Argentine Shortfin Squid

Argentina - Southwest Atlantic

Jig

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Seafood Watch Standard used in this assessment: Fisheries Standard v3

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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 provides a recommendation for Argentine shortfin squid (*Illex argentinus*) captured in the Argentinian squid jig fishery. The jig fishery catches most of the shortfin squid in Argentina, although some may be taken as bycatch in the trawl fishery for hake. Argentina accounts for around one-third of the total shortfin squid catch in the Southwest Atlantic.

Shortfin squid is found in the Southwest Atlantic from Brazil to southern Argentina, the Falkland Islands, and east to the high seas, and supports one of the largest fisheries in the world. Shortfin squid has a short lifespan of around one year. The adults tend to be associated with the bottom and are common between 100 and 600 m deep. Several seasonal spawning populations exist, which results in reproduction that occurs throughout the entire year. Paralarvae of this species are carried long distances in currents, and both juveniles and adults make long migrations along the shelf and slope in search of food. Because shortfin squid is an annual species, abundance is difficult to determine and varies greatly from year to year, but it may be strongly influenced by fishing pressure from the previous year along with environmental factors. There is evidence that overfishing is occurring on this species in recent years.

Jigging vessels use lights to attract and aggregate this species, and bycatch of other species is minimal. There is some evidence that derelict jig fishing gear can entangle southern elephant seals, but the evidence suggests the number of entanglements is very low.

Shortfin squid is managed by individual countries within their Exclusive Economic Zones (EEZs), but there is limited management on the high seas. Argentina manages the species based on 40% escapement to ensure successful recruitment in the following year; however, lack of cooperation between countries that fish this species, along with illegal fishing and fishing on the high seas, poses challenges for the effective management of this trans-boundary species.

Squid jigging takes place in surface waters between 0 and 50 m, so there are no impacts to the benthic environment. Given the important role of squid in the Southwest Atlantic food webs as forage for numerous species, relatively little progress has been made to manage the species in an ecosystem-based framework.

The jig fishery for Argentine shortfin squid is rated **Red/Avoid** due to likely overfishing of this species in recent years and concern over insufficient management, despite little to no bycatch and no direct impacts to habitat.

Final Seafood Recommendations

SPECIES | FISHERY	CRITERION 1 TARGET SPECIES	CRITERION 2 OTHER SPECIES	CRITERION 3 MANAGEMENT	CRITERION 4 HABITAT	OVERALL RECOMMENDATION
Argentine shortfin squid | Southwest Atlantic | Jig | Argentina	1.526	3.413	1.000	3.162	**Avoid (2.014)**

Summary

The jig fishery for Argentine shortfin squid is rated **Red/Avoid** due to likely overfishing of this species in recent years and concern over insufficient management and enforcement, despite little to no bycatch and no direct impacts to habitat.

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 analyzes the Argentine shortfin squid, *Illex argentinus*, caught in the jig fishery in the waters of Argentina. Shortfin squid is the sole target of this fishery, and jigging vessels typically use lights to attract the target species. It is also caught incidentally in the trawl fishery for hake, which is not discussed in this assessment.

Species Overview

Shortfin squid is typically found in nearshore waters from Brazil to Argentina, and the Falkland Islands (22 ^{O}S to 54 ^{O}S), and is most common in the waters over the Patagonian shelf and upper slope between 35 ^{O}S and 52 ^{O}S (Haimovici et al. 1998).

Shortfin squid is an important consumer in the shelf ecosystem, feeding primarily on midwater fish, other squid, and crustaceans (Ivanovic and Brunetti 1994) (Rosas-Luis et al. 2014). They are also considered an important forage species, and are fed upon on by marine mammals, fish, and seabirds (Santos and Haimovici 2000) (Rodhouse 2013) (Rosas-Luis et al. 2014). Shortfin squid is an annual species, reaching sexual maturity within a year; females release up to 750,000 fertilized, pelagic eggs that may be carried to various regions by surface currents (Laptikhovsky and Nigmatullin 1993) (Haimovici et al. 1998). Four to six different spawning groups have been identified, but recent evidence indicates more complex, and difficult to discern, stock structure. For assessment and management purposes, Argentina currently splits squid into two major spawning stocks: Unidades de Manejo (Management Unit, UM) south and north of 44 ^{O}S (pers. comm., Marcela Ivanovic 2016). Both stocks are fished within Argentina's EEZ. There is little evidence to suggest genetic differentiation among any potential spawning group (Roldan et al. 2014), and spawning occurs nearly continuously throughout the year (Crespi-Abril and Baron 2012). Population abundance is highly variable, and is strongly influenced by both spawning stock size and environmental variables such as the influence of the Brazil and Falkland (Malvinas) Currents. There is also evidence that recruitment is tied to the Southern Oscillation Index (SOI) and other major environmental variables (Waluda et al. 2001).

Management of this species is defined by individual countries; the last bilateral management organization (the South Atlantic Fishery Council; SAFC) disbanded in 2005 and today no regional fishery management body exists (Arkhipkin et al. 2015). In the Argentine Exclusive Economic Zone (EEZ), the species is managed by The National Institute for Fisheries Research and Development (INIDEP). Escapement of 40% of the squid is the only conservation metric currently used (pers. comm., Marcello Pájaro 2016); this metric was surpassed six times within the past 10 years (2007 to 2016) within the UM South, and five times for the UM North (pers. comm., Marcela Ivanovic 2016).

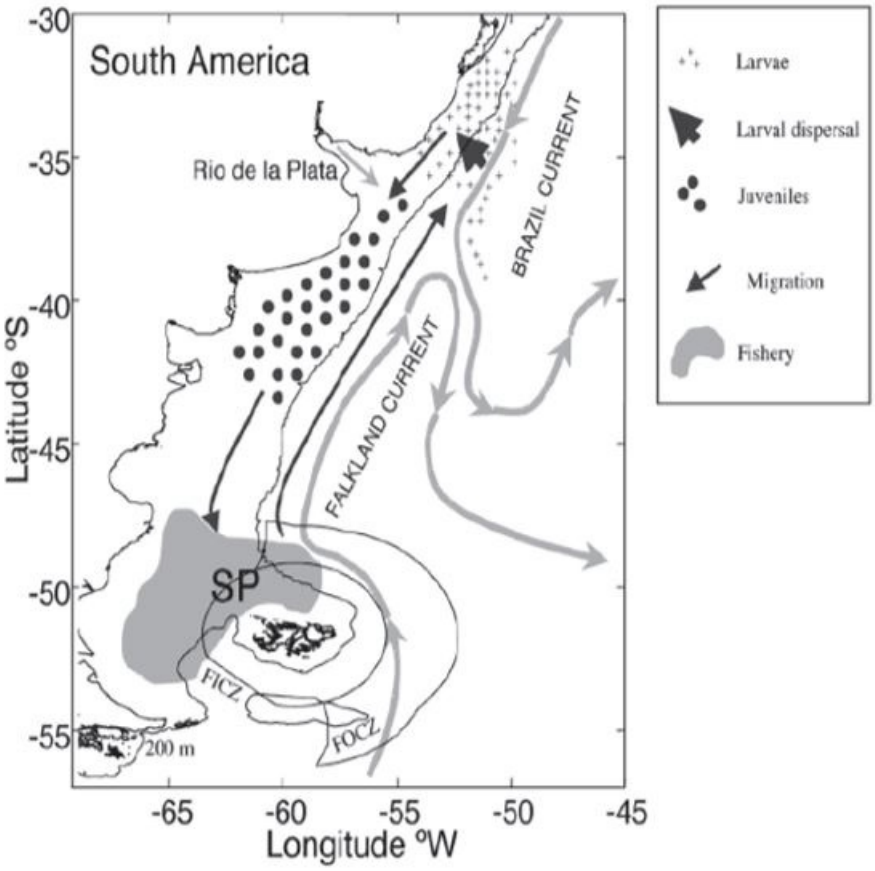

Figure 1: Overview of the migration patterns and fishery of the South Patagonian/Winter Spawning stock of Illex argentinus. Spawning population (SP), Falklands Inner Conservation Zone (FICZ), and Falklands Outer Conservation Zone (FOCZ) (Agnew et al. 2005).

Production Statistics

The Argentine shortfin squid fishery is the second-largest cephalopod fishery in the world (Barratt and Allcock 2014); total Southwest Atlantic landings between 1994 and 2013 ranged from 179,000 to 1,153,000 metric tons (MT) (FAO 2016). Commercial landings began in earnest in the 1970's with foreign fleets from Asia (Arkhipkin et al. 2015) and are taken within the EEZs of Argentina, the Falkland Islands, and the high seas (Figure 2). Argentina lands the most shortfin squid of any single country in the Southwest Atlantic (about 33%), but China, Taiwan, and Korea contribute substantially, each contributing 17 to 23% of landings in recent years, although smaller landings are caught by countries in the European Union (especially Spain) (Arkhipkin et al. 2015) (FAO 2016a) (Villasante et al. 2016).

Between 70,000 and 270,000 t of squid were captured in the Argentinean EEZ between 2004 and 2013, with a peak in landings occurring in 1997 (Figure 3, Arkhipkin et al. 2015). In 2016, 63 licensed jigging vessels landed 53,869 t of squid within Argentina's EEZ, of which 2,976 t were captured in the trawl fishery that targets hake (Revistapuerto.com.ar 2016). Shortfin squid ranked third in total seafood exports from Argentina in 2015, with primary destinations of China, Spain, and Japan and a total value of approximately $105 million (Ministerio de Agroindustria 2017).

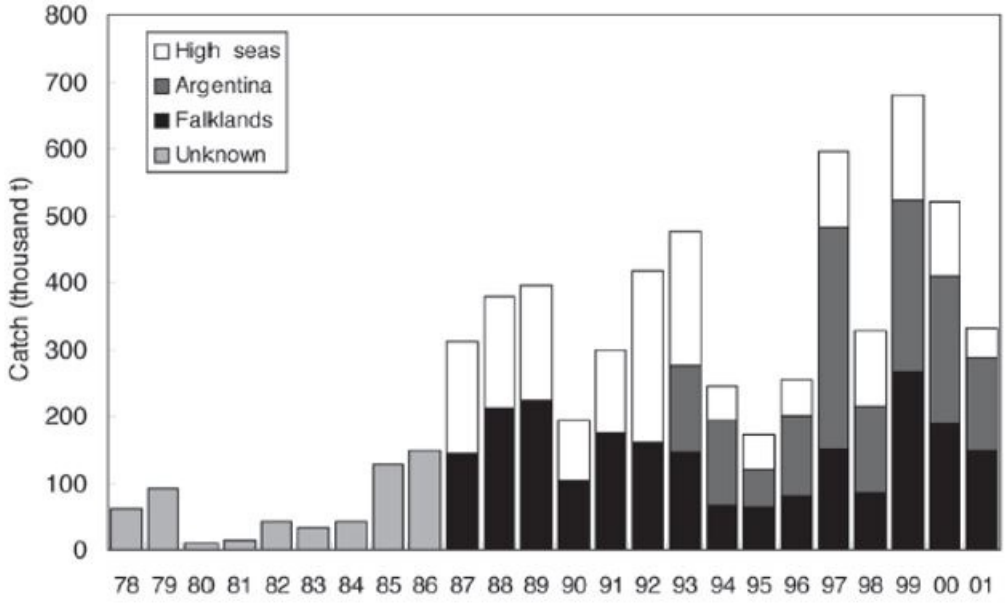

Figure 2: Total annual landings of Illex argentinus in the Southwest Atlantic, 1978 to 2001 (from: Agnew et al. 2005).

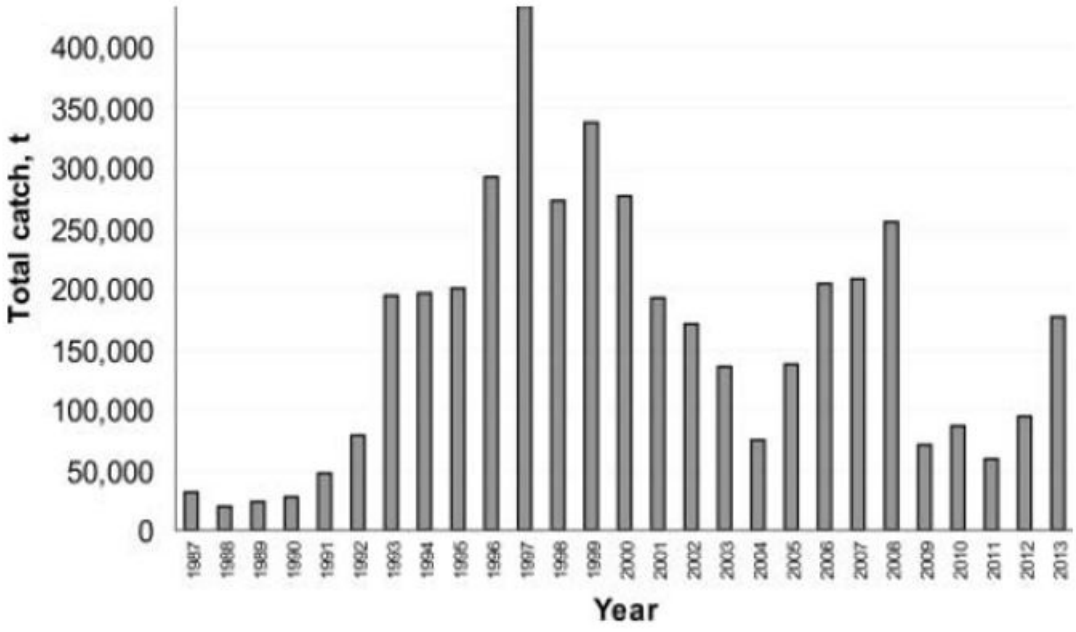

Figure 3: Landings of Illex argentinus by trawlers and jiggers within the Argentinean EEZ (from: Arkhipkin et al. 2015)

Importance to the US/North American market.

The United States imported approximately 5.3 million lbs (~2,400 t) of squid in 2015 (NOAA 2016a). Approximately 480,000 lbs of squid imports to the U.S. from Argentina were listed as "non-specific" squid that are not in the genus *Loligo*, and are therefore most likely Argentine shortfin squid. The 2015 value of these imported shortfin squid was $383,216 (NOAA 2016a)

Common and market names.

Argentine shortfin squid is commonly sold as "squid" or "calamari" (FDA 2016). In Argentina, it is marketed as "calamar" (FAO 2016b).

Primary product forms

Squid are primarily imported frozen, whole or cleaned, or separated into rings and tentacles or tubes (mantles) (SCA 2016). About 60% are sold whole (Ministerio de Agroindustria 2017). Some *Illex* may also be marketed as bait (IMI, Inc. 2016)

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 SHORTFIN SQUID			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southwest Atlantic | Jig | Argentina	2.330: Moderate Concern	1.000: High Concern	Red (1.526)

Argentina recognizes four stocks of shortfin squid, based on spawning area and stages of maturity: Summer Spawning Stock (SDV), South Patagonia Stock (SSP), Stock from Buenos Aires-North Patagonia (SBNP), and Spring Spawning Stock (SDP) (Allega et al. 2020). The fishery itself is managed by South and North Management Units (MUs): fishing for the SDV stock in the South MU (south of 44° S) generally occurs between February and March, while the SSP stock is targeted in the South MU in January. Fishers then move north to target the SBNP stock in April/May, before finishing the season catching squid from SDP; the SBNP and SDP stocks are part of the North MU (north of 44° S) (Allega et al. 2020).

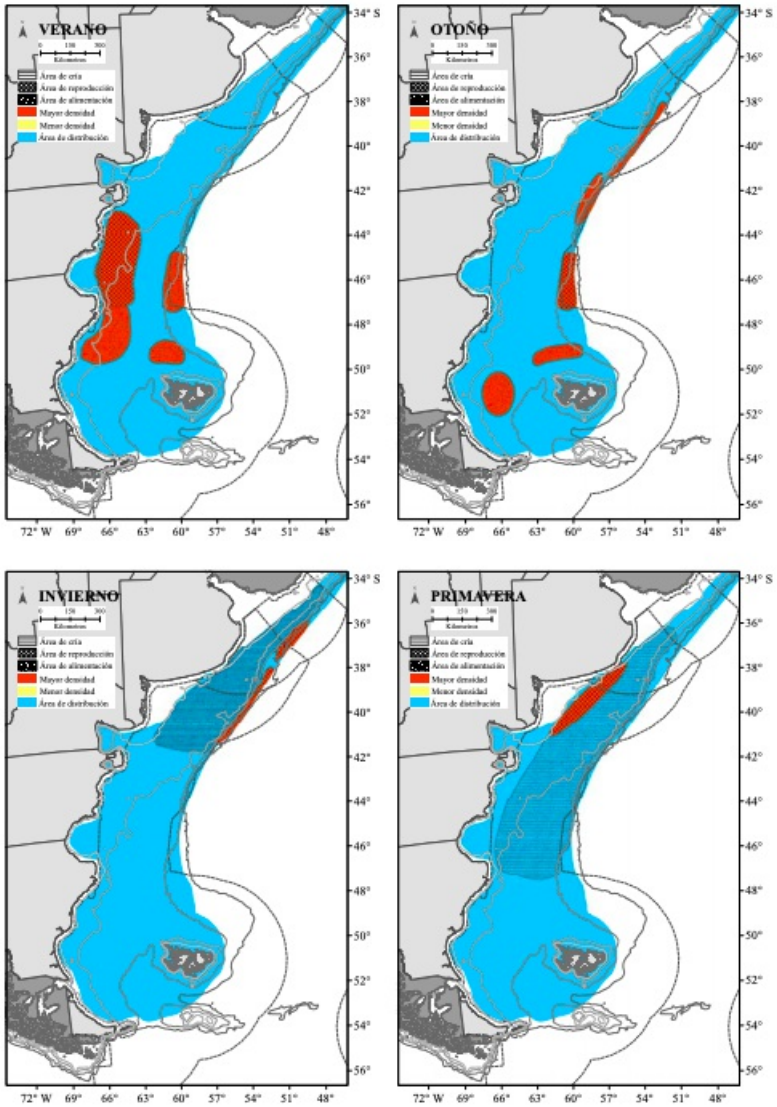

Figure 7: Spatio-temporal distribution of Argentine squid during summer, fall, winter and spring; high density areas are in red and distribution in blue (from Allega et al. 2020).

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 shortfin squid

Factor 1.1 - Abundance

Southwest Atlantic | Jig | Argentina

Moderate Concern

The abundance of shortfin squid in Argentina's waters is uncertain. It is an annual species, and measures of abundance are based on landings during the fishing season (Arkhipkin et al. 2015). The International Union for the Conservation of Nature (IUCN) has assessed Argentine shortfin squid as of "Least Concern" (Barratt and Allcock 2014), primarily due to its short generation time and high productivity. Nonetheless, jigging vessels use light to aggregate the squid and therefore are exceptionally good at capturing them in large numbers (Boyle and Rodhouse 2005), increasing this species vulnerability to fishing (see Productivity-Susceptibility Analysis scoring below). The Falklands and Argentina restarted joint survey and stock assessment covering illex squid mainly the winter spawning stock. They found that escapement exceeded the reference point in 2019, indicating successful management and potential good stock condition (Winter, A. 2019). However, the research is unable to cover the high sea catches which are presumably significant and the assessment does not include other spawning stocks targeted in Argentine waters. There is some research that utilizes squid landing/survey data to estimate regional/specific squid stock biomass via mathematical modeling. All data for stock biomass are more than 5 years old which results in high uncertainty considering the squid's short life span and high stock variation characteristics (Wang et al. 2018).

There is strong evidence that both recruitment and spatial distribution of migrating squid is highly dependent on factors like sea-surface temperature (Haimovici et al. 1998) (Waluda et al. 2001) (Chen et al. 2007) and abundance of other squid species (Arkhipkin and Middleton 2002). The government of the Falkland Islands stated that shortfin squid abundance has been highly variable since 2000, because of the interplay between fishing and climate, with gradual recovery of the south Patagonian stock from 2011 to 2013 (Falkland Islands Government 2015). Its annual nature ensures that abundance has the potential to increase rapidly following depletion, if environmental conditions are favorable and proper escapement targets are achieved, given that the fishery targets squid on their pre-spawning migrations (Rodhouse et al. 2014) (Arkhipkin et al. 2015). Prior work estimated that spawning stock biomass (SSB) should be between 32,000 and 64,000 mt based on the SSB-recruit relationship (Figure 4) in order to reduce depletion, but this metric is not currently used in management in Argentina's waters (pers. comm., Marcela Ivanovic 2016), nor has it been updated recently to account for changes in oceanographic conditions over the last decade.

Landings peaked in the Southwest Atlantic in the late 1990's, and abundance has been highly variable since then, with apparent low recruitment in 2004, 2011, and 2014 leading to early fishery closures in Argentinean waters (Arkhipkin et al. 2015). Biomass was estimated in several studies in the 1970's and 1980's, prior to heavy exploitation; it was found that total biomass varied between 636,000 and 2,605,000 mt (Arkhipkin et al. 2015).

Biomass is currently estimated for the Argentina EEZ annually in two surveys that happen prior to the fishing season; one on the stock south of 44 ^{o}S and one on the stock north of 44 ^{o}S (pers. comm., Marcello Pájaro 2016). Both stocks are fished by Argentinean licensed vessels. The Falkland Islands Government also estimates biomass in pre-fishing season surveys in combination with daily in-season fisheries data (Arkhipkin et al. 2013) (Rodhouse et al. 2014). There are no high seas biomass estimates, however. The species straddles Brazil, Uruguay, Argentina, the Falkland Islands, and the high seas and no regional cooperation exists to estimate abundance across these regions (Agnew et al. 2005) (Arkhipkin et al. 2015).

Because the abundance of Argentine shortfin squid is highly vulnerable to fishing pressure and environmental conditions, and biomass is only known for a portion of the stock, but some data suggest abundance is not a high concern, we have awarded "moderate" concern.

Justification:

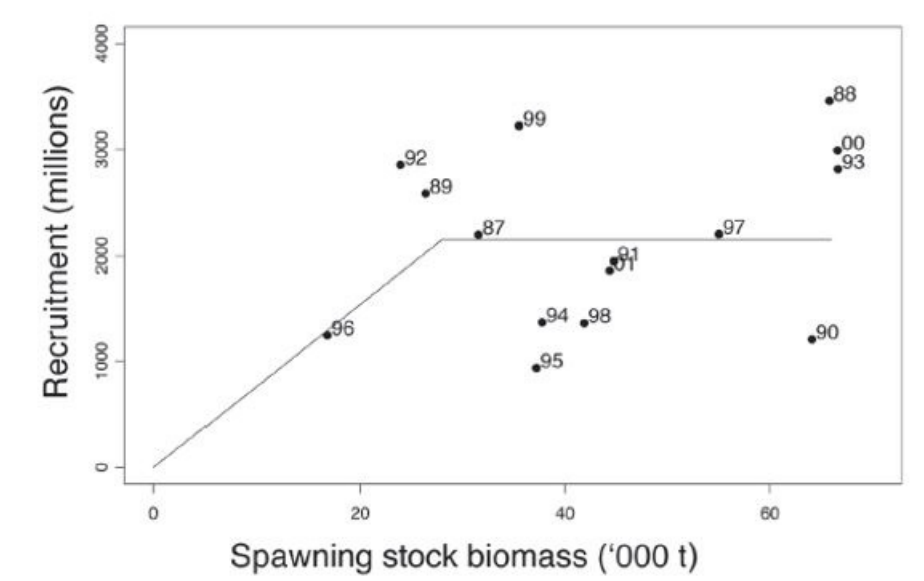

Figure 4: Illex argentinus spawner-recruit relationship. The line represents the approach that recruitment increases with target spawning stock biomass below 40,000 mt, but is independent of spawning stock biomass (SSB) above this threshold. This SSB metric, however, is not currently used for management of abundance in Argentina (from: Agnew et al. 2005).

Productivity-Susceptibility Analysis:

Scoring Guidelines

1.) Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

2.) Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows: ?? = [(??1 ∗ ??2 ∗ ??3 ∗ ??4) – 1/ 40] + 1 .

3.) Vulnerability score (V) = the Euclidean distance of P and S using the following formula: ?? = √(P² + S)²

Vulnerability Score Range

- *< 2.64 = Low vulnerability*
- *≥ 2.64 and ≤ 3.18 = Medium vulnerability*
- *> 3.18 = High vulnerability*

For details on the PSA method and scoring, please see the Seafood Watch Criteria

The PSA score for Argentine shortfin squid = 3.35. For this reason, the species is deemed as having a "High Vulnerability." Detailed scoring of each attribute is shown below.

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	<1 year (Barratt and Allcock 2014)	1
Average maximum age	1 year (Haimovici et al. 1998)	1
Fecundity	750,000 eggs (Laptikhovsky and Nigmatullin 1993)	1
Average maximum size (fish only)	N/A	
Average size at maturity (fish only)	N/A	
Reproductive strategy	Pelagic spawner (Leta 1992)	1
Trophic level	3.8 (Belleggia et al. 2014)	3
Density dependence (invertebrates only)	None	2

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	High overlap	3
Vertical overlap (Considers all fisheries)	High overlap	3
Selectivity of fishery (Specific to fishery under assessment)	Most jigging operations use lights to attract squid, which increases their susceptibility (Boyle and Rodhouse 2005)	3
Post-capture mortality (Specific to fishery under assessment)	Retained	3

Factor 1.2 - Fishing Mortality

Southwest Atlantic | Jig | Argentina

High Concern

The Argentine shortfin squid fishery is the second largest cephalopod fishery in the world (Barratt and Allcock 2014) with Argentina landing about 33% of the yearly take (FAO 2016a). Argentine shortfin squid is also considered an important prey item in the diet of higher trophic level animals and other squid (Rodhouse 2013). Fishing mortality is difficult to assess; the only consistent measure comes from in-season landings by licensed boats in Argentina (63 total). An additional 66 boats are licensed in the Falkland Islands, and 350 more foreign jigging vessels fish outside of the EEZ and potentially enter the EEZ illegally (pers. comm., Milko Schvartzman 2016). Activity of foreign fishing vessels

operating outside the Argentina EEZ and in the high seas has increased over time (Villasante and Sumaila 2009). No landings data are directly available from the large foreign fishing fleet on the high seas, so the number of vessels is estimated using satellite monitoring at night; from these data, landings are estimated (pers. comm., Marcello Pájaro 2016). The inability to receive real-time data from these sources makes it difficult to accurately assess current fishing mortality (Agnew et al. 2005).

In Argentinean waters, the species is fished until an estimate of 40% escapement is reached; this is based on preliminary biomass surveys followed by inspection of dockside landings (pers. comm., Marcelo Pájaro 2016). When 40% escapement is reached, the fishery may be closed; this is the only fishing mortality benchmark currently used for this fishery despite the recommended escapement spawning stock biomass minimum target of 40,000 mt established by the prior regional fishery management body in the early 1990s (Figure 2, Agnew et al. 2005) (Arkhipkin et al. 2015). In the past 10 years, the escapement target was exceeded 6 times for the UM South stock (23 to 39% escapement) and five times for the UM North stock (15 to 34% escapement); the fisheries were closed 4 times in the North and once in the South during that period (pers. comm., Marcela Ivanovic 2016). Most recently, escapement was estimated at 15.85% (2016; revistapuerto.com.ar 2016) at the end of the fishery season, which was substantially lower than the fishing mortality target. When landings are low, some foreign fleets will move to other regions, including the Southeast Pacific, to fish for other squid species (Arkhipkin et al. 2015), decreasing the potential pressure on the species. Total shortfin squid catches in 2016, including all fisheries, were estimated to be 99,700 mt (FAO 2016a). Biomass surveys have not been performed in most of the fishing areas in recent years, so current levels of fishing mortality relative to biomass is unknown.

This species is also caught as bycatch in the hake fishery in nearshore waters of the Patagonian shelf, mostly by licensed Spanish and Korean trawlers (Arkhipkin et al. 2015); in 2016, trawlers landed 2,976 mt.

Illegal fishing is also a problem in the Southeast Atlantic (pers. comm., Milko Schvartzman 2016) (Villasante et al. 2016). Illegal or underreported landings for *Illex argentinus* are difficult to document. Total illegal landings in the Southwest Atlantic Ocean accounted for 15 to 34% in all fisheries between 1980 and 2003 (Agnew et al. 2009), although there is some suggestion that illegal fishing of the *Illex* stock has declined in recent years (Villasante et al. 2015).

Fishing mortality relative to escapement goals is unknown for most fishing areas in recent years, but landings have been historically high. When fishing mortality is known (i.e. in years which biomass surveys are conducted), escapement values are often exceeded. Because fishing mortality is unknown, but there is evidence that escapement targets have been exceeded in recent years for this important forage species, we awarded a score of "high" concern.

Justification:

Estimates of fishing mortality relative to target levels are only available in years in which abundance surveys are conducted prior to the start of the fishing season. In most years when these estimates are available (2014, 2015, 2016) escapement was not reached for Argentine shortfin squid fisheries (INIDEP 2014)(INIDEP 2015)(INIDEP 2016). Escapement data is unavailable for 2017, 2018, and 2020 because abundance surveys did not occur in those years (Table 6, INIDEP 2019b; Table 4, INIDEP 2019a)(Puerto Magazine 2021a). In 2019, a joint stock assessment between Argentina and the Falkland Islands concluded that escapement reached 49%, but the estimate does not include high-seas catch or biomass (Winter, A. 2019).

In total, Argentina landed over 172,000 mt of shortfin squid in 2020 (Puerto Magazine 2021b). Historically, the bulk of shortfin squid landings in the South MU were from the SSP stock; however, over the last two years, between 80-90% of Argentina's shortfin squid catch in the South MU has been from the SDV stock (Garrone, Roberto 2021). Pre-season abundance campaigns were not performed in the South MU in 2020 (Puerto Magazine 2021a).

Landings from the North MU in 2020 were among the highest on record (Garrone, Roberto 2020b). Since 2000, abundance surveys for the SBNP stock in the North MU have only been carried out in the following years: 2000, 2001, 2004, 2005, 2011, and 2019 {INIDEP 2020}.

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 SHORTFIN SQUID			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Southwest Atlantic | Jig | Argentina	3.413	1.000: < 100%	Green (3.413)

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 | JIG | ARGENTINA			
SUB SCORE: 3.413	DISCARD RATE: 1.000	**SCORE: 3.413**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Argentine shortfin squid	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Southern elephant seal	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

Squid jig fisheries are highly targeted and therefore bycatch is minimal. Some additional species of squid may be caught in the jig fishery including *Doryteuthis gahi, Onykia (=Moroteuthis)* spp., and *Martialia* spp. (Boyle and Rodhouse 2005), but these constitute much less than 1% of the catches of Argentine shortfin squid (pers. comm., Laptikhovsky 2016). The majority of bycatch associated with Argentine squid occurs in the hake trawl fishery (UNEP 2002) (Perez et al. 2009).

There are a few studies confirming entanglement or interaction of southern elephant seals with squid fishing gear. One study confirmed repeated entanglement of animals in monofilament from the jig fishery on the Patagonian shelf, in some cases with jigs still attached (Campagna et al. 2007). Southern elephant seals forage for squid, fish, and crustaceans (Burton and van den Hoff 2002) to depths that average 500 m so their foraging grounds overlap both spatially and temporally with the jig fishery; however minimal interactions are anticipated (Burton and van den Hoff 2002). Overall, the southern elephant seal is not believed to be substantially impacted by this fishery.

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

Southern elephant seal

Factor 2.1 - Abundance

Southwest Atlantic | Jig | Argentina

Moderate Concern
The International Union for the Conservation of Nature (IUCN) lists the southern elephant seal, *Mirounga leonina*, as "Least Concern" globally due to its relatively stable or increasing population abundance (Hofmeyr 2015); however, recent, comprehensive abundance estimates are lacking. Colonies in Argentina (Peninsula Valdes and elsewhere) are reported to have increased in size in recent times (Hofmeyr 2015). There is evidence of decreases in population size in some subpopulations in the Indian and Pacific Ocean, but other evidence points to stable populations (Galimberti et al. 2001) (Hofmeyr 2015). We awarded a score of "moderate" concern as a balance between innate high vulnerability of marine mammals, as stated in the Seafood Watch criteria, and the IUCN rating of "Least Concern."

Factor 2.2 - Fishing Mortality

Southwest Atlantic | Jig | Argentina

Low Concern
Interaction of this species with deployed jig equipment is not well studied, but rates of entanglement appear to be as low as 0.001% over 10 years (3 to 5 newly entangled breeding seals yearly, 1995 to 2005, Campagna et al. 2007). The authors note that this number likely underestimates the interactions because any potential juvenile entanglement could not be observed in this study (Campagna et al. 2007). Because interactions are minimal we awarded a score of "low" concern.

Factor 2.3 - Discard Rate/Landings

Southwest Atlantic | Jig | Argentina

< 100%
Justification:

Ratio of bait + discards/landings	Factor 2.4 score
<100%	1
≥100	0.75

Figure 5:

Squid jigging both with and without lights is highly selective (Boyle and Rodhouse 2005). Very small catches of other squid species may be taken, but these are typically 1 to 2 kg (per species) per 20,000 to 50,000 kg of landed shortfin squid (pers. comm., Laptikhovsky 2016).

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

The Criterion 3 rating is determined as follows:

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

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	RESEARCH AND MONITORING	ENFORCEMENT	INCLUSION	SCORE
Southwest Atlantic | Jig | Argentina	Ineffective	Highly effective	Moderately Effective	Ineffective	Moderately Effective	**Red (1.000)**

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Management Strategy and Implementation
Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Factor 3.2 - Bycatch Strategy

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

Factor 3.3 - Scientific Research and Monitoring
Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - Enforcement of Management Regulations
Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

Factor 3.5 - Stakeholder Inclusion
Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

Factor 3.1 - Management Strategy And Implementation

Southwest Atlantic | Jig | Argentina

Ineffective
Shortfin squid was managed by the South Atlantic Fisheries Commission (SAFC) from 1990 to 2005, until Argentina withdrew from the joint agreement over shared fisheries resources (Agnew et al. 2005). Since then, no regional fishery management (RFM) body has existed, which is a critical need for a species that migrates from Brazil to Argentina and the Falkland Islands, and out of territorial waters (Barton 2002). The location of migrating squid depends heavily on environmental factors that vary from year to year, emphasizing the need for a multi-country management body, which currently does not exist (Chang et al. 2016). In fact, it's been argued that sustainable fisheries management for highly migratory species cannot be achieved by individual states (i.e. Argentina and Falkland Islands) alone and collapse of catches is likely due to unregulated catches in international waters (Moustahfid et al. 2021).

Shortfin squid are the sole target for this fishery (Agnew et al. 2005). The species is currently managed by The National Institute for Fisheries Research and Development (INIDEP), based solely on target escapement of 40% spawning stock biomass (SSB; Basson et al. 1996) (Agnew et al. 2005) (Arkhipkin et al. 2015); it is unclear if this is sufficient to maintain the population in the long term; success requires that "…the cephalopod to be the target of the fishery, natural seasonality of abundance (timing of migrations) to be sufficiently well-known, and licencing conditions that allow a fishery to be close early" (Arkhipkin et al. 2020). No other conservation measures exist, with the exception that squid are evaluated by the Hake Fishery Program to better understand consumption of squid by hake, and only 20% of the hake trawler landings can be composed of squid (pers. comm., Marcello Pájaro 2016). Management is based on annual surveys prior to the start of fishing season, but these surveys were not carried in recent years because of union issues (revistapuerto.com.ar 2015), lack of funding, and/or mechanical problems with survey vessels (Puerto Magazine 2019). Lags in obtaining real-time data have also been problematic for this fishery (Agnew et al. 2005).

Chang et al. (2015) suggest that management could be based on environmental variables in the Southwest Atlantic such as the Southern Oscillation Index and sea surface temperature (SST) to better predict squid population abundance

in a given year, but this is not currently factored into squid management in Argentina waters. However, the predictive relationships between SST and abundance no longer hold, and have not been effective for forecasting since 2004 (Moustahfid et al. 2021). Landings throughout the early 2000s were highly variable, which was likely due to a combination of fishing mortality and large scale climatic variations (Chang et al. 2015) making it difficult to discern management effectiveness, as has the recent lapses in preseason abundance surveys (Puerto Magazine 2021a).

Management has conservation goals (i.e. escapement targets) in place, but it is unknown if those goals are met since abundance surveys have not occurred in recent years. Additionally, there is a lack of coordinated regional management that is necessary for such a highly migratory species. Therefore, we awarded a score of "ineffective."

Justification:

The existence of RFM or cooperative regimes when managing fish stocks, like the Argentine shortfin squid, with migration from EEZ to the high seas, have proved to be a successful mechanism in modern fisheries management (Villasante et al. 2014). Current international evidence indicates that the ecological, economic, and social benefits under cooperative management systems are often higher than those managed individually by countries (Villasante et al. 2014). In addition, the development of economic incentives (e.g., taxes), to promote sustainable practices by fishing enterprises and avoid crossing critical thresholds, could be also desirable measures with high potential of for a resilient future of commercial fisheries in Argentina (Li et al. 2016).

Given the size of the fishery, there is an urgent need for more comprehensive coordination to better understand the impacts of the fisheries on squid (and other species) and to then ensure fishing mortality is controlled at a sustainable level. Management by an individual country (e.g. Argentina, which is likely following squid management best practice) will likely have a minimal impact unless there are coordination and agreement with other countries operating in the high seas fishery. Joint management is critical for long term sustainable squid resource utilization, especially under the background that illex squid is a highly variable and straddling species. In 1990, a bilateral South Atlantic Fisheries Commission (SAFC) was established that included Argentina and the United Kingdom to manage high sea fisheries resources included the illex. It applied survey and set catch limit based on the spawning stock biomass to manage the squid while since 2005 the SAFC has been inactive because the Argentine Government reduced cooperation and suspended joint scientific activities. Currently, the Southwest Atlantic high seas region suffers from lack of any effective regional management and conservation of straddling I. argentinus stocks because there is no regional fisheries management organization (RFMO)(Arkhipkin, A.I., Rodhouse, P.G.K., Pierce, G.J., Sauer, W. et al. (2015).).

Factor 3.2 - Bycatch Strategy

Southwest Atlantic | Jig | Argentina

Highly effective

Jigging for shortfin squid results in minimal bycatch (Agnew 2005) (pers. comm., Laptikhovsky 2016), including rare to limited interactions with southern elephant seals (Campagna et al. 2007). Therefore we deem the score to be "Highly Effective."

Factor 3.3 - Scientific Research And Monitoring

Southwest Atlantic | Jig | Argentina

Moderately Effective

Much of the scientific literature on management of this species is split between Taiwanese and Chinese researchers (Chen et al. 2008) (Chen and Chiu 2009) (Chang et al. 2015, 2016), in part because of the vested interest by these nations in this fishery, and by researchers in Argentina and Brazil (Santos and Haimovici 2000) (Crespi-Abril et al. 2015). The extent to which scientific advice from outside Argentina is followed is unknown. Two scientific studies are conducted each year by The National Institute for Fisheries Research and Development (INIDEP) in an effort to establish biomass of the species prior to the fishing season (pers. comm., Marcelo Pájaro 2016); from this information, target escapement can be monitored. Argentina's Federal Fisheries Council requested an alternative to these surveys when problems arose with the unions involved with INIDEP in 2008 (MercoPress 2008) and again in 2015; surveys were not conducted in 2015 (Revistapuerto.com.ar).

About 10% of the permitted squid jigging boats in Argentina have observers on board who collect data on the location, size, and reproductive status of the squid landed along with bycatch information, if any (pers. comm., Marcelo Pájaro 2016), but bycatch is generally $\leq$ 2% of the total catch in the *Illex* jigging fisheries in Falkland Island waters (pers. comm., Vladimir Laptikhovsky 2016). Total fishing effort on this species in all regions is estimated based on the number of squid jigging boats that can be counted using nighttime satellite images, because vessels use lights to attract squid (Waluda et al. 2002); currently, no landings data are collected from any vessels, so landings are estimated based on the number of vessels fishing in all regions (pers. comm., Marcelo Pájaro 2016).

Because there is pre-fishing season monitoring of population abundance, some observer coverage, and an attempt to estimate fishing mortality from all sources with satellites, we awarded a score of "moderately effective."
Justification:

Figure 6: Nighttime satellite image of the Southwest Atlantic. Lighted squid jigging vessels hug the EEZ and shelf/slope break to target squid during their pre-spawning migrations. Image copied from: qz.com (2013).

Factor 3.4 - Enforcement Of Management Regulations

Southwest Atlantic | Jig | Argentina

Ineffective

Inspectors collect landings information dockside from the Argentinean commercial fleet along with information collected by observers that cover about 10% of all licensed vessels in Argentinean waters; this includes foreign vessels licensed to fish within the EEZ. Yet, information is not gathered directly from the foreign fishing fleet in the high seas (pers. comm., Marcelo Pájaro 2016). High seas landings are estimated based on the number of jigging vessels operating outside of 200 nautical miles and estimated based on comparable landings from the licensed commercial fleet. Some additional information comes from the 10% observer coverage on licensed vessels in Argentina waters (pers. comm., Marcelo Pájaro 2016).

The Argentinean government does close the fishery when landings are low (Agnew et al. 2005, Arkhipkin et al. 2015), but not in every case. Furthermore, INIDEP has estimated that escapement has been exceeded 5 to 6 times in the past 10 years, in some cases leaving as few as 15 to 23% of the SSB to reproduce, indicating potential overfishing (escapement values are not publicly available but were provided by the Cephalopod program director; pers. comm., Marcela Ivanovic 2016). Illegal fishing is likely to occur within the EEZ even after these closures (pers. comm., Marcelo Pájaro 2016), although the extent to which illegal fishing occurs is difficult to discern. Other key commercial species, like Argentine hake, have been overexploited during the last few decades due to ineffective enforcement of fishery regulations (Villasante et al. 2014, 2016).

In an effort to reduce illegal fishing, Argentina recently added shortfin squid to the list of fisheries that must prove that landings are obtained legally in Argentinean waters (FIS 2016), but the success of this program is not yet known. In rare cases, illegal fishers are caught by the Argentinean coast guard and vessels with landings have been seized (Ferdman 2013). There is some monitoring of fishing vessels by satellite, but enforcement is still lacking due to an overtaxed Argentinian coast guard (Warren and Byrne 2013). In 2016, the Argentinean coast guard fired upon and sank a Chinese vessel that was illegally fishing for squid in Argentina's EEZ, demonstrating both frustration with, and an effort to combat, illegal fishing (Schvartzman 2016). According to a media report in April 2020 (Pescare 2020), members of the Argentine fleet spotted at least 95 vessels illegally fishing in jurisdictional waters. Other media outlets report that two vessels fishing illegally within the Argentine EEZ were seized and taken to port for prosecution during the 2020 fishing season (Puerto Magazine 2020a). Between, January 2018 and April 2021, the conservation NGO Oceana reported 6,227 instances (totally more than 600,000 fishing hours) in which fishing vessels turned off their automatic identification systems along Argentina's EEZ; roughly 66% of the cases involved Chinese-flagged squid jiggers (Oceana 2021). The authors suggest this tactic is used to avoid detection of vessels fishing illegally within Argentina's waters (ibid).

Evidence of overfishing and exceedance of escapement goals, combined with limited enforcement of illegal fishing resulted in a score of "ineffective."

Factor 3.5 - Stakeholder Inclusion

Southwest Atlantic | Jig | Argentina

Moderately Effective

The lack of a regional fishery management body or other potential cooperative regimes, particularly one that includes Argentina, the Falkland Islands, and foreign fleets is challenging for the sustainable management of shortfin squid in this region (Arkhipkin et al. 2013) (Villasante et al. 2014). Argentina withdrew from the South Atlantic Fisheries Commission (SAFC) in 2005, which effectively dissolved any cooperative, multi-country management of this species (Agnew et al. 2005) (Arkhipkin et al. 2013).

Within Argentina, a monitoring committee meets twice yearly, with additional meetings as needed. These meetings are routinely attended by fishing companies, the National Institute for Fisheries Research and Development (INIDEP), scientists and members of the Undersecretary of Fisheries (UF), and the Federal Fisheries Council (FFC). In these meetings, proposals by scientists and companies are discussed; UF and FFC decide which suggestions to adopt (pers. comm., Marcelo Pájaro 2016). We awarded "moderate" concern due to regional efforts to include stakeholders in discussions, but additional participation of conservation groups, fishers, and other stakeholders is desirable.

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 | Jig | Argentina	5	0	High Concern	**Yellow (3.162)**

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 | Jig | Argentina

5
Jigging gear is fished in surface waters and does not come into contact with substrate.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Southwest Atlantic | Jig | Argentina

0
Because the gear is fished in surface waters, it has limited impact on benthic environments.

Factor 4.3 - Ecosystem-based Fisheries Management

Southwest Atlantic | Jig | Argentina

High Concern
Shortfin squid is an important forage species in the Southwest Atlantic Ocean and the temperate ecosystem called the Extended Patagonian Marine Ecosystem (E-PME) in which no Marine Protected Areas currently exist (Campagna et al. 2008). These squid are a major component of the diet of fish, whales, seals, penguins, and other squid (Santos and Haimovici 2000) (Rodhouse 2013). Both hake and red cod derive much of their energy from squid on the Patagonian shelf (Laptikhovsky et al. 2010), and squid are consumed by at least 32 species in the region, including top predators like tuna, swordfish, and elephant seals (Santos and Haimovici 2000). Large scale migrations by this species suggest that they are a source of energy that is exported to the northern Patagonian shelf from the area surrounding the Falkland Islands (Laptikhovsky et al. 2010). This species likely plays a fundamental role in structuring Southwest Atlantic food webs, but scientific information on this is still lacking.

The Federal Fisheries council and the Federal Fisheries Act of Argentina recognize the need for ecosystem based management, but it has not been substantially implemented. There is some scientific research and monitoring on squid in the diet of hake, another important fishery species on the Patagonian shelf (pers. comm., Marcelo Pájaro 2016), but it appears that ecosystem based management is still in the planning stages within the fishery for shortfin squid. Given that many landings of this species come from the high seas by foreign fleets, implementing ecosystem-based management within the framework of this fishery is a challenge (Campagna et al. 2008).

Because of this species' importance to the food web of the Southwest Atlantic, but minimal progress toward ecosystem-based management of this fishery, we awarded a score of "high" concern.

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

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Appendix

Appendix A

Updates to the Argentine Shortfin Squid Report :
Updates to the October 2, 2017 Argentine Shortfin Squid Report were made on October 6, 2021:

Overall Recommendations for shortfin squid caught with jigs in Argentina remained unchanged, but individual criterion

updates are listed below.

C3.1 Downgraded from "Moderately Effective" to "Ineffective" because previously used conservation goals (i.e. escapement targets) are unavailable and there is no coordinated regional management for this migratory species.