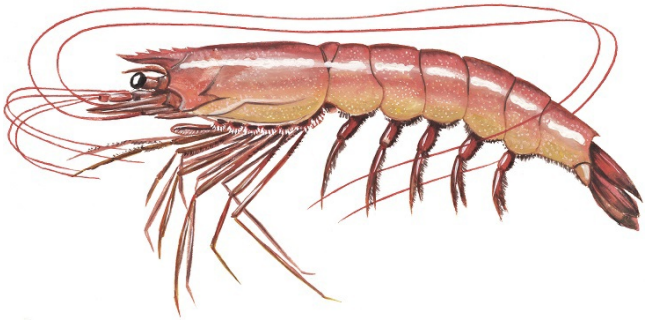
Argentine Red Shrimp



Argentina - Southwest Atlantic

Bottom trawls

Seafood Watch Consulting Researcher

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Seafood Watch Standard used in this assessment: Fisheries Standard v2

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About Seafood Watch

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

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

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

Guiding Principles

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

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

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

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

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

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

Best Choice/Green: 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 overfished, lack strong management or are caught or farmed in ways that harm other marine life or the environment.

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

Summary

This report focuses on the Argentine red shrimp *(Pleoticus muelleri)* fishery in Argentina. Both the industrial freezer trawl fleet, which fishes further from shore and lands frozen product, and the coastal trawl fleet, which lands fresh product and fishes more inshore waters**,** are included in this report. There is also a small-scale net fishery (in the Buenos Aires region) that is not included in this report and will not be assessed by SFW because of its small production capacity. This species has high commercial value in international markets and is one of the main export products of the Argentine fishing industry. Commercial products include frozen whole, graded, and tails both in the shell and shelled.

The Argentine red shrimp have a relatively short lifespan (estimated at 2 years), with extremely high and variable growth rates in space and time, with an almost total replacement of biomass in 2 years. Because of biological characteristics and the strong environmental influence over biomass, it is not possible to establish the maximum sustainable yield (MSY) or similar annual or biannual stock measure (nor is MSY necessarily an appropriate reference point for this fishery). The species is caught at the maximum advisable levels, and managers recommend maintaining current fishing pressure. The fishery is regulated via closures to protect juveniles and reproductive stages.

The industrial freezer trawl fishery typically has high bycatch and discard levels, and catches some species of concern (e.g., narrowmouthed catshark and yellownose skate). DISELA II, the hake bycatch reduction device, significantly reduced the amount of hake bycatch, but it is unknown if it reduces bycatch of other species. There is some evidence that the coastal fleet has lower volumes of bycatch, but some species of concern are still caught.

Management measures are based on species rather than on the ecosystem. There appear to be no integrated management plans in Argentina.

Several changes have occurred to the seafloor in the Gulf of San Jorge, where the industrial freezer trawl fishery occurs, which can be attributed to several natural and anthropogenic factors that act together. These changes are defaunation, a high percentage of dead bivalves and development of anoxic conditions in the bottom water and sediment. There is no specific study of the impact of the red shrimp fishery on the ocean floor, but the use of mobile fishing gear has become a source of concern because of the size of the affected fishing grounds.

Because of the impacts of the fishery on other species and because bycatch management needs significant improvement, the Argentine red shrimp bottom trawl fisheries, both coastal (1.86) and offshore (1.97) are rated Red or "Avoid".

Final Seafood Recommendations

SPECIES | FISHERY	CRITERION 1 TARGET SPECIES	CRITERION 2 OTHER SPECIES	CRITERION 3 MANAGEMENT	CRITERION 4 HABITAT	OVERALL RECOMMENDATION
Argentine red shrimp | Southwest Atlantic | Bottom trawls | Argentina	2.644	1.273	1.732	2.598	**Avoid (1.973)**
Argentine red shrimp | Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet	2.644	1.000	1.732	2.598	**Avoid (1.857)**

Summary

Argentine red shrimp caught in Argentina by the coastal bottom trawl fleet and the industrial bottom trawl freezer fleet is on the "Avoid" list. There's some evidence that bycatch levels are lower in the coastal fleet (compared to the offshore industrial fleet), but at-risk species of sharks and rays are caught. The high amount of bycatch in the industrial fleet is a serious concern in this fishery, and it includes several at-risk species. While the conservation measures for Argentine red shrimp are rated moderately effective, the bycatch strategy is a significant concern, resulting in an overall ineffective rating for management. The stock is unlikely depleted or undergoing overfishing, and habitat impacts from trawling are considered moderate. The management framework doesn't consider ecosystem impacts, but no species of exceptional importance are caught in this fishery. The coastal fleet generally lands fresh shrimp, while shrimp caught by the industrial fleet are generally frozen at sea.

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 the industrial Argentine red shrimp *(Pleoticus muelleri)* freezer trawl fishery and coastal trawl fishery in Argentina. The freezer trawl fishery primarily occurs in the offshore waters of the Gulf of San Jorge and is prosecuted by an industrial fleet of *tangoneros* (shrimp trawlers) that freeze their product on board. The coastal fleet fishes out of Rawson port in more inshore waters; it stows its catch in ice and lands fresh product. Because of its small production capacity, the small-scale fleet from the Buenos Aires region that primarily fishes with nets is not included in this report and will not be assessed by Seafood Watch.

Species Overview

The Argentine red shrimp is a benthic species occurring latitudinally in the Southwestern Atlantic Ocean from the coast of Santa Cruz, Argentina (approximate latitude 50º00'S) north to Rio de Janeiro, Brazil (approximate latitude 23º00'S). The fishery is managed as one stock, mainly because 95% of the fishery is carried out south of the 42nd degree of latitude (pers. comm., Juan de La Garza, 2018). It is thought that there may be multiple stock subunits (De Carli et al. 2012). The coastal trawl fleet fishes within 12 nautical miles of the shore targeting shrimp at depths less than 40 m (Ruiz y Mendia 2008) (CeDePesca 2016), and since 2016 this fleet also fishes in oceanic waters {De la Garza and Moriondo, 2018}

The Argentine red shrimp fishery (including the industrial freezer trawl and the coastal trawl fleets) is among the 25 major shrimp fisheries in the world. It began with the discovery of a significant concentration of the species in the Gulf of San Jorge waters in the late 1970s, growing to a size of 100 vessels between 1979 and 1984. The first tangoneros (shrimp vessels), operating with bottom trawls, appeared at the end of the 1980s and early 1990s. The fishery is still evolving, with modern vessels that are highly efficient at capturing the target species using double-beam trawls (Cedrola et al. 2012) {Góngora et al. 2012} (Bertuche et al. 2000). In the San Jorge Gulf, Patagonia, the fleet comprises 80 freezer vessels that are responsible for almost the entire (99%) shrimp landings in Argentina {Góngora et al. 2012}. However, in the last two seasons, the Gulf was closed to fishing activities in order to protect spawning activities {De la Garza and Moriondo, 2017} {De la Garza and Moriondo, 2018}. The coastal fleet in Rawson port is composed of 76 boats with a length between 10 and 21 m, with engine power ranging from 60 and 441 horsepower (Lasta et al. 2001) (Ruiz y Mendia 2008) (Fishbach 2013) (Spanjersberg et al. 2013), and the other fleet has vessels smaller than 10 m {Spangerberg et al. 2018}. The coastal fleet lands around 30,000 MT on average (Fishery Progress 2017), with a maximum of 75,000 MT in 2017 {De la Garza and Moriondo, 2018}.

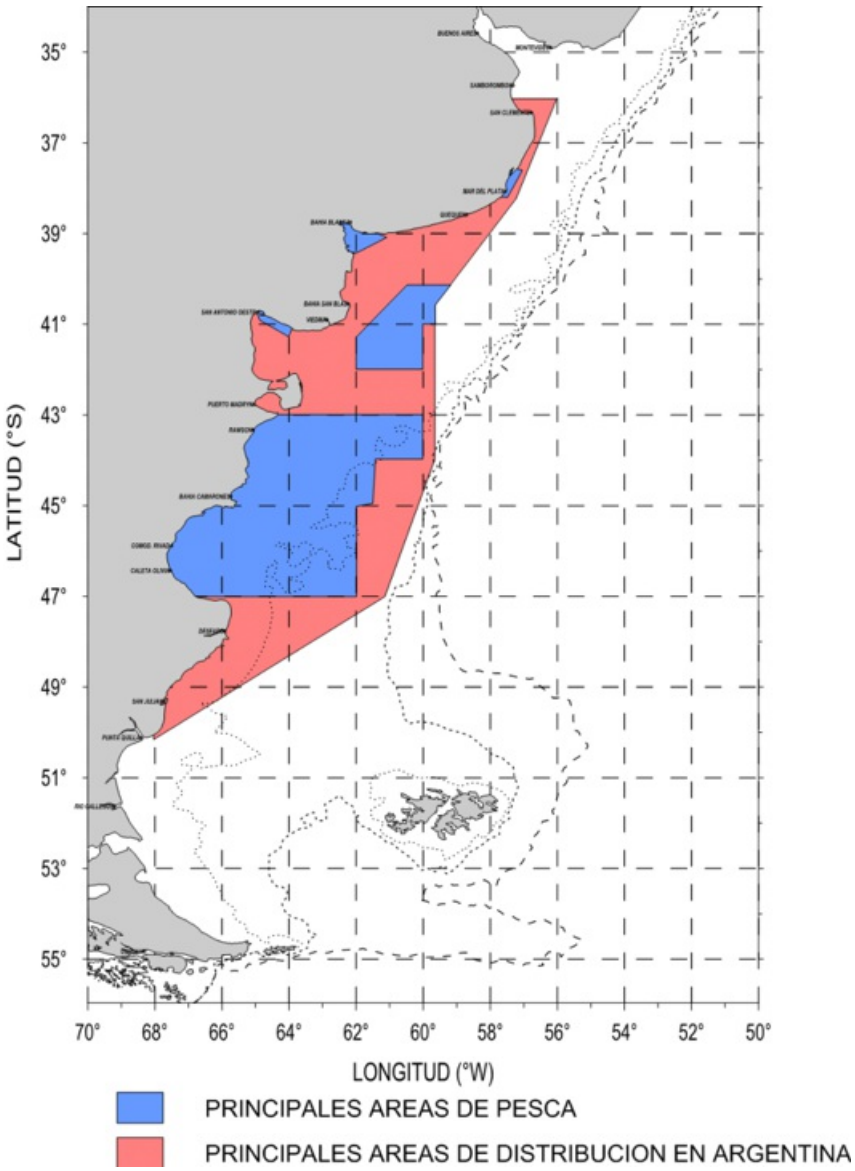

Figure 1: Distribution and fishery of the Argentine red shrimp (Pleoticus muellerii) in Argentina (Bertuche et al. 2000).

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Fishing for Argentine red shrimp in Patagonia is economically more significant than small-scale fishing with nets in the Buenos Aires region: 99.7% of catches come from the Patagonian fishery concentrated in the Gulf of San Jorge. Between 2010 and 2017, 70 to 100% of the red shrimp production was fished within the Gulf; currently, the area is closed for protection {Fischbach et al., 2016} {De la Garza et al., 2017}. The product is generally frozen on board, whole or without the head, and classified by size intended for different business categories. The coastal trawl fleet from Rawson port, which lands fresh product, on average accounts for 15% of Patagonia regional landings (Fishbach 2013) (Spanjersberg et al. 2013). In 2017, this fleet accounted for more than 35% of the total landings {De la Garza and Moriondo, 2017}. The coastal trawl fishery is important in terms of volume and quality of fresh shrimp landed, as well as the generation of labor on land. Rawson is the main fresh shrimp port of landing in Argentina (Fishbach 2013). Seafood Watch will not be assessing the artisanal fleet, which uses nets.

Regarding red shrimp's biological characteristics and environmental influence over biomass, it is not possible to establish the maximum sustainable yield (MSY) or similar annual or biannual measure with a strong biological basis. The fishery developed south of 43^{o} latitude is managed as one stock, of which several concentrations have their own management

schemes on a state level (pers.comm., Juan de la Garza).

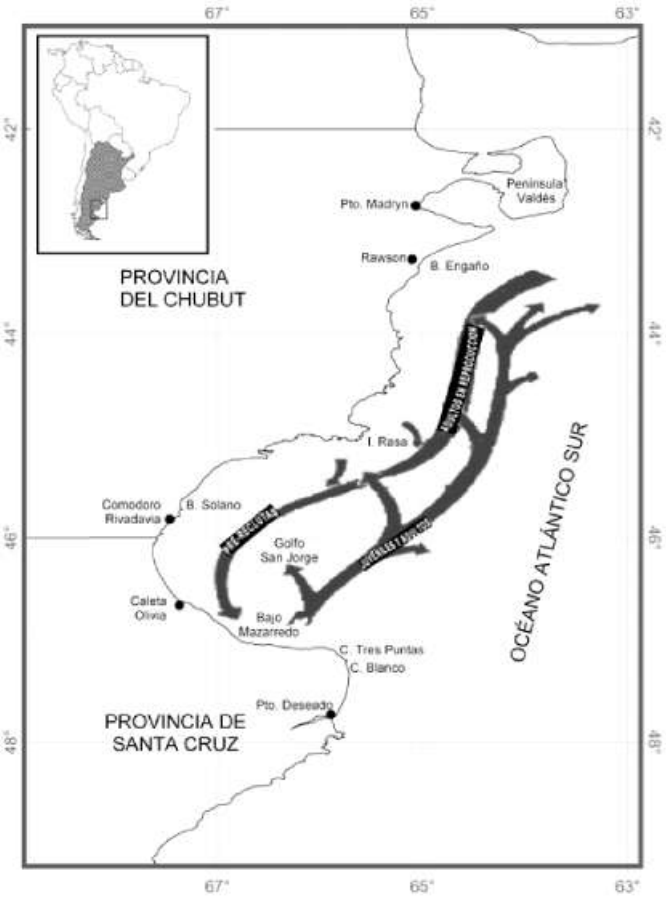

Figure 2: Life cycle of the Argentine red shrimp *(Pleoticus muellerii)* (De Carli et al. 2012).

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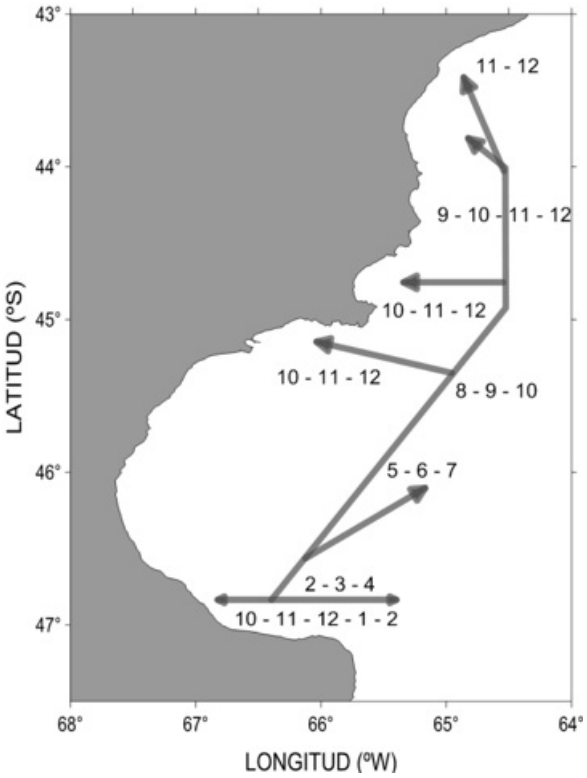

Figure 3: Example of migration route of shrimp marked in the south of San Jorge Gulf (Roux et al 2012)

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Fisheries management in Argentina is carried out by the Federal Fisheries Council (CFP), which was created by Law 24922 in 1998 to promote the sustainability of fishing activities and conservation of resources. The National Fisheries Research and Development Institute (INIDEP) is the scientific advisor to the CFP on fisheries management (Fisheries Federal Law, article 11).

Production Statistics

The Argentine red shrimp fishery largely consists of double-beam trawl vessels. It is the main crustacean fishery in the southwestern Atlantic Ocean, occupying 100% of the international trade of this species (Cedrola et al. 2012) {Góngora et al. 2012} (Bertuche et al. 2000) (pers. comm., Juan de la Garza, March 7, 2017). It is primarily an export fishery, sending the majority of its product to Europe and Asia, with a small but increasing proportion to the United States.

In Uruguay and Brazil, there are small, seasonal Argentine red shrimp fisheries (operating mainly in summer) that are carried out by artisanal and/or coastal vessels with low catch volume. Those shrimp are for domestic consumption rather than for export. In Brazil, the Argentine red shrimp fishery is 270% smaller than the fishery for *Artemesia longinaris* (long-face shrimp). The fishing season covers March to May and November to January, with commercial sizes, the largest compared to L6 (80 to 100 pcs per kilo) from Argentina. Landings from Brazil during 2000 to 2010 did not exceed 1000 t per year (Santos et al. 2016).

The capture of Argentine red shrimp in the period between 1989 and 2016 is shown in the following figure:

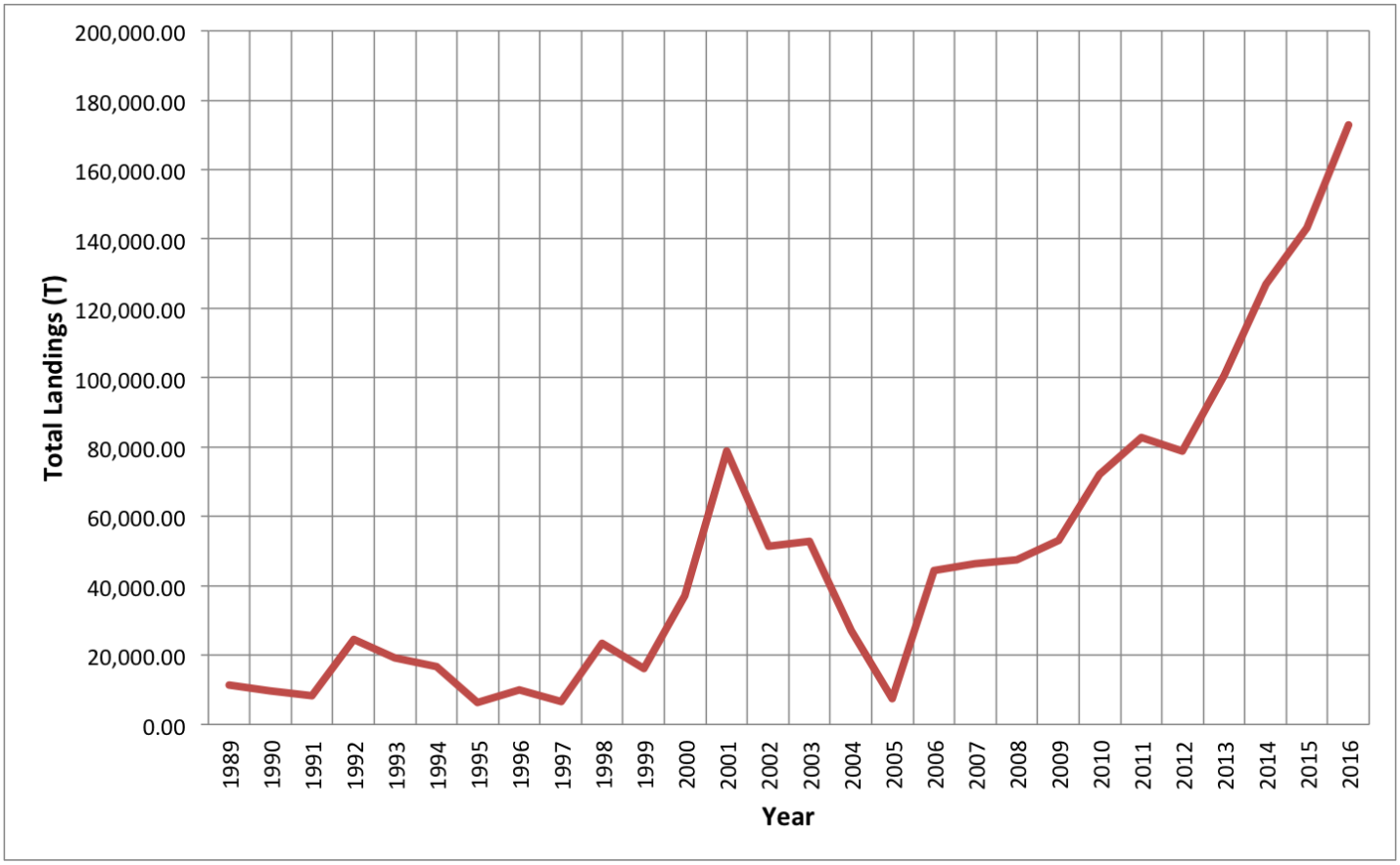

Figure 4: Argentine red shrimp *(Pleoticus muellerii)* landings from the Argentine fleet between 1989 and 2016 (from the Undersecretariat of Fisheries).

Argentine red shrimp has an annual cycle with fluctuations in abundance related to environmental and oceanographic conditions. Oceanographic fluctuations could be the cause of mortality in the early life stages. These fluctuations are observed in the landings, with 2016 (172,843 MT) a minimum in 1995 (6,203 MT) and a new record set in 2017 with 240,000 MT {De la Garza and Morionde, 2017}. Given these fluctuations, there is considerable uncertainty in the production and availability of product (Argentina 2007). This species is currently captured up to the maximum advisable levels (UNEP 2002) (BID 2013). ARS landings in 2016 were equivalent to 25% of the total landings of all the marine/continental species in Argentina (699,452.5 t; pers. comm., Juan de la Garza, March 7, 2017).

Importance to the US/North American market.

In 2016, the United States imported shrimp from 58 countries; most of it came from India, Indonesia, Thailand, Ecuador, and Vietnam (NOAA 2017). The following figures show US shrimp imports from Argentina between 2010 and 2016, in kilograms and in US dollars. The figures show a growing trend during this period.

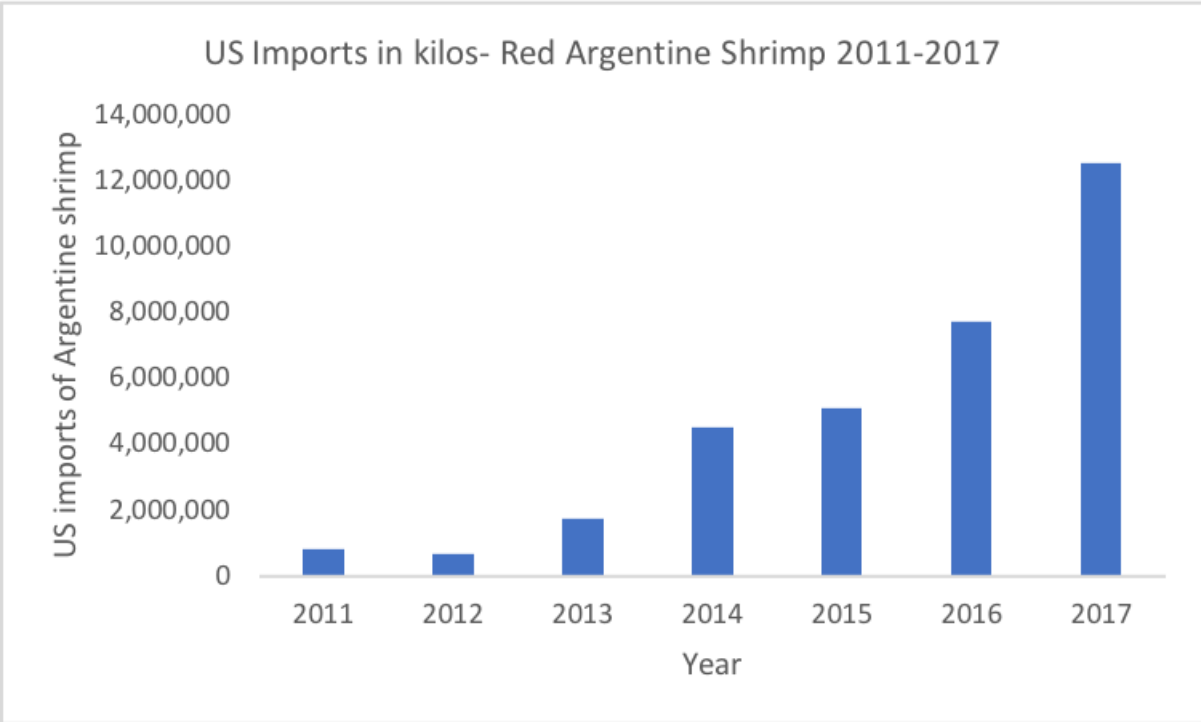

Figure 5: U.S. imports of Argentine Red Shrimp, in kilos (2011-2017); {NMFS 2017}

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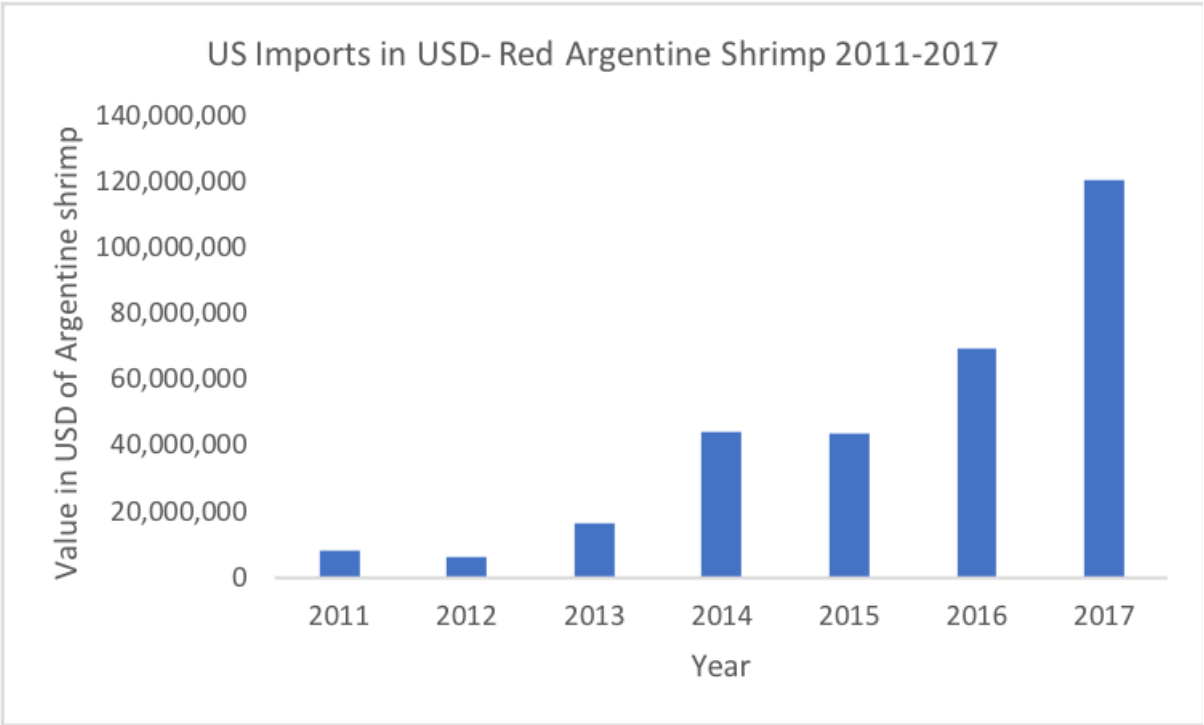

Figure 6: U.S. imports of Argentine Red Shrimp, in USD (2011-2017); {NMFS 2017}

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The proportion of Argentine red shrimp to the total US imports from Argentina between 2011 and 2017 (in kilos) oscillates from a low in 2011 of 0.12% to a high in 2017 of 1.89%.

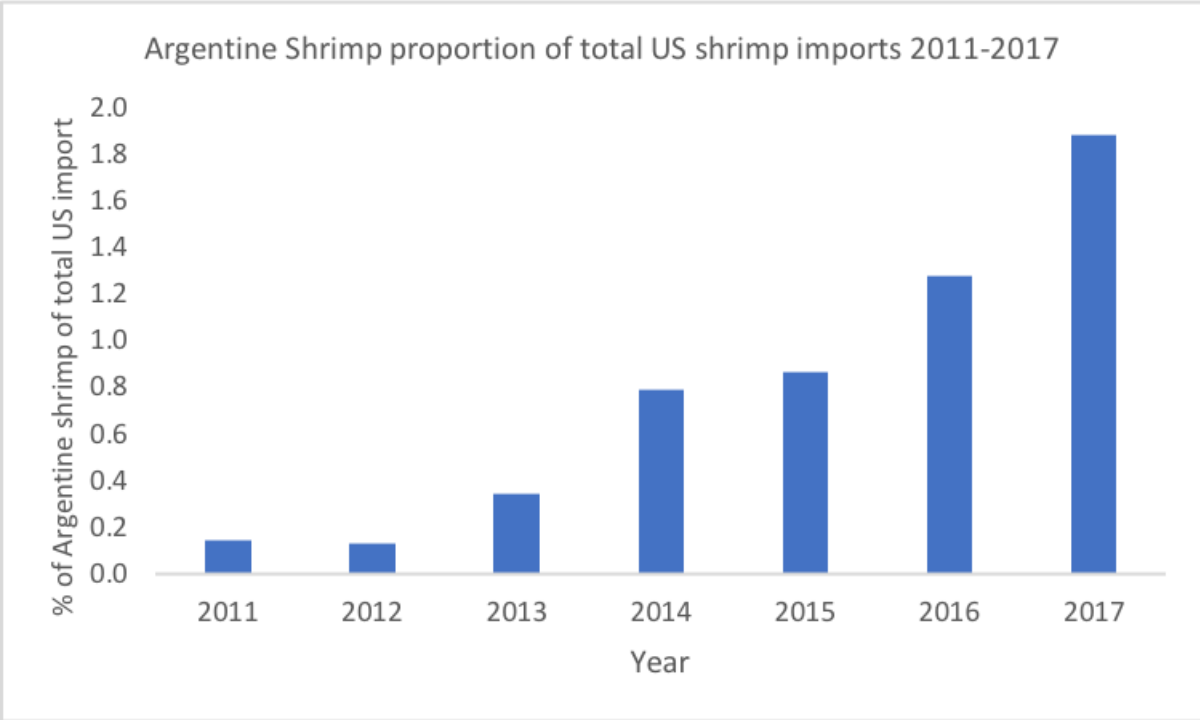

Figure 7: Argentine red shrimp as a proportion of total U.S. imports from Argentina {NMFS 2017}
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The proportion of Argentine red shrimp to the total US imports from Argentina between 2011 and 2017 (in US dollars) displays the same feature, with the lowest proportion in 2011 (0.16%) to the high value in 2017 (1.84%).

The destinations of Argentine red shrimp exports in 2016 were: 1) Spain, 61,232 t; 2) China, 32,773 t; 3) Italy, 18,116 t; 4) Japan, 12,815 t; 5) Vietnam, 6,320 t; and the 6) United States, 4,738 t (Ministerio 2017).

Common and market names.

According to the US Food and Drug Administration, the market name of *Pleoticus muelleri* is "shrimp" and the common name is "Argentine red shrimp" (USFDA 2015).

Primary product forms

In Argentina, commercial products of the Argentine red shrimp fishery include frozen and raw whole, graded, tails on or off, both in shell and shelled (Schonberger and Agar 2001). The Port of Rawson is the main port of landing of fresh shrimp in Argentina (Fishbach 2013). Most exports of *Pleoticus muelleri* are frozen whole raw shrimp (packed in 2kg boxes) (Argentina 2007). Most recently, in 2017 export of tails in blocks of 10/20 kg has been increasing significantly {MINAGRI, 2018}

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

ARGENTINE RED SHRIMP				
REGION / METHOD	**INHERENT VULNERABILITY**	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southwest Atlantic | Bottom trawls | Argentina	3.000: Low	3.000: Moderate Concern	2.330: Moderate Concern	Yellow (2.644)
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet	3.000: Low	3.000: Moderate Concern	2.330: Moderate Concern	Yellow (2.644)

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.*

Argentine red shrimp

Factor 1.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Low
The overall inherent vulnerability score from analysis is 2.75 (between 2.46 and 3), which ranks as "low" inherent vulnerability (Bertuche et al. 2000) (Glembocki et al. 2015) (Holthuis 1980) (Macchi et al. 1992) (Ruiz and Mendia, 2008).

Resilience attribute	Score =1	Score = 2	Score = 3
Average age at maturity			The average age at maturity is between 20 to 24 months, according to growth parameters {De la Garza, 2006}.
Average maximum age			Growth parameters and life span calculated using modal progression gives us a life span + - 4 years {De la Garza 2006}
Fecundity			Fecundity spread between 120,000 up to 700,000 eggs depending on female size {Fernandez & Macchi, 2009}. These numbers are for the Patagonian area. The fecundity for Argentinian red shrimp found in the Buenos Aires Province are different (pers. comm., De la Garza)
Average maximum size	N/A	N/A	For females: 55 mm carapace length (CL); for males: 47 mm CL {de la Garza 2006}. Although we have found females with 75 mm CL and males with 50 mm CL
Average size at maturity	N/A	N/A	Calculated size of first maturity: 31 mm CL for females and 28 mm CL for males (Fernandez and Macchi, 2006) and (Macchi and Lorio 1996)
Reproductive strategy			Broadcast spawner
Trophic Level	N/A	N/A	N/A
Density dependence		No depensatory or compensatory dynamics demonstrated or likely	

Factor 1.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderate Concern
The Argentine red shrimp has a high reproductive potential, with an almost total replacement of biomass available between two successive years of fishing (Bertuche et al. 2000) (De Carli et al. 2012). Because of several characteristics that affect biomass (i.e., a short life cycle, high growth rate, high reproductive potential, and spatial and temporal variability of recruitment), it is not possible to establish the maximum sustainable yield (MSY) or similar annual or biannual measure for this species with a strong biological basis (Bertuche et al. 2000).

In 2014, the relative density of shrimp vulnerable to fishing for the northern and southern Gulf of San Jorge was obtained by the swept area method, estimated from the density values obtained in fishing sets. The average density estimate for the southern Gulf, assuming a catchability q = 1, was 5.97 t/nm^2. These indices are used by managers as an indicator of the health of the stocks and a proxy of the biomass. In 2017 the average density was estimated at 13.45 t/ nm^2, and the biomass of the entire southern area calculated at 26,617 tons {De la Garza and Moriondo 2017}. The relative abundances of shrimp in the recruitment process (LC ≤ 25 mm) for this campaign were 78% for the southern Gulf region and 66% for the north {De la Garza and Moriondo 2017}. Authors stated that comparison with the 2013 campaigns (noting the 2017 estimate is higher) are not comparable due to the technical sampling technologies used.

The relationship between the relative abundance of mature and gravid females of Argentine red shrimp and environmental variables was connected to the bottom water temperature and salinity, and to depth. The relationship increased along with temperature; with salinity, however, it decreased for mature females and increased for impregnated females. An optimal depth range was evidenced, where the largest concentrations of these individuals were located (pers. comm., De la Garza, 2018).

The biological characteristics of the Argentine red shrimp in conjunction with the variation in the level of annual commercial fishing recruitment of this species can negatively affect its abundance {de Carli et al. 2012}.

Abundance is assessed as "moderate" concern because there is no evidence to suggest that the stock is either above or below reference points (there are no reference points); stock inherent vulnerability is low (as scored in Factor 1.1).

Factor 1.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderate Concern
Among the crustaceans on the central Patagonian shelf, the most abundant single species producing the highest yield is the Argentine red shrimp *(Pleoticus muelleri)* (FAO 2011).

It is unknown whether overfishing is occurring, but the biological features, along with the fluctuation in the level of annual commercial fishing recruitment (when the young individuals become vulnerable to capture in a fishery (NOAA 2006)) generate the observed variability in the abundance of biomass available for the shrimp fleet. This could put the resource at permanent risk of overfishing in the growth phase and overfishing in the recruitment phase (De Carli et al. 2012). However, managers in the last two seasons (2017 and 2018) closed the San Jorge Gulf region for fishing, with the main purpose of protecting recruitment and growth {De la Garza and Moriondo 2018}. In 2017, 99% of landings came from shrimp caught south of the 40th parallel, mostly (72%) from federal jurisdiction waters, 25% from the province of Chubut and the remaining 3% was fished in waters under the jurisdiction of Río Negro (2.9%) and Buenos Aires (0.1%) {De la Garza and Moriondo 2018}.

Finally, discard mortality can occur when high quantities of shrimp are caught, though this is thought to be uncommon (CeDePesca 2016).

This factor is scored as "moderate" concern because it is unknown whether overfishing is occurring, and although some management regulations have been implemented (closing the San Jorge Gulf to fishing), there is not sufficient information to confirm the probability (>50%) that current fishing mortality is at or below a sustainable level.
Justification:
Growth overfishing occurs when the effort is so high that the total yield decreases with increasing effort. Individuals are caught before they can grow to a sufficiently large size to substantially contribute to the biomass (Sparre and Venema 1998). Recruitment overfishing is a situation in which the rate of fishing is (or has been) such that annual recruitment to the exploitable stock has become significantly reduced. The situation is characterized by a greatly reduced spawning stock, a decreasing proportion of older individuals in the catch, and generally very low recruitment year after year (NOAA 2006).

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.

ARGENTINE RED SHRIMP			
REGION / METHOD	**SUB SCORE**	**DISCARDS+BAIT / LANDINGS**	**SCORE**
Southwest Atlantic | Bottom trawls | Argentina	1.414	0.900: 40-60%	Red (1.273)
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet	1.000	1.000: < 20%	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 | BOTTOM TRAWLS | ARGENTINA				
SUB SCORE: 1.414		DISCARD RATE: 0.900		**SCORE: 1.273**
SPECIES	**INHERENT VULNERABILITY**	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Narrowmouthed catshark	1.000: High	2.000: High Concern	1.000: High Concern	Red (1.414)
Pink cusk-eel	1.000: High	2.000: High Concern	1.000: High Concern	Red (1.414)
Spiny dogfish	1.000: High	2.000: High Concern	1.000: High Concern	Red (1.414)
Yellownose skate	1.000: High	2.000: High Concern	1.000: High Concern	Red (1.414)
Argentine red shrimp	3.000: Low	3.000: Moderate Concern	2.330: Moderate Concern	Yellow (2.644)
Magellanic penguin	1.000: High	3.000: Moderate Concern	2.330: Moderate Concern	Yellow (2.644)
South American sea lion	1.000: High	3.000: Moderate Concern	2.330: Moderate Concern	Yellow (2.644)
Argentine hake	2.000: Medium	4.000: Low Concern	2.330: Moderate Concern	Yellow (3.053)
Imperial shag	1.000: High	3.000: Moderate Concern	3.670: Low Concern	Green (3.318)
Loggerhead turtle	1.000: High	3.000: Moderate Concern	3.670: Low Concern	Green (3.318)

SOUTHWEST ATLANTIC | BOTTOM TRAWLS | ARGENTINA | COASTAL FLEET				
SUB SCORE: 1.000		DISCARD RATE: 1.000		**SCORE: 1.000**
SPECIES	**INHERENT VULNERABILITY**	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Angular angel shark	1.000: High	1.000: Very High Concern	1.000: High Concern	Red (1.000)
Narrownose smooth-hound	1.000: High	1.000: Very High Concern	1.000: High Concern	Red (1.000)
Rays (unspecified)	1.000: High	1.000: Very High Concern	1.000: High Concern	Red (1.000)
School shark	1.000: High	1.000: Very High Concern	1.000: High Concern	Red (1.000)
Spiny dogfish	1.000: High	2.000: High Concern	1.000: High Concern	Red (1.414)
Apron ray	1.000: High	3.000: Moderate Concern	2.330: Moderate Concern	Yellow (2.644)
Argentine red shrimp	3.000: Low	3.000: Moderate Concern	2.330: Moderate Concern	Yellow (2.644)
Magellanic penguin	1.000: High	3.000: Moderate Concern	2.330: Moderate Concern	Yellow (2.644)
South American sea lion	1.000: High	3.000: Moderate Concern	2.330: Moderate Concern	Yellow (2.644)

The bycatch species for the Argentine red shrimp industrial freezer trawl were obtained from the available literature. Species were selected using the Seafood Watch Criterion 2 species guidelines: the catch of the species in the fishery under assessment makes up > 5% of that fishery's catch; the species is overfished, depleted, a stock of concern, "Endangered," "Threatened," IUCN "Near Threatened," and/or subject to overfishing; they are charismatic species, or include turtles, marine mammals, and birds.

While the majority of bycatch information covers the industrial freezer trawl fleet, onboard observer information for the coastal trawl fleet's is available from CeDePesca as part of its Fishery Improvement Program (FIP). The offshore fleet observer program has been monitored since 2016. In addition, the Chubut Province has its own observers program in place that covers the Rawson's coastal fleet.

The CeDePesca monitoring program fully evaluated 135 fishing sets, over 68 days at sea, in nine fishing boats. In 135 fishing sets, 344 t of red shrimp and 29 t of bycatch were caught. Bycatch was composed of hake (16 t), invertebrates (7 t), other bony fishes (3 t) and batoids and sharks (1 t). This included 30 bony fish species, 16 elasmobranch species, and one myxini species. In contrast, the industrial fleet operating in San Jorge Gulf and adjacent waters (which has more extensive observations of catch composition) records capture of 44 bony fish species, 20 elasmobranch species, and two myxini species.

The CeDePesca monitoring program for the onshore fleet continued into the 2019-2020 season; in 361 sets, 1,272 t of red shrimp and 137 t of bycatch were caught. Bycatch consisted of hake (52.7 t), other bony fish (26.4 t), batoids and sharks (6.8 t), and invertebrates (40.4 t); three magellanic penguins, two imperial cormorants, and seven sea lions were also caught (CeDePesca 2020).

166 sets were observed in the offshore fleet in the 2019 season. Total catch in the observed offshore fleet was approximately 917.4 t, 763.8 t of which was red shrimp; the remainder of the catch consisted of hake (110.0 t), other bony fish (4.0 t), batoids and sharks (4.1 t), and invertebrates (31.1 t) (CeDePesca 2020b).

The lowest scoring species in the offshore industrial trawl fleet were: 1) pink cusk eel, 2) spiny dogfish, 3) yellownose skate, and 4) narrowmouthed catshark. The lowest scoring species in the onshore/coastal trawl fleet were: 1) angular angel shark, 2) narrownose smooth-hounds, 3) school sharks and 4) rays. These species limit the score for Criterion 2 due to their high vulnerability and unknown stock status, as well as their high potential to interact with this gear type.

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

Angular angel shark

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

High
Sharks are considered highly vulnerable according to SFW {Seafood Watch 2016}. The fishbase score for angular angel shark, *Squatina guggenheim*, is 65 of 100 (Froese and Pauly 2016), which also corresponds to "high" vulnerability.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Very High Concern
Angular angel sharks, *Squatina guggenheim*, are classified as "Endangered" according to the most recent status at the IUCN red list (Chiaramonte and Vooren 2007). Because Angular angel sharks are also highly inherently vulnerable (as per SFW), there is no indication of their current stock status and they have a decreasing population trend; therefore, they are scored as "very high" concern for abundance.
Justification:
The IUCN profile includes information about the total landings of angel shark in Mar del Plata harbor reaching 1,074 metric tonnes (MT) in 1964 and 2,355 MT in 1965. It was suggested that production peak was reached during the 1997-1998 seasons; since then, an overall negative trend can be seen (Massa et al. 2004). Based on {Vooren and Klippel, 2005} citing {Massa and Hozbor 2003} a 58% decline in the CPUE of angel shark in the coastal bottom trawl fleet has occurred (IUCN Shark Specialist Group. 2007)

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

High Concern

Trawl fishing is one of the main threats to Angular angel sharks (Chiaramonte and Vooren 2007). Gongora, E. analyzed the bycatch information collected by the Chubut onboard observers program from 2003 to 2007, and found that angular angel shark had a frequency of occurrence (FO) that varied between 0.8% in 2003 to 1.4% in 2007 in relation to the number of sets analyzed by the observers (Gongora 2011). In the 2015 to 2016 FIP bycatch report for the Argentine red shrimp (ARS) fishery, CeDePesca {2016} reported that 0.28% (1 ton of 344 shrimp tons) of bycatch relative to total shrimp tons in the 2015 to 2016 fishing season was made up of 16 different species of chondrichthyans. Of that, the batoids and sharks/target species rate accounted for even less: 0.1% (ibid). In 119 kg of sharks, 27 kg (11 individuals) of this species were recorded. A more recent INIDEP observers program report showed that in 2016, only 0.25 ton of rays and sharks were caught by 53.5 tons of shrimp {De la Garza et al. 2017}; however, it's unclear how much of the data are angular angel shark.

Considering that there is no updated quantitative estimation in the region about population size and trends (population is likely depleted), it is difficult to assess the kind of impact that the coastal Argentine red shrimp fleet exerts on angular angel shark populations. Due to the above, we have rated this factor as "high" concern.

Considering that the catches of angular angel shark are rare, the fishery is probably not a substantial contributor to the fishing mortality. However, the endangered status of the angel shark has a serious impact on the species; for that reason, this factor is scored as "high" concern.

Apron ray

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

High
Rays are considered highly vulnerable {Seafood Watch 2016}, since they grow slowly, reach sexual maturity at a moderate age, and produce few young.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderate Concern
The Southwest Atlantic subpopulation of apron rays, *Discopyge tschudii*, are classified as "Vulnerable" according to the IUCN Red List (Massa et al. 2004). However, a more recent assessment by IUCN lists the species is listed as "Least Concern" at the global level (Dulvy et al. 2020c). The stock status is unknown, but apron rays are thought to be locally abundant (Dulvy et al. 2020c). Abundance is scored as "moderate concern" based on the IUCN status.

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderate Concern
Trawl fishing is the main threat to Apron rays (Massa et al. 2004). CeDePesca {2016} reports that 0.28% (1 ton of 344 shrimp tons) of bycatch relative to total shrimp tons in the 2015 to 2016 fishing season was made up of 16 different species of chondrichthyans. Of that, the batoids and sharks/target species rate accounted for even less; 0.1% (ibid). Out of the 135 sets analyzed by species, apron rays had a rate of occurrence (per species) of approximately 18.5% (i.e., rare occurrence; ibid). There is no abundance estimate for this species, but it is discarded from inshore fisheries and survivorship is likely high (Dulvy et al. 2020c). Because this species is highly susceptible to fishing, but it is not thought to be depleted, we have rated this factor as "moderate" concern.

Argentine hake

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina

Medium

The FishBase score for Argentine hake is 58 of 100 {Froese and Pauly 2015}, which corresponds to "high" vulnerability. However, using the Seafood Watch productivity scoring analysis, Argentine hake has "moderate" inherent vulnerability (2.3) because of a combination of the factors presented in the table below:

Life history attribute	Hake *(Merluccius hubbsi)*			
	Score = 1	Score = 2	Score = 3	Sum
Average age at maturity			< 5 yrs	3
Average maximum age		10–25 yrs		2
Fecundity	NO	N/A	N/A	N/A
Average maximum size			< 100 cm	3
Average size at maturity		40–200 cm		2
Reproductive strategy			Broadcast spawner	3
Trophic level	> 3.25			1
Density dependence	N/A	N/A	N/A	N/A
			Score	2.3

References used in Seafood Watch productivity scoring analysis: (Bezzi et al 1994) {Cauhépé 1999} (Macchi et al. 2013).

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina

Low Concern
Two stocks are defined for common hake in Argentine waters, based on biological characteristics: north of 41°S (Bonaerense) and south of 41°S (Patagónico) {Góngora et al. 2012}.

The total biomass estimated in 2013 (1,043,000 t) south of 41°S, the main red shrimp fishing area, was approximately 19% higher than in 2012, mainly because of the presence of strong year classes in 2010 and 2011, which provided a 40% increase in reproductive biomass. The most recent assessment shows a 40% increase in spawning stock biomass in 2013 compared with 2012 (Villarino and Santos 2014).

Based on state test results of exploitation of hake south of 41°S, and with intent to capitalize on the stability of the reproductive biomass and the increased total biomass estimated in 2013, it is recommended to keep the 2015 maximum allowable catch at the same level established for 2014. This is recommended in order to reach 600,000 t in the medium term and to maintain a proportion of 18% of large individuals in the breeding population (Villarino and Santos 2014).

Biomass is above the limit reference point and may be estimated to be above a target reference point; therefore, this factor is considered to be "low" concern.

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina

Moderate Concern
Argentine hake is captured in a directed fishery and as bycatch in the red shrimp fishery south of 41°S (Bovcon et al. 2013)(Villarino and Santos 2014). In the Gulf of St. George (45°S, 65°W), red shrimp and Argentine hake share the same fishing grounds (Pettovello 1999), and this region is characterized as containing reproduction and recruitment concentration sites for hake (Villarino et al. 2012). To identify shark species in the bycatch of the Patagonian red shrimp fishery, (Cedrola et al. 2012) found the participation of the hake to be 34.5% of the total catch.

For the red shrimp coastal fishery, hake is the main bycatch (less than 0.5% of the total catch). Its capture was low, with high variability, and it presented a growing tendency toward the end of the fishing season (CeDePesca 2014).

The 2013 hake fishing mortality in the directed fishery and the red shrimp fishery was estimated at 1,043,000 t, representing a 19% increase from 2012 (Villarino and Santos 2014). The red shrimp fishery is a substantial contributor to hake fishing mortality {Góngora et al. 2012}. Considering the total fishing mortality on this hake stock, along with low recruitment and low spawning stock biomass, models suggest that this stock may be in a state of recruitment overfishing (Irusta 2014).

Based on this scenario, the fishing mortality may or may not be at or below a sustainable level that will allow the population to maintain its current level or to rebuild if depleted. Management is in place, but the contribution to fishing mortality from the shrimp fishery is high, warranting a score of "moderate" concern for fishing mortality for Argentine hake.

Imperial shag

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina

High
Seabirds have a high level of vulnerability (Seafood Watch 2013). Seabirds grow slowly, reach sexual maturity at a late age, and produce few young. These life history characteristics suggest a high level of inherent vulnerability to fishing. For seabirds, the effects of fisheries can be observed in a number of ways: competition for prey, provisioning from fisheries via discards, and incidental mortality due to bycatch (Wagner and Boersma 2011).

Commercial fisheries throughout the coastal zone of Patagonia have dramatically increased in the last two decades, and are based mainly on two target species, Argentine hake *(Merluccius hubbsi)* and Argentine red shrimp *(Pleoticus muelleri)*. Imperial cormorant foraging distribution often overlaps with commercial fisheries, and birds regularly gather near trawl vessels to take advantage of fisheries discards {Yorio et al. 2010}; this attraction often results in increased incidental mortality {González-Zevallos et al. 2011}.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina

Moderate Concern
The abundance of this species has not been quantified, but is evaluated as "Least Concern" under IUCN because it is wide ranging and because it is thought that the population is not decreasing at a rate that would classify it as "Vulnerable" (Birdlife International 2014)(BirdLife International 2018). Because of the IUCN evaluation, abundance scores as "moderate" concern.

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina

Low Concern
With trawls, negative interactions fall into two categories: seabirds can be struck by or become entangled in warp cables, and they can drown in trawl nets {Bull 2009}. Incidental mortality in nets (in the artisanal fleet) was associated with diving species such as Magellanic penguin and imperial shag, most likely because these species dive to take prey directly from the net during haulback, thus increasing their chances of becoming entangled (Marinao and Yorio 2011). The mortality decreased with the distance to the coast {González-Zevallos et al. 2011}.

Since the imperial shag represents a non-target species in which the fishery contribution to mortality may be low or unknown, the fishing mortality for this species is considered "low" concern.

Loggerhead turtle

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina

High
Sea turtles have a high level of vulnerability according to the Seafood Watch criteria, based on their life history characteristics that include being long-lived, attaining sexual maturity at a later age, and having a low reproductive rate (Seafood Watch 2013).

The life cycles of sea turtles are long and complex. Turtles occupy various ecosystems (nesting beaches, coastal, neritic and oceanic zones, as well as pelagic and demersal areas) throughout their lifetimes, spending time in various Exclusive Economic Zones (EEZs) and international waters. The five species that inhabit the Southwestern Atlantic Ocean (SWA) region perform vast feeding and reproductive migrations, traveling through areas where many different fishing fleets operate. Therefore, sea turtles in the SWA interact with virtually all fisheries {Domingo et al. 2006} In addition, according to {Gonzalez-Carman et al. 2011} turtle species like loggerhead, are regularly found in the coastal waters of Argentina, and are thus included in this report.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina

Moderate Concern
The International Union for Conservation of Nature (IUCN) classified south Atlantic subpopulation of loggerhead turtles as "Least Concern" in 2015 (Casale and Tucker 2015). Loggerhead is listed on Appendix 1 of CITES. Populations of nesting turtles in Brazil (South Atlantic) increased between 1988 and 2004 (NMFS 2009), following the cessation of egg and turtle harvesting in the 1980s (Marcovaldi and Chaloupka 2007). It is unclear if this trend exists throughout the region. For these reasons, this is scored as “moderate” concern.

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina

Low Concern
There is little information about loggerhead turtle capture by the red shrimp fishery, nor is there an official sea turtle monitoring program in Argentina {pers. comm., Laura Prosdocimi 2015}. The subpopulation is considered "Least Concern" by the IUCN. According to the available long-term series of nest counts, an increase over the past three generations in the South West Atlantic loggerhead subpopulation was found, so it is unlikely that the fishery is having an impact on the species. In addition, there are no reports of turtle catch in the shrimp fishery from a program of observers to the Board of Chubut Province {pers. comm., María Eva Góngora 2015}.

For these reasons, loggerhead captured by bottom trawl (coldwater shrimp) scores as "low" concern for fishing mortality.

Magellanic penguin

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet
Southwest Atlantic | Bottom trawls | Argentina

High
Seabirds have a high level of vulnerability {Seafood Watch 2016}. Seabirds grow slowly, reach sexual maturity at a late age, and produce few young. These life history characteristics suggest a high level of inherent vulnerability to fishing. For seabirds, the effects of fisheries can be observed in a number of ways: competition for prey, provisioning from fisheries via discards, and incidental mortality due to bycatch (Wagner and Boersma 2011).

Magellanic penguin, *Spheniscus magellanicus,* is listed as "Least Concern" by the IUCN (BirdLife International 2020b). At its largest colony in Punta Tombo, Chubut, Argentina, active nests declined > 30% over 30 years. Reproductive success is low, many penguins forage far from the colony, and starvation (the major cause of chick death) kills 39% of chicks on average each year (Boersma et al. 2015).

Commercial fisheries throughout the coastal zone of Patagonia have dramatically increased in the last two decades, and are based mainly on two target species, Argentine hake, *Merluccius hubbsi,* and Argentine red shrimp, *Pleoticus muelleri* {Yorio et al. 2010}. Seabirds are attracted to trawl vessels to make use of fishery waste, and this attraction often results in increased incidental mortality {González-Zevallos et al. 2011}.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet
Southwest Atlantic | Bottom trawls | Argentina

Moderate Concern
The Magellanic penguin is listed as "Least Concern" by the IUCN (BirdLife International 2020b). The population is large and widespread (between 1.1 and 1.6 million pairs, with 900,000 along the Argentinian coast) (Boersma et al. 2015). Trends of colonies along Argentina's coast are mixed, with some populations increasing and other declining (BirdLife International 2020b). Magellanic penguins throughout their range are thought to be stable or slowly declining over three generations. Abundance is scored “moderate concern” based on the most recent IUCN listing.

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet
Southwest Atlantic | Bottom trawls | Argentina

Moderate Concern
Although the incidental capture of Magellanic penguins by trawlers is reported, {Marinao et al. 2014} in their study found that almost all of the recorded penguin incidental captures occurred in coastal trawlers targeting hake. Since most coastal vessels targeting Argentine red shrimp operated further north and away from penguin colonies, the authors suggested that this very likely reduces the chances of the vessels to encounter commuting penguins. The authors mentioned that Magellanic Penguin mortality was higher at high-sea trawlers targeting Argentine hake than those targeting Argentine red shrimp in fishing areas north of Golfo San Jorge {González-Zevallos and Yorio 2006} {González-Zevallos et al. 2011}, and conclude that, given the number of Magellanic penguins breeding in the study area (~400,000 individuals) (Boersma et al. 2013), it is unlikely that mortality in nets has a significant impact on their population. However, the authors recommend that the effects should not be underestimated given the impact of other fisheries on the breeding populations. They concluded that an adequate assessment of the overall impact of fisheries on Magellanic penguin populations should consider the additive effects of all fisheries operating along the species distribution {Marinao et al. 2014}. In their review, (Crawford et al. 2017) suggest that cumulative impact from fisheries is a concern for population-level impacts to magellanic penguins, given that bycatch is mostly comprised of adults.

Because the Magellanic penguin represents a non-target species in which the fishery contribution to mortality may be low or unknown and the population is not depleted, the fishing mortality for this species is considered "moderate" concern.

Narrowmouthed catshark

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina

High

The FishBase score for narrowmouthed catshark is 52 of 100 (Froese and Pauly 2016), corresponding to moderate vulnerability. But using the Seafood Watch productivity scoring analysis {Seafood Watch 2016}, narrowmouthed catshark is considered a high vulnerability species, based on its life history characteristics that include being long-lived, attaining sexual maturity at a later age, and having a low reproductive rate {Seafood Watch 2016}.

Life history attribute	Narrowmouthed catshark *(Schroederichthys bivius)*			Score
	Score = 1	Score = 2	Score = 3	
Average age at maturity				unknown
Average maximum age				unknown
Fecundity	< 100 eggs/ yr			1
Average maximum size			< 100 cm	3
Average size at maturity		40–200 cm		2
Reproductive strategy		Demersal egg layer		2
Trophic Level	> 3.25			1
Density dependence	N/A	N/A	N/A	
				1.8

References used in Seafood Watch productivity scoring analysis: (Compagno 1984) (Chiaramonte 2005) (Fowler et al. 2005) {Seafood Watch 2016} (Froese and Pauly 2016).

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina

High Concern
The abundance of *S. bivius* between 1997 and 2001 decreased threefold (Cedrola et al. 2012) {Gongora et al. 2009}. This species is listed as "Least Concern" by IUCN on the basis that it is caught as bycatch in low numbers and is likely to withstand limited exploitation; however the IUCN assessment notes that there are no population size estimates (Dulvy et al. 2020). Abundance scores as "high" concern because abundance is unknown and stock inherent vulnerability is high (as scored in Factor 1.1).

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina

High Concern
The average annual bycatch in the Argentine red shrimp fishery of the oviparous shark *S. bivius* represents 0.07% of the total biomass reported by the INIDEP surveys between 1992 and 2001 {Marí 2005}. The bycatch of sharks in the red shrimp fishery was estimated at ~61 MT/year, equivalent to 0.15% of the shrimp total capture in 2003. *S. acanthias* contributed with 30.5 MT (50.6%) while *S. bivius* contributed 22.6 MT (37.2%). Whereas the abundance for *S. acanthias* in Patagonian waters increased threefold between 1997 and 2001, the abundance of *S. bivius* in the same period decreased by the same amount. Between 2003 and 2007, this species was captured in 26% of the hauls observed in the freezer fleet {Gongora et al. 2009}. In addition, losses of important reproductive sites in southern Patagonia for *S. bivius* were detected. These issues, together with the results presented in this report, add the Argentine red shrimp fishery to the potential threats to *S. bivius* (Cedrola et al. 2012).

According to Cedrola et al. (2012), in the double–beam trawl fishery for the Argentine red shrimp *(Pleoticus muelleri)*, six species of sharks were recorded as bycatch: *Squalus acanthias*, *Squalus mitsukurii*, *Squatina spp.*, *Schroederichthys bivius*, *Galeorhinus galeus*, and *Mustelus schmitti.* Seven species of rays were recorded: *Bathyraja albomaculata*, *Dipturus flavirostris*, *Dipturus trachydermus*, *Psammobatis normani*, *Psammobatis bergi*, *Psammobatis rudis,* and *Sympterygia bonapartei* (Cedrola et al. 2005). *S. acanthias and Z. chilensis* are typical species in this fishery (pers. comm., Gustavo E. Chiaramonte 2015).

The red shrimp fishery is a substantial contributor to mortality of this species, warranting a score of "high" concern.

Narrownose smooth-hound

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

High
Sharks are considered highly vulnerable according to SFW {Seafood Watch 2016}. The fishbase score for Narrownose smooth-hounds *Mustelus schmitti,* is 58 of 100 {Froese and Pauly 2015}, which also corresponds to high vulnerability.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Very High Concern
Narrownose smooth-hound is listed as "Critically Endangered" by the IUCN (Pollom et al. 2020), but NOAA's 12-month finding from 2015 determined that this species meets the definition of a "Threatened" species under the ESA {Federal Register 2015}. Narrownose smooth-hound continues to be overexploited with inadequate management in Argentina and elsewhere (Pollom et al. 2020). Therefore, a very high concern score is given.

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

High Concern
Fishing is the main threat to the narrownose smooth-hound in its entire area of distribution, including fishing by the Argentine red shrimp and hake fisheries (Massa et al. 2006). (CeDePesca 2016) reports that, for sharks, the main species caught is narrownose smooth-hound (220 kg), and in 119 kg, 357 individuals of this species were recorded, but with an overall shark/target species bycatch rate of less than 0.001. Out of 232 sets, narrownose smooth-hound accounted for 38% (ibid). Total catch of sharks as a whole (throughout the entire fishing season) was 0.03% (ibid). However, there is no updated quantitative estimation in the region about population size and trends; therefore, it is difficult to assess the kind of impact that the coastal Argentine red shrimp fleet exerts on narrownose smooth-hound populations. For these reasons, we have rated this factor as "high" concern.

Pink cusk-eel

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina

High
The FishBase score for pink cusk-eel is 79 of 100 {Froese and Pauly 2015}, which corresponds to high vulnerability. The characteristics of slow growth and high age at maturity contribute to low biological production. High concentrations of this species are observed in relatively small areas during breeding. These factors make it highly vulnerable to fishing, reflected in the high catches obtained during the first quarter {Góngora 2011}.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina

High Concern
Pink cusk-eel abundance shows a decreasing trend since 1995. Abundance in 2000 represented 58% of the corresponding abundance for 1995. This represents a significant decrease in the reproductive stock over a relatively short period of time (Cordo 2006).

Abundance scores as "high" concern because this is a high vulnerability species with unknown abundance; there is no evidence to suggest that the stock is either above or below reference points.

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina

High Concern
The pink cusk-eel is caught as bycatch in the red shrimp fishery in one of its main breeding areas, the Gulf of St. George, and is commercially exploited in the red shrimp fishery, presenting high capture frequency {Góngora 2011}. The pink cusk-eel is not targeted by the Argentine red shrimp fishery, but this fishery is a substantial contributor to its mortality; the species is considered unsustainable bycatch {Góngora 2011}. Fishing mortality is considered "high" concern because the fishery contribution is unknown, but the population is depleted and no reasonable management to curtail overfishing is in place (Seafood Watch 2013).

Rays (unspecified)

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

High
Rays are considered highly vulnerable {Seafood Watch 2016}, since they grow slowly, reach sexual maturity at a moderate age, and produce few young.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Very High Concern
According to the SFW criteria, rays have a high stock status concern for bottom trawl fisheries in the Southwest Atlantic. Rays also have high inherent vulnerability, according to the SFW criteria, and many of the rays caught in the ARS coastal fishery are listed as "Vulnerable," "Near Threatened," or "Endangered" (IUCN 2016). Due to these factors, their abundance is ranked as "very high" concern.
Justification:
Yellownose skates (*Zearaja chilensis;* "Vulnerable"), spotback skates (*Atlantoraja castelnaui*; "Endangered"), roughskin skates (*Dipterous trachyderma*; "Vulnerable"), Patagonian skates (Bathyraja macloviana; "Near-threatened") and eyespot skates (*Atlantoraja cyclophgora*; "Vulnerable") have been caught (in amounts of <5%) and recorded in the SLBSC fishery {Núñez et al. 2016}. The frequency of occurrence of two species, the smallnose fan skate (*Sympterygia bonapartii*) and the shortfin sandskate (*Psammobatis normans*), which are both data deficient according to the IUCN Red List, was over 10% (ibid).

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

High Concern
For bottom trawl fisheries in the Southwest Atlantic, ray fishing mortality is scored as 1 out of 5, or "high" concern, using the SFW unknown bycatch matrix.

School shark

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

High
Sharks are considered highly vulnerable according to SFW {Seafood Watch 2016}. The FishBase score for School shark, *Galeorhinus galeus,* is 74 out of 100 {Froese and Pauly 2015}, which also corresponds to a score of high vulnerability.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Very High Concern
Between 1992 and 2004, school shark abundance was reduced by 80% in Argentina (Walker et al. 2006). These declines were primarily due to the target fishery's recruitment overfishing. Globally, this species is listed as "Vulnerable" by the IUCN, but "Critically Endangered" in the Southwest Atlantic, with a decreasing population trend (Walker et al. 2006).

Abundance is scored as a "very high" concern because current abundance is unknown (though is likely depleted) and the inherent vulnerability of this species is high.

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

High Concern
The main threat to school sharks worldwide is over-exploitation, both by targeted fisheries and as bycatch in gillnets and longlines (Walker et al. 2006). (CeDePesca 2016) reports that school sharks are one of the top three species of sharks caught as bycatch during the 2015 to 2016 ARS coastal fishing season, but that 0.28% (1 ton of 344 shrimp tons) of bycatch relative to total shrimp tons in the 2015 to 2016 fishing season was made up of 16 different species of chondrichthyans. Of that, the batoids and sharks/target species rate accounted for even less: 0.1% (ibid). In 119 kg of sharks, 41 kg (8 individuals) of this species were recorded. Nevertheless, there is no updated quantitative estimation in the region about population size and trends; therefore, it is difficult to assess the kind of impact that the coastal Argentine red shrimp fleet exerts on school shark populations. For these reasons, we have rated this factor as "high" concern.

South American sea lion

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet
Southwest Atlantic | Bottom trawls | Argentina

High
Seafood Watch considers all marine mammals to have a high vulnerability to fishing pressure {Seafood Watch 2016}.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet
Southwest Atlantic | Bottom trawls | Argentina

Moderate Concern
The IUCN Red List considers South American (SA) sea lions, *Otaria flavescens*, as "Least Concern" and provides a global population estimate of over 445,000 SA sea lions, with no less than 123,200 in Argentina (Crespo et al. 2012) (Campagna 2014). SA sea lion numbers are increasing in northern and central Argentine Patagonia and northern Chile (Oliva et al. 2012) (Contreras et al. 2014), but decreasing in Uruguay (Dans et al. 2004) {Páez 2006} (Grandi 2010). The majority of subpopulations in the southwestern Atlantic Ocean are increasing, although the trends are not homogeneous (Crespo et al. 2012). Due to the high inherent vulnerability of this species, the generally increasing population, and the fact that the IUCN lists this species as "Least Concern," abundance is scored as "moderate" concern.

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet
Southwest Atlantic | Bottom trawls | Argentina

Moderate Concern
SA sea lions interact regularly with fisheries that use a variety of fishing gear and that target coastal and pelagic species (Riet-Sapriza et al. 2013) (Reyes et al. 2013) (Machado et al. 2015). During the 1990s, mortality in the fisheries of the Patagonian shelf varied from 175 to 602 sea lions per year, representing between 1% and 2% of the total population in the area, and males seemed to be the most affected group {Crespo et al. 1997} (Dans et al. 2003b). {Crespo et al. 2012} estimated that in the 2000s, 74 SA sea lions were caught per year in San Matías Gulf, Argentina, alone.

Intensive trawl fishing for several species in the coastal waters of the southwestern South Atlantic has been implicated in a decline of sea lions in Uruguay (Franco-Trecu 2015) and the Falkland-Malvinas Islands, where the population has fallen from 30,000 in the 1960s to approximately 15,000 in the 1980s, and possibly to as low as 3,000 in the 1990s (Campagna 2014).

SA sea lions are likely not depleted; however this species still scores as "moderate" concern because the fishery's contribution to fishing mortality is unknown, and their susceptibility to the fishery is moderate to high.

Spiny dogfish

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet
Southwest Atlantic | Bottom trawls | Argentina

High
Sharks are considered highly vulnerable according to SFW {Seafood Watch 2016}. The FishBase score for spiny dogfish, *Squalus acanthus,* is 68 out of 100 {Froese and Pauly 2015}, which also corresponds to a score of high vulnerability.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet
Southwest Atlantic | Bottom trawls | Argentina

High Concern
Between 1995 and 2005, spiny dogfish abundance was reduced by 50% on the northern Argentinean Continental Shelf (38–45°S) (Massa et al. 2007), whereas in the Patagonian region, the abundance assessed by the INIDEP for *S. acanthias* increased threefold between 1997 and 2001 (Cedrola et al. 2012). This species is listed as "Vulnerable" by the IUCN (Fordham et al. 2016), but South American stocks may prove to be "Endangered" when a more detailed regional review is undertaken (ibid).

Abundance is scored as a "high" concern because current abundance is unknown (though may be depleted) and the inherent vulnerability of this species is high.

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina

High Concern

The principle threat to this species worldwide is overexploitation, by target and bycatch fisheries. This is a valuable commercial species in many parts of the world, caught in bottom trawls, gillnets, and line gear, and by rod and reel (Fordham et al. 2016). At least half the shark bycatch biomass from the offshore fishery was *Squalus acanthias*, one of the most abundant shark species in Argentine waters (Cedrola et al. 2012) and, like most cartilaginous fish, *S. acanthias* is not subject to directed fisheries (Massa et al. 2007).

Based on 2003 bycatch survey data and *S. acanthias* biomass data collected between 1992 and 2001 by INIDEP, the average annual bycatch of *S. acanthias* in the offshore Argentine red shrimp fishery represents approximately 0.04% of the total biomass of this species {Marí 2005} in (Cedrola et al. 2012). Annual *S. acanthias* bycatch (based on the 2003 bycatch survey data) was estimated at 35.3 MT, which corresponds to 0.09% of the total shrimp catch (Cedrola et al. 2012). Between 2003 and 2007, this species was captured in 27% of the hauls observed in the freezer fleet {Gongora et al. 2009}.

Fishing mortality for *S. acanthias* from the Argentine red shrimp fishery is less than that in the commercial hake fishery in this region. But total fishing mortality for this species is unknown, with the population potentially depleted (see C 1.2), and no reasonable management to curtail overfishing is in place, justifying a score of "high" concern for fishing mortality {Seafood Watch 2016}.

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

High Concern

The main threat to spiny dogfish worldwide is over-exploitation, both by targeted fisheries and as bycatch in Argentine red shrimp and hake fisheries (Fordham et al. 2016). The frequency of occurrence of spiny dogfish in coastal ARS hauls operating from Puerto Rawson from 2005 to 2014 was 13.48% (Ruibal Nunez et al. 2016). However, these data are only from one fishing area, and there is no updated quantitative estimation in the region about population size and trends (population is likely depleted); therefore, it is difficult to assess the kind of impact that the coastal Argentine red shrimp fleet exerts on spiny dogfish populations. For these reasons, we have rated this factor as "high" concern.

Yellownose skate

Factor 2.1 - Inherent Vulnerability

Southwest Atlantic | Bottom trawls | Argentina

High
The FishBase score for yellownose skate is 57 of 100 {Froese and Pauly 2015}, which corresponds to high vulnerability.

Factor 2.2 - Abundance

Southwest Atlantic | Bottom trawls | Argentina

High Concern
This species is listed as "Vulnerable" by IUCN (Pollom et al. 2021). Abundance scores as "high" concern because abundance in all Argentine waters is unknown for this high vulnerability species.

Dipturus brevicaudatus (formerly *Zearaja chilensis)* presented the highest values of relative abundance and the most abundant members of the family Rajidae in Patagonia (Crespi-Abril et al. 2013) (Alonso et al. 2001). According to (Crespi-Abril et al. 2013), the mean value of relative abundance for *D. brevicaudatus* on the northern Patagonian shelf ranged between 9.12 and 151 ind/sq km, and presented the highest values of abundance in autumn and winter. Though the species remains common in some catches, heavy fishing pressure and inadequate management have led to an estimated population reduction of 30-49% over the last three generation lengths (Pollom et al. 2021).
Justification:
Shorttail yellownose skate (*Dipturus brevicaudatus*) split from the former species concept of *Zearaja chilensis*, the latter of which is now described as *Dipturus chilensis* (Pollom et al. 2021). *D. brevicaudatus* occurs in the SW Atlantic from Brazil through Argentina, while the yellownose skate (*D. chilensis*) inhabits waters of the Southeast Pacific (Pollom et al. 2021)

Factor 2.3 - Fishing Mortality

Southwest Atlantic | Bottom trawls | Argentina

High Concern

Yellownose skate *(Zearaja chilensis)* is a bycatch (often retained) in several multispecies demersal fisheries that operate within its Southwest Atlantic range; however, species-specific catch data are generally unavailable (Kyne et al. 2007). It is a typical bycatch of the Argentine red shrimp *(Pleoticus muelleri)* fishery {Marí 2005} {pers. comm., Gustavo E. Chiaramonte 2015}.

Fishing mortality for *Z. chilensis* from the red shrimp fishery is less than that in the commercial hake fishery in Patagonia, but total fishing mortality for this potentially depleted species is unknown. This species was observed with a frequency of occurrence of 62% in the freezer fleet from 2003 and 2007 {Gongora et al. 2009}.

In 2007, the national plan of action for elasmobranch conservation and management was created, but the information available regarding species biology and the specific composition of the elasmobranchs affected so far is not sufficient to develop adequate management actions (Crespi-Abril et al. 2013).

Because F is unknown, the population is likely depleted, and no effective management is in place, fishing mortality receives a score of "high" concern (Seafood Watch 2013).

Factor 2.3 - Modifying Factor: Discards and Bait Use

Southwest Atlantic | Bottom trawls | Argentina

40-60%
Shrimp trawling is generally regarded as one of the least selective fishing methods, because the bycatch may consist of over several hundred teleost species and outweigh the shrimp catch by 20 to 1 or more. No other fishing method comes close to matching such discarding and wastage of marine resources (Eayrs 2007).

In 2000, the red shrimp *tangoneros* trawl in Argentina had landings of 36,823 MT, a discard rate of 50.1%, and discards of 37,000 MT (Kelleher 2005).

The shrimp beam-trawl fishery (discard rate 50%) discards substantial quantities of juvenile hake (Kelleher 2005).

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

< 20%
Shrimp trawling is generally regarded as one of the least selective fishing methods, because the bycatch may consist of over several hundred teleost species and outweigh the shrimp catch by 20 to 1 or more. No other fishing method comes close to matching such discarding and wastage of marine resources (Eayrs 2007).

For the ARS coastal fishery specifically, discarding occurs in over 90% of trips (CeDePesca 2016). Out of the 135 sets analyzed in the 2015-2016 FIP onboard observer program report, the total bycatch to red shrimp rate was 0.084 or 8.4%; therefore, we have used a discard rate of <20% (CeDePesca 2016).

Criterion 3: Management Effectiveness

Seven subfactors are evaluated: Management Strategy, Recovery of Species of Concern, Scientific Research/Monitoring, Following of Scientific Advice, Enforcement of Regulations, Management Track Record, and Inclusion of Stakeholders. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.'

- *5 (Very Low Concern)—Rated as 'highly effective' for all seven subfactors considered*
- *4 (Low Concern)—Management Strategy and Recovery of Species of Concern rated 'highly effective' and all other subfactors rated at least 'moderately effective.'*
- *3 (Moderate Concern)—All subfactors rated at least 'moderately effective.'*
- *2 (High Concern)—At minimum, meets standards for 'moderately effective' for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated 'ineffective.'*
- *1 (Very High Concern)—Management exists, but Management Strategy and/or Recovery of Species of Concern rated 'ineffective.'*
- *0 (Critical)—No management exists when there is a clear need for management (i.e., fishery catches threatened, endangered, or high concern species), OR there is a high level of Illegal, unregulated, and unreported fishing occurring.*

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***

Criterion 3 Summary

FISHERY	HARVEST STRATEGY	BYCATCH MANAGEMENT STRATEGY	SCORE
Southwest Atlantic | Bottom trawls | Argentina	3.000	1.000	**Red (1.732)**
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet	3.000	1.000	**Red (1.732)**

Factor 3.1 Summary

FISHERY	STRATEGY	RECOVERY	RESEARCH	ADVICE	ENFORCE	TRACK	INCLUSION
Southwest Atlantic | Bottom trawls | Argentina	Moderately Effective	N/A	Highly effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet	Moderately Effective	N/A	Highly effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective

Factor 3.2 Summary

FISHERY	ALL SPECIES RETAINED?	CRITICAL?	STRATEGY	RESEARCH	ADVICE	ENFORCE
Southwest Atlantic | Bottom trawls | Argentina	No	No	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet	No	No	Ineffective	Moderately Effective	Moderately Effective	Moderately Effective

This report was reviewed for any major management updates in May 2021. While there were management changes under

the Fishery Improvement Projects (FIP) for both the coastal and industrial fleets, none occurred that changed the original scoring for management effectiveness of targeted or bycatch species. There is more observer data from the seasons following the publication of this report available through the FIP websites, but those data do not change the limiting species. Additionally, observer methodology often differs, which prohibits a complete understanding of the impact to retained, bycatch, and ETP species (CeDePesca 2020c). There have been conferences and committee meetings held to address bycatch in Argentina trawl fisheries (FAO 2019), but bycatch mitigation measures in the shrimp trawl are still focused on hake (Roth 2019)(CeDePesca 2020c) while IUCN Critically Endangered and Endangered species continue to be incidentally caught in these fisheries (CeDePesca 2019)(CeDePesca 2018). Therefore, management effectiveness of the bycatch strategy remains scored as "ineffective."

Criterion 3 Assessment

SCORING GUIDELINES

Subfactor 3.1.1 – Management Strategy and Implementation
Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? To achieve a highly effective rating, there must be appropriate management goals, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Subfactor 3.1.2 – Recovery of Species of Concern
Considerations: When needed, are recovery strategies/management measures in place to rebuild overfished/threatened/ endangered species or to limit fishery's impact on these species and what is their likelihood of success? To achieve a rating of Highly Effective, rebuilding strategies that have a high likelihood of success in an appropriate timeframe must be in place when needed, as well as measures to minimize mortality for any overfished/threatened/endangered species.

Subfactor 3.1.3 – Scientific Research and Monitoring
Considerations: How much and what types of data are collected to evaluate the health of the population and the fishery's impact on the species? To achieve a Highly Effective rating, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.

Subfactor 3.1.4 – Management Record of Following Scientific Advice
Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g. do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

Subfactor 3.1.5 – Enforcement of Management Regulations
Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

Subfactor 3.1.6 – Management Track Record
Considerations: Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels? A Highly Effective rating is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.

Subfactor 3.1.7 – Stakeholder Inclusion
Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent and

includes stakeholder input.

Subfactor 3.2.2 – Management Strategy and Implementation
Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and how successful are these management measures? To achieve a Highly Effective rating, the primary bycatch species must be known and there must be clear goals and measures in place to minimize the impacts on bycatch species (e.g., catch limits, use of proven mitigation measures, etc.)

Subfactor 3.2.3 – Scientific Research and Monitoring
Considerations: Is bycatch in the fishery recorded/documented and is there adequate monitoring of bycatch to measure fishery's impact on bycatch species? To achieve a Highly Effective rating, assessments must be conducted to determine the impact of the fishery on species of concern, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are being met

Subfactor 3.2.4 – Management Record of Following Scientific Advice
Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g., do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

Subfactor 3.2.5 – Enforcement of Management Regulations
Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management regulations and what is the level of fishermen's compliance with regulations? To achieve a Highly Effective rating, there must be consistent enforcement of regulations and verification of compliance.

Factor 3.1.1 - Critical?

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

No
In the Argentine red shrimp fishery, closures protect juveniles and reproductive stages of the red shrimp, but these closures are not directed by bycatch. On the other hand, the development of more selective gears is a recent issue. DISELA II significantly reduced the amount of bycatch compared with gears without any device. Elimination of the smaller grid enhanced the catches of shrimp, and the total weight of hake per kg of shrimp was low compared with previously established levels for this device (Pettovello 1999). By the end of 2008, Argentinian legislation allowed the use of different excluding devices in order to increase the use of devices. However, it was not until the observer's program in Chubut (2009) that compliance data was recorded. Until today, the level of compliance has been unclear {Gonogora 2011}.

Factor 3.1.2 - Mgmt Strategy / Implement

Southwest Atlantic | Bottom trawls | Argentina

Moderately Effective

The Federal Fisheries Council (CFP) manages Argentine fisheries in federal waters, including the red shrimp fishery. The Instituto Nacional de Investigación y Desarrollo Pesquero (National Fisheries Research and Development Institute) (INIDEP) provides scientific advice on fisheries management to the CFP (Congreso Argentino 1998).

The management of the Argentine red shrimp fishery in the Gulf of San Jorge consists of effort restrictions and temporal and spatial closures. The area in the south of the San Jorge Gulf was recently closed to protect larval and juvenile growth (the area is known as Mazarredo shoal) (de la Garza and Moriondo 2018) (de la Garza and Moriondo 2017). The closed areas have been implemented since 1985 in spring and/or summer seasons (Boschi, E. 1989). A system of mobile closures complements restrictions, such as minimum mesh size at the back of the net, escape devices for juvenile hake, limited time per fishing haul, towing speed, height at the mouth of the net, night fishing ban, and limits for the allowable amount of broken specimens and of specimens of sizes less than 70 units per kilo (up to 20% of total processed weight). Some of these regulations were created by the Agriculture Secretary in 2002 (SAGyP 2002) and modified in the resolution of 2015 (CFP 2015). The fishery does not have catch limits or an established maximum sustainable yield (MSY) (Bertuche et al. 2000). The strategy proposed for the Langostino Project by INIDEP is in line with the precautionary approach to fisheries management: management based on a continuous assessment of the recruitment process; obtaining periodic indicators of scenarios and future production based on information obtained in real time; proposing pragmatic steps quickly, such as dynamic closures or boundaries; and occasionally causing significant changes in fishing funds (adaptive management) (Bertuche et al. 2000)

Management strategy scores as "moderate" concern because some effective management is in place, but there is a need for increased precaution. Shrimp recruitment success depends on the magnitude of the spawning biomass and on the environmental conditions of the place in which the first stages of the life cycle are developed {Kalikoski et al. 2006}. Therefore, no management measure can guarantee shrimp abundance every fishing season because it is impossible to control environmental factors. So, sustainable management could attempt to minimize the fishery's impact on stock resilience. In 2016, shrimp producers and managers discussed the creation of a shrimp management plan, which was recently announced and approved in May 2018 (CFP 2018).

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderately Effective

The coastal ARS fishery is managed under the direction of the Secretary of Fisheries of the Province of Chubut. The Fisheries Secretariat of Chubut is responsible for provincial shrimp fishing permits (and therefore establish limitations on the number of vessels in the fishery). The Province of Chubut also has its own onboard observer program (POBCh (Programa de Observadores a bordo de la Secretaria de Pesca de Chubut), which is carried out by the Secretary and has the following objectives: 1) the implementation of a permanent monitoring system of the Provincial Fishing Fleet dynamics; 2) to obtain real-time biological fishery information relevant for decision-making by the Enforcement Authority (such as shrimp size analysis, maturity of females, yield of catch per vessel); and 3) to obtain basic information for fisheries research and management (pers. comm., Alejandra Cornejo, February 14, 2017).

The ARS harvesting strategy is based not on quotas, but on a continual assessment of the daily CPUE (catch per hour and catch per day) as a proxy of 1) shrimp abundance, 2) the length frequency of the catches, and 3) the shrimp/hake ratio {de la Garza et al. 2017}. Because shrimp stocks are so variable, periodic generation of estimates of future production scenarios and management tools are more appropriate and allow for real-time, quick decisions to be made, such as temporal and spatial closures that maximize potential resource renewal, as per shrimp ecology {de la Garza et al. 2017}; (Fishery Progress 2017). These closures are complemented by measures set at the national level and founded on the information provided by INIDEP and by Chubut's Onboard Observers Program (Fishery Progress 2017).

Since 2016, producers and the Secretary of Fisheries discussed the need for a management plan for the fishery. The management plan was recently approved in May 2018 (CFP 2018)

Management strategy scores as "moderate" concern because some effective management is in place, but there is a need for increased precaution. Shrimp recruitment success depends on the magnitude of the spawning biomass and on the environmental conditions of the place in which the first stages of the life cycle are developed {Kalikoski et al. 2006}. Therefore, no management measure can guarantee shrimp abundance every fishing season because it is impossible to control environmental factors. So, sustainable management could attempt to minimize the fishery's impact on stock resilience.

Justification:

Since its inception, the ARS fishery has been managed as a single biological stock unit (as migration and reproduction studies have shown {Fernandez et al. 2012} {Roux et al. 2012}. However, current genetic studies are in progress to prove this (pers. comm., de la Garza, 2018). According to reports, spawning is continuous during summer, but variable in time depending on water temperature. Usually spawning starts in the north area of the Patagonian coast (Rawson and adjacent areas) and continues toward the south (all the coast of San Jorge Gulf) depending on the increase of the water temperature (Fernandez et al. 2011).

The coastal fleet is not subject to the limitations and open/closed management areas when working on Chubut's jurisdiction; however, when the fleet moves to open waters, national limitations are in place. In 2004, the Área Interjurisdiccional de Esfuerzo Pesquero Restringido (AIER) area was declared in national and state waters, opening the fishing activity to the coastal fleet exclusively. Since the management in the AIER area depends on the national authorities, the fishing activity is opened by CFP based on INIDEP surveys and recommendations {Fishsource 2017}.

Factor 3.1.3 - Recovery of Stock Concerns

Southwest Atlantic | Bottom trawls | Argentina

N/A

In the red shrimp offshore trawl fishery, most taxa are discarded because of the high value of the target species (Bovcon et al. 2013). This fishery does not target or retain species that are overfished, depleted, endangered, or threatened.

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

N/A

In the red shrimp coastal trawl fishery, most taxa are discarded because of the high value of the target species (Bovcon et al. 2013). The small amount of species that are retained (*Pseudopercis semifasciata* and *Octopus tehuelche* in 15% out of the 287 sets from the 2015 onboard observers program) are kept for the vessel crew or "escrute" (CeDePesca 2016). This fishery does not target or retain species that are overfished, depleted, endangered, or threatened. Hence, a score of "not applicable" is applied for this factor.

Factor 3.1.4 - Scientific Research / Monitoring

Southwest Atlantic | Bottom trawls | Argentina

Highly effective
The INIDEP (Instituto Nacional de Investigación y Desarrollo Pesquero) has a monitoring program to track the abundance/stock health of red shrimp {De La Garza, J. 2014}. In the past the institute conducted surveys in May and August of each year in order to obtain estimates that allow corrections on the state of resources and the prospects it offers (Bertuche et al. 2000). In recent years, at least three red shrimp-focused research cruises are planned (pers. comm., De la Garza, 2018). There is an onboard observer program (Fishbach 2013) and monitoring of fleet landings {De la Garza and Moriondo 2018}

With the publication and approval of the new management plan, a monitoring program that seeks to generate knowledge related to the status of the stock will be conducted regularly and using independent and fishery-dependant data. For this reason, scientific research and monitoring scores as "highly effective."

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Highly effective
An initial onboard observer program, funded by the United Nations Development Program (UNDP), monitored the coastal red shrimp fleet from 1993 to 1996 to obtain information on both the target and bycatch species of the inshore fisheries (Caille et al. 1997). In addition, the INIDEP's observer program has been in place since 1987 {Blanco, G. 2018}, 2018). Since then, each coastal province has developed their own onboard observer program. In 2000, the Chubut province established the POBCh to collect biological information about target species and bycatch and contribute to strengthen the knowledge about ecosystem and biodiversity in their fishing areas (FishSource 2017). The POBCh covers all the fleets operating in their jurisdiction (offshore beam and bottom trawl, and inshore artisanal).

For CeDePesca's FIP, the 2015 to 2016 fishing season was monitored by a group of biologists chosen by the Hydrobiology Laboratory of the Faculty of Natural Sciences at Trelew's Patagonian National University San Juan Bosco (UNPSJB) (CeDePesca 2016). They were onboard for 68 days total from December to March and they observed two fishing areas, north of Puerto Rawson in the area known as "El Pozón" and south of the port in the fishing area known as "Isla Escondida" where they collected data on red shrimp CPUE and bycatch (ibid). CeDePesca (2016) noted that the Province of Chubut's Onboard Observers Program offers good coverage of the coastal vessels, and if the Secretariat of Fisheries is involved, it may be possible to appoint a group of observers to develop the protocols required by the FIP. This, together with the University observers could achieve good coverage of high technical quality.

The Scientific research and monitoring scores as "highly effective" because data related to stock abundance and health are collected by both dependent and fishery independent methods.
Justification:
INIDEP also has a monitoring program to track the abundance/stock health, migratory route and recruitment of red shrimp {De La Garza, J. 2014} {Fernández et al. 2015}. It conducts surveys in May and August of each year in order to obtain estimates that allow corrections on the state of resources and the prospects it offers (Bertuche et al. 2000), as well as analysis of annual statistics of landings (Fishbach 2013) with more recent results developed in 2018 {De la Garza and Moriondo 2018}.

Factor 3.1.5 - Scientific Advice

Southwest Atlantic | Bottom trawls | Argentina

Moderately Effective
Research surveys are conducted annually and cover all the San Jorge Gulf as well as the northern coast of Chubut up to Rawson (pers. comm., de la Garza, 2018). Depending on the shrimp sizes, the enforcement authority of Santa Cruz starts the harvest season in February or March, and sometimes implements temporary closures near the prohibition area (Gongora 2011). In 2017 and 2018, Santa Cruz and Chubut decided not to open the fishery in San Jorge Gulf to avoid impacting small shrimp (de la Garza and Moriondo 2018).

According to (Glembocki et al. 2015), the Gulf of San Jorge red shrimp fishery has remained productive for two decades despite the lack of a management strategy supported by regular stock assessments. However, (pers.comm., de la Garza 2018) disagreed and stated that after a big overfishing between 2001 and 2004 that led to a decline of catches in 2005, new federal and state regulations were set, and since then catches have been constantly increasing.

Scientific advice scores as "moderately effective" because the management of this resource only sometimes follows scientific advice.

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderately Effective
When INIDEP makes a recommendation regarding openings/closures of areas based on abundance, recruitment, and size distribution, as well as CPUE, size composition, and by-catch, the CFP (the federal management body) historically follows it (FishSource 2017). However, in the fishing areas under the Chubut province jurisdiction, information from monitoring programs that allowed the closure in real-time of the fishing seasons, was abandoned in 2004 (Gongora 2011) and instead the areas are closed between October and November when the shrimp production decline and the ratio of hake/shrimp reaches the value of 5.
Justification:
For the coastal fishery, the Subsecretaria de Pesca de la Provincia de Chubut takes into account the information obtained by POBCh, but does not have a formal assessment; however, the databases produced by the INIDEP cruises are shared with the Chubut and Santa Cruz authorities (pers. comm., de la Garza). Also, the information provided by the program and the specific regulation of the fishery is not made available to the public (FishSource 2017).

Factor 3.1.6 - Enforce

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderately Effective
A mandatory satellite vessel monitoring system is in place for vessels larger than 11 m (resolution 367/1998), and only the artisanal fleet does not have VMS.

The Fisheries Administration and Surveillance Division is responsible for monitoring and enforcement and conducts port inspections where they monitor landings, holds, and transshipments; measure fish/invertebrates; and monitor fishing gears. In 1997, an onboard inspector program was initiated (Schonberger and Agar 2001) and remains in place at a federal level; it is controlled by the National Undersecretary of Fisheries

Enforcement scores as "moderately effective" because there is some level of enforcement and monitoring made by the government (i.e., INIDEP), but effectiveness is uncertain.

Factor 3.1.7 - Track Record

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderately Effective
In the red shrimp fishery, management measures (e.g., a system of mobile closures, minimum mesh size between 45 and 50 mm all over the net, escape devices, limited time per fishing haul, towing speed, height at the mouth of the net, and a night fishing ban) are followed. The response to the management measures applied to this fishery has been positive, although reticence persists to make use of escape devices (CeDePesca 2014).

The track record scores as "moderately effective" because the track record relative to maintaining red shrimp abundance at healthy levels is uncertain, which may be partly due to the strong influence of environmental factors on the biomass of this species.

Factor 3.1.8 - Stakeholder Inclusion

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Highly effective
The stakeholders in these fisheries are identified, and a shrimp fishery following commission has been created, which allows all the stakeholders to share their ideas and take note of the fisheries/biology and political information. Therefore, this factor is scored "highly effective."

Factor 3.2.1 - All Species Retained?

Southwest Atlantic | Bottom trawls | Argentina

No
In this fishery, rajids are not processed onboard. All rajids are released at sea probably alive (handling time between tows averages 15 minutes, and discarding occurs immediately after the opening of the nets), although post-capture mortality is unknown. The captured rajids are *Bathyraja albomaculata*, *Zearaja chilensis, Dipturus trachydermus*, *Psammobatis normani*, *Psammobatis bergi*, *Psammobatis rudis*, and *Sympterygia bonapartei* (Cedrola et al. 2005) (Tamini et al. 2006). The utilization of different species caught when the fleet operated on hake was integral; however, when the fleet operated on shrimp *(Pleoticus)*, most of the taxa were discarded because of the high value of the target species (Bovcon et al. 2013).

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

No
In the ARS onshore fleet, all invertebrates (with the exception of *Octopus tehuelche*), bony fish (with the exception of *Pseudopercis semifasciata*), elephantfish (*Callorhynchus callorhynchus*), batoids and sharks are discarded (on more than 90% of trips) (CeDePesca 2016).

Factor 3.2.2 - Critical?

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

No
In the Argentine red shrimp fishery, closures protect juveniles and reproductive stages of red shrimp, but these closures are not directed by bycatch concerns. The development of more selective gears for the fishery started in the early 1990s (pers. comm., de la Garza, 2018). For example, the DISELA II devices significantly reduced the amount of bycatch compared with gears without any device. Elimination of the smaller grid enhanced catches of shrimp, and the total weight of hake per kg of shrimp was low compared with previously established levels for this device (Pettovello 1999).

Factor 3.2.3 - Mgmt Strategy / Implement

Southwest Atlantic | Bottom trawls | Argentina

Ineffective

Even though the industrial freezer trawl fishery for Argentine red shrimp fishery affects six of the nine shark species inhabiting the area, with an estimated annual shark bycatch of ~61 MT (equivalent to 0.15% of the shrimp total capture in 2003) (Cedrola et al. 2012), there is no management strategy to avoid these captures. The management of this fishery has prioritized controlling hake bycatch, which is reasonable given the size and commercial importance of this resource {Gongora et al. 2009}. Escape devices for juvenile hake are used, but there is no evaluation of the level of compliance with this rule by the fleet and the extent to which these devices reduce hake bycatch or bycatch of other species (Gongora 2011) (Gongora 2012).

Bycatch management strategy scores as "ineffective" because elasmobranchs and other species of concern are caught as bycatch in this fishery, and the reduction techniques used to minimize hake bycatch in shrimp trawls are not aimed at reducing bycatch of these species of concern.

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Ineffective

Argentina subscribes to various international agreements for the protection and conservation of endangered species (turtles, sharks, and birds) {Fernandez et al. 2015}. Yet, the ARS coastal fishery catches 20 different species of sharks and rays, 3 of which are classified as "Near Threatened" or "Endangered" on the IUCN Red List (CeDePesca 2016) (IUCN 2016). This fishery also potentially interacts with South American sea lions and Magellanic penguins. There is minimal to no management strategy to avoid these interactions/captures. For example, various types of scarecrow-like devices have been designed and tested in the San Jorge Gulf, as well as specific provisions for sharks, but their efficacy and the degree to which they are implemented has not been ascertained {Fernández et al. 2015}. Observers have shown that there is only partial compliance with the use of mitigating measures.

The management of the offshore fishery has prioritized controlling hake bycatch, which is reasonable given the size and commercial importance of this resource {Gongora et al. 2009}. Escape devices for juvenile hake are used, but there is no evaluation of the level of compliance with this rule by the fleet and the extent to which these devices reduce hake bycatch or bycatch of other species {Góngora 2011} (Gongora 2012). Bycatch management strategy for the coastal fleet scores as "ineffective" because elasmobranchs and other species of concern likely interact with or are caught as bycatch in this fishery, and the reduction techniques used to minimize hake bycatch in (offshore) shrimp trawls are not aimed at reducing bycatch of these species of concern.

Factor 3.2.3 - Scientific Research / Monitoring

Southwest Atlantic | Bottom trawls | Argentina

Moderately Effective
The INIDEP (Instituto Nacional de Investigación y Desarrollo Pesquero) has an onboard observer program monitoring the bycatch captures of the Argentine red shrimp fishery but does not cover all the fishing fleet cruises. The Chubut province has an observers program that had an average of 32% coverage between 2001 and 2008 (Gongora 2011). It is unclear if this coverage remains the same.

INIDEP conducts annual fishery evaluation campaigns, including bycatch surveys {Marí 2005} (Bertuche et al. 2000). A most recent effort to generate more information was developed by managers in 2017; the monitoring campaign was completed in 2017 {pers. comm., Alejandra Cornejo 2017}. The improvement project started with an onboard program in 2016 that covered one trip and in 2017, ten fishing trips with observers were reported (Gongora 2017).

Because the collection of observer monitoring data exists, but coverage and data analysis is still limited, scientific research/monitoring scores as "moderately effective," rather than "highly effective."

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderately Effective
The Province of Chubut has had an onboard observer program (POBCh) monitoring bycatch in the ARS coastal fishery since January 2016 (Fishery Progress 2017). In addition, during the 2015 to 2016 fishing season, the ARS coastal FIP privately funded an onboard observers program where they spent 68 days onboard nine different vessels (294 hauls observed) from December to March (CeDePesca 2016). The sets under observation were located in 2 fishing areas: north of Puerto Rawson ("El Pozón") and south of the fishing area port ("Isla Escondido") (ibid.) (Gongora b 2017). The privately funded onboard observer's program is planned to run until July 2018 (Fishery Progress 2017).

Because there are currently two onboard observer programs collecting bycatch information for the ARS coastal fleet, one of which will continue indefinitely, but because the results and analysis of the POBCh program are unavailable and the available data from the privately funded program represents low observer coverage, research/monitoring is scored as "moderately effective," rather than "highly effective."
Justification:
Monitoring protocols included recording the weight of all the bycatch separated by group: invertebrates, bony fish, elephant fish (*Callorhynchus callorhynchus*), batoids, and sharks (CeDePesca 2016) (Gongora b 2017).

Factor 3.2.5 - Scientific Advice

Southwest Atlantic | Bottom trawls | Argentina

Moderately Effective
In the red shrimp fishery, most taxa are discarded because of the high value of the target species (Bovcon et al. 2013), and the management actions focus on the target species. For bycatch, management only sometimes follows scientific advice, scoring as "moderately effective." The day-to-day management is more focused on short-term crises to balance conflicts of interest between different sectors. There is a lack of long-term policies, a lack of enough expertise on management issues, and a strong influence of politics or economics over technical decisions {Kalikoski et al. 2006}.

Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderately Effective
In the ARS fishery, most taxa are discarded because of the high value of the target species (Bovcon et al. 2013), and the management actions focus on these species. For bycatch, management only sometimes follows scientific advice; therefore, we have scored this factor as "moderately effective." The day-to-day management is more focused on short-term crises to balance conflicts of interest between different sectors. There is a lack of long-term policies, a lack of enough expertise on management issues, and a strong influence of politics or economics over technical decisions {Kalikoski et al. 2006}.

Factor 3.2.6 - Enforce

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderately Effective
The VMS does not comply fully with international standards. Although there is a system of vessel monitoring by satellite for vessels larger than 25 m, the scheme does not include vessels below 25 mi in a cost-effective way {Kalikoski et al. 2006}. According to María Eva Góngora (pers. comm., 2015), there is VMS for vessels larger than 10 m, and only the artisanal fleet does not have VMS.

The Fisheries Administration and Surveillance Division is responsible for monitoring and enforcement and conducts port inspections where they monitor landings, holds, and transshipments, measure fish, and monitor fishing gears. In 1997, an onboard inspector program was initiated, but discontinued because of concerns regarding the quality of the selection and training of inspectors (Schonberger and Agar 2001).

Enforcement and monitoring scores as "moderately effective" because enforcement and monitoring are in place, although effectiveness may be uncertain.

Criterion 4: Impacts on the Habitat and Ecosystem

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

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

Guiding principles

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

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	SCORE
Southwest Atlantic | Bottom trawls | Argentina	Moderate Concern	Minimal Mitigation	Moderate Concern	**Yellow (2.598)**
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet	Moderate Concern	Minimal Mitigation	Moderate Concern	**Yellow (2.598)**

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate
Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*

- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts
Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

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

Factor 4.3 - Ecosystem-Based Fisheries Management
Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

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

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

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderate Concern
Changes were detected in the Gulf of San Jorge's floor, which can be attributed to several natural and anthropogenic factors that act together. These changes are: defaunation, a high percentage of dead bivalves, development of anoxic conditions in the bottom water, and reduction conditions in the sediment. Changes in shrimp habitat can determine changes in spawning and migration of species in the area. They can also cause an increase in natural mortality, leading to a crisis in the resource (Bertuche et al. 2000).

There is no specific study of the impact of the red shrimp fishery on the ocean floor {pers. comm., María Eva Góngora 2015}, but it is known that the use of mobile fishing gear has become a source of concern because of the size of the affected fishing grounds, the modification of the substrate, the disturbance of benthic communities, and the removal of non-target species (National Research Council 2002). According to the (National Research Council 2002), a complete assessment of the ecosystem effects of trawling requires three types of information: 1) gear-specific effects on different habitat types; 2) frequency and geographic distribution of bottom tows (trawl fishing effort data); and 3) physical and biological characteristics of seafloor habitats in the fishing grounds.

Most recently, CeDePesca completed a Consequence Spatial Analysis following the MSC methodology (CSA) for the coastal fishery, using available information about the habitats, cross-referenced with bycatch data from the Observers Program. The analysis concluded that the fishery represents a low risk for the sub-biome of the coastal margin, and a medium risk for the sub-biome of the inner shelf (Fishery Progress 2017). The red shrimp coastal fishery occurs on soft sand and muddy bottom with low impact (CeDePesca 2016).

The red shrimp fishery scores as "moderate" concern for gear impacts on the substrate.
Justification:
Over the past few years, INIDEP has conducted numerous studies to determine possible changes of the benthos and associated organisms, which are considered indicators of the impact of trawling on ARS fishing grounds (Gaitan et al. 2013). Regarding the composition and structure of benthic fauna, it was found that, between 2005 and 2010, and between 2011 and 2014, there were no drastic changes in the structure of the benthic community associated with shrimp fishing grounds, i.e., non-target species and benthic habitats are not being altered as a result of being caught and returned to the ocean (Fernandez and Colleoni 2013).

It was also found that, from 1999 to 2002 (seasonal), 2005 to 2007 (seasonal) and during the summers of 2009, 2010, and 2013 (February), the values of dissolved oxygen recorded in the bottom waters of the San Jorge Gulf were within normal values known for oxygenated neurotic atmospheres (document prepared by Monica Fernández as per Stuart Anderson (pers. comm., April 7, 2017).

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Minimal Mitigation
Most of the fishery management efforts are aimed at mitigating the fishery's impact on the target species, not to the benthic habitat. There are mobile and permanent closed areas that reduce the spatial extent of impacts to the seafloor. Because of the existence of some closed areas, mitigation of gear impacts scores as "minimal."

Factor 4.3 - Ecosystem-based Fisheries Management

Southwest Atlantic | Bottom trawls | Argentina
Southwest Atlantic | Bottom trawls | Argentina | Coastal Fleet

Moderate Concern
Management measures are based on species rather than on the ecosystem. There do not appear to be integrated management plans in Argentina {Kalikoski et al. 2006}.

Ecosystem-based management scores as "moderate" concern because the fishery does not catch “exceptional species” and because scientific assessment and management of ecosystem impacts are not yet underway.

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Appendix

Appendix A

Updates to the Argentine Red Shrimp Report :

Updates to the September 4, 2018 Argentine Red Shrimp report were made on October 6, 2021

Overall Recommendations for red shrimp caught by bottom trawls in Argentina remained unchanged, but individual updates are described below. While there were management changes under the Fishery Improvement Projects (FIP) for both the coastal and industrial fleets, none occurred that changed the original scoring for management effectiveness of targeted or bycatch species.

Updates Included:

C2.2 Imperial shag downgraded from "Low Concern" to "Moderate Concern" based on unknown population trends and an IUCN rating of Least Concern.
C2.2 Magellanic penguin upgraded from "High Concern" to "Moderate Concern" based on a new IUCN rating of Least Concern.
C2.3 Magellanic penguin upgraded from "High Concern" to "Moderate Concern" because the population is not depleted and the fishery's contribution to mortality is unknown.
C2.2 Apron ray upgraded from "High Concern" to "Moderate Concern" based on an updated IUCN rating of Least Concern.
C2.3 Apron ray upgraded from "High Concern" to "Moderate Concern" because susceptibility to the fishery is high, but the population is not depleted.