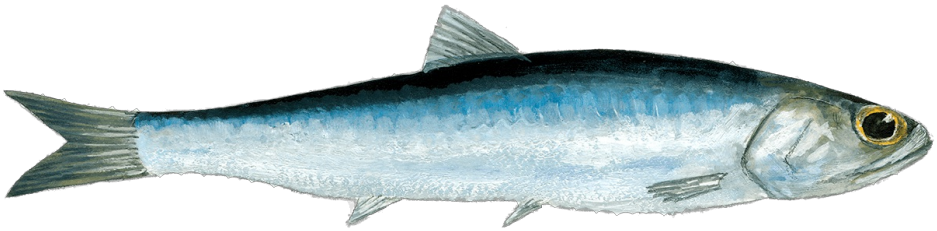
Anchoveta, Araucanian herring, Inca scad, Pacific chub mackerel

Engraulis ringens, *Clupea bentincki*, *Trachurus murphyi*, *Scomber japonicus*



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Pacific, Southeast (Chile, Peru)

Purse seines

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Seafood Watch Standard used in this assessment: Fisheries Standard v4

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About Seafood Watch

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

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

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

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.

- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.

- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

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

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

Guiding Principles

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

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

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

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

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

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

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

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

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

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

Summary

This Seafood Watch assessment covers the main anchoveta (*Engraulis ringens*) fisheries in Peru and the main small pelagic fish fisheries in Chile: anchoveta, Inca scad/Chilean jack mackerel (*Trachurus murphyi*), Araucanian herring (*Clupea bentincki*), and Pacific chub mackerel (*Scomber japonicus*). These fisheries are all prosecuted with purse seines, and are separated into industrial fleets and artisanal/small scale fleets. The majority of the Peruvian catch is destined for reduction into fishmeal and fish oil, with only around 2% of the landings going to direct human consumption. Little of the catch from either country ends up on the U.S. market.

Criterion 1

Criterion 1 assesses the population-level impacts of fishing on the species or stocks being rated, expressed in terms of current biomass and current fishing mortality relative to a sustainable level. All species rated in this assessment are key forage species, which means they play an outsize role in the ecosystem as prey for other species. Accounting for the natural volatility of such species is an important consideration in understanding their stock status. Both countries explicitly do this for anchoveta (see Criterion 3), and recent assessments suggest no concerns (scores of very low concern for abundance and low concern for fishing mortality). Chile also does this for Araucanian herring, but fishing mortality may be too high in the most recent year (scores of low concern for abundance and moderate concern for fishing mortality). Chile does not account for volatility in Inca scad biomass, and has not conducted a recent assessment of Pacific chub mackerel (both are a moderate concern for abundance and moderate concern for fishing mortality).

Criterion 2

Criterion 2 assesses the population impacts of the fisheries on all other species caught, as well as the impacts of bait use and discards. Some endangered or protected species are caught (seabirds, rays, turtles, and marine mammals) but all are either not main species (i.e., are excluded from the assessment) or score a low concern for fishing mortality. The only major concern (i.e., Red color) is for Pacific sardine/sardina espanola (*Sardinops sagax*) in the South Peru-North Chile fisheries, which has been depleted for at least 20 years (score of high concern for abundance). Managers consider this to be the result of unfavorable environmental conditions. There is a limit on the catch of the species, but it is not clear what it is based on or whether it is likely to remain an obstacle to recovery (score of moderate concern for fishing mortality).

Criterion 3

Criterion 3 assesses the effectiveness of management in maintaining fishing mortality below a sustainable level for all species caught. A combination of government measures and data collection and analyses conducted by the Fishery Improvement Projects in the Peruvian industrial and artisanal fisheries on the North-Central anchoveta stock suggests a strong management regime, though there remain weaknesses in reducing fishing mortality on juvenile anchoveta, enforcement, and stakeholder inclusion. Chile's management regime is even stronger in many of these aspects, with the main challenge being the multispecies nature of the fisheries. Management of the impacts on the shared stock in South Peru-North Chile is not as effective, because there is a lack of high-level policy coordination on shared catch limits.

Criterion 4

Criterion 4 assesses the broader impacts on the ecosystem. There are no particular concerns with these fisheries' impacts on the seabed because the gear likely touches the seafloor only occasionally. Both countries go some way to accounting for the ecosystem role of these key forage species and so mitigate any major concerns, but more explicit measures and management of these aspects are necessary to have confidence that ecosystem-level impacts are fully minimized.

Resumen ejecutivo

Esta evaluación de Seafood Watch cubre las principales pesquerías de anchoveta (*Engraulis ringens*) en Perú y las principales pesquerías de peces pelágicos pequeños en Chile: las de anchoveta, jurel (*Trachurus murphyi*), arenque araucano (*Clupea bentincki*) y estornino (*Scomber japonicus*). Todas estas pesquerías se realizan con redes de cerco y se dividen en flotas industriales y flotas artesanales/de pequeña escala. La gran mayoría de las capturas peruanas se destinan a la reducción en harina y aceite de pescado, y solo alrededor del 2% de los desembarques se destinan al consumo humano directo. Muy poco de la captura de ambos países termina en el mercado estadounidense.

Criterio 1

El Criterio 1 es una evaluación de los impactos a nivel de población de la pesca sobre las especies o poblaciones que se están evaluando, expresados en términos de biomasa actual y mortalidad por pesca actual en relación con un nivel sostenible. Todas las especies evaluadas en esta evaluación son especies forrajeras clave, lo que significa que desempeñan un papel descomunal en el ecosistema como presas de otras especies. Tener en cuenta la volatilidad natural de dichas especies es una consideración importante para comprender el estado de sus poblaciones. Ambos países hacen esto explícitamente para la anchoveta, y las evaluaciones recientes no sugieren preocupaciones (“muy poca preocupación” por la abundancia y “poca preocupación” por la mortalidad por pesca). Chile también hace esto para el arenque de Arauca, pero la mortalidad por pesca puede ser demasiado alta en el año más reciente (“poca preocupación” por la abundancia y “moderada preocupación” por la mortalidad por pesca). Chile no tiene en cuenta la volatilidad en la biomasa del jurel inca, y no ha realizado una evaluación reciente del estornino del Pacífico (ambos son de “moderada” preocupación por la abundancia y de “moderada preocupación” por la mortalidad por pesca).

Criterio 2

El criterio 2 es una evaluación de los impactos poblacionales de las pesquerías sobre todas las demás especies capturadas, así como los impactos del uso de cebo y los descartes. Se capturan algunas especies en peligro o protegidas (aves marinas, rayas, tortugas y mamíferos marinos), pero todas no son especies principales (es decir, están excluidas de la evaluación) o tienen una puntuación de "baja preocupación" en cuanto a mortalidad por pesca. La única preocupación importante (es decir, puntuación "roja") es la sardina del Pacífico/sardina española (Sardinops sagax) en las pesquerías del sur de Perú/norte de Chile, que se ha agotado durante al menos 20 años ("alta preocupación" por la abundancia). Los administradores consideraron que esto se debe a que las condiciones ambientales son desfavorables. Hay un límite en la captura de la especie, pero no está claro en qué se basa o si es probable que siga siendo un obstáculo para la recuperación (preocupación "moderada" por la mortalidad por pesca).

Criterio 3

El criterio 3 es una evaluación de la eficacia de la gestión para mantener la mortalidad por pesca por debajo de un nivel sostenible para todas las especies capturadas. Una combinación de medidas gubernamentales y recopilación de datos y análisis realizados por los Proyectos de Mejoramiento Pesquero en las pesquerías artesanales e industriales peruanas sobre el stock de anchoveta del centro-norte sugiere un régimen de gestión sólido, aunque siguen existiendo debilidades en la reducción de la mortalidad por pesca de la anchoveta juvenil, la aplicación de la ley y la inclusión de las partes interesadas. El régimen de gestión de Chile es incluso más sólido en muchos de estos aspectos, siendo el principal desafío la naturaleza multiespecífica de las pesquerías. La gestión de los impactos sobre el stock compartido en el sur de Perú y el norte de Chile no es tan eficaz, ya que hay una falta de coordinación de políticas de alto nivel sobre los límites de captura compartidos.

Criterio 4

El criterio 4 es una evaluación de los impactos más amplios sobre el ecosistema. No existen preocupaciones particulares con los impactos de estas pesquerías sobre el lecho marino, ya que es probable que el arte de pesca solo toque ocasionalmente el lecho marino. Ambos países hacen algo para tener en cuenta el papel ecosistémico de estas especies forrajeras clave y, por lo tanto, mitigar cualquier preocupación importante, pero se necesitan medidas y una gestión más explícitas de estos aspectos para tener la confianza de que los impactos a nivel de ecosistema se minimicen por completo.

Final Seafood Recommendations

SPECIES | FISHERY	C 1 TARGET SPECIES	C 2 OTHER SPECIES	C 3 MANAGEMENT	C 4 HABITAT	OVERALL	VOLUME (MT) YEAR
Anchoveta | Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery	5.000	2.236	3.000	3.464	**Best Choice (3.283)**	198,532 (MT) 2021
Anchoveta | Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery	5.000	2.236	3.000	3.464	**Best Choice (3.283)**	0 (MT) 2021
Anchoveta | South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery	5.000	2.236	3.000	3.464	**Best Choice (3.283)**	164,942 (MT) 2021
Anchoveta | South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery	5.000	1.732	3.000	3.464	**Good Alternative (3.080)**	129,437 (MT) 2021
Anchoveta | Central - North Chile stock | Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery	3.873	2.236	3.000	3.464	**Good Alternative (3.080)**	Unknown
Anchoveta | North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet	5.000	2.644	4.000	3.464	**Best Choice (3.679)**	98,910 (MT) 2021
Anchoveta | North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet	5.000	2.236	4.000	3.464	**Best Choice (3.528)**	4,916,307 (MT) 2021
Anchoveta | South Peru - North Chile stock | Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet	5.000	1.732	3.000	3.464	**Good Alternative (3.080)**	242,302 (MT) 2021
Araucanian herring | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery	3.318	2.236	3.000	3.464	**Good Alternative (2.963)**	0 (MT) 2021
Araucanian herring | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery	3.318	2.236	3.000	3.464	**Good Alternative (2.963)**	207,653 (MT) 2021
Inca scad | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	2.644	2.644	3.000	3.464	**Good Alternative (2.919)**	88,324 (MT) 2021

Inca scad | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	2.644	2.236	3.000	3.464	**Good Alternative (2.800)**	590,783 (MT) 2021
Inca scad | Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery	2.644	2.236	3.000	3.464	**Good Alternative (2.800)**	37,932 (MT) 2021
Pacific chub mackerel | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	2.644	2.644	3.000	3.464	**Good Alternative (2.919)**	67,422 (MT) 2021
Pacific chub mackerel | Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery	2.644	2.236	3.000	3.464	**Good Alternative (2.800)**	4,889 (MT) 2021

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 Concern[2], and no more than one Red Criterion, and no Critical scores

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

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

Introduction

Scope of the analysis and ensuing recommendation

The following Seafood Watch assessment is of the Peruvian and Chilean fisheries for anchoveta and other small pelagics in the Southeastern Pacific. Table 1 shows the common names, scientific names, and market names for the main species in this assessment. IFOP: Instituto de Fomento Pesquero (Chilean fisheries science agency); IMARPE: Instituto del Mar del Perú; FDA: U.S. Food and Drug Administration; and FAO: UN Food and Agriculture Organization. The FAO uses ASFIS (Aquatic Sciences and Fisheries Information System) for species names. The common names and scientific names highlighted in blue are the ones used in this Seafood Watch assessment.

Table 1: Common names, scientific names, and market names for the main species in this assessment.

Table 1

IFOP/IMARPE		FDA			FAO (ASFIS)	
Common Name	**Scientific name**	**Common name**	**Scientific name**	**Acceptable market names**	**Common name**	**Scientific name**
Anchoveta	*Engraulis ringens*	Anchoveta	*Engraulis ringens*	Anchovy	Anchoveta (Peruvian anchovy)	*Engraulis ringens*
Caballa	*Scomber japonicus*	Pacific chub mackerel	*Scomber japonicus*	Mackerel, chub	Pacific chub mackerel	*Scomber japonicus*
Jurel	*Trachurus murphyi*	Inca scad	*Trachurus murphyi*	Mackerel, jack	Chilean jack mackerel	*Trachurus murphyi*
Sardina comun	*Strangomera bentincki*	Araucanian herring	*Clupea bentincki*	Herring	Araucanian herring	*Strangomera bentincki*

Peru

The Peruvian fleet for anchoveta through 1997 was purely an industrial fleet, but Peru has since allowed other fleets and destination of the catch (Vilela Rios 2020). Today, there is an industrial fleet that targets anchoveta for reduction into fishmeal, and an artisanal/small-scale fleet that target anchoveta and other species for direct human consumption. The active industrial fleet comprises around 300 steel vessels, with a hold capacity of 110–898 m^3 that together account for around 80% of total landings, and around 400 wooden vessels, with a hold capacity of 32.6–110 m^3 that account for some 17% of the total landings. This fleet is currently permitted to operate outside of 5 nautical miles from the coast (and not permitted within 5 nm) (Law Nº 31749 2023). The fleet targeting anchoveta for direct human consumption accounts for 3% of the landings (some 80,000mt - see Table 2 below) and comprises “small-scale” vessels that use mechanized gears and “artisanal” vessels that are manually operated. Both types of vessels are limited to a hold capacity of 32.6m^3 and are currently permitted to fish outside of 3 nm from the coast (Law Nº 31749 2023) (0–3 nm is reserved for artisanal vessels using gears other than purse seine).

Table 2 lists the Peruvian small pelagics fisheries and 2020–22 average landings by species and anchoveta stock (PRODUCE 2023). Anchoveta stock is assumed based on landings region and stock range (vessels landing in the Departamentos from Tumbes to Ica are assumed to be catching from the North-Central Peruvian stock, and vessels from the Departamentos of Arequipa to Tacna are assumed to be catching from the South Peru-North Chile stock). Anchoveta caught by the artisanal/small-scale sector was minimal in 2021, and the fishery is not included in this Seafood Watch assessment. The artisanal fisheries that catch Inca scad/Chilean jack mackerel/jurel and Pacific chub mackerel/caballa are also excluded because observer data suggest they are distinct from the anchoveta fisheries (see Criterion 2).

Table 2: Peruvian small pelagics fisheries and 2020–22 average landings by species and anchoveta stock (PRODUCE 2023).

Table 2

Fishery	Target species (stock)	2020–22 average landings of target (mt)
Industrial steel and wood purse seine fleet (reduction fishery)	Anchoveta (North-Central Peru)	4,331,725
	Anchoveta (South Peru-North Chile)	169,144
Artisanal/small-scale purse seine fleet (direct human consumption fishery)	Anchoveta (North-Central Peru)	80,814
	Anchoveta (South Peru-North Chile)	130
	Inca scad/Chilean jack mackerel/jurel	102,426
	Pacific chub mackerel/caballa	73,361

Chile

The Chilean industrial and artisanal fisheries also target other species, such as Inca scad/Chilean jack mackerel/jurel (*Trachurus murphyi*) and Araucanian herring/sardina común (*Strangomera bentincki*) (IFOP 2020). Table 3 shows the Chilean small pelagics fisheries and 2020–22 average landings by species, anchoveta stock, region, and fishery (Tables 35–43, (IFOP 2022a))(SERNAPESCA 2023). There has been no industrial anchoveta fishery in the Central North Zone since around 2012 (p. 7, (IFOP 2022a)), and the Central South Zone industrial anchoveta and Araucanian herring/sardina común fishery was not active in 2021 (p. 123, (IFOP 2022a)), so neither fishery is considered further in this Seafood Watch assessment. The artisanal Falkland sprat/sardina austral fishery is also not included in this assessment because landings of anchoveta and Araucanian herring/sardina común are relatively minor (7,022 mt and 1,732 mt in 2021, respectively). Note that region numbers are now obsolete but still appear in some documentation, so they are included here for reference. Anchoveta stock is assumed based on the spatial distribution of stocks and from stock descriptions in the introduction to (IFOP 2022a) (see Criterion 1). All catches are with purse seines.

Virtually all of the anchoveta (99.85% of the catch in 2023) and Araucanian herring (99.91%) is reduced into fishmeal/oil ((SERNAPESCA 2023) - see “Chile, materia prima y producción por especie y línea de elaboración, 2023”). Pacific chub mackerel, which is also caught in these fisheries, is also primarily reduced (97.74%). The remainder for these species (generally less than 1000mt) is mainly frozen or refrigerated. About half of the Inca scad is reduced (48.74%), and the remainder is mainly frozen.

Table 3: Chilean small pelagics fisheries and 2020–22 average landings by species, anchoveta stock, region, and fishery (Tables 35–43, (IFOP 2022a))(SERNAPESCA 2023).

Table 3

Fishing Zone	Region (Region number)	Fishery	Target (stock)	2020–22 average landings of target (mt)
North Zone	Arica y Parinacota to Antofagasta (XV, I, II)	Industrial anchoveta	Anchoveta (South Peru-North Chile)	73,321
		Industrial Inca scad/Chilean jack mackerel/jurel	Chilean jack mackerel	55,529

		Artisanal anchoveta	Anchoveta (South Peru-North Chile)	296,997
Central North Zone	Atacama to Coquimbo (III, IV)	Industrial anchoveta	Anchoveta (Central-North Chile)	0 (fishery closed)
		Artisanal anchoveta		58,620
		Artisanal Inca scad/Chilean jack mackerel/jurel	Chilean jack mackerel	32,717
Central South Zone	Valparaíso to Los Ríos (V–IX, XIV, XVI)	Industrial anchoveta and Araucanian herring/sardina común	Anchoveta (Central-South Chile)	0 (fishery closed)
	Valparaíso to Los Ríos (Biobio—VIII)	Industrial Inca scad/Chilean jack mackerel/jurel	Chilean jack mackerel	522,254
		Artisanal anchoveta and Araucanian herring/sardina común	Anchoveta (Central-South Chile)	173,528
			Araucanian herring	202,906
	Valparaíso to Los Ríos (Los Rios—XIV)	Artisanal anchoveta and Araucanian herring/sardina común	Anchoveta (Central-South Chile)	9,205
			Araucanian herring	68,126

Species Overview

The Peru and Chilean fisheries for anchoveta and other small pelagics catch several small pelagic species, depending on the region, target, and year.

Anchoveta (*Engraulis ringens*)

The anchoveta is a small, short-lived, fast-growing species generally found in waters with temperatures between 14 and 22 °C (57–72 °F) 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 nm 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. Anchoveta breeds throughout the year along the entire coast of Peru and Chile, but with a major spawning during winter (August–October) and summer (February–March) (Perea et al 2011)(Bouchon 2007).

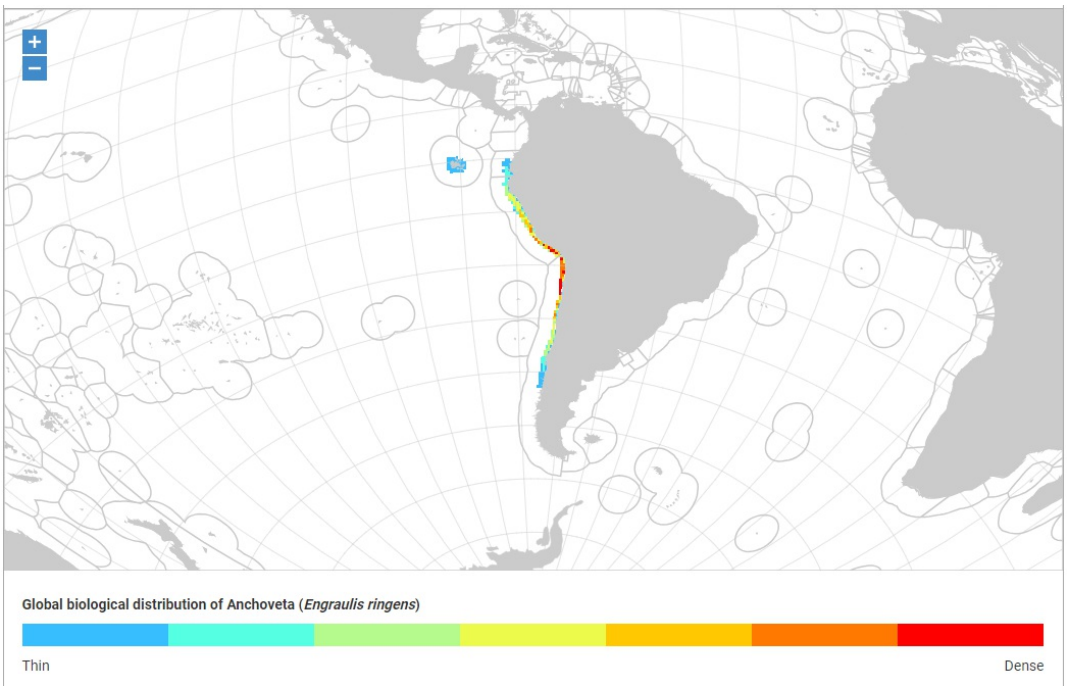

Figure 1: Global biological distribution of anchoveta. Map generated from https://www.seaaroundus.org/

Pacific chub mackerel/caballa (*Scomber japonicus*)

Pacific chub mackerel is widely distributed in the Pacific. It schools with other small pelagics, such as other mackerels and sardines. It is an opportunistic predator (Alegre et al 2015) generally found within 20 mi (37 km) of the coast in waters between 10 and 22 °C (50–72 °F).

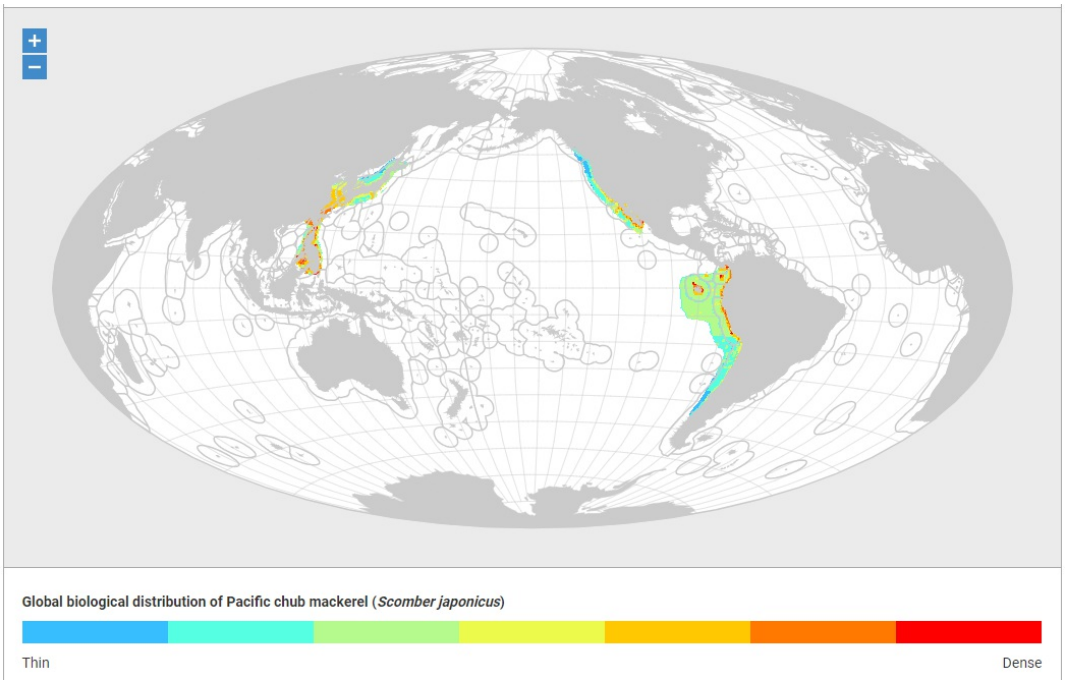

Figure 2: Global biological distribution of Pacific chub mackerel. Map generated from https://www.seaaroundus.org/

Inca scad/Chilean jack mackerel/jurel (*Trachurus murphyi*)

Inca scad is found on both sides of the South Pacific. It generally lives at depths within the first 200 m (the “epipelagic zone”), mostly over the continental shelf off the coast or around islands. It is a schooling species that feeds primarily on euphausidae (krill), copepods, and shrimps, but also small fishes and squid (Alegre et al 2015). All have pelagic eggs and spawning generally occurs during the summer. It reaches a maximum size of around 24 in.

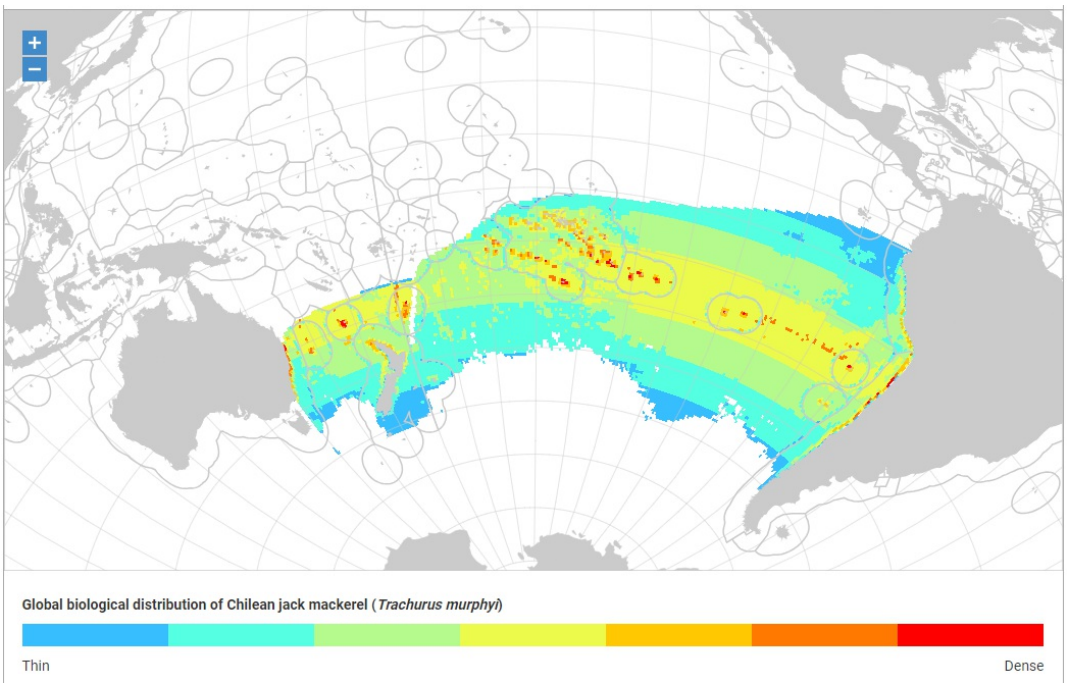

Figure 3: Global biological distribution of Inca scad. Map generated from https://www.seaaroundus.org/

Araucanian herring/sardina comun (*Clupea bentincki* or *Strangomera bentinckl*)

Araucanian herring is a coastal species that occurs at depths from 0 to 70 m, and it schools at or near the surface. It feeds on plankton, especially diatoms (filter-feeding). It breeds mainly during June to November, from about 10 cm; it apparently releases planktonic eggs (cf. the demersal eggs of Northern Hemisphere *Clupea*).

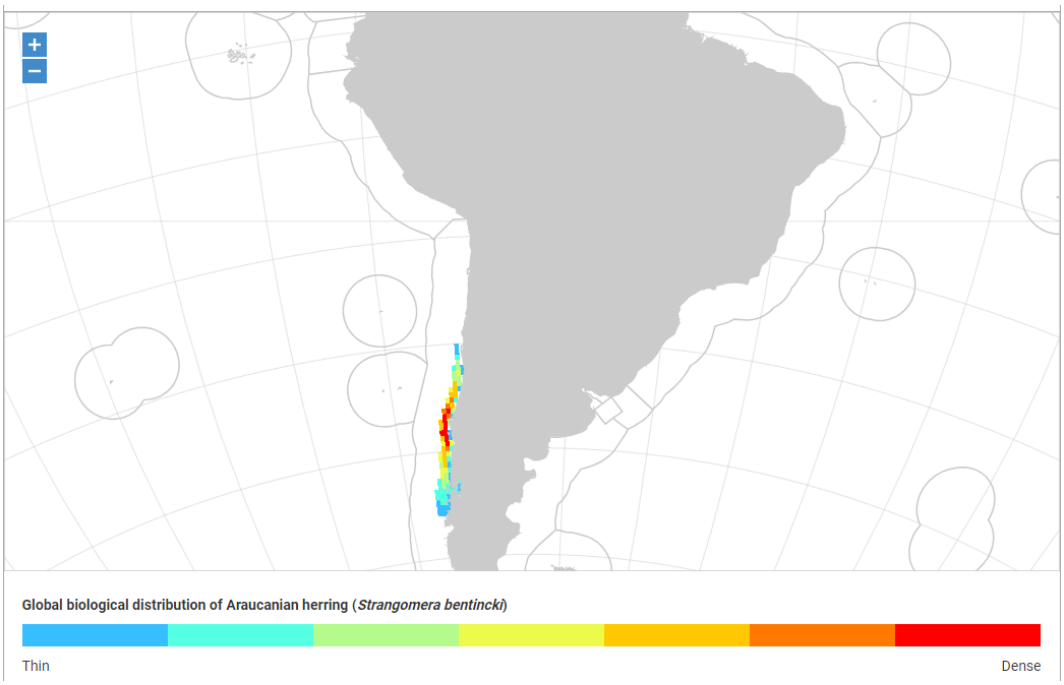

Figure 4: Global biological distribution of Araucanian herring. Map generated from https://www.seaaroundus.org/

Production Statistics

The fisheries included in this assessment are among the biggest in the world (measured by volume of landings). Anchoveta is the biggest single-species fishery, at around 5–6 million mt in recent years. Landings are almost entirely by Peru and Chile, with Peru dominating at around 90% of landings (Figure 5).

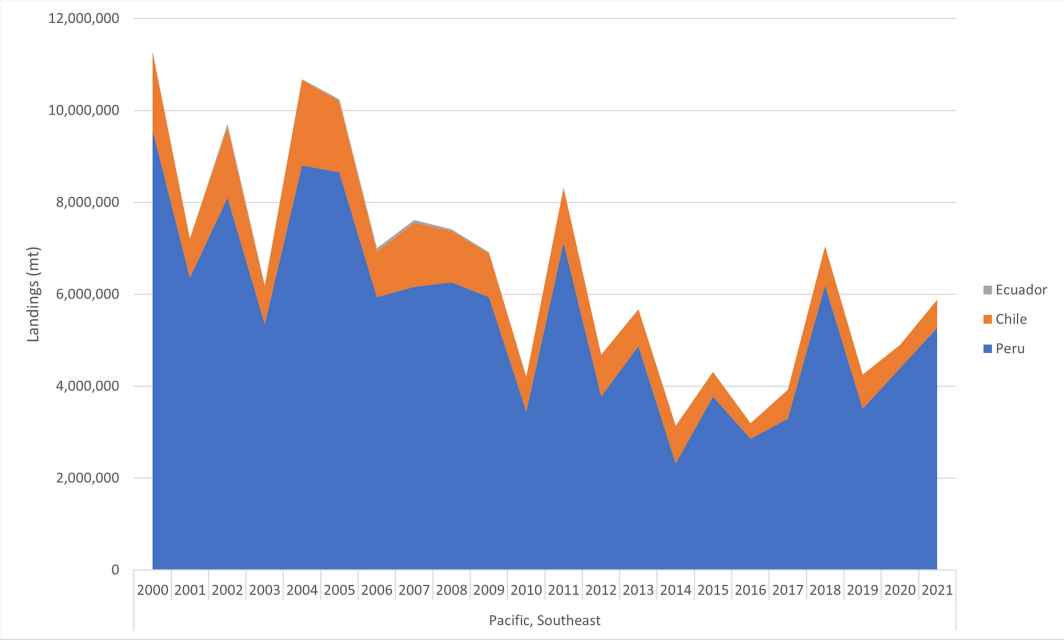

Figure 5: Peruvian anchoveta landings by country, 2000–21 (FAO 2023).

Landings of Inca scad/Chilean jack mackerel/jurel have dropped significantly over the last 20 years (due to improved management), and the number of countries accounting for a significant percentage of the landings has too. In 2021, Chile accounted for around 76% of landings, and Peru around 14% (Figure 6).

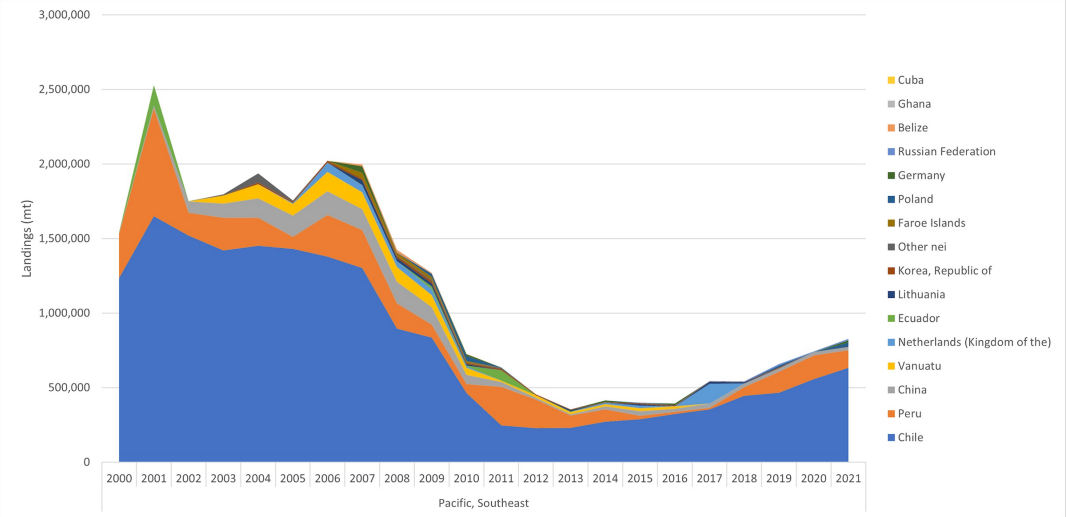

Figure 6: Inca scad/Chilean jack mackerel/jurel landings by country, 2000–21 (FAO 2023).

Landings of Pacific chub mackerel/caballa are dominated by countries fishing in the Northwest Pacific (Japan, China, Korea, and Taiwan, and more recently, Russia). The Southeast Pacific accounts for most of the remainder of the landings, with Ecuador, Peru, and Chile accounting for around 57%, 21%, and 19%, respectively, in 2021 (Figures 7 and 8).

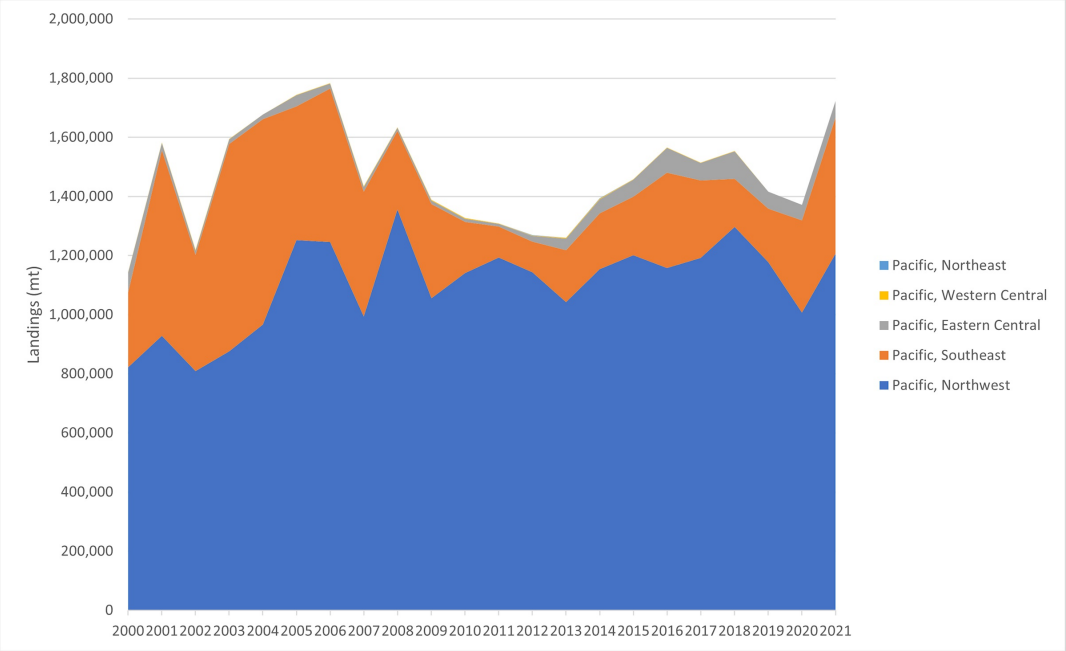

Figure 7: Pacific chub mackerel/caballa landings by FAO major fishing area, 2000–21 (Pacific Ocean only; a small volume of landings is reported from other ocean basins but these are excluded from this chart) (FAO 2023).

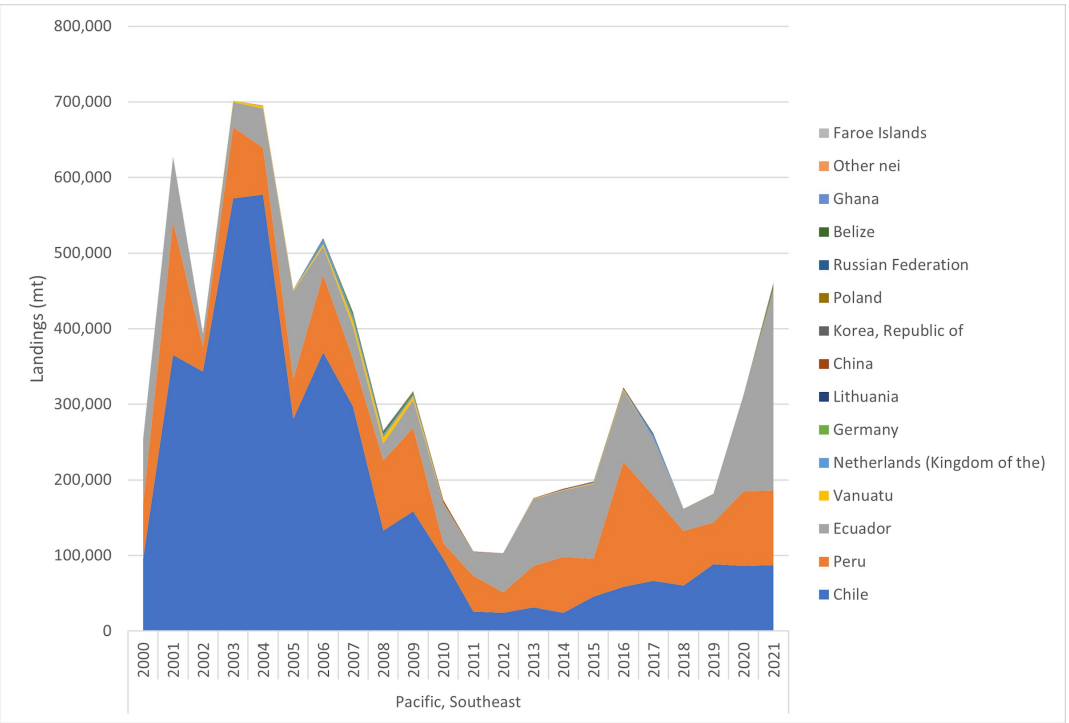

Figure 8: Pacific chub mackerel/caballa landings in the Southeast Pacific by country, 2000–21 (FAO 2023).

Araucanian herring/sardina comun is caught only by Chile (Figure 9).

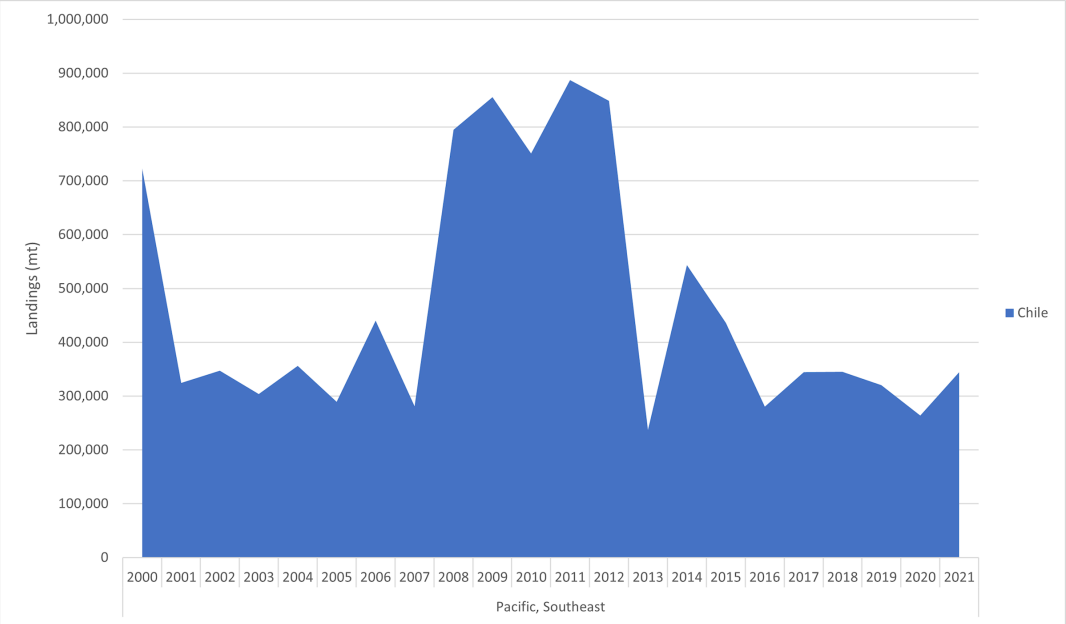

Figure 9: Araucanian herring/sardina comun landings, 2000–21 (FAO 2023).

Importance to the US/North American market.

The anchoveta 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)(PRODUCE 2023)(SERNAPESCA 2023). According to the FAO, some 16 million mt of wild fisheries and aquaculture production was reduced to fishmeal and fish oil in 2020 (FAO 2022). The majority of fishmeal now goes to aquaculture (around 85%), with the remainder being used for pigs (10%), poultry, and other usage (FAO 2022). Aquaculture has dominated fish oil utilization for over 20 years, though the portion going to direct human consumption has also grown in that time (in 2020, some 75% went to aquaculture, and some 15–20% to direct human consumption) (FAO 2022). Trade statistics suggest that the United States is not the major market for any of the fisheries rated in this assessment, whether for direct human consumption or not (Table 4).

Table 4: Recent imports into the United States of products with “mackerel,” “anchovy,” “sardine,” and “herring” in the product name, and whether or not the product was denoted fit for human consumption (NOAA 2023).

Table 4

Country/Product	For Direct Human Consumption					Not for Human Consumption				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Peru	**823**	**1,303**	**736**	**1,023**	**893**		**6**		**1**	
Anchovy	769	662	570	905	810					
Mackerel	54	622	165	92	52					
Horse mackerel				1	31					
Sardine				26						
Herring		19					6		1	
Chile	**686**	**809**	**1,540**	**1,830**	**1,629**					

Mackerel	428	589	1,353	1,595	1,449					
Horse mackerel	14	34	116	150	180					
Anchovy	215	140	58	1						
Herring	29	34	13	47						
Sardine, Sardinella, Brisling, Sprat Frozen			1	27						
Fishmeal for human consumption		12		9						
Other Countries	**129,017**	**105,517**	**113,903**	**134,403**	**151,507**	**2,827**	**1,911**	**3,232**	**13,793**	**13,803**
Herring	38,762	30,617	24,172	51,094	60,504	1,012	364	484	1,035	2,131
Sardine	33,782	30,810	42,838	36,278	42,711					
Mackerel	31,303	29,054	30,766	29,179	30,737					
Sardine, Sardinella, Brisling, Sprat Frozen	16,494	7,479	9,040	10,530	10,093					
Herring, Pilchard meal unfit for human consumption						1,815	1,547	2,748	12,758	11,672
Anchovy	4,916	4,086	3,878	3,417	4,089					
Horse mackerel	2,065	1,769	2,306	2,374	2,321					
Fishmeal for human consumption	1,263	1,353	524	895	63					
Herring, Anchovy, Sardine, Sprat, Mackerel, Indian Mackerel, Seerfish, Jack and Horse Mackerel, Jacks, Crevalles, Cobia, Silver Pomfrets, Pacific Saury, Scad, Capelin, Swordfish, Kawakawa, Bonito, Marlin, Sailfish, Spearfish Dried	154	251	229	370	466					
Sardine, Sardinella, Brisling, Sprat	278	98	153	1,266	523					

Common and market names.

See Table 1 in the preceding section, “Scope of analysis and ensuing recommendation.”

Primary product forms

Anchovy (including Peruvian anchoveta) imported to the United States market is canned, fresh, or salted; virtually all the anchovy imported into the United States from Peru and Chile is canned in oil. Mackerel is fresh, frozen, salted, smoked, or otherwise prepared. Horse mackerel is fresh or frozen. Sardines are canned. Herring is imported in many different forms: as fillets, fresh, frozen, kippered, pickled, salted, smoked, or otherwise prepared; the small volume from Peru is oil or roe, while that from Chile is frozen or otherwise prepared (NOAA 2023).

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

ANCHOVETA			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Central - North Chile stock | Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery	5.000: Very Low Concern	3.000: Moderate Concern	Green (3.873)
North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
South Peru - North Chile stock | Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

ARAUCANIAN HERRING			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

INCA SCAD			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

PACIFIC CHUB MACKEREL			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

Criterion 1 assesses the population-level impacts of fishing on the species or stocks being rated, expressed in terms of current biomass and current fishing mortality relative to a sustainable level.

Stock structure

Anchoveta is managed as four separate stocks, three of which are partly or fully in Chilean waters (Figure 38), and the fourth is exclusively in Peruvian waters (North-Central Peru stock; not shown in Figure 38). Araucanian herring (sardina comun in Peru and Chile), Inca scad/Chilean jack mackerel (jurel in Peru and Chile), and Pacific chub mackerel (caballa in Peru and Chile) are all managed as a single stock in Chilean waters.

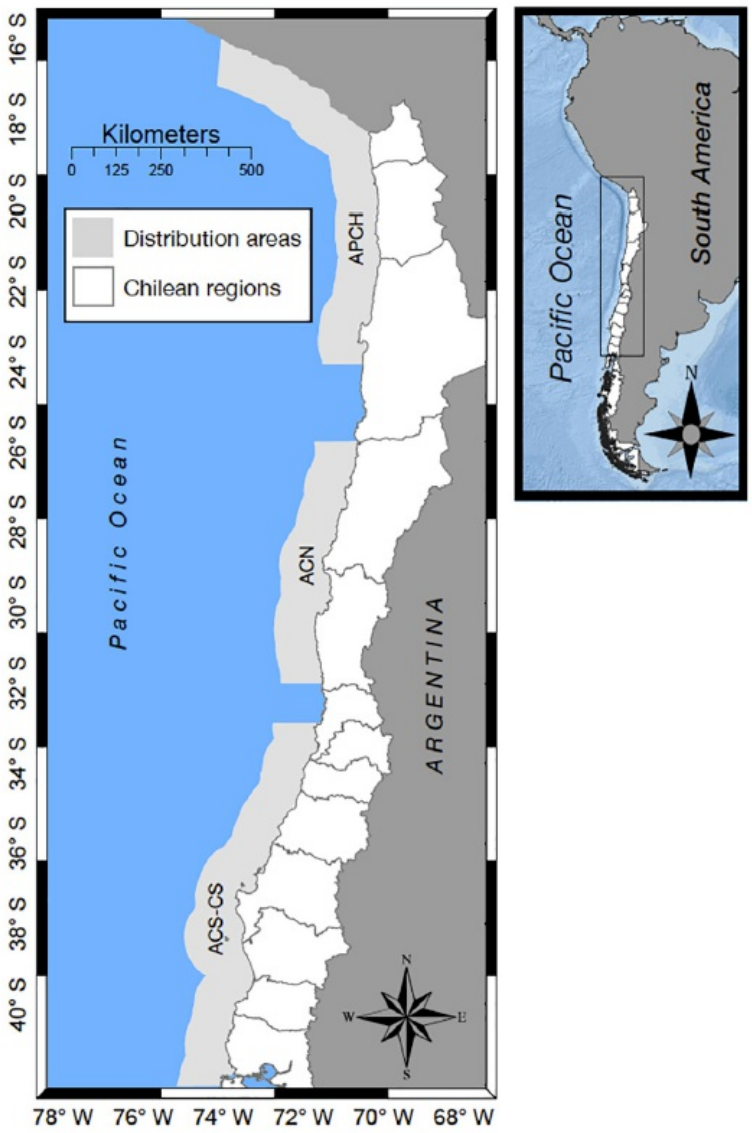

Figure 38: Distribution of anchoveta and Araucanian herring populations along the Chilean coast and the southern Peruvian coast. The first anchoveta population (APCH) is shared between southern Peru and northern Chile (16–24 LS), referred to as the South Peru-North Chile stock in this assessment. The second anchoveta population (ACN) is distributed along central-northern Chile (25–32 LS), referred to as the Central-North Chile stock in this assessment. The third anchoveta population (ACS) and the Araucanian herring/common sardine (CS) population inhabit the area from 33 to 41 LS, referred to as the Central-South Chile stock in this assessment. From (Canales et al 2020).

Determination of key forage species

A number of species caught in these fisheries and assessed in Criterion 1 or Criterion 2 in this assessment meet the

criteria to be considered a “key forage species” (Appendix A):

- Peruvian anchoveta in all fisheries
- Pacific chub mackerel/caballa off North Chile
- Sardine/sardina española (*Sardinops sagax*) off North Chile (not rated; see Criterion 2)
- Inca scad/Chilean jack mackerel/jurel off Central Chile
- Araucanian herring/sardina común off Central Chile
- Colorado langostino (*Pleuroncodes monodon*) off Central Chile (not rated; see Criterion 2)

The scoring for abundance and fishing mortality is more conservative for key forage species than for species that do not meet the criteria. Specifically, static reference points with stationary parameters, such as unfished biomass and B_0, are not considered to meet this requirement for forage species, because of those species’ dynamic productivity that shifts in response to environmental conditions. Seafood Watch considers forage stock biomass and fishing mortality highly uncertain for these stocks, with the best possible scores being 2.33 (Moderate Concern) for Factor 1.1—Abundance and 3 (Moderate Concern) for Factor 1.2—Fishing Mortality. Specific measures that account for the highly fluctuating nature of the species can moderate this uncertainty and allow for better scores. For example, a measure that is used for some stocks caught in these fisheries is an approach based on “dynamic B_0,” which is the reference level of unfished biomass under prevailing conditions. The approach acknowledges that drivers other than fishing influence population size, and it differs from the more typical “static” B_0 approach, in which B_0 is a fixed reference point based on estimated biomass at the start of fishing (e.g., (Bessell-Browne et al 2022)).

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.*

Anchoveta (Engraulis ringens)

Factor 1.1 - Abundance

Central - North Chile stock | Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery

Very Low Concern

The current reference points used by the IFOP for the Central-North Chile anchoveta stock are based on the recommendations from a 2013 workshop with domestic and international scientists (Payá et al 2014). For demersal fish and crustaceans, these recommendations included MSY proxy reference points of $F45\%_{SPR}$ and $40\%_{B0}$. But, for key small pelagics, 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" (Payá et al 2014). The biomass reference points for Central-North anchoveta (target = SSB_{MSY} = $55\%SSB_0$ and limit = $27.5\%SSB_0$) (SUBPESCA 2024) are consistent with these recommendations. Furthermore, unfished biomass is recalculated when survey information is updated—often multiple times a year for this stock (i.e., B_0 is dynamic) (Table 17 in (IFOP 2022a)). The most recent status determination document from IFOP estimated spawning biomass to be around the target reference point (SB_{2021}/SB_{MSY} = 1.02) (IFOP 2022a)(SUBPESCA 2023a). Since then, spawning biomass has increased by an estimated 60% (IFOP 2023d), and, based on preliminary information from IFOP, SUBPESCA reports SBB_{2023}/SBB_{MSY} = 2.28 (SUBPESCA 2024) (Figures 13–14).

Anchoveta is a key forage species for which abundance greatly depends on environmental conditions (see the Criterion 1 Summary and Appendix A). For these species, static reference points are not considered appropriate, a concern that is mitigated for this stock by the frequent recalculation of unfished biomass.

A recent stock assessment with findings that biomass is above appropriate reference levels allows for a score of 5 and a rating of very low concern.

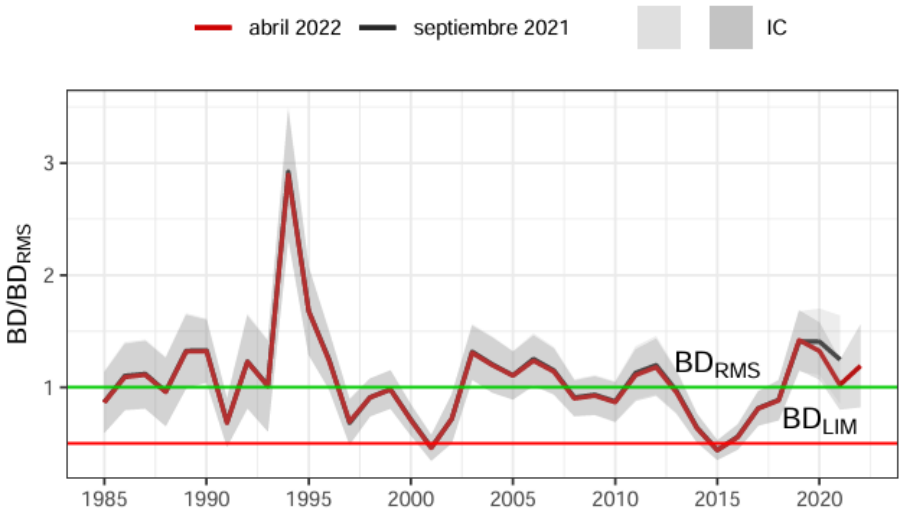

Figure 13: Estimated spawning biomass (BD or biomasa desovante) relative to the target reference point (spawning biomass at MSY or BD at Rendimiento Máximo Sostenible) and limit reference point (50%BD_{RMS}) (IFOP 2022a). Dates refer to survey dates.

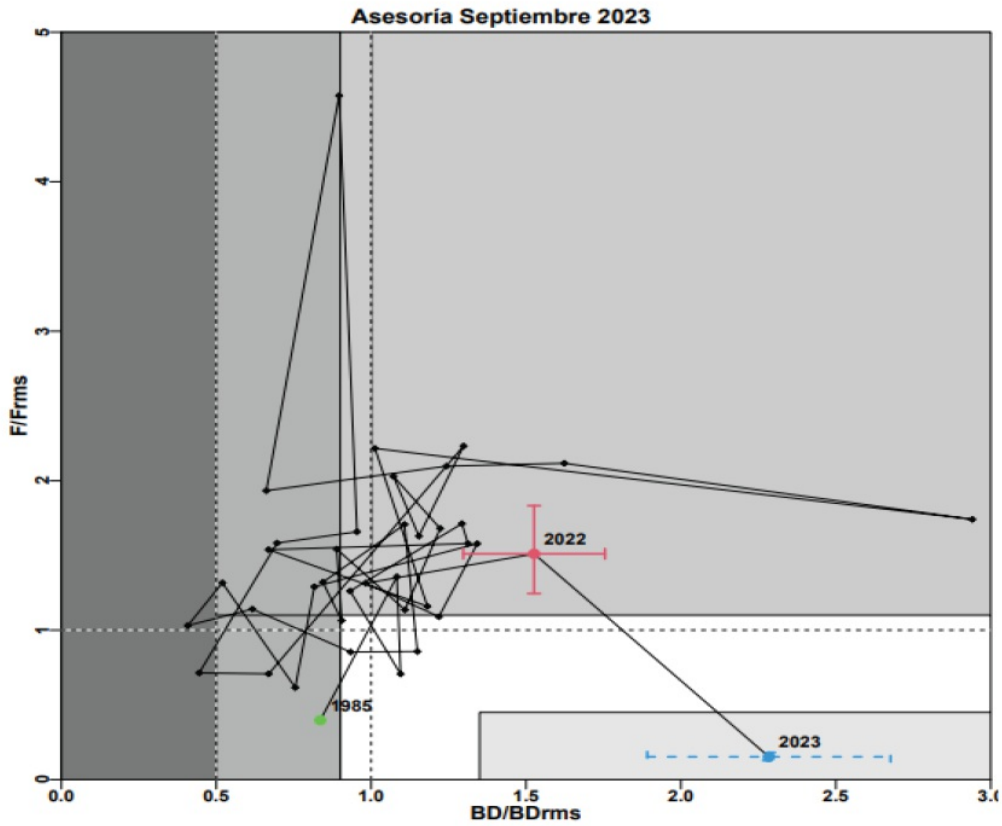

Figure 14: Phase diagram of anchovy regions of Atacama and Coquimbo. The blue dot represents the condition for the year 2023 (with preliminary information). Diagram and text from (SUBPESCA 2024).

Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery

Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery

Very Low Concern

The current reference points used by the IFOP for the Central-South Chile anchoveta stock are based on the recommendations from a 2013 workshop with domestic and international scientists (Payá et al 2014). For demersal fish and crustaceans, these recommendations included MSY proxy reference points of $F45\%_{SPR}$ and $40\%_{B0}$. But, for key small pelagics, 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" (Payá et al 2014). The biomass reference points for Central-South anchoveta are consistent with these recommendations (target = SSB_{MSY} = $55\%SSB_0$ and limit = $27.5\%SSB_0$) (SUBPESCA 2024). Furthermore, unfished biomass is recalculated when survey information is updated—often multiple times a year for this stock (i.e., B_0 is dynamic)

(e.g., Table 27 in (IFOP 2022b)). Current biomass is estimated to be greater than the target reference point (Figure 15) (IFOP 2023c)(SUBPESCA 2024).

Anchoveta is a key forage species for which abundance greatly depends on environmental conditions (see the Criterion 1 Summary and Appendix A). For these species, static reference points are not considered appropriate, a concern that is mitigated for this stock by the frequent recalculation of unfished biomass.

A recent stock assessment with findings that biomass is above appropriate reference levels allows for a score of 5 and a rating of very low concern.

Justification:

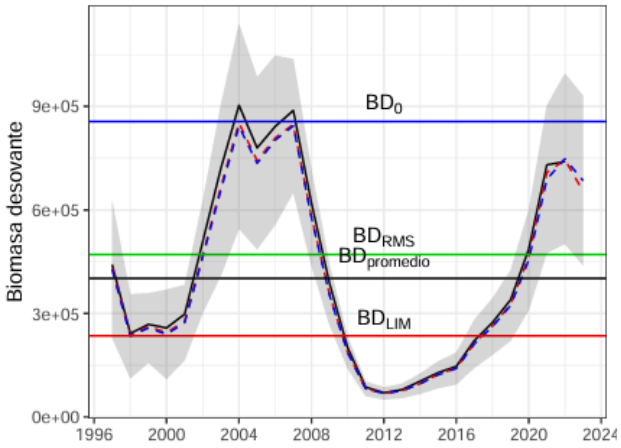

Figure 15: Series of spawning biomass (BD or biomasa desovante) relative to the target reference point (spawning biomass at MSY or BD at Rendimiento Máximo Sostenible), average BD (BD promedio) and limit reference point (50%BD) for the period 1997–2023. From (IFOP 2023c).

North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet
North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet

Very Low Concern

Biomass reference points for the North–Central Peru anchoveta stock have been defined, taking into account the relationship between spawning biomass and recruitment over a 40-year period of observations (Hervas & Medley 2015). Biomass thresholds are based on values of spawning stock biomass that have been observed to cause declines; limit SSB_{lim} and target SSB_{target} are set at 4 and 6 million mt, respectively (IMARPE 2020b). Annually, the IMARPE conducts two hydroacoustic surveys to evaluate the state of the North-Central Peru anchoveta stock relative to these reference points. Biomass is estimated to have been above the target in summer surveys, and mostly above the target in the winter surveys, since 2000 (Figure 16) (IMARPE 2024a). A recent assessment using an alternative methodology (i.e., one not yet used by IMARPE for recommending the TAC) found B_{MSY} at 5.09 (95%CI = 3.66–7.06), indicating this finding to be quite similar to the SSB_{target} currently used in management (Diaz Acuna et al 2022). The authors find that biomass has been approximately within the 95%CI range of B_{MSY} values for around two decades (Figure 17).

Anchoveta is a key forage species for which abundance greatly depends on environmental conditions (see Appendix A). For these species, the Seafood Watch Standard for Fisheries notes that "while static reference points do not describe the shifts in productivity … (instead, at best, they represent a long-term average), they can be used effectively in management when 1) the harvest strategies based upon them account for volatility AND 2) when the harvest strategy outcomes have been tested using a proven, robust Management Strategy Evaluation framework, demonstrating that fishing mortality is set low enough to prevent collapse during periods of low stock productivity." Volatility is accounted for through decision tables based on the findings from the first hydroacoustic survey of the year, which allow for reduced TACs in "unfavorable" conditions (IMARPE 2021a). The harvest strategy is not formally tested through an MSE framework by managers (Licandeo et al 2023), but an independent MSE conducted by Licandeo et al (2023) suggests that the strategy has been effective in offsetting large-scale ocean-climate variability, leading the stock to sustainable levels, allowing the rebuilding of biomass after the collapse in 1971–72 (to levels higher than pre-collapse), and ensuring quick recovery after more recent unfavorable conditions (strong El Nino events in 1997–98 and 2015–16).

A recent stock assessment that finds biomass to be above an appropriate reference point (that accounts for volatility and is tested by MSE) allows for a score of 5 and a rating of very low concern.

Justification:

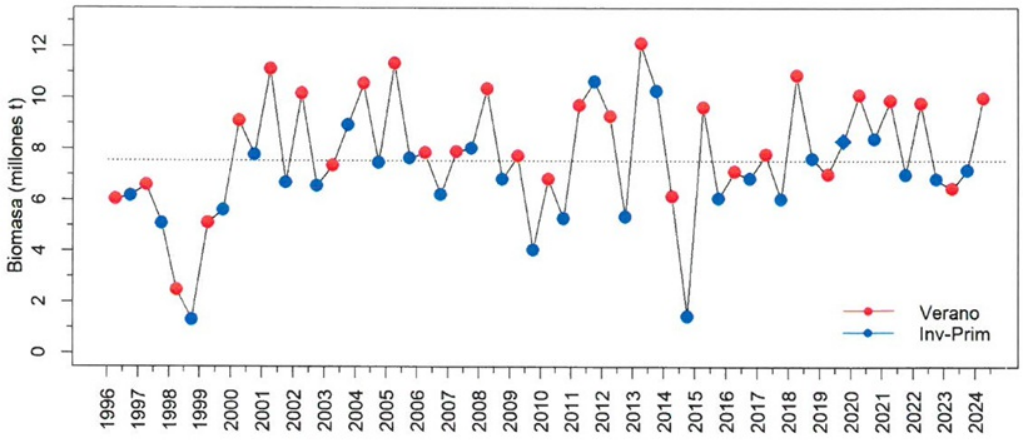

Figure 16: Acoustic biomass of anchovy observed by Evaluation Cruise from 1996 to 2024: the red dots are summer series and blue dots are winter-spring series (IMARPE 2024a). The dashed line is the average of the time series, rather than the target biomass of 6 million mt.

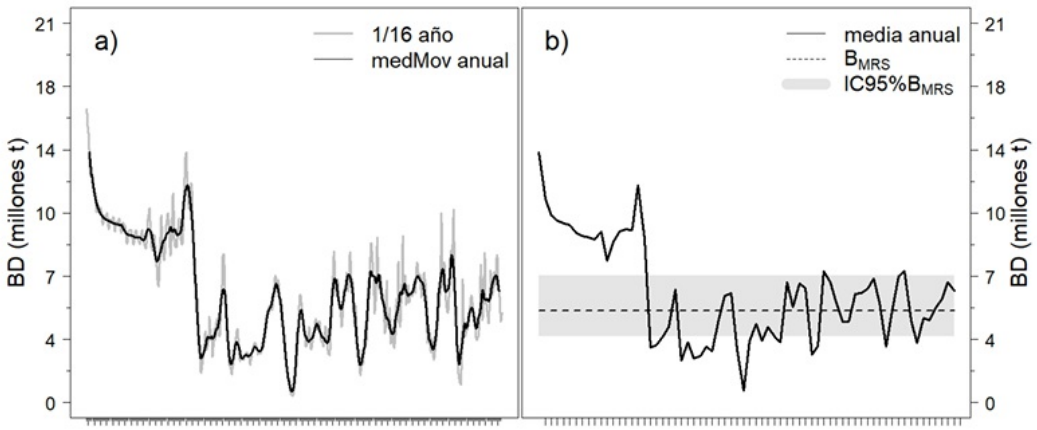

Figure 17: Time series (1994–2021) of: a) spawning biomass at a scale of 1/16 of a year; b) spawning biomass on an annual scale. B = B. From (Licandeo et al 2023).

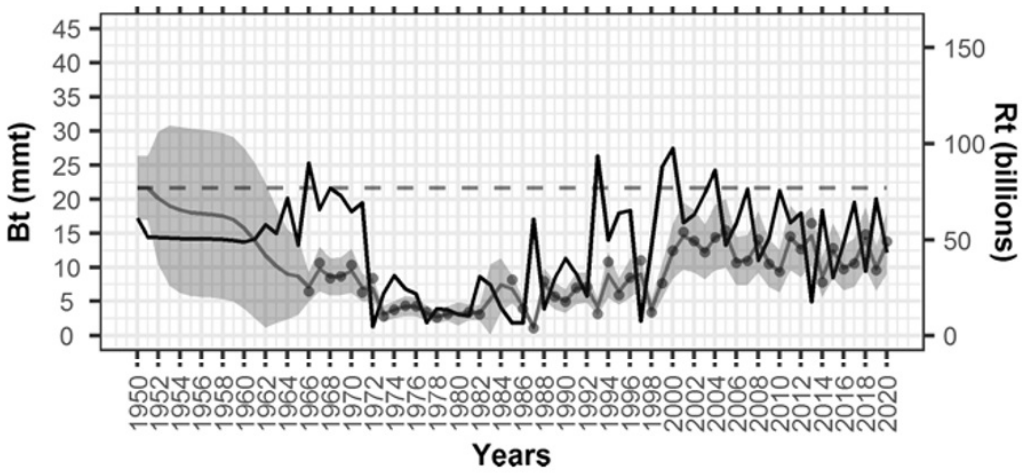

Figure 18: Observed biomass survey index (dots), predicted stock biomass (gray line), and recruitment (black line) for the North-Central Peru anchoveta stock. The dashed line is B_0 (this is denoted as B_{MSY} in the original manuscript, but the author confirmed the error; pers. comm., Licandeo).

South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
South Peru - North Chile stock | Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Very Low Concern

The South Peru-North Chile anchoveta stock is fished by fleets out of Peru fishing in Peruvian waters (i.e., the Peruvian EEZ) and those out of Chile fishing in Chilean waters.

Peru: The IMARPE conducts two hydroacoustic surveys annually to assess the status of anchoveta in the Southern region of Peru. Using these and other data, the authors of the latest stock assessment determined

biomass to be highly variable but generally fluctuating around B_{MSY} in recent years (Figure 19) (IMARPE 2024b).

Chile: The current reference points used by the IFOP are based on the recommendations from a 2013 workshop with domestic and international scientists (Payá et al 2014). For demersal fish and crustaceans, these recommendations included MSY proxy reference points of $F45\%_{SPR}$ and $40\%_{B0}$. But, for key small pelagics, 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" (Payá et al 2014). The biomass reference points for South Peru-North Chile anchoveta are consistent with these recommendations (target = $SSB_{MSY} = 50\%SSB_0$ and limit = $25\%SSB_0$) (SUBPESCA 2024). Furthermore, unfished biomass is calculated multiple times a year for this stock (i.e., B_0 is dynamic) (Table 27 in (IFOP 2022b)). Chile conducts a regular stock assessment that considers South Peru-North Chile anchoveta to be a single stock and uses data from both fisheries (Canales and Cubillos 2021). The data comprise abundance indices from surveys, length compositions from surveys and fisheries, and estimated landings from 1985 onward (Canales and Cubillos 2021). The stock has been over the target reference point for a number of years, including in the most recent year ($SBB_{2022}/SBB_{MSY} = 1.63$) (Figure 20) (IFOP 2023b)(SUBPESCA 2024).

Anchoveta is a key forage species for which abundance greatly depends on environmental conditions (see the Criterion 1 Summary and Appendix A). For these species, static reference points are not considered appropriate, a concern that is mitigated for this stock by Chile's frequent recalculation of unfished biomass.

A recent stock assessment with findings that biomass is above appropriate reference levels allows for a score of 5 and a rating of very low concern.

Justification:

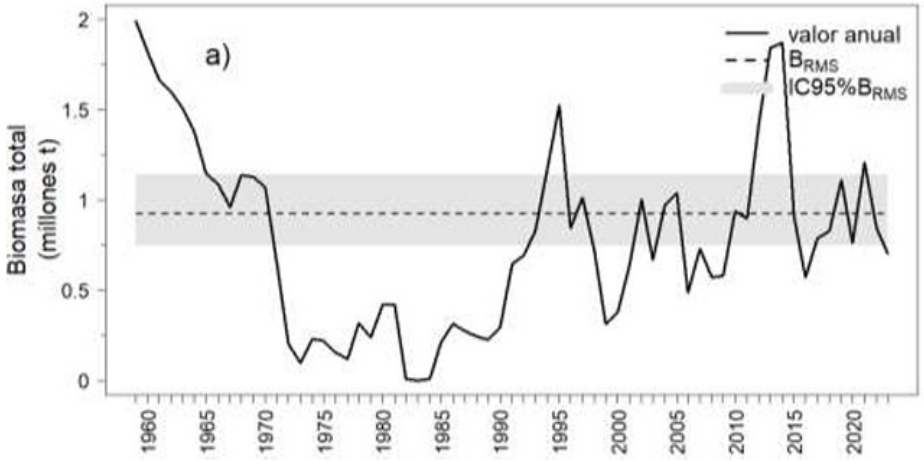

Figure 19: Anchoveta biomass available in the southern region of the Peruvian Sea from 1959 to 2023 and relationship with its reference level (B_{RMS} in Spanish, B_{MSY} in English) according to what is estimated by the Surplus Production Model. Chart and text from (IMARPE 2024b).

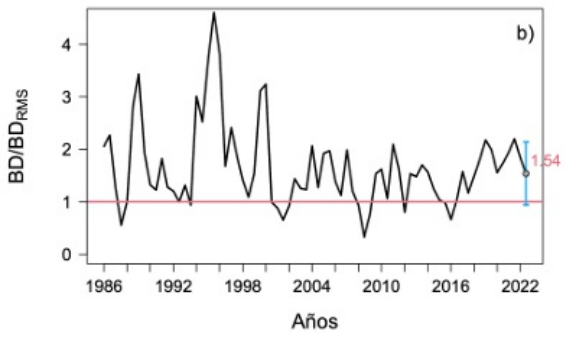

Figure 20: North Chile anchoveta spawning biomass over time in relation to the management target (B: red line), including uncertainty in the last month (IFOP 2023b).

Factor 1.2 - Fishing Mortality

Central - North Chile stock | Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery

Moderate Concern

Fishing mortality in the most recent IFOP status report was above the reference point (F_{2021}/F_{MSY} = 1.21) for the Central-North Chile stock (Figure 21) (IFOP 2022a)(SUBPESCA 2023a), and the stock was considered subject to overfishing (IFOP 2022a)(SUBPESCA 2023a). Since then, spawning biomass has increased significantly, and SUBPESCA reports that F_{2023}/F_{MSY} = 0.15 based on preliminary information from IFOP (SUBPESCA 2024) (see Figure 14 in Factor 1.1 for this stock). A recent (data <10 yrs old) stock assessment that shows F has been above F_{MSY} (based on dynamic B_0 for key forage species) but is currently below that level would warrant a score of low concern; however, the preliminary nature of the latest year data point requires some caution, so a score of moderate concern is given.

Justification:

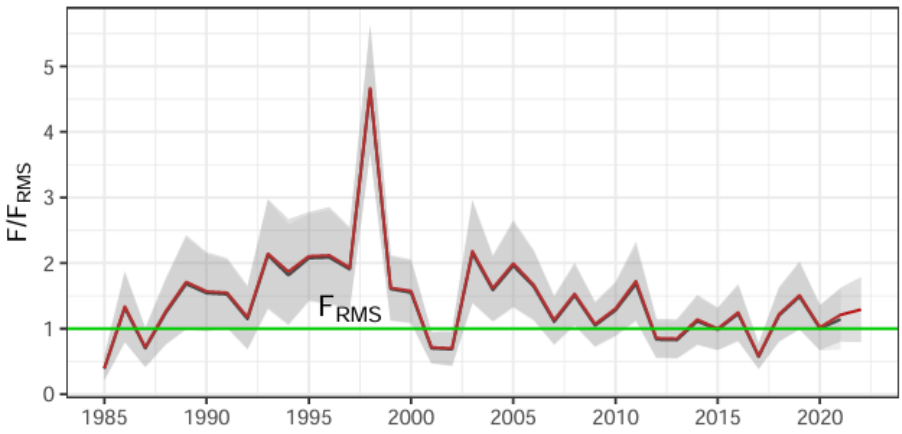

Figure 21: Estimated fishing mortality relative to the target reference point (F_{MSY} or F_{RMS}) (IFOP 2022a).

Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery

Low Concern

F has been below F_{MSY} since dropping below it in 2017 (see Justification). A recent (data <10 yrs old) stock assessment that shows F below F_{MSY} (based on dynamic B_0 for key forage species) is scored a low concern.

Justification:

Fishing mortality for this stock has decreased since 2021–22 because of the low level of biomass of this stock. The estimated fishing mortality for 2022–23 was $0.725F_{MSY}$ (Table 26 in IFOP 2023c}) (Figure 22).

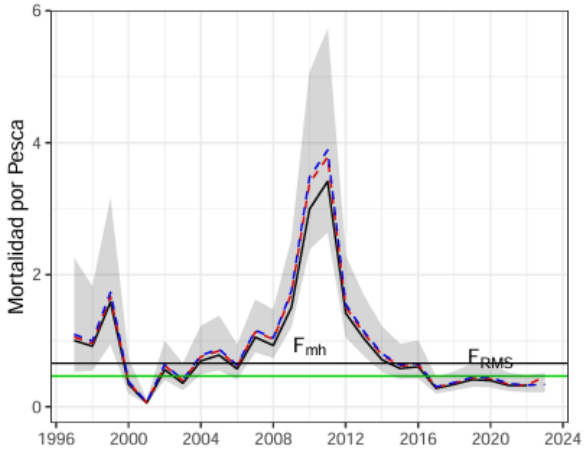

Figure 22: Estimated fishing mortality relative to the target reference point (F_{MSY} or F_{RMS}) (IFOP 2023c).

North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet
North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet

Low Concern

IMARPE bases catch recommendations on preseason surveys of biomass and environmental conditions. The exploitation rate is typically set at around 0.30–0.35, corresponding to a fishing mortality rate (F) of around 0.5 (see, e.g., Table A2 in (IMARPE 2022a)). The recent stock assessment (Diaz Acuna et al 2022) estimates F_{MSY} at 1.14 (95%CI = 0.79–1.65) and that fishing mortality has been below even the lower bound (i.e., 0.79) for most of the last 10 years (Figure 23). Based on a recent stock assessment that finds F to be below an appropriate reference point (that accounts for volatility and as tested by MSE; see Factor 1.1 for more information), a score of 5 is given and a rating of low concern.

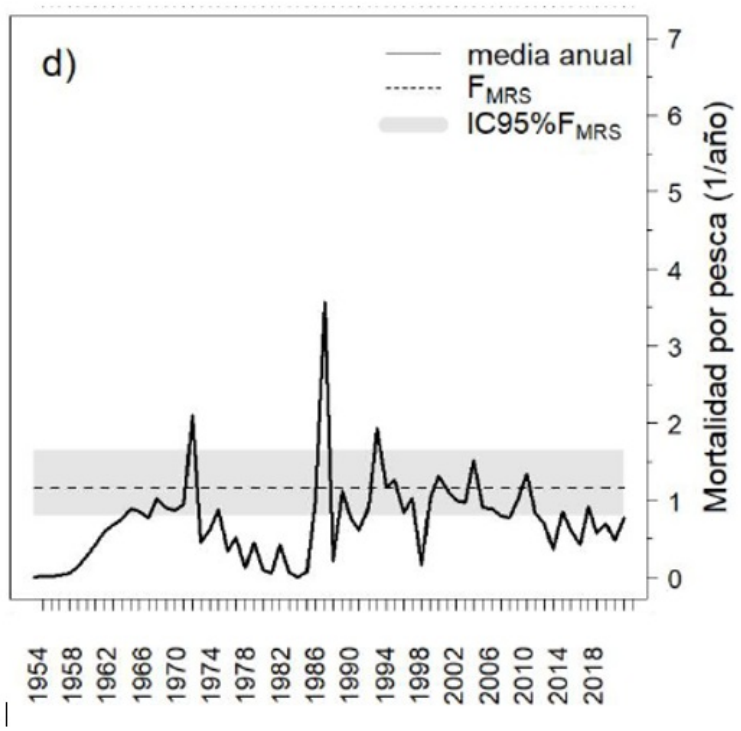

Figure 23: Annual fishing mortality relative to F_{MSY}, with confidence intervals (Diaz Acuna et al 2022).

South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
South Peru - North Chile stock | Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Low Concern

Fishing mortality is well below the target reference point used by the IFOP (Chile: F_{2022}/F_{MSY} = 0.66 (SUBPESCA 2024)) and by IMARPE (Peru) (F_{MSY} in both cases) (Figures 24–25). A recent (data <10 yrs old) stock assessment that shows F has been below F_{MSY} (and, for key forage species, F_{MSY} is based on dynamic B_0 or as tested by MSE) but is currently below that level is scored a low concern.

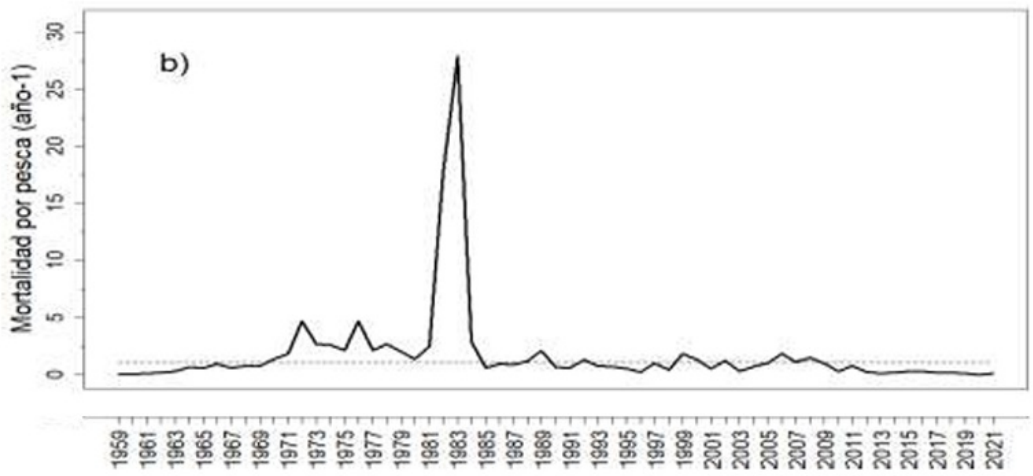

Figure 24: Estimated fishing mortality relative to the target reference point (F_{MSY}) (IMARPE 2021e).

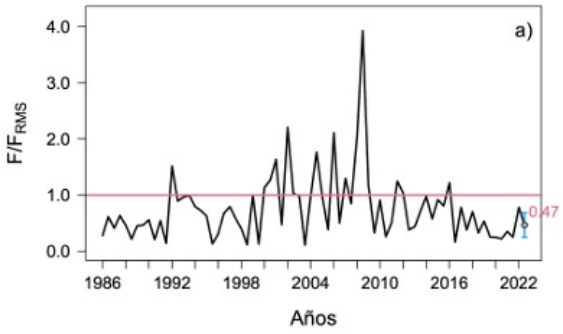

Figure 25: Estimated fishing mortality relative to the target reference point (F_{MSY}) (IFOP 2022a).

Araucanian herring (Clupea bentincki)

Factor 1.1 - Abundance

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery

Low Concern

The current reference points used by the IFOP for Araucanian herring (sardina común in Chile) are based on the recommendations from a 2013 workshop with domestic and international scientists (Payá et al 2014). For demersal fish and crustaceans, these recommendations included MSY proxy reference points of $F45\%_{SPR}$ and $40\%_{B0}$. But, for key small pelagics, 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" (Payá et al 2014). The biomass reference points for Araucanian herring (target = SSB_{MSY} = 55%SSB_0 and limit = 27.5%SSB_0) (SUBPESCA 2024) are consistent with these recommendations. Furthermore, unfished biomass is recalculated when survey information is updated—often multiple times a year for this stock (i.e., B_0 is dynamic) (Table 33 in (IFOP 2022c)). Chile conducts a regular stock assessment, and the stock has been over the target reference point for a number of years but dropped below in 2021, only to return above in the most recent year in the stock assessment (2022) (Figure 26) (IFOP 2022c). But there is great uncertainty around this estimate, with the lower 95%CI often at the limit reference point, and below it in 2021. In addition, SUBPESCA reports that the stock declined again in the 2022–23 season, to a level around the target reference point (SUBPESCA 2024).

Araucanian herring is a key forage species for which abundance greatly depends on environmental conditions (see the Criterion 1 Summary and Appendix A). For these species, static reference points are not considered appropriate, a concern that is mitigated for this stock by the frequent recalculation of unfished biomass.

The combination of recent stock assessments with findings that biomass is above appropriate reference levels would typically allow for a score of 5 and very low concern; however, because of high uncertainty, with the lower bound being at or even below the limit at times in the last few years, this is moderated down to 3.67 and a rating of low concern.

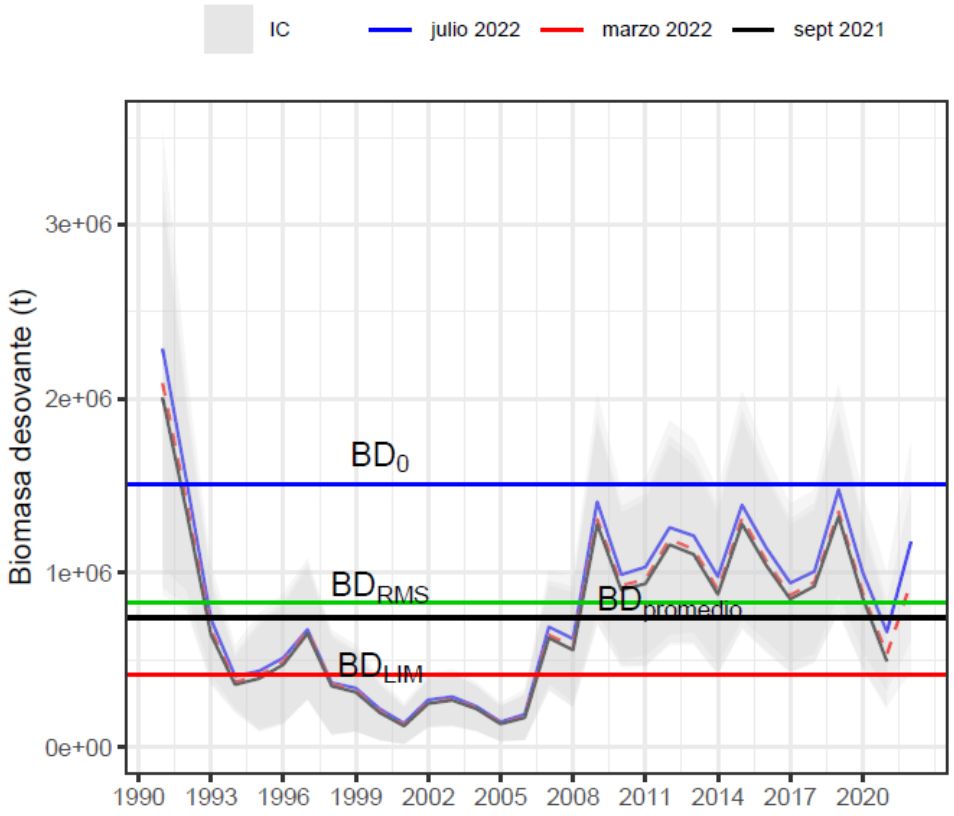

Figure 26: Araucanian herring spawning biomass relative to target (SB_{MSY}) and limit (SB_{LIM}) reference points (IFOP 2023c). Colors relate to the three surveys; uncertainty is illustrated in grey.

Factor 1.2 - Fishing Mortality

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery

Moderate Concern

F is fluctuating around the reference point, especially when uncertainty is taken into account (Figure 27), and SUBPESCA reports that F was just above the reference point in the most recent year ($F_{2022–23}/F_{MSY}$ = 1.06) (not reflected in Figure 27) (SUBPESCA 2024). Therefore, fishing mortality is deemed a moderate concern.

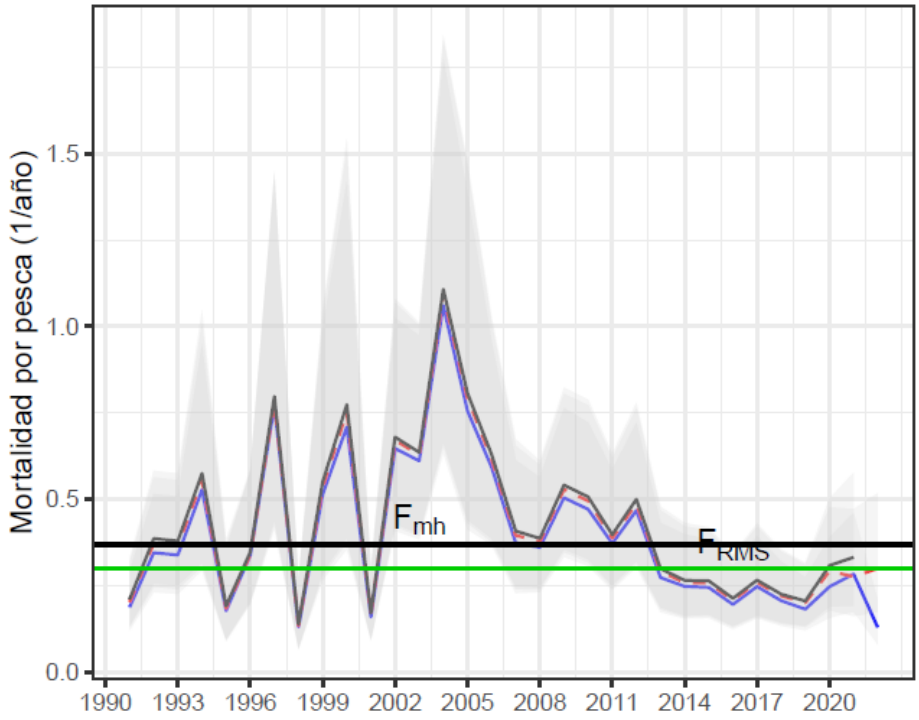

Figure 27: Araucanian herring fishing mortality relative to target (F_{MSY}) reference point (IFOP 2023c). Colors relate to the three surveys; uncertainty is illustrated in grey.

Inca scad (Trachurus murphyi)

Factor 1.1 - Abundance

Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Moderate Concern

The current biomass reference points for Inca scad (jurel in Chile, Chilean jack mackerel at the FAO) used by the IFOP are a target B_{MSY} proxy of 30%SSB_0 and a limit of 9%SSB_0 (SUBPESCA 2024). The stock has been above B_{MSY} in recent years (Figure 28) (SSB_{2023}/SSB_{MSY} = 2.29 (SUBPESCA 2024)).

Inca scad is a key forage species for which abundance greatly depends on environmental conditions (see the Criterion 1 Summary and Appendix A). For these species, reference points based on a static estimate of unfished biomass (B_0) are not considered appropriate. In the case of Inca scad, unfished biomass (B_0) was recalculated in the latest assessment based on the average estimates of B_0 for the years 2010–20, whereas in earlier assessments it was based on 2001–15 (Table 3/p. 254 in (IFOP 2024)). But managers do not use a dynamic B_0 approach like that used for anchoveta or Araucanian herring.

There is a recent stock assessment that finds biomass to be above the target reference point; however, the reference point is static, so the score is limited to 2.33 and a rating of moderate concern.

Justification:
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 extends from the coast of Chile to New Zealand within lat. 35° to 50° S. (SPRFMO 2021).

Although the stock structure for Inca scad is unclear, and up to five separate stocks have been suggested, the Jack Mackerel Sub-group of the SPRFMO carried out two assessments of the species in the Eastern South Pacific under two main working hypotheses: a) 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, b) jack mackerel caught off the coasts of Peru and Chile constitute a single shared stock, which straddles the high seas (SPRFMO 2021). A stock assessment has been conducted for both scenarios, and in all cases, the current spawning biomass is above B_{MSY} (Figure 28) (IFOP 2024).

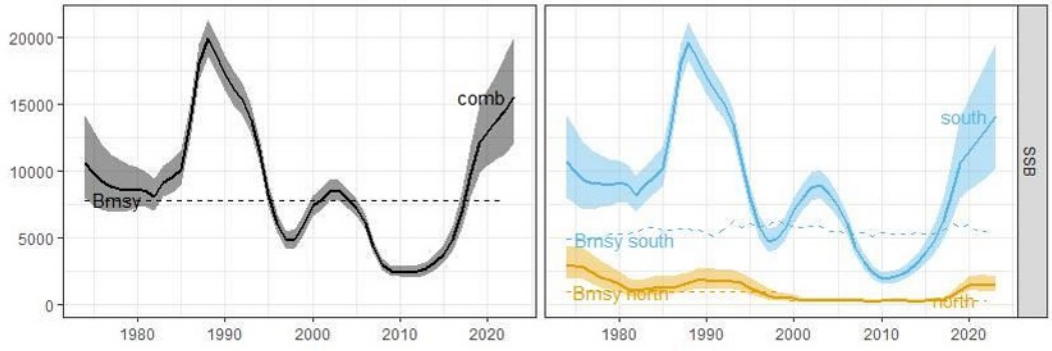

Figure 28: Summary of stock assessment estimates through 2022 showing spawning biomass (thousands of t) relative to the target reference point (B_{MSY} proxy). The separate graphs show the results of the hypothesis of a single stock unit (left) and the hypothesis of two stock units (right; stock "north" in yellow and stock "south" in blue). The shaded areas refer to the estimated uncertainties (IFOP 2024).

Factor 1.2 - Fishing Mortality

Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Moderate Concern

The current fishing mortality of Inca scad/jurel is estimated to be below the dynamic F target reference point of F_{MSY} = 0.13 year-1 (for both a single stock hypothesis and a two-stock hypothesis (Figure 29) (IFOP 2024) (F_{2023}/F_{MSY} = 0.4 (SUBPESCA 2024)). But because the reference point used is static (see Factor 1.1), the score is limited to 3 and a rating of moderate concern.

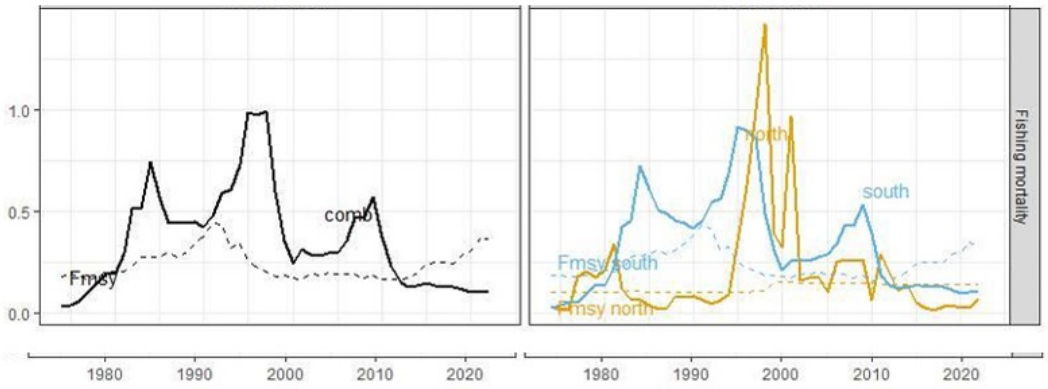

Figure 29: Summary of fishing mortality relative to the target reference point (F_{MSY} proxy as an instantaneous rate per year). The separate graphs show the results of the hypothesis of a single stock unit (left) and the hypothesis of two stock units (right; stock "north" in yellow and stock "south" in blue) (IFOP 2024).

Pacific chub mackerel (Scomber japonicus)

Factor 1.1 - Abundance

Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Moderate Concern

Pacific chub mackerel (caballa in Chile) is taken in the anchoveta and horse mackerel fisheries in Chile. Reference points have not been determined, no stock assessments are conducted, and no quota has been established (IFOP 2022d). There is an IFOP stock assessment from 2003, but it is too old to use for scoring (data are >10 years old). The International Union for the Conservation of Nature (IUCN) has assessed the species as "Least Concern" globally (Collette et al 2023). In lieu of better information, the IUCN determination allows a score of 2.66 and a rating of moderate concern.

Factor 1.2 - Fishing Mortality

Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Moderate Concern

Because reference points have not been determined and no stock assessments have been conducted for Pacific chub mackerel in Chilean waters (since 2003), fishing mortality relative to a sustainable level is unknown. Thus, a score of 3 and a rating of moderate concern are given.

Criterion 2: Impacts on Other Species

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

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

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

Guiding principles

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

Criterion 2 Summary

Criterion 2 score(s) overview

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

ANCHOVETA			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery	2.236	1.000: < 100%	Yellow (2.236)
Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery	2.236	1.000: < 100%	Yellow (2.236)
South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery	2.236	1.000: < 100%	Yellow (2.236)
South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery	1.732	1.000: < 100%	Red (1.732)
Central - North Chile stock | Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery	2.236	1.000: < 100%	Yellow (2.236)
North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet	2.644	1.000: < 100%	Yellow (2.644)
North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet	2.236	1.000: < 100%	Yellow (2.236)
South Peru - North Chile stock | Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet	1.732	1.000: < 100%	Red (1.732)

ARAUCANIAN HERRING			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery	2.236	1.000: < 100%	Yellow (2.236)
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery	2.236	1.000: < 100%	Yellow (2.236)

INCA SCAD			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	2.644	1.000: < 100%	Yellow (2.644)
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	2.236	1.000: < 100%	Yellow (2.236)
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery	2.236	1.000: < 100%	Yellow (2.236)

PACIFIC CHUB MACKEREL			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	2.644	1.000: < 100%	Yellow (2.644)
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery	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 | CHILE | PURSE SEINES | CENTRAL NORTH REGION (ATACAMA TO COQUIMBO - III, IV) | ARTISANAL ANCHOVETA FISHERY			
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)
Anchoveta	5.000: Very Low Concern	3.000: Moderate Concern	Green (3.873)

SOUTHEAST PACIFIC | CHILE | PURSE SEINES | CENTRAL NORTH REGION (ATACAMA TO COQUIMBO - III, IV) | ARTISANAL INCA SCAD/CHILEAN JACK MACKEREL/JUREL FISHERY			
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)
Pacific chub mackerel	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Inca scad	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

SOUTHEAST PACIFIC | CHILE | PURSE SEINES | CENTRAL SOUTH REGION (VALPARAÍSO TO LOS RÍOS - V-IX, XIV, XVI) | ARTISANAL ANCHOVETA AND ARAUCANIAN HERRING/SARDINA COMÚN FISHERY			
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	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Anchoveta	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

SOUTHEAST PACIFIC | CHILE | PURSE SEINES | CENTRAL SOUTH REGION (VALPARAÍSO TO LOS RÍOS - V-IX, XIV, XVI) | INDUSTRIAL ANCHOVETA AND ARAUCANIAN HERRING/SARDINA COMÚN FISHERY

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	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Anchoveta	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

SOUTHEAST PACIFIC | CHILE | PURSE SEINES | CENTRAL SOUTH REGION (VALPARAÍSO TO LOS RÍOS - V-IX, XIV, XVI) | INDUSTRIAL INCA SCAD/CHILEAN JACK MACKEREL/JUREL FISHERY

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)
Inca scad	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

SOUTHEAST PACIFIC | CHILE | PURSE SEINES | NORTH REGION (ARICA Y PARINACOTA TO ANTOFAGASTA - XV, I, II) | ARTISANAL ANCHOVETA FISHERY

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)
Anchoveta	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

SOUTHEAST PACIFIC | CHILE | PURSE SEINES | NORTH REGION (ARICA Y PARINACOTA TO ANTOFAGASTA - XV, I, II) | INDUSTRIAL ANCHOVETA FISHERY

SUB SCORE: 1.732 | DISCARD RATE: 1.000 | **SCORE: 1.732**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Pacific sardine	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Seabirds	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Anchoveta	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

SOUTHEAST PACIFIC | CHILE | PURSE SEINES | NORTH REGION (ARICA Y PARINACOTA TO ANTOFAGASTA - XV, I, II) | INDUSTRIAL INCA SCAD/CHILEAN JACK MACKEREL/JUREL FISHERY

SUB SCORE: 2.644 | DISCARD RATE: 1.000 | **SCORE: 2.644**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Inca scad	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific chub mackerel	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

SOUTHEAST PACIFIC | PERU | PURSE SEINES | NORTH-CENTRAL PERU | ARTISANAL FLEET			
SUB SCORE: 2.644	DISCARD RATE: 1.000	SCORE: 2.644	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Longnose anchovy	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Anchoveta	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

SOUTHEAST PACIFIC | PERU | PURSE SEINES | NORTH-CENTRAL PERU | INDUSTRIAL FLEET			
SUB SCORE: 2.236	DISCARD RATE: 1.000	SCORE: 2.236	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Rays	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Seabirds	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Longnose anchovy	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Anchoveta	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Pacific chub mackerel	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

SOUTHEAST PACIFIC | PERU | PURSE SEINES | SOUTH PERU-NORTH CHILE | INDUSTRIAL FLEET			
SUB SCORE: 1.732	DISCARD RATE: 1.000	SCORE: 1.732	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Pacific sardine	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Seabirds	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Colorado langostino	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Anchoveta	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

Criterion 2 is an assessment of the population impacts of the fisheries on all species caught other than those assessed in Criterion 1. Criterion 2 also assesses the impacts of bait use and discards.

Determining “main species” for each fishery

The SFW Standard for Fisheries (v4) defines “main species”—those to be included in the fishery (i.e., in Criterion 1 or 2)—as those that meet any of the following criteria (Seafood Watch 2020):

- 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, approximately 20% or more of total fishing mortality.

The main species for each fishery are determined as follows. Because of the high number of species of concern

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

Peru: North-Central

Industrial fishery

In Peru, two onboard observer programs are currently in place in the industrial Peruvian anchoveta fishery: the public observer program conducted by IMARPE (Bitacoras de pesca), which covers around 4–5% of the trips (IMARPE 2019), and the private observer program SALVAMARES (set because of the fishery improvement plan [FIP] in place for the fishmeal/fish oil fishery), where crew members act as observers {CeDePesca 2020}(CeDePesca 2020b). In 2021, the SALVAMARES program covered around 65% of the sets made by vessels in the FIP or around 80% of the total volume landed across the entire fleet (nearly all the steel vessels but not the wooden vessels) (pers. comm., Ernesto Godelman, CeDePesca). A separate private observer program, aimed at validating the results of the SALVAMARES, is managed by CeDePesca in collaboration with the Instituto de Educación Superior Tecnológico Público “Ricardo Ramos Plata” (CeDePesca 2019). This private program is audited by MRAG (Marine Resources Assessment Group) (SNP/MRAG 2021).

The catch in the industrial anchoveta fishery in the North-Central area is dominated by anchoveta. Pacific chub mackerel accounts for 1–2% of the catch, but given the sheer volume of the catch in this fishery, this may be one of the main sources of mortality for the stock. The industrial anchoveta fishery is also likely a main source of fishing mortality on múnida, a squat lobster (Escobedo Oblitas 2018). A number of species of concern are caught, including rays, mammals, seabirds, and turtles. The mammals are generally listed as IUCN “Least Concern” and are either caught in relatively low numbers, released alive, or both. Turtles are rarely caught, and are released alive. But seabirds are included as main species, based on the combination of their IUCN categories, the number caught, and the number dying. Rays are also included because mortality in this fishery could be a significant portion of total mortality of these species.

In addition, anchoveta and longnose anchovy/samasa (*Anchoa nasus*) are managed together under the same management regime and quota in Peruvian waters (the quota is based on anchoveta abundance alone, but catches of longnose anchovy are counted against the quota). Normally, longnose anchovy accounts for only a small percentage of total landings (around 3%). But during El Niño events, landings increase by 100% compared to the annual average, because the species’ distribution expands to the South (Bouchon 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 an MSC pre-assessment for the anchoveta fishery, consider these species as inseparable or practicably inseparable stocks (IPI), which means that these species are not separated in the catch.

Main species: Anchoveta, Pacific chub mackerel, longnose anchovy, squat lobster, seabirds, and rays

Table 5: Projected catch composition in the North-Central anchoveta fishery, summed from SALVAMARES 2019-1 (April–August 2019) and 2019-II (November 2019–January 2020) (CeDePesca 2020b)(CeDePesca 2020a). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category. Table split into two for formatting purposes.
* Pota/jibia/jumbo flying squid (*Dosidicus gigas*) is considered “sin riesgo” (without risk) in Peru (IMARPE 2024c).

Table 15

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Projected catch (mt)	Projected catch (%)
Anchoveta	*Anchoveta*	Anchoveta	Criterion 1	300,349.0	97.60

Caballa	*Scomber japonicus peruanus*	Pacific chub mackerel	Criterion 1	4,410.8	1.43
Múnida	*Pleuroncodes monodon*	Carrot squat lobster/Colorado langostino	Not assessed	2,324.0	0.76
Bagre	*Galeichthys peruvianus*	Peruvian sea catfish	Least Concern	369.6	0.12
Camarón	*Decápoda no identificada*	Shrimp	—	52.1	0.02
Cabrilla	*Paralabrax humeralis*	Peruvian rock seabass	Data Deficient	51.3	0.02
Camaroncito rojo	*Munididae*	—	—	50.3	0.02
Camotillo	*Diplectrum conceptione*	Sand perch	Least Concern	34.1	0.01
Aguja	*Strongylura scapularis*	Needlefish	Least Concern	32.4	0.01
Pampanito	*Selene peruviana*	Pacific moonfish	Least Concern	20.1	0.01
Lorna	*Sciaena deliciosa*	Lorna drum	Least Concern	16.3	0.01
Merluza	*Merluccius gayi peruanus*	South Pacific hake (*Merluccius gayi*)	Data Deficient	11.5	0.00
Bonito	*Sarda chiliensis chiliensis*	Eastern Pacific bonito	Least Concern	8.5	0.00
Camaroncillo	*Decápoda no identificada*	Caridean shrimp	—	6.5	0.00
Agujilla	*Sphyraena ensis*	Mexican barracuda	Least Concern	2.1	0.00
Grand Total				**307,738.6**	

Table 16

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Projected catch (mt)	Projected catch (%)
Raya	*Urotrygon* sp.	Round ray	Near Threatened/Vulnerable (various spp.)	0.6	0.00
Lengueta	*Paralichthyidae?*	Flounder?	Most are Least Concern	0.5	0.00
Raya águila	*Myliobatis longirostris*	Peruvian eagle ray	Vulnerable	0.4	0.00
Tiburón azul	*Prionace glauca*	Blue shark	Near Threatened	0.4	0.00
Pámpano	*Trachinotus paitensis*	Paloma pompano	Least Concern	0.3	0.00
Barrilete	*Katsuwonus pelamis*	Skipjack tuna	Least Concern	0.3	0.00
Pota	*Dosidicus gigas*	Jumbo flying squid	Data Deficient ("without risk"*)	0.2	0.00
Raya violácea	*Pteroplatytrygon violacea?*	Pelagic stingray?	Least Concern	0.2	0.00
Samasa	*Anchoa nasus*	Longnose anchovy	Least Concern	0.1	0.00
Pez volador	*Exocoetidae*	Flying fish	29 of 30 species are Least Concern, 1 is Data Deficient	0.1	0.00
Lenguado	*Paralichthyidae*	Flounder	Most are Least Concern	0.1	0.00

Perico	*Coryphaena hippurus*	Common dolphinfish	Least Concern	0.1	0.00
Suco	*Paralonchurus goodei*	Croaker	Least Concern	0.0	0.00
Tiburón martillo	*Sphyrna zygaena*	Smooth hammerhead	Vulnerable	0.0	0.00
Chiri	*Peprilus medius*	Pacific harvestfish	Least Concern	0.0	0.00
Vinciguerria	*Vinciguerria lucetia pacifici*	Panama lightfish	Least Concern	0.0	0.00
Cojinova	*Seriolella punctata?*	Silver warehou?	Not assessed	0.0	0.00
Anguila	*Sphyraena ensis*	Mexican barracuda	Least Concern	0.0	0.00
Jurel	*Trachurus picturatus murphyi*	Inca scad/Chilean jack mackerel	Criterion 1	0.0	0.00
Vinciguerria*	*Vinciguerria lucetia pacifici*	Panama lightfish	Least Concern	0.0	0.00
Mobula*	*Mobula sp.*	Devil/Manta ray	Vulnerable/Endangered (various spp.)	0.0	0.00
Calamar*	*Doryteuthis gahi*	Patagonian longfin squid	Least Concern	0.0	0.00
Grand Total				**3.4**	

Similarly, during the first anchoveta season of 2019, the groups with the highest incidence in the data collected by 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 reports), and the group of invertebrates, with red squat lobster as 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/longnose anchovy (*Anchoa nasus*) (IMARPE 2019).

Table 6: Projected sightings, interactions, and disposition of seabirds in SALVAMARES 2019-I and 2019-II (CeDePesca 2020b)(CeDePesca 2020a). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.

Table 17

Nombre común	Nombre científico/Scientific name	Common name	IUCN category	Total interactions	Total observed individuals	Escaped by themselves	Dead	Released alive	Released injured
Seabirds									
Pelícano peruano	*Pelecanus thagus*	Peruvian pelican	Near Threatened	16,273	2,098,194	2,083,958	3,668	9,441	964
Pardela común	*Ardenna grisea*	Sooty shearwater	Near Threatened	10,214	1,646,461	1,630,433	2,502	2,020	1,285
Piquero peruano	*Sula variegata*	Peruvian booby	Least Concern	8,534	1,156,490	1,135,885	5,500	3,180	81
Gaviota peruana	*Larus belcheri*	Belcher's gull	Least Concern	4,224	603,731	603,731	0	0	0
Zarcillos	*Larosterna inca*	Inca tern	Near Threatened	3,794	553,572	55,331	17	245	—

Guanay	*Phalacrocorax bouganvilli/ Leucocarbo bougainvilliorum*	Guanay cormorant	Near Threatened	3,215	453,146	449,004	3,080	899	162
Gaviota	*Larus* spp.	–	–	2,612	348,792	340,988	16	0	0
Gaviota de Franklin	*Larus pipixcan*	Franklin's gull	Least Concern	2,275	286,791	286,637	130	25	0
Piquero de patas azules	*Sula nebouxii*	Blue-footed booby	Least Concern	1,639	347,589	345,431	1,555	310	292
Zarcillo	*Larosterna inca*	Inca tern	Near Threatened	1,233	131,742	131,742	0	0	0
Piqueros peruanos	*Sula variegata*	Peruvian booby	Least Concern	1,021	1,873,983	1,868,013	4,063	1,551	354
Albatros de Galápagos	*Phoebastria irrorata*	Waved albatross	Critically Endangered	548	15,379	15,379	—	—	—
Albatros indeterminados	*Diomedeidae*	Albatross	–	389	14,975	14,975	0	0	0
Golondrina	*Oceanodroma* sp.	–	–	271	9,824	9,824	0	0	0
Gaviotín peruano	*Sternula lorata*	Peruvian tern	Endanged	261	56,322	56,314	8	—	—
Gaviota dominicana	*Larus dominicanus*	Kelp gull	Least Concern	229	33,802	33,802	0	0	0
Pingüino de Humboldt	*Spheniscus humboldti*	Humboldt penguin	Vulnerable	25	67	34	—	34	—
Pardela de pata rosada	*Ardenna creatopus*	Pink-footed shearwater	Vulnerable	16	324	308	0	16	0
Tijereta	*Fregata magnificens*	Magnificent frigatebird	Least Concern	8	51	51	—	—	—
Piquero enmascarado	*Sula dactylatra*	Masked booby	Least Concern	8	8	8	—	—	—
Albatros de ceja negra	*Thalassarche melanophris*	Black-browed albatross	Least Concern	—	—	—	—	—	—
Total				**56,789**	**9,631,243**	**9,061,848**	**20,539**	**17,721**	**3,138**

Table 7: Projected sightings, interactions, and disposition of mammals, turtles, and elasmobranchs in SALVAMARES 2019-I and 2019-II (CeDePesca 2020b)(CeDePesca 2020a). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.

Table 18

Nombre común	Nombre científico/Scientific name	Common name	IUCN category	Total interactions	Total observed individuals	Escaped by themselves	Dead	Released alive	Released injured
Marine mammals									
Lobo chusco	*Otaria flavescens*	South American sea lion	Least Concern	27,065	1,380,684	1,355,434	463	24,404	25
Lobo fino	*Arctocephalus australis*	South American fur seal	Least Concern	2,665	110,307	109,652	17	638	0

Delfín nariz de botella	*Tursiops truncatus*	Common bottlenose dolphin	Least Concern	51	430	371	—	34	25
Delfín común	*Delphinus capensis/Dephinus delphis*	Common dolphin	Least Concern	42	101	34	8	51	8
Delfín oscuro	*Lagenorhynchus obscurus*	Dusky dolphin	Least Concern	34	202	34	—	169	—
Delfín no identificado	*Delphinus* sp.	—	—	16	81	0	0	81	0
Turtles									
Tortuga verde	*Chelonia mydas*	Green turtle	Endangered	51	51	34	—	17	—
Tortuga pico de loro	*Lepidochelys olivacea*	Olive ridley turtle	Vulnerable	34	34	—	—	34	—
Tortuga indeterminada	*Chelonioidea*			16	16	16	0	16	0
Tortuga cabezona	*Caretta caretta*	Loggerhead turtle	Vulnerable	8	8	—	—	8	—
Tortuga dorso de cuero	*Dermochelys coriacea*	Leatherback turtle	Vulnerable	8	8	—	—	8	—
Rays and sharks									
Mobula	*Mobula* sp.			16	16	0	0	16	0
Total				**30,006**	**1,491,938**	**1,465,575**	**488**	**25,476**	**58**

The IMARPE observer data also documented interactions with a number of the species in Tables 6–7 in 2019, as well as pardela pata rosada/pink-footed shearwater (*Puffinus creatopus*, IUCN "Vulnerable") and two individuals of ballena jorobada/humpback whale (*Megaptera novaeangliae*, IUCN "Least Concern") (IMARPE 2019).

Artisanal and small-scale fishery

The IMARPE Bitacoras de Pesca observer program also observes the artisanal anchoveta (including small-scale) fleet along the entire Peruvian coast. In 2015, the program found that 97.96% of the artisanal fleet's catch was of anchoveta, with lorna (Lorna drum, *Sciaena deliciosa*) and samasa (longnose anchovy, *Anchoa nasus*) accounting for 1.91% and 0.03% of the catch, respectively (IMARPE 2015). The small-scale fleet's catch was entirely of anchoveta. Both Lorna drum and longnose anchovy are considered of "Least Concern" by the IUCN (Espinosa Pérez & Chao 2020)(Di Dario 2020).

There is also a private observer program in place for the Fishery Improvement Project for the artisanal/small-scale anchoveta fleet in Peru (Ceballes 2023)(CeDePesca 2022). The fleet in the FIP accounts for around 25% of the landings of the entire fleet. For the years 2018–22, anchoveta accounted for 98.31% of the expanded catch, Pacific chub mackerel for 1.13%, and longnose anchovy for 0.31% (Ceballes 2023). A number of vulnerable rays were caught in relatively low numbers, and the fishery also interacted with 12 different sea bird taxa, South American sea lion, and common dolphin (CeDePesca 2022). Few seabirds (4) and no sea lions were observed dead upon escape or release, but 10 of the 12 common dolphins entangled in the net were dead, and the other 2 were seriously injured. Common dolphin (*Delphinus capensis* in CeDePesca 2022, but a change in taxonomy in 2016 means it is no longer considered a separate species to *D. delphis*) is circumglobal in range and one of the most widespread and abundant cetaceans globally, with population estimates of over 6 million individuals. The species is considered "Least Concern" by the IUCN (Braulik et al 2021).

A recent catch analysis of the Peruvian artisanal purse seine fleet based on fisher surveys suggests that turtles, seabirds, and marine mammals are typically released alive or discarded dead, although all taxa are also consumed and even sold in some cases (Peña-Cutimbo et al 2024). The fate of sharks and rays is typically sale and/or consumption. Eagle rays (*Myliobatis* spp.) are targeted in some Peruvian artisanal fisheries, especially in Northern Peru (Peña-Cutimbo et al 2024), which, combined with the relatively small numbers caught, allows them to be excluded from further consideration in this Seafood Watch assessment of this fishery. A caveat in using this study for further conclusions of catch composition in the Peruvian artisanal anchoveta fishery is that, although anchoveta is targeted by the artisanal purse seine fleet, the fleet targets many other species, and none of the respondents in the survey indicated that anchoveta was their target (Table 2 in (Peña-Cutimbo et al 2024)). The authors also note that the sample size is relatively small. Thus, the observer data reports noted above are the primary information source used to determine the main species for this fishery.

Main species: Anchoveta, longnose anchovy (see the preceding industrial fishery stock determination)

Table 8: Projected catch composition in the artisanal/small-scale anchoveta fishery, summed for 2018–22 (Ceballes 2023). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.

Table 19

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Expanded catch 2018–22 (mt)	Extended catch (%)
Anchoveta	*Engraulis ringens*	Anchoveta	Criterion 1	123,397	98.31
Caballa	*Scomber japonicus peruanus*	Pacific chub mackerel (*Scomber japonicus*)	Criterion 1	1,414	1.13
Samasa	*Anchoa nasus*	Longnose anchovy	Least Concern	388	0.31
Espejo	*Selene peruviana*	Pacific moonfish	Least Concern	148	0.12
Munida	*Pleuroncodes monodon*	Carrot squat lobster	Not assessed	73	0.06
Lorna	*Sciaena deliciosa*	Lorna drum	Least Concern	62	0.05
Cabrilla	*Paralabrax humeralis*	Peruvian rock seabass	Data Deficient	15	0.01
Malagua	*Chrysaora plocamia*	South American sea nettle	Not assessed	6	0.00
Jurel	*Trachurus picturatus murphyi*	Inca scad/Chilean jack mackerel	Criterion 1	4	0.00
Cachema	*Cynoscion analis*	Peruvian weakfish	Least Concern	4	0.00
Raya aguila hocicuda	*Myliobatis longirostris*	Longnose eagle ray	Vulnerable	3	0.00
Raya negra	*Pteroplatytrygon violacea*	Pelagic stingray	Least Concern	3	0.00
Merluza	*Merluccius gayi peruanus*	South Pacific hake (*Merluccius gayi*)	Data Deficient	3	0.00

Algas	*Algas*	Seaweeds	—	1	0.00
Bagre	*Galeichthys peruvianus*	Peruvian sea catfish	Least Concern	1	0.00
Chiri	*Peprilus medius*	Pacific harvestfish	Least Concern	0	0.00
Chiri Lomo negro	*Peprilus snyderi*	Salema butterfish	Least Concern	0	0.00
Raya águila peruana	*Myliobatis peruvianus*	Peruvian eagle ray	Vulnerable	0	0.00
Krill	*Euphasidos indeterminados*	Krill	—	0	0.00
Pez aguja	*Hemiramphus saltator*	Longfin halfbeak	Least Concern	0	0.00
Concha de abanico	*Argopecten purpuratus*	Peruvian scallop	—	0	0.00
Cangrejo araña	*Majidae indeterminado*	Spider crab	—	0	0.00
Pulpo	*Octopus* sp.	Octopus	—	0	0.00
Total				**125,524**	**100.00**

Peru: South (South Peru-North Chile stock shared with Chile)

Industrial fishery

Information about bycatch in the fishery is scarce. A EUREKA operation was conducted in the region in April 2022 by IMARPE in collaboration with the industry. Bycatch species caught during the survey included squat lobster (5%) and other species (1%), such as chub mackerel, jack mackerel, and Humboldt squid (IMARPE 2022) (no data table is presented in that document). No information was presented on seabirds, mammals, turtles, and other vulnerable taxa. In lieu of data specific to this fishery, the Chilean North Zone industrial anchoveta fishery that also fishes on the South Peru-North Chile stock was used to select main species.

Main species: Anchoveta, squat lobster, Pacific sardine, and seabirds

Chile: North Zone—Arica y Parinacota to Antofagasta (South Peru-North Chile stock shared with Peru)

Industrial anchoveta fishery

The catch in the industrial anchoveta fishery in the North Zone is dominated by anchoveta. A number of species of concern are caught, including Pacific sardine, swordfish, and thresher shark. Swordfish and thresher shark are excluded from further consideration in this Seafood Watch assessment because they are the target and bycatch in many fisheries, particularly those for tuna and other large pelagic species. Jumbo squid is the target of the largest invertebrate fishery in the world, so it is also excluded from further consideration here. Pacific sardine/sardina española is also caught is relatively low numbers, but the stock is considered “depleted” in Chilean waters and it seems likely that the fishery is a main source of mortality. A number of mammals, seabirds, and turtles are also caught. The mammals are generally listed as IUCN “Least Concern” and are either caught in relatively low numbers, released alive, or both. Turtles are rarely caught and are released alive. Both taxa are excluded from further consideration. Seabirds are included as a main species, based on the combination of their IUCN categories, the number caught, and the number dying.

Main species: Anchoveta, Pacific sardine, and seabirds

Table 9: Total catch, average catch, and catch of the species of accompanying fauna with respect to the target species during the period 2017–21 in the industrial pelagic anchoveta fishery in the North Zone (regions from Arica

and Parinacota to Antofagasta) (data from Anexo 10.2, Table 9 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.
* Pacific sardine (*Sardinops sagax*) is IUCN "Least Concern" but is also considered depleted in Chilean waters.
** Some species are considered "Data Deficient" by IUCN but have stock assessments in Chile, including *Merluccius gayi*, *Dosidicus gigas*, and *Macruronus magellanicus* (SUBPESCA 2023a). The tables in this section also reflect those species' status in Chile.

Table 20

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Average annual catch (t)	Average annual catch (%)
Anchoveta	*Engraulis ringens*	Anchoveta	Criterion 1	12,841	98.6
Medusa	*Scyphozoa*	Jelly	Not assessed	86	0.7
Jurel	*Trachurus murphyi*	Inca scad	Criterion 1	54	0.4
Langostino colorado enano	*Pleuroncodes monodon pelagicus*	Carrot squat lobster	Not assessed	29	0.2
Caballa	*Scomber japonicus*	Pacific chub mackerel	Least Concern	4	0.0
Agujilla	*Scomberesox saurus*	Atlantic saury	Least Concern	2	0.0
Sardina española	*Sardinops sagax*	Pacific sardine	Depleted*	1	0.0
Jibia	*Dosidicus gigas*	Jumbo flying squid	Data Deficient (overexploited**)	0	0.0
Albacora	*Xiphias gladius*	Swordfish	Near Threatened	0	0.0
Mote o bacaladillo	*Normanichthys crockeri*	Mote sculpin	Not assessed	0	0.0
Tiburón pejezorro	*Alopias vulpinus*	Thresher	Vulnerable	0	0.0

Table 10: Catch and incidental mortality of mammals, seabirds, and turtles by species in the industrial purse seine fleet that operated on the anchoveta in the North Zone. Data from the registry of scientific observers on 3,772 commercial fishing sets during the period 2017–21 (data from Table 79 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.

Table 21

Nombre común	Nombre científico/Scientific name	Common name	IUCN rating	Catch (individuals)	Deaths (individuals)
Lobo marino común	*Otaria flavescens/ O. byronia*	South American sea lion	Least Concern	5,338	9
Delfín común	*Delphinus delphis*	Common dophin	Least Concern	72	23
Delfín oscuro	*Lagenorhynchus obscurus*	Dusky dolphin	Least Concern	56	38
Delfín	—	Dolphin	(blank)	15	0

Delfín nariz de botella	*Tursiops truncatus*	Common bottlenose dolphin	Least Concern	4	4
Lobo fino austral	*Arctocephalus australis*	South American fur seal	Least Concern	1	0
Fardela negra	*Ardenna grisea*	Sooty shearwater	Near Threatened	568	390
Guanay/Cormorán guanay	*Phalacrocorax bouganvilli/ Leucocarbo bougainvilliorum*	Guanay cormorant	Near Threatened	452	420
Piquero	*Sula variegata*	Peruvian booby	Least Concern	71	59
Gaviotín monja	*Larosterna inca*	Inca tern	Near Threatened	61	0
Pelicano peruano	*Pelecanus thagus*	Peruvian pelican	Near Threatened	31	17
Pingüino de Humboldt	*Spheniscus humboldti*	Humboldt penguin	Vulnerable	12	1
Fardela blanca	*Ardenna creatopus*	Pink-footed shearwater	Vulnerable	8	8
Gaviota garuma	*Leucophaenus modestus*	Grey gull	Least Concern	6	6
Yeco/Pato yeco	*Phalacrocorax brasilianus/ Nannopterum brasilianus*	Neotropical cormorant	Least Concern	4	4
Gaviota de Franklin	*Larus pipixcan*	Franklin's gull	Least Concern	2	2
Albatros de ceja negra	*Thalassarche melanophris*	Black-browed albatross	Least Concern	1	1
Tortuga olivácea	*Lepidochelys olivacea*	Olive ridley turtle	Vulnerable	3	0
Tortuga verde	*Chelonia mydas*	Green turtle	Endangered	3	0
Tortuga Laúd	*Dermochelys coriacea*	Leatherback turtle	Vulnerable	2	0
Tortuga cabezona	*Caretta caretta*	Loggerhead turtle	Vulnerable	1	0

Artisanal anchoveta fishery

The catch in the artisanal anchoveta fishery in the North Zone is dominated by anchoveta. No finfish species of concern are caught. A number of mammals, seabirds, and turtles are also caught. The mammals (South American sea lion) are IUCN Least Concern, and are nearly always released alive. Turtles (green turtle) are rarely caught and are released alive. Both taxa are excluded from further consideration. But seabirds are included as a main species, based on the combination of their IUCN categories, the number caught, and the number dying.

Main species: Anchoveta and seabirds

Table 11: Total catch, average catch, and catch of the species of accompanying fauna with respect to the target species during the period 2017–21 in the artisanal pelagic anchoveta fishery in the North Zone (regions of Arica and Parinacota to Antofagasta) (data from Anexo 10.2, Table 10 in (IFOP 2022a)).

Table 22

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Average annual catch (t)	Average annual catch (%)
Anchoveta	*Engraulis ringens*	Anchoveta	Criterion 1	3,542	99.7
Langostino colorado enano	*Pleuroncodes monodon pelagicus*	Carrot squat lobster	Not assessed	5	0.1
Medusa	*Scyphozoa*	Jelly	Not assessed	3	0.1
Roncacho o corvinilla	*Sciaena deliciosa*	Lorna drum	Least Concern	1	0.0
Mote o bacaladillo	*Normanichthys crockeri*	Mote sculpin	Not assessed	<1	0.0
Machuelo o tritre	*Ethmidium maculatum*	Peruvian menhaden	Data Deficient	<1	0.0
Caballa	*Scomber japonicus*	Pacific chub mackerel	Least Concern	<1	0.0
Mojarilla	*Stellifer* spp.	Drum	4 assessed (3 Least Concern, 1 Data Deficient)	<1	0.0
Bagre de mar	*Aphos porosus*	Banded toadfish	Least Concern	<1	0.0
Pampanito	*Stromateus stellatus*	Starry butterfish	Least Concern	<1	0.0
Bonito	*Sarda chiliensis chiliensis*	Eastern Pacific bonito	Least Concern	<1	0.0
Pejerrey de mar	*Odontesthes regia*	Chilean silverside	Least Concern	<1	0.0
Jurel	*Trachurus murphyi*	Inca scad	Data Deficient	<1	0.0
Corvina	*Cilus gilberti*	Corvina drum	Data Deficient	<1	0.0
Agujilla	*Scomberesox saurus*	Atlantic saury	Least Concern	<1	0.0
Pichibuen (cabinza)	*Isacia conceptionis*	—	Least Concern	<1	0.0

Table 12: Catch and incidental mortality of mammals, turtles, and seabirds in the artisanal purse seine fleet that operated on the anchoveta resource (regions of Arica and Parinacota to Antofagasta). Data from the registry of scientific observers on 830 commercial fishing sets during the period 2017–21 (data from Table 81 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.

Table 23

Nombre común	Nombre Científico	Common name	IUCN rating	Catch (individuals)	Deaths (individuals)

Lobo marino común	*Otaria flavescens/ O. byronia*	South American sea lion	Least Concern	805	4
Guanay/Cormorán guanay	*Phalacrocorax bouganvilli/ Leucocarbo bougainvilliorum*	Guanay cormorant	Near Threatened	217	216
Piquero	*Sula variegata*	Peruvian booby	Least Concern	58	55
Pelicano peruano	*Pelecanus thagus*	Peruvian pelican	Near Threatened	29	4
Fardela negra	*Ardenna grisea*	Sooty shearwater	Near Threatened	8	8
Gaviota garuma	*Leucophaenus modestus*	Grey gull	Least Concern	2	0
Cormorán	*Phalacrocoracidae*	Cormorant	—	1	0
Tortuga verde	*Chelonia mydas*	Green turtle	Endangered	1	0

Industrial jurel fishery

The catch in the industrial jurel fishery in the North Zone is dominated by Inca scad and Pacific chub mackerel. A number of sharks are caught, including smooth hammerhead, blue, and thresher sharks. These species are excluded from further consideration in this Seafood Watch assessment because they are caught in low volumes in this fishery relative to the catch (both target and bycatch) in other fisheries, particularly those for tuna and other large pelagic species. Jumbo squid is the target of the largest invertebrate fishery in the world, so it is also excluded from further consideration here. A number of mammals are also caught but are listed as IUCN “Least Concern” or caught in quite low numbers (pilot whale and fur seal) or almost always released alive (sea lions). No seabirds or turtles are caught. All three taxa are excluded from further consideration in this Seafood Watch assessment.

Main species: Inca scad/Chilean jack mackerel and Pacific chub mackerel

Table 13: Estimates of total catch by species in the North Zone for the industrial horse mackerel fishery during the year 2021. Estimates in tons with data from scientific observers (data from Table 36 in (IFOP 2022}). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.
* Some species are considered “Data Deficient” by IUCN but have stock assessments in Chile, including *Merluccius gayi*, *Dosidicus gigas*, and *Macruronus magellanicus* (SUBPESCA 2023a). The tables in this section also reflect those species’ status in Chile.

Table 24

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Average annual catch (t)	Average annual catch (%)
Jurel	*Trachurus murphyi*	Inca scad	Criterion 1	88,324	55.9
Caballa	*Scomber japonicus*	Pacific chub mackerel	Criterion 1	67,422	42.7
Anchoveta	*Engraulis ringens*	Anchoveta	Criterion 1	1,376	0.9
Agujilla	*Scomberesox saurus*	Atlantic saury	Least Concern	457	0.3
Medusa	*Scyphozoa*	Jelly	Not assessed	321	0.2

Bonito	*Sarda chiliensis chiliensis*	Eastern Pacific bonito	Least Concern	5	0.0
Marlín rayado	*Tetrapturus audax/Kajikia audax*	Striped marlin	Least Concern	not specified	0.0
Tiburón martillo	*Sphyrna zygaena*	Smooth hammerhead	Vulnerable	not specified	0.0
Langostino colorado enano	*Pleuroncodes monodon pelagicus*	Carrot squat lobster	Not assessed	not specified	0.0
Palometa	*Seriola lalandi*	Yellowtail amberjack	Least Concern	not specified	0.0
Calamar	*Doryteuthis (Amerigo) gahi*	Patagonian squid	Least Concern	not specified	0.0
Pez volador	*Exocoetidae*	Flying fish	29 of 30 species are Least Concern, 1 is Data Deficient	not specified	0.0
Tiburón azulejo	*Prionace glauca*	Blue shark	Near Threatened	not specified	0.0
Pez linterna	*Vinciguerria* sp.	(blank)	All species (n = 5) are Least Concern	not specified	0.0
Tiburón pejezorro	*Alopias vulpinus*	Thresher	Vulnerable	not specified	0.0
Jibia	*Dosidicus gigas*	Jumbo flying squid	Data Deficient (overexploited*)	not specified	0.0

Table 14: Catch and incidental mortality by species in the industrial purse seine fleet that operated over the horse mackerel resource (regions of Arica and Parinacota to Antofagasta). Data from the registry of scientific observers on 720 commercial fishing sets during the period 2017–21 (data from Table 80 in (IFOP 2022a)).

Table 25

Nombre común	Nombre científico/Scientific name	Common name	IUCN rating	Catch (individuals)	Deaths (individuals)
Lobo marino común	*Otaria flavescens/O. byronia*	South American sea lion	Least Concern	902	3
Calderón	*Globicephala* sp.	Pilot whales	2 of 2 are Least Concern	1	0
Lobo fino austral	*Arctocephalus australis*	South American fur seal	Least Concern	1	0

Chile: Central North Zone—Atacama to Coquimbo

Artisanal anchoveta fishery

The catch in the artisanal anchoveta fishery in the Central North Zone is dominated by anchoveta. Pacific sardine, a species of concern due to its IUCN “Depleted” status, is also caught. Pacific sardine/sardina española is caught in relatively low numbers, but the stock is considered “depleted” in Chilean waters and it seems likely that the fishery is a main source of mortality. A number of mammals and seabirds are caught (in the artisanal fleets for anchoveta and jurel together—the observer data are combined for these fleets), but no turtles. The mammals (South American sea lion) are listed as IUCN “Least Concern” and are nearly always released alive, so they are excluded from further

consideration. Seabirds are included as a main species, based on the combination of their IUCN categories, the number caught, and the number dying.

Main species: Anchoveta, Pacific sardine, and seabirds

Table 15: Total catch, average catch, and catch of the species of accompanying fauna with respect to the target species during the period 2018–21 in the pelagic artisanal anchoveta fishery in the Central North Zone (in the Atacama and Coquimbo regions) (data from Anexo 10.2, Table 11 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.
* Some species are considered Data Deficient by IUCN but have stock assessments in Chile, including *Merluccius gayi*, *Dosidicus gigas*, and *Macruronus magellanicus* (SUBPESCA 2023a). The tables in this section also reflect those species' status in Chile.

Table 26

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Average annual catch (t)	Average annual catch (%)
Anchoveta	*Engraulis ringens*	Anchoveta	Criterion 1	1,136	97.5
Sardina española	*Sardinops sagax*	Pacific sardine	Depleted	17	1.5
Jurel	*Trachurus murphyi*	Inca scad	Criterion 1	8	0.6
Caballa	*Scomber japonicus*	Pacific chub mackerel	Least Concern	3	0.3
Merluza común	*Merluccius gayi*	South Pacific hake	Data Deficient*	1	0.1
Cabinza	*Isacia conceptionis*	Cabinza grunt	Least Concern	<1	0.0
Agujilla	*Scomberesox saurus*	Atlantic saury	Least Concern	<1	0.0
Corvina	*Cilus gilberti*	Corvina drum	Data Deficient	<1	0.0

Table 16: Catch and incidental mortality in the artisanal purse seine fleet that operated on the anchoveta resource and horse mackerel, between the Atacama and Coquimbo regions. Data from the registry of scientific observers on 414 commercial fishing sets during the period 2018–21 (data from Table 82 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.

Table 27

Nombre común	Nombre científico/Scientific name	Common name	IUCN rating	Catch (individuals)	Deaths (individuals)
Lobo marino común	*Otaria flavescens/O. byronia*	South American sea lion	Least Concern	471	1
Yunco	*Pelecanoides garnotii*	Peruvian diving petrel	Near Threatened	31	25
Pelicano peruano	*Pelecanus thagus*	Peruvian pelican	Near Threatened	21	6
Piquero	*Sula variegata*	Peruvian booby	Least Concern	15	15

Guanay/Cormorán guanay	*Phalacrocorax bouganvilli/ Leucocarbo bougainvilliorum*	Guanay cormorant	Near Threatened	5	3
Yeco/Pato yeco	*Phalacrocorax brasilianus/ Nannopterum brasilianus*	Neotropical cormorant	Least Concern	3	3
Pingüino de Humboldt	*Spheniscus humboldti*	Humboldt penguin	Vulnerable	3	1
Gaviota dominicana	*Larus dominicanus*	Kelp gull	Least Concern	2	1

Artisanal jurel fishery

The catch in the artisanal jurel fishery in the Central North Zone is dominated by Inca scad and Pacific chub mackerel. See the preceding artisanal anchoveta fishery section for information on mammals, seabirds, and turtles.

Main species: Inca scad, Pacific chub mackerel, and seabirds

Table 17: Total catch, average catch, and catch of the species of accompanying fauna with respect to the target species during the period 2018–21 in the artisanal pelagic jack mackerel fishery in the Central North zone (in the Atacama and Coquimbo regions) (data from Anexo 10.2, Table 12 in (IFOP 2022a)).

Table 28

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Average annual catch (t)	Average annual catch (%)
Jurel	*Trachurus murphyi*	Inca scad	Criterion 1	719	86.0
Caballa	*Scomber japonicus*	Pacific chub mackerel	Least Concern	116	13.8
Agujilla	*Scomberesox saurus*	Atlantic saury	Least Concern	2	0.2

Chile: Central South Zone—Valparaíso to Los Lagos

Artisanal anchoveta and Araucanian herring fishery

The catch in the artisanal anchoveta and Araucanian herring fishery in the Central South Zone is dominated by those two species. Three fish species caught in relatively low volumes are species of concern due to their IUCN status (plownose chimaera) or Chilean stock status (South Pacific hake and Patagonian grenadier). All three are targeted in demersal fisheries in the area (South Pacific hake and Patagonian grenadier: p. 2 in https://www.ifop.cl/wp-content/contenidos/uploads/RepositorioIfop/InformeFinal/2023/P-682099_seccion_II_merluza_cola.pdf) (plownose chimaera: {Finucci, B. & Cuevas, J.M. 2020}). Fishing mortality is assumed to be primarily in these fisheries, so the species are excluded from further assessment here. A number of mammals and seabirds are caught, but no turtles. The mammals (South American sea lion) are IUCN “Least Concern” and are nearly always released alive, so they are excluded from further consideration. Seabirds are included as a main species, based on the combination of their IUCN categories, the number caught, and the number dying.

Main species: Araucanian herring, anchoveta, and seabirds

Table 18: Total catch, average catch, and catch of the species of accompanying fauna with respect to the target

species during the period 2016–21 in the artisanal pelagic fishery for anchoveta and Araucanian herring in the Central South Zone (between the regions of Valparaíso and Los Lagos) (data from Anexo 10.2, Table 13 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.
* Some species are considered "Data Deficient" by IUCN but have stock assessments in Chile, including *Merluccius gayi*, *Dosidicus gigas*, and *Macruronus magellanicus* (SUBPESCA 2023a). The tables in this section also reflect those species' status in Chile.

Table 29

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Average annual catch (t)	Average annual catch (%)
Sardina común	*Strangomera bentincki*	Araucanian herring	Criterion 1	2,699	72.5
Anchoveta	*Engraulis ringens*	Anchoveta	Criterion 1	872	23.4
Mote o bacaladillo	*Normanichthys crockeri*	Mote sculpin	Not assessed	101	2.7
Jurel	*Trachurus murphyi*	Inca scad	Criterion 1	35	0.9
Merluza común	*Merluccius gayi*	South Pacific hake	Data Deficient (overexploited*)	6	0.2
Pampanito	*Stromateus stellatus*	Starry butterfish	Least Concern	4	0.1
Machuelo o tritre	*Ethmidium maculatum*	Peruvian menhaden	Data Deficient	3	0.1
Lenguado de ojo chico	*Paralichthys microps*	Small-eyed flounder (IUCN)	Least Concern	2	0.0
Blanquillo	*Prolatilus jugularis*	Pacific sandperch	Not assessed	1	0.0
Sierra	*Thyrsites atun*	Snoek	Not assessed	1	0.0
Pejerrey de mar	*Odontesthes regia*	Chilean silverside	Least Concern	1	0.0
Medusa	*Scyphozoa*	Jelly	Not assessed	1	0.0
Bagre de mar	*Aphos porosus*	Banded toadfish	Least Concern	<1	0.0
Pejegallo	*Callorhinchus callorynchus*	Plownose chimaera	Vulnerable	<1	0.0
Calamar	*Doryteuthis (Amerigo) gahi*	Patagonian squid	Least Concern	<1	0.0
Jaiba reina	*Cancer plebejus*	Chilean crab	Not assessed	<1	0.0
Corvina	*Cilus gilberti*	Corvina drum	Data Deficient	<1	0.0
Merluza de cola	*Macruronus magellanicus*	Patagonian grenadier	Not assessed (exhausted*)	<1	0.0
Salmón	*Oncorhynchus* spp.; *Salmo* spp.	Salmon	Invasive	<1	0.0

Table 19: Catch and incidental mortality by species in the artisanal purse seine fleet that operated between the Valparaíso Region to Los Ríos Region. Data from the observer register scientists on 988 fishing sets, during the period January 2015 to December 2021 (data from Table 89 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.

Table 30

Nombre común	Nombre científico/Scientific name	Common name	IUCN rating	Catch (individuals)	Deaths (individuals)
Lobo marino común	*Otaria flavescens/O. byronia*	South American sea lion	Least Concern	3,760	5
Orca	*Orcinus orca*	Killer whale	Data Deficient	6	0
Fardela Blanca	*Ardenna creatopus*	Pink-footed shearwater	Vulnerable	1,343	893
Fardela negra	*Ardenna grisea*	Sooty shearwater	Near Threatened	1,323	1,029
Pelicano peruano	*Pelecanus thagus*	Peruvian pelican	Near Threatened	368	20
Gaviota dominicana	*Larus dominicanus*	Kelp gull	Least Concern	177	69
Fardela blanca de más a tierra	*Pterodroma defilippiana*	Masatierra petrel	Vulnerable	38	38
Pingüino de Humboldt	*Spheniscus humboldti*	Humboldt penguin	Vulnerable	22	0
Piquero	*Sula variegata*	Peruvian booby	Least Concern	10	10
Gaviota de Franklin	*Larus pipixcan*	Franklin's gull	Least Concern	9	0
Gaviota garuma	*Leucophaenus modestus*	Grey gull	Least Concern	8	0
Fardela blanca de Juán Fernández	*Pterodroma externa*	Juan Fernandez petrel	Vulnerable	7	7
Pingüino de Magallanes	*Spheniscus magellanicus*	Magellanic penguin	Least Concern	6	3
Yeco/Pato yeco	*Phalacrocorax brasilianus/ Nannopterum brasilianus*	Neotropical cormorant	Least Concern	4	1
Gaviota cáhuil	*Larus maculipennis*	Brown-hooded gull	Least Concern	2	2
Gaviotín monja	*Larosterna inca*	Inca tern	Near Threatened	1	0
Pingüino	*Spheniscus* sp.	Penguin		1	0
Golondrina de mar	*Oceanites oceanicus*	Wilson's storm-petrel	Least Concern	1	0

Industrial anchoveta and Araucanian herring fishery

The catch in the industrial anchoveta and Araucanian herring fishery in the Central South Zone is dominated by those two species. Bigeye tuna and plownose chimaera (also known as American elephantfish) are species of concern caught in this fishery, due to their IUCN status. Bigeye tuna is caught in quite low volumes compared to the major targeted tuna fisheries. Plownose chimaera is caught as targeted and incidental catch by handline and by demersal gillnet, trawl, and longline, and is fished year-round throughout most of its depth and distribution {Finucci, B. & Cuevas, J.M. 2020}. South Pacific hake and Patagonian grenadier are likewise subject to targeted fisheries in the area (p. 2 in https://www.ifop.cl/wp-content/contenidos/uploads/RepositorioIfop/InformeFinal/2023/P-682099_seccion_II_merluza_cola.pdf). These species are all excluded from further consideration. A number of mammals and seabirds are caught, but no turtles. The mammals (South American sea lion) are listed as IUCN “Least Concern” and are nearly always released alive, so they are excluded from further consideration. Seabirds are included as a main species, based on the combination of their IUCN categories, the number caught, and the number dying.

Main species: Araucanian herring, anchoveta, and seabirds

Table 20: Total catch, average catch, and catch of the species of accompanying fauna with respect to the target species during the period 2016–21 in the industrial pelagic fishery for anchoveta and Araucanian herring in the Central South Zone (between the regions of Valparaíso and Los Lagos) (data from Anexo 10.2, Table 14 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.
* Some species are considered "Data Deficient" by IUCN but have stock assessments in Chile, including *Merluccius gayi*, *Dosidicus gigas*, and *Macruronus magellanicus* (SUBPESCA 2023a). The tables in this section also reflect those species' status in Chile.

Table 31

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Average annual catch (t)	Average annual catch (%)
Sardina común	*Strangomera bentincki*	Araucanian herring	Criterion 1	1,808	85.0
Anchoveta	*Engraulis ringens*	Anchoveta	Criterion 1	268	12.6
Mote o bacaladillo	*Normanichthys crockeri*	Mote sculpin	Not assessed	45	2.1
Sierra	*Thyrsites atun*	Snoek	Not assessed	4	0.2
Merluza común	*Merluccius gayi*	South Pacific hake	Data Deficient (overexploited*)	2	0.1
Corvina	*Cilus gilberti*	Corvina drum	Data Deficient	1	0.0
Pampanito	*Stromateus stellatus*	Starry butterfish	Least Concern	<1	0.0
Pejegallo	*Callorhinchus callorynchus*	Plownose chimaera	Vulnerable	<1	0.0
Salmón	*Oncorhynchus* spp.; *Salmo* spp.	Salmon	Invasive	<1	0.0
Atún ojo grande	*Thunnus obesus*	Bigeye tuna	Vulnerable	<1	0.0
Jurel	*Trachurus murphyi*	Inca scad	Data Deficient	<1	0.0
Salmón del Atlántico	*Salmo salar*	Atlantic salmon	Invasive	<1	0.0

Table 21: Catch and incidental mortality by species in the industrial purse seine fleet of anchoveta and Araucanian herring that operated between the Valparaíso Region and the Los Lagos Region. Data from the registry of scientific observers on 324 fishing sets, during the period January 2015 to December 2021 (data from Table 88 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.

Table 32

Nombre común	Nombre científico/Scientific name	Common name	IUCN rating	Catch (individuals)	Deaths (individuals)
Lobo marino común	*Otaria flavescens/O. byronia*	South American sea lion	Least Concern	1,679	25
Fardela blanca	*Ardenna creatopus*	Pink-footed shearwater	Vulnerable	1,578	943
Pelicano peruano	*Pelecanus thagus*	Peruvian pelican	Near Threatened	407	62

Fardela negra	*Ardenna grisea*	Sooty shearwater	Near Threatened	399	151
Gaviota dominicana	*Larus dominicanus*	Kelp gull	Least Concern	185	2
Fardela	*Ardenna* sp.	Petrel	—	132	132
Gaviota cáhuil	*Larus maculipennis*	Brown-hooded gull	Least Concern	80	0
Pingüino de Humboldt	*Spheniscus humboldti*	Humboldt penguin	Vulnerable	43	29
Pingüino	*Spheniscus* spp.	Penguin	—	27	23
Golondrina	*Hydrobatidae*	Shearwater	—	11	11
Albatros de ceja negra	*Thalassarche melanophris*	Black-browed albatross	Least Concern	7	7
Petrel moteado	*Daption capense*	Cape petrel	Least Concern	4	4
Petrel	*Procellariidae*	Petrel	—	2	2
Petrel gigante antártico	*Macronectes giganteus*	Southern giant petrel	Least Concern	2	0
Cormorán	*Phalacrocorax* spp.	Cormorant	—	2	2
Fardela gris	*Procellaria cinerea*	Grey petrel	Near Threatened	2	2
Petrel gigante	*Macronectes* sp.	Giant petrel	—	2	2
Petrel gigante subantartico	*Macronectes halli*	Northern giant petrel	Least Concern	1	1
Pingüino de Magallanes	*Spheniscus magellanicus*	Magellanic penguin	Least Concern	1	0
Albatros chico	*Thalassarche* spp.	Albatross	—	1	1
Gaviotín sudamericano	*Sterna hirundinacea*	South American tern	Least Concern	1	1

Industrial jurel fishery

The catch in the industrial jurel fishery in the Central South Zone is dominated by the target species (jurel). A number of sharks are caught, including blue, thresher, porbeagle, and shortfin mako, as well as swordfish. These species are excluded from further consideration in this Seafood Watch assessment because they are caught in low volumes in this fishery relative to the catch (both target and bycatch) in other fisheries, particularly those for tuna and other large pelagic species. South Pacific hake and Patagonian grenadier are likewise subject to targeted fisheries in the area (p. 2 in https://www.ifop.cl/wp-content/contenidos/uploads/RepositorioIfop/InformeFinal/2023/P-682099_seccion_II_merluza_cola.pdf), so they are also excluded. A number of mammals, seabirds, and turtles are also caught. The mammals (South American sea lion) are listed as IUCN "Least Concern" and are nearly always released alive. Turtles (green turtle) are rarely caught and are released alive. Both taxa are excluded from further consideration. Seabirds are included as a main species, based on the combination of their IUCN categories, the number caught, and the number dying.

Main species: Inca scad and seabirds

Table 22: Total catch, average catch, and catch of the species of accompanying fauna with respect to the target species during the period 2016–21 in the industrial pelagic jack mackerel fishery in the Central South Zone (between the regions of Valparaíso and Los Lagos, including international waters) (data from Anexo 10.2, Table 15 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.
* Some species are considered "Data Deficient" by IUCN but have stock assessments in Chile, including *Merluccius gayi*, *Dosidicus gigas*, and *Macruronus magellanicus* (SUBPESCA 2023a). The tables in this section also reflect those species' status in Chile.

Table 33

Nombre común	Nombre científico/Scientific name	Common name	IUCN Category	Average annual catch (t)	Average annual catch (%)
Jurel	*Trachurus murphyi*	Inca scad	Criterion 1	40,677	97.5
Caballa	*Scomber japonicus*	Pacific chub mackerel	Least Concern	902	2.2
Sierra	*Thyrsites atun*	Snoek	Not assessed	57	0.1
Jibia	*Dosidicus gigas*	Jumbo flying squid	Data Deficient*	44	0.1
Pez medusa	*Cubiceps caeruleus*	Blue fathead	Least Concern	19	0.0
Agujilla	*Scomberesox saurus*	Atlantic saury	Least Concern	13	0.0
Merluza común	*Merluccius gayi*	South Pacific hake	Data Deficient*	8	0.0
Reineta	*Brama australis*	Southern rays bream	Not assessed	4	0.0
Medusa	*Scyphozoa*	Jelly	Not assessed	1	0.0
Besugo	*Epigonus crassicaudus*	Thicktail cardinalfish	Not assessed	<1	0.0
Merluza de cola	*Macruronus magellanicus*	Patagonian grenadier	Not assessed (exhausted*)	<1	0.0
Bonito	*Sarda chiliensis chiliensis*	Eastern Pacific bonito	Least Concern	<1	0.0
Atún aleta larga	*Thunnus alalunga*	Albacore	Least Concern	<1	0.0
Tiburón pejezorro	*Alopias vulpinus*	Thresher shark	Vulnerable	<1	0.0
Tiburón azulejo	*Prionace glauca*	Blue shark	Near Threatened	<1	0.0
Albacora	*Xiphias gladius*	Swordfish	Near Threatened	<1	0.0
Atún listado	*Katsuwonus pelamis*	Skipjack tuna	Least Concern	<1	0.0
Marrajo sardinero	*Lamna nasus*	Porbeagle shark	Vulnerable	<1	0.0
Tiburón marrajo	*Isurus oxyrinchus*	Shortfin mako shark	Vulnerable	<1	0.0

Table 23: Catch and incidental mortality in the jack mackerel industrial purse seine fleet that operated between the regions of Valparaíso and Los Lagos and in international waters. Data from the registry of scientific observers on 2,398 fishing sets, during the period January 2015 to December 2021 (data from Table 87 in (IFOP 2022a)). Red cell indicates taxa that Seafood Watch considers species of concern, based on IUCN category.

Table 34

Nombre común	Nombre científico/Scientific name	Common name	IUCN rating	Catch (individuals)	Deaths (individuals)
Lobo marino común	*Otaria flavescens/O. byronia*	South American sea lion	Least Concern	1,870	13
Gaviota dominicana	*Larus dominicanus*	Kelp gull	Least Concern	244	1
Albatros de ceja negra	*Thalassarche melanophris*	Black-browed albatross	Least Concern	215	1
Pelicano peruano	*Pelecanus thagus*	Peruvian pelican	Near Threatened	109	3
Albatros chico	*Thalassarche* spp.	Albatross		61	0
Fardela negra	*Ardenna grisea*	Sooty shearwater	Near Threatened	47	2
Albatros de cabeza gris	*Thalassarche chrysostoma*	Grey-headed albratross	Endangered	36	0
Golondrina de mar	*Oceanites oceanicus*	Wilson's storm-petrel	Least Concern	18	1
Fardela blanca	*Ardenna creatopus*	Pink-footed shearwater	Vulnerable	16	16
Pingüino de Humboldt	*Spheniscus humboldti*	Humboldt penguin	Vulnerable	13	1
Petrel gigante antártico	*Macronectes giganteus*	Southern giant petrel	Least Concern	8	0
Petrel moteado	*Daption capense*	Cape petrel	Least Concern	8	0
Fardela negra grande	*Procellaria aequinoctialis*	White-chinned petrel	Vulnerable	8	1
Pingüino	*Spheniscus* sp.	Penguin	—	1	1
Golondrina	*Hydrobatidae*	Shearwater	—	1	1
Albatros errante	*Diomedea exulans*	Wandering albatross	Vulnerable	1	0
Tortuga Laúd	*Dermochelys coriacea*	Leatherback turtle	Vulnerable	1	0

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

Colorado langostino (Pleuroncodes monodon)

Factor 2.1 - Abundance

Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Moderate Concern

Colorado langostino/carrot squat lobster/munida (*Pleuroncodes monodon*/*Grimothea monodon*) is not targeted in Peru as it is in Chile (Escobedo Oblitas 2018)(Yapur-Pancorvo et al 2023); rather, it is primarily caught alongside anchoveta. There are no reference points, stock assessments, or quotas for the species in Peru. A study by a Master's student determined relative abundance from 1997 to 2014, and found relatively low abundance through 1999, higher abundance through 2004, and low relative abundance again through 2014 (Figure 30) (Escobedo Oblitas 2018). Relative abundance seemed to be driven most heavily by extreme El Niño events (1997–98) (Escobedo Oblitas 2018). A productivity-susceptibility analysis (PSA) determined the species to have medium vulnerability to overfishing, allowing for a score of 2.33 and a moderate concern rating.

Justification:

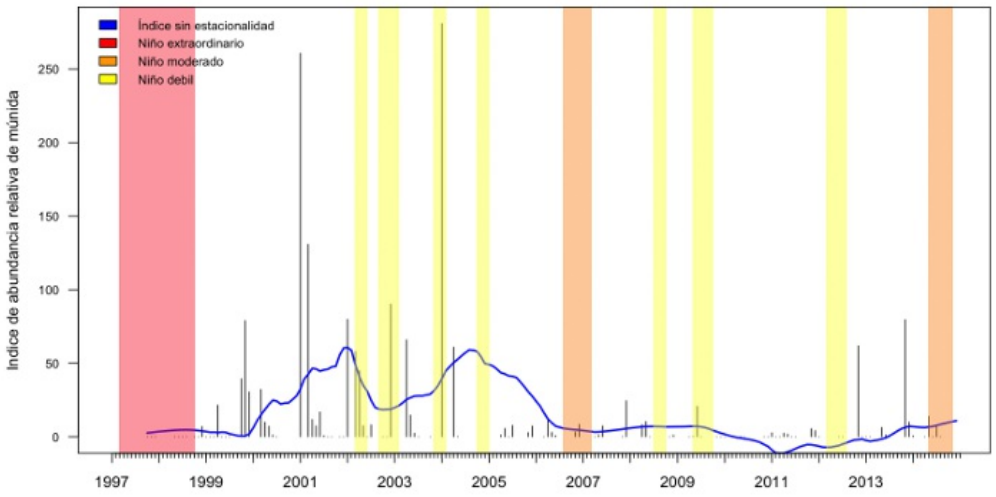

Figure 30: Calculated values of the relative abundance index for Colorado langostino from 1997 to 2014. El Niño events are illustrated in color (Escobedo Oblitas 2018).

Summary of PSA for *Pleuroncodes monodon*. See Seafood Watch Standard for Fisheries v4 for more information.

Table 9

Productivity Attribute	High productivity (low risk, score = 1)	Medium productivity (medium risk, score = 2)	Low productivity (high risk, score = 3)	Score	Value; {Reference(s)}
Average age at maturity	< 5 years	5–15 years	>15 years	1	Unknown but assumed based on max age

Average maximum age	<10 years	10–25 years	>25 years	1	6 years (Bahamonde et al 1986) and references therein
Von Bertalanffy (Brody) Growth Coefficient (K) (to be used for species that exhibit first-order growth)	>0.25	0.15–0.25	<0.15		Unknown
Fecundity	>20,000 eggs per year	100–20,000 eggs per year	<100 eggs per year	2	1,808–33,966 eggs per laying (Yapur-Pancorvo 2023)
Reproductive strategy	Broadcast spawner	Demersal egg layer or brooder	Live bearer	2	
Density dependence	Compensatory dynamics at low population size demonstrated or likely	No depensatory or compensatory dynamics demonstrated or likely	Depensatory dynamics at low population sizes (Allee effects) demonstrated or likely		
Productivity score (mean of attribute scores)				**1.5**	

Table 10

Susceptibility Attribute (default scores in bold)	**Low S (score = 1)**	**Medium S (score = 2)**	**High S (score = 3)**	**Score**	**Value/notes; {Reference}**
Areal overlap (all fisheries)	>90% of species concentration is unfished	70%–90% of species concentration is unfished	**>30% of the species concentration is fished**	3	Overlap between the Peruvian anchoveta fishery (in Peru) and munida habitat is roughly 50% (Escobedo Oblitas 2018)
Vertical overlap (all fisheries)	>67% of species' depth range is unfished	33%–66% of species' depth range is unfished	**>33% of species' depth range is unfished**	3	
Seasonal Availability (all fisheries)	Fisheries overlap with species <3 months/year	Fisheries overlap with species 3–6 months/year	**Fisheries overlap with species >6 months/year**	3	Default values selected
Selectivity of fishery (specific to fishery under assessment)	Species is not targeted AND is not likely to be captured by gear	**Species is targeted, or is incidentally encountered AND is not likely to escape the gear**	Species is targeted or is incidentally encountered AND combination of fishery attributes and species' biology increase its susceptibility to the gear	2	
Post-capture mortality (specific to fishery under assessment)	>66% individuals survive post-capture	33%–66% individuals survive post-capture	**Retained species, or >66% do not survive post capture**	3	
Susceptibility score (mean of attribute scores)				**2.8**	

Table 11

Table 11

Productivity-Susceptibility Score ($V = \sqrt{(P^2 + S^2)}$)	3.176
Vulnerability Rating: < 2.64 = Low vulnerability, = 2.64 and = 3.18 = Medium vulnerability, > 3.18 = High vulnerability	**Medium**

Factor 2.2 - Fishing Mortality

Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Moderate Concern

Wlth no reference points, stock assessments, or quotas, fishing mortality relative to sustainable levels is unknown, which requires a score of 3 and a rating of moderate concern.

Longnose anchovy (Anchoa nasus)

Factor 2.1 - Abundance

Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet

Moderate Concern

Longnose anchovy is known as samasa in Peru. Limit and target reference points for longnose anchovy are not defined, data limited assessments are not available, and the stock status is unknown. But, the species is listed as “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 that 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/prefishing abundance of this stock is unknown, but a peak in abundance of 2 million mt was observed in 1998 during a strong El Niño event (Bouchon 2007).

In 2019, 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 anchoveta, samasa (longnose anchovy), catfish, red squat 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 distribution (within 10 nm of the coast), 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).

Factor 2.2 - Fishing Mortality

Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet

Moderate Concern
Anchoveta and longnose anchovy are not separated in the catch. Therefore, official catches of longnose anchovy 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 70,000 mt of longnose anchovy was landed in Peru; however, in 1998, during a strong El Niño event, this quantity increased to 283,000 mt (Bouchon 2007). It composed 37% of the total anchoveta landed that year (Hervas & Medley 2015). According to the SALVAMARES programs, during the first and second anchoveta 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 and a minimum of 235 mt in 2018 (INEI 2020). It is unclear if longnose anchovy is really caught in inappreciable numbers or if it is not adequately recorded as a separate species because of its similarity to anchoveta (INEI 2020).

Pacific chub mackerel (Scomber japonicus)

Factor 2.1 - Abundance

Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet

Very Low Concern
Pacific chub mackerel has a widespread pelagic coastal distribution. In the southern Pacific, the species is generally restricted to the eastern area {SPFRMO 2007}. Serra et al. (1982) suggests the existence of two stocks in southeastern Pacific waters: i) Central-North Peru and ii) the northern border of Chilean waters to 40°S. (between 33° S. and 40° S.), though there is evidence that there may be separate stocks that exist in Ecuador and central Chile (SPRFMO 2007). The stock in Peruvian waters has been recently assessed by IMARPE, and the biomass of the stock is estimated to be exceeding the B_{MSY} level by several orders of magnitude in recent years (Figure 31). A recent stock assessment that finds biomass to be above an appropriate reference level (Pacific chub mackerel is not considered a key forage species in the present assessment; see Appendix A) allows for a score of 5 and a rating of very low concern.

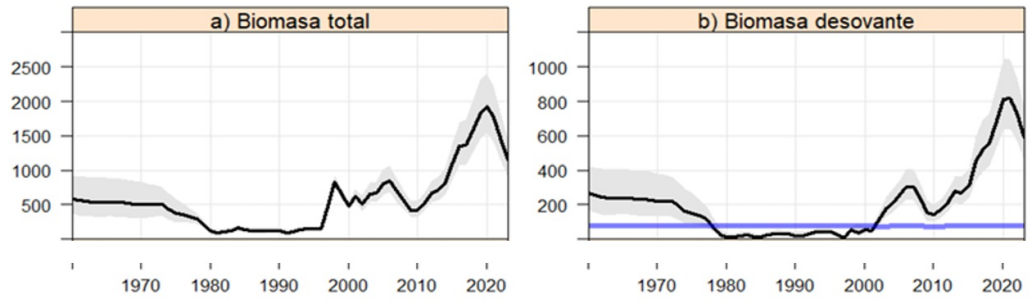

Figure 31: Estimated population indicators for Pacific chub mackerel present in Peruvian waters: a) Total annual biomass (thousands t); b) Annual spawning biomass relative to spawning biomass at MSY (thousands t) (IMARPE 2024).

Factor 2.2 - Fishing Mortality

Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet

Low Concern

Fishing mortality of Pacific chub mackerel is estimated to have been below F_{MSY} for around two decades, allowing for a score of 5 and low concern.

Justification:

Figure 32: Estimated annual fishing mortality rate for Pacific chub mackerel present in Peruvian waters, relative to fishing mortality at MSY (IMARPE 2024).

Pacific sardine (Sardinops sagax)

Factor 2.1 - Abundance

Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery

Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

High Concern

Pacific sardine is caught in the Chilean North Zone industrial anchoveta fishery and is assumed to also be caught in the Peruvian industrial fishery on the South Peru-North Chile anchoveta stock (see the Criterion 2 Summary for more information). Reference points are not defined for Pacific sardine (sardina española in Chile, South American pilchard by the FAO), but the stock is considered to be depleted by managers due to minimal landings in recent decades (SUBPESCA 2024). Therefore, Seafood Watch considers the abundance of the Pacific sardine in the region a 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 (440 South) (SUBPESCA 2008). This is a coastal fish found at depths to 200 m that forms large schools (Whitehead 1985). In contrast to the anchoveta, 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 anchoveta and the South American pilchard have been suggested (Figure 33) (IFOP 2020a).

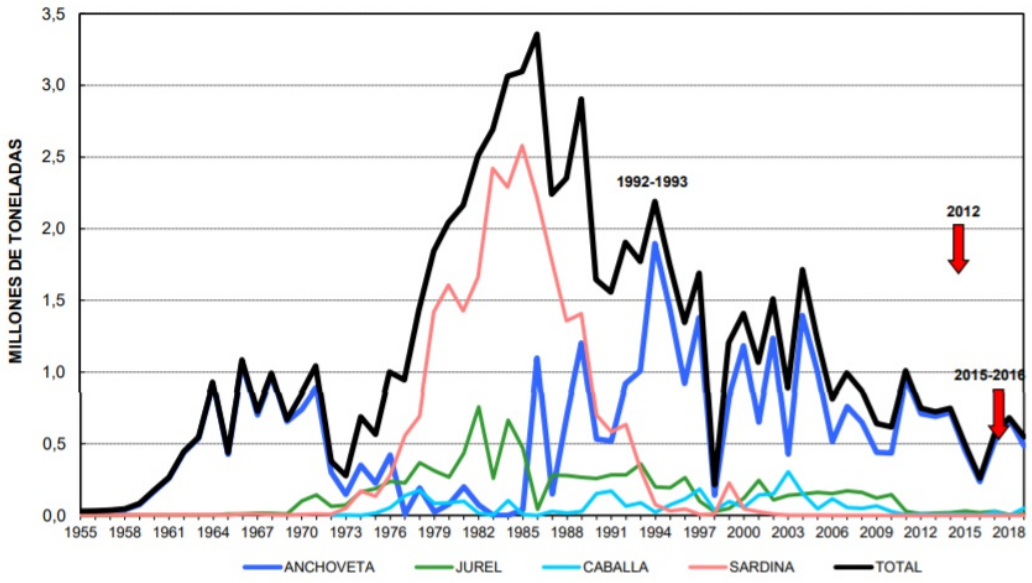

Figure 33: Catches of the main pelagic species in Chilean waters (1955–2018). The red arrows indicate El Niño events (IFOP 2020a).

In the case of the South American pilchard in Chilean Regions XV-II and III-IV, IFOP considers that the current condition of the resource, which shows extremely low abundance levels since the mid-1990s, 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. 1ºC No. 59) (Law 18,892 1991)(SUBPESCA 2024). The current status of the fishery is caused by adverse physical and biological environmental conditions. As stated, 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 | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Moderate Concern
Fishing mortality reference points have not been defined, so fishing mortality relative to a sustainable amount 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).

Rays (Batoidea)

Factor 2.1 - Abundance

Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet

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 2020). 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 their biology, although they are suspected to have limited life history parameters similar to other myliobatid rays (including low fecundity) (Dulvy et al 2020). Both species are listed as “Vulnerable” (VU) on the IUCN Red List (Dulvy et al 2020)(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 their 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 | Peru | Purse seines | North-Central Peru | Industrial fleet

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 anchoveta fishery is not a substantial contributor to fishing mortality of these species, and 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 2020).

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

Seabirds (Aves)

Factor 2.1 - Abundance

Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

High Concern

Several of these seabird species are listed as “Vulnerable” or “Near Threatened,” allowing for a score of high concern.

Justification:
Several species of seabirds interact with the anchoveta 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.) Nº 105/2019).

Among the species identified as interacting with these fisheries are: shearwaters such as the sooty shearwater ("Near Threatened") {BirdLife International 2019a} and pink-footed shearwater ("Vulnerable") {Birdlife International 2018a}; petrels such as the white-chinned petrel ("Vulnerable"), grey petrel ("Near Threatened"), cape petrel ("Least Concern"), northern giant petrel ("Least Concern"), and Wilson's storm petrel ("Least Concern") (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 ("Near Threatened"), Peruvian booby ("Least Concern"), guanay cormorant ("Near Threatened"), Inca tern ("Near Threatened") {Birdlife International 2018g}{Birdlife International 2018h} {Birdlife International 2018i}{Birdlife International 2018j}, and Humboldt penguin ("Vulnerable") (BirdLife International 2020).

Factor 2.2 - Fishing Mortality

Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

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, which are used to determine the relative impact of a fishery on bycatch species of various taxa for fisheries where species and amounts of bycatch are not available or are incomplete. The matrices represent typical relative impacts of different fishing gear on various taxa, based on the best available science (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 collecting data on bycatch since 2017, under the FIP currently in place for the IHD fishery {CeDePesca 2020}.

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

Chile

In Chile, catches of seabirds were recorded by IFOP observers working onboard 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 and 2020 (854 sets monitored), 17.1% of the bycatch reported by the industrial fishery operating in the north were seabirds: the main species caught were sooty shearwater and booby, with 582 individuals (390 dead) and 98 individuals (58 dead), respectively. In the case of the artisanal fishery operating in the northern regions, the seabirds represented 34.4% of the bycatch, with guanay cormorant (200 individuals, all dead) and booby (53 individuals, all dead) as the main species caught (IFOP 2020). In the central artisanal fishery, booby was again the main species caught (12 individuals).

In the case of the auto-reported catches, data were 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 2017–19 (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 guanay 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 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, where a multispecific artisanal fleet for Aracaunian herring and anchoveta 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 sooty shearwater (1,576 individuals, 1,282 dead), pink-footed shearwater (1,283 individuals, 830 dead), Peruvian pelican, and 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 were not reliable.

Factor 2.3 - Discard Rate/Landings

Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Central - North Chile stock | Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
South Peru - North Chile stock | Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

< 100%

No bait is used in purse seine fisheries. While accurate quantitative estimates of discard mortality, including that from releasing catch before it is landed, are not generally available, it is nonetheless clear that the ratio of discards/landings in the Peruvian and Chilean small pelagics purse seine fisheries is <100%.

Justification:
According to the most recent assessment of global marine fisheries discards from the FAO, purse seine fisheries generally have very low discard rates (though the actual discard levels can be quite high due to the volume of the catch) (Figures 34–35) (Pérez Roda et al 2018). Data from the observer programs suggest that the ratio of the catch of nontarget species to target species is quite low in the small pelagics fisheries in Peru and Chile (see Criterion 2). But few documents from those programs report discards of anchovy (e.g., (IMARPE 2019)(CeDePesca 2020a)(CeDePesca 2020b)), challenging the robust quantification of total discard mortality. As noted by Pérez Roda et al. (2018), it is common practice in purse seine fisheries to release the catch while it is still in the water when the size or species composition of the catch is not desirable. This "slipping" is not accounted for in (Pérez Roda et al 2018), and no information on it is presented in the observer reports from Peru (e.g., (IMARPE 2019)(CeDePesca 2020a)(CeDePesca 2020b)). For the industrial purse seine fishery fishing on the North-Central Peruvian stock, Torrejón-Magellanes et al. (2016) used modeling to estimate the discards in that fleet due to excess catch for the years 2005–14. The average estimated catch for the study period was 121,312 mt, or 2.6% of landings. That study also noted a decline in these "discards" from 2010, down to close to zero in 2014. The authors note a change in the spatial behavior of the fleet and posit that this may explain the decreasing trend (Torrejón-Magellanes et al 2016). No more recent data were found to confirm that discards due to excess catch have remained at the low 2013–14 levels.

Peru industrial fleet: According to the FIP manager, it is not economical for the industrial fleet to make a last haul where part of the catch will not have a place in the hold (pers. comm., Ernesto Goldelman). While this suggests that the fleet would try to minimize these events, the IMARPE observer program has reported a number of discard events due to excess capture (15) and due to the high presence of juveniles (11) (IMARPE 2019) (that document does not provide the volume or percentage of discards). The industrial fleet also directly pumps the fish into the hold, so releasing the catch before hauling is relatively easy (pers. comm., Ernesto Goldelman).

Peru small-scale/artisanal fleet: Releasing part of the last set used to be common practice in the smaller nonindustrial fleet, where there was less space in the hold (pers. comm., Ernesto Goldelman). Elimination of such discards has been a goal of the FIP, where observers call another boat to take the excess catch (pers. comm., Ernesto Goldelman). According to the August 2023 report for the private observer program for the FIP, of the 2,135.71 mt of observed (not weighed) estimated anchoveta catch in 2022, 347 mt were transferred to other boats (CeDePesca 2022). In addition, 57.2 mt were returned to the sea due to a high presence of juveniles, 16 mt were discarded due to high incidence of sea lions when closing the net, 6 mt due to excess catch of nontarget species (Munida spp.), 5.4 mt for insufficient capture, 42 mt for excess capture, 7.9 mt released just by opening the net, and <1 mt consumed by the crew (CeDePesca 2022). In sum, of the catch observed, around 135 mt or 6% were "discarded."

Chile: The Scientific and Technical Committee of the Small Pelagic Fishery (CCT_PP 2021) used the following values for discard mortality when proposing a quota in 2021/2022, based on observer data and expert judgment:

Anchoveta Valparaíso—Los Lagos: 2%
Sardine Valparaíso—Los Lagos: 4%
Anchoveta northern zone: 2% first semester, 1.8% second semester

No values were indicated for Regions III-IV in that report.

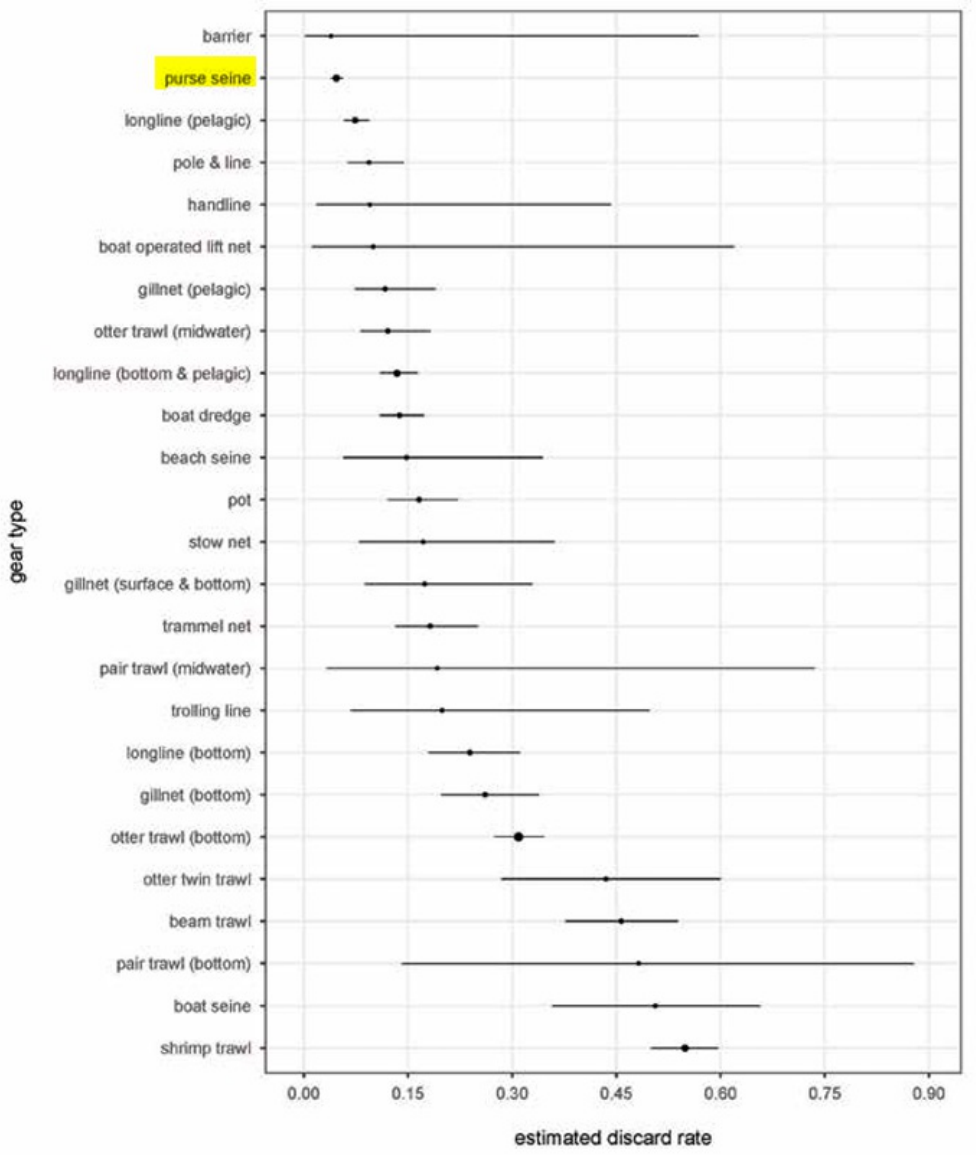

Figure 34: Mean discard rates and 95% credible intervals for 25 gear types, estimated from gear-specific zero-inflated beta regression models fitted within a Bayesian inferential framework. Discard rates are expressed in tonnes of discards per tonnes of total catch. The solid dots represent mean discard rates for different gear types, and their sizes are proportional to their sample sizes. Plot and text from (Pérez Roda et al 2018). **NOTE: the Seafood Watch Standard for Fisheries requires the discard rate to be expressed in terms of discards/landings rather than discards/catch.**

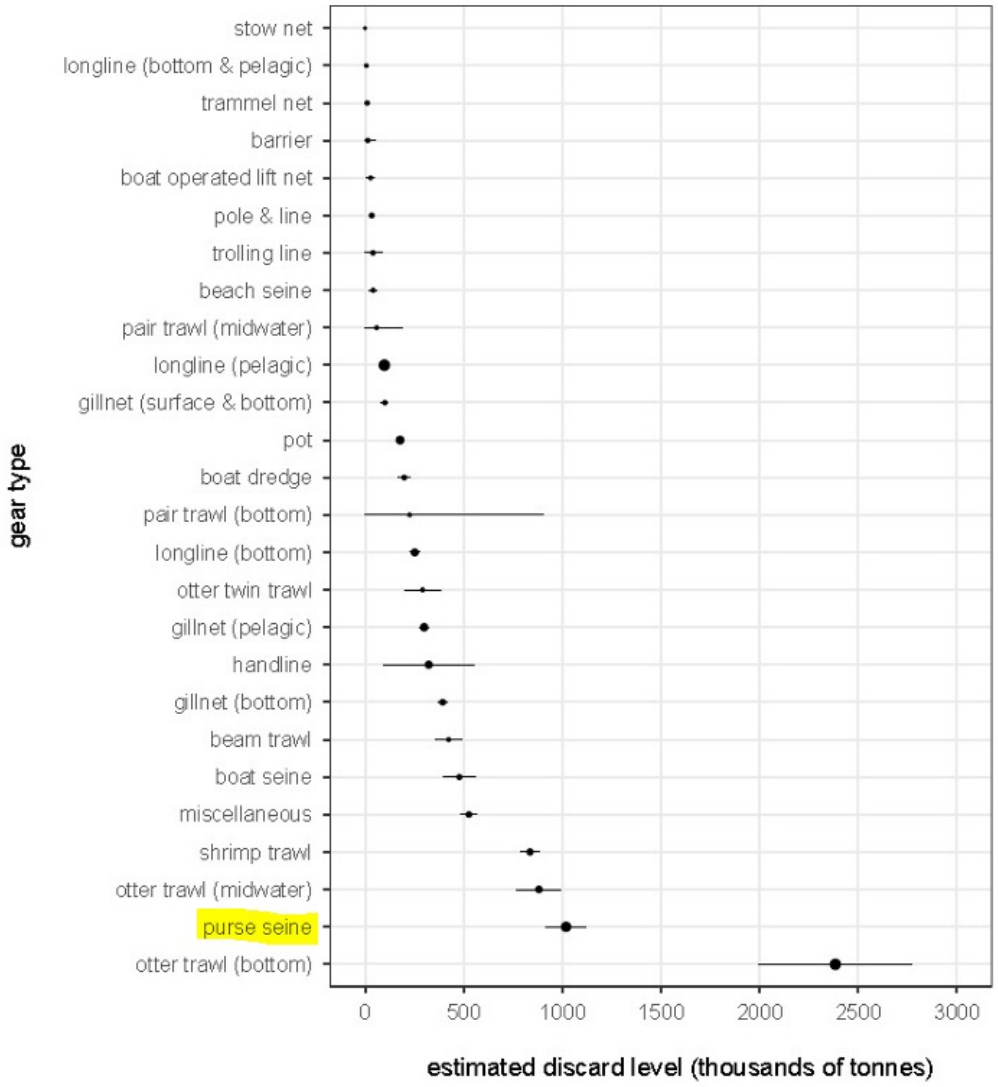

Figure 35: Mean discard levels (thousand tonnes) and 95% confidence intervals by gear type. The solid dots represent mean discard levels for different gear types, and their sizes are proportional to their sample sizes. Plot and text from (Pérez Roda et al 2018).

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 LowConcern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (LowConcern) — 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 | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	**Yellow (3.000)**
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	**Yellow (3.000)**
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	**Yellow (3.000)**

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	Yellow (3.000)
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	Yellow (3.000)
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	Yellow (3.000)
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	Yellow (3.000)
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Highly effective	Yellow (3.000)
Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet	Highly effective	Moderately Effective	Highly effective	Moderately Effective	Moderately Effective	Green (4.000)
Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet	Highly effective	Moderately Effective	Highly effective	Moderately Effective	Moderately Effective	Green (4.000)
Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet	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 manages followscientific 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? Howsuccessful are these management measures? To achieve a Highly Effective rating, the fishery must have no or lowbycatch, 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: Howmuch and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments

must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

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

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

Factor 3.1 - Management Strategy And Implementation

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Moderately Effective

A number of management regulations apply to the small pelagics fisheries in Chile (Table 24). Management plans have been established for the main small pelagics species caught (currently: anchoveta, Inca scad/Chilean jack mackerel/jurel, and Araucanian herring). Reference points are defined and quotas based on those reference points are set annually for managing the fishery; a number of these quotas are based on an unfished biomass parameter that is recalculated quite frequently (i.e., dynamic B_0). There are no management plans or reference points for other small pelagics species caught, such as Pacific sardine (sardina espanola) or Pacific chub mackerel (caballa)—the latter accounted for about 9% and 2% of the landings of the industrial and artisanal fleets, respectively, in 2021 (see the Introduction). But monitoring is conducted for these species, with the intention of more active management if catches were to increase (and thereby data were to become available for determining reference points and conducting stock assessments, etc.). There is a catch limit for Pacific sardine because the stock is depleted, but it is set to allow an anchoveta fishery and it is unclear whether it is set low enough to not hinder recovery of the stock. Furthermore, fishing mortality on Araucanian herring is currently likely too high.

Although a seemingly robust and dynamic framework is in place for the majority of the main retained stocks, management has yet to implement a Management Strategy Evaluation (MSE), which could help understanding of the effectiveness of the management regime in ensuring that fishing mortality does not hinder the recovery of the stock during periods when environmental conditions are unfavorable to the stock. As noted by Punt et al. (2016), the MSE framework is the most appropriate way to evaluate harvest strategies for achieving long-term fishery and conservation objectives under multiple sources of uncertainty. Such uncertainties in this fishery include the great irregularity and contradictory signals between the data sources used in the South Chile stock assessment, which make it difficult to ascertain stock condition (Canales et al 2020a)(Canales and Cubillos 2021). There is a project to develop and implement an MSE for the fisheries (i.e., industrial and artisanal fisheries for anchoveta and Araucanian herring/sardina común in Central-South Chile) (Cubillos et al 2012) (Canales et al 2020a)(Canales and Moises 2023). An early contribution in that project suggested that a sustainable level of catch would be around 400,000 to 450,000 mt for anchoveta and sardina común combined (Canales et al 2020a); recent catches have been around that level but higher in 2019 and 2021 (476,000 mt and 514,000 mt, respectively). There is no MSE project in place for the small pelagics fisheries in other Chilean regions.

In addition, there is little coordination between the management agencies of Chile and Peru on the main fishery management tools (setting TACs and closed areas) for the South Peru-North Chile stock (Canales and Cubillos 2021), which accounts for the biggest portion of Chilean anchoveta landings. Canales and Cubillos (2021) show that a lack of coordination does not necessarily preclude effective management, as long as an effective harvest control rule (HCR) is in place. The example given in (Canales and Cubillos 2021) is a HCR based on the daily egg production method surveys in Chile, which could allow for a sustainable fishery under different sources of uncertainty in the biological fishing system. No such rule is currently in place in Chile or Peru.

In short, a number of different weaknesses across the fisheries preclude a finding that management is highly effective for any of them, including limited international cooperation, limited application of MSE or other independent validation of the effectiveness of the strategy, excessive fishing mortality on Araucanian herring, and unclear justification for the Pacific sardine catch limit. Therefore, the management strategy is Chile is considered moderately effective.

Table 24: Management regulations among the small pelagics fisheries in Chile

Table 12

Region	Fishery	Criterion 3.1 species	Management plan	Other
North Zone: Arica y Parinacota to Antofagasta (XV, I, II) (South Peru-North Chile stock shared with Peru)	Industrial anchoveta fishery	Anchoveta, Pacific sardine	Approved (Res. Ex. No 1197 2018}, with an implementation report in 2022 (COMPLAZE-ZN 2023)	Limited international coordination
	Artisanal anchoveta fishery	Anchoveta		
	Industrial jurel fishery	Inca scad/Chilean jack mackerel and Pacific chub mackerel	No	
Central North Zone: Atacama to Coquimbo (III, IV)	Artisanal anchoveta fishery	Anchoveta, Pacific sardine	Approved (Res. Ex. N° 3893 2017)	
	Artisanal jurel fishery	Inca scad, Pacific chub mackerel	No	
Central South Zone: Valparaíso to Los Lagos (V–IX, XIV, XVI)	Artisanal anchoveta and Araucanian herring fishery	Araucanian herring, anchoveta	No	Tested with MSE
	Industrial anchoveta and Araucanian herring fishery	Araucanian herring, anchoveta	Approved (Res. Ex. N° 2746 2016)	
	Industrial jurel fishery	Inca scad	Approved (Res. Ex. N° 4344 2017)	

Justification:

Reference points and performance

The Chilean anchoveta fisheries target three stocks of anchoveta, as well as Inca scad/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 (Table 25) (see also Criterion 1 and Criterion 2). Except for 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. The fishery also catches other small pelagics such as Pacific chub mackerel/caballa and Pacific sardine/sardina Espanola. Catches of these species are currently relatively low, likely from low abundance caused by environmental conditions favoring anchoveta and inca scad, so data are not available to determine reference

points or conduct stock assessments ((SUBPESCA 2023a) p8). But, as these species become more prevalent in the catch, stock assessments and more active management will be implemented. That said, the depleted stock status for Pacific sardine is of particular concern, and the catch limit for the species is set to allow the anchoveta fishery to commence ((SUBPESCA 2023a) p. 8). It does not seem to be set on any particular scientific advice or analysis, so it is unclear whether it could be hindering recovery of the stock.

Table 25: Reference points among the small pelagics fisheries in Chile

Table 13

Stock	Biomass reference points	Fishing mortality reference points	Reference
Peruvian anchoveta: South Peru-North Chile	B_{MSY} proxy: 55% SSB_{PR} (spawning stock biomass per recruit) (50% SSB_0) B_{LIM}: 25% SSB_0 B_0 is dynamic	F_{MSY} proxy: $F_{55\%}$	(SUBPESCA 2022)(Payá et al 2014)
Peruvian anchoveta: Central Chile	B_{MSY} proxy: 60% SSB_{PR} (55% SSB_0) B_{LIM}: 27.5% SSB_0 B_0 is dynamic	F_{MSY} proxy: $F_{60\%}$	(SUBPESCA 2022)(Payá et al 2014)
Peruvian anchoveta: Southern Chile	B_{MSY} proxy: 60% SSB_{PR} (55% SSB_0) B_{LIM}: 27.5% SSB_0 B_0 is dynamic	F_{MSY} proxy: $F_{60\%}$	(SUBPESCA 2022)(Payá et al 2014)
Inca scad/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 B_0 is static (though recalculated recently)	F_{MSY} = 0.13 year-1 (dynamic)	{Res. Ex. N 2791 - 2020}
Araucanian herring	B_{MSY} proxy: 55% SSB_0 B_{LIM}: 27.5% SSB_0 B_0 is dynamic	F_{MSY} proxy: $F_{60\%}$	(CCT_PP 2020)

Decisions based on science

The Chilean fisheries law requires conducting 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 a specified period of time.

These results of stock assessments are presented to the scientific technical committee for small pelagics fisheries (Comité Científico Técnico de Pesquerías de Pequeños Pelágicos, CCT-PP), which comprises scientists and managers' representatives and 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 anchoveta stocks and provides catch options based on different scenarios.

Legal and regulatory framework

Chilean fisheries are governed through three agencies: the Undersecretary of Fisheries (Subsecretaria 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}; it was updated in 2013 {Law 20,657 2013} and 2019 {Law 21.287-2019}. The main objective of the law 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 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 5 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 anchoveta fisheries. Management plans have been approved for the following small pelagics fisheries {SUBPESCA 2021}(SUBPESCA 2023d):

1. Management plan for the anchoveta and Spanish sardine Regions XV–II (Res. Ex. No 1997 2018)
2. Management plan for the anchoveta and Spanish sardine fishery Regions III and IV (PDMASC) (Res. Ex. N° 3893 2017)
3. Management plan for the anchoveta and common sardine (Araucanian herring) fishery Regions V–X (PDMASE) (Res. Ex. N° 2746 2016)
4. Management plan for the jack mackerel (Inca scad) fishery XV–X Regions (Res. Ex. N° 4344 2017).

The following general management measures regulate these fisheries (SUBPESCA 2023a):

- an annual total allowable catch established by SUBPESCA for each stock;
- closed access to the fishery for new vessels for fisheries declared “fully exploited”;
- 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 2023a):

- 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 5 nm of the coast (except in Regions XV–I–II, and IV) and within the first nm for artisanal vessels smaller than 12 m;
- An Artisanal Extraction Regime that allows individual artisanal fishermen or associations to obtain catch quotas;
- Since 2015, artisanal vessels (>15 m) are required to use VMS.

Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet

Highly effective

A seemingly robust and dynamic framework of laws and regulations governs the anchoveta fisheries in Peru. For the North-Central stock, which accounts for some 90% of the Peruvian landings, a recently published Management Strategy Evaluation suggests that the strategy is effective at maintaining anchoveta biomass even in years where environmental conditions are unfavorable to the stock. Management Strategy and Implementation is considered highly effective.

Justification:

Reference points and performance

The Peruvian anchoveta fisheries only target anchoveta (though longnose anchoveta is part of the anchoveta TAC; see the following “Decisions based on science”).

- Target and limit biomass reference points have been defined for the North-Central Peruvian stock (6 million mt and 4 million mt, respectively). The target is set at a level higher than recent estimates of B_{MSY} (Diaz Acuna et al 2022)(Licandeo et al 2023). There is an indirect fishing mortality reference point based on the Exploitation Rate (E) (see the following “Decisions based on science”). A recent independent (i.e., not yet used by managers) Management Strategy Evaluation suggests that the broader strategy (including these reference points) has been effective at reducing fishing mortality in times of low biomass (driven by unfavorable environmental conditions) (Licandeo et al 2023).

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 North-Central anchoveta stock was developed by 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 case anomalies are observed during the acoustic surveys. In such a case, a precautionary approach is taken (IMARPE 2020a)(IMARPE 2020b). The elaboration of the decision table comprises five stages:

1. Determination of the occurrence of oceanographic anomalies during the 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 then correspond to the catch quota. Different environmental scenarios are considered: favorable, neutral, and unfavorable (sometimes also a mix of them), which are related to changes in environmental conditions that affect the anchoveta population dynamics. The fishing mortality (F) target reference point is set to be equal to or lower than the estimated natural mortality (F = 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). While the TAC covers both anchoveta and longnose anchovy/samasa (*Anchoa nasus*), the latter's biomass does not figure in the TAC decision table (MRAG 2019). Longnose anchovy biomass varies greatly, peaking in El Niño years, and occasionally (rarely) reaching almost 40% of the catch (MRAG 2019).

In 2023, IMARPE provided this information in two fishery status reports, one for the first season (IMARPE 2023a) and one for the second season (IMARPE 2023c). In the first season, IMARPE recommended a “precautionary” exploitation rate of less than 0.35 due to moderate to strong El Niño conditions (i.e., unfavorable conditions) (IMARPE 2023a). PRODUCE ultimately selected a total maximum allowable catch level (LMTCP) of 1.091 million mt (PRODUCE 2023b), which corresponds to an exploitation rate of around 0.25 in a strong El Niño year (see Tablas de Decisión in Appendix 3 in (IMARPE 2023a)). The process for the second season was similar, with IMARPE continuing to recommend a “precautionary" exploitation rate of less than 0.35 (IMARPE 2023c), which PRODUCE adhered to with an LMTCP of 1.682 million mt (PRODUCE 2023a), which corresponds to an exploitation rate of 0.313 in a strong El Niño year (see Tablas de Decisión in Appendix 3 in (IMARPE 2023c)).

There have been allegations of corruption within IMARPE related to the manipulation of data, leading to anchoveta quotas being inflated (e.g., (La República 2021a)(La República 2021b)). That case was dismissed in court in 2021, based on there not being enough evidence (Ministerio Público 2021)(Convoco 2021).

Legal and regulatory framework

The 1992 General Fisheries Law (GFL) {Law 25,977 - 1999} regulates fishing activities in Peru with the aim of promoting fishing’s sustainable development and ensuring its continuity as an important source of food, employment, and income in the country {Arias Schereiber 2013}. The Vice-Ministry of Fisheries and Aquaculture (VMPA) 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 into the large-scale/industrial fleet and the small-scale and artisanal fleet, each subject to a separate set of regulations (Sánchez Durand & Gallo Seminario 2009)(Zenteno 2014)(Monteferri et al 2020). Any fishing vessel longer than 15 m or with more than 32.6 m^3 of holding capacity belongs to the large-scale fishery (Arias Schreiber 2013)(Monteferri et al 2020).

The anchoveta fisheries in Peru are managed by a dynamic regulatory system that applies to the two stocks found in the country, which are managed separately {Serra et al., 2012}{Dunlon 2014}(Monteferri et al 2020). A global quota (TAC) is calculated by fishing season (autumn-winter and spring-summer) and assigned to each stock, following annual acoustic surveys conducted by 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 anchoveta fishery. TACs are also set separately for the industrial fleet and the direct human consumption fleets (i.e., artisanal and smaller-scale fleets) (Paredes 2012)(Arias Schreiber 2013)(Monteferri et al 2020).

The artisanal/small-scale fleet is managed through the Fisheries Regulation (ROP) for direct human consumption (DHC) {Supreme Decree 005-2017-PRODUCE}(Monteferri et al 2020). The specific regulations that apply to this sector are as follows:

- A total maximum allowable catch level (LMTCP) for the DHC (set at 150,000 mt for the entire Peruvian coastline in 2023 (PRODUCE 2023c));
- Operate with a valid fishing license and register for DHC in the regional register of artisanal vessels;
- Operate with a mesh size of ½ in (13 mm) and a maximum height of 44 m (artisanal fleet);
- Spatial restriction allowing artisanal boats to operate outside 3 nm from the coast (5 nm in the north);
- Small-scale vessels (including artisanal 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 bycatch (anchovies <12 cm in length); limit of incidental catches to 5% of total landings; required monitoring by third-party operators or government inspectors to verify landing statistics; and 24-hour independent reporting of landings. Controls for the processing industry are also in place (Paredes 2012)(Arias Schreiber 2013)(Monteferri et al 2020).

Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet

Highly effective

A seemingly robust and dynamic framework of laws and regulations governs the anchoveta fisheries in Peru. For the North-Central stock, which accounts for some 90% of the Peruvian landings, a recently published Management Strategy Evaluation suggests that the strategy is effective at maintaining anchoveta biomass even in years when environmental conditions are unfavorable to the stock. Management Strategy and Implementation is considered highly effective.

Justification:

Reference points and performance

See Factor 3.1 for the North-Central artisanal fishery.

Decisions based on science

See Factor 3.1 for North-Central artisanal fishery.

Legal and regulatory framework

See Factor 3.1 for the North-Central artisanal fishery. The main regulations set for the industrial anchoveta fishery (IHD) are the following (Paredes 2012)(Arias Schreiber 2013)(Monteferri et al 2020):

- A total maximum allowable catch level (LMTCP) and a maximum catch limit per vessel (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 in (13 mm) for catching the species;
- Exclusion area of 5 nm from the coast;
- Closed access for new vessels (Art 24 GFL D.L. N01084);
- Operate under a 24-hour fishing day (between 8 a.m. and 8 a.m. the next day);
- Operate with the required vessel monitoring system (VMS).

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 bycatch (anchovies <12 cm in length); limit of incidental catches to 5% of total landings; required monitoring by third-party operators or government inspectors to verify landing statistics; and 24-hour independent reporting of landings. Controls for the processing industry are also in place (Paredes 2012)(Arias Schreiber 2013)(Monteferri et al 2020).

Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Moderately Effective

A seemingly robust and dynamic framework of laws and regulations governs the anchoveta fisheries in Peru. For the South Peru-North Chile stock, there are no analyses that suggest the strategy is effective at maintaining anchoveta biomass even in years when environmental conditions are unfavorable to the stock (compare to the North-Central stock), and there is little coordination at a political level between the Peruvian and Chilean management agencies in the main fishery management tools (setting TACs and closed areas). There is evidence that a lack of coordination does not necessarily preclude effective management, as long as an effective harvest control rule is in place. No such rule is currently in place in Chile or Peru for the South Peru-North Chile stock. Management Strategy and Implementation is considered moderately effective.

Justification:

Reference points and performance

The Peruvian anchoveta fisheries only target anchoveta (though longnose anchoveta is part of the anchoveta TAC, per the following).

- Fishing mortality reference points have been determined in both Peru and Chile for the South Peru-North Chile stock. In Peru's case, F_{MSY} is determined as part of the decision tables presented to PRODUCE for setting the TAC (e.g., Table 3 in (IMARPE 2023b). But there is no coordination between Peru and Chile on TACs or closed areas, and no HCR is in place (Canales and Cubillos 2021). While stock assessments in both countries suggest that the stock is above biomass reference points and below fishing mortality reference points in both countries (see Criterion 1), no Management Strategy Evaluation has been conducted to analyze whether the strategy is likely to be effective in low biomass regimes.

Decisions based on science

Scientific input into the management of Peruvian fishing mortality on the South Peru-North Chile stock follows a similar process as for the North-Central stock. For the 2023 fishing season, IMARPE recommended a precautionary exploitation rate, and presented a decision table to PRODUCE that specified catch limits that corresponded to 80% ("precautionary"), 90% ("intermediate"), and 100% ("limit") of the MSY, among other options (Table 3 in (IMARPE 2023b)). PRODUCE then set the LMTCP at 80% MSY (674,000 mt) and divided it equally between the first and second fishing seasons (PRODUCE 2022). IMARPE later provided a postseason summary of the first fishing season, which found that, because only 7.5% of the LMTCP for the first fishing season (337,000 mt) had been reached, the initial LMTCP was still valid (IMARPE 2023d).

PRODUCE also closes areas of particularly high juvenile catch; for example, seven areas were closed in the first season of 2023 in the South Peru-North Chile fishery (IMARPE 2023d), consistent with advice from IMARPE to protect juveniles.

Legal and regulatory framework

See Factor 3.1 for the North-Central stock industrial fishery.

Factor 3.2 - Bycatch Strategy

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Highly effective

Managers of Chilean fisheries, including those for small pelagics, are required to develop discard and bycatch reduction plans based on monitoring programs in those fisheries. Discards are typically not permitted for any fish or invertebrate species, though there are exceptions (see Justification). Discard rates in the small pelagics fisheries are low (typically less than 1–2% of the catch, but up to 8.4% in the Central Zone artisanal anchoveta fishery; Tables 35–43 in (IFOP 2022)), but this can still mean thousands of mt of fish are discarded because the total catch is so high. For this reason, all discards are required to be recorded, and, in the case of species with quotas, the quota for the species is reduced to allow for discard mortality. Thus, there are no "main species" for which discards are greater than landings.

Chilean law uses the term “pesca incidental” (which can be translated as “bycatch”) for mammals, turtles, penguins, and seabirds, and a number of measures are in place to require them to be released without harm or rehabilitated if injured and rehabilitation is possible; vessels communicate with each other to avoid bycatch hotspots; and interactions are documented (see Justification below).

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), and explicit measures are in place to monitor and minimize mortality.

Therefore, bycatch management is considered highly effective.

Justification:
Regulatory framework

Article 7 of the Chilean fishery law (GLFA) {Law 20,657 2013} refers to discard and bycatch management in Chilean fisheries. Article 7A requires the Undersecretariat of fishing to conduct a 2-year research program to assess the level of discards and bycatch in Chilean fisheries. This research program must compile information on the level of discards 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 3 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;
- 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 7B {Law 20,657 2013} indicates that individuals of a target or nontarget species may not be discarded unless the following requirements are met (e.g., (SUBPESCA 2023c)):

- sufficient technical background information on the discard has been compiled, in accordance with the research program requirements of Article 7A;
- 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;
- the volume of discards does not affect the conservation of the target species.

Article 7B also requires the Undersecretariat of Fisheries to establish annually the list of the target species and accompanying fauna that comply with these requirements.

Article 7C requires that marine mammals, reptiles, and penguins and other seabirds be returned to the sea, unless they are severely damaged or injured, in which case they will be retained onboard for the purpose of being sent to a rehabilitation center if possible. In the case of the Chondrichthyes (sharks, rays, and skates), (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 (e.g., (SUBPESCA 2023c)).

Implementation

The SUBPESCA website provides all the discards and bycatch plans and target and accompanying fauna lists developed so far (SUBPESCA 2023b). For the small pelagics fisheries, these are:

- Artisanal anchoveta and jurel fisheries for the Atacama and Coquimbo Regions: plan (Informe Técnico (R. PESQ.) N° 58/2021); plan authorization (Res. Ex. N° 1468-2021 with addendum Res. Ex. N° 2399-2021); fauna list for 2023 (Res. Ex. N° 2399-2021).
- Industrial jurel in the Arica y Parinocota and Los Lagos Regions: plan (Informe Técnico (R. PESQ.) N° 106/2019); plan authorization (Res. Ex. N° 1626-2019); fauna list for 2023 (Res. Ex. N° 0119-2023).
- Artisanal and industrial fisheries for anchoveta in the Arica and Parinacota, Tarapacá and Antofagasta Regions: plan (Informe Técnico (R. PESQ.) N° 105/2019); plan authorization (Res. Ex. N° 1625-2019); fauna list for 2023 (Res. Ex. N° 2842-2022).
- Artisanal and industrial fisheries for anchoveta and Araucanian herring/sardina común in the Valparaiso to Los Lagos Regions: plan (Informe Técnico N° 095-2017); plan authorization (Res. Ex. N° 2463-2017); fauna list for 2023 (Res. Ex. N° 2751-2022).
- Artisanal fisheries for Falkland sprat/sardina austral in the Los Lagos Regions: plan (Informe Técnico (R. PESQ.) N° 187/2021; plan authorization (Res. Ex. N° 2490-2021); fauna list for 2022 (Res. Ex. N° 1003-2022).

The fauna lists are updated every year based on the discard plans and continued monitoring of the fisheries, with the target and associated species divided into one of four categories (species lists are from the artisanal fishery for anchoveta in the Atacama and Coquimbo Region as an example):

1. Target species: Anchoveta only. Discards are prohibited except as noted above.
2. Accompanying fauna subject to the discard and reduction plan and managed with a quota: Pacific sardine/Sardina espanola (*Sardinops sagax*), jumbo squid/jibia (*Dosidicus gigas*), whiting/South Pacific hake/merluza comun (*Merluccius gayi gayi*). Discards prohibition, record all catches in fishing logs, and all catches count against the quota.
3. Accompanying fauna subject to the discard and reduction plan and *not* managed with a quota (see Tabla 3): Discards generally prohibited, mandatory return for rays and sharks, landings for some (*Katsuwonus pelamis* through *Thyesites atun*) must comply with maximum landings percentages established for the fishery, gear specific regulations, records of all catches in fishing logs.
4. Bycatch species subject to the reduction plan (see Tabla 4): Mandatory return and recording of all individuals, avoiding areas of high bycatch and communicating this with the fleet, and suspension of fishing operations until cetaceans and turtles are removed from the net.

Tabla3. Nómina de especies de fauna acompañante (**FA**) de la pesquería artesanal de Anchoveta y Coquimbo, sometidas al Plan de Reducción y no administradas con cuota global anual de captura (sin **CGA**) sujetas a regulación de arte según resolución exenta N° 3917/ 2019 entre las regiones de Arica a Los Lagos (*) o al Plan de Acción Nacional para la Conservación de Tiburones (**PANT**) y la Res. Ex. N° 2063 de 2020 que estableció protocolos de devolución de condrictios, según corresponda.

Categoría	Nombre común	Nombre científico	Condición de la especie en el Plan de Reducción
Fauna Acompañante sin CGA, sujeta a regulación de arte/aparejo para su extracción entre Arica y Los Lagos	Pez linterna (*)	*Hygophum brunni*	• Prohibición de descarte • Especies con regulación de arte/aparejo para su extracción entre Arica y Los Lagos, según Res. Ex. SUBPESCA N° 3917/2019. • Registrar todas sus capturas en bitácoras de pesca para futuros ajustes normativos
	Atún de aleta amarilla (*)	*Thunnus albacares*	
Fauna Acompañante sin CGA, sujeta a regulación de arte/aparejo para su extracción y porcentaje de desembarque como fauna acompañante entre Arica y Los Lagos	Barrilete o Atún listado (*)	*Katsuwonus pelamis*	• Prohibición de descarte • Especies con regulación de arte/aparejo para su extracción entre Arica y Los Lagos, según Res. Ex. N° 3917/2019. • Entre Arica y Los Lagos y con arte de cerco, estas especies solo pueden ser capturadas como fauna acompañante. • Su retención y desembarque debe respetar los porcentajes máximos de desembarque autorizados como fauna acompañante por Decreto. EX N° 45/2020 • Registrar todas sus capturas en bitácoras de pesca para futuros ajustes normativos
	Ayanque (*)	*Cynoscion analis*	
	Cabinza (*)	*Isacia conceptionis*	
	Corvina (*)	*Cilus gilberti*	
	Dorado de altura (*)	*Coryphoena hippurus*	
	Pejerrey de mar (*)	*Odontesthes regia*	
	Lenguado (*)	*Paralichthys sp.*	
	Sierra (*)	*Thyesites atun*	
Fauna acompañante sin CGA y sin regulación de arte Autorizada como FA por Res. Ex. N° 3115/2013	Agujilla	*Scomberesox saurus*	• Prohibición de descarte • Especies de fauna acompañante autorizadas para pesquerías artesanales con cerco en las Regiones de Atacama y Coquimbo por Res. Ex. N° 3115 de 2013 y sus modificaciones. • Obligatoriedad de informar en la bitácora de pesca la totalidad de las capturas de estas especies de fauna acompañante para los lances donde ocurran (D.S. N° 129/2013) • Registrar todas sus capturas en bitácoras de pesca para futuros ajustes normativos.
	Bacaladillo o mote	*Normanichthys crockeri*	
	Bonito	*Sarda chilensis*	
	Caballa	*Scomber japonicus*	
	Calamar	*Loligo gahi*	
	Cojinoba del norte	*Seriolella violacea*	
	Machuelo o Tritre	*Ethmidium maculatus*	
	Pampanito	*Stromateus stellatus*	
Fauna acompañante sin CGA, sujeta a regulación de arte y al Plan de Acción para la Conservación de Tiburones (PANT)	Raya sin identificar (*)	*Raja sp*	• Especies con regulación de arte/aparejo para su extracción entre Arica y Los Lagos, según Res. Ex. N° 3917/2019. No están autorizadas a ser capturadas con arte de cerco. • Devolución obligatoria de todos los ejemplares capturados conforme al Plan de Acción Nacional para la Conservación de Tiburones (**PANT**) dando además cumplimiento al protocolo de devolución de condrictios establecido por Res. Ex. N° 2063/2020 • Obligatoriedad de informar en la bitácora de pesca la totalidad de las capturas y devolución de ejemplares de condrictios en los lances que ocurran (D.S. N° 129/2013)
	Tiburón azulejo(*)	*Prionace glauca*	

Tabla4. Nómina de especies de captura incidental de la pesquería de Anchoveta de Atacama y Coquimbo, sometidas al plan de reducción.

Categoría	Nombre común	Nombre científico	Condición de la especie en el Plan de Reducción
Pesca incidental	Lobo marino común	*Otaria byronia*	• Devolución obligatoria de todos los ejemplares capturados incidentalmente en conformidad con Art 7°C de LGPA. • Informar la captura incidental de estas especies por cada lance en que ocurran en términos establecidos por D.S. N° 129/2013. • Cumplimiento de buenas prácticas incluyendo cambio de área y comunicación al resto de la flota cuando exista presencia de pesca incidental en faenas de pesca, evitar calar en zonas de alta presencia de pesca incidental. • Suspender el lance de pesca y descartar las capturas permitiendo liberar/devolver la pesca incidental al mar sin daño en los casos que habiendo aplicado protocolos de evitamiento persisten cetáceos o tortugas marinas en el cerco.
	Albatros sin identificar		
	Piquero	*Sula variegata*	
	Cormorán guanay	*Phalacrocorax bouganvilli*	
	Cormorán sin identificar	*Phalacrocorax*	
	Cormorán lile	*Phalacrocorax gaimardi*	
	Pelícano peruano	*Pelecanus thagus*	
	Gaviota sin identificar	*Larus sp.*	
	Gaviota dominicana	*Larus dominicanus*	
	Cormorán yeco	*Phalacrocarax brasilianus*	
	Pingüino de Humboldt	*Spheniscus humboldti*	
	Yunco	*Pelecanoides garnotii*	

Ghost gear

No information was found on ghost gear impacts in the Peruvian anchoveta fisheries; however, this is likely the result of the relatively low risk of ghost gear impacts in purse seine fisheries for small pelagics (see Figure 36 in Factor 3.2 for Peru purse seine fisheries) (Gilman et al 2021).

Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet
Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Moderately Effective

The anchoveta fishery in Peru is considered to have a rate of discards/nontarget catch at >5% of landings. Bycatch and discard management measures are in place, but their effectiveness is in question, and bycatch limits of 5% for nontarget species or 10% for juveniles could still lead to very high discards of these taxa/age classes, given the relatively high volume of the fishery landings overall. Changes to measures to reduce juvenile mortality have been implemented, and an initial indicator is positive, but it is too early to have confidence that juvenile mortality will continue to decrease. The fishery is not otherwise thought to have any major impacts on bycatch species (see Criterion 2). Thus, bycatch management is considered moderately effective.

Justification:

As indicated in the management strategy section (Factor 3.1), management measures to control bycatch in the anchoveta fishery in Peru include maximum bycatch limits of 5% of nontarget species and 10% of the maximum catch of juveniles for the anchoveta fishery (and 20% for the samasa fishery); minimum mesh size (13 mm); and minimum landing size for the target species. Spatial or temporal closures to protect the juveniles are also in place (Arias Schreiber 2013)(Paredes 2014)(Monteferri et al 2020).

In 2016, Supreme Decree 24-2016-PRODUCE established new measures to strengthen the control and surveillance of fishing activities and established penalties for noncompliance to eliminate the practice of discarding at sea. That regulation attempts to fix earlier legislation (D.S. 009-2013-PRODUCE) that was found to be counterproductive: increasing the discard of juveniles at sea to avoid being sanctioned by the authorities (Paredes 2014). Supreme Decree 24-2016-PRODUCE instead permits the landing of juveniles without being penalized, even if the 10% limit is exceeded, 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 PRODUCE to protect juveniles of anchoveta. During the first 2019 and 2020 fishing seasons, 124 (IMARPE 2019} and 54 {PRODUCE 2021} temporal closures, respectively, were implemented for the North-Central anchoveta stock fishery, to protect juveniles {PRODUCE 2021}. Even though this measure was implemented to discourage discards, adequate technology has not been implemented to monitor compliance. It is unclear if: a) there is effective communication about the presence of juveniles to the authorities; b) there are not repeated fishing activities in these areas with a high presence of juveniles; and c) there are no discards of these juveniles {Aguilar Ramírez, D. & Barrera Guevara, J.C. 2018}.

A recent study suggests that the policy (as implemented in 2017–19) does allow regulators to succeed in closing areas where juveniles are abundant (Englander 2022). But that study also indicates a large increase in juvenile catch in the closed areas between the announcement and the beginning of the closure, just outside closed areas during closure periods, and inside closed areas one and two days after closures end. As a result, closures actually increase total juvenile catch by 48%, because fleets see the announcements of closure as an indication of high productivity. In 2020 (the year after the last data year for the study), PRODUCE modified the closure strategy in three ways: shortened the announcement window from 9 hours to 3 hours; lengthened the average closure period from 3.9 days to 4.5 days, and increased the average closure area from 1,328 km^2 to 2,238 km^2. Englander found that the 2020 closures reduced juvenile catch by 9%, which may have been due to these changes (Englander 2023).

In the case of large species (e.g., seabirds, marine mammals, sea turtles), national legislation {DS 004-2014-MINAGRI} and other binding international agreements (e.g., ACAP, IAC, CITES) signed by Peru recognize different ETP species susceptible to interactions with the anchoveta 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 have been prohibited by national law since the mid-1990s {DS 002-96-PE}(Hervas & Medley 2015). A national action plan for the protection and conservation of sharks and rays was approved in 2014 {DS 002-2014-PRODUCE}. A National Plan for the Conservation of Marine Turtles was approved by resolution N°253-2019-MINAGRI-SERFOR-DE.

A bycatch study of the industrial fishery with landings data from 2003 to 2011 indicated that, although variable by area, month, and year, the bycatch of this fishery was around 5%, decreasing in the most recent years (Saldarriaga Mendoza 2015). But these conclusions are based on data collected in ports at the time that the catch was landed. Instead, Torrejón (2014), using bootstrapping and other indirect models, estimated that the real bycatch onboard industrial vessels 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}.

Regarding the catch of top predators, the SALVAMARES program reports a large number of interactions with top predators but quite low mortality rates among these species. Currently, the only mitigation measure is to

train crew members in the correct release of bycaught species as part of the program {CeDePesca 2020}, the manual for which (SNP 2022) is effectively an industry code of conduct (pers. comm., Ernesto Godelman, CeDePesca). Some protected areas have been also created in Peruvian coastal areas to protect seabird colonies, and a new MPA (Dorsal de Nasca) was recently established, which would increase the protected marine areas in the country to 8% if and when implemented (protections appear to be only in deep waters, with no restrictions on fishing in surface waters) (MPA atlas 2021).

Ghost gear

No information was found on ghost gear impacts in the Peruvian anchoveta fisheries; however, this is likely the result of the relatively low risk of ghost gear impacts in purse seine fisheries for small pelagics (Figure 36) (Gilman et al 2021), because it is extremely rare for an anchoveta gear to be lost (the floaters are quite expensive to replace) (pers. comm., Ernesto Godelman, CeDePesca).

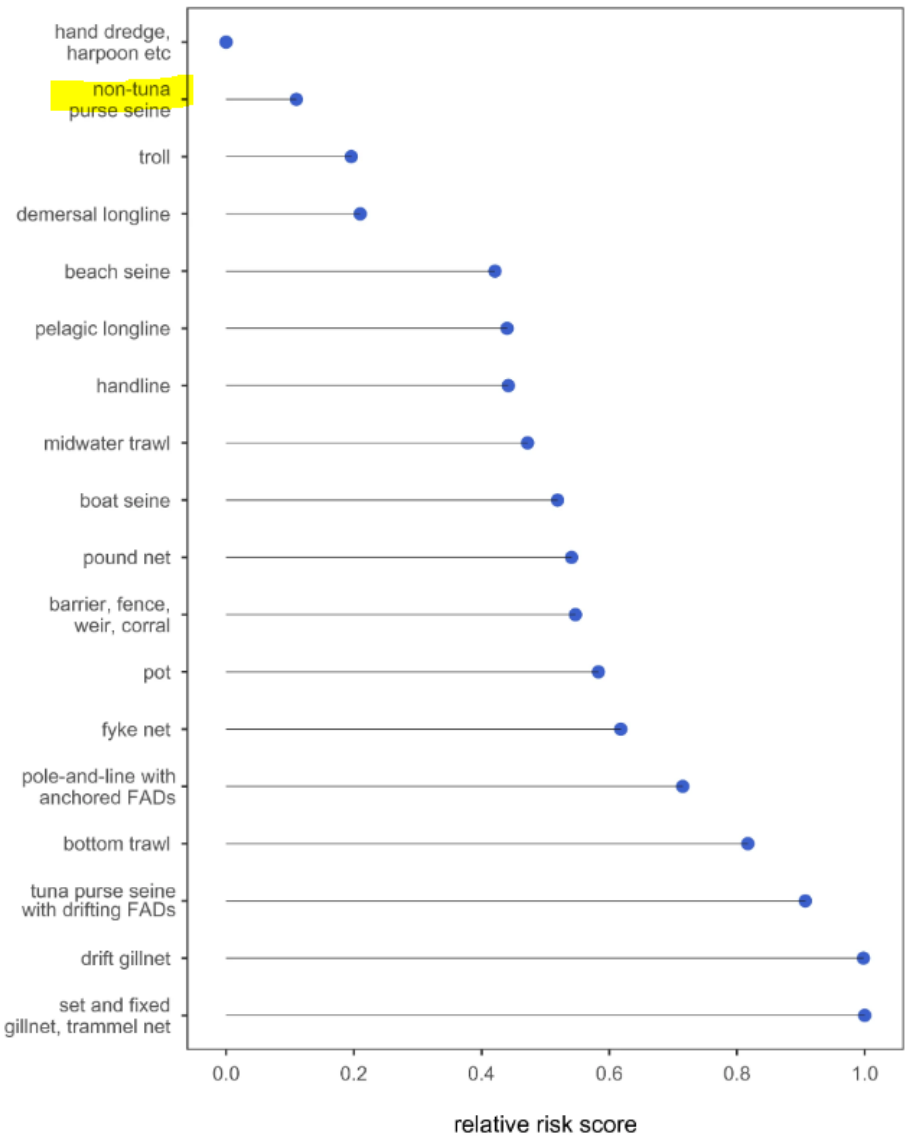

Figure 36: Gear-specific relative risk from abandoned, lost, and discarded fishing gear (ALDFG). From the top of the *y*-axis, fishing gears are listed from lowest overall relative risk score, which accounts for: (a) rate of production of ALDFG, (b) fishing effort (accounts for gear-specific weight of total catch and geospatial area of fishing grounds), and (c) adverse

ecological and socioeconomic impacts of ALDFG (accounts for ghost fishing; dispersal and transfer of toxins and microplastic into marine food webs; dispersal of invasive alien species and microalgae that cause harmful algal blooms; habitat degradation; obstruction and safety risks to navigation and in-use fishing gear; and reduced socioeconomic, aesthetic, and use values of coastal and nearshore habitats). The higher the relative risk score, the larger the amount of global adverse effects from ALDFG that the gear is estimated to be causing, based on the quantity of derelict gear that leaks into the oceans and the relative adverse effects caused by ALDFG from that gear type. The first gear category includes boat and shore-based hand dredge, harpoon, spear, lance, tongs, rakes, and hand-collected, including diving. Chart and text from (Gilman et al 2021).

Factor 3.3 - Scientific Data Collection and Analysis

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Highly 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 are collected. There is no stock assessment for Pacific chub mackerel or Pacific sardine, but data are collected on the species and a stock assessment will be conducted when they show up in larger volumes in the catch. There is an observer program in place that helps better understand fishery impacts on nontarget species. Therefore, scientific research and monitoring are considered highly effective for Chilean waters.

Justification:
The Fisheries Development Institute (IFOP) conducts stock assessments for pelagic resources in Chile using both direct and indirect assessment methods. Hydroacoustic surveys are conducted for anchoveta in two cruises per year: 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 are also collected from the commercial fishery. Based on the scientific and fishery data collected, IFOP establishes the status of the anchoveta 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 nongovernmental 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).

Anchoveta, Chilean jack mackerel, and Araucanian herring stock assessment

Stock assessments are produced annually for the three anchoveta stocks based on the twice-annual surveys and other data. Stock assessments produce different scenarios for recruitment and warm/cold regimes. 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 (Pacific sardine and Pacific chub mackerel), but catches are monitored and stock assessments are planned for when these species show up in the catch in higher volumes. 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 fishery subjected to a discard management plan is annually published by 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).

Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet
Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet

Highly 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 are collected. There is an observer program in place that helps better understand fishery impacts on nontarget species. Therefore, scientific research and monitoring are considered highly effective for the North-Central anchoveta fishery in Peruvian waters.

Justification:

The Marine Research Institute of Peru (IMARPE) is the scientific institute in charge of carrying out most of the research used by the Peruvian Ministry of Production (PRODUCE) to develop fishery management policies in Peru. Since 1982, IMARPE has monitored anchoveta populations using acoustic techniques through twice-yearly hydro-acoustical cruises along the geographical range of the anchoveta 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). These are coupled with cruise survey data to estimate spawning biomass of the North-Central stock through the "Método de Producción de Huevos" (Egg Production Method) (e.g., (IMARPE 2024d)).

Anchoveta stock assessment

Stock assessments are produced annually for the two anchoveta stocks based on twice-yearly surveys and other data (see the following context); however, there are no separate stock assessments for longnose anchovy (which is currently managed together with anchoveta).

IMARPE methods to assess the anchoveta 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. But it was concluded that there is a high standard of scientific support for the management of fisheries in Peru {FAO 2014}. Under the FIP for the North-Central anchoveta industrial fishery, a management strategy evaluation has been conducted for the fishery (Siple et al 2021)(Licandeo et al 2023).

Monitoring of retained catch and bycatch

In Peru, two onboard observer programs are currently in place in the North-Central industrial Peruvian anchoveta fishery: the public observer program conducted by IMARPE (Bitacoras de pesca), which covers 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), in which crew members act as observers {CeDePesca 2020}(CeDePesca 2020b). In 2021, the SALVAMARES program covered around 65% of the sets made by vessels in the FIP or around 80% of the total volume landed across the entire fleet (nearly all the steel vessels but not the wooden vessels) (pers. comm., Ernesto Godelman, CeDePesca). A separate private observer program, aimed at validating the results of the SALVAMARES, is also conducted by observers from the Instituto de Educación Superior Tecnológico Público “Ricardo Ramos Plata” (CeDePesca 2019).

IMARPE’s Bitacora program deploys observers onboard fishing vessels to collect biological samples, while a private company collects them at ports. All data are analyzed and used to assess the status of the stock and calculate the catch quotas for the two anchoveta fishing seasons per year for both the North-Central and South stocks (Zenteno 2014){Arias Schreiber & Halliday 2013}(Arias Schreiber 2013). When conditions are anomalous, real-time monitoring is intensified.

Similar efforts to those in place for the industrial North-Central fishery are in place for the artisanal anchoveta fishery. The IMARPE Bitacoras de Pesca observer program also observes the artisanal anchoveta fleet (including the small-scale fleet) along the entire Peruvian coast. There is also a private observer program in place for the Fishery Improvement Project for the artisanal/small-scale anchoveta fleet in Peru (Ceballes 2023) (CeDePesca 2022). The fleet in the FIP accounts for around 25% of the landings of the entire small scale/artisanal fleet.

Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Moderately Effective

The management process uses an independent and up-to-date scientific stock assessment for the main targeted stock. Both fishery-independent and -dependent data are collected. But there is no observer program, so data on the catch composition (target, bycatch, and species of concern) are currently limited to the findings from a single EUREKA survey, which did not provide information on the catch of taxa of concern (see the Criterion 2 Summary). This precludes a finding of highly effective, so a score of moderately effective is given.

Factor 3.4 - Enforcement of and Compliance with Management Regulations

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

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 instances of noncompliance 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 deals with monitoring, surveillance, and control (VMS, landing and quota control, enforcement, and statistics) (OECD 2009). Both agencies are within the Ministry of Economy, Development and Tourism. The Chilean Navy monitors Chile's exclusive economic zone (EEZ) to protect natural resources and the ecosystem from unauthorized activities.

Infractions, penalties, and procedures are set out under "Title IX" in the GLFA {Law 20,657 2013}. The measures that can be applied include administrative and judicial sanctions, such as fines; suspension or removal of the captain's license; 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; and the closure of fishing and processing facilities.

A system of fishing quotas is applied to regulate the anchoveta 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 anchoveta stock (CCT_PP 2021). The percentage of the TAC that corresponds to each sector depends on the management unit: 85% and 15% for the industrial and the artisanal fisheries, respectively, in Regions XV–II, 50% for each sector in Regions III–IV, and 20% and 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 anchoveta fisheries are fully exploited by the authorities, and access to these fisheries is closed to new vessels, to avoid increasing pressure on the resource {SUBPESCA 2021}. Moreover, all purse seiners over 12 m are fitted with a VMS to ensure that they do not operate inside prohibited areas (such as designated areas of recovery) or, in the case of industrial vessels, within 5 mi of the coast, which is reserved for the artisanal fleet. Both industrial and artisanal fisheries must register the catch in a logbook (SUBPESCA 2021a).

The fisheries and aquaculture inspection report published by SERNAPESCA for 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 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 COVID-19, several inspection goals were reached in 2020: the monitoring of the fleet through the VMS was decentralized, which allowed for the significant 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, and fish processing plants. Of these, 57% of the inspections undertaken were related to fishing quotas, whereas 21% and 12% of the inspections were related to fishing access and fishing closures, respectively (IFPA 2021). Inspections were most frequently associated with capturing closed resources (22% of noncompliances), followed by giving false information to the authorities (15.4%), and possessing or transporting unauthorized resources (13.2% and 11%, respectively) (IFPA 2021).

Considering the cases reported to the courts, 10.7% of noncompliances were related to the common hake fishery, followed by 8% related to the extraction of the grey seaweed, and 7.7% related to the anchoveta resource. In 2020, 433 mt of Aracaunian herring and 393 mt of anchoveta were confiscated by the authorities (IFPA 2021).

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

Regarding the monitoring of the fleet by VMS, the most frequent problem was of vessels operating in restricted areas, and it mainly occurred in the following fisheries: artisanal king crab (44% of the noncompliances), artisanal Spanish sardine and anchoveta (34%), and artisanal anchoveta and Araucanian herring (18%) (IFPA 2021). Around 84% of these noncompliances 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 problem reached 68 in 2020, of which 98% corresponded to the artisanal fishery, which was a 224% increase over 2019 as a result of the increase in the capacity of this inspection service. In general, in the pelagic fishery, there was a 350% increase in the number of operations in unauthorized areas (IFPA 2021).

Catches of anchoveta in 2020 were below the set TAC (Table 26) (IFPA 2021).

Table 26: Industrial and artisanal TACs and catches of anchoveta by region for 2020 (IFPA 2021).

Table 14

Stock	Industrial TAC	Artisanal TAC	Industrial TAC as % of total	Industrial Catch	Artisanal catch	Industrial catch as % of total
XV–II	458,284	123,745	79	56,614	122,728	32
III–IV	7,159	45,069	14	0	34,226	0
V–X	5,214	169,927	3	1,794	164,450	1

Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet
Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Moderately 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, VMS, and observer programs. Although monitoring and enforcement are particularly challenging for artisanal fisheries, TACs have not been exceeded in any fishery, and there is evidence of sanctions against transgressors. But in Peru, there does not seem to be a comprehensive analysis of the effectiveness of the enforcement system available (unlike in Chile). Therefore, a moderately effective score applies.

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), VMS, and observer programs (with a compliance mandate for the industrial fleet). TACs have not been exceeded in either fishery (IMARPE 2020a)(IMARPE 2021a).

Audits for the 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} (Gomez 2022), though little information was given to support this conclusion. {MRAG 2019a} also notes that there were no compliance reports from PRODUCE to support this assertion at that time (there are data available on sanctions now; see the following paragraph about Supreme Decree N.° 017-2017-PRODUCE 2017). More broadly, in 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 2014)(Gozzer-Wuest et al 2021). These problems seem to be more pronounced in the small-scale fisheries.

In Peru, industrial fishing activity is controlled by a number of mechanisms: vessel departure control by DICAPI; monitoring fishing activities through a satellite surveillance system (SD-001-2014-PRODUCE), which transmits vessel positions every 15 minutes; and the Fishing and Landings Surveillance Program (PVCPDAM - SD 027-2003-PRODUCE) (Arias Schreiber 2012). The government's DGSFS (Dirección General de Supervisión, Fiscalización y Sanciones) agency imposes sanctions on offenders. Compliance observers and an electronic logbook system have also been established in the industrial fishery {MRAG 2019a}.

PRODUCE has also recently approved the SITRAPESCA (Traceability System for Fisheries and Aquaculture), a program designed to ensure the traceability of the catch. The program is in the process of being implemented in the industrial anchoveta fishery (Supreme Decree No. 024-2021-PRODUCE 2021).

A system of fishing quotas has been regulating the anchoveta 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 also been 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 anchoveta fishery and trip limitation (one fishing trip per day) {Dunlon et al., 2014}(Zenteno 2014)(Monteferri et al 2020).

The Regulation of Inspection and Sanction for the Activities of Fishing and Aquaculture (Supreme Decree N.° 017-2017-PRODUCE 2017) defines inspections, the types and severity of offenses, penalties (fines, loss of fishing rights, etc.), and allocation of seized resources. There is evidence that sanctions are applied (data from PRODUCE available from that agency upon request), though they are applied through a long judicial process and it is not clear that they are a sufficient deterrent (Gomez 2022).

Improvements have been made for the control of the catch in the industrial anchoveta fishery since the publication of SD 024–2016-PRODUCE, with initial implementation of voluntary measures to report catches of juvenile anchoveta, to reduce illegal discards at sea, and to ensure timely reporting of areas with high levels of juveniles to enable temporary spatial closures to protect the juveniles. In industrial vessels, a member of the crew is in charge of undertaking biometric measures of the catch, and when the percentage of juveniles surpasses the 10% limit, communicating it to the authorities (SD 024-2016-PRODUCE). During the first fishing season of 2019, over 100 temporary closures were set to the IHC fleet to protect the juvenile portion of the stock. In the second season of 2019, the entire fishery was closed (MRAG 2019). There is evidence that the closures in place at that time (2017–19) led to an increase in juvenile catch, because fleets saw the announcement of closed areas as an indication of high productivity and fished in the area before and after the closure, and around it when closed (Englander 2023). Modifications to the closure system in 2020 may have led to a decrease in juvenile catch that year (Englander 2022). In any case, there is no indication that such behavior is noncompliant.

In the case of the artisanal segment, PRODUCE has established that the entire fleet must have a satellite tracking system or an 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). It also may not need to be: the artisanal fleet needs larger fish (>14 cm) because the product is canned or salted rather than turned into fishmeal. When the catches of juveniles are extremely high, the artisanal sector has been known to protest the opening or continued operation of the industrial fleet (e.g., in the second season of 2019) (MRAG 2019). There are also some concerns with the small-scale/artisanal fleet selling their catch for fishmeal, which is illegal (Grillo et al 2018).

MR Nº 00306-2020-PRODUCE has recently updated the methodology to set the quota for the DHC fleet, which will be based on the DHC catch from the previous 5 years, and taking into consideration that the sum of the DHC and the DHI catch does not exceed the limit set by the IMARPE for the first fishing season of the North-Central Peruvian stock. The DHC quota will be issued for the whole year (although it can be modified before the start of the second fishing season).

Factor 3.5 - Stakeholder Inclusion

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) |Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Highly effective

Based on the information provided, it seems that roles 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 mechanisms 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 industrial and small-scale vessels, and dealing with the National Fisheries Development Plan, the National Research Plan, etc. The National Fisheries Council includes 27 members from SERNAPESCA, IFOP, industry, and small-scale fishers. Their roles have 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 Cientifico Tecnicos (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, and demersal) 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 Investigacion 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 nonclassified 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 anchoveta fishery. These management committees are advisory and consultative bodies of the fishing authority, and comprise SUBPESCA and SERNAPESCA members, artisanal and industrial fishers, and the processing industry (SUBPESCA 2021a).

Management committees have been created for the three anchoveta fisheries covered by this assessment (SUBPESCA 2021a). Meetings of the management committees are conducted regularly, and acts of these meetings are 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 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 | Peru | Purse seines | North-Central Peru | Artisanal fleet
Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Moderately Effective
Because 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 its management responsibilities with regional governments. The responsibility of the management of fisheries falls exclusively on the government. The GLF in Article 3 states that “the State encourages the widest participation of natural and legal persons in Peruvian fisheries (...).”

But a recent study conducted by Grandez & Monteferri (2020) indicated that, although Peru has made progress in terms of stakeholder participation, the Ministry of Production was falling below and there was not an adequate stakeholder participation process in the fisheries and aquaculture sectors.

It is worth noting that a participatory space has been created called the “Executive worktable for the development of the fishery sector,” which is led by the Ministry of Economy and Finance, with the participation of PRODUCE, among others, and industry members (which include the SNP, as the major anchoveta representative). This space is useful to discuss regulations and create opportunities to improve and solve problems that affect productivity; nevertheless, artisanal or small-scale fishers are not considered {Rovegno pers. comm.}. A new “participatory approach” has been approved in the form of the AIR Ex Ante (Supreme Decree N° 063-2021-PCM), but it is still in implementation.

Therefore, it is considered that administrative tools enabling stakeholders to participate in the decision-making process for fisheries management have not yet 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 (NGOs, small-scale fisheries, universities, etc.). Thus, in this case, the level of participation is considered to be 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 - North Chile stock | Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**
Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**
Central - South Chile stock | Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**
South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**
South Peru - North Chile stock | Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**
North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**
North - Central Peru stock | Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**
South Peru - North Chile stock | Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet	Score: 4	Score: 0	Moderate Concern	Yes	**Green (3.464)**

Criterion 4 Assessment

SCORING GUIDELINES

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

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*

- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

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

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

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

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

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

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Score: 4

Because of the limited available information, the effects of the purse seine fishery on the marine benthos in Chile cannot be established. But along the coast of Chile, the continental slope is quite steep and reaches deep waters in a few miles, and Chilean fishing operations are generally conducted in open sea waters. Occasional contact with the seafloor is assumed for at least some fisheries. Therefore, a score of 4 is given for this factor, based on the more data-rich situation in Peru.

Justification:

Although specifications can vary, artisanal purse seine nets for anchoveta, which are called “sardineras,” are typically made of nylon mesh around 250–350 m long and 36 m (20 fathoms) deep. Mesh size varies between 13 and 14.3 mm (1/2 and 9/16 in). 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 m) in waters deeper than 40 meters (IFOP 2006). Industrial nets are longer and higher (Figure 37) (SUBPESCA 2008). In Chile, artisanal fisheries have exclusive fishing rights in the first 5 nm contiguous to the coastline (OECD 2009).

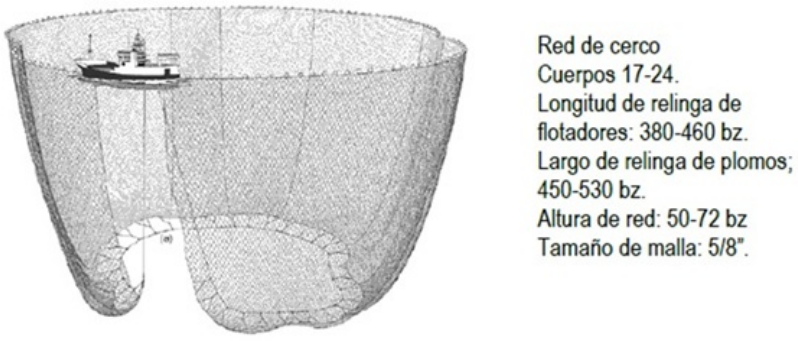

Figure 37: Purse seine used by the industrial fleet in Chile (SUBPESCA 2008).

There is little information about the effects of the purse seine fishery on the marine benthos in Chile. But in Chile, the continental slope is quite steep and reaches great depths in a few miles, and fishing operations occur mainly in open waters {Wiff pers. comm}.

Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet
Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Score: 4

The Peruvian fishery comprises industrial and artisanal/small-scale vessels, all using purse seine gear. The species is caught in the EEZ waters of Peru and Chile by both industrial and artisanal fishing vessels working with purse seines. Studies of both fleets indicate that nets do contact the seafloor at least occasionally, but generally conclude that impacts are relatively minimal. Therefore, a score of 4 is given.

Justification:

Anchoveta is a pelagic fish that occurs mainly within 80 km of the coast and forms huge schools, typically in surface waters (Iwamoto et al 2010). The Peruvian fishery comprises industrial and artisanal/small-scale vessels, all using purse seine gear.

Purse seine fishing involves enclosing a school of fish, in this case anchoveta, 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 partly hauled, concentrating the fish near the boat and allowing them to be brought onboard {Morison, A. & Mc Loughlin, K. 2015}. Although specifications can vary, nets for anchoveta are typically made of nylon mesh between 400 and 1,500 m long and 35 to 44 m deep {Aguilar Ramírez, D. & Barrera Guevara, J.C. 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.

A recent study of the industrial fleet found that the nets contacted the seafloor in 12–16% of sets, averaged over all sets from 2009–20 (IHMA 2021). The authors conclude that this magnitude of impact is likely insignificant, especially given the absence of bottom-dwelling species (benthic or demersal) in the catch and the anoxic environment that dominates much of the Peruvian continental shelf. The SALVAMARES observer program also documented a relatively low incidence of seabed contact in the industrial fleet (e.g., 5% of the hauls in the first season of 2019 {CeDePesca 2020}). Observer data also show that the small-scale and artisanal fleets at least occasionally contact the seafloor (CeDePesca 2020c).

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) |Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) |Industrial anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Score: 0

A general strategy to protect habitats seems to be being implemented, and MPA coverage has improved in the country in the last years but is still below 20% coverage. Therefore, a score of 0 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 within 1 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 | Peru | Purse seines | North-Central Peru | Artisanal fleet
Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

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 thought 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 anchoveta ROP established reserved areas for the CHD fleet. The first 5 nm were reserved for artisanal purse seine vessels, while the area between the 10 and 4 nm was reserved for smaller-scale purse seine vessels. But this regulation was later declared unconstitutional by the Supreme Court, and since then, the first five coastal marine miles were generally kept for the artisanal and smaller-scale fishing, while the industrial fleet could only operate outside 5 nm (Monteferri et al 2020).

In order to protect the anchoveta 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 for 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 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, especially 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).

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). A new marine protected area ("The Nazca Ridge") has been recently approved and will increase the country's MPA coverage to 8% of the country's EEZ when implemented (https://www.gob.pe/institucion/minam/noticias/498428-gobierno-aprueba-creacion-de-la-reserva-nacional-dorsal-de-nasca/). Few of the MPAs actually restrict fishing in the surface waters however (MPA atlas 2021). No Vulnerable Marine Ecosystems have been mapped yet in Peruvian waters.

Factor 4.3 - Ecosystem-based Fisheries Management

Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Artisanal anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial anchoveta and Araucanian herring/sardina común fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial anchoveta fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal anchoveta fishery
Southeast Pacific | Chile | Purse seines | North Region (Arica y Parinacota to Antofagasta - XV, I, II) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central South Region (Valparaíso to Los Ríos - V-IX, XIV, XVI) | Industrial Inca scad/Chilean jack mackerel/jurel fishery
Southeast Pacific | Chile | Purse seines | Central North Region (Atacama to Coquimbo - III, IV) | Artisanal Inca scad/Chilean jack mackerel/jurel fishery

Moderate Concern

Anchoveta, Inca scad, Araucanian herring, and Pacific chub mackerel are considered key forage species in the Humboldt Current ecosystem off Chile (see the Criterion 1 Summary and Appendix A). Chile has incorporated the concept of EBFM in national legislation, including the need for an adequate network of MPAs, and specific mechanisms are being implemented. A recent study found that the biological reference points currently in place for small pelagics are set at a level that is both precautionary and accounts for the needs of the ecosystem. A score of moderate concern is awarded.

The Chilean fisheries law (as amended in 2013) 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 {Law 20,657 2013}. The country's Biodiversity Policy (MMA 2017) and Climate Change Adaptation Plan for Fisheries and Aquaculture (Government of Chile 2016) also both expressly adopt an EBFM approach (Macpherson et al 2021). The climate change plan reinforces EBFM, allowing for more flexibility and providing tools for addressing climate change, as well as improving coordination between different sectors (including the government and private sector) (Porobic et al 2018).

Specific objectives related to the ecosystem are laid out in the management plans for small pelagics fisheries, and state that the purpose of the management plans is to "manage the anchoveta resources in each of the corresponding regions in a biologically, environmentally, economically and socially sustainable manner" (Res. Ex. N° 1197-2018 (Res. Ex. N° 3893-2017)(Res. Ex. N° 2746-2016). For example, the management plan for the anchoveta and Spanish sardine fishery in Regions XV–II requires the implementation of a control rule that accounts for the effects of El Niño and La Niña, and the development of a discard and bycatch reduction plan (Res. Ex. No 1997 2018). There are no explicit requirements in the law or the plan that catch limits take into account the broader ecosystem, though this was one of the reasons given when setting the reference points at a more precautionary level than for non-small pelagics (see Factor 1.1 for anchoveta) (Payá et al., 2014).

A recent review of Chilean fisheries management with a focus on EBFM implementation found generally positive changes in Chile's implementation of EBFM, but also noted a number of weaknesses (Porobic et al 2018). These include the need for management entities to be structured around ecosystems rather than single species, the inclusion of a wider diversity of stakeholders, and the need to review using MSY as the target (within an EBFM context, MSY is better seen as a limit).

Indeed, as noted in Factor 3.1, all the main stocks targeted by the Chilean anchoveta fisheries have minimum biomass reference points of less than 30% of SSB_0 (25–27.5% SSB_0 for anchoveta, 9% for Chilean jack mackerel, and 27.5% for Araucanian herring). This is lower than the 30–40% of B_0 recommended by the Lenfest Forage Fish Task Force (30% B_0 for data-rich fisheries, 40% B_0 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% F_{MSY} for data-intermediate fisheries, and 75% F_{MSY} for data-rich fisheries). But a recent study of the Chilean small pelagics fisheries was conducted with the explicit goal of determining whether the current reference points are precautionary and account for the needs of the ecosystems where they operate, per the Chilean fisheries law (Neira et al 2022). The study concluded that, "[I]n the fisheries studied, the current objective biological reference points (BRPs) (F_{target} and B_{target}) seem adequate from both the monospecific and ecosystem point of view, and reflect the mandate of the General Law on Fisheries and Aquaculture to apply the precautionary approach and the ecosystem approach in the management of fisheries" (Neira et al 2022).

Southeast Pacific | Peru | Purse seines | North-Central Peru | Artisanal fleet
Southeast Pacific | Peru | Purse seines | North-Central Peru | Industrial fleet
Southeast Pacific | Peru | Purse seines | South Peru-North Chile | Industrial fleet

Moderate Concern

Anchoveta is considered a key forage species in the Northern Humboldt Current ecosystem off Peru. The Peruvian legal framework does not explicitly include an ecosystem-based fisheries management approach, though government agencies such as IMARPE do consider such an approach in their recent objectives. Although maintaining the role of anchoveta is not a focus of management, a recent study does suggest that the current strategies employed for the fishery are not likely to lead to major changes in the abundance levels of other species or trophic groups in the Peruvian ecosystem. A score of moderate concern is awarded, to reflect the lack of explicit management but also that the fishery is likely not causing major ecosystem impacts.

Justification:
Anchoveta is one of the most important species in the Northern Humboldt Current System (NHCS), where it plays a fundamental ecological role (e.g., (Bakun and Weeks 2008)(Espinoza 2014)(Plaganyi and Essington 2014)(Gonzalez-Pestana et al 2022)). Some 39 species eat anchoveta in the Northern Humboldt Current System (NHCS) off Peru, including such taxa as larger fish, sharks, marine mammals, seabirds, squids, turtles, and jellies (Gonzalez-Pestana et al 2022). Anchoveta is considered a key forage species in this Seafood Watch assessment, so an improved understanding of the ecosystem and deeper evidence that the fishery is not causing ecosystem harm are needed, relative to non-key forage species (see Appendix A).

The regulatory framework for the industrial fishery (Supreme Decree N° 063-2021-PCM) and artisanal/small-scale fisheries (Supreme Decree 005-2017-PRODUCE 2017) details how the fishery should operate (see Criterion 3), and from a single species perspective, the fishery performs relatively well (see other criteria in this assessment). But to be sustainable at an ecosystem level, it is necessary to understand ecosystem processes and include them in the management framework. The management framework for anchoveta fisheries in Peru does not explicitly do this (Gozzer-Wuest et al 2021)(Gonzalez-Pestana et al 2022). The decision table used by managers when setting catch limits also does not include any explicit requirement around accounting for ecosystem needs.

Nonetheless, there have been a number of initiatives and practices in recent years within the Peruvian management system that appear to consider and monitor the impacts of the fishery on the ecosystem. For example, in 2010, IMARPE organized the V international expert panel to evaluate the status of the anchoveta fishery (Guevara-Carrasco et al 2010), and the first strategic objective of IMARPE's recent operative plan 2021 is to improve the fisheries research with a focus on the ecosystem approach (IMARPE 2021b). There have also been international programs implemented in the country that may help move management to EBFM. Examples include the GEF-UNDP Project "Towards an Ecosystem Approach to Management of Large Marine Ecosystem of the Humboldt Current," which aims to develop management approaches and tools for strengthening governance and sustainable use of living marine resources and the ecosystem in Peru and Chile (Gutiérrez et al 2017), and the collaboration between the Nature Conservancy, the Sustainable Fisheries Group (SFG), the University of California Santa Barbara (UCSB), and 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).

Recent depletion studies conducted by Tam et al. (2023) that varied levels of fishing mortality of adult anchoveta in the North-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 anchoveta depletion (around 19% B_0), there is not an impact in the abundance levels of other species or trophic groups in the Peruvian ecosystem.

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Appendix A: Forage Fish Determination

Version 4 of the Seafood Watch Standard for Fisheries (Seafood Watch 2020) updated the requirements around "forage species" as follows (Seafood Watch 2020a):

- Criterion 1: Acknowledges the high level of uncertainty associated with static reference points and lowers the score where B > B_{MSY} for forage species (relative to nonforage species). Specifically, static reference points with stationary parameters such as unfished biomass and B_0 are not considered to meet this requirement for forage species, as a result of those species' dynamic productivity that shifts in response to environmental conditions.
- Criterion 3: Requires adaptive and flexible management to account for environment-driven biomass and fluctuating populations (not just for forage species).
- Criterion 4: Requires a greater understanding of forage species' role in the ecosystem to get a moderate concern or better. Addition of a critical score when there is evidence of fisheries affecting the ecosystem; e.g., trophic cascades.

According to the glossary of Version 4 of the Seafood Watch Standard for Fisheries (Seafood Watch 2020):

"Forage species play an important role in food webs because they 1) exhibit high connectance to other organisms in the ecosystem, and 2) a large amount of energy is channeled through that species. Forage species typically exhibit highly variable productivity, such that there may be high uncertainty in their reference points, making it difficult to evaluate their stock status. The drivers of this variability in productivity may be environmental forcing and/or other factors. As a result of their importance in food webs, these stocks require management that is tailored to their specific life histories and ecological roles. Species that generally qualify as forage species include sandeels, sandlances, herrings, menhaden, pilchards, sardines, sprats, anchovies, krill, lanternfish, smelts, capelin, mackerels, silversides, sand smelts, Norway pout (adapted from MSC Fisheries Standard V2.01, p. 14). Other species or stocks may qualify if they meet the definition above."

To determine whether a species within a particular ecosystem is defined as a "forage species," it must fulfill both of the criteria in the glossary term: 1) exhibits high connectance and 2) serves as a channel for a large amount of energy. To identify a species' potential key role, a forthcoming white paper commissioned by Seafood Watch computed three indices, using data and food webs applied to existing static ecosystem models. The connectance index and the SUpportive Role to Fishery ecosystems (SURF) index were calculated from mass-balanced models, and an energy index from energy-balanced models. Excerpts from that study follow. The supporting data are available upon request.

Northern Humboldt Current

The model area considered in the food web model for the northern Humboldt Current ecosystem as developed by Chiaverano et al (2018a) extended from lat. 4° S. to 16° S. and 111 km (60 nm) off the Peruvian coast, representing an area of 165,000 km^2 (Figure 10). This area concerns a year-round upwelling system (Carr 2001) and includes vital habitats of commercially important forage fish, including sardines (Chavez et al 2008)(Cárdenas-Quintana et al 2015) and anchoveta, with the latter representing the world's largest fishery by weight (Pennington et al 2006)(Chavez et al 2008). Chiaverano et al. (2018a) used the model to assess the roles of large jellyfish and forage fish in the northern Humboldt Current in general.

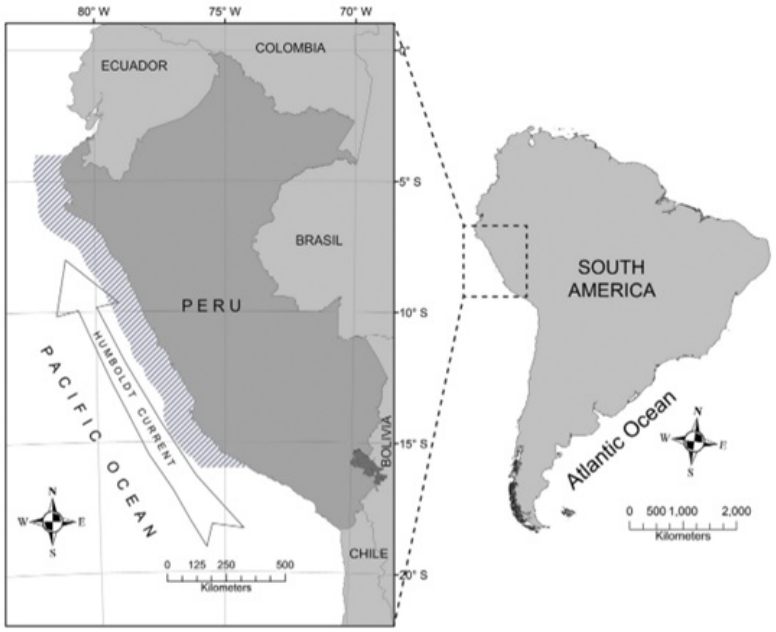

Figure 10: The model area in the northern Humboldt Current ecosystem off the Peruvian coast (hatched area) as considered in the food web model by Chiaverano et al. (2018a). Image copied from Chiaverano et al. (2018a).

Results

Of the species included in this assessment, anchoveta in the northern Humboldt Current off Peru meets the criteria for a key forage species.

The high occurrence of species' keyness according to the connectance index is because this index is affected by species aggregation in general, whereas SURF is mainly affected by aggregation of forage species (Plaganyi and Essington 2014). The SURF index is used here to determine whether a species meets the connectance requirement. More information and underlying data files are available on request. In the following table, taxa in bold are rated in this assessment; taxa in blue highlight (i.e., Peruvian anchoveta) are rated AND key forage species.

Table 5

Ecosystem model	Taxon	Key Connectance	Key SURF	Key Energy
Northern Humboldt Current	Microzooplankton	KEY		
	Mesozooplankton	KEY	KEY	KEY
	Macrozooplankton	KEY	KEY	KEY
	Small jellyfish	KEY		
	Large jellyfish	KEY	KEY	
	Macrobenthos	KEY	KEY	KEY
	Sardine	KEY		
	Peruvian anchovy (anchoveta)	**KEY**	**KEY**	**KEY**
	Mesopelagics	KEY		KEY
	Jumbo squid	KEY	KEY	
	Other cephalopods	KEY		
	Pelagic planktivorous fish	KEY		

Horse mackerel	KEY		
Chub mackerel	KEY		
Other pelagic piscivorous fish	KEY		
Small demersal fish	KEY	KEY	KEY
Benthic elasmobranchs	KEY		
Pelagic planktivorous fish	KEY		
Apex predatory fish	KEY		
Seabirds			
Pinnipeds			
Cetaceans			
Fish eggs			
Detritus offal			
Pelagic detritus			
Benthic detritus	KEY	KEY	KEY
Phytoplankton	KEY	KEY	
Demersal piscivorous fish	KEY		KEY
Other demersal fish	KEY	KEY	
Sea turtles			KEY
Import ecosystem			

Chile—North

Barros et al. (2014) developed a food web model for the upwelling ecosystem off northern Chile (Barros et al 2014a). The model area ranged from approximately 18.3° S. to 24.0° S. and 71.8° W. to 70.1° W. (up to 60 nm offshore), including a total area of 65,000 km^2 (Figure 11). These waters represent the main fishing grounds for the commercial and artisanal purse seine fisheries targeting pelagic fish (Serra 1986), including anchovy, mackerel, jack mackerel, and sardine (Castillo et al 1997)(Braun et al 1999). The area is influenced by permanent coastal upwelling (Shaffer et al 1999)(Blanco et al 2001) due to the Humboldt Current System and is therefore characterized by high productivity (Thiel et al 2007)(Carr 2001). Other oceanographic features of the area include low turbulence, almost permanently increased sea-surface temperature with cold coastal water (Bernal 1990)(Cubillos et al 1998), and interannual effects by El Niño-Southern Oscillation (ENSO) events (Fuenzalida, 1992). Barros et al. (2014) developed the food web model for 1997 to assess predator-prey interactions, community structure, and trophic flows in the upwelling ecosystem in relation to the strong ENSO conditions during that year. Diet data were collected from published information.

From (Barros et al 2014a): “The model considers 21 functional groups from primary producers to top predators. The model is focused on target species and their main prey and predators. The groups are: phytoplankton, microzooplankton, mesozooplankton (copepods), macrozooplankton (euphausiids), gelatinous zooplankton (siphonphores and salps), mackerel (*Scomber japonicus*), sardine (*Sardinops sagax*), anchovy (*Engraulis ringens*), mesopelagic fish (Myctophidae), jack mackerel (*Trachurus murphyi*), demersal fish (black cusk-eel *Genypterus maculatus* and *Genypterus chilensis* red cusk-eel; southern grut *Cilus gilberti* and rock seabass *Paralabrax humeralis*), jumbo squid (*Dosidicus gigas*), palm ruff *(Seriolella violacea*), Eastern Pacific bonito (*Sarda chilensis*), common dolphinfish (*Coryphaena hippurus*), swordfish (*Xiphias gladius*), pelagic sharks (short fin mako *Isurus oxirynchus* and blue shark *Prionace glauca*), sea lions (*Otaria flavescens*), cetaceans (small cetaceans and dolphins), marine birds (guanay cormorants *Leucocarbo bougainvilli*, Peruvian booby *Sula variegata* and pelicans *Pelecanus thagus*), and detritus.”

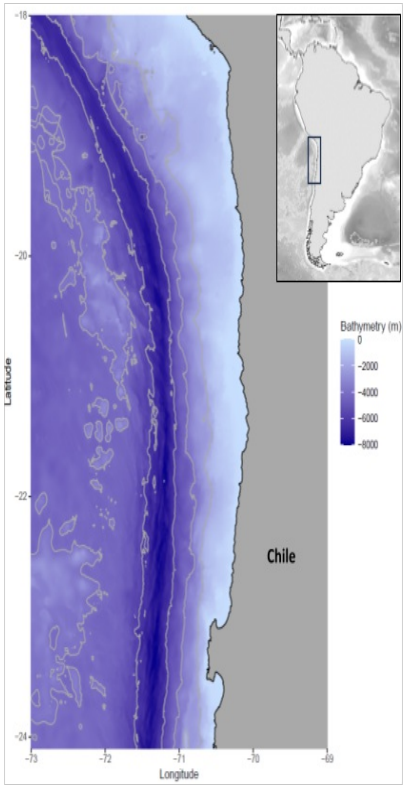

Figure 11: The waters and bathymetry off northern Chile for which Barros et al. (2014) produced a food web model. The bathymetry is shown by colors and the land is shaded dark grey. For the original map with information on the study area, see Barros et al. (2014).

Results

Of the species included in this assessment, anchoveta, Pacific chub mackerel, and Pacific sardine (not rated; Criterion 2 only) meet the criteria for key forage species in the ecosystem off Northern Chile.

The high occurrence of species' keyness according to the connectance index is because this index is affected by species aggregation in general, whereas SURF is mainly affected by aggregation of forage species (Plaganyi and Essington 2014). The SURF index is used here to determine whether a species meets the connectance requirement. More information and underlying data files are available on request. In the following table, taxa in bold are rated in this assessment; taxa in blue highlight are rated AND key forage species.

Table 6

Ecosystem model	Taxon (Common name as used in this Seafood Watch assessment)	Connectance*	SURF	Energy
North Chile	Phytoplankton	KEY	KEY	KEY
	Microzooplankton	KEY	KEY	
	Mesozooplankton	KEY	KEY	KEY
	Macrozooplankton	KEY	KEY	KEY
	Gelatinous zooplankton	KEY		
	Mackerel (Pacific chub mackerel)	**KEY**	**KEY**	**KEY**
	Sardine	**KEY**	**KEY**	**KEY**
	Anchovy (anchoveta)	**KEY**	**KEY**	**KEY**
	Mesopelagic fish	KEY	KEY	KEY
	Jack mackerel	**KEY**		
	Demersal fish	KEY		
	Jumbo squid	KEY	KEY	KEY
	Palm ruff	KEY		
	Eastern pacific bonito	KEY		
	Common dolphinfish	KEY		
	Swordfish	KEY		
	Pelagic sharks	KEY		
	Sea lions	KEY		
	Cetaceans	KEY		
	Marine birds	KEY		
	Detritus		KEY	KEY
	Import			
	Phytoplankton	KEY	KEY	KEY

Chile—Central

Neira and Arancibia (2004) developed a food web model for the upwelling ecosystem off central Chile {Neira, S & Arancibia, H. 2004a}. The model area ranged from approximately 33° S. to 39° S. and 72° W. to 74° W. (up to 30 nm offshore), including a total area size of 50,042 km^2 (Figure 12). These waters represent the main fishing grounds of commercial purse seine and trawling fleets {Neira, S & Arancibia, H. 2004a}. The study area is part of the southern Humboldt Current upwelling system, and its remarkably high primary productivity is influenced by the occurrence of moderate, seasonal (September to March), wind-driven coastal upwelling events (Strub et al 1998)(Daneri et al 2000). Its high fish biomass sustains important fisheries (FAO 1995). The study area is further characterized by a relatively narrow continental shelf of less than 30 nm (Neira and Arancibia, 2004). Neira and Arancibia (2004) developed the food web model to analyze the trophic interactions and community structure in the central Chile upwelling system for the year 1992, when fish stocks were considered healthy (i.e., not heavily exploited) and no significant environmental

changes occurred. A later paper by the same authors provide a smiilar assessment fo the year 2000 (Neira & Arancibia 2007). Diet data were collected from existing literature.

From {Neira, S & Arancibia, H. 2004a}: “The model encompasses 22 functional groups, including the main trophic components of the system with emphasis on fish species, both target and nontarget species. The functional groups are: phytoplankton, zooplankton I (microzooplankton), zooplankton II (mesozooplankton, represented by copepods), zooplankton III (macrozooplankton, represented by euphausiids), jellies (salps and jellyfishes), macrobenthos (represented by red squat lobster *Pleuroncodes monodon*; yellow squat lobster *Cervimunida johni*), anchovy (*Engraulis ringens*), common sardine (*Strangomera bentincki*), mesopelagic fish, horse mackerel (*Trachurus symmetricus*), hake (*Merluccius gayi*), pelagic fish I (medium-sized pelagic fish represented by hoki *Macrouronus magellanicus*), demersal fish I (benthic feeders species), demersal fish II (pelagic feeders species), condrichthyans (mainly skates), pelagic fish II (large-sized pelagic fish represented by swordfish *Xiphias gladius*), cephalopods (squid *Loligo gahi*), sea lion (*Otaria flavescens*), sea birds (penguins, pelicans, cormorants), cetaceans (killer whale and dolphins), and detritus.”

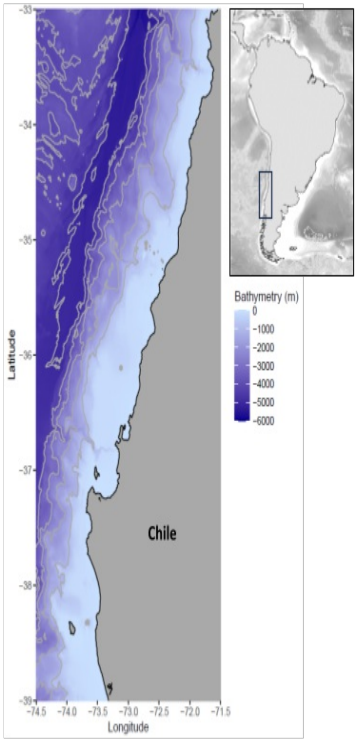

Figure 12: The waters and bathymetry off central Chile for which Neira and Arancibia (2004) produced a food web model. The bathymetry is shown by colors and the land is shaded dark grey. For the original map with information on the study area, see Neira and Arancibia (2004).

Results

Of the species included in this assessment, anchoveta, Inca scad/Chilean jack mackerel, Araucanian herring, and Colorado langostino (not rated; Criterion 2 only) meet the criteria for key forage species in the ecosystem off central Chile.

The high occurrence of species' keyness according to the connectance index is because this index is affected by species aggregation in general, whereas SURF is mainly affected by aggregation of forage species (Plaganyi and Essington 2014). The SURF index is used here to determine whether a species meets the connectance requirement. More information and underlying data files are available on request. In the following table, taxa in bold are rated in this assessment; taxa in blue highlight are rated AND key forage species. For the purposes of this Seafood Watch

assessment, *Trachurus symmetricus* (horse mackerel) is assumed to be *Trachurus murphyi* (Inca scad/Chilean jack mackerel/jurel), because the former is a Northern Hemisphere species, and *Strangomera bentincki* (common sardine) is referred to as Araucanian herring (*Clupea bentincki*) (the common and scientific names used by the FDA). The Central Chile (1992) data were from (Neira & Arancibia 2004a), and the 2000 data from (Neira & Arancibia 2007).

Table 7

Ecosystem model	Taxon (Common name as used in this Seafood Watch assessment)	KEY connectance	KEY SURF.mass	KEY SURF.energy
Central Chile (1992)	Phytoplankton	KEY	KEY	KEY
	Microzooplankton	KEY	KEY	KEY
	Mesozooplankton	KEY	KEY	KEY
	Macrozooplankton	KEY	KEY	KEY
	Jellies	KEY		
	Macrobenthos	KEY	KEY	KEY
	Anchovy (anchoveta)	**KEY**	**KEY**	**KEY**
	Common sardine (Araucanian herring)	**KEY**	**KEY**	**KEY**
	Mesopelagic fish	KEY	KEY	KEY
	Horse mackerel (Inca scad)	**KEY**	**KEY**	**KEY**
	Pelagic fish I	KEY	KEY	KEY
	Demersal fish I	KEY		
	Demersal fish II	KEY		
	Chondrictht hyans			
	Pelagic fish II	KEY		
	Cephalopods	KEY	KEY	KEY
	Sea lion	KEY		
	Seabirds	KEY		
	Cetaceans	KEY		
	Detritus		KEY	KEY
	Import			
	Hake	KEY	KEY	KEY

Table 8

Ecosystem model	Taxon (Common name as used in this Seafood Watch assessment)	KEY connectance	KEY SURF.mass	KEY SURF.energy
Central Chile (2000)	Cetaceans	KEY		
	Sea lion	KEY		
	Marine birds	KEY		
	Small squids	KEY		KEY
	Large squids	KEY		

Mesopelagic fish	KEY	KEY	KEY
Yellow squat lobster	KEY		
Pink shrimp			
Horse mackerel (Inca scad)	**KEY**	**KEY**	**KEY**
Hoki	KEY	KEY	KEY
Swordfish	KEY		
Black conger eel	KEY		
Rattail fish	KEY		
Big-eye flounder			
Cardinal fish	KEY		
Pacific sand perch			
Skates			
Polychaetes			
Gelatinous zooplankton			
Copepods	KEY	KEY	KEY
Euphausiids	KEY	KEY	KEY
Phytoplankton	KEY	KEY	KEY
Detritus	KEY	KEY	KEY
Import			
Hake	KEY	KEY	KEY
Common sardine (Araucanian herring)	**KEY**	**KEY**	**KEY**
Anchovy (anchoveta)	**KEY**	**KEY**	**borderline**
Red squat lobster (Colorado langostino)	**KEY**	**KEY**	**KEY**