

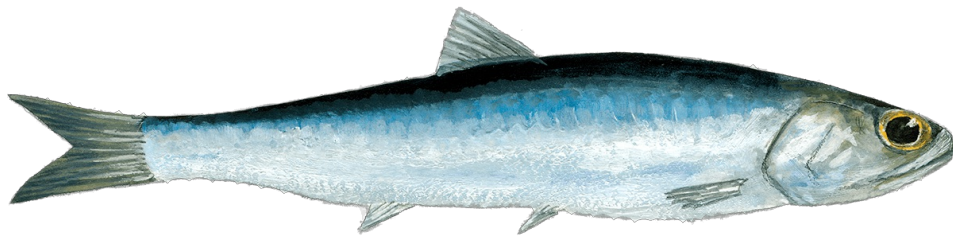


Monterey Bay Aquarium Seafood Watch

Draft Assessment for Review

Anchoveta, Peruvian (Chile, Peru)

Engraulis ringens



Pacific, Southeast

Purse seines

Report ID 27723

Seafood Watch Standard used in this assessment: Fisheries Standard v4

Disclaimer

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

Table of Contents

Table of Contents	2
About Seafood Watch	3
Guiding Principles	4
Summary	5
Final Seafood Recommendations	6
Introduction	8
Criterion 1: Impacts on the species under assessment	14
Criterion 1 Summary	14
Criterion 1 Assessments	16
Criterion 2: Impacts on Other Species	28
Criterion 2 Summary	29
Criterion 2 Assessment	37
Criterion 3: Management Effectiveness	60
Criterion 3 Summary	60
Criterion 3 Assessment	61
Criterion 4: Impacts on the Habitat and Ecosystem	79
Criterion 4 Summary	79
Criterion 4 Assessment	79
Acknowledgements	89
References	90
Appendix A: Review Schedule	97

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

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

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

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

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

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

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished¹ or farmed, that can maintain or increase production in the long term without jeopardizing the structure or function of affected ecosystems.

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

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

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

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

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

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

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

Avoid/Red: Take a pass on these for now; they're caught or farmed in ways that harm other marine life or the environment.

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

Summary

To be completed when reviewed

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Final Seafood Recommendations

SPECIES FISHERY	CRITERION 1 TARGET SPECIES	CRITERION 2 OTHER SPECIES	CRITERION 3 MANAGEMENT	CRITERION 4 HABITAT	OVERALL RECOMMENDATION
Peruvian anchoveta Southern Peru - Northern Chile stock Southeast Pacific Purse seines Southern Peru Northern Chile	4.284	1.732	4.000	2.646	Avoid (2.977)
Peruvian anchoveta Central - Southern Chile stock Southeast Pacific Purse seines Central Southern Chile/Southern Unit	3.318	2.236	4.000	2.646	Good Alternative (2.977)
Peruvian anchoveta Central - Southern Chile stock Southeast Pacific Purse seines Central Southern Chile/Central Unit	3.318	1.732	4.000	2.646	Avoid (2.793)
Peruvian anchoveta Southern Peru - Northern Chile stock Southeast Pacific Purse seines Southern Peru Northern Chile	4.284	1.732	3.000	2.449	Avoid (2.717)
Peruvian anchoveta Northern-Central Peruvian stock Southeast Pacific Purse seines Northern Central Peru	2.644	2.236	3.000	2.449	Good Alternative (2.567)

Summary

To complete when reviewed

Scoring Guide

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

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

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

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

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

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

Introduction

Scope of the analysis and ensuing recommendation

The following Seafood Watch report provides recommendations for the anchoveta/anchovy (*Engraulis ringens*) fisheries occurring in the Southeastern Pacific. Anchovy is caught in Peru and Chile using purse seines. In Peru, the fisheries only target anchoveta {IMARPE 2015}. In Chile, the southern fisheries also target other species, such as Chilean jack mackerel/jurel (*Trachurus murphyi*) and Araucanian herring/sardina común (*Strangomera bentincki*) {IFOP 2020}(see table below).

In Peru, the anchovy fleet is mainly divided into two segments: the steel and wooden industrial fleet and the small- and medium-scale (SMS or artisanal) fleet. The industrial fishery accounts for more than 95% of the anchovy landings, which are exclusively used by the reduction industry (fish meal/fish oil), while landings from SMS vessels are mainly destined for direct human consumption.

Both the industrial and the small-scale fleet target the species along the Chilean coast.

In total, nine fisheries are assessed in this report:

Country	Stock	Fisheries	Target species
Peru	Northern - Central Peruvian stock	Steel and wooden industrial purse-seine fleet	Anchoveta
		Medium and small-scale purse-seine fleet	
	Southern Peru - Northern Chile stock (Regions Arica y Parinacota (XV) - Antofagasta (II))	Steel and wooden industrial purse-seine fleet	
		Medium and small-scale purse-seine fleet	
Chile	Southern Peru - Northern Chile stock (Regions Arica y Parinacota (XV) - Antofagasta (II))	Industrial fleet	
		Small-scale fleet	
	Central - Southern Chile stock - Central unit (Regions Atacama (III) - Coquimbo (IV))	Small-scale fleet	Anchoveta, Chilean jack mackerel (<i>Trachurus murphyi</i>)
	Southern Chile stock - Southern unit (Regions Valparaiso (V) - Los Lagos (X))	Industrial fleet	Anchoveta, Araucanian herring (<i>Strangomera bentincki</i>)
Small-scale fleet			

Species Overview

The anchovy (*Engraulis ringens*) is a small, short-lived, fast-growing species generally found in waters with temperatures between 14 and 22 °C and depths ranging from the surface to 70 m {Sánchez Durand & Gallo Seminario 2009}. In the spring and summer, anchovies concentrate in shoals located 30 nautical miles offshore from the coast, whereas in autumn and winter, they are dispersed along a broader coastal strip (Arias Schreiber 2013). It has a lifespan of 3 to 4 years and reaches sexual maturity at a total length of 12 cm. Anchovy breeds throughout year along the entire coast of Peru and Chile, but with a major spawning in winter/spring (July to September) and a lesser one in summer (February and March) (Bouchon 2007).

Anchovy has a wide geographical distribution in the Southeastern Pacific Ocean, from Punta Aguja (Perú) to Talcahuano (Chile). Three anchovy stock have been described in the area {IMARPE 2021} (IFOP 2021):

- Northern-Central Peruvian stock, managed by the Peruvian authorities;
- Southern Peru/Northern Chilean stock, managed independently by both the Peruvian and the Chilean authorities (Regions XIV – II);
- Central-Southern Chilean stock. This stock is managed by the Chilean authorities as two different fishery units: a central unit (Chilean regions III and IV) and a southern unit (Chilean regions V-X).

The Vice-Ministry of Fisheries (VMP), under the Peruvian Ministry of Production (PRODUCE) is the central government authority in charge of managing fisheries in Peru. This agency is responsible for regulating, approving, executing and supervising the development of the fisheries sector (Zenteno 2014). The Instituto del Mar de Peru (Marine Institute of Peru, IMARPE) conducts scientific research and provides advice and technical support to the government on fisheries issues (Arias Schreiber 2013).

The Chilean fisheries are managed by the Subsecretaria de Pesca (Undersecretariat of Fisheries, SUBPESCA) within the Chilean Ministry of Economy; the Servicio Nacional de Pesca (National Fisheries Service, SERNAPESCA) is responsible for executing policy and ensuring enforcement; and the Instituto de Fomento Pesquero (Fisheries Development Institute, IFOP), is the research institution in charge of conducting stock assessment and giving advice to the government {SUBPESCA 2021}.

Production Statistics

The anchovy fishery is the world's most important fishery per volume (7,045,000 MT in 2018) representing 10% of the global marine catch in 2018 (FAO 2020). Anchovy abundance is strongly dependent on environmental variables (El Nino event, Kelvin waves, etc) resulting in rapid fluctuations in biomass (Cubillos et al., 2007), and annual landings of the species are a reflection of both oceanographic conditions and fishing intensity (Figure below). Peru has dominated the catch through the history of the fishery, accounting for some 90% of the catch in recent years.

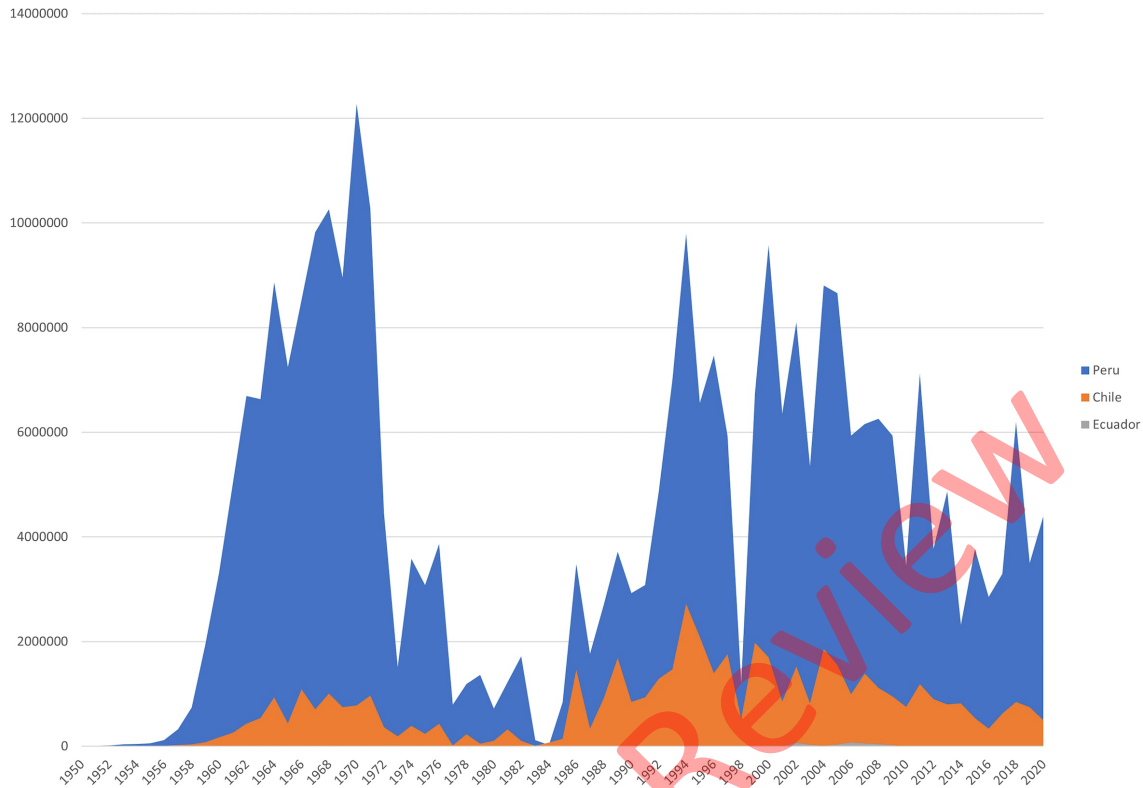


Figure 1: Peruvian anchoveta landings in mt, 1950-2020 {FAO FishStatJ 2022}

The anchovy fishery in Peru supports the largest national fleet targeting a single species worldwide (Freon et al., 2014a) {Freon et al., 2014b}. Around 90% of the catch in this period came from the northern-central Peruvian anchovy stock {IMARPE 2020}.

In Peru, industrial anchovy landings are destined for indirect human consumption (reduction into fish meal and fish oil), whereas artisanal landings are required by law to be used for direct human consumption. In the period 2015-2019, catches by the industrial fleet represented around 97% of the total landings, while the landings from the artisanal fleet represented 3% of the total, according to PRODUCE landing statistics. Around 78% of the anchovy landed by the artisanal fleet was canned (PRODUCE 2020).

Anchovy landings in Chile from both the industrial and the artisanal fleet by management area for the last three years are shown in the figure below. As indicated in the previous section, Chilean anchovy is managed as three separate fishery units. Between 2017 and 2019, industrial landings represented around 60% of the total catch in the country, all coming from the northern management fishery unit. Artisanal landings represented some 40% of the total catch. The anchovy catch in the southern regions is artisanal only (see Figure below).

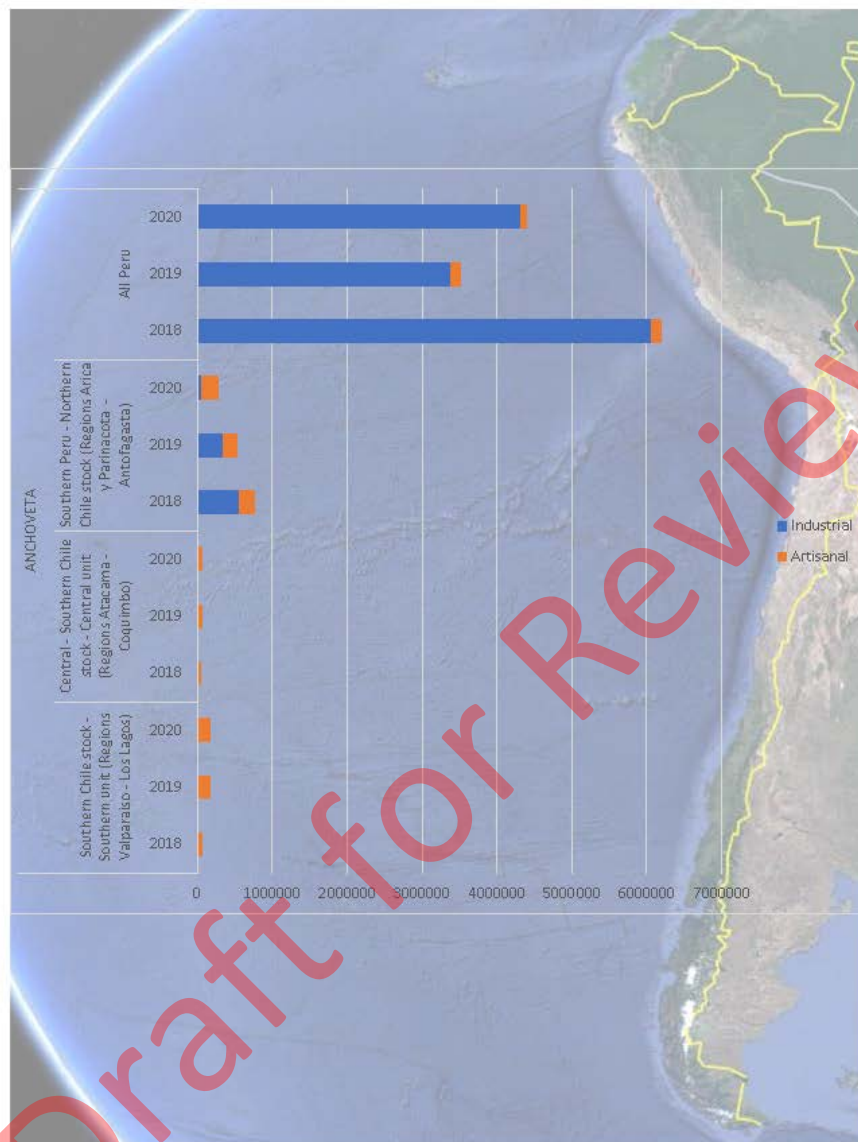


Figure 2: Map of anchovy fisheries in Peru and Chile, including landings by year (2018-2020), anchovy management region (Chile only) and fleet. Management regions are illustrative and not perfectly accurate. Data sources: (PRODUCE 2020) (SERNAPESCA 2021) and Google Earth Pro

Importance to the US/North American market.

The anchovy fishery in both Peru and Chile supports a massive reduction industry (>98% of total landings) and a small industry for direct human consumption (Avadi et al., 2014a). According to {Globefish 2021}, total production of fishmeal in the world in 2019 was 4,887,000 MT, Peru and Chile were the world's first

and fourth largest fish meal producers, exporting 796,000 MT and 310,000 MT respectively. Primary markets for fishmeal are the manufacturers of feeds for aquaculture (65%), pigs (24%) and poultry (7%) (Arias Schreiber 2013). Fish oil is also principally sold for the aquaculture feed market. In 2019, Chile (133,000 MT) and Peru (126,000 MT) were the second and third world's largest producers, after Viet Nam {Globefish 2021}.

US fish oil and fish meal imports from Chile and Peru for the period 2016-2020 are shown in figure 4 below (NFMS 2021). Fish meal imports from Chile have been variable in this period from a minimum of 24,100 MT in 2019 to a maximum of 35,100 MT in 2020. Imports from Peru were low and have decreased in recent years. Fish oil imports were dominated by Peru with an average of around 5,500 MT per year. Fish oil imports from Chile decreased between 2016 and 2018 from 5,200 to 2,900 MT and increased again to 4,100 MT in 2020 (NFMS 2021). Both, fish meal and fish oil represented nearly 90% of the anchovy imports from Peru and Chile into the US, showing the importance of this species in indirect human consumption (IHC) (NFMS 2021).

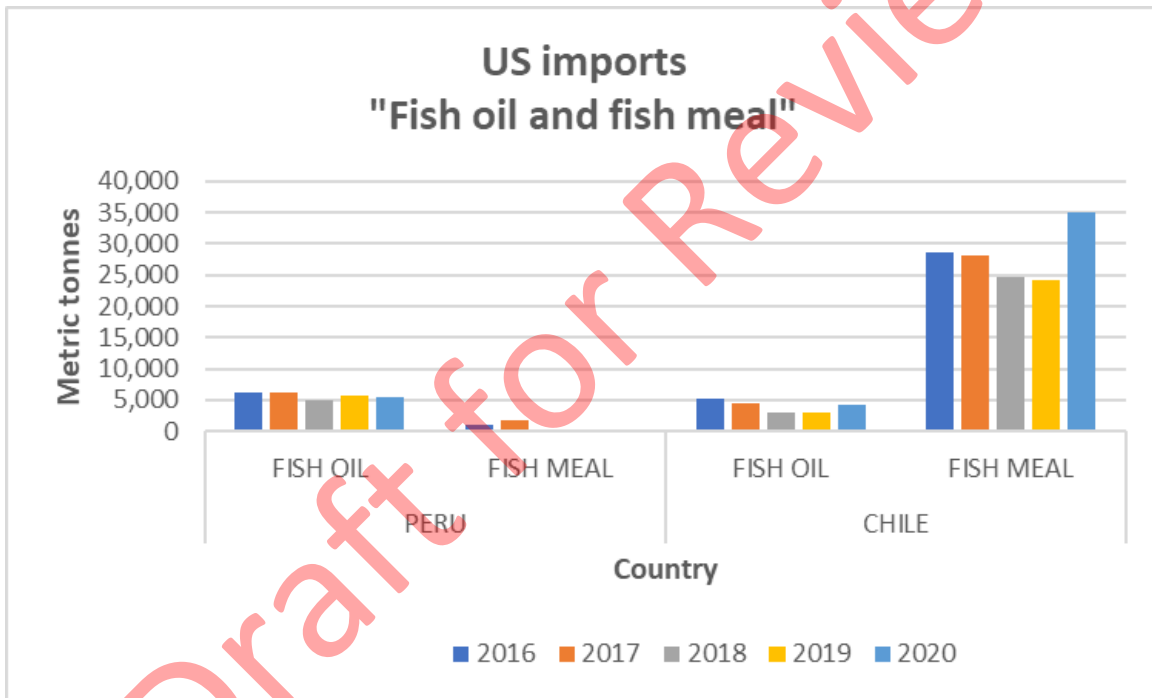


Figure 3 Fish oil and fish meal imports to US from Peru and Chile (NFMS 2020)

US imports of anchovy for human consumption from Chile and Peru for the period 2016-2020 are shown in figure 5 below (NFMS 2021). Imports from Peru for direct human consumption increased from 555.8 MT in 2016 to a maximum of 769.3 MT in 2017 and decreased again afterward to 570.4 MT in 2020. The price was constant at around 9.3 USD/Kilo (NFMS 2021) Imports from Chile have dropped from 243.4 MT in 2016 to only 57.5 MT in 2020 (NFMS 2021). Prices were lower than for Peru, at around 8.5 USD/Kilo. It is important to highlight that nearly all the anchovy imported to the US from both countries for human consumption was in the form of "anchovy canned in oil". Only a very small quantity of fresh anchovy was imported from Chile in 2020 (10.8 MT) (NFMS 2021).

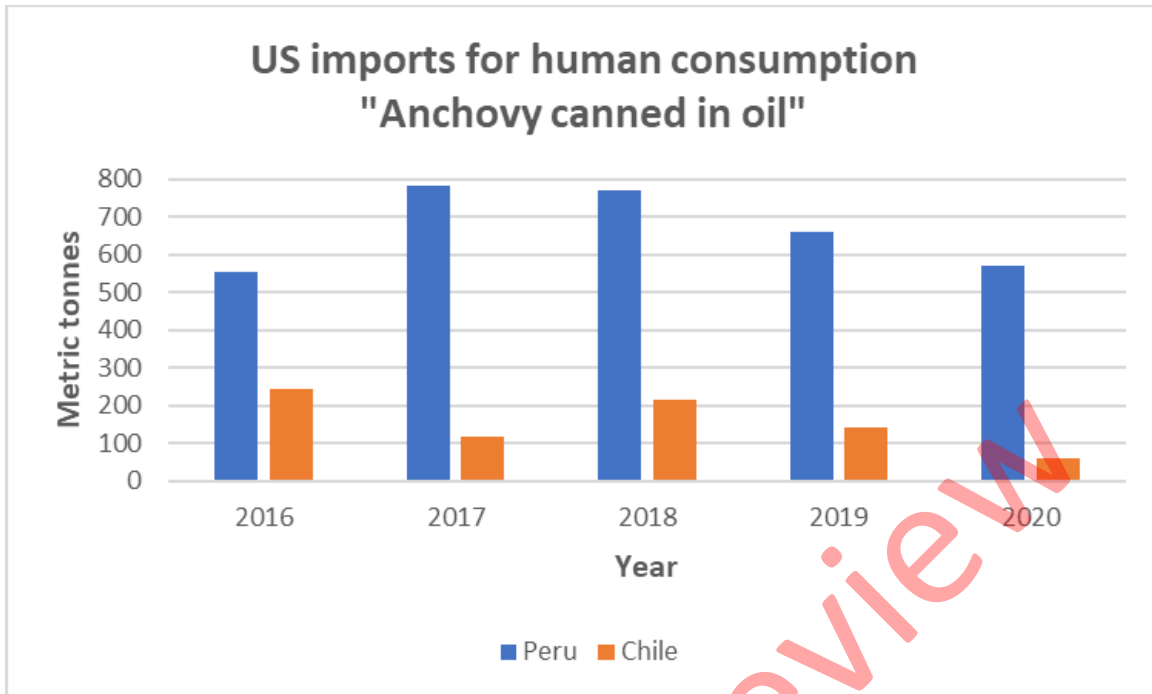


Figure 4 Anchovy imports to US for human consumption from Peru and Chile by year (NFMS 2020)

Common and market names.

The commercial names used in the US for *Engraulis ringens* are anchovy, anchoveta (the Spanish name for anchovy), or Peruvian anchovy/anchoveta. No other commercial names have been reported.

Primary product forms

Anchovy landings are destined for either reduction into fishmeal and fish oil or food products ("direct human consumption"). More than 95% of the landings are used for fishmeal and fish oil. Primary markets for fishmeal are the manufacturers of feeds for aquaculture (60-70%), pigs (25-30%) and poultry (5-10%) (Arias Schreiber 2013).

Anchovy is also available in US seafood markets or speciality grocery stores for human consumption. The main products identified in U.S. markets are canned or pot anchovy fillets in olive oil and anchovy paste.

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

PERUVIAN ANCHOVETA			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Southern Peru - Northern Chile stock Southeast Pacific Purse seines Southern Peru Northern Chile	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Central - Southern Chile stock Southeast Pacific Purse seines Central Southern Chile/Southern Unit	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Central - Southern Chile stock Southeast Pacific Purse seines Central Southern Chile/Central Unit	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Southern Peru - Northern Chile stock Southeast Pacific Purse seines Southern Peru Northern Chile	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Northern-Central Peruvian stock Southeast Pacific Purse seines Northern Central Peru	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

In order for a fishery on a native stock to receive a high score for Criterion 1 (i.e. 3.67 (Low Concern) or 5.00 (Very Low Concern) in C1.1 Abundance, and 5.00 (Low Concern) in C1.2 (Fishing Mortality)), the stock must be performing well relative to reference points appropriate for the species based on a recent assessment.

Age of assessment

Stock assessments are conducted annually for all anchoveta stocks targeted by Peruvian and Chilean fisheries.

Appropriateness of reference points

A 2013 workshop with Chilean and international scientists provided recommendations on reference points for a number of fish stocks in Chile (Clark et al 2014). For demersal fish and crustaceans, these recommendations included MSY proxy reference points of F45%SPR and 40%B₀. For key small pelagics though, they recommended more conservative reference points between 50%SPR and F60%SPR for a number of reasons, including "the high sensitivity of the values of F45%SPR and F60%SPR against the relative position and the distance between the curves of maturity and fishing selectivity; the high sensitivity of these short-lived species to successive year-class failures (two consecutive poor recruitments could strongly decrease abundance); their role as forage species in the ecosystem; and management based on escape biomass, which is used more frequently in other countries for this type of species." Clark et al 2014}. Reference points used in management of the Chilean small pelagics fisheries are consistent with these recommendations (see Table below). It is not clear how consistent the reference points used for the North-Central Peruvian stock are (see stock account below).

However, current management uses a static unfished biomass (B₀) estimate in the calculations, rather than a dynamic B₀, so shifts in productivity of the stock may not be taken into account (rather, the static B₀ is, at best, a long term average). In these cases, Seafood Watch considers forage stock biomass and fishing mortality to be highly uncertain, moderating scores for Abundance and Fishing Mortality. This is the case for all of the small pelagics species considered in this assessment based on the species that generally qualify as forage species listed in the Seafood Watch Standard for Fisheries v4 (page 46): sandeels, sandlances, herrings, menhaden, pilchards, sardines, sprats, anchovies, krill, lanternfish, smelts, capelin, mackerels, silversides, sand smelts, and Norway pout. If there is a determination that these species do not 1) exhibit high connectance to other organisms in the ecosystem and 2) a large amount of energy is not channeled through that species, they can be scored for non-forage species which would allow for improved scoring where static reference points are used. No such determination was found during this assessment. Regardless of whether a species is considered a forage species, if biomass falls below BLIM or if fishing mortality exceeds F_{MSY}, it is assigned a score of 1 High Concern for Abundance or Fishing Mortality respectively (see table below).

Stock	Biomass reference points	Fishing mortality reference points	Reference
Peruvian anchoveta: Southern Peru - Northern Chile	B_{MSY} proxy: 55% SSB_{PR} (Spawning Stock Biomass Per Recruit) (50% SSB_0) B_{LIM} : 25% SSB_0	F_{MSY} proxy: $F_{55\%}$	(SUBPESCA 2022),(Clark et al 2014)
Peruvian anchoveta: Central Chile	B_{MSY} proxy: 60% SSB_{PR} (55% SSB_0) B_{LIM} : 27.5% SSB_0	F_{MSY} proxy: $F_{60\%}$	(SUBPESCA 2022),(Clark et al 2014)
Peruvian anchoveta: Southern Chile	B_{MSY} proxy: 60% SSB_{PR} (55% SSB_0) B_{LIM} : 27.5% SSB_0	F_{MSY} proxy: $F_{60\%}$	(SUBPESCA 2022),(Clark et al 2014)

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.*

Peruvian anchoveta

Factor 1.1 - Abundance

Central - Southern Chile stock | Southeast Pacific | Purse seines | Central Southern Chile/Central Unit

Low Concern

Anchovy is a forage species with an important role in the ecosystems and which abundance greatly depends on environmental conditions. The current reference points used by the IFOP were set in collaboration with international experts (Clark et al 2014) and while the fluctuating nature of the species was considered, the reference points are still based on a static estimate of unfished biomass and so may not fully take into account shifts in productivity (see Criterion 1 synthesis above). The stock was assessed in 2021 by the IFOP. For the year 2021, estimates of total biomass indicate that the stock is over the target reference point (SUBPESCA 2022). Therefore, based on the SFW standard a “**low concern**” score is awarded.

Justification:

According to (SUBPESCA 2022), the estimated spawning biomass in the central anchovy stock (Regions III-IV) continues to increase since 2015. A good recruitment episode was observed in 2019, 120% over the 2018 recruitment, the third highest recruitment episode in the history of this fishery. For the year 2021, estimates of total biomass and SSB were 291 thousand MT, value 8% lower than in the year 2020. SSB was estimated at 66 thousand MT, a value 11% lower than in the previous year. The anchovy stock from the central regions was in a favorable condition in terms of biomass ($SSB_{2021}/SSB_{MSY} = 1.3$)(SUBPESCA 2022).

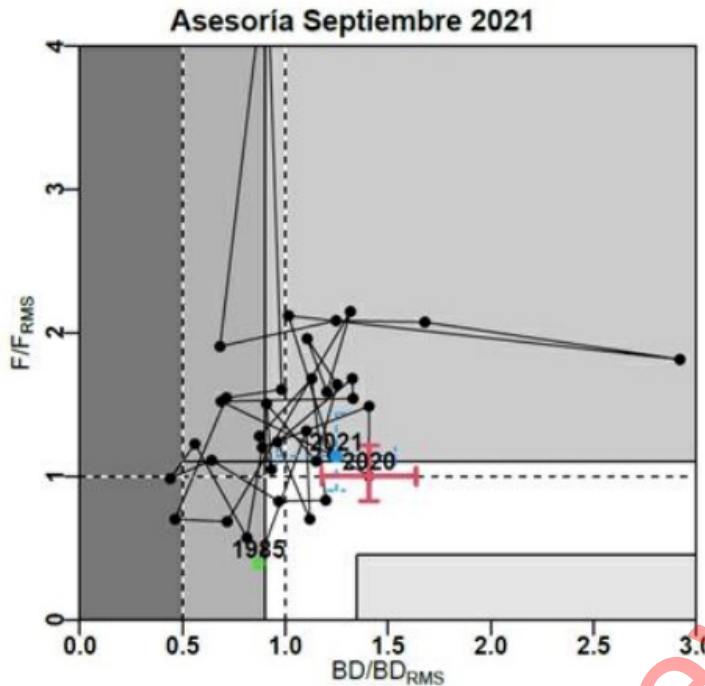


Figure 5 Phase diagram for the anchovy stock Regions III-IV (SUBPESCA 2022)

Central - Southern Chile stock | Southeast Pacific | Purse seines | Central Southern Chile/Southern Unit

Low Concern

Anchovy is a forage species with an important role in the ecosystems and which abundance greatly depends on environmental conditions. The current reference points used by the IFOP were set in collaboration with international experts (Clark et al 2014) and while the fluctuating nature of the species was considered, the reference points are still based on a static estimate of unfished biomass and so may not fully take into account shifts in productivity (see Criterion 1 synthesis above). The stock in 2021 was over the target reference point ($SSB_{2021}/SSB_{MSY} = 1.37$) (SUBPESCA 2022).

Therefore, based on the SFW standard a **“low concern”** score is awarded.

Justification:

The historical series of total and spawning biomass showed a sustained decrease since 2005/2006, a condition that was reversed as of 2014/2015 when they started to increase again. The stock was collapsed from 2009/2010 to 2016/2017 but due to the increase in recruitment and a decrease in fishing mortality the stock recovered to fully exploited in 2021 (CCT_PP 2020). Total biomass in the 2020/2021 season was estimated at 928 thousand MT, the highest in the last 13 years (SUBPESCA 2022). The SSB in 2020/2021 increased 35% (630 thousand MT) compared to the previous season 2019/2020 (SUBPESCA 2022). Consequently, on the basis indicated above, the CCT-PP agreed in 2021, that the status of the anchovy stock in the regions V-X was fully exploited ($SSB_{2021}/SSB_{MSY} = 1.37$) (SUBPESCA 2022).

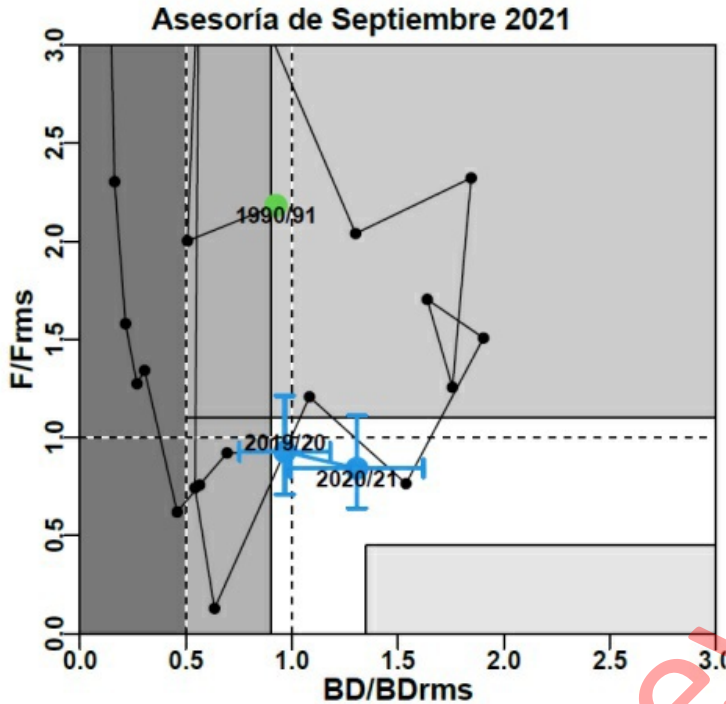


Figure 6 Phase diagram for the anchoveta stock Regions V-X (SUBPESCA 2022)

Northern-Central Peruvian stock | Southeast Pacific | Purse seines | Northern Central Peru

Moderate Concern

Anchovy is a forage species which plays an important role in the Peruvian ecosystem (see factor 4.3 for more information). Limit and target reference points used by the IMARPE for this stock (currently set at 4 and 6 million MT respectively) were defined considering the relationship between spawning biomass and recruitment over a 40-year period of observations {Hervas & Medley 2015}. However, a clear explanation in the IMARPE's protocols indicating how these reference points were set and if they have been reviewed, does not seem to be available. Although the estimated anchovy biomass for the Northern-Central anchovy stock has been above that target reference point in recent years (IMARPE 2021c), some concerns exist about how these reference points were set. Therefore, based on the SFW standard, abundance is scored as **"moderate concern"** (there are no appropriate reference points).

Justification:

Annually, the IMARPE conducts two hydroacoustic surveys to evaluate the state of the Northern-Central anchovy stock. In 2021, the first survey was carried out from February 15 to April 1 to assess the status of the anchovy stock before the fishing season (survey cruise 2102-04) (IMARPE 2021a).

According to the survey, the acoustic biomass of the North-Central Stock of anchovy on April 1 amounted to 9,881 million MT. This figure was 17% higher than the biomass estimated in the

winter-spring 2020 survey (Cr. 2009-11, 8,423 million MT) and comparable (-2%) to that observed in the previous summer 2020 survey (Cr. 2002-04, 10,107 million MT). Furthermore, this value is 20% higher than the average of all summer observations corresponding to the period 1994-2019 (8.18 million t) (see figure X below) (IMARPE 2021a).

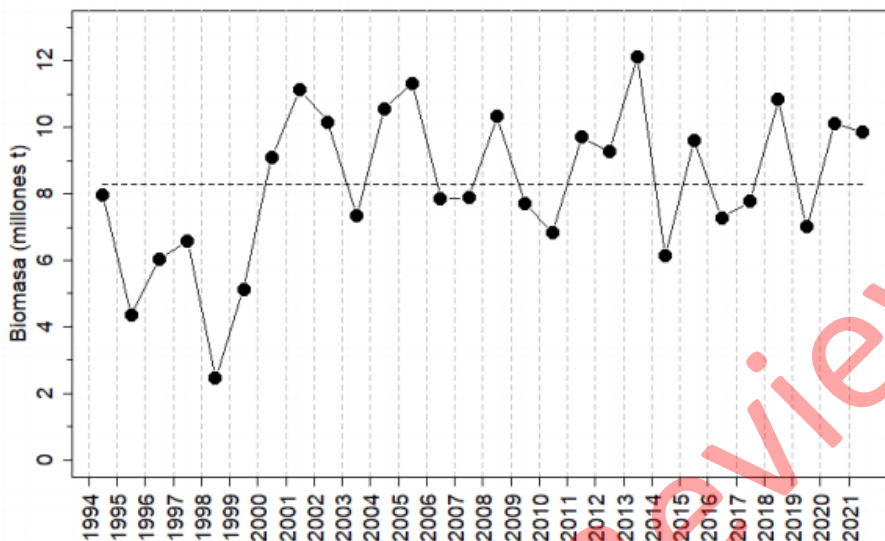


Figure 7 Biomass (in millions tonnes) of the North-Central anchovy Stock observed during the summer assessment survey since 1994 (IMARPE 2021a).

The resource was found up to 80 nm from the coast, with 33.4% of the biomass located within the first 10 nm, while 73.1% of it was located within the first 30 nm. Latitudinally, 50.3% of the anchovy was distributed in the northern part of the Peruvian sea, between Punta Sal ($\sim 3^{\circ} 50' S$) and Huarney ($\sim 09^{\circ} 59' S$), while the remaining 49.7% was found in the central zone, between Huarney ($\sim 10^{\circ} 00' S$) and Chala ($\sim 16^{\circ} 00' S$) (IMARPE 2021a).

The sizes observed during Cr. 2102-04 ranged between 2.0 cm and 18.0 cm TL, observing a main mode at 9.5 cm (~ 0.5 -year-old individuals) and secondary modes at 11.0 cm (~ 1.0 year old individuals), 14.5-15.0 cm (~ 1.5 -2.0 year old individuals) and 6.0 cm (0-year-old individuals). The incidence of juveniles was 77% in number of individuals [95% CI = 68-79%] and 47% in weight [95% CI = 36-49%] (IMARPE 2021a).

In September 2021 a new survey to assess the SSB of the anchoveta stock using the edd production method was undertaken by the IMARPE (IMARPE 2021c). The SSB for the stock was estimated at 1.92 million MT. However, it was considered that this value was underestimated as the survey did not cover the entire spawning area of the species as high egg densities were found outside of 100 nautical miles from shore in Pucusana, Chimbote y Chicama (area which was not covered by the survey) (IMARPE 2021c).

A new acoustic survey was undertaken between September and October 2021 to assess the status of the anchoveta stock (IMARPE 2021c). According to that survey, the acoustic biomass of the North-Central Stock of anchovy on November 1 amounted to 7,008 million MT. This figure was 29% lower than the biomass estimated in the summer 2021 survey (Cr. 2102-04) and 17% lower to that observed in the winter 2020 survey (Cr. 2009-11). However, this figure is 6% higher than the

average of all winter-spring observations corresponding to the period 1996-2020 (6.6 million t) (see figure X below) (IMARPE 2021c).

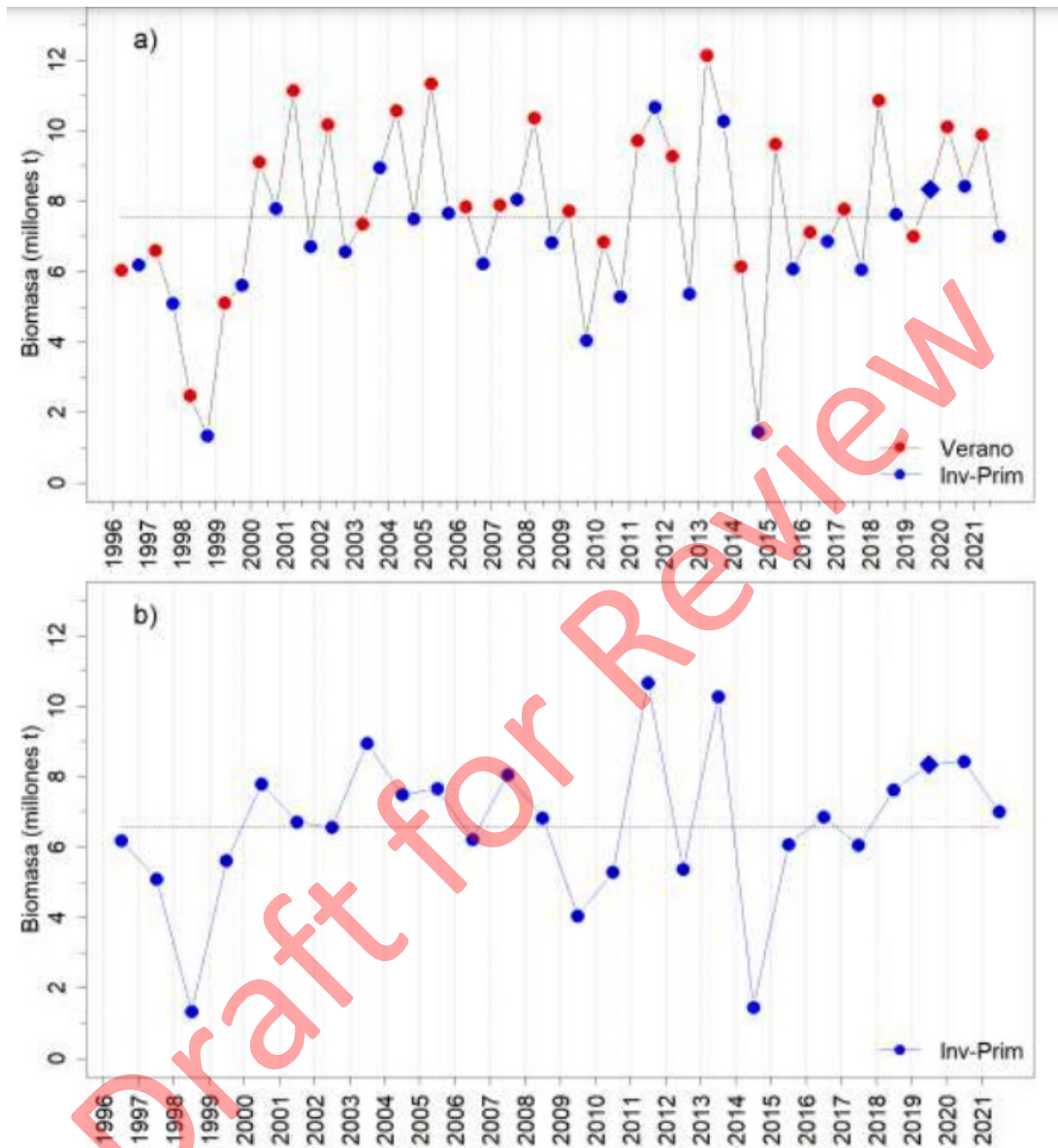


Figure 8 Acoustic biomasses of the Northern-Central Peruvian anchoveta stock in summer (top figure) and winter (bottom figure) for the period 1996-2021 (IMARPE 2021c).

Southern Peru - Northern Chile stock | Southeast Pacific | Purse seines | Southern Peru Northern Chile

Low Concern

Anchovy is a forage species with an important role in the ecosystems and which abundance greatly depends on environmental conditions. The current reference points used by the IFOP were set in collaboration with international experts (Clark et al 2014) and while the fluctuating nature of the species was considered, the reference points are still based on a static estimate of unfished biomass

and so may not fully take into account shifts in productivity (see Criterion 1 synthesis above). The stock in 2021 was over the target reference point (SUBPESCA 2022). The Southern Peruvian anchovy stock is shared by Peru and Chile. For consistency reasons a similar score to the Northern Chilean anchovy stock is given here. Abundance for the shared stock is scored as “**low concern**”.

Justification:

In Peru, the IMARPE conducted two hydroacoustic surveys in 2021 to assess the status of anchovy and white anchovy in the Southern region of Peru. In July and October 2021, the acoustic biomass of anchovy was estimated at 1.02 and 1.04 million MT respectively. In eight of the ten last hydroacoustic surveys, the biomass of anchoveta has been estimated above the 1million MT. It was considered that the biomass was above the BMSY. A decision table was built by the IMARPE to recommend the catch for the first 2022 fishing season {Nº 00463-2021-PRODUCE}.

Between February and March 2020, the IMARPE conducted an hydroacoustic survey to assess the status of the anchovy, horse mackerel, mackerel and others pelagic species in the southern region of Peru (Cr. 2020-0203) (IMARPE 2020c). The acoustic biomass of the anchovy was estimated 940 thousand MT. 88% of the biomass observed in this region was located within the first 10 nautical miles and the sizes of the anchovy in this region fluctuated between 2.0 and 16.0 cm in LT, with several modes of 7.0, 8.5 and 11.5 cm. Using a stochastic surplus production model, the MSY for the southern stock was calculated at $SSB_{MSY} = 939,000$ MT, a decision table was built by the IMARPE to recommend the catch for the second fishing season (IMARPE 2020c)

In Chile, the IFOP conducts stock assessment of the pelagic stock, including the anchovy stock using both direct and indirect assessment methods. Biannual acoustic surveys, estimates from the Daily Egg Production Method and data from commercial landings are used for this purpose (CCT_PP 2020). In 2014, the country hosted an international workshop that revised reference points for the main fisheries. These reference points are MSY proxies relative to the spawning stock virgin (unfished) biomass (SSB_0) {Clark et al., 2014}.

In October 2020, IFOP presented the results associated with the assessment of the anchovy stock from southern Peru and northern Chile, which contained the following biological-fishing information until the second half of 2019: (i) total acoustic biomass from southern Peru and northern Chile; (ii) spawning biomass estimated through the Chilean daily egg production method; (iii) landings and size structures of commercial fleets for Peru and Chile; and (iv) size abundance from the acoustic survey conducted by Chile (CCT_PP 2020).

The main population variables: total biomass, biomass spawning, reproductive potential ratio and recruitments; have showed an increasing trend during the last 4 years with marked interannual fluctuations. Spawning biomass approached 1, 3 million tons, this estimate being one of the highest since 2011 an 118% over the management objective. Similarly, the ratio of the reproductive potential to the second semester of 2019 indicates a value of 1.09, also above the biological reference point of management objective. Based on this information, the Scientific committee of small pelagics (CCT-PP) considered that the northern anchovy stock was not overfished ($SSB/SSB_{BMSY} = 2.026$) (CCT_PP 2020).

Similarly, the most recent report published by SUBPESCA indicates that for the year 2021 (SUBPESCA 2022), the Northern Chilean anchovy stock was underfished, as the total biomass of the stock reached 1.7 million MT, whereas the spawning stock biomass was 1.1 million MT, a 0.87 value over the SSB_{MSY} (SUBPESCA 2022).

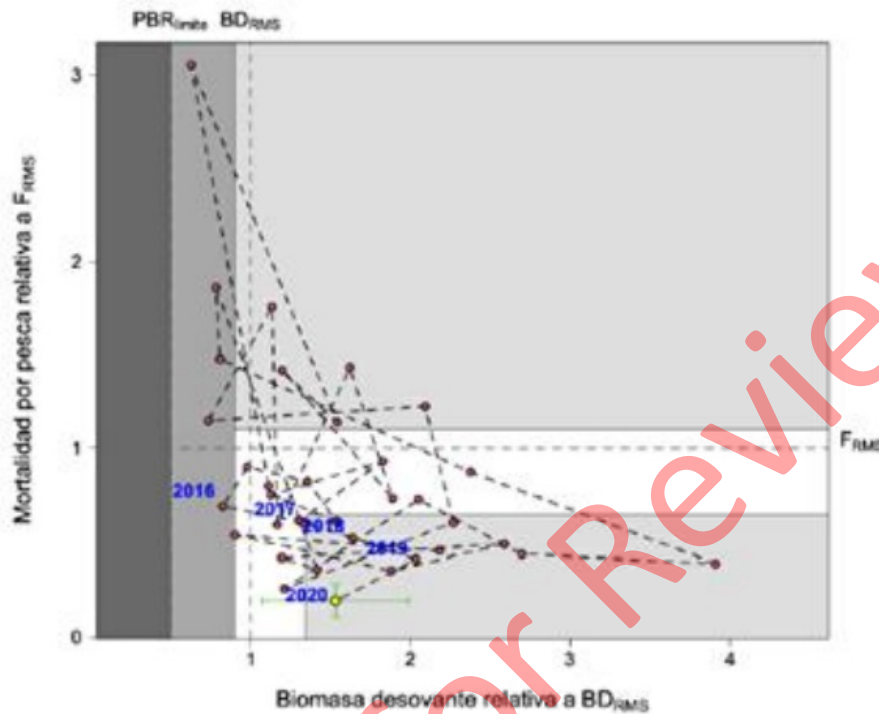


Figure 9 Phase diagram for the anchoveta stock Regions XIV-II (SUBPESCA 2022)

Factor 1.2 - Fishing Mortality

Central - Southern Chile stock | Southeast Pacific | Purse seines | Central Southern Chile/Central Unit

Moderate Concern

Fishing mortality in 2021 for the central Chilean anchovy stock (Regions III-IV) was fluctuating around F_{MSY} (SUBPESCA 2022). Therefore, this issue awards a “**moderate concern**” score.

Justification:

Anchovy catches in the central Chilean area (Regions III-IV) show fluctuating values with a decreasing trend between 2011 (60 thousand MT) and 2017 (22 thousand MT), which has been reversed in the last two years, reaching 66 thousand tons in 2019 (CCT_PP 2020). Spatially, the anchovy catches were mainly done between the coast and the first 10 miles. In 2019 the anchovy size ranged from 6.5 and 18.5 cm, with a main mode at 13-14 cm (CCT_PP 2020). For the year 2021, F was estimated at 0.96 year^{-1} considering a catch of 54.7 thousand MT, corresponding to the 77% of the TAC for 2021 (SUBPESCA 2022). A TAC of 51,287 MT was recommended by the

CCT_PP, which would correspond to a maximum catch of between 41,030 and 51,287 MT according to the article 153c of the LGPA (SUBPESCA 2022).

Current Fishing mortality for the stock was estimated at 0.96 year⁻¹, which is very close to F_{MSY} (see figure X in the biomass section). Therefore, the CCT_PP considered that in 2022 the stock was fully exploited with a very low probability (0.04%) of being overexploited (SUBPESCA 2022).

Central - Southern Chile stock | Southeast Pacific | Purse seines | Central Southern Chile/Southern Unit

Moderate Concern

F is fluctuating around a reference point. Therefore, it is scored as a “**moderate concern**”.

Justification:

Fishing mortality for this stock has decreased since 2011/2012 due to the low level of biomass of this stock. Estimated fishing mortality for 2020/2021 was 0.38 year⁻¹, a 16% lower of F_{MSY} . The committee considered that the overfishing was not occurring for this stock ($F_{2021}/F_{MSY} = 0,842$) (CCT_PP 2022). The range of TACs recommended by the CCT-PP for the 2021/2022 were based on the biological reference points established by the Committee on the CCT-PP No. 01/2015 Report (Res. Ex. No. 291 of 2015)) and set at 138,652 to 173,315 MT (CCT_PP 2022).

Northern-Central Peruvian stock | Southeast Pacific | Purse seines | Northern Central Peru

Moderate Concern

The precautionary mortality rate (E) set by the IMARPE to set the TAC for the first 2021 fishing season (E=0.30) would be below the optimum value, which means that the stock is not being overfished. However, it is unclear if the fishing mortality targets set by the IMARPE are precautionary enough to prevent collapse of the stock during periods of low productivity. Therefore, based on the SFW standard, a “**moderate concern**” score is awarded for this issue.

Justification:

In April 2021, after conducting the first annual hydroacoustic surveys to evaluate the state of the Northern-Central stock, IMARPE built four decision tables for the unfavourable, neutral-unfavourable, neutral and favourable scenarios (IMARPE 2021a). A high interaction between the fleet and the juvenile fraction of the stock was anticipated due to a strong overlap between juveniles and adults of the stock in the survey and a precautionary exploitation rate (E) of 0.30 was recommended. In the IMARPE's report it is not specifically indicated which environmental scenario was chosen but R.M. N° 00120-2021-PRODUCE set a TAC of 2,509,000 MT for the first fishing season 2021, which seems to correspond to the neutral-unfavorable scenario (see **figure X** below), and 98.3% of the TAC was landed by the anchoveta fleet {IMARPE2021a} (IMARPE 2021c). During the fishing season, 109 areas were temporally closed by the authorities to protect juveniles of the stock (IMARPE 2021c).

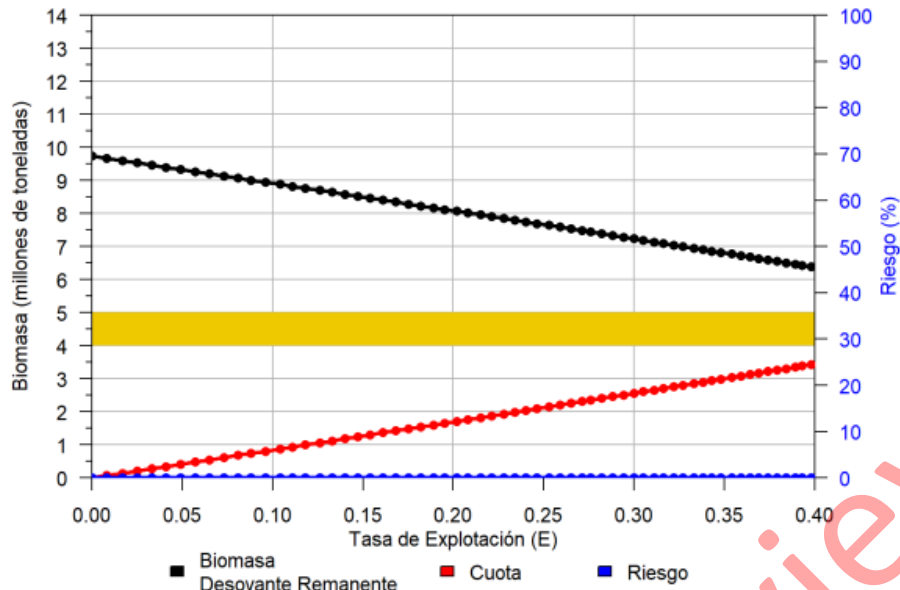


Figure 10 Decision table related to a NEUTRAL-UNFAVOURABLE environmental scenario. It is assumed that the catches would be taken quickly at the beginning of the season. In the figure, the X axis contains different levels of Exploitation Rate (E), to each of which corresponds a quota of capture (red line whose value is read on the left vertical axis). The black line is the Spawning Biomass that would be available to the next reproductive process (winter 2021) as a consequence of applying each level of exploitation rate. The yellow bar denotes the target and limit spawning biomass levels necessary to sustainably renew the stock. The blue line corresponds to the risk or probability of having a spawning biomass of less than 5 million t (whose scale is read on the right vertical axis) as consequence of applying each level of exploitation rate (IMARPE 2021).

For the second fishing season 2021, a precautionary exploitation rate (E) was also recommended by the IMARPE to protect the juvenile fraction of the stock (IMARPE 2021c). In that last season, 1.6 million MT of anchoveta were landed, which corresponded to 96,7% of the TAC set by the authorities (Ministerial decree N.00008- 2022).

NOTE: As indicated above, the IMARPE uses the rate (E) for recommending a TAC for the anchovy fishing season. E is calculated based on the values of Fishing mortality (F) and natural mortality (M) using the following formula:

A rough determination to know if a resource is overfished or not assumes that the optimal value of E (E_{opt}) is approximately equal to 0.5. The use of $E \approx 0.5$ as the optimum value for the exploitation rate is based on the correctness according to which the sustainable yield is optimized when $F \approx M$ (Gulland 1971). The mortality rate set by the IMARPE on April 1 and November 2021 was precautionary and would be below the optimum value. The correspondent TAC set by the authorities was not reached either during the first nor the second fishing seasons 2021.

Southern Peru - Northern Chile stock | Southeast Pacific | Purse seines | Southern Peru Northern Chile

Low Concern

Fishing mortality is well below the target reference point used by the IFOP. Therefore, this issue is scored as "**low concern**".

Justification:

For this stock, catches show a negative trend from 2005 onwards, reaching the lowest value in the historical series (1986-2018) in 2016, when 239 thousand MT were caught in the north area of Chile. Annual catches recovered in 2017, 2018 and 2019 when 520, 750 and 667 thousand MT were caught respectively. In 2020 and 2021, total catches were between 255 and 265 thousand MT. During recent years, fishing mortality has been under F_{MSY} . During the second semester of 2019, F would be with a 95% confidence interval between 0.11 and 0.27 of the F_{MSY} (CCT_PP 2021).

Based on the information provided by the IFOP, the CCT-PP considered that overfishing was not occurring ($F_{2020}/F_{MSY} = 0.1916$). Therefore, the committee recommended a TAC tending to MSY equivalent to 576,000 MT. Consequently, discounting the 2% estimated discard for the year 2020, a maximum TAC 564,480 MT was considered (TAC range between 451,584 and 564,480 MT) (CCT_PP 2021).

Similarly, for the second semester of the year 2020, fishing mortality $F = 0.23$ year⁻¹, was below the target exploitation level equal to the F_{MSY} ($F_{2020}/F_{MSY} = 0.21$) (CCT_PP 2021). Therefore, overfishing is not occurring.

Southern Peru - Northern Chile stock | Southeast Pacific | Purse seines | Southern Peru Northern Chile

Low Concern

The Southern Peruvian anchovy stock represents only 10% of the Northern-Central anchovy stock in Peru. It means that in some cases, it seems that this stock is somehow forgotten by the authorities, and information about some issues (fishing mortality, etc) is not available or more difficult to find than for the Northern-Central stock. For consistency reasons, fishing mortality for the Southern Peruvian stock is scored as "**low concern**", based on the more complete stock assessments provided by the IFOP (the stock is shared by both countries).

Justification:

In 2019, landings of anchoveta in the south region were 196,000 MT. This amount was 15% lower than the volume landed in 2018 for the same stock, and 8% higher than the landings in 2017 (IMARPE 2020a). In general terms, landings of anchovy from the southern stock were quite constant, at around 191,000 MT. 98% of the anchovy landings in 2019 were done during the first fishing season (only 4,000 MT were landed during the second fishing season) (IMARPE 2020a).

Ministerial resolution 249-2020-PRODUCE opened the first fishing season for the Southern anchoveta stock, which runs between August and December 2020. Based on the reports provided by the IMARPE (IMARPE 2020a), the TAC set by the authorities was 435,000 MT {MR 249-2020-PRODUCE}. Resolution 463-2021 opened the first 2022 fishing season for the Southern anchoveta stock which will run between January and June 2022. In this case, the TAC set by the authorities is

486,500 MT.

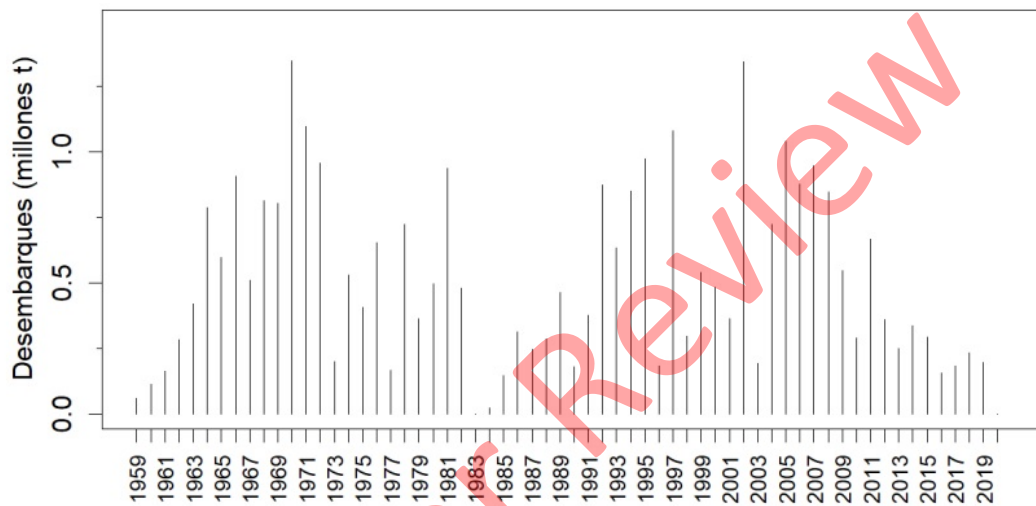


Figure 11. Landings for the southern anchoveta stock between 1959 and 2020 (Source: (IMARPE 2021d))

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

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

Rating is Critical if Factor 2.3 (Fishing Mortality) is Critical

Guiding principles

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

Criterion 2 Summary

Criterion 2 score(s) overview

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

PERUVIAN ANCHOVETA			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Southern Peru - Northern Chile stock Southeast Pacific Purse seines Southern Peru Northern Chile	1.732	1.000: < 100%	Red (1.732)
Central - Southern Chile stock Southeast Pacific Purse seines Central Southern Chile/Southern Unit	2.236	1.000: < 100%	Yellow (2.236)
Central - Southern Chile stock Southeast Pacific Purse seines Central Southern Chile/Central Unit	1.732	1.000: < 100%	Red (1.732)
Southern Peru - Northern Chile stock Southeast Pacific Purse seines Southern Peru Northern Chile	1.732	1.000: < 100%	Red (1.732)
Northern-Central Peruvian stock Southeast Pacific Purse seines Northern Central Peru	2.236	1.000: < 100%	Yellow (2.236)

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.

SOUTHEAST PACIFIC PURSE SEINES CHILE CENTRAL SOUTHERN CHILE/CENTRAL UNIT			
SUB SCORE: 1.732		DISCARD RATE: 1.000	SCORE: 1.732
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Japanese pilchard	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Marine mammals	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Rays	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Sea turtles	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Seabirds	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Sharks	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Peruvian anchoveta	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific chub mackerel	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Chilean jack mackerel	3.670: Low Concern	5.000: Low Concern	Green (4.284)

SOUTHEAST PACIFIC PURSE SEINES CHILE CENTRAL SOUTHERN CHILE/SOUTHERN UNIT			
SUB SCORE: 2.236		DISCARD RATE: 1.000	SCORE: 2.236
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Seabirds	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Araucanian herring	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Peruvian anchoveta	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Marine mammals	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

SOUTHEAST PACIFIC PURSE SEINES CHILE SOUTHERN PERU NORTHERN CHILE			
SUB SCORE: 1.732		DISCARD RATE: 1.000	SCORE: 1.732
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Japanese pilchard	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Marine mammals	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Rays	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Sea turtles	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Seabirds	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Sharks	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Pacific chub mackerel	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Chilean jack mackerel	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Peruvian anchoveta	3.670: Low Concern	5.000: Low Concern	Green (4.284)

SOUTHEAST PACIFIC PURSE SEINES PERU NORTHERN CENTRAL PERU			
SUB SCORE: 2.236		DISCARD RATE: 1.000	SCORE: 2.236
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Marine mammals	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Rays	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Sea turtles	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Seabirds	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Sharks	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Longnose anchovy	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Peruvian anchoveta	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific chub mackerel	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

SOUTHEAST PACIFIC PURSE SEINES PERU SOUTHERN PERU NORTHERN CHILE			
SUB SCORE: 1.732		DISCARD RATE: 1.000	SCORE: 1.732
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Japanese pilchard	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Marine mammals	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Rays	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Sea turtles	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Seabirds	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Sharks	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Pacific chub mackerel	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Chilean jack mackerel	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Peruvian anchoveta	3.670: Low Concern	5.000: Low Concern	Green (4.284)

Criterion 2 assesses the population impacts of the fisheries on all species caught other than those assessed in Criterion 1 (i.e. anchoveta). The Criterion also assesses the impacts of bait use and discards.

Target species

Peruvian fisheries for anchoveta target only anchoveta (IMARPE 2015), while the southern Chilean fisheries are multi-species, also catching horse mackerel and Araucanian herring (IFOP 2020) (see table below, repeated from the Introductory sections).

Country	Stock	Fisheries	Target species	Anchoveta landed volumes in mt (rough estimate 2017-2019)	
Peru	Northern - Central Peruvian stock	Steel and wooden industrial purse-seine fleet	Anchoveta	4,000,000	
		Medium and small-scale purse-seine fleet		100,000	
	Southern Peru - Northern Chile stock (Regions Arica y Parinacota (XV) - Antofagasta (II))	Steel and wooden industrial purse-seine fleet		500,000	
		Medium and small-scale purse-seine fleet		10,000	
	Chile	Southern Peru - Northern Chile stock (Regions Arica y Parinacota (XV) - Antofagasta (II))		Industrial fleet	400,000
				Small-scale fleet	190,000
Central - Southern Chile stock - Central unit (Regions Atacama (III) - Coquimbo (IV))		Small-scale fleet	Anchoveta, Chilean jack mackerel (<i>Trachurus murphyi</i>)	40,000 (anchoveta only)	
		Industrial fleet		0 (anchoveta only)	
Southern Chile stock - Southern unit (Regions Valparaiso (V) - Los Lagos (X))	Small-scale fleet	Anchoveta, Araucanian herring (<i>Strangomera benticki</i>)	100,000 (anchoveta only)		

Bycatch and discards

Information about bycatch, discards and endangered, threatened, or protected (ETP) species interactions in the anchovy fishery in both Peru and Chile is fragmented although in some areas of the Southeast Pacific, and under certain oceanographic conditions, anchovy (*E. ringens*) overlaps with a number of species, including the Chilean jack mackerel (*Trachurus murphyi*), chub mackerel (*Scomber japonicus*), Pacific bonito or Pacific sardine (*Sardinops sagax*) {Segura & Aliaga 2013}{Serra & Tsuakayama 1988}. The sources of information used and the bycatch for each of the assessed fisheries is listed below:

Peru northern-central anchovy fishery

In Peru, two onboard observer programs are currently in place in the Peruvian anchovy fishery: the public observer program conducted by the IMARPE (Bitacoras de pesca), which cover around 4-5% of the trips (IMARPE 2019); and the private observer program SALVAMARES (set because of the FIP in place for the fishmeal/fish oil fishery), where crew members act as observers, which monitoring around 8-10% of the trips {CeDePesca 2020} (CeDePesca 2020b). A private observer program, aimed at validating the results of the SALVAMARES was also conducted by observers from the Instituto de Educación Superior Tecnológico Público "Ricardo Ramos Plata" in 2017-2018 and 2019 (CeDePesca 2019)

Interactions with fish species

During the first and second fishing seasons of 2019, conducted between April-August 2019 and November-January 2019 respectively, the SALVAMARES program monitored 41 (first season) and 34 (second season) vessels, covering 452 trips/1,227 fishing sets and 1.116 trips/3.146 sets respectively (CeDePesca 2020a) (CeDePesca 2020b). The top five bycatch species for both seasons are shown in the table below. Similar catch profiles are expected for other years. Regarding bony fish, the predominant species was Pacific chub mackerel (*Scomber japonicus peruanus*), reaching between 0.06 and 0.08% of the total catch, whereas the dominant invertebrate species was the red squat lobster (*Pleuroncodes monodon*), with between 0.08 and 0.18% of the total catch.

Species	First fishing season 2019		Species	Second fishing season 2019	
	Percentage (%)	Projected total catch (MT)		Percentage (%)	Projected total catch (MT)
Pacific chub mackerel	0.06	1,239	Red squat lobster	0.11	1,085
Red squat lobster	0.18	3,609	Pacific chub mackerel	0.08	802
Jumbo flying squid (<i>Dosidicus gigas</i>)	0.011	213	Peruvian sea catfish (<i>Galeichthys peruvianus</i>)	0.04	370
Longnose anchovy	0.007	139	Peruvian rock seabass (<i>Paralabrax humeralis</i>)	0.01	51
Flying fish	0.005	104	Sand-perch (<i>Diplectrum conceptione</i>)	0.003	34

Similarly, during the first anchovy season of 2019, the groups with the highest incidence in the data collected by the IMARPE were: the pelagic group, mainly Pacific chub mackerel (this group appeared in 21.9% of the sets observed, no percentage of the total catch is given in the IMARPE's reports) and the group of invertebrates, being red squat lobster the main bycatch (appearing in 11.2 % of the sets observed, but representing only between 0.11 and 0.18% of the total catch). Other species recorded were: Lumptail searobin (*Prionotus stephanophrys*) and Samasa (*Anchoa nasus*) (IMARPE 2019).

Interactions with non-fish species (marine mammals, seabirds and sea turtles)

On the other hand, interaction of the anchovy fishery with top predators (marine mammals, seabirds, and sea turtles) includes both the search for food by these organisms in or around the purse seines during fishing operations and the direct contact with the nets or some other structure of the vessels.

The SALVAMARES and IMARPE observer program indicate interactions of the Northern-central anchovy fishery with (CeDePesca 2020a) (CeDePesca 2020b) (IMARPE 2019):

- Marine mammals, including common dolphins (*Delphinus sp.*), bottlenose dolphins (*Tursiops truncatus*) and dusky dolphins (*Lagenorhynchus obscurus*); South American sea lions (*Otaria byronia*) and South American fur seals (*Arctocephalus australis*). Two interactions with whales (Humpback whale (*Megaptera novaeangliae*)) were also recorded by the IMARPE.
- Regarding seabirds, the Peruvian booby (*Sula variegata*), the Peruvian pelican (*Pelecanus thagus*) (IUCN Near Threatened - henceforth NT) and the sooty shearwater (*Ardenna grisea*) (NT) were the species with the highest interactions. Other species affected were blue-footed booby (*Sula nebouxii*), Guanay cormorant (*Leucocarbo bougainvillii*), waved albatross (*Phoebastria irrorata*), black-browed Albatross (*Thalassarche melanophris*), Franklin's gull (*Larus pipixcan*) (IUCN Least Concern, henceforth LC) and the pink-footed shearwater (*Ardenna creatopus*) (IUCN Vulnerable, henceforth VU).

- Five species of turtles have been also recorded, including Olive ridley turtle (*Lepidochelys olivacea*), green turtle (*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea*) and the loggerhead turtle (*Caretta caretta*) and Hawksbill turtle (*Eretmochelys imbricata*).
- Other species reported as bycatch from previous seasons are the giant manta ray (*Manta birostris*), eagle rays (*Myliobatis* spp.), sand skates (*Psammobatis* spp.), hammerhead sharks (*Sphyrna zygaena*) speckled smoothhound (*Mustelus whitneyi* and *M. mento*) and thresher sharks (*Alopias pelagicus* and *A. superciliosus*) {CeDePesca 2020} (IMARPE 2015).

Southern Peru anchovy fishery

Information about bycatch in the fishery is scarce. A EUREKA operation was conducted by IMARPE, in collaboration with the industry, in April 2022. Bycatch species caught during the survey included squat lobster (9%) and other species (1%), such as chub mackerel, jack mackerel and Humboldt squid (IMARPE 2022).

Chilean northern and central anchovy fisheries

Interactions with fish species

To select the bycatch species in the northern (regions XV-II) and northern-central (regions III-IV) Chilean anchovy fishery, data from the onboard observer program conducted by the IFOP for the fishing season 2019-2020 has been used (no previous data seems to be available) (IFOP 2020). Data caught in these two fisheries are shown in the table below:

Name	2019-2020	
	Total catch (MT)	% Catch
	Regions XV-II and III-IV	
Anchovy (<i>Engraulis ringens</i>)	40,599	65.3
Chilean Jack mackerel (<i>Trachurus murphyi</i>)	18,562	29.8
Chub mackerel (<i>Scomber japonicus</i>)	3,005	4.8
Mote sculpin (<i>Normanichthys crockeri</i>)	19	0.03
South American pilchard (<i>Sardinops sagax</i>)	13	0.02
Corvina drum (<i>Cilus gilberti</i>)	4	0.01
TOTAL	62,198	100

Interactions with non-fish species (marine mammals, seabirds and sea turtles)

In Chile, the Fisheries Law (LGPA) requires that a resolution listing the bycatch species for each of the fisheries subjected to a discard management plan is annually published by the SUBPESCA. In the most recent resolutions, a number of species are listed as potential bycatch of the northern (Regions XV-II) and central (Regions III-IV) anchovy fisheries: marine mammals such as common dolphins, bottlenose dolphins and dusky dolphins, the South American sea lion ; seabirds such as the sooty shearwater, Franklin's Gull and the grey gull (*Leucophaeus modestus*), the Inca tern (*Larosterna inca*) (NT), the Humboldt penguin (*Spheniscus humboldti*) (VU), the Peruvian pelican, the Peruvian booby and cormorants (*Phalacrocorax gaimardi*, *Phalacrocorax bouganvillii*); sea turtles, including green turtle, leatherback turtle and the loggerhead turtle ; skates and rays such as eagle rays (*Myliovatis peruvianus*) and *Raja* sp.; and sharks such as: thresher sharks, blueshark (*Prionace glauca*), hammerhead sharks and speckled smoothhound.

Chilean southern anchovy fishery

Interactions with fish species

To evaluate the bycatch species in the southern Chilean anchovy fishery (regions V-X), data from the onboard observer program conducted by the IFOP for the 2018-2019 and 2019-2020 fishing seasons have been used {IFOP 2019} (IFOP 2020). In 2019-2020 there were no observers in the artisanal fishery for common sardine and anchovy that operated in the Valparaíso Region (Region V). As seen in the table below, this is a mixed fishery which includes the catch of Araucanian herring (66% of the catch) and anchovy (30.5%). These species are targeted by both artisanal and industrial vessels using the same fishing gear {IFOP 2019} (IFOP 2020).

Species	Total catch (MT)					TOTAL	%
	2019-2020		2018-2019				
	VIII	XIV	V	VIII	XIV		
Araucanian herring (<i>Clupea bentincki</i>)	120,382	50,188	5,962	254,575	30,653	461,760	66.0
Anchovy	127,791	3,781	3,596	65,075	13,586	213,829	30.4
Mote sculpin	4,157	3,145	0	15,451	0	22,753	3.3
Starry butterfish (<i>Stromelatus stellatus</i>)	957	11	0	158	20	1,146	0.02
Other species	112	883	0	2,256	293	3,544	0.04
TOTAL	253,399	58,008	9,558	337,515	44,552	703,032	100

Interactions with non-fish species (marine mammals, seabirds and sea turtles)

As indicated above, the Chilean fisheries law requires that a resolution listing the bycatch species for each of the fisheries subjected to a discard management plan is annually published by the SUBPESCA. For the Chilean southern anchovy fishery (Regions V-X) the following species are listed (Res. Ex. N° 410-2021): the American elephantfish or cockfish (*Callorhynchus callorhynchus*) (VU); seabirds including the black-browed albatross (*Thalassarche melanophris*) (LC), shearwaters such as the pink-footed shearwater and the sooty shearwater; petrels such as the white-chinned petrel (*Procellaria aequinoctialis*) (VU), grey petrel (*Procellaria cinerea*) (NT), cape petrel (*Daption capense*) (LC), the Northern Giant Petrel (*Macronectes halli*) (LC) and Wilson's storm petrel (*Oceanites oceanicus*) (LC); the Humboldt penguin and a number of other seabirds such as the Peruvian pelican and seagulls (kelp gull (*Larus dominicanus*)) (LC) and the brown-hooded gull (*Chroicocephalus maculipennis*) (LC). As marine mammals, it only includes the South American sea lion (*Otaria byronia*) (LC) and no sea turtles.

The SFW criteria defines "main species," those to be included in Criterion 1 or Criterion 2, as those that meet any of the following criteria:

- A common component of the catch (as guidance, >5% of the catch in most cases), or
- Overfished, endangered, threatened, undergoing overfishing, or otherwise a species of concern, where catch occurs regularly and may significantly contribute to the conservation concern (i.e., more than a negligible and/or sporadic level of catch). As guidance, mortality of the species caused by this fishery is >5% of a sustainable level, or
- Fishery under assessment is one of the main sources of fishing mortality for the species, including bait species if known (as guidance, approx. 20% or more of total fishing mortality).

Based on the information shown above and the SFW criteria, and the information shown above, the following species have been selected:

- *Peruvian northern-central anchovy fishery*. The data shown indicates that no species other than anchovy seem to be over the 5% threshold. Considering the catch raised by the data provided by the SALVAMARES program, the total amount of any of the other species is less than 1,000 MT. However, anchovy and longnose anchovy (*Anchoa nasus*) are managed together under the same management regime and quota in Peruvian waters. Normally, longnose anchovy accounts for only a small percentage of total landings (around 3%). However, during the El Niño events, landings increase by 100% compared to the annual average, because its distribution expands to the South (Bouchon Corrales 2007). Gutierrez (2015, cited in Hervas & Medley 2015) reported the proportion of longnose anchovy landings as high as 37% in 1998 (Strong el Niño event). Hervas & Medley 2015 in a MSC pre-assessment for the anchovy fishery consider these species as inseparable or practicably inseparable stocks (IPI) which means that these species are not separated in the catch. Therefore, longnose anchovy has been included as a main species in this fishery.
- *Chilean northern (regions XV-II) and northern-central (regions III-IV) anchovy fisheries*. Chilean jack mackerel (>5% threshold), chub mackerel (very close to the 5% threshold which in some years/areas may be surpassed), South American pilchard (overfished).
- *Chilean southern (regions V-X) anchovy fishery*. Araucanian herring (>5% threshold).

Due to high number of ETP species caught, and in some cases the scarcity of data about the impact of the assessed fisheries on specific species, ETP species have been assessed as groups: marine mammals, seabirds, sea turtles, skates and rays and sharks.

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

Araucanian herring

Factor 2.1 - Abundance

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Moderate Concern

Limit and target reference points for the stock are defined. In 2020/2021, spawning stock biomass of the stock was 40% below the biomass target level (SSB_{MSY}). Biomass limit and target reference point for the stock are defined at 27.5% SSB_0 and 55% SSB_0 respectively, which seem to be conservative enough to keep the stock at safe levels. Abundance for Araucanian herring is deemed 'moderate concern'.

Justification:

Araucanian herring is a forage fish stock. Annual recruitment and abundance of this species is largely affected by environmental conditions. Direct hydroacoustic surveys are conducted biannually in summer and autumn by the IFOP to assess the status of the stock (CCT_PP 2020).

Biomass of this resource has shown an increasing trend since 2007/2008 with high variability due to recruitment fluctuations. For the year 2020/2021 total biomass was estimated at around 2 million MT, 33% higher than in the previous year and 22% higher than lower than the average biomass in the recent 30 years (average biomass 1.65 million MT) (SUBPESCA 2022). SSB has also shown a high variability since 2013/2014 (CCT_PP 2020). For the year 2020/2021 it was estimated at 492,050 MT, 43% lower than in the previous year. CCT-PP concluded that based on the reference points recently adopted, the stock was overfished ($SSB/SSB_{MSY}=0,601$) (SSB is 40% below the SSB_{MSY}) (SUBPESCA 2022).

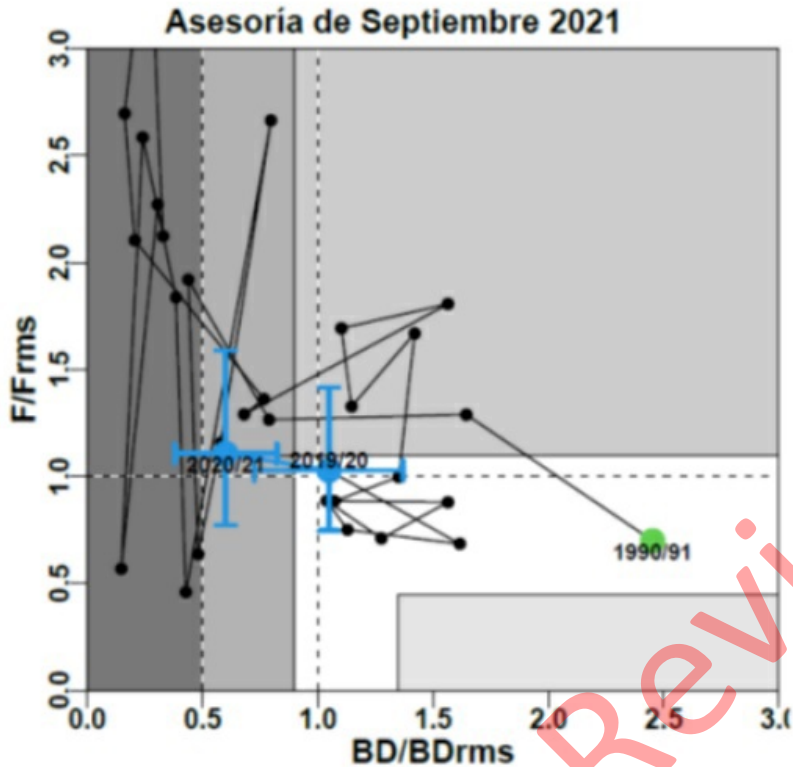


Figure X Phase diagram araucanian herring (SUBPESCA 2022)

Factor 2.2 - Fishing Mortality

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Moderate Concern

Reference points are defined. Natural mortality for this stock is estimated between 0.85 year⁻¹ and 1.2 year⁻¹ (IFOP 2020). FMSY was set at 60% of the SSBPR0 (Spawning Stock Biomass Per Recruit) (CCT_PP 2020) which corresponds to a value of F between 0.27 and 0.56 year⁻¹. Current fishing mortality is over FMSY ($F/F_{MSY}=1.108$) (SUBPESCA 2022). As, F is fluctuating around F_{target}/F_{MSY} , fishing mortality for the Araucanian herring is deemed '**moderate concern**'.

Justification:

Since 2005, fishing mortality has shown a decreasing trend, more marked since 2013/2014, being below the FMSY. However, after fluctuating around values of 0.2 year⁻¹ during the last 2 years, the estimated fishing mortality for the year 2020/2021 was estimated at 0.33 year⁻¹, 11% over the target reference point F_{MSY} . Based on the reference points defined, CCT-PP considers that it was highly likely that overfishing on the stock is occurring ($F/F_{MSY}=1.108$) (SUBPESCA 2022).

Chilean jack mackerel

Factor 2.1 - Abundance

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit
Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Low Concern

Chilean jack mackerel is a forage species with an important role in the ecosystems and which abundance greatly depends on environmental conditions. The current reference points used by the IFOP were set in collaboration with international experts (Clark et al 2014) and while the fluctuating nature of the species was considered, the reference points are still based on a static estimate of unfished biomass and so may not fully take into account shifts in productivity (see Criterion 1 synthesis above). current SSB is above SSB_{MSY} . For this reason, abundance for Chilean jack mackerel is deemed 'low concern'.

Justification:

The Inca scad or Chilean Jack mackerel is widespread throughout the South Pacific, along the shelf and oceanic waters adjacent to Ecuador, Peru, and Chile, and across the South Pacific along the Subtropical Convergence Zone ("jack mackerel belt") that goes from the coast of Chile to New Zealand within the 35° to 50°S (SPRFMO 2019).

Although stock structure for jack mackerel is unclear and up to 5 separate stocks have been suggested, the Jack Mackerel Sub-group (JMSG) of the SPRFMO carried out two assessments of the species in the Eastern South Pacific under two main working hypotheses: 1. that Jack mackerel caught off the coasts of Peru and Chile each constitute separate stocks (Peruvian or northern and Chilean or southern stocks, which straddle the high seas); and, 2. that Jack mackerel caught off the coasts of Peru and Chile constitute a single shared stock which straddles the high seas (SPRFMO 2019).

A statistical catch-at-age model was used to evaluate the Jack mackerel stocks (SPRFMO 2019). A summary of the time series stock status (spawning biomass, F, recruitment, total biomass) for the single-stock hypothesis is shown in the **figure X** below. The biomass was projected forward based on the estimated recruits to evaluate the impact of fishing under four scenarios with different recruitment (and hence productivity) assumptions. For the Jack mackerel stock, fishing appears to be a major cause of the population trend, with the current level of SSB at around 48% of what is estimated to have occurred had there been no fishing (SSB_0). Current SSB would be over SSB_{MSY} (SPRFMO 2019).

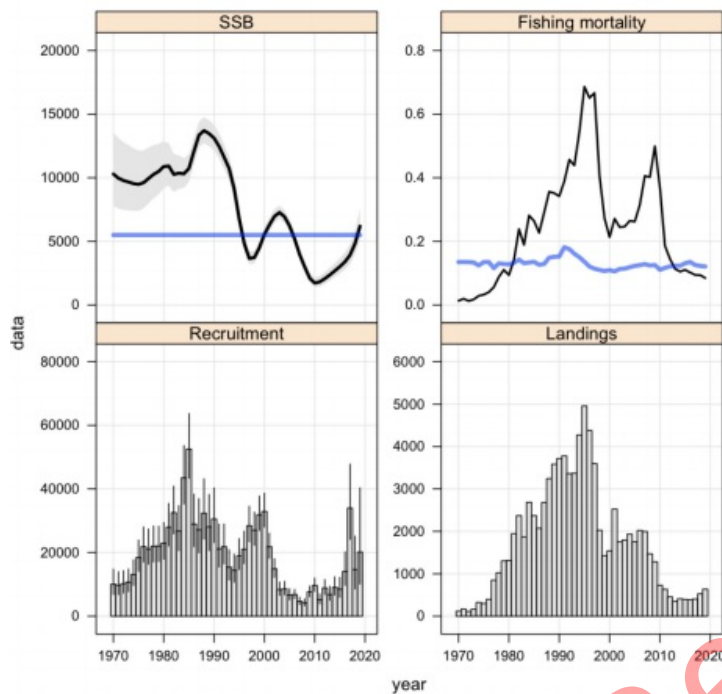


Figure X Single-stock hypothesis—summary estimates over time showing spawning biomass (kt; top left), recruitment at age 1 (millions; lower left) total fishing mortality (top right) and total catch (kt; bottom right) Blue lines represent the provisional SSB_{MSY} (upper left) and dynamic estimates of F_{MSY} (upper right) (SPRFMO 2019).

Under the 2-stock hypothesis, the jack mackerel stock in its entire distribution range in the southeast Pacific shows a continued recovery since the time series low in 2010 (SPRFMO 2019). The northern unit shows stable and relatively low biomass over the last decade, while the southern unit shows an increasing trend. The southern unit showed similar results to that of the single-stock hypothesis, although SSB was estimated slightly higher under the former scenario. Estimates of stock size and exploitation rate for the Northern stock were comparable to previous years and show a small increase in stock size in the last year while fishing mortality is low. In both cases SSB would be over the estimated SSB_{MSY} .

According to the most recent international stock assessment for jack mackerel under both the single-stock and the two-stock hypothesis, current SSB is over SSB_{MSY} (SPRFMO 2019).

Similarly, in Chile biomass reference points for the jack mackerel stock are defined at $SSB_{MSY} = 36\% SSB_0$ and $SSB_{lim} = 9\% SSB_0$ (Resolution Ex. N°291 de 2015).

The jack mackerel stock has recovered since the low biomass levels registered in 2010 due to the recent good recruitment episodes and low mortality and it is now over the SSB_{MSY} {CCT-PP 2020}. In this context and on the basis of the evaluation provided by IFOP and the dynamic biological

reference points currently implemented ($SSB_{MSY} = 5.5$ million MT), the CCT-J concluded that the resource was fully exploited ($SSB/SSB_{MSY} = 1.81$) (SUBPESCA 2022).

Factor 2.2 - Fishing Mortality

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Low Concern

Reference points are defined. Current fishing mortality is estimated to be below the dynamic F target reference point. Moreover, the main catches of jack mackerel are taken by the directed jack mackerel fishery and it is therefore considered that the anchoveta fishery is not a substantial contributor to fishing mortality of the species. Therefore, a “**low concern**” score is awarded.

Justification:

The fishery for Inca scad or jack mackerel in the south-eastern Pacific is conducted by fleets from the coastal states, and by distant water fleets from various countries, operating beyond the EEZ of the coastal states (SPRFMO 2019). In both Peru and Chile, jack mackerel is an important commercial species which is exploited by the industrial and the artisanal purse seine fleet (SPRFMO 2019).

A dynamic fishing mortality reference point is currently used for this stock by the IFOP and defined at $F_{MSY} = 0.13$ year⁻¹. Fishing mortality has decreased in recent years, and it is now estimated at $F/F_{MSY} = 0.5$. The TAC for Chile in 2021 was set at 508,000 MT (SUBPESCA 2021a).

Japanese pilchard

Factor 2.1 - Abundance

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

High Concern

Reference points are not defined though the stock is considered to be depleted. Therefore, Seafood Watch deems the abundance of the S. American pilchard as “**high concern**”.

Justification:

Pacific sardine/South American pilchard is a widely distributed species, occurring in South America from the Gulf of Guayaquil (Ecuador) to Chiloe in Chile (44° South) (SUBPESCA 2008). This is a coastal fish found at depths to 200m that forms large schools (Whitehead 1985). In contrast to the anchovy, Pacific sardine is a larger fish with a life span of 10 to 12 years and a size-at-first maturity of 26 cm (SUBPESCA 2008). The species' abundance is also highly variable and greatly dependent on environmental conditions. Synchronous shifts between the abundance of the anchovy and the South American pilchard have been suggested (see **figure X** below) (IFOP 2020a).

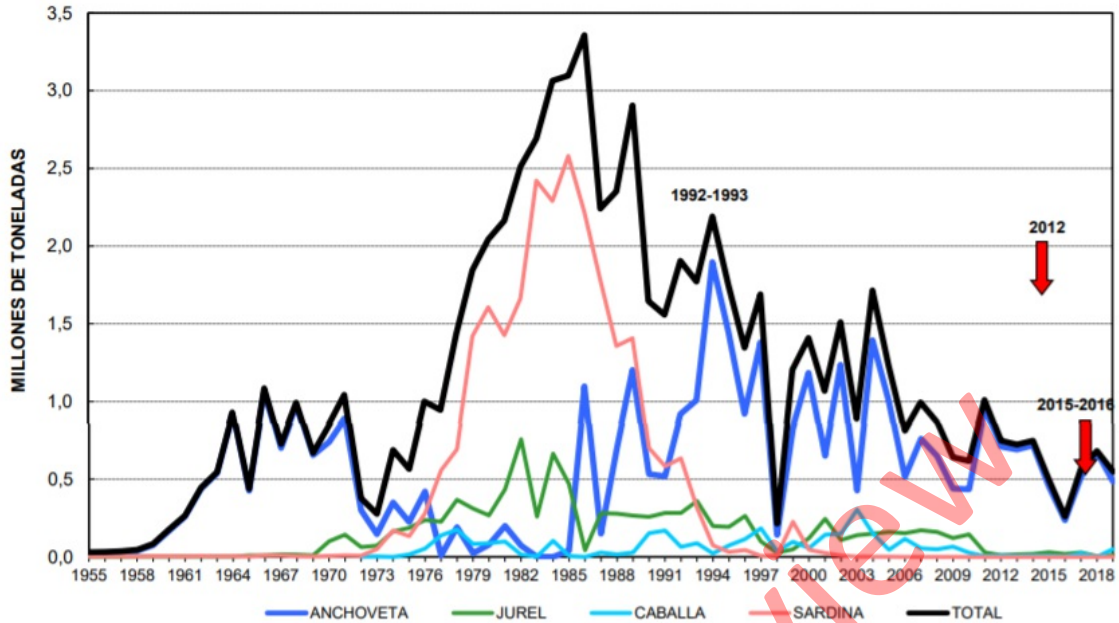


Figure X Catches of the main pelagic species in Chilean waters (1955-2018). The red arrows indicate El Niño events (IFOP 2020a).

In the case of the South American pilchard in Chilean Regions XV-II and III-IV Regions, IFOP considers that the current condition of the resource, which show extremely low abundance levels since the mid-90's, does not allow to undertake an assessment of the stock and there is not sufficient information to define a biological framework (target and limit reference points). Information about the species in Peruvian waters is scarce and reference points are not defined. According to the {CCT-PP 2020}, the resource is in a situation of collapse, evidenced by the low catch levels recorded in the last 20 years, well below historical levels (Art. 1° C No. 59) (Law 18,892 1991). The current status of the fishery is caused by adverse physical and biological environmental conditions. As stated above, information about the species in Peruvian waters is scarce but it seems that the stock is also depleted (CCT_PP 2020).

Factor 2.2 - Fishing Mortality

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit
Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Moderate Concern

Fishing mortality reference points have not been defined, and so fishing mortality relative to a sustainable is unknown. A "moderate **concern**" score is awarded.

Justification:

Considering the condition of the resource, the (CCT_PP 2020) indicated that it was not possible to establish a biologically acceptable quota that tends to the maximum sustained yield for the resource. Based on a precautionary approach, the committee considered maintaining the status quo and recommended a reference CBA range between 4,000 and 5,000 tons. The CBA status and rank were adopted by consensus (CCT_PP 2020).

Longnose anchovy

Factor 2.1 - Abundance

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Moderate Concern

Limit and target reference points for longnose anchoveta are not defined, data limited assessments are not available and the stock status is unknown. However, the species is listed as a Least Concern by the IUCN (Di Dario 2020). Therefore, a “**moderate concern**” score is awarded.

Justification:

Longnose anchovy is a schooling species that occurs in nearshore, coastal waters and bays that can tolerate lower salinities. The species has a transboundary distribution, from the northern Gulf of California to Peru {Froese, R. & Pauly, D. 2021}. In this country, longnose anchovy is mainly found in the Northern Region {IHMA 2021}. Stock structure is largely unknown. The species is a forage fish stock which fluctuates in abundance with environmental conditions. The abundance of this and other pelagic species is conditioned by the variability of the oceanographic characteristics of the Peruvian marine ecosystem where important areas of upwelling or outcrops of high productivity are located (Morón, O. 2000). Historical/pre-fishing abundance of this stock is unknown but a peak in abundance of 2 million MT was observed in 1998 during a strong El Nino event (Bouchon 2007)

According to (Bouchon 2007), the species abundance seems to be directly correlated with the sea surface temperature (SST) and inversely correlated to the abundance of anchovy (see **figures X and X** below).

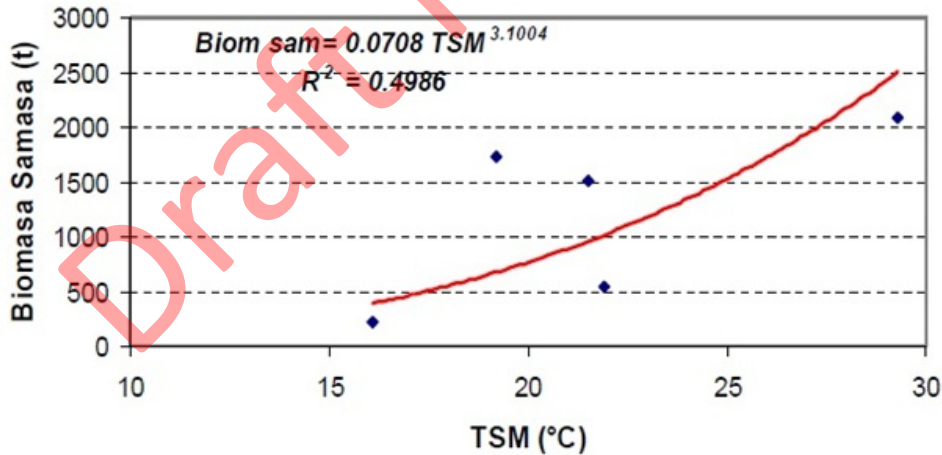


Figure X. Relationship between Sea Surface temperature (TSM in 0C) and Longnose anchovy biomass (MT). As shown, abundance of the species increases with temperature (Bouchon 2007).

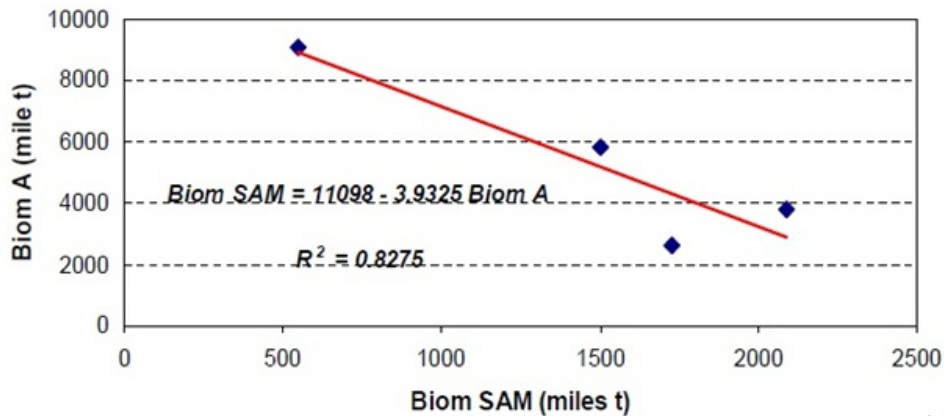


Figure X. Relationship between abundance of anchovy (Biom A in MT) and longnose anchovy (Biom SAM in MT). As seen, the biomass of the species decreases when the anchovy biomass increases. The coefficient of determination R^2 indicates how close the data are to the fitted regression line. The higher the R-squared (Between 0 and 1), the better the model fits the data. In this case R is quite close to 1 which indicates a good correlation (Bouchon 2007).

Figures X and X Longnose anchovy

In 2019, the IMARPE carried out two hydroacoustic surveys, in summer (Cr. 1902-03) and spring (Cr. 1909-11), to establish the biomass, distribution, and biological aspects of the main pelagic species (namely anchovy, samasa, catfish, red squad lobster, and the most oceanic ones such as jack mackerel, chub mackerel, jumbo flying squid, and vinciguerria lightfish (*Vinciguerria lucetia*)), as well as to determine the oceanographic conditions of the Peruvian sea (IMARPE 2019). In summer, longnose anchovy distribution was a patchy coastal (within 10 nm of the coast) distribution, whereas in spring it was only recorded to the south of Punta La Negra (North of Peru). In summer, the estimated biomass of longnose anchovy was 123,996 MT, whereas in spring it decreased to 39,800 MT (IMARPE 2019). No data has been published yet for 2020.

Factor 2.2 - Fishing Mortality

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Moderate Concern

Anchovy and longnose anchovy are not separated in the catch. Therefore, official catches of longnose anchoveta are considered unreliable (INEI 2020). Fishing mortality for the species is unknown. Therefore, a "moderate concern" score is awarded.

Justification:

Longnose anchovy landings are highly variable and the largest landings correspond to the austral winter (representing 40% of the annual landings). During El Niño events, landings increase by 100% compared to the annual average, and the species expands its distribution to the South (Bouchon 2007).

Between 1993 and 1997, an annual average of 70 thousand MT of longnose anchovy was landed in Peru. However, in 1998, during a strong El Niño event, this quantity increased to 283 thousand MT (Bouchon 2007). It comprised 37% of the total anchovy landed that year {Hervas & Medley 2015}. According to the SALVAMARES programs during the first and second anchovy season of 2019, only 139 and 51 MT were caught respectively (CeDePesca 2020a) (CeDePesca 2020b).

Substantive landings of longnose anchovy were reported only in 2010 and 2011, 26,752 MT and 3,520 MT respectively (INEI 2020). Between 2015 and 2019, declared landings of longnose anchovy varied between a maximum of 2,918 MT in 2016 to a minimum of 235 MT in 2018 (INEI 2020). {Hervas & Medley 2015} classified this species as a practically inseparable species (IPI) from anchovy. Therefore, it is unclear if longnose anchovy is really caught in inappreciable numbers or if it is not adequately recorded as a separate species due to their similarity to anchovy (INEI 2020).

Marine mammals

Factor 2.1 - Abundance

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Moderate Concern

The only species of marine mammal which regularly interacts with the fishery is the South American sea lion, which is listed as least concern by the IUCN (Cárdenas-Alayza et al., 2016). Therefore, a “**moderate concern**” score is awarded.

Justification:

According to the IFOP observer program (IFOP 2020), it seems that the only marine mammal species which regularly interacts with the southern anchovy fishery in Chile is the South American sea lion. Six non-lethal interactions with killer whales (*Orcinus orca*) have been also reported between 2019 and 2020.

The South American sea lion is widely distributed in the area and their numbers seem to be recovering from the strong El Niño event of 1997/98. The species is classified as least concern (LC) (Cárdenas-Alayza et al., 2016). Killer whales are data deficient but interactions seem to be very low (Reeves et al., 2017).

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

High Concern

According to the Chilean (IFOP 2021) and Peruvian {CeDePesca 2020} (CeDePesca 2020b) (IMARPE 2019) observer programs, the Northern-central anchovy fishery mainly interacts with the following species of marine mammals: common dolphins, bottlenose dolphins and dusky dolphins; South American sea lions and South American fur seals. Punctual interaction with other species,

such as humpback whale were also recorded by the Peruvian observer program (IMARPE 2019).

Common dolphins and bottlenose dolphins are listed as least concern (LC) in the IUCN red list (Braulik et al., 2021) (Wells et al., 2019). However, the Peruvian subspecies of dusky dolphins is listed as vulnerable (VU) {Mangel & Alfaro-Shigueto 2019} due to its restricted distribution (the species shows a coastal distribution between Lima (Peru) and Santiago (Chile) and its suspected abundance decline {Mangel & Alfaro-Shigueto 2019}).

The South American Sea Lion and the South American Fur Seal have both large, widely distributed populations that are increasing in several areas. Therefore, they are classified as least concern (LC) (Cárdenas-Alayza et al., 2016) (Cárdenas-Alayza et al., 2016b).

A score of “**high concern**” is awarded based on the IUCN listing of “Vulnerable” for dusky dolphins.

Factor 2.2 - Fishing Mortality

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Low Concern

There are no analyses of the impacts of the Peruvian and Chilean anchoveta fisheries on marine mammal populations. Scoring is thus based on the Unknown Bycatch Matrices (see Seafood Watch standard for Fisheries, version 4). Eastern Pacific purse seines not set on Fish Aggregating Devices or mammals are considered a “**low concern**.”

Justification:

Peru

Of the fishing gears monitored in Peruvian waters, gillnets had the most frequent interactions with threatened taxa such as marine mammals, seabirds and sea turtles (Alfaro-Shigueto et al., 2010). Longlines, although more selective than gillnets, still had bycatch of turtles and seabirds, and marine mammals (Alfaro-Shigueto et al., 2010).

Two monitoring programs are currently in place in the country which seem to cover around 3% and 8-9% of the trips in the artisanal and industrial fishery respectively {CeDePesca 2020} (IMARPE 2019).

The only species which seems to interact with the artisanal anchovy fishery in Peru seems to be the South American sea lion. During 2017-2018, 5,608 individuals interacted and escaped by themselves {CeDePesca 2020}. In the 2018-2019 season, 3,718 individuals interacted, with five being released with injuries {CeDePesca 2020}.

In relation to the industrial fishery, the 2019-I SALVAMARES season report, which covered 3,146

fishing sets, included the bycatch of 12 common dolphins (1 dead), 51 bottlenose dolphins, 24 dusky dolphins, 125,306 South American sea lions (53 dead) and 7,612 South American fur seals (2 died) {CeDePesca 2020}. Other mammals such as bottlenose dolphins and dusky dolphins interacted with the fishery as reported by the Salvamares Program but escaped alone or were released alive {CeDePesca 2020}. The projected bycatch for the entire fleet would result in the death of 447 South American sea lions {CeDePesca 2020}.

In relation to marine mammals, the 2019-II season report {1,227 fishing sets covered) includes a lower number of interactions with 5 common dolphins (0 dead), 19,980 South American sea lions (1 deceased, 16 if the catch is projected to the entire fleet) and 2,843 South American fur seals (CeDePesca 2020b).

Chile

According to (IFOP 2021), for the artisanal anchoveta fleet operating in the northern region, 867 animals were reported corresponding to 7 identified species. Of the total number of animals caught, marine mammals represented 67%. 100% of the marine mammals' catches were common sea lions (582 individuals, 4 dead).

For the industrial fleet operating in the same area, 5,833 animals were reported corresponding to 21 identified species. In that case, marine mammals represented 79% of the catch. The sea lions were the most common species caught (4,468 individuals, 9 dead) whereas other marine mammal species caught included common dolphin (71 individuals, 23 dead), dusky dolphin (56 caught, 38 dead) and bottlenose dolphin (4 caught, 4 dead) (IFOP 2021).

For the multispecific artisanal fleet targeting Araucanian herring and anchovy, in the studied period between 2015 and 2019, an incidental catch of 3,912 marine mammals was recorded (52.3% of the total bycatch). 99.8% of the incidental capture of marine mammals corresponded to the common sea lion species (3,906 individuals, 5 dead), also registering the capture of 6 specimens of killer whales. For the industrial fleet, marine mammals represented 36.8% of the total bycatch. In this case, the incidental capture of marine mammals consisted exclusively of the common sea lion species, with 1,679 individuals captured and 25 dead (Technical report (R. PESQ.) N° 095-2017 2017) (Technical report (R. PESQ.) N° 105/2019).

In the artisanal fleet that operated between the Atacama and Coquimbo regions, incidental catch of 189 animals. Of the total animals captured, the common sea lion was the only mammal caught incidentally and represented 88.3% (167 individuals, or dead), with records between the port of Chañaral (26 ° 20 'S) and Punta Huber (27 11'S) (Technical report (R. PESQ.) N° 105/2019).

The bycatch self-reported by fishermen in the central region came from 1,199 logbooks collected by the authorities, corresponding to the 2018-2019 period. Of the total number of entries, 723 recorded the incidental catch of birds, mammals, and turtles, with 8 different species and 6 groups (family or class level). 4,508 animals were caught, corresponding 72% of the catches to marine mammals (only sea lions were observed with 3,233 individuals and 90 dead) (Technical report (R. PESQ.) N° 105/2019).

Pacific chub mackerel

Factor 2.1 - Abundance

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Moderate Concern

The species is not regularly assessed in the area (SPRFMO 2007). No data-limited assessments seem to be available either. According to the SFW standard a Productivity Susceptibility Analysis (PSA) needs to be conducted for the species. The stock is not Highly vulnerable (PSA score is 2, low vulnerability). It results in a “**moderate score**” for abundance.

Justification:

Pacific chub mackerel has a widespread pelagic coastal distribution. In the southern Pacific the species is generally restricted to the eastern area {SPRFMO 2007}. (Serra et al., 1982) suggests the existence of two stocks in South Pacific waters: i) central-north Peru and ii) northern border of Chilean waters to 40° S (between 33°S and 40°S). Although evidence suggests that other stocks may exist in Ecuador and central Chile (SPRFMO 2007).

The species is listed as Least Concern in the IUCN red list (Collette et al., 2009). Based on the SFW standard, and given the age of the IUCN assessment, a PSA analysis has been undertaken for the species.

Productivity			
Productivity Attribute	Value	Score	Reference
Average age at maturity	(2-3)	1	{Froese & Pauly 2021}
Average maximum age	10 (Peru)	2	{Froese & Pauly 2021}
Von Bertalanffy growth coefficient	(0.12-0.22)	2	{Froese & Pauly 2021}
Fecundity	(86,616-213,422)	1	{Froese & Pauly 2021}
Average size at maturity	31.5 (Chile)	1	{Froese & Pauly 2021}
Reproductive strategy	Broadcast spawner	1	{SPRFMO 2007}
PRODUCTIVITY SCORE		1.3	
Susceptibility			
Susceptibility attribute	Value	Score	Reference
Areal overlap	The Chilean stock occurs between 33°S and 40°S. The species is mainly catch in areas XV, I (50% of the total catch), III and VIII (30%) by the industrial fleet and in areas III-IV by the artisanal fleet.	3	{SPRFMO 2007}{SUBPESCA 2020}

Vertical overlap	The species occurs from the surface to about 250-300 metres depth. Industrial purse seines in Chile are up to 130 meters high.	3	{SPFRMO 2007}{SUBPESCA 2008}
Seasonal availability	The species is caught all year around	3	
Selectivity of fishery	Targeted or captured as bycatch	2	{SUBPESCA 2020}
Post-capture mortality	Retained species	3	{SPFRMO 2007}
TOTAL SCORE		2.8	

Factor 2.2 - Fishing Mortality

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Low Concern

Catches of chub mackerel are usually associated with the jack mackerel fishery (SPRFMO 2007). Catches of chub mackerel in the artisanal anchovy fishery, which represents around 50% of the catch of anchovy in the country are low. Therefore, it is considered that the anchovy fishery as a whole, is not a substantial contributor to the catch of chub mackerel. A "low concern" score is given.

Justification:

In the south Pacific, chub mackerel catches are usually associated with the jack mackerel fishery (SPRFMO 2007). Landings of chub mackerel in America have decreased in recent years from a maximum of 401,770 MT in 2016 to a minimum of 238,215 MT in 2019 (average around 250,000 MT per year) (FAO 2021). However, catches of the species in Chile have increased in the same period from 58,583 MT to 88,241 MT (FAO 2021). In Chile, the industrial fishery landed 93% of the catch in 2019, mainly in regions I (50% of the total catch in Chile) and VIII (around 30% of the catch) (SUBPESCA 2021a).

According to (IFOP 2020), 3,004 MT of chub mackerel were landed in the central region in the period 2019-2020. It would correspond to 3.4% of the total catch in the country, but it corresponds to purse seine fisheries targeting anchoveta and jack mackerel. In the northern area, the catch of chub mackerel is even lower (78 MT in the period 2019-2020) (IFOP 2020). Therefore, the catch of chub mackerel in the anchoveta fishery is considered low.

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Low Concern

Fishing mortality of Pacific chub mackerel in the Southern anchovy fishery in Peru is unknown but due to the volume of this fishery, it is considered that the impact of this fishery on the stock will be lower than the impact of the Northern anchovy fishery. Therefore, a "low concern" score is given.

Justification:

Catches of chub mackerel in Peru are variable decreased in recent years, from 165,396 MT caught in 2016 to 55,521 MT in 2019 (FAO 2021). Peru represents 23% of the total catch of the species in

the area (FAO 2021).

No specific information for this particular fishery has been found.

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Low Concern

Catches of the species by the anchovy fleet represent less than 4% of the total catch of chub mackerel in the country. Therefore, it is considered that the fishery is not a substantial contributor to fishing mortality of the species and a “**low concern**” score is given.

Justification:

Catches of chub mackerel in Peru are variable decreased in recent years, from 165,396 MT caught in 2016 to 55,521 MT in 2019 (FAO 2021). Peru represents 23% of the total catch of the species in the area (FAO 2021).

According to the SALVAMARES program, projected catches of this species in the North-Central anchovy fishery in Peru for 2019, were 2,041 MT, which would represent 3.7% of the catch of the species in the country (CeDePesca 2020a) (CeDePesca 2020b).

Rays

Factor 2.1 - Abundance

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

High Concern

Rays are scored a “high concern” based on the IUCN rating for the eagle rays.

Justification:

Myliobatis peruvianus and *M. chilensis* are poorly known eagle rays from the Southeast Pacific (Dulvy et al., 2020a). These species have been documented in the open ocean over the continental shelf and slope, and not yet on the benthos. Their depth distribution is not clear and essentially nothing is known of its biology, although it is suspected to have limited life history parameters similar to other myliobatid rays (including low fecundity) (Dulvy et al., 2020a). Both species are listed as vulnerable (VU) in the IUCN red list (Dulvy et al., 2020a) (Dulvy et al., 2020b).

Psammobatis spp. (probably *scobina* or *normani*) are a group of small, poorly known sand skate species endemic to Chile (Dulvy et al., 2020c) (Dulvy et al., 2021). Very little is known about its distribution and biology. The species are listed as least concern (LC) (Dulvy et al., 2020c) (Dulvy et al., 2021).

Factor 2.2 - Fishing Mortality

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Low Concern

Bycatch of these species is largely unknown but it seems that they are mainly taken in target purse seine, gillnet and trawl fisheries. Therefore, it is considered that the anchovy fishery is not a substantial contributor to fishing mortality of these species. A “**low concern**” score is awarded.

Justification:

Myliobatids are generally highly susceptible to a variety of fishing gear. These species are taken in intense target artisanal purse seine and gillnet fisheries in Peru and as bycatch in artisanal gillnet fisheries in north and central Chile (Dulvy et al., 2020a).

Psammobatis scobina is mainly taken as discarded bycatch of bottom trawl fisheries (Dulvy et al., 2020c).

Sea turtles

Factor 2.1 - Abundance

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

High Concern

Five species of turtles have been recorded, interacting with the anchoveta fishery in Peru, including Olive ridley turtle, green turtle, leatherback turtle, loggerhead turtle and Hawksbill turtle. No specific information has been found for Chile but these species are also present in the area (SUBPESCA 2022b).

Olive ridley turtle and the loggerhead turtle are listed in the IUCN red list as vulnerable (VU) at the global level {Abreu-Grobois & Plotkin 2008} {Casale & Tucker 2017}, the green turtle is endangered (EN) (Seminoff 2004) whereas the Hawksbill turtle and the East Pacific Ocean subpopulation of the leatherback are listed as critically endangered (CR) {Mortimer & Donnelly 2008} (Wallace et al., 2013) although some of these assessments need to be updated.

Turtles are scored as “**high concern**” based on the IUCN listings.

Factor 2.2 - Fishing Mortality

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit
Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Peru | Northern Central Peru
Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Low Concern

There are no analyses of the impacts of the Peruvian and Chilean anchoveta fisheries on sea turtle populations. Scoring is thus based on the Unknown Bycatch Matrices (see Seafood Watch standard for Fisheries, version 4). Eastern Pacific purse seines not set on Fish Aggregating Devices or mammals are considered a " **low concern**" for turtles.

Justification:

Peru

The SALVAMARES program has collected data on bycatch since 2017, under the FIP currently in place for the IHD fishery (CeDePesca 2020a).

During the first season of 2019, four species of sea turtles interacted with the fishery, including loggerhead, leatherback, green turtle and olive ridley, making a total of 12 individuals, but all of them were released alive (CeDePesca 2020a). During the second season of 2019, only 1 unidentified sea turtle interacted with the fishery and again it was released alive (CeDePesca 2020b).

Chile

In Chile catches of sea turtles were recorded by IFOP observers working aboard industrial and artisanal fleets and auto reported in the logbook "Bitacora de pesca"(IFOP 2020). During the bycatch program conducted by the IFOP observers between 2019-2020 (854 sets monitored), 8 and 1 sea turtles were reported as bycaught by observers in the industrial and artisanal fisheries operating in the northern area, respectively. No sea turtles were reported by the artisanal fishery operating in the central regions (IFOP 2020). In the case of the auto-reported catches (5,173 logbook received), sea turtles represented only 1 and 0.3% of the bycatch in the industrial and artisanal anchovy fishery respectively. Again, no individuals were reported in the fishery operating in the central regions (IFOP 2020). In all cases, the sea turtles were released alive.

Seabirds

Factor 2.1 - Abundance

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit
Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit
Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Peru | Northern Central Peru

High Concern

Several of these seabird species are vulnerable or near threatened, allowing for a score of "**high concern**".

Justification:

Several species of seabirds interact with the anchovy fisheries in Peru and Chile. In general, the artisanal fisheries caught more coastal birds such as the booby and cormorants and the industrial fisheries more offshore seabirds such as sooty shearwaters (Technical report (R. PESQ.) N° 105/2019).

Among the species identified as interacting with these fisheries are: shearwaters such as the sooty shearwater (NT) {BirdLife International 2019a} and the pink-footed shearwater (VU) {Birdlife International 2018a}; petrels such as the white-chinned petrel (VU), grey petrel (NT), cape petrel (LC), the Northern Giant Petrel (LC) and Wilson's storm petrel (LC) (BirdLife International 2018b) {Birdlife International 2018c} (Birdlife International 2018d) {Birdlife Internationale} {Birdlife International 2018f}; and a number of other birds such as: the Peruvian pelican (NT), the Peruvian booby (LC), the guanay cormorant (NT), the Inca tern (NT) {Birdlife International 2018g} {Birdlife International 2018h} {Birdlife International 2018i} {Birdlife International 2018j} and the Humboldt penguin (VU) (BirdLife International 2020).

Factor 2.2 - Fishing Mortality

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Low Concern

There are no analyses of the impacts of the Peruvian and Chilean anchoveta fisheries on seabird populations. Scoring is thus based on the Unknown Bycatch Matrices (see Seafood Watch standard for Fisheries, version 4). Eastern Pacific purse seines not set on Fish Aggregating Devices or mammals are considered a "**low concern**" for seabirds.

Justification:

Peru

In Peru, the SALVAMARES program has been collected data on bycatch since 2017, under the FIP currently in place for the IHD fishery {CeDePesca 2020}.

During the first fishing season of 2019, the Peruvian booby and the Peruvian pelican were the species with the highest number of interactions with the fishery. Of 222,259 individuals of the Peruvian boobies observed, 482 died during fishing operations (0.22% of the total observed). As for the pelicans, only 0.02% (29) of the birds that interacted with the fishery (144,545) were killed. On the other hand, 100,682 sooty shearwaters interacted with the fishery, 214 died (0.21%), 220 individuals were released alive and 85 in a poor condition {CeDePesca 2020}. 146 and 96 blue-footed booby (*Sula nebouxii*) and guanay cormorants also died during the fishing operations {CeDePesca 2020}. On the other hand, not all albatross species could be identified, therefore, they were only reported at the genus level, but although 65 interactions were reported for this group, no deaths occurred {CeDePesca 2020}.

During the second fishing season of 2019, again the Peruvian booby and the Peruvian pelican were the species with the highest number of interactions with the fishery (CeDePesca 2020b). Regarding the Peruvian booby, of a total of 71,281 individuals observed, 339 specimens died (0.48%), while with respect to the Peruvian pelican, 211 specimens died (0.39% of the total observed). 140 guanay cormorants died during the fishing operations. The albatross group interacted with the fishery in 24 occasions but again no individuals were reported dead (CeDePesca 2020b).

Chile

In Chile catches of seabirds were recorded by IFOP observers working aboard industrial and artisanal fleets and auto reported in the logbook "Bitacora de pesca" (IFOP 2020). During the bycatch program conducted by the IFOP observers between 2019-2020 (854 sets monitored), 17.1% of the bycatch reported by the industrial fishery operating in the north were seabirds, being the main species caught the sooty shearwater and the booby with 582 individuals (390 dead) and 98 (58 dead) individuals caught respectively. In the case of the artisanal fishery operating in the northern regions, the seabirds represented 34,4% of the bycatch, being the guanay cormorant (200 individuals, all dead) and the booby (53 individuals, all dead) the main species caught (IFOP 2020). In the central artisanal fishery, again the booby were the main species caught (12 individuals).

In the case of the auto-reported catches, data was recorded from 23,128 industrial vessels, 4,642 logbooks from the artisanal fishery and 1,199 from the artisanal fishery operating in the central region corresponding to the years 2017-2019 (IFOP 2020). In this case the main species caught were shearwaters in the industrial fishery (1,367 non-identified shearwaters and 485 sooty shearwaters, 50% of them dead), and 904 Peruvian pelicans (79 dead). In the artisanal fishery mainly Peruvian pelicans (169 caught, 4 dead) and guanays cormorants (100 individuals, all released alive) were the main species caught, although 775 individuals were not identified (IFOP 2020). In the central fishery, the main species were booby (585 individuals, 222 dead), Peruvian pelican (364, 21 dead) and the guanay cormorant (164 individuals, 8 dead). In general, the artisanal fisheries caught more coastal birds such as the booby and cormorants {IFOP 2019}.

In the southern regions, were a multispecific artisanal fleet for Aracaunian herring and anchovy operates, 2,905 seabirds belonging to the family Procellariidae (shearwaters, petrels) (38.8%) and 664 coastal seabirds (8.9%) were recorded as bycatch between 2015 and 2019 {IFOP 2019}. The main species caught were the sooty shearwater (1,576 individuals, 1,282 dead), pink-footed shearwater (1,283 individuals, 830 dead), Peruvian pelican, and the Kelp gull, species that represented 96.8% of the total number of seabirds caught by this fleet {IFOP 2019}. Incidental mortality mainly affected shearwaters (94.7%) and coastal birds (5.1%) {IFOP 2019}. The industrial fleet catches similar species (sooty shearwater, 1,578 individuals, 943 dead; pink-footed shearwater, 399 individuals, 151 dead) {IFOP 2019}. The auto-reported data was not reliable.

Sharks

Factor 2.1 - Abundance

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

High Concern

Several species of sharks have been identified as interacting with the anchovy fishery in Peru and Chile, including smooth hammerhead, thresher sharks, blue shark and speckled smoothhound. All are of conservation concern according to the IUCN, and are scored as "**high concern**" as a group.

Justification:

The smooth hammerhead is one of the larger hammerhead sharks, found world-wide in temperate and tropical seas, with a wider range than other members of its family {Casper et al., 2005}. It is a coastal and semi-oceanic pelagic shark {Rigby et al., 2019a}. The species shows one of the fastest population rates of pelagic sharks, at 0.225 {Rigby et al., 2019a}. The introduction of management measures may be allowing slow recoveries for the species in the Atlantic, lesser declines in the South Pacific, and increases in the Indian Ocean {Rigby et al., 2019a}. The species is assessed as vulnerable in the IUCN red list.

The pelagic thresher shark is a large, wide-ranging, pelagic shark, that inhabits the Indo-Pacific region. It is highly migratory, with low fecundity (two pups/litter) and a low (0.033) annual rate of population increase {Rigby et al., 2019b}. The species is assessed as endangered (EN) in the IUCN red list.

The bigeye thresher shark is a highly migratory, oceanic and coastal species found virtually circumglobally in tropical and temperate seas {Rigby et al., 2019c}. Such as the previous one, it has low fecundity (2-4 pups/litter) and an exceptionally low (0.002) potential annual rate of population increase (it shows the lowest intrinsic rebound potential of the thresher shark species) {Amorim et al., 2009} {Rigby et al., 2019c}. The species is listed as vulnerable (V) in the IUCN red list.

Speckled smoothhound is a temperate, demersal, triakid shark that lives in the Southeast Pacific from Peru to southern Chile, although in this last country is rarely found {Dulvy et al., 2020}. In Peru, this species is grouped with *Mustelus mento* and probably also with *Triakis maculata* under the name of "tollo" {Romero 2007} {Dulvy et al., 2020}. However, the abundance of *M. mento* increases towards the south and Peruvian catches of this species are probably small {Romero 2007}. Speckled smoothhound is assessed globally as critically endangered (CE) based on a suspected population decline of more than 80% in 30 years.

Factor 2.2 - Fishing Mortality

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit
Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Peru | Northern Central Peru
Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Low Concern

There are no analyses of the impacts of the Peruvian and Chilean anchoveta fisheries on shark populations. Scoring is thus based on the Unknown Bycatch Matrices (see Seafood Watch standard for Fisheries, version 4). Eastern Pacific purse seines not set on Fish Aggregating Devices or mammals are considered a "low concern" for sharks.

Justification:

The smooth hammerhead is caught with a wide variety of gears in both coastal and oceanic fisheries, as both bycatch and target species {Casper et al., 2005} {Rigby et al., 2019a}.

Both thresher species are caught globally as target and bycatch in pelagic and coastal commercial and small-scale longline, purse seine, and gillnet fisheries {Rigby et al., 2019a} {Rigby et al., 2019b}. However, although intrinsically more sensitive to over-exploitation, the bigeye thresher swims deeper, and it seems to be less catchable than the pelagic thresher, which is especially susceptible to exploitation because its epipelagic habitat occurs within the range of many largely unregulated and under-reported fisheries {Rigby et al., 2019b}.

In Peru, between 1966 and 1989 landings of tollo were high, averaging 11,276 t per year, with a peak of 25,000 MT in 1984 {Dulvy et al., 2020}. Between 1990 and 2004, landings decreased to an average of 4,806 MT {Dulvy et al., 2020}. In general, the artisanal fishery effort has increased, with increased demand for this species. The decline in catches is most likely to reflect a reduction in population size {Dulvy et al., 2020}.

In Chile, catch statistics for tollo reported to FAO as "smoothhound nei" are mainly *Mustelus mento*, but they also include other species such as *M. whitneyi* and *Triakis maculata* in the north {Romero et al., 2007}.

Factor 2.3 - Discard Rate/Landings

Southern Peru - Northern Chile stock | Southeast Pacific | Purse seines | Southern Peru Northern Chile
Central - Southern Chile stock | Southeast Pacific | Purse seines | Central Southern Chile/Southern Unit
Central - Southern Chile stock | Southeast Pacific | Purse seines | Central Southern Chile/Central Unit
Northern-Central Peruvian stock | Southeast Pacific | Purse seines | Northern Central Peru

< 100%

No bait is used in purse seine fisheries. Based on the information provided by the IMARPE's onboard observer program {IMARPE 2020} and the SALVAMARES program (CeDePesca 2020a) in Peru, and CCT-PP {CCT-PP 1-2021} in Chile, the ratio of discards/landings in the Peruvian anchoveta purse seine fisheries is considered <100%.

Justification:

Peru

According to {Kelleher 2005}, Peru has a higher discard rate in the small pelagic fisheries than Chile. From 1992 to 2001, 8 million MT of pelagic fish were caught, and 260,000 MT discarded, which corresponds to 3.25% of the total catch.

In Peru, discard at sea is prohibited. However, in a recent study about the industrial anchovy fishery {Torrejon 2014}, total values of discard and bycatch were estimated using bootstrapping and the delta method for the period 2008-2011. Both models show an increasing trend in discards and bycatch in this fishery in recent years.

{Paredes 2014} indicated that the discard of juveniles in the anchovy fishery in Peru has increased in recent years due to the passage of the law D.S. 009-2013-PRODUCE. This law included the requirement for skippers to report to government officials the catch of juveniles and introduced sanctions for the vessels that land more than 10% of juveniles in its catch (an extra 10% is permitted if the presence of juveniles has been previously reported). However, although aimed to reduce the catch of juveniles in the fishery, the directive has been counterproductive, increasing the discard of juveniles at sea to avoid being sanctioned by the authorities.

In 2016, SD 024-2016-PRODUCE obliged the fishing permit holders to use the electronic logbook or other means to report to PRODUCE when capturing juveniles in order to conserve their catches without Sanctions. In practical terms, this means that juveniles are not penalized (regardless of the percentage) as long as the authority is informed in due time that the closure of the fishing zone is required.

Since 2007, the IMARPE's onboard observer program (Bitacoras de Pesca) register events of discarding and entangling when targeting anchovy. During the first fishing season of 2019, recorded 15 anchovy discard events due to excess of capture and 11 discard events due to high incidence of juveniles were recorded {IMARPE 2020}. It seems to be a relatively low percentage of the total sets observed (531 trips). On the other hand, in 31% of the sets observed entanglement events were observed {IMARPE 2020}.

The SALVAMARES program during the first season of 2019 registered a percentage of bycatch of 0.27% in the anchoveta fishery (CeDePesca 2020a).

Chile

Law 20.625 on by-catch and discards in Chilean fisheries (MINECON 20.625-2012) was promulgated in 2012. Its objective of this law is to gradually eliminate the wasteful practice of discarding and reducing bycatch in Chilean fisheries. The main causes of discarding in the pelagic fisheries in Chile include the catch of juvenile of anchovy, under the MLS; and to exceed the limit of bycatch set by the law.

According to {Kelleher 2005}, fisheries for small pelagics in Chile have a low discard rate. From 1992 to 2001 an average of 5 million MT of small pelagics were harvested in the country and 40,000 MT were discarded (0.8%). For 2021 and 2022 the discard percentages considered by the CCT-PP for the anchoveta fisheries in Chile were {CCT-PP 1-2021}:

2% for the first semester and 1.8% for the second semester for the anchovy in regions XIV-II;
2% in the regions V-X;

No values were indicated for the regions III-IV in that report, but they seem in the range of the above values.

Criterion 3: Management Effectiveness

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

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

The Criterion 3 rating is determined as follows:

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

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

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

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

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	DATA COLLECTION AND ANALYSIS	ENFORCEMENT	INCLUSION	SCORE
Southeast Pacific Purse seines Chile Central Southern Chile/Central Unit	Highly effective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	Green (4.000)
Southeast Pacific Purse seines Chile Central Southern Chile/Southern Unit	Highly effective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	Green (4.000)
Southeast Pacific Purse seines Chile Southern Peru Northern Chile	Highly effective	Moderately Effective	Moderately Effective	Highly effective	Highly effective	Green (4.000)

Southeast Pacific Purse seines Peru Northern Central Peru	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Yellow (3.000)
Southeast Pacific Purse seines Peru Southern Peru Northern Chile	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Yellow (3.000)

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Management Strategy and Implementation

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

Factor 3.2 - Bycatch Strategy

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

Factor 3.3 - Scientific Research and Monitoring

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

Factor 3.4 - Enforcement of Management Regulations

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

Factor 3.5 - Stakeholder Inclusion

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

Factor 3.1 - Management Strategy And Implementation

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Highly effective

A number of management regulations apply to the anchovy fisheries in Chile. Management committees and management plans have been established for each of these fisheries. Reference points are defined and TACs based on those reference points set annually for managing the fishery. While fishing mortality on Araucanian herring is likely currently too high, on balance, the management strategy in Chile is considered “highly effective”.

Justification:

Reference points and performance

The Chilean anchoveta fisheries target three stocks of anchoveta, as well as Chilean jack mackerel and Araucanian herring (the latter two only in the South) (IFOP 2020). All have target and limit biomass reference points and fishing mortality reference points (see Criterion 1 and Criterion 2).

With the exception of Araucanian herring, which is currently below the target reference point and experiencing relatively heavy fishing mortality, all are above the biomass target and below the fishing mortality reference point.

Stock	Biomass reference points	Fishing mortality reference points	Reference
Peruvian anchoveta: Southern Peru - Northern Chile	B_{MSY} proxy: 55% SSB_{PR} (Spawning Stock Biomass Per Recruit) (50% SSB_0) B_{LIM} : 25% SSB_0	F_{MSY} proxy: $F_{55\%}$	(SUBPESCA 2022),(Clark et al 2014)
Peruvian anchoveta: Central Chile	B_{MSY} proxy: 60% SSB_{PR} (55% SSB_0) B_{LIM} : 27.5% SSB_0	F_{MSY} proxy: $F_{60\%}$	(SUBPESCA 2022),(Clark et al 2014)
Peruvian anchoveta: Southern Chile	B_{MSY} proxy: 60% SSB_{PR} (55% SSB_0) B_{LIM} : 27.5% SSB_0	F_{MSY} proxy: $F_{60\%}$	(SUBPESCA 2022),(Clark et al 2014)
Chilean jack mackerel	B_{MSY} proxy: 4,583 million MT B_{LIM} : 1,146 million MT B_{MSY} proxy: 36% SSB_0 B_{LIM} : 9% SSB_0	$F_{MSY} = 0.13$ year-1 (dynamic)	{Res. Ex. N 2791 - 2020}

Araucarian herring	B _{MSY} proxy: 55% SSB ₀ B _{LIM} : 27.5% SSB ₀	F _{MSY} proxy: F60%	(CCT_PP 2020)
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Decisions based on science

The Chilean fisheries law requires to conduct the research necessary to regulate fisheries and obtain information on aquatic resources and ecosystems to support conservation and management measures and the decision-making processes in Chile. The law requires these resources to be managed based on the concept of maximum sustainable yield (MSY) and defines stock status levels based on that concept {Law 18,892–1991}. For fisheries declared fully exploited or in recovery, the law establishes a series of specific management measures, such as a closed access regime or catch limitations for specified period of time.

These results of stock assessments are presented to the scientific technical committee for small pelagic fisheries (Comité Científico Técnico de Pesquerías de Pequeños Pelágicos, CCT-PP), composed by scientists and managers’ representatives, which proposes advice to SUBPESCA on the total allowance catch for the assessed stocks. These annual catch limits can be modified in an adaptive way during the year because of updated scientific data (CCT_PP 2020) (CCT_PP 2021). Based on the scientific and fishery data collected (see Criterion 3.3), the IFOP establishes the status of the anchovy stocks and provides catch options based on different scenarios.

Legal and regulatory framework

Chilean fisheries are governed through three agencies: the Undersecretary of Fisheries (Subsecretaría de Pesca) – SUBPESCA, which creates the management policy and the regulatory framework; the National Fisheries Service (Servicio Nacional de Pesca) – SERNAPESCA, which implements and enforces regulations; and the Fisheries Development Institute (Instituto de Fomento Pesquero) - IFOP), the research institution that assesses fish stocks and provides scientific advice to the government.

A General Law on Fisheries and Aquaculture (GLFA) was first promulgated in Chile in 1991 to establish the legal framework for fisheries management in the country {Law 18,892 - 1991}; and updated in 2013 {Law 20,657 2013} and 2019 {Law 21.287-2019}. This is a modern and very complete law which main objective is the conservation and sustainable use of fishery resources in the country through the application of precautionary and ecosystem approaches. The fisheries law requires that fishery policies in the country account for a number of issues:

- long-term objectives for the conservation and management of fisheries and protection of the ecosystems;
- the use and conservation of the marine resources based on the concept of maximum sustainable yield (MSY);
- the consideration of the impacts of fishing on associated or dependent species and the minimization of discards through the development of discard management plans.
- the management of fisheries resources in a transparent and inclusive manner;

It also requires that every five years the effectiveness and implementation of conservation and

management measures must be evaluated.

The Chilean fisheries law requires Management Committees to develop management plans for the fisheries in Chile with a closed-access system, such as the anchovy fisheries. Management plans have already been approved for the three anchovy fisheries {SUBPESCA 2021}:

1. Management plan for the anchovy and Spanish sardine Regions XV – II approved by Res. Ex. 1197-2018;
2. Management plan for the anchovy and Spanish sardine fishery Regions III and IV (PDMASC) approved by Res. Ex. 3893-2017;
3. Management plan for the anchovy and common sardine fishery Regions V-X (PDMASE) approved by Res. Ex. 2746-2016.

The following general management measures regulate the anchovy fisheries {SUBPESCA 2021}:

- an annual total allowable catch established by SUBPESCA for each stock;
- closed access to the fishery for new vessels for fisheries declared “fully exploited” such as the anchovy fishery;
- temporal and spatial closures to protect spawning and recruitment;
- technical measures regulating fishing gear and minimum landing sizes.

In addition, all fishing boats in Chile are fitted with a Vessel Monitoring System (VMS) to ensure that they do not operate inside prohibited areas (such as designated areas of recovery) or the zone reserved for small artisanal fisheries- A Maximum Catch Limit per Vessel Owner regime has been also established for the industrial sector.

Specific regulations that apply to the artisanal fleet are {SUBPESCA 2021}:

- A National Registry for Artisanal Fishermen is implemented (NRAF) to control unregulated access to artisanal fisheries, and to limit the fishers’ activities to the Region where they are registered;
- Spatial restriction allowing only artisanal boats to operate within five nautical miles of the coast (except in Regions XV – I – II and IV) and within the first nautical mile for artisanal vessels smaller than 12 meters;
- An Artisanal Extraction Regime that allows individual, artisanal fishermen or associations to obtain catch quotas;
- Since 2015 artisanal vessels (> 15 meters of length) are required to use VMS.

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Moderately Effective

A seemingly robust and dynamic framework of laws and regulations governs the anchoveta fishery in Peru, and there is no specific evidence that either stock appears to be undergoing overfishing. However, it is not clear how appropriate the biomass reference point is for the main stock (North-Central Peru), and fishing mortality reference points have not been defined for either stock.

Therefore, the management strategy in Peru is considered “moderately effective.”

Justification:

Reference points and performance

The Peruvian anchoveta fisheries only target anchoveta. Appropriate biomass and fishing mortality reference points are not defined for both stocks:

- The Northern-Central Peruvian stock has a biomass reference point, but it is not clear how appropriate this is for the stock (see Criterion 1). There is no fishing mortality reference point.
- The Southern Peru-Northern Chile stock has an appropriate biomass reference point, but no fishing mortality reference point.

Decisions based on science

In 2020, a new protocol for the elaboration of the decision table used for advising the government on the annual TAC for the Northern-Central anchovy stock was developed by the IMARPE (IMARPE 2019). This protocol improved the previous procedure in which the demographic structure (abundance by size) and biomass (weight) of the stock were estimated exclusively from the hydroacoustic evaluation surveys to another in which population dynamics models are also used in the case that anomalies are observed during the acoustic surveys. In this case, a precautionary approach is taken (IMARPE 2020a) (IMARPE 2020b). The elaboration of the decision table comprises 5 stages:

1. Determination of the occurrence of oceanographic anomalies during development of the evaluation survey;
2. Quantification of oceanographic anomalies observed during the surveys and discussion of their impacts on the status of the stock;
3. Estimation of the abundance by size and biomass of the stock;
4. Projection of abundance by size and biomass under different exploitation scenarios;
5. Preparation of the decision table.

The decision table shows different levels of Exploitation Rate (E) which the correspondent catch quota. Different environmental scenarios are considered: favourable, neutral and unfavourable (sometimes also a mix of them), which are related to changes in environmental conditions which affect the anchovy population dynamics. The fishing mortality (F) target reference point is set to be equal to or lower than the estimated natural mortality ($F \leq M$). Natural mortality varies by age depending on the environmental scenario. These values are used to calculate the spawning stock biomass available to the next reproductive season and the risk of probability of reaching that SSB limit is given for each E (IMARPE 2020a).

Legal and regulatory framework

The fisheries in Peru are managed by a dynamic regulatory system which applies to the two stocks found in the country, which are managed separately {Serra et al., 2012}{Dunlon 2014}{Monteferrri et al., 2020}. A global quota (TAC) is calculated by fishing season (autumn-winter and spring-

summer) and assigned to each stock, following IMARPE's annual acoustic surveys conducted by the IMARPE (Monteferri et al., 2020). PRODUCE, based on the scientific reports issued by IMARPE, establishes both fishing seasons and the total allowable catch for the anchovy fishery. TACs are also set separately for the industrial fleet and the Direct Human Consumption fleets (i.e. artisanal and smaller-scale fleets). (Paredes, C. 2012) (Arias Schreiber 2013) (Monteferri et al., 2020).

The 1992 General Fisheries Law (GFL) {Law 25,977 - 1999} regulates fishing activities in Peru with the aim of promoting its sustainable development and ensure its continuity as an important source of food, employment, and income in the country {Arias Schreiber 2013}. The Vice-Ministry of Fisheries (VMP) under the Ministry of Production (PRODUCE) is the central government authority in charge of managing fisheries in the country. PRODUCE is responsible for establishing the regulatory framework for fisheries management, issuing and administering fisheries regulations, and executing and supervising the development of the fisheries sector in the country (Zenteno 2014). The Instituto del Mar de Peru (IMARPE) is responsible for conducting research and providing scientific advice and technical support to the government on fisheries issues (Arias Schreiber 2013).

In general terms, the marine fishery sector in Peru is divided in two sub-sectors that are managed by a separate set of regulations: the industrial or large-scale and the small-scale and artisanal fishery {Sánchez Durand & Gallo Seminario 2009} (Zenteno 2014) (Monteferri et al., 2020). Any fishing vessel with more than 15 meters or length of more than 32.6 m³ of holding capacity belongs to the large-scale fishery (Arias Schreiber 2013) (Monteferri et al., 2020).

Fisheries resources in the country are generally managed through specific regulations (Reglamentos de Ordenamiento Pesquero (ROPs)) (SNP 2021). In the case of the anchovy fishery, the Direct Human Consumption (DHC) fishery is managed by a ROP introduced in 2010 and modified in 2017 (Supreme Decree 010-2010-PRODUCE 2010) (Supreme Decree 005-2017-PRODUCE 2017). However, the industrial fishery destined to Indirect Human Consumption (IHC) in accordance with "provisional fishing regimes" (Arias Schreiber 2013).

The main regulations set for the industrial anchovy fishery (IHD) are the following (Paredes, C. 2012) (Arias Schreiber 2013) (Monteferri et al., 2020):

- A Total Maximum Allowable Catch Level (LMTCP) and a Maximum catch limit per vessels (IVQ-LMCE) in place since 2009;
- Minimum catch limit of 12 cm for the species;
- Operate with a valid fishing license, hold quota, and abide by Legislative Decree 1084 which established quota regulations;
- Mesh size of ½ inch (13 mm) for catching the species;
- Exclusion area of 5 nautical miles from the coast;
- Closed access for new vessels (Art 24 GFL D.L. N01084);
- Operate under a 24-hour fishing day (between 8 am and 8 am next day);
- Operate with the required vessel monitoring system (VMS).

As indicated above, the most important management tool for anchovy is the Fisheries Regulation (ROP) for direct human consumption (DHC) {Supreme Decree 005-2017-PRODUCE}. Because anchovy fishing for DHC (fresh, canned, cured and frozen) is not allowed for the industrial fleet, this

ROP basically manages the artisanal and smaller-scale fleet (Monteferri et al., 2020). The specific regulations which apply to this sector are as follows:

- A Total Maximum Allowable Catch Level (LMTCP) for the DHC;
- Operate with a valid fishing license and register for DHC in the regional register of artisanal vessels (Supreme Decree 010-2010-PRODUCE);
- Operate with a mesh size of ½ inch (13 mm) and a maximum height of 44 meters (artisanal fleet);
- Spatial restriction allowing artisanal boats to operate outside the 3 nautical miles line from the coast (5 nautical miles in the North);
- Small-scale vessels are obligated to operate with the required vessel monitoring system;

Other general measures include: closed entry for new fishing boats in both the industrial and the artisanal fleets (Supreme Decree 010-2010 PRODUCE) (new vessels can only replace decommissioned vessels); seasonal closures published by the Ministry; seasonal total catch limits based on IMARPE's recommendations; temporal restrictions and ports closures when landings report more than 10% of juvenile (anchovies <12 cm in length) bycatch; limit of incidental catches to 5% of total landings; required monitoring by third-party operators to verify landing statistics; 24-hour independent recording and reporting of landings, etc.. Additional controls for the processing industry are also in place (Paredes, C. 2012) (Arias Schreiber 2013) (Monteferri et al., 2020).

Factor 3.2 - Bycatch Strategy

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Moderately Effective

Bycatch species in the anchoveta fisheries in Chile that are landed are Pacific chub mackerel and South American pilchard. Neither is managed relative to reference points, but the fisheries' impacts on Pacific chub mackerel appear minimal (based on a score of 'low concern' for fishing mortality).

However, the status of South American pilchard is a concern, and better understanding the fisheries' impacts on this stock needs more attention. Plans to reduce bycatch and discards have been implemented or are being developed for the assessed fisheries. Discard percentages estimated for these fisheries seem to be low, at around 2% (CCT_PP 2021).

There are a number of vulnerable species caught in the fisheries, but fishing mortality from these fisheries does not seem to be a major problem for any of them (based on scores of 'low concern' for fishing mortality).

A "moderately effective" score is awarded.

Justification:

Article 7 of the Chilean fishery law (GLFA) {Law 20,657 2013} refers to the discard and bycatch in Chilean fisheries. It indicates that the Undersecretariat of fishing must conduct a two-years research program to assess the level of discards and bycatch in Chilean fisheries. This research program must compile information on level of discard of both the target species and the accompanying fauna, their causes, and how this information is compiled; and include measures to reduce both discards and bycatch. It also requires that within a maximum period of three years after that research program, a discard and bycatch management plan must be approved for the fishery, containing at least the following elements:

conservation measures and effective tools necessary to reduce discards and bycatch,
a monitoring and follow-up program of the plan,
an evaluation of the measures adopted,
and a training and dissemination program.

This reduction plan must consider a code of good practices in fishing operations, as a complementary mitigation measure. Likewise, it may consider incentives for innovation in fishing systems and gears, aimed at mitigating or reducing discards and bycatch.

Article 7 B {Law 20,657 2013} indicates that individuals of a target species may not be discarded, whatever their access regime, and their accompanying fauna, unless the following requirements are met:

sufficient technical background information on the discard has been compiled, in accordance with the research program,
a global annual catch quota has been set for the target species and discards have been considered when establishing that quota,
the target species and its accompanying fauna are subject to the reduction plan, and
the discard does not affect the conservation of the target species.

The Undersecretariat of Fisheries will establish annually the list of the target species and accompanying fauna that comply with these requirements.

The law also specifies that it will be mandatory to return marine mammals, reptiles, penguins, and other seabirds to the sea, unless they are severely damaged or injured, in which case they will be retained on board for the purpose of being sent to a rehabilitation centre if possible. In the case of the Chondrichthyes, (Res.Ex. 2,063 2020) establishes a code of conduct for the capture and handling of these species and describes how to return them safely to the sea.

The IFOP's "Scientific Observer Program" monitors bycatch and discards in Chilean fisheries. Discard and bycatch reduction plans have been already approved for the anchovy fishery in regions XV-II (Res.Ex. 1,625 2019); and regions V-X (Res.Ex. 2,463 2017). A resolution listing the bycatch species for each of the fisheries is annually published by the SUBPESCA. These species are subject to two general measures: species which cannot be discarded (e.g: cuttlefish, hake, horse mackerel, etc.) and their catch accounted against the quota for incidental catch; and species which must be returned to the sea, alive if possible, such as salmon, chimaeras and sharks (subject to the shark management plan (PANT 2007), marine mammals and seabirds.

In the case of the anchovy fishery in regions III-IV preliminary results of the research program on discard and bycatch in the artisanal fishery were recently presented to the management committee but a discard and bycatch management plan have not been implemented yet (CCT_PP 2021).

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Peru | Northern Central Peru

Moderately Effective

The anchovy fishery in Peru is considered to have a rate of discards/non-target catch >5% of landings. Bycatch and discard management measures are in place, but their effectiveness is unknown and taking into account the huge volume of the fishery and the unknown level of unreported discards at sea, a bycatch limit of 5% for non-target species or 10% for juveniles, seems to be relatively high.

Bycatch species in the anchoveta fisheries in Peru that are landed are Chilean jack mackerel, Pacific chub mackerel, South American pilchard, and longnose anchovy. Of these, impacts of the fishery on Chilean jack mackerel is managed through reference points, and the stock appears to be neither overfished nor undergoing overfishing. The other species do not have reference points, but the fisheries' impacts on Pacific chub mackerel and longnose anchovy appears to be minimal (based on scores of 'low concern' for fishing mortality). However, the status of South American pilchard is a concern, and better understanding the fisheries' impacts on this stock needs more attention.

There are a number of vulnerable species caught in the fisheries, but fishing mortality from these fisheries does not seem to be a major problem for any of them (based on scores of 'low concern' for fishing mortality).

A "moderately effective" score is awarded.

Justification:

As indicated in the management strategy section, management measures to control bycatch in the anchovy fishery in Peru include maximum bycatch limits: 5% of non-target species, 10% of maximum catch of juveniles for the anchovy fishery (and 20% for the samasa fishery; minimum mesh size (13mm); and minimum landing size for the target species. Spatial or temporal closures to protect the juveniles are also in place (Arias Schreiber 2013) (Paredes, C. 2014) (Monteferri et al., 2020).

In 2016, Supreme decree 24-2016-PRODUCE established new measures to strengthen the control and surveillance of the fishing activities and establishes penalties for non-compliance to eliminate the practice of discarding at sea. That regulation permits the landing of juveniles, even if the 10% limit is exceeded without being penalized, as long as the presence of juveniles is communicated immediately to the authorities (Monteferri et al., 2020). With this information, provided by the industrial fleet, short-term temporal and spatial closures are implemented by the PRODUCE to protect juveniles of anchovy. During the first 2020 fishing season, 54 temporal closures were implemented for the north-central anchovy stock fishery {PRODUCE 2021}. However, although this measure was implemented in order to discourage discards, the adequate technology has not been implemented to monitor compliance and it is unclear if: i) there is an effective communication of the

presence of juveniles to the authorities, ii) if there are not repeated fishing activities in these areas with high presence of juveniles; and iii) there are no discards of these juveniles {Aguilar Ramírez, D. & Barrera Guevara, J.C. 2018}.

In the case of large species (seabirds, marine mammals, sea turtles, etc) national legislation {DS 004-2014-MINAGRI} and other binding international agreements (eg. ACAP, IAC, CITES) signed by Peru recognize different ETP species susceptible to interactions with the anchovy fishery. SD 034-2004-AG for the protection of endangered and threatened species is based on the IUCN Red List and prohibits the capture of protected species for commercial purposes, including species such as: Peruvian Diving Petrel, Humboldt penguin, Guanay cormorant, pelican, Peruvian booby, green sea turtle, South American sea lion and Southern fur seal. Small cetaceans are protected by Law No 26585 and the commercial catch, processing and marketing of these species is prohibited by a national law since the mid-90s {DS 002-96-PE} {Hervas & Medley 2015}. A national action plan for the protection and conservation of sharks and rays was also approved in 2014 {DS 002-2014-PRODUCE}.

(Saldarriaga Mendoza, M.S. 2015) conducted a bycatch study of the industrial fishery with landings data from 2003 to 2011, which indicated that although variable by area, month and year, the bycatch of this fishery was around 5%, decreasing in the most recent years. However, these conclusions are based on data collected in ports at the time that the catch is landed. Instead, (Torrejón, E. 2014) using bootstrapping and other indirect models, estimated that the real bycatch onboard industrial vessel in the North of Peru was around 10%, with an increasing trend between 2008 and 2011. According to the most recent SALVAMARES observer program, bycatch in the industrial fishery represents 0.25% of the catch {CeDePesca 2020}.

In relation to the catch of top predators, the SALVAMARES program reports a large number of interactions with top predators but very low mortality rates among these species. Currently the only mitigation measure to avoid it is to train crew members in the correct release of bycaught species as part of the program {CeDePesca 2020}. Some protected areas have been also created in Peruvian coastal areas to protect seabird colonies, but currently only between 0.5 and 1% of the Peruvian marine area is protected (MPA atlas 2021).

Factor 3.3 - Scientific Data Collection and Analysis

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Moderately Effective

The management process uses an independent and up-to-date scientific stock assessment for the main targeted stocks. Both fishery-independent and dependent data is collected. However, environmental variables are not taking into consideration when assessing the stocks and there are some concerns about the biological reference points used for the anchovy stocks, which is key species in the Chilean sea. In addition, there is no stock assessment for Pacific chub mackerel or South American pilchard. Therefore, scientific research and monitoring is scored as “moderately effective” for Chilean waters.

Justification:

The Fisheries Development Institute ('IFOP') conducts stock assessment for pelagic resources in Chile using both direct and indirect assessment methods. Hydroacoustic surveys are conducted for anchovy biannually in two cruises: RECLAS during the summer season, over the recruitment period; and PELACES during the autumn season. Fisheries related data such as landings, CPUE indices and length-at-age catch composition is also collected from the commercial fishery. Based on the scientific and fishery data collected, the IFOP establishes the status of the anchovy stocks and provides catch options based on different scenarios.

Other fisheries research institutes in the country include: the applied research center of the sea (CIAM), a non-governmental institution; private research institutions such as the Instituto de Investigacion Pesquera (Fisheries research institute, INPESCA); and some universities (Universidad Arturo Prat) which also collaborate on monitoring and assessing the stocks and take part in CCT-PP meetings (CCT_PP 2021).

Anchovy, Chilean jack mackerel and Araucanian herring stock assessment

Stock assessments are produced annually for the three anchovy stocks based on twice-annual surveys and other data (see context below). There is also a recent stock assessment for Chilean jack mackerel (SPRFMO 2019) and for Araucanian herring (SUBPESCA 2022).

Monitoring of retained catch and bycatch

There are no stock assessments for the other main species caught and retained in the fishery (South American pilchard and Pacific chub mackerel). The IFOP's "Scientific Observer Program" monitors bycatch and discards in Chilean fisheries. Every month a number of fishing vessels are required by the authorities to take observers onboard. This list covers all main industrial and artisanal fisheries (IFOP 2020).

In Chile, the Fisheries Law (LGPA) requires that a resolution listing the bycatch species for each of the fisheries subjected to a discard management plan is annually published by the SUBPESCA.

There are a number of species of concern documented in these fisheries, and higher levels of observer coverage would normally be necessary to sample what are relatively rare interactions. However, fishing mortality is not deemed a major risk to these species' survival (see Criterion 2).

Ghost gear

No information was found that suggests ghost gear is or is not an issue in this fishery, or that there is any research to assess the risk, or policies to reduce ghost gear impacts.

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Peru | Northern Central Peru

Moderately Effective

While there is significant research effort in place for understanding fishing impacts on the two anchovy stocks in Peruvian waters, as well as observer programs to help quantify the impacts on discarded species (including species of concern) there is far less for the other species retained and discarded in the fishery. Therefore, scientific research and monitoring is scored as “moderately effective” in Peruvian waters.

Justification:

The Marine Research Institute of Peru - IMARPE is the scientific institute in charge in carrying out most of the research used by the Peruvian Ministry of Production (PRODUCE) to develop fishery management policies in Peru. Since 1982, the IMARPE has monitored anchovy populations using acoustic techniques through twice-yearly hydro-acoustical cruises along the geographical range of the anchovy population. In these surveys, performed before each fishing season, IMARPE monitors oceanographic conditions and carries out direct biomass estimates and onboard sampling to estimate size structure and reproductive parameters (IMARPE 2020a) (IMARPE 2020b).

Anchovy stock assessment

Stock assessments are produced annually for the two anchovy stocks based on twice-yearly surveys and other data (see context below). There is also a recent stock assessment for Chilean jack mackerel (SPRFMO 2019). However, there are no stock assessments for the other main species: Pacific chub mackerel, South African pilchard, or longnose anchovy.

IMARPE methods to assess the anchovy stock were peer reviewed by an international panel of experts in 2009 and again by FAO experts in 2014 {FAO 2014}. FAO experts provided a series of recommendations to IMARPE such as using integrative, indirect methods for stock assessment, long-term projections, harvest control rules for different environmental conditions, and including catches and biomass of all fleets, etc. However, it was concluded that there is a high standard scientific support towards the management of fisheries in Peru {FAO 2014}. Under the FIP for the anchovy industrial fishery, a Management Strategy Evaluation has been initiated in collaboration with international experts from the University of Washington (Siple et al., 2021).

Monitoring of retained catch and bycatch

In Peru, two onboard observer programs are currently in place in the Peruvian anchovy fishery: the public observer program conducted by the IMARPE (Bitacorás de pesca), which cover around 4-5% of the trips (IMARPE 2019); and the private observer program SALVAMARES (set because of the FIP in place for the fishmeal/fish oil fishery), where crew members act as observers, which monitoring around 8-10% of the trips {CeDePesca 2020} (CeDePesca 2020b). There are a number of species of concern documented in these fisheries, and higher levels of observer coverage would normally be necessary to sample what are relatively rare interactions. However, fishing mortality is not deemed a major risk to these species' survival (see Criterion 2).

The IMARPE's Bitacora program deploys observer aboard fishing vessels in order to collect biological samples while a private company collects them at ports. All data are analyzed and used to calculate the catch quotas for the two anchovy fishing seasons per year for both the northern-central and southern stock (Zenteno 2014) {Arias Schreiber & Halliday 2013} (Arias Schreiber 2013). When conditions are anomalous, real-time monitoring is intensified.

Ghost gear

No information was found that suggests ghost gear is or is not an issue in this fishery, or that there is any research to assess the risk, or policies to reduce ghost gear impacts.

Factor 3.4 - Enforcement of and Compliance with Management Regulations

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Highly effective

A number of measures are in place to control fishing effort and ensure compliance with rules in both the industrial and artisanal fisheries, including limited entry permits and logbooks, Vessel Monitoring Systems, and observer programs. Although monitoring and enforcement are particularly challenging for artisanal fisheries, TACs have not been exceeded in any fishery and detected non-compliances have been addressed by the authorities. Therefore, a "highly effective" score applies.

Justification:

In Chile, SUBPESCA and SERNAPESCA are responsible for the management of fisheries. SUBPESCA deals with policy, planning and regulation. SERNAPESCA, which within the ministry of economy, deals with monitoring, surveillance, and control (VMS, landing & quota control, enforcement and statistics) (OECD 2009). Moreover, the Chilean Navy monitors Chile's Exclusive Economic Zone (EEZ) to protect natural resources and ecosystem unauthorized activities.

Infractions, penalties, and procedures are set out under "Title IX" in the GLFA {Law 20,657 2013}. The measures which can be applied include administrative and judicial sanctions, such as: fines; suspension or removal of the Captains licence, removal of quota; seizure of gear and means of transporting gear, the confiscation of catch and fines in multiples above the value of the confiscated fish, closure of fishing and processing facilities, etc.

A system of fishing quotas is applied to regulate the anchovy fishery in Chile. Recommendations, based on the annual scientific advice are provided by the CCT-PP to SUBPESCA. TACs are split between commercial (both industrial and artisanal sectors) and research purposes and are allocated to the industrial fishery in one or two periods depending on the anchovy stock (CCT_PP 2021). The percentage of the TAC that corresponds to each sector depends on the management unit: 85%-15% for the industrial and the artisanal fishery respectively in Regions XV – II, 50% for each sector in Regions III - IV, and 20% - 80% for the industrial and the artisanal sectors respectively in Regions V – X. A Maximum Catch Limit per Vessel Owner regime has been established for the industrial sector (SUBPESCA 2021a).

The anchovy fisheries are fully exploited by the authorities and the access to these fisheries are closed to new vessels to avoid increasing pressure on the resource {SUBPESCA 2021}. Moreover, all purse seiners over 12 meters in length are fitted with a Vessel Monitoring System (VMS) to ensure that they do not operate inside prohibited areas (such as designated areas of recovery) or in the case of industrial vessels in the first five miles from the coast, reserved for the artisanal fleet. Both industrial and artisanal fisheries need to register the catch in a logbook (SUBPESCA 2021a).

The fisheries and aquaculture inspection report published by SERNAPESCA for the year 2020 (IFPA 2021) indicates that within the framework of the SERNAPESCA 2020 National Inspection Plan, inspection activities were focused on controlling the main behaviors affecting to the sustainable use of the marine resources in the country, and two special inspection programs were implemented: "Landing Control (in fishing areas and landing points)" and "Fighting IUU fishing in the Value Chain"(IFPA 2021). Despite the COVID-19 situation, several inspection goals were reached in that year: the monitoring of the fleet through the VMS was decentralized, which allowed to significantly increase of coverage and capacity to respond to illegal activities; an electronic monitoring (EM) system to control bycatch and discards was implemented in 100% of the industrial fishing fleet; and 100% of the landings were certified by the authorities (IFPA 2021).

During 2020, SERNAPESCA conducted 45,543 inspections in the fisheries sector, 54% of them in the Bio Bio area, including inspections of fishing vessels (VMS), landing points fish processing plants. Of these, 57% of the inspection undertaken were related to fishing quotes, whereas 21% and 12% of the inspections were related to fishing access and fishing closures respectively (IFPA 2021). The most frequently were associated with capturing closed resources (22% of non-compliances), followed by given false information to the authorities (15.4%), and possessing or transporting unauthorized resources (13.2% and 11% respectively) (IFPA 2021).

Taking into consideration the cases reported to the courts, 10.7% of non-compliances were related to the common hake fishery, followed by 8% related to the extraction of the grey seaweed, and 7.7% related to the resource anchovy. In 2020, 433 MT and 393 MT of Araucaian herring and anchovy were confiscated by the authorities respectively (IFPA 2021).

During 2020, a close monitoring was carried out by the authorities on the percentages of bycatch in pelagic fisheries (anchovy, sardines and horse mackerel) to detect possible underreporting which seems to be a common non-compliance in these fisheries. In 2020, it seems that the level of bycatch underreporting was lower than in previous years (IFPA 2021).

In relation to the monitoring of the fleet using the VMS technology, the most frequent problem found was of vessels operating in restricted areas, and it mainly occurred in the following fisheries: artisanal king crab (44% of the non-compliances), artisanal Spanish sardine and anchovy (34%) and Artisanal anchovy and Araucaian herring (18%) (IFPA 2021). Around 84% of these non-compliances were managed by the authorities, of which 68% resulted in preventive measures (verbal and 32% in punitive measures (fines or similar). Citations issued for this issue, reached 68 in 2020, 98% artisanal corresponding to the artisanal fishery, an 224% increase compared to 2019, as a result of the increase in the inspection capacity of this inspection service. In general, in the pelagic fishery there was an 350% increase in the number of operations in unauthorized areas (IFPA 2021).

As seen in the table below catches of anchovy in 2020 were below the set TAC (IFPA 2021).

Stock	Industrial TAC	Artisanal TAC	Industrial TAC as % of total	Industrial Catch	Artisanal catch	Industrial catch as % of total
XV-II	458284	123745	79	56614	122728	32
III-IV	7159	45069	14	0	34226	0
V-X	5214	169927	3	1794	164450	1

**Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Peru | Northern Central Peru**

Moderately Effective

Landings in the most recent fishing seasons (2020, 2021) have been below the set TAC (IMARPE 2020a) (IMARPE 2021a). Peruvian fishing companies representing over 70% of industrial boats are organized into the National Fisheries Society (Sociedad Nacional de Pesquerías, SNP) and developed an Ethical Code of Conduct with responsible fishing as a main aim, including strict compliance with regulations. Some independent reports indicate that compliance in the industrial fishery (at least referring to landings) is good (MRAG 2019). However, although an enforcement and monitoring system are in place, the effectiveness of some measures (juvenile and bycatch limits) seems to be unclear. Therefore, a “moderately effective” score is awarded.

Justification:

A number of measures are in place to control fishing effort and ensure compliance with rules in both the industrial and DHC fisheries, including limited entry permits and logbooks (industrial only), Vessel Monitoring Systems, and observer programs (with a compliance mandate). See Context below for more details. TACs have not been exceeded in either fishery (IMARPE 2020a) (IMARPE 2021a).

A recent audit of a Fishery Improvement Project for the Peruvian fishery on the North-Central stock noted that the strength of the surveillance system in the industrial fleet suggests that compliance is good {MRAG 2019a}. The audit also notes that there are currently no compliance reports from PRODUCE to support this assumption. More broadly, a recent study based on literature review and key stakeholder consultation (Gozzer-Wuest et al., 2021), fishery stakeholders in Peru identified the lack of capacity of the authorities to control the different fleets, and the permanent presence of illegal, unreported and or unregulated (IUU) fishing as some of the main weaknesses of the Peruvian fisheries management system. There is a shortage of resources for the MCS system, as well as a limited use of technology and management procedures for coordination between the different enforcement entities. It is also indicated that the current penalties are unfair, difficult to understand and too low to dissuade offenders and deter unlawful activity; and enforcement is applied in a flexible, discretionary, and selective manner, often because of mismanagement within the relevant institutions (De La Puente et al., 2011) (Paredes, C. 2014) (Gozzer-Wuest et al., 2021). These problems seem to be more pronounced in the small-scale fishery but compliance reports for either of the industrial and small-scale fisheries are not available.

In Peru, the industrial fishing activity is mainly controlled by a number of mechanisms: vessel

departure control by DICAPI; monitoring fishing activities through a Satellite Surveillance System (SISESAT - SD 026-2003-PRODUCE), which transmit vessel positions every 15 minutes; and the Fishing and Landings Surveillance Program (PVCPDAM - Ministerial Resolution 591-2008-PRODUCE) (Arias Schreiber 2012). The Government's DIGSECOVI agency imposes sanctions on offenders (Zenteno 2014) (De La Puente et al., 2011). Compliance observers and an electronic logbook system have also established in the industrial fishery {MRAG 2019a}.

A system of fishing quotas has been regulating the anchovy fishery since 1967. Total allowable quotas (TAQs) are established by the Government based on the available scientific evidence as well as socioeconomic factors (Arias Schreiber 2013). Since 2009 an Individual Vessel Quota (IVQ) system has been also implemented for the industrial fleet. This system assigns a percentage of the TAC to each of the fishing vessels authorized to operate in the fishery (Tveteras et al., 2011) (Avadi et al., 2014a). Fishing effort is also controlled through closed entry to the anchovy fishery and trip limitation (one fishing trip per day) {Dunlon et al., 2014} (Zenteno 2014) (Monteferrri et al., 2020).

The Regulation for Fishing and Aquaculture Inspections and Sanctions (RISPAC - SD 019-2011-PRODUCE) and the law of Inspection and Sanction for the Activities of Fishing and Aquaculture (SD 017-2017-PRODUCE) defines inspections, the types and severity of offences, penalties (fines, loss of fishing rights, etc) and allocation of seized resources.

Improvements have been made for the control of the catch in the industrial anchovy fishery since the publication of SD 024-2016-PRODUCE, with initial implementation of voluntary measures to report catches of juvenile anchovy, to reduce illegal discards at sea, and to ensure timely reporting of areas with high levels of juveniles so as to enable to temporary spatial closures to protect the juveniles. In industrial vessels, a member of the crew is in charge of undertaking bio-metric measures of the catch and in the case the percentage of juveniles surpasses the 10% limit communicate it to the authorities (SD 024-2016-PRODUCE). During the first fishing season of 2019, over 100 temporarily closures were set to the IHC fleet to protect the juvenile portion of the stock. And in the second season of 2019, the entire fishery was closed (MRAG 2019). Although, as it was indicated in the bycatch section, the effectiveness of these measures have been questioned by several authors (Torrejón, E. 2014) (Paredes, C. 2014) {Aguilar Ramírez, D. & Barrera Guevara, J.C. 2018} (Gozzer-Wuest et al., 2021).

In the case of the artisanal segment, PRODUCE has established that the entire fleet must have a satellite tracking system or another alternative system (SD 005-2017). Landings of the DHC fishery are monitored in port by inspectors from PRODUCE. There are no logbooks mandated for the DHC fleet (MRAG 2019). The system of closing the artisanal fishery when the catches of juveniles are high, is not as effective as in the IHC fishery (MRAG 2019). For example in the second season of 2019, artisanal fishermen protested when the catches of juveniles were extremely high but the fishery had not been closed by PRODUCE (MRAG 2019).

The quota for the DHC fleet is calculated using just the biomass of the North-Central stock and then used to cover both the Northern-Central stock, and the Southern stock, although in the south there is not much small-scale fishing for anchovy (MRAG 2019). The DHC quota is issued for the whole year and is not allocated per vessel. Until 2009, it remained at 300,000 MT (MRAG 2019). The DHC fleet have not reached their quota ever.

Factor 3.5 - Stakeholder Inclusion

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

Highly effective

Based on the information provided, it seems that role and responsibilities are clearly defined in Chilean fisheries. The management process is transparent and stakeholder inclusion is adequate. Therefore, this section has awarded a “**highly effective**” score.

Justification:

In Chile, several organisms aimed at promoting the participation of fisheries stakeholders in the decision-making process have been established (SUBPESCA 2021a).

The Consejo Nacional de Pesca (National Fisheries Council, CNP) was created by the fisheries and aquaculture Law 18.892. CNP’s role is to ensure the effective involvement of stakeholders in the fisheries sector at the national level on matters related to fishing activity and aquaculture {Arana, P. & Scott, I. 2015}. It is a ruling, advisory, and consultative body for matters such as establishing fishing quotas for industry and small-scale vessels, dealing with the National Fisheries Development Plan, the National Research Plan, etc. The National Fisheries Council includes 27 members from SERNAPESCA, the IFOP, industry, small-scale fishermen, etc. Their role has been instrumental in facilitating consensus and social acceptance of management measures proposed by the authorities (OECD 2009) (SUBPESCA 2021b). The Consejo Nacional de Pesca obtains inputs on policies and regulations from the eight Zonal Fisheries Councils, whose aim is to contribute to the decentralization of management measures and enhance regional participation of fisheries stakeholders {Arana, P. & Scott, I. 2015} (SUBPESCA 2021b).

The Comites Científico Técnicos (Scientific Technical Committee, STCs) were originally established in 2007 (Resolution no. 997) for each of the main species’ groups (e.g. small pelagics, jack mackerel, demersal, etc) to inform the fisheries councils. Each of the eight established STCs has associated task groups that undertake detailed analyses {Arana, P. & Scott, I. 2015} (SUBPESCA 2021a).

The Instituto de Fomento Pesquero’s (IFOP) main objective is to carry out scientific and technological research oriented to the exploitation of fisheries resources in Chilean waters. Universities and private research institutions such as the Instituto de Investigación Pesquera (Fisheries Research Institute, INPESCA) also collaborate on monitoring and assessing fish stocks in the country {Arana, P. & Scott, I. 2015} (CCT_PP 2021).

Each of those entities has stakeholder representation and the rights of citizens are explicitly defined as having access to access non-classified documents {Law 20,285 access to Information}, knowing the identity of the authorities and officials involved in fisheries administration and management procedures, etc {Arana, P. & Scott, I. 2015}.

The Chilean fisheries Law also requires specific Management Committees to develop Management Plans for the fisheries in Chile with a closed-access system such as the anchovy fishery. These management committees are advisory and consultative bodies of the fishing authority, composed of SUBPESCA and SERNAPESCA members, artisanal and industrial fishermen and the processing industry (SUBPESCA 2021a).

Management committees have been created for the three anchovy fisheries covered by this assessment (SUBPESCA 2021a). Meetings of the management committees are conducted regularly and acts of these meetings published on the SUBPESCA website (SUBPESCA 2021a). The development of the management plans for these fishery units was carried out within the framework of a participatory process between representatives of the artisanal and industrial fishing sector, processing plants and with representatives of the institutional fishing sector, Undersecretariat of Fisheries and Aquaculture (SSPA) and Service National Fisheries and Aquaculture (SNPA), within both Committees (SUBPESCA 2021a).

**Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Peru | Northern Central Peru**

Moderately Effective

As not all user groups are effectively considered in the decision-making process, this section is assessed as "**moderately effective**".

Justification:

Roles and responsibilities in Peruvian fisheries management are defined by the General Fisheries Law (GFL) (Legislative decree No 25977 2010). According to the GFL, the Vice-Ministry of Fisheries (VMP) is the central governmental authority in charge of managing fisheries in Peru, under the Peruvian Ministry of Production (PRODUCE) (FAO 2020). PRODUCE is therefore responsible for regulating, approving, executing and supervising the development of the fisheries sector (Zenteno 2014). According to the Organic Law of Regional Governments No. 27867, the central government can also share their management responsibilities with regional governments. The responsibility of the management of fisheries falls exclusively on the Government.

The Legislative Decree 012-2001 in Article 3 states that "the State encourages the widest participation of natural and legal persons in Peruvian fisheries (...) ". However, Administrative tools enabling stakeholders to participate in the decision-making process for fisheries management have not been adequately developed. Consultation processes are scarce and informal. When these processes are developed, the consultations are conducted with agents directly involved in the fishery, especially in the case of industrial fishing for IHC, but without involving other stakeholders (NGO's, Universities, etc). Therefore, in this case the level of participation is considered biased (De La Puente et al., 2011) {Hervas & Medley 2015}.

Criterion 4: Impacts on the Habitat and Ecosystem

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

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

Guiding principles

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

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	FORAGE SPECIES?	SCORE
Central - Southern Chile stock Southeast Pacific Purse seines Central Southern Chile/Central Unit	Score: 3	+ .5	High Concern	Yes	Red (2.646)
Central - Southern Chile stock Southeast Pacific Purse seines Central Southern Chile/Southern Unit	Score: 3	+ .5	High Concern	Yes	Red (2.646)
Southern Peru - Northern Chile stock Southeast Pacific Purse seines Southern Peru Northern Chile	Score: 3	+ .5	High Concern	Yes	Red (2.646)
Northern-Central Peruvian stock Southeast Pacific Purse seines Northern Central Peru	Score: 3	Score: 0	High Concern	Yes	Red (2.449)
Southern Peru - Northern Chile stock Southeast Pacific Purse seines Southern Peru Northern Chile	Score: 3	Score: 0	High Concern	Yes	Red (2.449)

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.*

Draft for Review

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

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

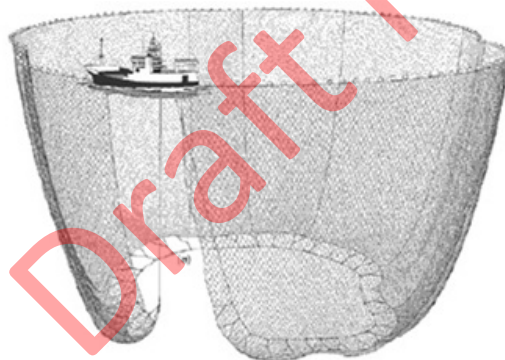
Score: 3

Due to the limited available information, the effects of the purse seine fishery on the marine benthos in Chile cannot be established. There is some data in Peru which indicates contacts with the habitats when operating close to the coast. Therefore, a **SFW score of 3** is given in this section.

Justification:

The effects of fishing on the habitat are related to physical disturbance when the bottom gear in contact with the seabed (ICES 2006). By definition gears used in pelagic fishing, such as purse seines, do not directly impact the seabed and it is considered that they do not have an impact on the habitat (ICES 2006) (Grieve et al., 2014).

Although specifications can vary, artisanal purse seine nets for anchovy called "sardineras" are typically made of nylon mesh around 250 - 350 meters long and 36 meters (20 fathoms) in depth. Mesh size varies between 13 and 14.3 mm (1/2" – 9/16"). The maximum permitted height for nets used in coastal waters is regulated by law (DS 445-1989 for the X, XI and XII regions) to a maximum of 20 fathoms in shallow waters and to a maximum of 33 fathoms (60 meters) in waters deeper than 40 meters (IFOP 2006). Industrial nets are longer and higher (see figure X below) (SUBPESCA 2008). In Chile, artisanal fisheries have exclusive fishing rights in the first 5nm contiguous to the coastline (OECD 2009).



Red de cerco
Cuerpos 17-24.
Longitud de relinga de
flotadores: 380-460 bz.
Largo de relinga de plomos;
450-530 bz.
Altura de red: 50-72 bz
Tamaño de malla: 5/8".

Figure 12. Purse seine used by the industrial fleet in Chile (SUBPESCA 2008)

There is very little information about the effects of the purse seine fishery on the marine benthos in Chile. However, as indicated in the Peruvian section, large purse seines can contact the seabed in shallow waters (MRAG 2019). Moreover, when slipping occurs, it can cause considerable local and temporal damage to the benthos in terms of organic enrichment and disturbance of the benthic community (Peiro Crespo et al., 2020).

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile
Southeast Pacific | Purse seines | Peru | Northern Central Peru

Score: 3

The purse seine fishing method, used to catch anchovy, operates in the water column and the impact on the habitat seems to be low. However, concerns have been raised about the impact on bottom habitats in shallow waters by the industrial fleet {Hervas & Medley 2015} (MRAG 2019). Therefore, a SFW **score of 3** (purse seine known to commonly contact bottom) is given due to the uncertainty of benthic impacts between 5-10 nm from the larger nets used in the industrial fleet.

Justification:

Anchovy is a pelagic fish that occurs mainly within 80 km of the coast that forms huge schools, chiefly in surface waters (Iwamoto et al., 2010). The species is caught in Peruvian and Chilean waters by both industrial and artisanal fishing vessels working with purse seines (Avadi et al., 2014a).

Purse seine fishing involves enclosing a school of fish, in this case anchovy, with a curtain of netting. The top of the net is mounted on a float line and the bottom on a lead line that usually consists of a steel chain with steel rings, known as "purse rings". The purse line, which runs through the purse rings, is made of steel and allows for the pursing of the net. Once the fish are encircled by the net, the bottom of the net is closed underneath, which stops the fish from escaping. The net is then partially hauled, concentrating the fish near the boat and allowing them to be brought on board {Morison, A. & Mc Loughlin, K. 2015}.

Although specifications can vary, nets for anchovy are typically made of nylon mesh of between 400 and 1,500 meters long and 35 to 44 meters in depth {Aguilar-Ramírez & Barrera-Guevara 2018}. Mesh size is 13 mm in the center, and 200 mm in the wings. The net lengths are divided into separate panels, which can be replaced when the nets are damaged.

In Peru, Supreme Decree N 005-2012-PRODUCE established fishing zones for the fishery, reserving the first ten nautical miles (nm) for the artisanal and small-scale fleet (DHC).

According to (Salazar Céspedes et al., 2014), the nets used for direct human consumption, which can reach up to approximately 44 m depth, has no impact on the habitat within the range of 0-10 nautical miles. However, there is uncertainty about the impact of the nets used by the industrial fleet on the seabed. The SALVAMARES collection program, conducted under the FIP currently in place for the IHC fishery, observed interactions with the seabed in 5% of the hauls in the first season of 2019 {CeDePesca 2020}. Also 122 interactions with muddy, sandy and rocky benthos were also reported during the second season of 2018 {CeDePesca 2020}. This happens most often near islands and islets or where the continental shelf extends further (Mar del Peru 2021).

Moreover, when "slipping" (the catch is discarded in the water prior to lifting the net aboard) occurs, it can cause considerable local damage to the benthos in terms of organic enrichment and disturbance of the benthic community. It normally occurs when there are an excess of juveniles or unwanted bycatch in the catch (Peiro Crespo et al., 2020).

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

+.5

A general strategy to protect habitats seems to be being implemented and MPA coverage has improved in the country in the last years. Therefore, **a score of +0.5** is awarded.

Justification:

Chilean legislation regulates fishing intensity through fishing licenses, bycatch limits, fishing area restrictions, closed seasons, etc {SUBPESCA 2021}. In some bays along the Chilean coast, purse-seines also are restricted or prohibited in the first nm from the coast (Coquimbo, Guanaqueros and Tongoy) {Decree 408-1987}.

In 2018, the Chilean government froze the bottom trawl footprint in the Chilean EEZ, meaning that some 98% of the EEZ is now off limits to trawlers (SUBPESCA 2018). Some 12% of the EEZ is in a no-take reserve, which is mostly due to two very large areas around islands and seamounts beyond the main EEZ (MPA atlas 2021). There are other areas designated as MPAs in Chile, but with unclear levels of protection from fishing (MPA atlas 2021).

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Peru | Northern Central Peru

Score: 0

The gear used in the fishery is specifically designed to reduce impacts on the seafloor. Some measures are in place to protect the coastal area, where it is though that the main impacts of the fishery occur. However, the effectiveness of these measures is unknown and the MPA coverage is considered deficient. Therefore, **a score of 0** is awarded.

Justification:

Peruvian legislation regulates fishing intensity through fishing licenses, bycatch limits, fishing area restrictions, and temporal and spatial closures to protect spawning and recruitment (Monteferri et al., 2020). In 2012, an amendment to the anchovy ROP established reserved areas for the CHD fleet. The first five nautical miles were reserved for artisanal purse seine vessels, while the area between the 10 and 4 nm was reserved for smaller-scale purse seine vessels. However, this regulation was later declared unconstitutional by the Supreme Court and from that time, the first five coastal marine miles were generally kept the artisanal and smaller-scale fishing, while the industrial fleet could only operate outside the 5 nm (Monteferri et al., 2020).

In order to protect the anchovy spawning areas, the ROP for the CHD, in force since 2017, prohibits any fleet from extracting these resources within the first three coastal nautical miles. Although this is an important measure, it is considered very difficult to implement due to small-scale and artisanal purse seine vessels can alternate between different fishing gears and target species (prior to the 1982-1983 Niño, fishing permits or licenses fishing used to be species specific). De la Puente (Mar

del Peru 2021) points out that the impact of fishing by smaller-scale vessels, between the 3 and 5 nm from the coast, is considerable given the small mesh size used by the anchoveta purse seines and because the gear can contact the seabed, specially near islands (Chincha, Pisco, Paracas, etc.) or where the continental shelf extends further (Chimbote, Coishco, Samanco). Only in the Tumbes area (northern Peru) fishing by artisanal or smaller-scale purse seine vessels is prohibited within the first five miles from the coast.

There is also a management measure in place specifically aimed at minimizing the risk of the impact of the fishery on the habitat. DS 012-2001-PE specifically prohibits the use of the "antifango", an illegal device placed at the bottom of the purse nets which in shallow waters removes the seabed producing a negative impact on the habitat {Hervas & Medley 2015}.

Management measures have been also implemented in order to reduce the discard (and therefore "slipping events") of anchovy in the Peruvian regulation (SD 024-2016-PRODUCE).

Marine protected areas in Peru cover 639,282 ha, which represents only 3.9% of the marine areas in the country. These are the "Paracas National Reserve", the "Guano Islands and Capes National Reserve" and the "San Fernando National Reserve" which, although considerably well managed, are insufficient to guarantee the protection of all Peruvian marine ecosystems (OECD 2016). No VMEs have been mapped yet in Peruvian waters.

Factor 4.3 - Ecosystem-based Fisheries Management

Southeast Pacific | Purse seines | Chile | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Southern Unit

Southeast Pacific | Purse seines | Chile | Central Southern Chile/Central Unit

High Concern

Anchovy is a key resource for some marine species in the HCLME. Chile has incorporated the concept of EBFM in the national legislation, including the need for an adequate network of MPAs and specific mechanisms are being implemented. However, the fishery lacks a comprehensive system to protect ecosystem functioning and account for capture species' ecological role, and reference points for both biomass and fishing mortality are set at levels inconsistent with levels recommended by the Lenfest Forage Fish Task Force. A score of "high concern" is awarded.

Justification:

The Chilean fisheries law specifically states that the main objective of fisheries management in Chilean waters is the conservation and sustainable use of fishery resources through the application of precautionary and ecosystem approaches (GLFA 1991). The law covers quotas, fishing areas, gear, and seasons, and presents a coherent, logical set of procedures within an established structure to deliver sustainable fisheries {Arana, P. & Scott, I. 2015}.

Specific objectives are laid out in the management plans for the three Chilean anchovy stocks of the purse seine fisheries targeting the three anchovy stocks in Chile have been specified in their respective management plans. They indicate that the purpose of the management is to "manage the

anchovy resources in each of the corresponding regions in a biologically, environmentally, economically and socially sustainable manner”, objective which seems quite in line with the EBFM approach (Res. Ex. N° 1197-2018((Res. Ex. N° 3893-2017) (Res. Ex. N° 2746-2016).

In Chile, studies carried out in both the north and the central-south and inland sea areas of Chiloé indicate that anchovies and sardines are species that represent an important component in the diet of sea lions, sharks, and other important fish of economic importance, such as horse mackerel, hake and red-cusk eels {Neira, S & Arancibia, H. 2004a} (Neira et al., 2004) (Neira et al., 2014). Foraging efficiency of breeding seabirds may be also significantly affected by not only the global quantity but also the temporal and spatial patterns of fishery removals (Bertrams et al., 2012).

Research aimed at fishery management includes the Stock Evaluation and Total Allowable Catch Calculation Program (Programa de Evaluación de Stock y Cálculo de la Captura Total Permissible), developed by IFOP for over 15 years. Although these studies normally have been carried out for individual species, ecosystem elements recently have been incorporated into the studies to establish recommended catch quotas using a multi-species approach. For example, when the limit and target reference points for pelagic species were reviewed in 2014 (see section 1.1), it was specifically indicated that for pelagic stocks the key role of these species in the ecosystem was considered (Payá et al., 2014). However, although specific studies for the anchovy are scarce, a recent study conducted by (Neira et al., 2014) on the ecosystem role of the southern sardine and the impact of its exploitation on the sustainability of other species of commercial interest, which could be an example for a similar species, determined that the reference points currently used could be not precautionary enough, which would threaten the sustainability of this and other fisheries which target predatory fish which rely on this species as a prey (mainly hoki, southern hake and red cusk-eel).

As noted in C3.1, all of the main stocks targeted by the Chilean anchoveta fisheries have minimum biomass reference points less than 30% of SSB0 (25-27.5%SSB0 for anchoveta, 9% for Chilean jack mackerel, and 27.5% for Araucanian herring). This is lower than the 30-40% of B0 recommended by the Lenfest Forage Fish Task Force (30% B0 for data-rich fisheries, 40% B0 for data-intermediate fisheries) (Pikitch et al., 2012). Permitted fishing mortality also appears to be higher than recommended by the Task Force (no more than 50%FMSY for data-intermediate fisheries, and 75%FMSY for data rich fisheries).

Southeast Pacific | Purse seines | Peru | Southern Peru Northern Chile

Southeast Pacific | Purse seines | Peru | Northern Central Peru

High Concern

Despite the anchovy being a key resource for Peru, a fisheries management plan for the whole fishery has not been established (Heck Franco, C. 2015), the ecosystem approach to fisheries management is not explicitly integrated in the management policies in Peruvian waters (Gozzer-Wuest et al., 2021), and reference points (RPs) for the stock are not clearly established, particularly regarding the impacts on the food web and the ecosystem {Hervas & Medley 2015}. Therefore, it is considered that the fishery lacks policies to protect ecosystem functioning and account for the ecological role of dependent species. Specifically, reference points for both biomass and fishing mortality are set at levels inconsistent with levels recommended by the Lenfest Forage Fish Task Force.. A score of “**high concern**” is awarded.

Justification:

Several management policies are in place in Peruvian waters to protect the anchovy resource, including measures to control fishing effort (fishing seasons, closed access to the fishery) and protect the species (temporally spawning and recruitment closures, bycatch limits, minimum landing size, etc) (Monteferri et al., 2020). The overwhelming pressure on fish stocks exerted in Peru by the reduction industry, associated with the growing international demand for fishmeal and fish oil, has led authorities in Peru to gradually tighten fisheries management regulations (especially those pertaining to the exploitation of anchoveta) towards an Ecosystem Approach to Fisheries (Avadi et al., 2014a).

In recent years, there have been a number of initiatives and practices within the Peruvian management system that appear to consider and monitor the impacts of the fishery on the ecosystem: for example, in 2010, the IMARPE organized the V international expert panel to evaluate the status of the anchovy fishery (Guevara-Carrasco et al., 2010). International programs have been also implemented in the country, such as the GEF-UNDP Project "Towards an Ecosystem Approach to Management of Large Marine Ecosystem of the Humboldt Current" aimed to develop management approaches and tools aimed at strengthening governance and sustainable use of living marine resources and the ecosystem; or the collaboration between the Nature Conservancy, the Sustainable Fisheries Group (SFG) and the University of California Santa Barbara (UCSB) and the IMARPE to address sustainable fisheries and marine conservation issues in Peru and predict how fish stocks will behave given certain environmental changes (The Nature Conservancy 2016a) (The Nature Conservancy 2016b).

The first strategic objective of the recent IMARPE's operative plan 2021 is to improve the fisheries research with a focus on the ecosystem approach. Censuses to monitor populations of sea lions and guano bird species and studies to assess interaction with predators are among the works carried out by the IMARPE's pelagic resources department which is also in charge of recommending the anchoveta quotas (Arias Schreiber 2013) (IMARPE 2021b).

As indicated previously, limit and target reference points set by the IMARPE for the anchovy stock in Peru are based on historical levels of fishing mortality {Hervas & Medley 2015}. Recent depletion studies conducted by (Tam et al., 2020) varying levels of fishing mortality of adult Peruvian anchovy in the northern-central stock, using ecosystem models (both with and without considering environmental forcing), indicated that at the current fishing mortality status quo ($F = 0.784$) and level of anchovy depletion (around 19 % B_0), there is not an impact in the abundance levels of other species or trophic groups in the Peruvian ecosystem. However, these studies have not been peer reviewed (MRAG 2019).

However, despite advances in inter-institutional coordination of marine affairs, fisheries policy continues to be defined with a sectoral perspective and not with an ecosystem approach. There are a large number of organizations that have responsibilities related to the sea (the Ministry of Production, regional governments, MINAM, OEFA, SERNANP, SENACE, DICAPE, ANA and SANIPES) but there is a low level of coordination between them. In particular, the anchovy resource lacks a comprehensive plan to establish a quota based on the science (OECD 2016) (Monteferri et al., 2020).

There are still considerable information gaps regarding the key forces governing living marine resources in the area. A Fisheries Management Plan (FMP) for the whole fishery is necessary but has not been developed (Heck Franco, C. 2015) and reference points (RPs) for the stock are not clearly established, particularly in regard to the impacts on the food web and the ecosystem {Hervas & Medley 2015}. Specifically, where reference points have been determined, they do not seem consistent with the requirements of the Lenfest Forage Fish Task Force recommendations (>30% B0 and <75%FMSY for data-rich fisheries, 40% B0 and 75%FMSY for data-intermediate fisheries) (Pikitch et al., 2012).

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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 A: Review Schedule

The anchovy is a forage species which stock status depends greatly on the environmental conditions. Therefore, I would recommend a partial review (for Category 1 and for some species in category 2) every two years (if possible) to be sure that stock status of the target and other forage species have not changed. Conducting a general review every 5 years should be sufficient as no substantial changes are expected for the assessment and management of these fisheries in the next years.