussed or implemented, which represented an imminent risk of repealing Ordinance MMA 228/2018 (which recognizes the possibility of using the species despite its "Vulnerable" conservation status) (MMA 2018c) and creating a serious setback in the species' management. Before the 2021 season started, the federal government (under Ordinance no. 119/2021 MAPA/SAP (SAP/MAPA 2021)) finally enforced the red snapper recovery plan (BRASIL 2018) and withdrew authorization for 72 boats to fish for 60, 90, or 180 days until the fleet complied with regulation (sharing navigation and harvest data), thus meeting emergency action #1 and partly meeting emergency action #3. The emergency action #4 was recently partly met when the federal government published in June 2021 the establishment of a National Collaborative Network for the Sustainable Management of Fishing Resources–Rede Pesca Brasil (BRASIL 2021).

The Caribbean red snapper trap/pot fishery improvement plan (FIP) was initiated in 2014 and has an expected end date of December 2022, involving a significant portion of stakeholders and fishing unions and covering nearly 70% of the entire Caribbean red snapper landings in Brazil {Fishery Progress 2020}. Within the FIP, several attempts to set harvest control, harvest strategy, and management plan were postponed, due to the federal government's transition, followed by the COVID-19 pandemic (Fishery Progress 2021). There was a pilot project to set a quota at 4,500 mt for the 2020 season, but this has not been implemented yet. In 2021, a meeting took place to request more governmental support, particularly to follow management rules and avoid illegal, unreported, and unregulated fishing (IUU). The FIP Management Committee needs to resume the meetings, even if they are held virtually, to share updates and strategies being implemented (Fishery Progress 2021).

This factor receives a score of moderately effective because there are some specific measures for fisheries targeting Caribbean red snapper, although emergency measures that were expected to be implemented in the 2018–2019 season only began to be partly implemented in 2021. Other important management measures (such as harvest control/strategy) are yet to be implemented.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Ineffective

This fishery targets reef species and small pelagics throughout several states from Pará to Espírito Santo, at depths up to 250 meters, by over 300 vessels (Zamboni 2020). The variety of this multispecies fishery is influenced by which state the vessel is fishing in. Some species targeted in this fishery are managed by Ordinances no. 40/2018 and 59-C/2018 (Brasil 2018c)(BRASIL 2018b) that establish minimum sizes and closed seasons, and set regulations for stock recovery

of snowy grouper (*Hyporthodus niveatus*), yellowmouth grouper (*Mycteroperca interstitialis*), black grouper (*Mycteroperca bonaci*), red grouper (*Epinephelus morio*), and cubera snapper (*Lutjanus cyanopterus*).

In addition, any fishery targeting Scombridae in Brazil must follow the recommendations and management strategies of the International Commission for the Conservation of Atlantic Tunas (ICCAT); however, such regulations have never become national regulations to be implemented in the country (Zamboni 2020). A 2019 Ordinance (no. 89/2019) attempts to limit fishing effort on both target and secondary species by suspending new fishing permits that target any tuna species (Brasil 2019b).

Even though relevant species (e.g., tunas and some red-listed species) have specific regulations, a great number (20+) of species in this fishery do not have any specific regulation, and neither does the fishery itself. Because the fishery does not have specific management regulations, and existing measures apply only to some of the target species (and existing measures do not include catch limits or other harvest control rules), this factor receives a score of ineffective.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Critical

This fishery occurs particularly in the states of Paraíba and Pernambuco, where about 115 vessels export most of their catches (Zamboni 2020). There are no specific management measures for this fishery. Over the years, the production in this fishery has shifted from spotted goatfish as the main species to tomtate grunt and lane snapper as the most abundant species, due to unmanaged catches (Souza Jr 2018). Because this fishery has no specific management, and a population decline for at least one of the target species is a direct effect of this fishery, this factor receives a score of critical.

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

Ineffective

The vertical line fishery targeting snappers in the Southeast Region of Brazil is carried out by 15 vessels from the state of Espírito Santo (Zamboni 2020). This fishery has no specific management plan; however, two target species have management measures: a minimum size and a closed season for cubera snapper, and the management plan for Caribbean red snapper (BRASIL 2018b)(BRASIL 2018), both of which are currently listed as "Vulnerable" by the national Red List (ICMBio 2020)(SiBBr 2020). Other guidelines for the fishery are not available. Because existing management strategies are insufficiently precautionary to protect the majority of retained populations, this factor scores ineffective.

Factor 3.2 - Bycatch Strategy

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

Moderately Effective

The trap/pot and vertical line fisheries targeting Caribbean red snapper have goliath grouper listed as a by-catch species (Brasil 2011), which is under a moratorium until 2023 (BRASIL 2015b). Within the trap/pot fishery improvement plan (FIP), data collection for secondary/ETP (endangered, threatened, and protected) species has been developed since 2016, with the goal of developing a continuous fisheries data collection program (including catch, effort, fishing areas, by-catch, and ghost fishing data) (Fishery Progress 2021). Catches of goliath grouper for both fisheries have been rare but still occur after some years of monitoring (da Silva et al. 2017)(Freire JL 2019). Because the catch of ETP species listed in these fisheries targeting Caribbean red snapper is still occurring, even in small numbers, this factor receives a score of moderately effective.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Highly effective
The multispecies handline fishery targeting Carangidae, Serranidae, Scombridae, and Lutjanidae has no species listed as by-catch (Brasil 2011). But, by-catch may eventually occur (although handline gear scores low concern for by-catch in this region). Because by-catch species are not expected in this fishery, this factor is marked highly effective.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Highly effective
The trap/pot fishery in the Northeast Region of Brazil has no species listed as by-catch (Brasil 2011). (This gear scores low concern for by-catch in this region, except for potential impact over corals and other biogenic structures, where this fishery usually occurs.) Because by-catch species are not expected in this fishery, this factor is scored highly effective.

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

Ineffective
The vertical line fishery targeting snappers in the Southeast Region of Brazil has wreckfish and nine shark species listed as by-catch (Brasil 2011). Wreckfish has a specific federal Ordinance (no. 14/2015 (Brasil 2015c)) that prohibits fishing, retention onboard, transshipment/landing, storage, transport, and selling of the species until 2023 in all Brazilian territory. Any incidentally caught individual must be immediately released and its catch/disposal (with fins attached) must be recorded. For the shark species, there is a specific federal Ordinance (no. 5/2011 (Brasil 2011b)) for bigeye thresher that also prohibits catch, retention onboard, landing, storage, and selling of the species. Other shark species (tope shark, narrownose smooth-hound, angular angelshark, and hidden angelshark) listed as by-catch species in this fishery are currently classified as "Critically Endangered" by the national Red List; any capture of these species has been prohibited since 2014, and any incidental catch must be reported and the animal released alive or discarded (with fins attached) (Ordinances 10/2011 and 445/2014 (Brasil 2011)(MMA 2014)). In addition, from 2014 to 2019, a National Action Plan for endangered shark species in Brazil was developed (ICMBio 2016b). Since the ending of this Plan's first cycle, no updates on the second cycle are available, nor any information regarding specific management measures for this fishery. The Plan's release after the end of this first cycle mentions that fishing management strategies were the ones with the least progress (CEPSUL 2020). Lastly, a diagnosis of Brazilian fisheries released in 2020 calls for attention to the fact that there are no legal means for enforcing any of these measures in this fishery (Zamboni 2020b). This factor receives a score of ineffective because, although there are specific regulations for species of concern listed as by-

catch in this fishery, mechanisms for compliance and enforcement for such measures are unclear, and lack of progress is evident for shark management.

Factor 3.3 - Scientific Data Collection and Analysis

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

Moderately Effective
The trap/pot fishery targeting Caribbean red snapper has started specific monitoring of this fisheries with the fishery improvement plan (FIP) (Fishery Progress 2021). Harvest data collection is mandatory by the government since 2019, and there is a specific federal online platform where this data is displayed (https://www.gov.br/agricultura/pt-br/assuntos/aquicultura-e-pesca/mapas-de-bordo/mapas-de-bordo-2019-da-especie-pargo). Such harvest data will be used by the government to monitor and manage the fisheries. Another relevant research initiated within the FIP was to assess the impact of trap gears on the benthos. With the publication of a detailed description of an extensive reef system at the Amazon River mouth (where a significant part of the fishery occurs) (Moura et al. 2016), caution was raised within the FIP, and a study to evaluate the impact and interaction of trap gear on the benthos was carried out by a local university (Schmid and Giarizzo 2019). The study concluded that "the seafloor in the fishing grounds is muddy or sandy, with sparse unconsolidated coral reefs structures. Some interactions were found when the trap is collected slowly or far away from the boat as the ropes make an obtuse angle, the trap drags and interacts with the seafloor/benthos. On the other hand, collections made fast with the ropes in the 'right' angle avoid almost completely the interaction" (Fishery Progress 2021). This bottom survey is expected to continue as part of the monitoring program. Mislabeling of snapper species may happen throughout the supply chain, and its effects on data collection and management is still poorly explored (Veneza et al. 2014) (Freire JL 2019). Because some data collection related to the stock and fishing impacts are happening, this factor receives a score of moderately effective.

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

Moderately Effective
Harvest data collection is mandatory by the government since 2019 for fisheries targeting Caribbean red snapper, and there is a specific federal online platform where this data is displayed (https://www.gov.br/agricultura/pt-br/assuntos/aquicultura-e-pesca/mapas-de-bordo/mapas-de-bordo-2019-da-especie-pargo). Such harvest data will be used by the government to monitor and manage the fisheries. Mislabeling of snapper species may happen throughout the supply chain, and its effects on data collection and management is still poorly explored (Veneza et al. 2014) (Freire JL 2019).

Because some data collection related to the stock and fishing impacts is happening, this factor receives a score of moderately effective.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Ineffective
This fishery is not included in any port/landing monitoring program. Fisheries statistics at a national level have stopped

since 2010. Because this fishery targets tuna species, it is mandatory to provide information on monthly production of tuna and other species that are monitored by ICCAT (Ordinance no. 5/3013) (Brasil 2013b). Out of the 308 vessels registered in this fishery, about 33% (101 vessels) have to deliver monthly production information to comply with this regulation (Zamboni 2020). Information on whether all these 101 vessels are currently complying is not available. Since 2018, a nationwide research project, "REPENSA PESCA," led by the government, aims to foster sustainable marine fisheries management in the country (MCTI/MPA/CNPQ n. 22/2015) (Brasil 2015d). This is a follow-up project to REVIZEE (Bastos et al. 2005)(MMA 2006)(IBAMA 2006), which created a baseline for targeted species management data (e.g., biomass and fishing mortality). The REPENSA PESCA is expected to be finalized in 2022 and data will be publicly available. Another concern poorly explored is the mislabeling of snapper species throughout the supply chain, which may cause errors in data collection (Veneza et al. 2014)(Freire JL 2019).

Because current research or monitoring projects only apply to a small portion of targeted species in the fishery (i.e., tuna) or have been in development with quite limited available data to support decision-making in the past decade, this factor receives a score of ineffective.

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Ineffective
These fisheries are not included in any port/landing monitoring program. Fisheries statistics at a national level have stopped since 2010 (ICMBio 2019). These fisheries have been assessed by academic research (e.g., (Souza Jr 2018) (Souza 2002)(Araujo et al. 2002)(Aschenbrenner, A. C., 2009)(Batista et al. 2012)(Begossi et al. 2012)(Ferreira et al. 2004)(Fredou and Ferreira 2005)(Fredou et al. 2009)(Freitas et al. 2014)(Freitas et al. 2011b)(Freitas et al. 2011a)) but these provide only short snapshots of the activity. For the past years, a nationwide research project, "REPENSA PESCA," led by the government, aims to ordain marine fisheries in the country (Brasil 2015d). This is a follow-up project to REVIZEE (IBAMA 2006)(MMA 2006), which created a baseline for targeted species management data (e.g., biomass and fishing mortality). The REPENSA PESCA program is expected to be finalized in 2022 and data will be publicly available. Another concern that is poorly explored is the mislabeling of snapper species throughout the supply chain, which may cause errors in data collection (Veneza et al. 2014)(Freire JL 2019).

This factor scores ineffective because none of these fisheries are part of a continuous research or monitoring program.

Factor 3.4 - Enforcement of and Compliance with Management Regulations

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

Moderately Effective
In compliance with the SEAP-PR/MMA Ordinance No. 42, of July 27, 2018 (MMA 2018b), which is the management plan for Caribbean red snapper and defines rules for the sustainable use and recovery of stocks of the species, specifically following the provisions of Article 11, the Secretariat of Aquaculture and Fisheries of the Ministry of

Agriculture, Livestock and Supply (SAP/MAPA) promotes the publication of onboard harvest data referring to catches made in the year 2020, while safeguarding personal information, as provided for in current legislation. The published data were extracted from the onboard harvest data of the following fishing modalities: traps/pots and vertical lines having Caribbean red snapper as target species, and fishing areas in the N/NE Territorial Sea (from the states of AP to AL) and the ZEE N/NE (from the states of AP to AL), provided for in the Normative Instruction MPA/MMA No. 10, of June 10, 2011 (Brasil 2011). In addition, information obtained directly from the National Fishing Vessel Tracking Program (Brasil 2006) for all vessels of these fisheries for the year 2020 was included. Considering the continuity of shipboard deliveries, the data will be updated periodically. In November 2021, the Brazilian government started to share data from the National Fishing Vessel Tracking Program into the Global Fishing Watch platform, and this action will contribute to fishing transparency (Brasil 2021b).

Despite specifications on hooks and mesh sizes of traps (MMA 2018b), there are evidences that some vessels use other mesh sizes to catch smaller individuals, which have a higher value in the international trade market (Freire JL 2019).

Before the 2021 season started in May, the Brazilian government, through MAPA/SAP Ordinance No. 119 (SAP/MAPA 2021), finally enforced the Caribbean red snapper management plan by withdrawing authorization for 72 boats to fish from 60 to up to 180 days until the fleet complies with regulation (sharing navigation and harvesting data).

This factor receives a score of moderately effective because enforcement has recently been in place for this fishery, including specific regulations for the species.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Ineffective

Enforcement and compliance with the limited existing regulations for the handline fishery targeting Carangidae, Serranidae, Scombridae, and Lutjanidae is poor, and the only production monitoring (following ICCAT's regulations) applies to less than 50% of the fleet (Zamboni 2020). The observer program in the country is currently inoperative. Most of the fleet (≈97%) are too small to comply with the National Fishing Vessel Tracking Program, which is required only from vessels greater than 50 metric tons or 15 meters long (Ordinance no. 02/2006 (Brasil 2006)) (Zamboni 2020). Due to a lack of enforcement over a large portion of this fishery, this factor is deemed ineffective.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Ineffective

The National Program of Observers Onboard Fishing Fleets (PROBORDO), established by the federal government (Brasil 2006b), is currently inoperative. Harvest data collection is mandatory only for larger vessels following federal regulation (Brasil 2014), and for this fishery, only 27 vessels from the registered fleet (≈23% of total) are obliged to comply (Zamboni 2020). In addition, because the vessels are small, they are not subject to the National Fishing Vessel Tracking Program (Brasil 2006)(Zamboni 2020). This factor scores ineffective because the fleet in this fishery is not included in enforcement programs established by the government.

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

Moderately Effective
The National Program of Observers Onboard Fishing Fleets (PROBORDO), established by the federal government (Brasil 2006b), is currently inoperative. Harvest data collection is mandatory only for larger vessels following federal regulation (Brasil 2014), and for this fishery, all 15 vessels from the registered fleet are obliged to comply (Zamboni 2020). But, they are not subject to the National Fishing Vessel Tracking Program (Brasil 2006)(Zamboni 2020). This factor scores moderately effective because the fleet in this fishery is only partly included in enforcement programs established by the government.

Factor 3.5 - Stakeholder Inclusion

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

Highly effective
The development of the Caribbean red snapper trap/pot fishery fishery improvement plan (FIP) in Brazil has integrated fishing unions, local city councils, industry, trade companies, government entities, NGOs, and universities to address the needs identified within the program (Fishery Progress 2021). The FIP has funding to promote up to three more in-person meetings to consolidate the stakeholders group, define operational objectives, monitor performance indicators, and advance the harvest control rules. Stakeholder engagement scores highly effective because the management process within the development of the FIP has been transparent and has included stakeholder input.

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

Moderately Effective
Small-scale fishers are becoming progressively more involved in the process of establishing policies for fisheries in Brazil (CONFREM 2015). The federal government created Permanent Management Committees in 2015 to bring together various stakeholders to facilitate discussions and decision-making to promote sustainable fisheries (e.g., (BRASIL 2015)). Such committees were a demand after a setback from the national Red List, released in 2014, which included several targeted species and suspended catches of species listed as "Vulnerable" (MMA 2014). These committees were suspended by the new government in 2019 (BRASIL 2019), and only in June, 2021 were they re-created in a new format (as part of a National Collaborative Network for the Sustainable Management of Fisheries Resources) (BRASIL 2021). In the meantime, the Fisheries and Aquaculture Secretariat promoted public consultations to keep the fishing sector involved. Because stakeholder participation was just restored and is not fishery-specific, this factor receives a score of moderately 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	FORAGE SPECIES?	SCORE
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)	2	+.5	Moderate Concern	No	**Yellow (2.739)**
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)	4	+.5	Moderate Concern	No	**Green (3.674)**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	4	0	High Concern	No	**Yellow (2.828)**
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)	2	0	High Concern		**Red (2.000)**
Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)	4	0	High Concern		**Yellow (2.828)**

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

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

2
The trap/pot fishery that targets Caribbean red snapper in the North and Northeast Regions of Brazil ranges primarily around the Amazon river plume. This region is characterized by muddy bottoms, but a recent mapping of a coralline reef in the area (Moura et al. 2016) raised concerns about the impacts of this fishery on the reef. Because the gear may interact with biogenic reefs, this gear type scores a 2.

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

4
The vertical line fishery that targets Caribbean red snapper in the North and Northeast Regions of Brazil ranges primarily around the Amazon river plume. This region is characterized by muddy bottoms, but due to a recent mapping of a coralline reef in the area (Moura et al. 2016) and because Caribbean red snapper is a reef-associated species, this factor scores a 4.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

4
Even though handlines typically do not contact the bottom, there are possible impacts from boat anchors on the reefs because many of the target species are reef-associated (Pinheiro et al. 2018). Therefore, this gear type scores a 4.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

2
This trap fishery occurs in the Northeast Region, which is known for its many coastal biogenic reefs. These biogenic reefs can be found at many different depths (Coni et al. 2013)(Fredou and Ferreira 2005)(Souza Jr 2018)(Melo CC 2019), and this gear type scores a 2.

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

4
Because this vertical line fishery targets reef-associated species (Pinheiro et al. 2018) and the impact on the habitat is expected to be low/minimal, it receives a score of 4.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North

(Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)

+.5
The region where the trap/pot and vertical line fisheries targeting Caribbean red snapper occur makes up one of the largest mangrove forests in the world, which has several extractive reserves (territorial user rights fisheries reserves) that cover most of the mangrove complex (ICMBio 2018b). The Amazon reefs are unprotected, although there are studies supporting the creation of a marine protected area (MPA) in the area (Magris et al. 2020). A study was carried out to assess the potential impacts of trap gears on the Amazon reefs. The results indicate that "it was already possible to see that the traps stayed stuck when land[ed], with almost no interaction with bottom and benthic. The seafloor in the fishing grounds is muddy or sandy, with sparse unconsolidated coral reef structures. Some interactions were found when the trap is collected slowly or far away from the boat as the ropes make an obtuse angle, [the] trap drags and interacts with the seafloor/benthos. On the other hand, collections made fast with the ropes in [the] 'right' angle, avoid almost completely the interaction" (Fishery Progress 2021)(Schmid and Giarizzo 2019). The underwater footage assessment is expected to be a continuous part of the monitoring program started with the Caribbean red snapper trap fishery improvement plan (FIP). Because specific monitoring and adaptation to minimize impacts are being provided and are reasonably expected to be effective, this factor receives a score of 0.5.

Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

0
The region where these fisheries occur has several marine protected areas (MPAs), which cover habitats such as reefs, sponge/algae banks, estuaries, and mangrove forests (Prates et al. 2012)(Magris et al. 2020)(Marine Conservation Institute 2021), although most "protected areas" refer to multiple-use MPAs where fishing activities take place. The coverage of protected habitats relevant to target species is less than 20% for some habitats, so this factor scores a 0.

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)

0
The state of Espírito Santo and the Abrolhos banks region, where the vertical line fishery targeting snappers occurs, have some marine protected areas (MPA) protecting relevant habitats such as biogenic reefs, mangrove forests, and seagrass beds, but protection from all bottom contact is not guaranteed except for the only fully protected MPA in the region where fishing is strictly prohibited (Abrolhos National Marine Park) (Coni et al. 2013)(Previero and Gasalla 2018) (Previero 2018)(Francini-Filho and Moura 2008). Because sensitive habitats relevant to the target species in this fishery are unprotected, this factor scores 0.

Factor 4.3 - Ecosystem-based Fisheries Management

Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Traps | Brazil | North (Amapá and Pará): FAO 41 (1.1, 1.2)
Southwest Atlantic | Atlantic, Southwest / 41.1.1 | Atlantic, Southwest / 41.1.2 | Vertical lines | Brazil |

North (Amapá and Pará): FAO 41 (1.1, 1.2)

Moderate Concern

Caribbean red snapper is a macro-carnivore reef-associated species, which during its life cycle is also known to inhabit estuarine regions (Pinheiro et al. 2018), such as the Amazon River mouth. The species' functional role in the ecosystem is relevant at keeping control of its prey (which varies among fish, shrimp, crabs, and cephalopods) (Froese and Pauly 2015). The fishery improvement plan (FIP) for the trap/pot fishery targeting this species has identified potential impacts of this fishery over recently mapped biogenic reefs in the Amazon River mouth, and has become a continuous part of the fishery monitoring program (Schmid and Giarizzo 2019). Because long-term management of ecosystem potential impacts are in the planning stages, this factor receives a score of moderate concern.

Southwest Atlantic | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.2.1 | Vertical lines | Brazil | Southeast Region (Espírito Santo, Rio de Janeiro, São Paulo, Distrito Federal): FAO 41 (1.3, 2.1)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Handlines | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)
Southwest Atlantic | Atlantic, Southwest / 41.1.2 | Atlantic, Southwest / 41.1.3 | Atlantic, Southwest / 41.1.4 | Traps | Brazil | Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe, Bahia): FAO 41 (1.2, 1.3, 1.4)

High Concern

These fisheries target carnivore species (including apex predators such as tunas in the vertical line fishery in the Northeast Region). Most species depend on multiple habitats to complete their life cycle and/or are highly migratory (Pinheiro et al. 2018)(Vila-Nova et al. 2014)(Gonçalves 2019). The region where these fisheries occur has multiple-use marine protected areas (MPA), but most of them are coastal and do not have specific policies in place (i.e., no harvest control rule, no protection of spawning areas, or precautionary management strategies), and the likelihood of food web impacts is high. Because of a lack of historical fisheries data, this cannot be confirmed, so this factor receives a score of high concern.

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