Monterey Bay Aquarium Seafood Watch

Environmental sustainability assessment of wild-caught groundfish from British Columbia caught using bottom and midwater trawls, jigs, set longlines, trolling lines, and traps

Species:	Arrowtooth flounder, Big skate, Blackspotted rockfish, Bocaccio rockfish, Canary rockfish, Copper rockfish, Darkblotched rockfish, Dover sole, English sole, Flathead sole, Kelp greenling, Lingcod, Longnose skate, North Pacific spiny dogfish, Pacific cod, Pacific halibut, Pacific Ocean perch, Petrale sole, Quillback rockfish, Redbanded rockfish, Redstripe rockfish, Rex sole, Rougheye rockfish, Sablefish, Sharpchin rockfish, Shortraker rockfish, Shortspine thornyhead, Silvergray rockfish, Southern rock sole, Splitnose rockfish, Walleye pollock, Widow rockfish, Yelloweye rockfish, Yellowmouth rockfish, Yellowtail rockfish
Location:	British Columbia: Northeast Pacific Ocean
Gear:	Bottom trawls, Midwater trawls, Lines (jig, set longlines, trolling lines), and Traps
Type:	Wild Caught
Author:	Seafood Watch
Published:	August 5, 2025
Report ID:	27835

Assessed using Seafood Watch Fisheries Standard v4

Table of Contents

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

Scope of assessment

This assessment updates the Seafood Watch ratings for British Columbia (BC) groundfish fisheries. For practical reasons, the assessment has been restructured to align with the Groundfish Integrated Fisheries Management Plan (IFMP). The assessment covers the following "sectors," as outlined in the IFMP: Groundfish Trawl, Inside Rockfish, Outside Rockfish, Sablefish, and Lingcod. Vessels in the Rockfish sector are permitted to fish by hook and line (which includes longline, jig, and troll); the Lingcod sector is limited to troll and jig gear; and the Sablefish sector includes fishing by hook and line and trap gear. Because catch composition differs significantly between line and trap gear, we have created separate assessments for the Sablefish sector. We have further separated the Bottom Trawl and Midwater Trawl sectors into several fisheries, based on target species and region fished (see the Introduction, Overview of Species). The Halibut Hook and Line and Pacific Hake Midwater Trawl fisheries have been certified by the Marine Stewardship Council (MSC), and the Dogfish sector has not been active in recent years. Therefore, these three fisheries are excluded from this assessment.

Criterion 1: Impacts on the Species under Assessment

The single greatest factor that reduced scores was a broad lack of up-to-date information for stock status and mortality; many stocks received conservative stock status and fishing mortality scores as a result of a lack of available information. Because of this paucity of information for many species, and that many species caught are long-lived and highly vulnerable to overfishing, there is at least one low-scoring stock in most of the fisheries. The scores under Criterion 1 were mixed. Up-to-date and reliable information is essential for a high score, and those species that have been recently assessed generally fared well. Many stocks have never been assessed or have out-of-date assessments, so they have received conservative scores for Criterion 1.

Criterion 2: Impacts on Other Capture Species

Because of the multispecies nature of the integrated groundfish fishery, few fish species exclusively qualify as bycatch in the traditional sense. Non-retained species of concern include Chinook salmon in the 3CD Midwater Trawl fishery and coldwater corals and sponges in the coastwide Rockfish Bottom Trawl and 5ABC-5DE Shallow Flatfish Bottom Trawl fisheries. As was the case for Criterion 1, information availability—especially in the form of up-to-date stock assessments—is the primary determinant of many of the Criterion 2 scores.

Criterion 3: Management Effectiveness

The Seafood Watch criteria define effective management via a number of guidelines. To score highly effective for any of the guidelines, a fishery must achieve all of that guidelines' requirements. Because of the multispecies nature of these fisheries, achieving all the requirements for the management strategy and implementation guidelines is challenging. A particular issue that precludes a highly effective score for Factor 3.1: Management Effectiveness is the lack of appropriate reference points for rockfish species. Specifically, the default target (0.8 B_{MSY}) and limit (0.4 B_{MSY}) reference points used by Fisheries and Oceans Canada (DFO) are less conservative than those recommended for species with low levels of recruitment compensation. Certain aspects of these fisheries' management regimes are quite strong (e.g., 100% at-sea and dockside monitoring requirements, bycatch mitigation measures, and regular monitoring of all fisheries through annual fishery-independent surveys), and assessed stocks generally perform well relative to the management targets in place. Also, DFO has recently developed management procedures to identify specified probabilities of meeting fishery and conservation objectives and to provide harvest advice for a handful of stocks.

Criterion 4: Impacts on the Habitat and Ecosystem

The gears used in the BC groundfish fisheries are expected to come into contact with the seafloor during their regular use. Thus, the potential for disturbance and destruction of habitat is always present with these gears. The destructive potential of mobile gears is well known, and bottom longlines and pots may also cause damage. Many of the species that the groundfish fisheries pursue are known to associate with hard substrates, which are more susceptible to gear disturbance and damage than soft substrates in high-energy areas. Spatial management measures such as the sponge reef trawl closures have helped to minimize the potential for damage to certain habitats, and over 160 Rockfish Conservation Areas have been established to protect rockfish habitat. A new suite of management measures for the trawl fishery was implemented in 2012 to minimize and manage bycatch of corals and sponges, and there is evidence that these measures have been effective. Detrimental food web impacts from harvesting are possible for some species, and there are no programs or management measures in place that are meant to specifically manage groundfish fisheries according to the target species' ecological role. But the development of tools for ecosystem-based management is ongoing in Canada, and spatial and temporal management measures are in place in BC that are likely to be effective.

Final Seafood Recommendations

SPECIES | FISHERY	C 1 TARGET SPECIES	C 2 OTHER SPECIES	C 3 MANAGEMENT	C 4 HABITAT	OVERALL	VOLUME (MT) YEAR
Arrowtooth flounder | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	191
Arrowtooth flounder | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	30
Arrowtooth flounder | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	47
Arrowtooth flounder | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	5.000	1.526	3.000	3.000	**Good Alternative (2.879)**	2,766
Arrowtooth flounder | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	5.000	1.526	3.000	3.000	**Good Alternative (2.879)**	653
Arrowtooth flounder | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	5.000	1.526	3.000	3.000	**Good Alternative (2.879)**	34
Arrowtooth flounder | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000	1.526	3.000	2.449	**Good Alternative (2.736)**	110 (MT) 2021
Big skate | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	21
Big skate | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	2.644	1.526	3.000	3.000	**Good Alternative (2.455)**	20
Big skate | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	2.644	1.526	3.000	3.000	**Good Alternative (2.455)**	108
Blackspotted rockfish | BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.644	1.526	3.000	2.449	**Good Alternative (2.333)**	71
Blackspotted rockfish | BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.526	3.000	2.449	**Avoid (2.034)**	71
Blackspotted rockfish | BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	2.644	1.526	3.000	2.739	**Good Alternative (2.400)**	36
Blackspotted rockfish | BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.526	3.000	2.739	**Avoid (2.091)**	36
Blackspotted rockfish | BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	2.644	1.526	3.000	2.739	**Good Alternative (2.400)**	3
Blackspotted rockfish | BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.526	3.000	2.739	**Avoid (2.091)**	1

Bocaccio rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	11
Bocaccio rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	79
Bocaccio rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	5.000	1.526	3.000	3.000	**Good Alternative (2.879)**	16
Bocaccio rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000	1.526	3.000	2.449	**Good Alternative (2.736)**	313 (MT) 2021
Bocaccio rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	33
Bocaccio rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	163
Canary rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	16
Canary rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000	1.526	3.000	2.449	**Good Alternative (2.736)**	517 (MT) 2021
Canary rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	12
Canary rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	247
Copper rockfish | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	1.732	1.732	3.000	2.739	**Avoid (2.228)**	1 (MT) 2021
Copper rockfish | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.732	1.526	3.000	2.739	**Avoid (2.159)**	17 (MT) 2021
Darkblotched rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.732	1.526	3.000	2.449	**Avoid (2.099)**	36 (MT) 2021
Dover sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	3.318	2.644	3.000	3.000	**Good Alternative (2.981)**	25
Dover sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	3.318	2.644	3.000	3.000	**Good Alternative (2.981)**	46
Dover sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	3.318	1.732	3.000	3.000	**Good Alternative (2.682)**	17
Dover sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	3.318	1.526	3.000	3.000	**Good Alternative (2.598)**	505
Dover sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	3.318	1.526	3.000	3.000	**Good Alternative (2.598)**	509

Dover sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	3.318	1.526	3.000	2.449	**Good Alternative (2.470)**	130 (MT) 2021
English sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	3.318	2.644	3.000	3.000	**Good Alternative (2.981)**	19
English sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	3.318	1.732	3.000	3.000	**Good Alternative (2.682)**	15
English sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	3.318	1.526	3.000	3.000	**Good Alternative (2.598)**	267
English sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	3.318	1.526	3.000	3.000	**Good Alternative (2.598)**	46
Flathead sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	2.644	3.000	3.000	**Good Alternative (2.816)**	63
Kelp greenling | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	2.644	1.732	3.000	2.739	**Good Alternative (2.477)**	1 (MT) 2021
Lingcod | Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	1.732	2.644	3.000	3.000	**Good Alternative (2.534)**	271
Lingcod | Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	1.732	2.644	3.000	3.000	**Good Alternative (2.534)**	14
Lingcod | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	2.644	3.000	3.000	**Good Alternative (2.534)**	84
Lingcod | Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.732	1.526	3.000	3.000	**Avoid (2.208)**	27
Lingcod | Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	1.732	1.526	3.000	3.000	**Avoid (2.208)**	13
Lingcod | Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.732	1.526	3.000	2.449	**Avoid (2.099)**	95 (MT) 2021
Lingcod | Outside Stock | Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery	1.732	5.000	3.000	3.674	**Good Alternative (3.126)**	370 (MT) 2021
Lingcod | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.732	1.526	3.000	2.739	**Avoid (2.159)**	39
Lingcod | Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	1.732	1.732	3.000	2.739	**Avoid (2.228)**	1 (MT) 2021
Lingcod | Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.732	1.526	3.000	2.739	**Avoid (2.159)**	15 (MT) 2021
Longnose skate | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	2.644	3.000	3.000	**Good Alternative (2.816)**	14

Longnose skate | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	2.644	1.526	3.000	3.000	**Good Alternative (2.455)**	15
Longnose skate | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.644	1.526	3.000	2.449	**Good Alternative (2.333)**	17
Longnose skate | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	2.644	1.526	3.000	2.739	**Good Alternative (2.400)**	39 (MT) 2021
North Pacific spiny dogfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.644	1.526	3.000	2.449	**Good Alternative (2.333)**	13 (MT) 2021
Pacific cod | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	3.413	2.644	3.000	3.000	**Good Alternative (3.002)**	22
Pacific cod | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	3.413	1.732	3.000	3.000	**Good Alternative (2.701)**	188
Pacific cod | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	3.413	1.732	3.000	3.000	**Good Alternative (2.701)**	45
Pacific cod | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	3.413	1.526	3.000	3.000	**Good Alternative (2.617)**	94
Pacific cod | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	3.413	1.526	3.000	3.000	**Good Alternative (2.617)**	211
Pacific cod | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	3.413	1.526	3.000	2.449	**Good Alternative (2.487)**	48 (MT) 2021
Pacific halibut | Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	3.318	1.526	3.000	2.739	**Good Alternative (2.540)**	610
Pacific halibut | Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	3.318	1.526	3.000	2.739	**Good Alternative (2.540)**	16
Pacific Ocean perch | 5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	4.284	1.526	3.000	3.000	**Good Alternative (2.770)**	33
Pacific Ocean perch | 5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	4.284	1.526	3.000	3.000	**Good Alternative (2.770)**	56
Pacific Ocean perch | 5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	4.284	1.526	3.000	2.449	**Good Alternative (2.633)**	934
Pacific Ocean perch | 5DE Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.644	1.526	3.000	2.449	**Good Alternative (2.333)**	1,107
Pacific Ocean perch | 3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.732	3.000	3.000	**Avoid (2.279)**	Unknown

Pacific Ocean perch | 3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.732	1.526	3.000	3.000	**Avoid (2.208)**	24
Pacific Ocean perch | 3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.732	1.526	3.000	2.449	**Avoid (2.099)**	371
Pacific Ocean perch | 5ABC Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	4.284	2.644	3.000	3.000	**Good Alternative (3.178)**	59
Pacific Ocean perch | 5DE Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	2.644	3.000	3.000	**Good Alternative (2.816)**	16
Pacific Ocean perch | 3CD Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.732	1.732	3.000	3.000	**Avoid (2.279)**	17
Petrale sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	2.644	3.000	3.000	**Good Alternative (2.816)**	101
Petrale sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	79
Petrale sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	47
Petrale sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	2.644	1.526	3.000	3.000	**Good Alternative (2.455)**	11
Petrale sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	2.644	1.526	3.000	3.000	**Good Alternative (2.455)**	209
Petrale sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.644	1.526	3.000	2.449	**Good Alternative (2.333)**	88
Quillback rockfish | Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	5.000	1.526	3.000	2.739	**Good Alternative (2.814)**	26 (MT) 2021
Quillback rockfish | Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	3.318	1.732	3.000	2.739	**Good Alternative (2.621)**	11 (MT) 2021
Redbanded rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.732	1.526	3.000	2.449	**Avoid (2.099)**	128 (MT) 2021
Redbanded rockfish | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.732	1.526	3.000	2.739	**Avoid (2.159)**	63 (MT) 2021
Redbanded rockfish | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.732	1.526	3.000	2.739	**Avoid (2.159)**	6 (MT) 2021
Redstripe rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000	1.526	3.000	2.449	**Good Alternative (2.736)**	276 (MT) 2021

Redstripe rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	33
Redstripe rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	145
Rex sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	2.644	3.000	3.000	**Good Alternative (2.816)**	103
Rex sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	2.644	1.526	3.000	3.000	**Good Alternative (2.455)**	18
Rex sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	2.644	1.526	3.000	3.000	**Good Alternative (2.455)**	198
Rex sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.644	1.526	3.000	2.449	**Good Alternative (2.333)**	65
Rougheye rockfish | BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	2.644	3.318	3.000	3.000	**Good Alternative (2.981)**	15
Rougheye rockfish | BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.644	1.526	3.000	2.449	**Good Alternative (2.333)**	71
Rougheye rockfish | BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.526	1.732	3.000	3.000	**Avoid (2.208)**	29
Rougheye rockfish | BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.526	3.000	2.449	**Avoid (2.034)**	71
Rougheye rockfish | BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	2.644	1.526	3.000	2.739	**Good Alternative (2.400)**	36
Rougheye rockfish | BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.526	3.000	2.739	**Avoid (2.091)**	36
Rougheye rockfish | BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	2.644	1.526	3.000	2.739	**Good Alternative (2.400)**	3
Rougheye rockfish | BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.526	3.000	2.739	**Avoid (2.091)**	1
Sablefish | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	21
Sablefish | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	5.000	1.526	3.000	3.000	**Good Alternative (2.879)**	64
Sablefish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000	1.526	3.000	2.449	**Good Alternative (2.736)**	51 (MT) 2021

Sablefish | Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery	5.000	5.000	4.000	2.739	**Best Choice (4.068)**	1,306 (MT) 2021
Sablefish | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	5.000	1.526	3.000	2.739	**Good Alternative (2.814)**	845 (MT) 2021
Sablefish | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	5.000	1.526	3.000	2.739	**Good Alternative (2.814)**	17 (MT) 2021
Sharpchin rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.732	1.526	3.000	2.449	**Avoid (2.099)**	103 (MT) 2021
Shortraker rockfish | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.732	1.526	3.000	2.739	**Avoid (2.159)**	61 (MT) 2021
Shortspine thornyhead | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.916	1.526	3.000	3.000	**Avoid (2.265)**	35
Shortspine thornyhead | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.916	1.526	3.000	2.449	**Avoid (2.153)**	60
Shortspine thornyhead | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.916	1.732	3.000	3.000	**Avoid (2.338)**	12
Shortspine thornyhead | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.916	1.526	3.000	2.739	**Avoid (2.214)**	62 (MT) 2021
Silvergray rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	79
Silvergray rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.644	1.526	3.000	2.449	**Good Alternative (2.333)**	1,240 (MT) 2021
Silvergray rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	2.644	3.000	3.000	**Good Alternative (2.816)**	22
Silvergray rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	39
Southern rock sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	3.318	1.732	3.000	3.000	**Good Alternative (2.682)**	28
Southern rock sole | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	3.318	1.526	3.000	3.000	**Good Alternative (2.598)**	150
Splitnose rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.732	1.526	3.000	2.449	**Avoid (2.099)**	113 (MT) 2021
Walleye pollock | BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	4.284	2.644	3.000	3.000	**Good Alternative (3.178)**	13
Walleye pollock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	4.284	1.732	3.000	3.000	**Good Alternative (2.859)**	12

Walleye pollock | BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.732	3.000	3.000	**Avoid (2.208)**	147
Walleye pollock | BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	1.526	1.732	3.000	3.000	**Avoid (2.208)**	25
Widow rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000	1.526	3.000	2.449	**Good Alternative (2.736)**	157 (MT) 2021
Widow rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	1,065
Widow rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	5.000	1.732	3.000	3.000	**Good Alternative (2.971)**	753
Yelloweye rockfish | Outside (remaining areas) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	5.000	1.526	3.000	2.739	**Good Alternative (2.814)**	10 (MT) 2021
Yelloweye rockfish | Inside (Area 4B) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	3.413	1.732	3.000	2.739	**Good Alternative (2.640)**	2 (MT) 2021
Yellowmouth rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000	1.526	3.000	2.449	**Good Alternative (2.736)**	947 (MT) 2021
Yellowmouth rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	5.000	2.644	3.000	3.000	**Best Choice (3.303)**	342
Yellowtail rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	30
Yellowtail rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	18
Yellowtail rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	2.644	1.526	3.000	3.000	**Good Alternative (2.455)**	14
Yellowtail rockfish | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.644	1.526	3.000	2.449	**Good Alternative (2.333)**	1,011 (MT) 2021
Yellowtail rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	2.644	3.000	3.000	**Good Alternative (2.816)**	201
Yellowtail rockfish | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	2.644	1.732	3.000	3.000	**Good Alternative (2.534)**	1,865

All production volumes in the trawl fisheries are from the annual average in metric tons from 2019 to 2023 (DFO Pacific Region 2024). Volumes for all other fisheries are the annual average from 2019 to 2021 (DFO Pacific Region 2021). Ratings in the trawl and sablefish fisheries are for all species landed in average volumes exceeding 10 t/yr, whereas ratings for line fisheries are only for species that fit the main species criterion. Landings of rougheye rockfish and blackspotted rockfish are combined because of their similarity in appearance into a species complex, “REBS.” Genetically, 83% of REBS North complex in region 5DE composes blackspotted rockfish, 65% of REBS South (3CD-5AB composes rougheye rockfish, and area 5C is a hybridization area (Starr and Haigh 2022). We used these percentages

to apportion volume to each trawl fishery. Because line fisheries are not separated by region, we apportioned 25% of REBS landings to each individual species for line fisheries.

Summary

The single greatest factor that reduced scores was a broad lack of up-to-date information for stock status and mortality; many stocks received conservative stock status and fishing mortality scores from a lack of available information. Strengths for these fisheries include data collection and monitoring, 100% at-sea and dockside monitoring, and habitat conservation measures. Because of the multispecies nature of the integrated groundfish fishery, there are few fish species that exclusively qualify as bycatch in the traditional sense. As was the case for Criterion 1, information availability—especially in the form of up-to-date stock assessments—is the primary determinant of many of the Criterion 2 rankings. There are concerns with bycatch of Threatened and Endangered Chinook salmon stocks in the 3CD Midwater Trawl fishery and of highly vulnerable coldwater coral and sponge taxa in the Rockfish Bottom Trawl and 5ABC-5DE Shallow Flatfish Bottom Trawl fisheries.

The Seafood Watch criteria define effective management via a number of guidelines. To be scored highly effective for any of the guidelines, a fishery must achieve all of that guidelines' requirements. Because of the multispecies nature of these fisheries, achieving all the requirements for the management strategy and implementation guidelines is challenging. Certain aspects of these fisheries' management regimes are quite strong. This is especially true for the at-sea and dockside monitoring requirements that are in place and for the regular monitoring of all fisheries through annual fishery-independent surveys. But challenges noted in Factor 3.1—Management Strategy preclude a higher score for Criterion 3, except for the Sablefish Pot fishery.

The groundfish fishing gears used in the British Columbia fisheries are expected to come into contact with the seafloor during their regular use. Thus, the potential for disturbance and destruction of habitat is always present with these gears. The destructive potential of mobile trawl gears is well known, and bottom longlines and pots may also cause damage. Many of the species that the groundfish fisheries pursue are known to associate with hard substrates, which are known to be more susceptible to gear disturbance and damage than soft substrates in high-energy areas. Spatial management measures such as the sponge reef trawl closures have helped to minimize the potential for damage to certain habitats, and in 2012 a new suite of management measures for the trawl fishery was implemented in order to minimize and manage this fishery's bycatch of corals and sponges.

Scoring Guide

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

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

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

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

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

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

Introduction

Scope of the analysis and ensuing recommendation

This analysis encompasses the major commercial groundfish species that are caught in the seven integrated commercial groundfish fisheries off the coast of British Columbia, Canada. The Groundfish IFMP breaks down the commercial fishery into seven sectors: Groundfish Trawl (T), Halibut (L), Sablefish (K), Inside Rockfish (ZNI), Outside Rockfish (ZNO), Lingcod, and Dogfish (DFO 2022d). We have separated the Sablefish sector into the Sablefish Trap and Sablefish Longline fisheries, and the Groundfish Trawl sectors into multiple Bottom Trawl and Midwater Trawl fisheries, based on the target species and the region fished (see Overview of Species); regional divisions include BC South (subareas 3C and 3D), BC Central (subareas 5A, 5B, and 5C), and BC North (subareas 5D and 5E) (Figure 1). We use the term "sector" to identify the target species and gear type (e.g., Deepwater Flatfish Bottom Trawl) and the term "fishery" to identify the target species, gear type, and region(s) fished (e.g., 5DE Deepwater Flatfish Bottom Trawl). We have capitalized the fisheries throughout this report to avoid confusion when referring to a fishery or a gear; species common names are typically capitalized in Canada, but we have not capitalized here. The species addressed in this analysis include a variety of flatfish, rockfish, and other roundfish. A species is included in a fishery if either (a) it accounts for >5% of the fishery's catch; (b) it is a species of concern, where catch occurs regularly and may significantly contribute to conservation concern; *or* (c) the fishery under assessment accounts for >20% of total fishing mortality *and* the catch of this species in the fishery is >10 t/year. Additional information is provided in Appendix D. We used catch data provided by Department of Fisheries and Oceans Canada (DFO) from the 2018/19 to 2022/23 fishing seasons to determine main species by fishery.

Species Overview

The seven integrated groundfish fisheries use trawl, longline, jig, troll, handline, and pot gears to catch a variety of rockfish, flatfish, and roundfish species along the BC coast in "Outside" (subareas 3C, 3D, 5A, 5B, 5C, 5D, and 5E) and "Inside" (subarea 4B) waters (Figure 1). The number of active vessels has declined from 359 to 330 from 2012 to 2022 (DFO 2024). These fisheries are unique in that they are managed separately but in an integrated manner, with one integrated management plan. Key features of this integrated fishery include (DFO 2024):

- Individual accountability for all catch of quota species (retained and released)
- An Individual Vessel Quota (IVQ) system, commercial total allowable catches (TACs), sector caps, and research allocations
- Reallocation of IVQs between vessels and fisheries as necessary
- 100% at-sea and dockside monitoring
- Lost gear reporting requirements
- Rockfish Conservation Areas and other marine protected areas
- First Nations' Aboriginal right to fish for Food, Social, and Ceremonial (FSC) purposes.

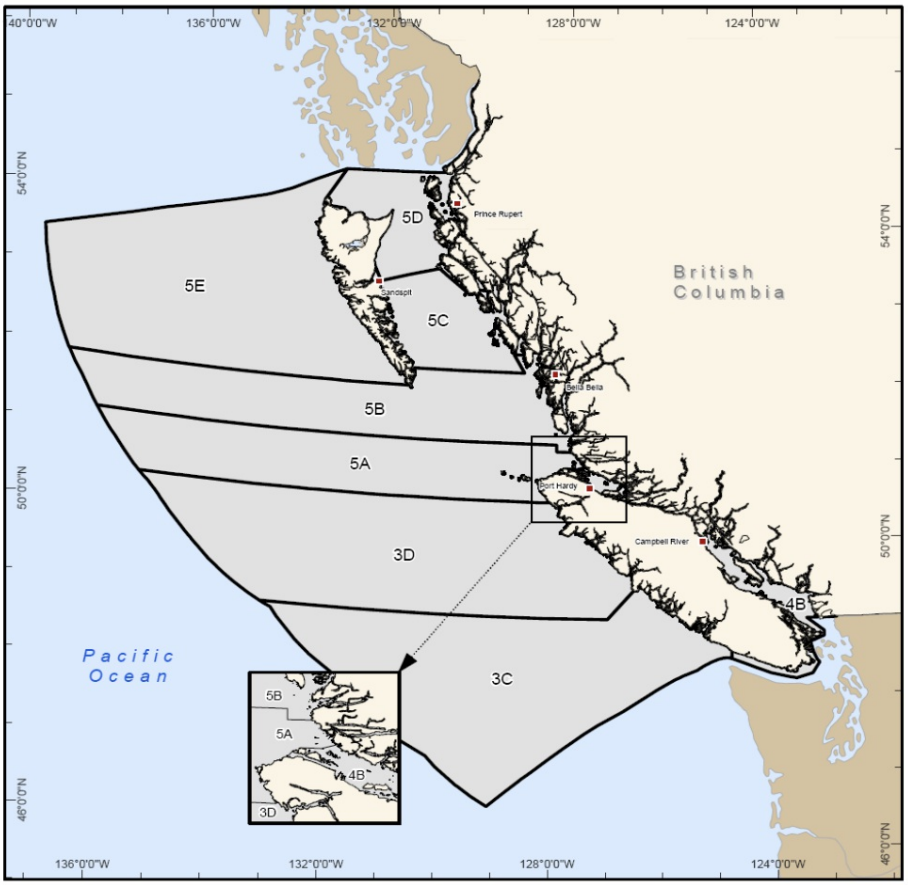

Figure 1: Commercial Groundfish Management Area Map. Figure from (DFO 2024).

Inside Rockfish

The permitted species include rockfish (*Sebastes* spp.) thornyheads (*Sebastolobus* spp.), halibut, lingcod, spiny dogfish, skate (*Rajidae*), sole and flounder (*Pleuronectiformes* other than *Hippoglossus stenolepis*), Pacific cod, and greenlings (*Hexagrammos* spp.) The fishery operates within Groundfish Management Area 4B ("Inside waters"). The main species/stocks assessed in Criterion 1 include quillback rockfish, copper rockfish, kelp greenling, Inside lingcod, and Inside yelloweye rockfish.

Outside Rockfish

The permitted species include all the species listed above in the Inside Rockfish fishery, plus sablefish. The fishery is carried out in subareas 3C, 3D, 5A, 5B, 5C, 5D, and 5E. The main species/stocks assessed in Criterion 1 include quillback rockfish, copper rockfish, kelp greenling, sablefish, Outside lingcod, redbanded rockfish, and the rougheye/blackspotted (REBS) rockfish complex.

Sablefish

The permitted species include sablefish, Pacific halibut, rockfish, lingcod, spiny dogfish, skates, and Pacific cod. The fishery is carried out in portions of Outside Waters. The main species/stocks assessed in Criterion 1 in the Line fishery include sablefish, longnose skate, redbanded rockfish, Outside yelloweye rockfish, Outside lingcod, shortraker rockfish, shortspine thornyhead, and the REBS rockfish complex. Sablefish is the only Criterion 1 species in the Trap fishery.

Lingcod

The Lingcod fishery is classified as "Schedule II," and lingcod-directed trips are limited to troll and jig gear. Although other species may be retained, the majority of the catch in this fishery consists of lingcod.

Bottom and Midwater Trawl

The permitted species in the Bottom and Midwater Trawl fisheries include more than six dozen species, including numerous rockfish, flatfish, and roundfish species. The fisheries are carried out in portions of Coastwide waters that are not covered by species and spatial closures, as described in the IFMP. Prohibited species include Pacific halibut, salmon species, Pacific herring, green sturgeon, white sturgeon, wolf eel, Pacific basking shark, tope, bluntnose sixgill shark, and eulachon (DFO 2024). See Appendices D and E for additional information on species co-occurrence in the BC trawl fisheries.

The majority of the non-hake and non-walleye pollock catch in the Rockfish Midwater Trawl fishery comprises widow rockfish and yellowtail rockfish (Figure 2). The main species/stocks assessed in Criterion 1 include bocaccio, canary rockfish, Pacific ocean perch, redstripe rockfish, silvergray rockfish, widow rockfish, yellowmouth rockfish, and yellowtail rockfish. The Midwater Trawl fisheries targeting Pacific hake in regions 3CD and 5ABC and walleye pollock in region 5DE are not included in this report.

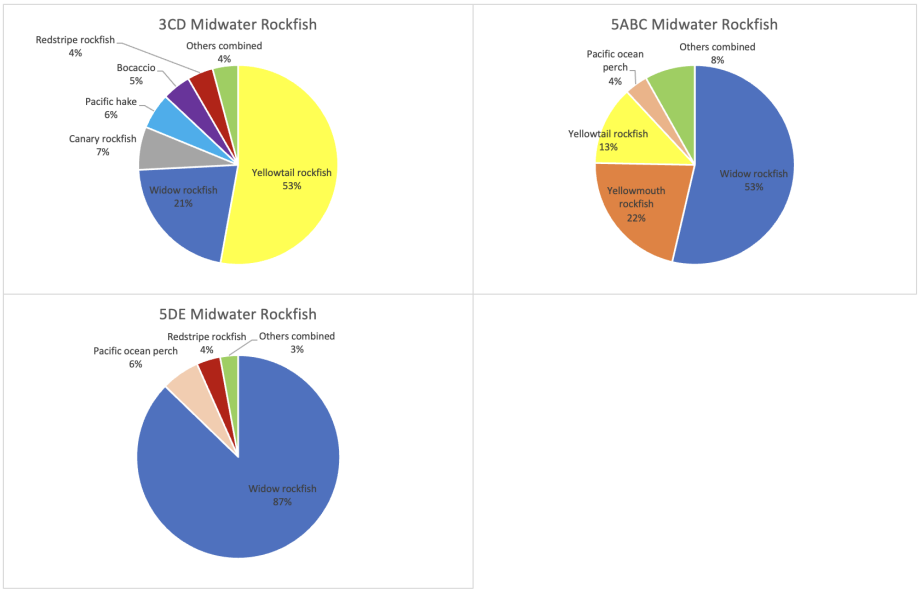

Figure 2: Catch composition of Rockfish Midwater Trawl fisheries by target species group and area (DFO Pacific Region 2024).

In recent years, arrowtooth flounder, Pacific Ocean perch, Dover sole, silvergray rockfish, and yellowtail rockfish have accounted for the majority of the catch in the Bottom Trawl fishery (DFO Pacific Region 2024). Because catch composition in this sector varies by fishing area and main target species, we have divided the bottom trawl fleet into several different "sub-fisheries." First, we divided the fleet into four sectors based on main target species reported by fishers—these include the Pelagic, Rockfish, Shallow Flatfish, and Deepwater Flatfish sectors. We further divided these sectors into sub-fisheries based on management area(s) fished. For brevity, we have combined sub-fisheries in instances in which catch composition is relatively similar and a Red-scoring main species precludes a Green overall rating. For example, because shortspine thornyhead is a main species in the Deepwater Flatfish Bottom Trawl fisheries in regions 3CD and 5ABC and this species scores Red, neither fishery would receive any Green ratings, and the two sub-fisheries are combined in this report.

The Pelagic Bottom Trawl fishery (hereafter referred to as "Pelagic") mainly targets lingcod and Pacific cod. There are different Red-scoring species for these fisheries, and catch composition is considerably different by area (Figure 3), so ratings are separated by area for the Pelagic fisheries.

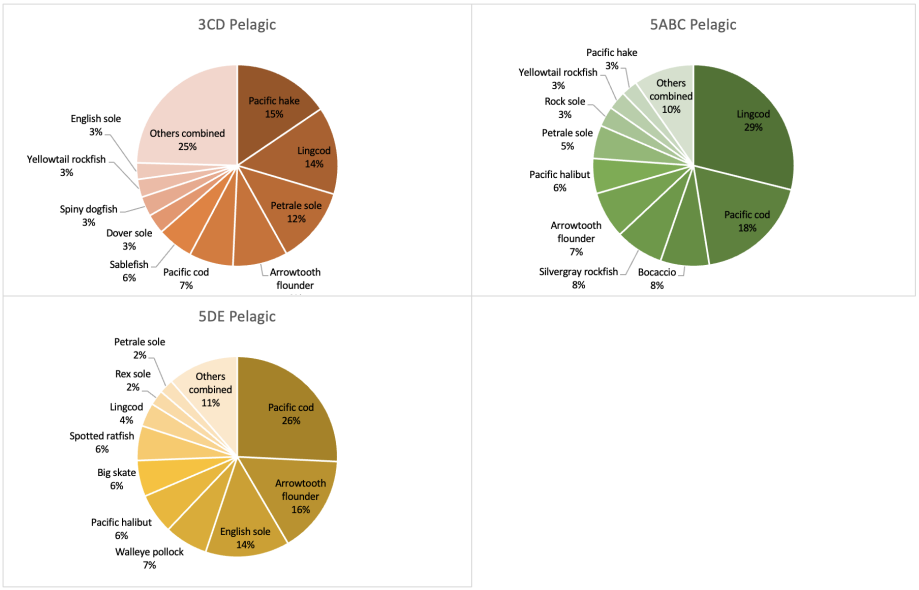

Figure 3: Catch composition of Pelagic Bottom Trawl fisheries by target species group and area (DFO Pacific Region 2024).

The Shallow Flatfish Bottom Trawl fishery (hereafter referred to as “Shallow Flatfish”) catches a mix of sole species and arrowtooth flounder (Figure 4). The 5ABC and 5DE Shallow Flatfish fisheries both have Red-scoring species (coldwater corals and sponges in 5ABC and walleye pollock in 5DE). Because the presence of one or more Red-scoring species precludes a Green rating in these fisheries, the two sub-fisheries have been combined in this report. The 3CD fishery does not have any Red-scoring species.

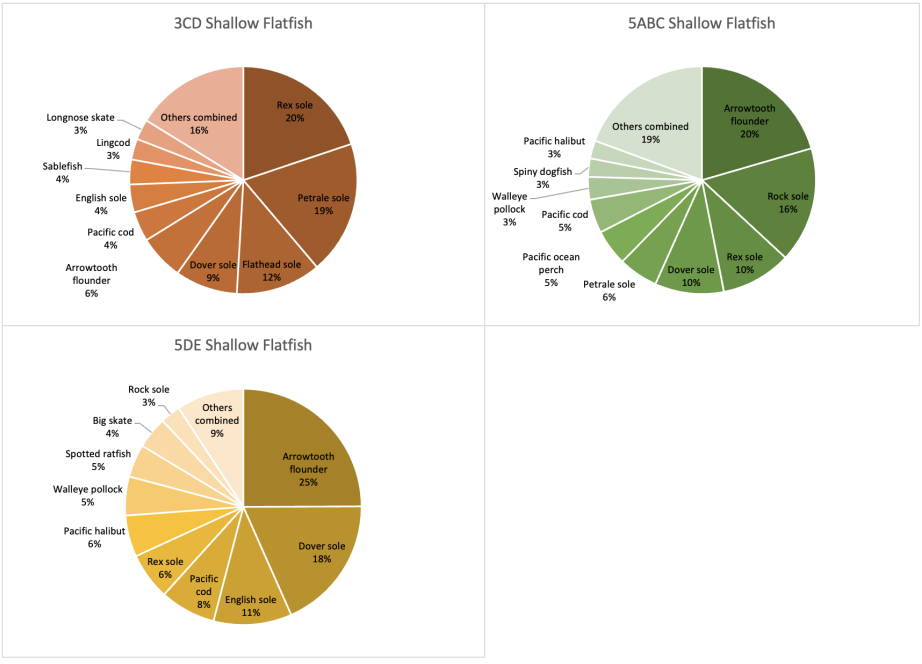

Figure 4: Catch composition of Shallow Flatfish Bottom Trawl fisheries by target species group and area (DFO Pacific Region 2024).

The Rockfish Bottom Trawl fishery (hereafter referred to as “Rockfish Trawl”) catches a mix of rockfish species (Figure 5). There are multiple Red-scoring species in each Rockfish Trawl fishery, so we have opted to scope the Rockfish Trawl fishery with all three areas combined. Although species composition varies regionally (Figure 5), overall Green ratings are precluded by one or more Red-rated main species; however, there are still separate ratings for individual stocks (e.g., there are three stocks of Pacific Ocean perch rated in the Rockfish Trawl fishery).

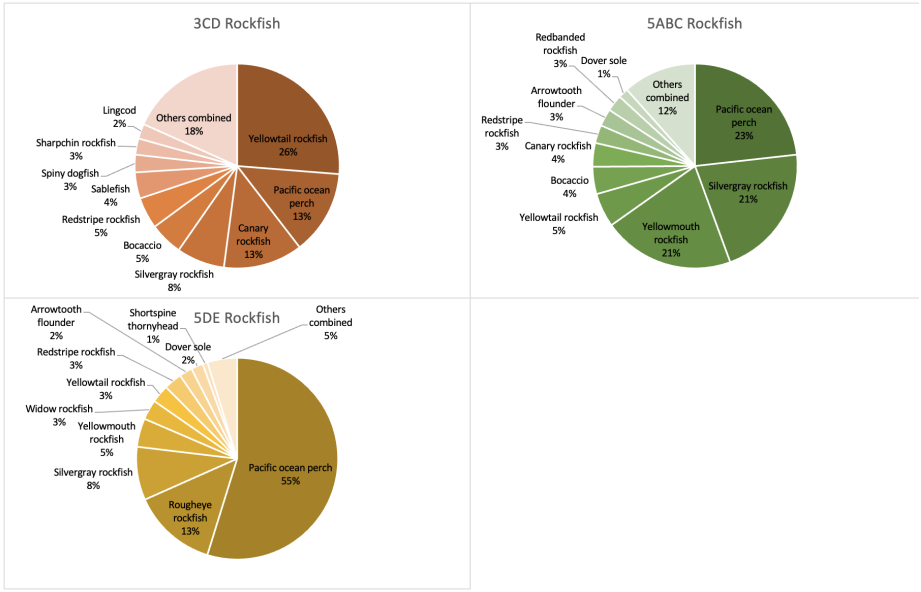

Figure 5: Catch composition of Rockfish Bottom Trawl fisheries by target species group and area (DFO Pacific Region 2024).

The Deep Flatfish Bottom Trawl fishery (hereafter referred to as “Deep Flatfish”) mainly catches arrowtooth flounder, Dover sole, and sablefish (Figure 6). Shortspine thornyhead is a main species in the 5ABC and 3CD Deep Flatfish fisheries, and it is a Red-scoring species. For this reason, the two fisheries are combined in this report. There are no Red-scoring species in the 5DE Deep Flatfish fishery; sablefish is mostly discarded in the 5DE fishery and is included in Criterion 2 rather than Criterion 1.

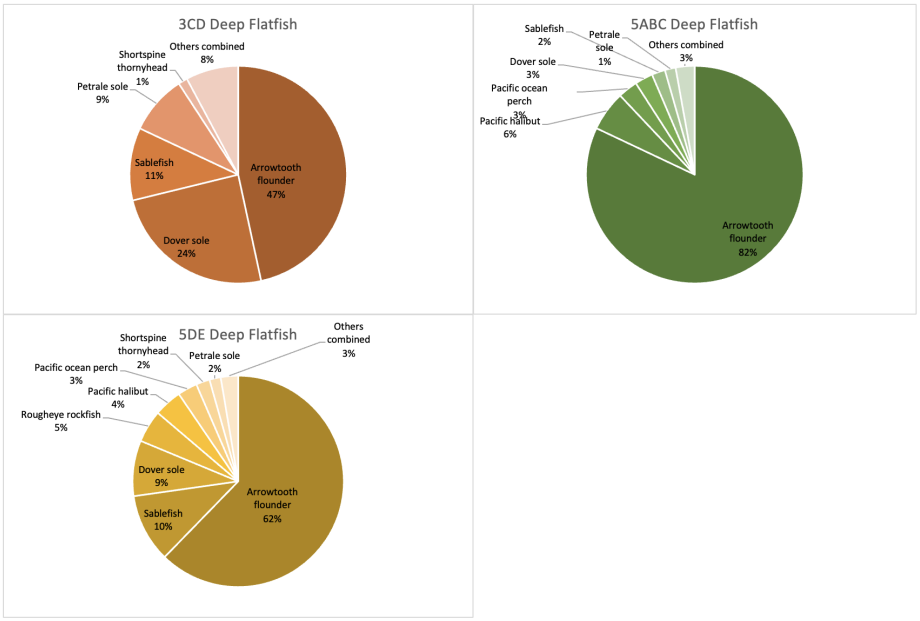

Figure 6: Catch composition of Deepwater Flatfish Bottom Trawl fisheries by target species group and area (DFO Pacific Region 2024).

Production Statistics

In 2022, the total landed value of BC's groundfish landings was $153 million, a decline from a peak of $223.6 million in 2017 but a slight increase compared to 2021 (Figure 7). The Trawl and Halibut fisheries produced the highest value (Figure 7). The trawl sector accounts for the majority of total landings in the groundfish fishery (Figure 8). In 2022, the landed volume for non-trawl and non-halibut fisheries was 605 t in the Lingcod fishery, 2,928 t in the Sablefish (trap and line combined) fishery, and 278 t in the Rockfish fisheries. Excluding Pacific hake, the following species accounted for the highest quantity of landings (by metric ton) across trawl and line sectors combined in 2020: yellowtail rockfish (3,315 t), Pacific ocean perch (2,618 t), sablefish (2,508 t), Pacific halibut (2,333 t), widow rockfish (1,987 t), and arrowtooth flounder (1,954 t) (Appendix 2, Table 1 in (Cornthwaite & Workman 2021)).

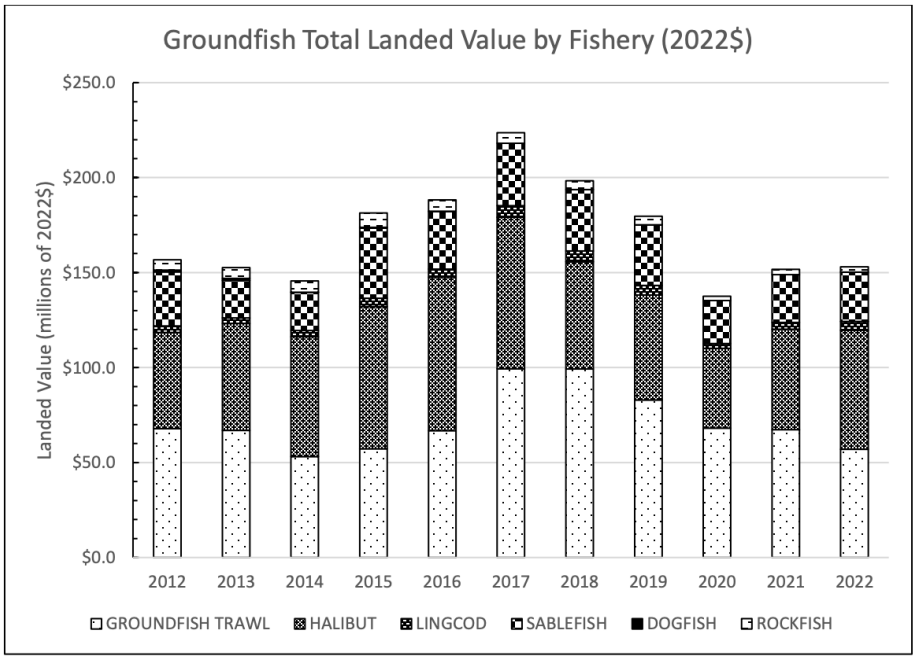

Figure 7: Groundfish total landed value (in 2022$) by fishery from 2012 to 2022 (DFO 2024).

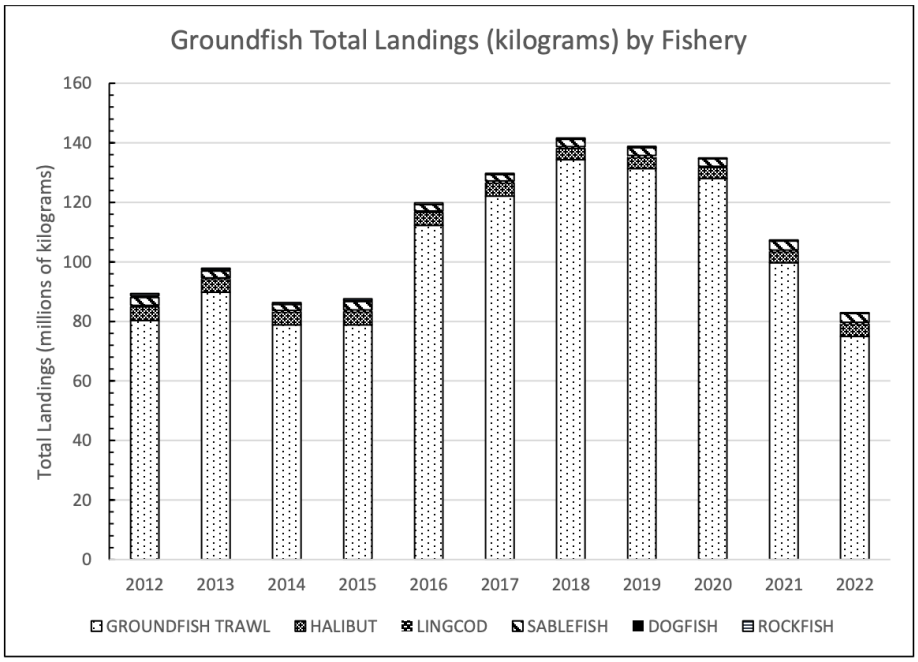

Figure 8: Groundfish total landed volume (kilograms) by fishery from 2012 to 2022 (DFO 2024).

Importance to the US/North American market.

Much of the seafood produced by the groundfish fisheries is destined for export. Fresh and frozen fillets and whole fish are exported to markets along the "I-5 Highway Corridor" that runs along the U.S. West Coast (GSGislason & Associates 2010). It has been estimated that approximately 72% of Canada's total domestic catch (marine fisheries, aquaculture, and freshwater fisheries combined) is exported (Talloni-Álvarez 2021), though the proportion may be as high as 85% for BC fisheries (Fawcett-Atkinson 2020). The United States is Canada's top export market (in wholesale value) for BC groundfish, accounting for 28% of the total market share in 2019; the wholesale value (in millions of Canadian dollars (CAD)) of select BC groundfish exports from 2017 to 2019 are presented in Table 1, along with the United States percent share in 2019 (Ministry of Agriculture 2020).

Table 1. Export and market value of Pacific groundfish.

BC Export Product	2017 ($ Millions)	2018 ($ Millions)	2019 ($ Millions)	US % Share of the Market in 2019
Hake*	72.0	102.7	102.9	
Rockfish**	51.6	52.8	34.5	N/A
Halibut	39.0	33.4	35.5	99%
Sablefish	18.4	22.3	22.5	9%
Sole	7.2	9.4	6.6	10%
Cod	4.0	4.7	3.9	17%
Flounder	5.1	2.5	2.5	25%
Lingcod	1.1	0.6	0.5	100%
Skate	0.5	0.6	0.5	10%
Pacific ocean perch	0.7	0.5	0.7	11%
Dogfish	0.3	0.1	0.02	100%
Other groundfish	31.5	26.9	20.9	71%
Total groundfish***	181.7	206.3	200.3	28%

* Hake is not rated in this report.
** Rockfish landings are presented in total wholesale value (i.e., domestic and export value combined) from 2016 to 2018. (Ministry of Agriculture 2019).
*** The export value of total groundfish does not include the wholesale value of rockfish from 2016 to 2018.

Rockfish are primarily exported to the U.S., where they are sold as fresh and frozen fillets {BCSeafood 2014}; a market for live rockfish

also exists in the Vancouver region (GSGislason & Associates 2010){BCSeafood 2014}). The primary market for sablefish is Japan {BCSeafood.ca 2014}. Halibut and lingcod are primarily destined for domestic markets and for export to the U.S. {BCSeafood 2014}. Lingcod is sold as fresh and frozen fillets, while halibut is sold in a variety of products. Dogfish is exported, primarily to the United Kingdom, Europe, and Asia {BCSeafood 2014}. Other notable export markets include China (flounder), Russia (sablefish, dogfish), and Ukraine (pollock, flounder) (Ministry of Agriculture 2012). In 2019, BC's non-hake groundfish exports were valued at approximately $97.4 million, which represented a 6% decline from 2018 (Ministry of Agriculture 2020). Total landings (tonnes, rounded to the nearest whole number) in 2019 (2019/20 season for Canada) of selected groundfish species in Pacific U.S. waters (NOAA 2021) and Canadian waters (DFO Pacific Region 2021) are provided in Table 2.

Table 2. Landings of groundfish species in BC and the U.S. (Alaska and West Coast combined) in 2019.

2019 Rockfish Landings (t)	Bocaccio	Canary	Copper	Pacific ocean perch	Quillback	Redbanded	Redstripe	Rougheye/Blackspotted	Shortraker	Silvergray	Widow	Yelloweye	Yellowmouth	Yellowtail
BC	256	783	33	3,566	112	339	726	720	121	1,792	1,723	90	1,435	3,488
U.S.	399	452	17	63,843	NA	43	42	672 (rougheye only)	563	79	9,315	3	26	3,299

2019 Groundfish Landings (t)	Big skate	Lingcod	Kelp greenling	Longnose skate	Longspine thornyhead	Pacific cod	Pacific spiny dogfish	Sablefish	Shortspine thornyhead
BC	199	961	4	113	22	502	163	2,485	274
U.S.	146	952	12	NA	258	210,415	476	18,466	674

2019 Flatfish Landings (t)	Arrowtooth flounder	Butter sole	Butter sole	English sole	Flathead sole	Petrale sole	Rex sole	Rock sole
BC	7,072	13	13	529	22	516	370	155
U.S.	32,664	300	300	387	17,420	2,621	2,784	26,268

Common and market names.

Table 3. Common, market, and vernacular names of commercial groundfish species (as used in the U.S.) (FDA 2022).

Common name	Scientific name	Acceptable market name(s)	Vernacular name(s)
Arrowtooth flounder	*Atheresthes stomias*	Flounder, Arrowtooth	Turbot
Big skate	*Raja binoculata*	Skate	NA
Bocaccio	*Sebastes paucispinis*	Rockfish	Longjaw, Rock salmon
Butter sole	*Isopsetta isolepis*	Sole or flounder	NA
Canary rockfish	*Sebastes pinniger*	Rockfish	Orange rockfish
Copper rockfish	*Sebastes caurinus*	Rockfish	NA
Darkblotched rockfish	*Sebastes crameri*	Rockfish	Blackmouth rockfish
Dover sole	*Microstomus pacificus*	Sole	Slime sole, Slippery sole
English sole	*Parophrys vetulus*	Sole	Lemon sole
Flathead sole	*Hippoglossoides elassodon*	Sole or flounder	Flathead Flounder, Halibut-like flounder
Greenstriped rockfish	*Sebastes elongatus*	Rockfish	NA
Kelp greenling	*Hexagrammos decagrammus*	Greenling	Rock Trout, Sea Trout, Boregat, Bodieron
Lingcod	*Ophiodon elongatus*	Lingcod	Cultus cod, Blue cod, Buffalo cod, Ling
Longnose skate	*Raja rhina*	Skate	NA
Longspine thornyhead	*Sebastolobus altivelis*	Thornyhead	NA
North Pacific spiny dogfish	*Squalus suckleyi*	Shark, dogfish or shark, cape	Spring dogfish, Spiked dogfish, Spur Dog
Pacific cod	*Gadus macrocephalus*	Cod, Alaska cod	Alaska cod, Grey cod, True cod
Pacific Ocean perch	*Sebastes alutus*	Ocean perch, rockfish	NA
Petrale sole	*Eopsetta jordani*	Sole or flounder	California sole, brill
Quillback rockfish	*Sebastes maliger*	Rockfish	Yellowback rockcod, brown rockcod, orangespotted rockcod
Redbanded rockfish	*Sebastes babcocki*	Rockfish	NA
Redstripe rockfish	*Sebastes proriger*	Rockfish	NA
Rex sole	*Errex zachirus*	Sole or Flounder	Longfin sole, Witch
Rougheye rockfish	*S. aleutianus/melanostictus* complex	Rockfish	NA
Sablefish	*Anoplopoma fimbria*	Sablefish	Black cod, Butterfish, Skil, Skilfish, Coalfish

Sandpaper skate	*Bathyraja interrupta*	Skate	NA
Sharpchin rockfish	*Sebastes zacentrus*	Rockfish	Bigeyed rockfish
Shortraker rockfish	*Sebastes borealis*	Rockfish	NA
Shortspine thornyhead	*Sebastolobus alascanus*	Thornyhead	NA
Silvergray rockfish	*Sebastes brevispinis*	Rockfish	NA
Southern rock sole	*Lepidopsetta bilineata*	Sole or Flounder	Rock flounder
Splitnose rockfish	*Sebastes diploproa*	Rockfish	Lobejawed Rockfish
Walleye pollock	*Gadus chalcogrammus*	Pollock	Whiting, Pacific Tomcod, Pacific Pollock
Widow rockfish	*Sebastes entomelas*	Rockfish	Brownies
Yelloweye rockfish	*Sebastes ruberrimus*	Rockfish	Rasphead rockfish
Yellowmouth rockfish	*Sebastes reedi*	Rockfish	NA
Yellowtail rockfish	*Sebastes flavidus*	Rockfish	Greenies

Primary product forms

See “Importance to the US/North American market.”

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

ARROWTOOTH FLOUNDER			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

BIG SKATE			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

BLACKSPOTTED ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	2.330: Moderate Concern	1.000: High Concern	Red (1.526)

BOCACCIO ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

CANARY ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

COPPER ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

DARKBLOTCHED ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

DOVER SOLE			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

ENGLISH SOLE			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

FLATHEAD SOLE			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

KELP GREENLING			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

LINGCOD			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Outside Stock | Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

LONGNOSE SKATE			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTH PACIFIC SPINY DOGFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

PACIFIC COD			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

PACIFIC HALIBUT			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

PACIFIC OCEAN PERCH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	3.670: Low Concern	5.000: Low Concern	Green (4.284)
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	3.670: Low Concern	5.000: Low Concern	Green (4.284)
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	3.670: Low Concern	5.000: Low Concern	Green (4.284)
5DE Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
5ABC Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	3.670: Low Concern	5.000: Low Concern	Green (4.284)
5DE Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
3CD Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

PETRALE SOLE			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

QUILLBACK ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

REDBANDED ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

REDSTRIPE ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

REX SOLE			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

ROUGHEYE ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	2.330: Moderate Concern	1.000: High Concern	Red (1.526)

SABLEFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

SHARPCHIN ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

SHORTRAKER ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

SHORTSPINE THORNYHEAD			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	3.670: Low Concern	1.000: High Concern	Red (1.916)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	3.670: Low Concern	1.000: High Concern	Red (1.916)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	3.670: Low Concern	1.000: High Concern	Red (1.916)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	3.670: Low Concern	1.000: High Concern	Red (1.916)

SILVERGRAY ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

SOUTHERN ROCK SOLE			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

SPLITNOSE ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

WALLEYE POLLOCK			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	3.670: Low Concern	5.000: Low Concern	Green (4.284)
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	2.330: Moderate Concern	1.000: High Concern	Red (1.526)

WIDOW ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

YELLOWEYE ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Outside (remaining areas) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Inside (Area 4B) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

YELLOWMOUTH ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

YELLOWTAIL ROCKFISH			
REGION / METHOD	ABUNDANCE	FISHING MORTALITY	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

Scoring Relative to Reference Points

In this assessment, B_{MSY} is the biomass at maximum sustainable yield, while B_0 is the estimate of a stock's biomass in the absence of fishing, at equilibrium with long-term average recruitment. Seafood Watch scores abundance relative to target reference points (TRPs) B_{MSY} or 0.4 B_0 and limit reference points (LRPs) of 0.5 B_{MSY} or 0.2 B_0, unless there is information in the stock assessment to suggest that alternatives are more appropriate. Following the guidance of the U.S. groundfish fisheries, Seafood Watch considers 0.25 B_0 an appropriate TRP for flatfish, while all other groundfish should be managed with a TRP of 0.4 B_0.

DFO uses a harvest strategy that utilizes reference points to define the status of a given stock and thereby guide decisions regarding allowable removals. The two reference points are the upper stock reference point (USRP) and LRP. The USRP is not necessarily the management target; a target reference point may be higher than the USRP (DFO 2009a). DFO suggests that if stock-specific data are not available, 0.80*B_{MSY} may be used as the USRP, and 0.40*B_{MSY} may be used as the LRP (Annex 1b in DFO 2009a). A third reference, the removal reference, governs allowable mortality rates; the removal rate declines between the USRP and the LRP. Multiple stock assessments specifically note that no evaluation has been carried out to determine the suitability of the provisional RPs, nor have acceptable levels of risk been specified (e.g., (Haigh et al. 2019)).

Because DFO stock assessments often present stock status relative to the USRP of 0.8 B_{MSY} and LRP of 0.4 B_{MSY}, a stock may be in DFO's Cautious Zone (i.e., above 0.4 B_{MSY}), but score a high concern in this Seafood Watch assessment because the stock is below 0.5 B_{MSY}. When scoring fishing mortality, the Seafood Watch Standard provides the following guidance: If the stock assessment, or the data used within it, is greater than 10 years old, then there is a high level of uncertainty associated with the result (with respect to how it reflects the current situation). In cases where $F < F_{MSY}$ (or an appropriate reference point) and the data are greater than 10 years old, fishing mortality should be considered "unknown" or a moderate conservation concern. In all cases where $F > F_{MSY}$ (or an appropriate reference point), regardless of the age of the assessment, fishing mortality should be scored as a high conservation concern.

Data-Limited Abundance Indicators

Throughout this report, indices of relative abundance are referenced to inform stock status evaluations when formal stock assessments are unavailable or outdated, and when there is no assessment by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or by the International Union for the Conservation of Nature (IUCN). The trawl survey biomass indices are derived from multispecies trawl surveys that take place in four areas: West Coast Vancouver Island (WCVI), West Coast Haida Gwaii (WCHG), Queen Charlotte Sound (QCS), and Hecate Strait (HS). These surveys follow a random depth stratified design (Sinclair et al. 2003). The purpose of the trawl survey biomass indices is to monitor changes in relative abundance. To that end, the index values are not estimates of absolute

abundance, but should be interpreted relative to the other points in the relevant time series. Similarly, Outside Hard Bottom Long Line (HBLL) surveys and the International Pacific Halibut Commission (IPHC) Fishery Independent Setline surveys provide biomass indices for some species (DFO 2022)(Anderson and English 2022). DFO provided data from selected surveys that are most appropriate for a given species (based on decisions in previous assessments or based on a combination of the survey CVs and which commercial gear type tends to catch the species). Also, where there are multiple surveys of the same gear type, DFO combined them into a single index covering the area of interest. Additional information can be found in DFO (2022) and Anderson and English (2022).

In lieu of (or in addition to) *data-moderate* assessments, Seafood Watch can use relative abundance indices such as survey data to score abundance. Where the index shows a stable or increasing trend over three generations, abundance can be scored a low concern. Generation time is calculated using the same methods as IUCN and COSEWIC assessments: Generation time (G) in an unfished population can be estimated using the formula: G = A + 1/M, where A is the age at 50% maturity and M is the natural mortality rate (e.g., (IUCN 2024) and (COSEWIC 2009b)). If a previous stock assessment with data that are ≥10 years old showed abundance to be healthy *and* the survey index shows a continued positive or stable trend, abundance can be scored a moderate concern. When multiple indices are available for a given species and those trends are conflicting, or in cases in which surveys are not covering three generations, the score is based on other supporting information, such as an IUCN rating or a productivity-susceptibility analysis (PSA). The PSA for teleost fish and invertebrate species is according to the PSA adapted from the Marine Stewardship Council (MSC 2014) with revisions made in 2020. A determination of high vulnerability leads to a high concern score for abundance unless there are other data points to offset the concern. The Productivity score (P) is calculated by taking the arithmetic mean of the productivity attribute scores (p1, p2, p3, p4, p5, p6, p7, and p8, where p8 is only used for invertebrates). The Susceptibility score (S) equals the arithmetic mean of the susceptibility attribute scores (s1, s2, s3, s4, s5). The Vulnerability score (V) equals the Euclidean distance of 1 and 2 using the following formula: $V = \sqrt{(P^2 + S^2)}$, which produces the Vulnerability score range:

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

Although deep-sea habitats are protected from bottom trawl gear under the Habitat Conservation Collaboration Agreement, midwater trawling still occurs in many of the areas closed to bottom trawling (Wallace et al. 2015), which affects the vertical overlap component of the Susceptibility score. For example, 88% of the total coastwide 800–1,500 m depth stratum is closed to bottom trawling (Wallace et al. 2015), and longspine thornyhead primarily occur at depths of 500–1,600 m (COSEWIC 2007c). If the bottom trawl fishery were the only fishery affecting longspine thornyhead, then the vertical overlap score would be scored differently. Because the midwater trawl fishery still operates in areas closed to bottom trawling, we do not have evidence that >33% of the depth range is unfished, considering all fisheries.

Interpretation of Fishing Mortality Information

Throughout this assessment, several sources of information are used to evaluate fishing mortality. Where it is available, information from recent stock assessments takes priority over other sources of information. Many stocks in this report have a total allowable catches (TACs) but lack regularly updated stock assessments. In such a situation, the TAC is adjusted by DFO, based on trends in survey indices and fishery-dependent data; the metrics and methods for such decisions are not made public. Thus, for stocks with TACs but without recent stock status information, this assessment takes a conservative approach: catches that are less than the TACs are generally scored moderate for fishing mortality, unless there is other information to suggest a lesser or greater concern (e.g., recent catches well over historic catches). For stocks without TACs, a fishing mortality score of unknown is the general starting point; this may be revised upward or downward based on other sources of information. It should also be noted that data presented for rockfish catches during the late 1980s and early 1990s are considered to be uncertain, because there existed at that time an incentive to misreport catches.

There are many species/stocks that do not have recent stock assessments or reliable estimates of sustainable fishing mortality, but some of these species are managed with TACs and sector caps (DFO 2022d). Of those, the following are managed with TACs: big skate, canary rockfish, copper rockfish, Dover sole, English sole, Outside lingcod, longnose skate, longspine thornyhead, north Pacific spiny dogfish, petrale sole, shortraker rockfish, and silvergray rockfish (DFO 2022d). There is no evidence that catches of these species regularly exceed the TAC levels (e.g., (DFO 2020b) and (DFO 2020a)). Unassessed species/stocks that are not managed with TACs include darkblotched rockfish, flathead sole, kelp greenling, rex sole, sharpchin rockfish, splitnose rockfish, and spotted ratfish (DFO 2022d).

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.*

Arrowtooth flounder (Atheresthes stomias)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Very Low Concern

In the most recent coastwide stock assessment (excluding Inside waters), arrowtooth flounder female spawning biomass was estimated to be 0.37 of B_0, which is above the LRP and below the USR (DFO 2023e). But Seafood Watch has deemed that 0.25 B_0 is an appropriate TRP for flatfish species. Because the median biomass in 2022 was above 0.25 B_0 (Figure 9), abundance is scored a very low concern.

Justification:

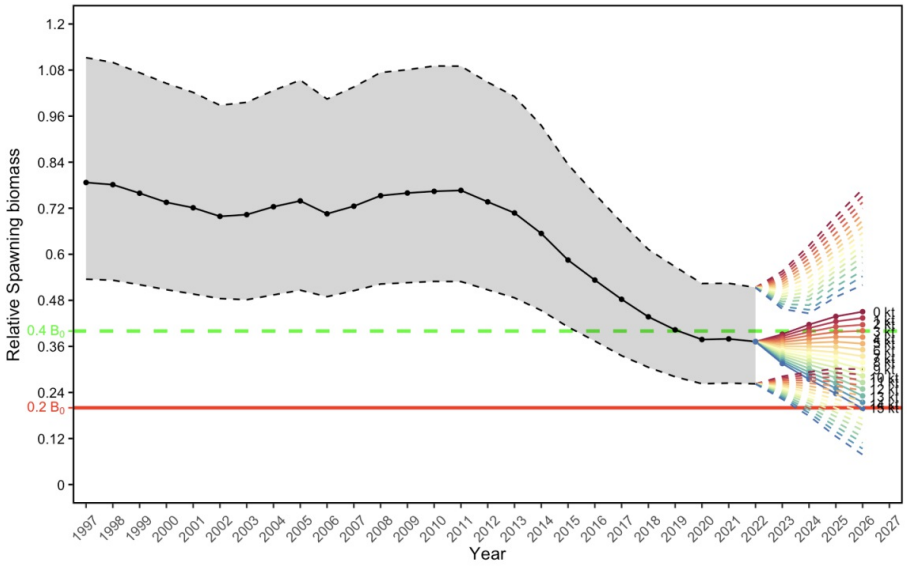

Figure 9: Arrowtooth flounder estimated relative spawning biomass (B_t/B_0) for the base model with 95% credible interval (shaded area). Horizontal lines indicate the 0.2 B_0 (solid red) and proposed 0.4 B_0 (dashed green) reference points. The colored dots from 2023 to 2026 are the medians of the posteriors for the projected catch levels, with solid lines connecting them; the dashed lines from 2023 to 2026 represent the 95% CIs for those posteriors. The constant catch values in kilotons (kt) are shown as text on the right of the end points of each projected trajectory (DFO 2023e).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Low Concern

MSY-based reference points were not used in the 2023 stock assessment for arrowtooth flounder because commercial age selectivity suggests that a large proportion of the mature biomass is not vulnerable to the fishery and could be taken without repercussions to the stock, which is considered implausible (DFO 2023e). Therefore, the stock assessment presented a reference removal rate (0.105) relative to the USR of 0.4 B_0 to identify catch scenarios that would result in long-term biomass equal to this target level (DFO 2023e). The stock was projected to reach the USR by 2026 under annual catch scenarios of 3,000 t or less, and remain above the LRP under all annual catch scenarios below 15,000 t (DFO 2023e).

The TAC for arrowtooth flounder was reduced from 14,000 t to 5,000 t in 2020, following a declining trend in the spawning biomass (DFO 2023e). The average annual catch from the 2020/21 to 2022/23 bottom trawl seasons was 3,468 t (DFO 2021j)(DFO 2022e) (DFO 2023g), which was below the reduced TAC. While there is no explicit MSY reference point provided in the stock assessment, nor a reference removal rate relative to a biomass target of 0.25 B_0, recent catch levels have been below catch at the reference removal rate (4,400 t) that was projected to bring biomass close to the USR in the long term. Also, managers recently implemented a seasonal bottom trawl closure in Rennel Sound (subarea 5E) and Cape Cook (subarea 3D) to protect arrowtooth flounder spawning aggregations (DFO 2024). Fishing mortality is scored a low concern because catch levels are below the target levels that are expected to maintain the stock at healthy levels.

Justification:

Until recently, arrowtooth flounder was discarded in substantial quantities: its marketability was compromised because its flesh can degrade rapidly after being caught. But a market has developed in recent years, and arrowtooth flounder landings have increased (Figure 10); for 2014, the total catch (landings + discards) of arrowtooth flounder was 13,571 t (Table 1 in Grandin & Forrest 2017), while the TAC was 15,000 t (Grandin & Forrest 2017). Because of a decline in spawning biomass, the TAC was reduced to 5,000 t in 2020, and the catch in 2022/23 was 4,482 t (DFO 2023e).

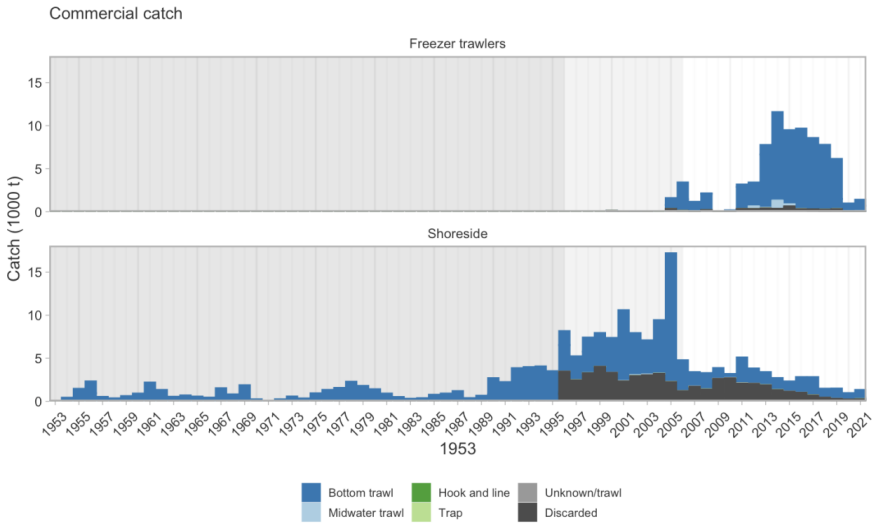

Figure 10: Commercial catch of arrowtooth flounder by fleet (DFO 2023e).

Big skate (Raja binoculata)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish

Moderate Concern

The last stock assessment was unable to yield reliable biomass estimates for big skate, but noted that there were no significant trends in survey abundance indices (DFO 2014d). Multiple stock assessment models were also pursued in 2015, but the results

were unreliable (King et al. 2015). The data used in these assessments are >10 years old, so the stock status is considered unknown. Recent survey indices indicate an increasing trend in the relative biomass of big skate in Inside and Outside waters since 2010 (Figure 11). But the surveys do not cover three generations (the big skate generation time is 12.25 years (Farrugia et al. 2016)). The IUCN has assessed big skate as a species of Least Concern (Farrugia et al. 2016). Abundance is scored a moderate concern, based on the IUCN status.

Justification:

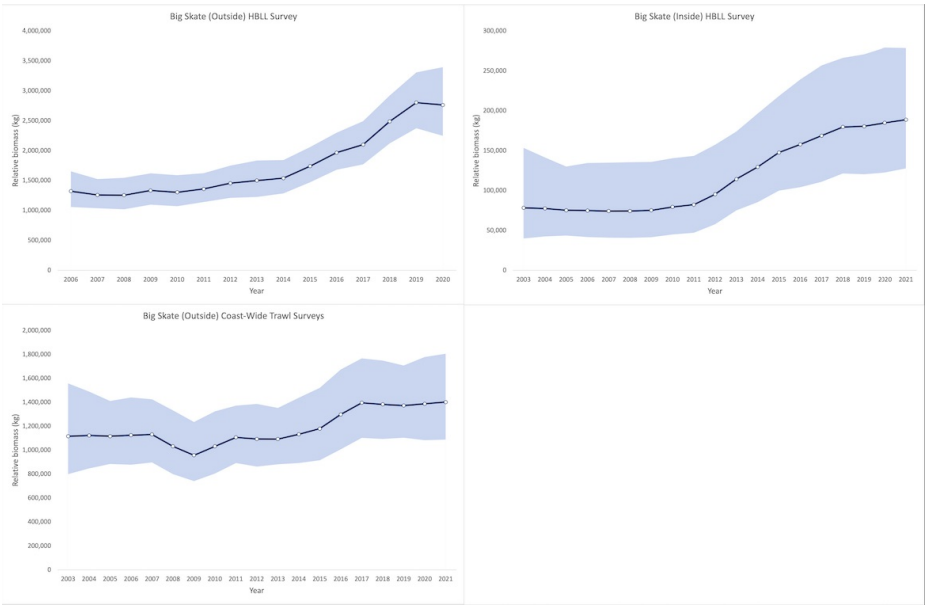

Figure 11: Big skate relative biomass trends in Outside waters from the Outside HBLL survey (top left), Inside waters from the Inside HBLL survey (top right), and coast-wide trawl surveys (bottom left). Dots represent mean estimates of relative biomass and shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish

Moderate Concern

The 2020 catches of big skate in the Trawl fisheries were 167.02 t (Area 5C,D,E), 9.11 t (Area 5A,B), and 4.59 t (Area 3C,D); catches were well below the TACs for each area (DFO 2020a). Likewise, catches of big skate in Hook and Line fisheries were well below TACs in all areas, with the largest quantities of catch from the Halibut fishery (16.54 t) (DFO 2020b). According to the data-limited Catch-MSY Approach, catches of big skate were below the maximum MSY from 2007 to 2011, but results were extremely sensitive to assumptions (King et al. 2015). But because these data are now >10 years old, Seafood Watch considers the sustainability of current fishing levels as unknown. Therefore, this factor is scored a moderate concern.

Blackspotted rockfish (Sebastes melanostictus)

Factor 1.1 - Abundance

BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish

Fishery

BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Moderate Concern

Rougheye rockfish (*Sebastes aleutianus*) and blackspotted rockfish (*S. melanostictus*) are assessed as a species complex called the Rougheye/Blackspotted (REBS) rockfish complex. The 2020 assessment used a two-fishery, two-sex catch-at-age model and provided stock status and advice for two identified REBS complex stocks: the northern stock in Area 5DE (REBS north) and the southern stock in Areas 3CD5AB (REBS south) (DFO 2020d).

Advice to managers is based on an LRP of 0.4 B_{MSY} and a TRP of 0.8 B_{MSY} consistent with DFO's Precautionary Approach. But given that an MSY-based approach may not be appropriate for such a long-lived species, alternative reference points are provided relative to unfished biomass, B_0. Both MSY-based and B_0-based reference points are presented in Table 4. REBS north rockfish is above the TRP and LRP under DFO's Precautionary approach (Figure 12, left panel); the stock is also above B_{MSY} (B_{2021}/B_{MSY} = 2.21); REBS south rockfish is slightly above B_{MSY} (B_{2021}/B_{MSY} = 1.07) and above both DFO provisional RPs (Figure 12, right panel).

The recent stock assessment concluded that the REBS north stock appears to be healthy despite a long history of fishing, and the results appear to be robust to a range of assumptions, but the results for the REBS south stock are less definitive and the stock may be at low levels (DFO 2020d). Seafood Watch scores this factor relative to MSY-based reference points, rather than DFO's provisional reference points. Both REBS stocks are above B_{MSY} but there is less certainty for the REBS South stock. Because the two species are managed as a species complex, there is uncertainty around species-specific impacts, so this factor is scored a moderate concern.

Justification:

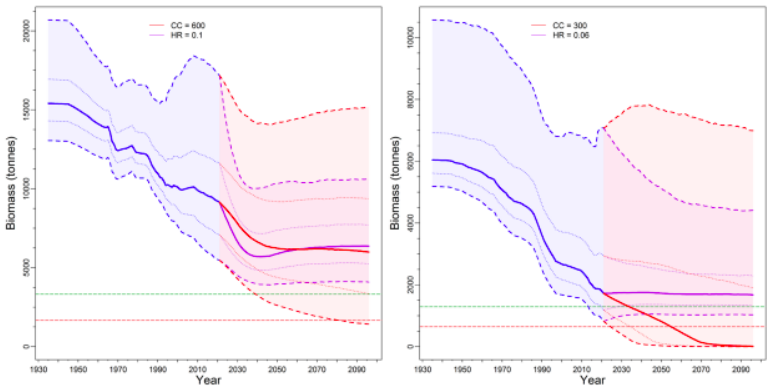

Figure 12: Estimates of spawning biomass Bt (tonnes) from the model posteriors of the REBS north (left, 9,000 samples) and REBS south (right, 6,000 samples) composite base cases. The median biomass trajectory appears as a solid curve surrounded by a 90% credibility envelope (quantiles: 0.05, 0.95) in blue and delimited by dashed lines for years t = 1935–2021; projected biomass appears in light red (constant catch) and purple (harvest rate) for years t = 2022–2096 (1.5 generations). Also delimited is the 50% credibility interval (quantiles: 0.25–0.75) delimited by dotted lines. The horizontal dashed lines show the median LRP (red: 0.4 B_{MSY}) and USR (green: 0.8 B_{MSY}). Figure from (DFO 2020d).

Table 4. Model output with median (50%) values and associated 5% and 95% quantiles from (DFO 2020d).

	Median Value (t)	5–95% Percentiles (t)	B_{2021}/Reference Point (5–95% Percentiles)
REBS North			
B_0	15,413	13,058–20,693	0.595 (0.405–0.840)
B_{2021}	9,153	5,475–17,176	—
B_{MSY}	4,149	3,519–5,519	2.21 (1.5–3.15)
REBS South			

B_0	6,045	5,187–0,574	0.286 (0.155–0.680)
B_{2021}	1,725	818–7,078	—
B_{MSY}	1,611	1,380–2,739	1.07 (0.582–2.61)

Factor 1.2 - Fishing Mortality

BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Moderate Concern

The median exploitation rate on the north stock in 2020 (u_{2020}) did not exceed u_{MSY} for the Trawl sector (u_{2020}/u_{MSY} = 0.06) or Line sector (u_{2020}/u_{MSY} = 0.11) (DFO 2020d). According to the decision table in the recent stock assessment for REBS north, all levels of constant catch—up to 1,200 t—have a >50% probability that $u_t < u_{MSY}$ in every year from 2021 to 2031 (DFO 2020d), suggesting that the TAC of 783 t is lower than the catch at MSY. But there is uncertainty in the exploitation status of each species individually. Because there is no information on regional or species differences in the contribution of each species to the stock complex, fishing mortality on each species is unknown and this factor is scored a moderate concern.

BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

High Concern

According to the most recent assessment, the median exploitation rate on the REBS south stock in 2020 (u_{2020}) exceeded u_{MSY} (u_{2020}/u_{MSY} = 1.17) in the Trawl sector, but not in the commercial non-trawl sector (u_{2020}/u_{MSY} = 0.72) (Figure 13). The south stock predominantly contains rougheye rockfish. Although annual catches of REBS rockfish have remained below the established TAC, it is probable [$P(u_{2020} > u_{MSY} = 0.58)$] that the current harvest rate from the Trawl sector on the south stock is exceeding MSY (DFO 2020d). At current catch levels, the south stock is expected to decline to the "Critical Zone" ($B_t < 0.4\ B_{MSY}$) after 2050 (DFO 2020d). Because this stock is harvested above sustainable levels in the Trawl sector and fishing mortality from all sources is expected to reduce the stock below 0.4 B_{MSY}, fishing mortality is scored a high concern.

Justification:

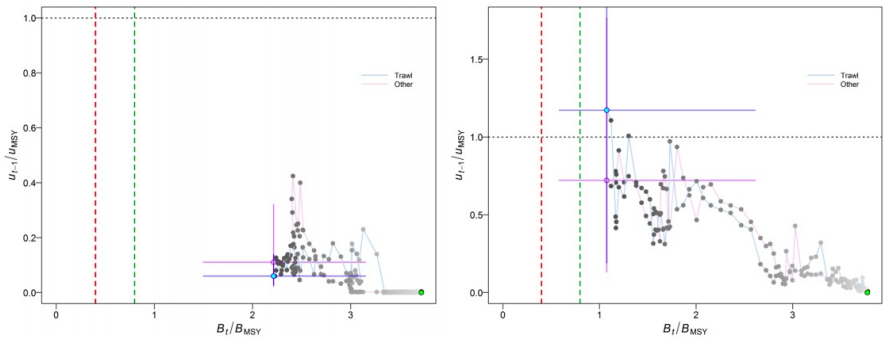

Figure 13: Phase plot through time (REBS north on left, REBS south on right) of the medians of the ratios B_t/B_{MSY} (the spawning biomass at the start of year t relative to B_{MSY}) and two measures of fishing pressure: trawl ($u_{t-1(trawl)}/u_{MSY}$: cyan dot) and "other" ($u_{t-1(other)}/u_{MSY}$: purple dot) (both represent the exploitation rate in the middle of year t–1 relative to u_{MSY} for each fishery) for the composite base cases. The filled green circle is the starting year (1935). Years then proceed from lighter shades through to darker, with the final year (t = 2021) as a filled cyan or purple circle, and the blue/purple cross lines represent the 0.05 and 0.95 quantiles of the posterior distributions for the final year. Red and green vertical dashed lines indicate the PA provisional LRP = 0.4 B_{MSY} and USR = 0.8 B_{MSY}, and the horizontal grey dotted line indicates u_{MSY}. Figure from (DFO 2020d).

$P(u_t < u_{MSY})$

Catch policy	Projection year										
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
0	1	1	1	1	1	1	1	1	1	1	1
50	>0.99	>0.99	>0.99	>0.99	1	1	1	1	1	1	1
100	0.87	0.88	0.89	0.91	0.93	0.94	0.96	0.97	0.98	0.98	0.98
150	0.63	0.63	0.63	0.64	0.65	0.67	0.68	0.7	0.72	0.73	0.74
200	0.49	0.49	0.49	0.49	0.50	0.50	0.51	0.51	0.52	0.52	0.52
250	0.40	0.40	0.40	0.40	0.40	0.41	0.41	0.42	0.42	0.42	0.43
300	0.34	0.33	0.33	0.33	0.33	0.33	0.34	0.34	0.34	0.34	0.34
350	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.28	0.27
400	0.24	0.23	0.23	0.22	0.22	0.22	0.23	0.23	0.23	0.23	0.22
450	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.19
500	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17
550	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15
600	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.14

Figure 14: REBS south decision tables for the reference points u_{MSY} for projections through 2031 for a range of constant catch policies (in tonnes/year) using the composite base case. Values are the probability (proportion of 6,000 MCMC samples) of the exploitation rate of vulnerable biomass in the middle of year t being less than the u_{MSY} reference point. For reference, the average annual catch of REBS south over the last 5 years (2015–19) was 291 tonnes. Table from (DFO 2020d).

Bocaccio rockfish (Sebastes paucispinis)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Very Low Concern

In the recent assessment of the bocaccio stock, the median estimate of B_{2020}/B_0 = 0.028 (5th and 95th percentiles = 0.013 and 0.058) (DFO 2020f). That assessment also found that the probability of B_{2020} being less than the LRP is 99% (DFO 2020f); the stock is thus within DFO's "critical zone." But a stock status update from the October 28, 2021 Science Response Process report suggests that bocaccio moved into the "healthy zone" as a result of a quite strong 2016 cohort (DFO 2022b). The estimated spawning biomass in 2022 is 13,080 t, which is greater than B_{MSY} (B_{2022}/B_{MSY} = 1.5; 5–95% confidence intervals: 0.625–3.42) (Figure 15).

According to a recent stock assessment, bocaccio is above the MSY target reference point, largely driven by a 2016 cohort that led to the full recovery of the BC population. Therefore, this factor is scored a very low concern.

Justification:

In 2013, COSEWIC assessed BC bocaccio as Endangered because of a continuous decline for 60 years and a 28% decline in the 10 years following the Threatened listing in 2002 (COSEWIC 2013a). Although the Seafood Watch criteria require a stock status score of high concern for a species that has been assessed as Endangered by a national scientific body such as COSEWIC, it should be recognized that a new stock assessment, conducted since the COSEWIC designation, indicates that bocaccio biomass is above the target level and is expected to continue to increase.

Advice to managers is based on an LRP of 0.4 B_{MSY} and a TRP of 0.8 B_{MSY} consistent with DFO's Precautionary Approach. But given that an MSY-based approach may not be appropriate for such a long-lived species, alternative reference points are provided relative to unfished biomass, B_0.

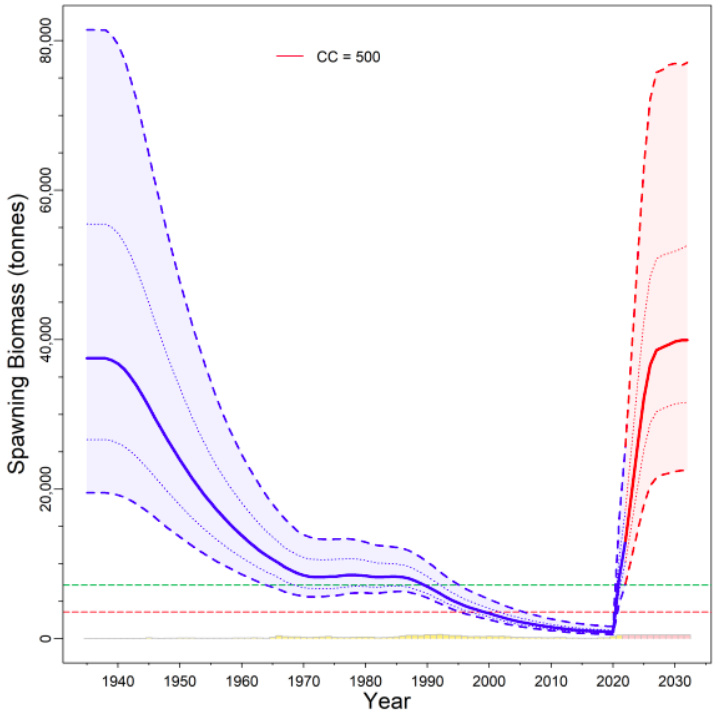

Figure 15: Bocaccio estimates of spawning biomass B_t (tonnes) from pooled model posteriors. The median biomass trajectory appears as a solid curve surrounded by a 90% credibility envelope (quantiles: 0.05–0.95) in light blue and delimited by dashed lines for years t = 1935–2022; projected biomass appears in light red for years t = 2023–2032. Also shown is the 50% credibility interval (quantiles: 0.25–0.75), delimited by dotted lines. The horizontal dashed lines show the median LRP and USR. Catches are represented as bars along the bottom axis, and assumed catch policy appears in the legend, where CC = constant catch (t/y). Figure from (DFO 2022b).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Low Concern

In British Columbia, bocaccio is primarily caught by the Trawl sector. In the recent assessment, the median exploitation rate in 2021 (u_{2021}) did not exceed u_{MSY} for the Trawl sector (u_{2021}/u_{MSY} = 0.240) or "other" fisheries (u_{2021}/u_{MSY} = 0.006) (DFO 2022b). Recent fishery-dependent and fishery-independent data suggest that the 2016 recruitment was 44 times the average recruitment from 1935 to 2019 (DFO 2020f). Under all catch levels up to 2,000 t, the bocaccio stock is projected to remain above B_{MSY} with >99% probability by 2032 (DFO 2022b). The average catch from 2017 to 2021 was 204 t annually (DFO 2022b). It is likely that current fishing mortality is below sustainable levels. Therefore, a low concern score is awarded.

Canary rockfish (Sebastes pinniger)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Very Low Concern

Canary rockfish is assessed as a single coastwide stock across management areas 3CD and 5ABCDE, with the highest population density occurring around WCVI (DFO 2023a). In the recent assessment of the canary rockfish stock, the median estimate of B_{2023}/B_0 = 0.778 (5th and 95th percentiles = 0.570 and 1.045) and B_{2023}/B_{MSY} = 3.043 (5th and 95th percentiles = 1.924 and 4.886) (Figure 16).

According to a recent stock assessment, BC canary rockfish is above the target reference points with no scientific controversy, and the data used in the assessment are <5 years old. Therefore, abundance is scored a very low concern.

Justification:

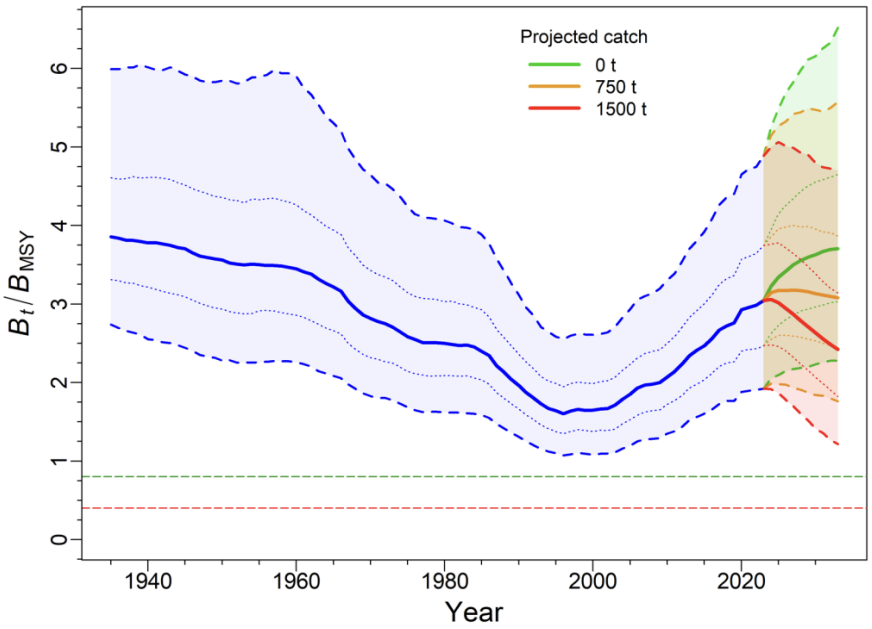

Figure 16: Estimates of spawning biomass B_t relative to B_{MSY} from the model posteriors (2,000 samples) of the CAR base run. The median biomass trajectory appears as a solid curve surrounded by a 90% credibility envelope (quantiles: 0.05, 0.95) in blue and delimited by dashed lines for years t = 1935–2023; projected biomass using constant catch appears in green (no catch), orange (750 t/y), and red (1,500 t/y) for years t = 2024–2033 (10 years). Also shown is the 50% credibility interval (quantiles: 0.25–0.75) delimited by dotted lines. Figure from (DFO 2023a).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Low Concern

The Trawl sector is allocated approximately 87.7% of the total canary rockfish TAC (DFO 2021a). Total commercial landings of canary rockfish in 2020 (603 t) were approximately 54.8% of the available coastwide TAC; approximately 98.8% of the 2020 canary rockfish catch was taken in the Trawl sector (Cornthwaite & Workman 2021). An additional 12.7 t of canary rockfish were taken through research allocations in 2020 (Cornthwaite & Workman 2021). The median exploitation rate in 2022 was below the exploitation rate at MSY, where u_{2022}/u_{MSY} = 0.270 (5th–95th percentiles = 0.151–0.474) (DFO 2023a). The current exploitation is

below that associated with MSY (Figure 17), and this factor is scored a low concern.

Justification:

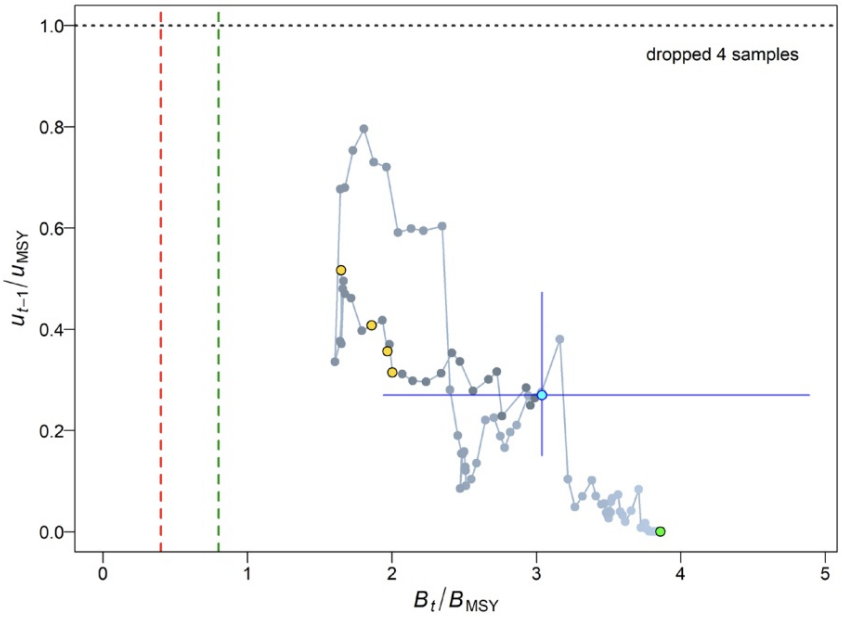

Figure 17: Phase plot through time of the medians of the ratios B_t/B_{MSY} (the spawning biomass at the start of year t relative to B_{MSY}) and fishing pressure u_{t-1}/u_{MSY} (representing the exploitation rate in the middle of year t–1 relative to u_{MSY}) for the combined fishery (trawl + other) for the CAR base run. The filled green circle is the equilibrium starting year (1935). Years then proceed from lighter shades through to darker, with the final year (t = 2023) as a filled cyan circle, with the blue cross lines representing the 0.05 and 0.95 quantiles of the posterior distributions for the final year. Previous assessment years (1999, 2005, 2007, 2009) are indicated by gold circles. The horizontal grey dotted line indicates u_{MSY}. Four MCMC samples with estimated $u_{MSY} = 0$ were dropped. Figure from (DFO 2023a).

Copper rockfish (Sebastes caurinus)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

High Concern

There is no up-to-date stock assessment for copper rockfish. This species has not been rated by the IUCN or COSEWIC. Copper rockfish is considered to have the highest vulnerability of any U.S. West Coast groundfish (Cope et al. 2015). The HBLL survey index indicates a stable-to-increasing trend in the relative biomass of copper rockfish Outside waters since 2006 (Figure 18), but the trends do not cover three generations. In the absence of information on abundance of copper rockfish in BC waters, this factor was scored using the Seafood Watch productivity-susceptibility analysis (PSA) scoring tool (Table 5). Copper rockfish has high vulnerability (V = 3.52) to fishing pressure and is therefore scored “high” concern for abundance.

Justification:

Table 5. Copper rockfish PSA

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Avg Age @ maturity; Tm (years)	6	2	(Cope et al. 2015)
von Bertalanffy (K) Fish only	0.09	3	(McGreer et al. 2020)
Avg Max Age; Tmax (years) Inverts only when you know Lmax for Finfish (Col. J)	NA		
Fecundity (Eggs/year)	90,000	1	(Murie 1991)
Avg Max Size; Lmax (cm) (fish only)	66	1	(McGreer et al. 2020)
Avg Size @ maturity; Lm (cm) (fish only)	26.9	1	(McGreer et al. 2020)
Reproductive Strategy	Live bearer	3	(Dick et al. 2016)
Density Dependence (inverts only)	NA		
Productivity Subscore		**1.83**	

Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Areal overlap	>30% of the species concentration is fished, considering all fisheries Default score if unknown	3	
Vertical overlap	Default score for target species	3	
Seasonality	Fisheries overlap with species >6 months/year Default score if unknown	3	
Selectivity	High site fidelity	3	(Patrick et al. 2009) (Dick et al. 2016)
Post-capture Mortality	Default score for retained species	3	
Susceptibility Subscore		**3**	

Productivity-Susceptibility Score	3.52
Vulnerability Rating (high, medium or low)	High

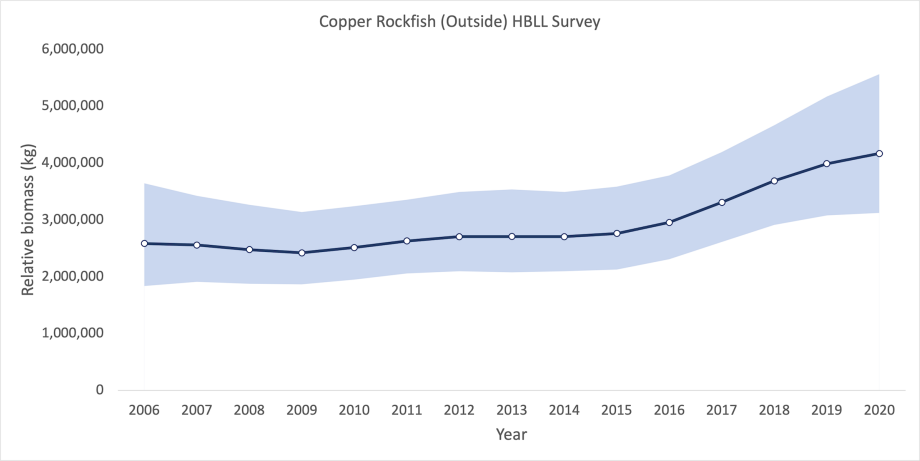

Figure 18: Copper rockfish relative biomass in trends in Outside waters from the Outside HBLL survey. Dots represent mean estimates of relative biomass and shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Moderate Concern
The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Darkblotched rockfish (Sebastes crameri)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

High Concern
There is no stock assessment for darkblotched rockfish or an IUCN rating. The species is listed as Special Concern by COSEWIC (Appendix C) (COSEWIC 2009). But according to the SFW criteria, only species listed by COSEWIC as Endangered or Threatened score a high concern for abundance. The coast-wide trawl survey biomass index indicates a stable-to-increasing trend in the relative biomass of darkblotched rockfish since 2003 (Figure 19), but the trends do not cover three generations. Therefore, this factor is scored against the PSA (see Justification). Darkblotched rockfish is highly vulnerable to fishing pressure (V = 3.52) according to the PSA (Table 6). Therefore, abundance is scored a high concern.

Justification:
Table 6. Darkblotched rockfish PSA

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Avg Age @ maturity; Tm (years)	9	2	(COSEWIC 2009)
von Bertalanffy (K) Fish only	0.08 (male and female combined)	3	(COSEWIC 2009)
Avg Max Age; Tmax (years) Inverts only when you know Lmax for Finfish (Col. J)	NA	NA	(COSEWIC 2009)
Fecundity (Eggs/year)	20,000 to 610,000	1	

Avg Max Size; Lmax (cm) (fish only)	58	1	(Haigh & Starr 2008)
Avg Size @ maturity; Lm (cm) (fish only)	35	1	(COSEWIC 2009)
Reproductive Strategy	Livebearer	3	
Density Dependence (inverts only)	NA	NA	
Productivity Subscore		**1.83**	

Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Areal overlap	>30% of the species concentration is fished, considering all fisheries, OR Default score if unknown	3	
Vertical overlap	Default score for target species	3	
Seasonality	Fisheries overlap with species >6 months/year	3	(Fox et al. 2020)(IPHC Secretariat 2022)
Selectivity	High site fidelity	3	(COSEWIC 2009)
Post-capture Mortality	Default score for retained species	3	
Susceptibility Subscore		**3**	

Productivity-Susceptibility Score	**3.52**
Vulnerability Rating (high, medium or low)	**High**

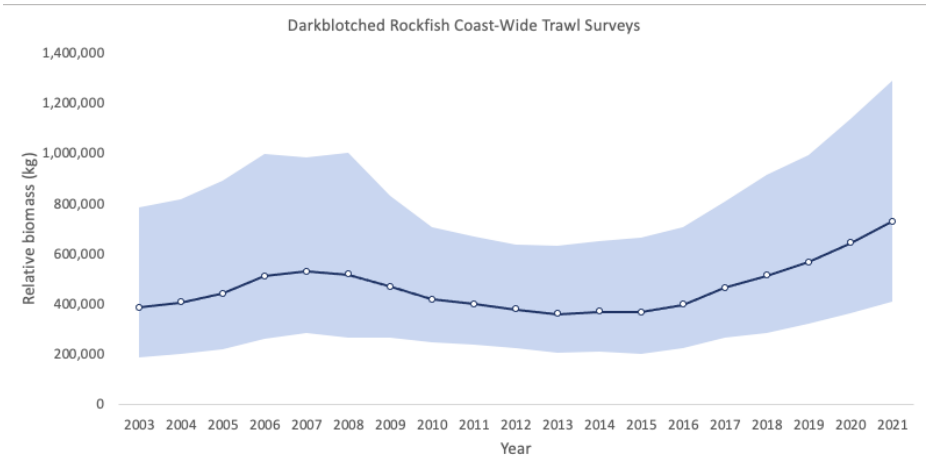

Figure 19: Darkblotched rockfish relative biomass in trends in BC waters from coast-wide trawl surveys. Dots represent mean estimates of relative biomass and shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Dover sole (Microstomus pacificus)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Low Concern

Two populations of Dover sole are found in British Columbia's waters: a southern population off the west coast of Vancouver Island in Areas 3CD, and a northern population found in Hecate Strait, Queen Charlotte Sound, and the west coast of Haida Gwaii in Areas 5A–5E (DFO 2001). Biomass estimates for Dover sole, English sole, and rock sole were derived from single-species, data-pooling, and hierarchical state-space surplus production models to evaluate management performance under different simulation scenarios (Johnson and Cox 2021). Biomass estimates were based on commercial trawl catch data, commercial catch rates (measured in catch per unit effort, CPUE), and fishery-independent trawl surveys (Johnson and Cox 2021). The value of B_{2016}/B_{MSY} was greater than 1.0 in the single-species assessment for all stocks (Figure 20). Because Dover sole stocks are above a target reference point but the data are more than 5 years old, abundance is scored a low concern.

Justification:

Stock	B_0	SS reference points			Stock status		q^F	MS reference points		
		$B_{MSY,SS}$	MSY_{SS}	$U_{MSY,SS}$	B_{2016}	$B_{2016}/B_{MSY,SS}$		$B_{MSY,MS}$	MSY_{MS}	$U_{MSY,MS}$
Dover sole										
HSHG	16.51	4.34	1.22	0.28	8.36	1.92	0.022	5.77	1.18	0.20
QCS	5.45	1.46	0.42	0.28	3.36	2.30	0.015	1.91	0.40	0.21
WCVI	13.59	3.58	1.14	0.32	8.45	2.36	0.025	3.60	1.14	0.32
English sole										
HSHG	8.60	2.21	0.87	0.39	4.85	2.20	0.026	2.31	0.87	0.38
QCS	0.57	0.15	0.06	0.39	0.41	2.78	0.016	0.16	0.06	0.36
WCVI	0.86	0.22	0.09	0.39	0.50	2.23	0.020	0.20	0.09	0.43
Rock sole										
HSHG	12.34	3.78	1.07	0.28	7.68	2.03	0.025	2.81	1.03	0.37
QCS	4.33	1.29	0.40	0.31	2.13	1.65	0.014	1.04	0.39	0.38
WCVI	1.12	0.34	0.10	0.29	0.55	1.62	0.012	0.35	0.10	0.28

Figure 20: Unfished biomass B_0; single-species MSY-based reference points $B_{MSY,SS}$, MSY_{SS}, and $U_{MSY,SS}$; stock status as absolute biomass in 2016 B_{2016}; depletion relative to single-species optimal biomass $B_{2016}/B_{MSY,SS}$; commercial trawl catchability scalar q^F; and multispecies reference points including technical interactions $B_{MSY,MS}$, MSY_{MS}, and $U_{MSY,MS}$ for all nine DER complex stocks in 2016. Biomass quantities are given in kilotonnes, and depletion levels and harvest rates are unitless (Johnson and Cox 2021).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

English sole (Parophrys vetulus)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics

Low Concern

Biomass estimates for dover sole, English sole, and rock sole were derived from single-species, data-pooling, and hierarchical state-space surplus production models to evaluate management performance under different simulation scenarios (Johnson and Cox 2021). Biomass estimates were based on commercial trawl catch data, commercial catch rates (measured in catch per unit effort, CPUE), and fishery-independent trawl surveys (Johnson and Cox 2021). The value of B_{2016}/B_{MSY} was greater than 1.0 in the single-species assessment for all stocks (Figure 20). Because English sole stocks are above a target reference point but the data are more than 5 years old, abundance is scored a low concern.

Justification:

Stock	B_0	SS reference points			Stock status		q^F	MS reference points		
		$B_{MSY,SS}$	MSY_{SS}	$U_{MSY,SS}$	B_{2016}	$B_{2016}/B_{MSY,SS}$		$B_{MSY,MS}$	MSY_{MS}	$U_{MSY,MS}$
Dover sole										
HSHG	16.51	4.34	1.22	0.28	8.36	1.92	0.022	5.77	1.18	0.20
QCS	5.45	1.46	0.42	0.28	3.36	2.30	0.015	1.91	0.40	0.21
WCVI	13.59	3.58	1.14	0.32	8.45	2.36	0.025	3.60	1.14	0.32
English sole										
HSHG	8.60	2.21	0.87	0.39	4.85	2.20	0.026	2.31	0.87	0.38
QCS	0.57	0.15	0.06	0.39	0.41	2.78	0.016	0.16	0.06	0.36
WCVI	0.86	0.22	0.09	0.39	0.50	2.23	0.020	0.20	0.09	0.43
Rock sole										
HSHG	12.34	3.78	1.07	0.28	7.68	2.03	0.025	2.81	1.03	0.37
QCS	4.33	1.29	0.40	0.31	2.13	1.65	0.014	1.04	0.39	0.38
WCVI	1.12	0.34	0.10	0.29	0.55	1.62	0.012	0.35	0.10	0.28

Figure 20: Unfished biomass B_0; single-species MSY-based reference points $B_{MSY,SS}$, MSY_{SS}, and $U_{MSY,SS}$; stock status as absolute biomass in 2016 B_{2016}; depletion relative to single-species optimal biomass $B_{2016}/B_{MSY,SS}$; commercial trawl catchability scalar q^F; and multispecies reference points including technical interactions $B_{MSY,MS}$, MSY_{MS}, and $U_{MSY,MS}$ for all nine DER complex stocks in 2016. Biomass quantities are given in kilotonnes, and depletion levels and harvest rates are unitless (Johnson and Cox 2021).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Flathead sole (Hippoglossoides elassodon)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish

Moderate Concern

There is no stock assessment for flathead sole. Recent survey indices indicate an increasing trend in the relative biomass of flathead sole in BC waters (Figure 21), but the surveys do not cover three generations (the flathead sole generation time is 14–15 years (Bryan et al. 2021b)). The IUCN has assessed flathead sole as a species of Least Concern and it is considered common

and abundant off BC (Bryan et al. 2021b). Therefore, a moderate concern score is awarded, based on the IUCN status.

Justification:

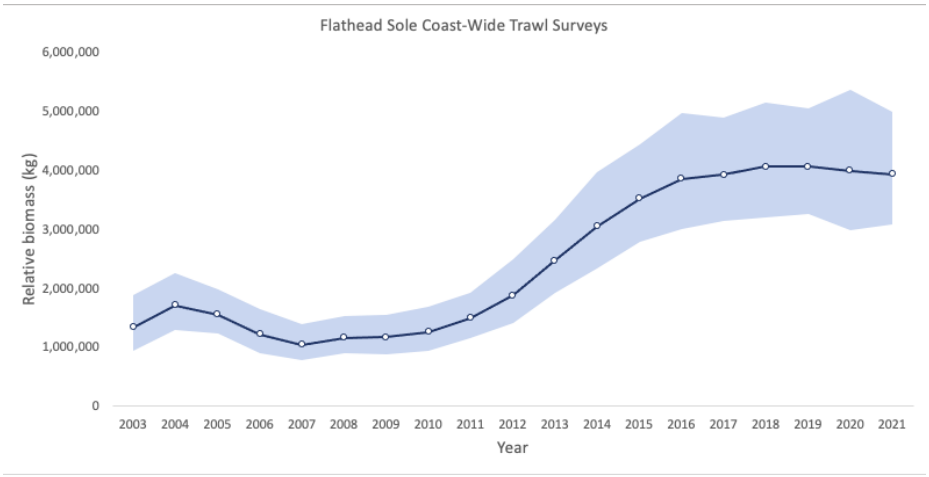

Figure 21: Flathead sole relative biomass trends in BC waters from coast-wide trawl surveys. Dots represent mean estimates of relative biomass and the shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Kelp greenling (Hexagrammos decagrammus)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

Moderate Concern

There is no stock assessment for kelp greenling. The HBLL Outside survey shows an increasing trend in the relative biomass of kelp greenling in BC waters, while the coastwide biomass index from trawl surveys exhibits a stable trend (Figure 22). Kelp greenling has a maximum age of 12 to 13 years, its age at maturity is between 3 to 5 years (Frid et al. 2012), and the natural mortality rate is estimated at 0.26 yr^{-1} for both sexes (Cope and MacCall 2006), so the surveys do not cover at least three generations (21–27 years). The IUCN has assessed this species as Least Concern because there are no major threats and it is considered locally abundant (Cope et al. 2020). Therefore, a moderate concern score is given.

Justification:

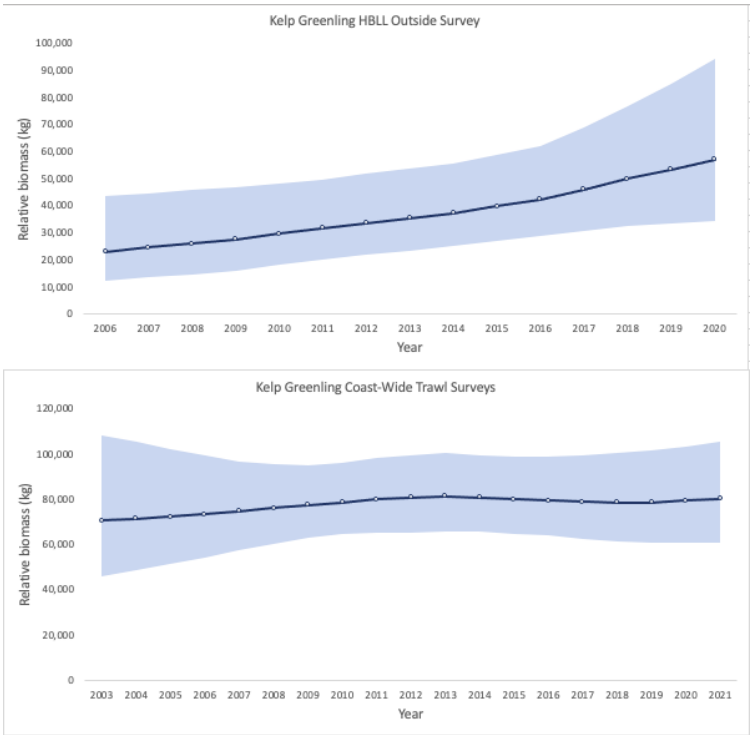

Figure 22: Kelp greenling relative biomass in Outside waters from Outside HBLL survey (top) and coast-wide trawl surveys (bottom). Dots represent mean estimates of relative biomass and the shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Lingcod (Ophiodon elongatus)

Factor 1.1 - Abundance

Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Outside Stock | Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

High Concern

Lingcod is assessed and managed as five different stocks, which include: Strait of Georgia, southwest Vancouver Island, northwest Vancouver Island, Queen Charlotte Sound, and Hecate Strait and the west coast of Haida Gwaii (Holt et al. 2016). Lingcod in

Outside waters (Areas 3C, 3D, 5AB, and 5C/DE) was last assessed in 2011, and the planned 2019 assessment was pushed back (Cornthwaite & Workman 2021). According to the previous assessment, lingcod biomass has generally declined over the course of several decades and has recently been assessed at the lowest values since the late 1920s (DFO 2011c). Despite the long decline of lingcod biomass in Outside waters, each area's estimated B_{2010} exceeded the USRP. But there was substantial uncertainty regarding this result for Areas 3C and 5AB (DFO 2011c). Despite the long-term declining trend noted for each stock's estimated lingcod biomass, each stock's estimated B_{2010} was above the USRP ($0.8*B_{MSY}$) and thus qualified as being within DFO's Healthy Zone. Because of greater uncertainty in the stock status for Areas 3C and 5AB, the 90% probability intervals extend through the Cautious Zone into the Critical Zone (e.g., $B_{2010} < 0.4*B_{MSY}$) for these two areas. The HBLL Outside survey and coast-wide trawl survey indices show a stable trend in the relative biomass of lingcod in Outside waters (DFO 2022c), but the surveys do not cover three generations (one generation is 8–10 years for female lingcod). Female lingcod have a maximum age of 20 years, age at maturity is between 3 to 5 years, and the natural mortality rate is estimated at 0.20 yr^{-1} (DFO 2011c).

The Strait of Georgia lingcod stock ("Inside" lingcod) was assessed in 2016 to compare how stock status had changed since management measures were implemented in 2006 and to present stock status relative to updated reference points (Holt et al. 2016). The assessment used nine scenarios that varied in treatment of historical catch, assumptions about density-dependent mortality and catchability relationships, and the natural mortality rate (Holt et al. 2016). Results were presented by scenario, as well as a model average. According to the results of the scenario-averaging approach, there was a 58% probability of being in the Cautious Zone, and the median estimate for B_{2014}/B_{MSY} was 0.513 (Holt et al. 2016), which was less than the Seafood Watch TRP of 75% of B_{MSY}. Because the data used in this assessment are now >10 years old, the current status is considered unknown.

Given the uncertainty of lingcod status in the last stock assessment, the age of the data from that assessment, and the lack of an apparent trend in recent biomass indices, Seafood Watch considers the current stock status to be unknown for all stocks. Abundance is scored with the PSA (see Justification). Lingcod is highly vulnerable (V = 3.26), so its abundance is scored a high concern.

Justification:
Table 7. Lingcod PSA

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Avg Age @ maturity; Tm (years)	4.18	1	(DFO 2011c)
von Bertalanffy (K) Fish only	0.20	2	(Holt et al. 2016)
Avg Max Age; Tmax (years) Inverts only when you know Lmax for Finfish (Col. J)	NA	NA	
Fecundity (Eggs/year)	290,000	1	{ASFC 2021}
Avg Max Size; Lmax (cm) (fish only)	152	2	(AFSC 2021)
Avg Size @ maturity; Lm (cm) (fish only)	63.6	2	(DFO 2011c)
Reproductive Strategy	Demersal egg layer or brooder	2	(DFO 2011c)
Density Dependence (inverts only)	NA	NA	
Productivity Subscore		**1.67**	

Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Areal overlap	>30% of the species concentration is fished, considering all fisheries.	3	
Vertical overlap	Default score for target species	3	

Seasonality	Fisheries overlap with species >6 months/year	3	(Fox et al. 2020) (IPHC Secretariat 2022)
Selectivity*	Species is targeted AND attributes of the fishery, in combination with the species' biology or behavior increase its susceptibility to the gear. However, effective management is in place.	2	
Post-capture Mortality	Default score for retained species	3	
Susceptibility Subscore		**2.8**	

Productivity-Susceptibility Score	3.26
Vulnerability Rating (high, medium or low)	High

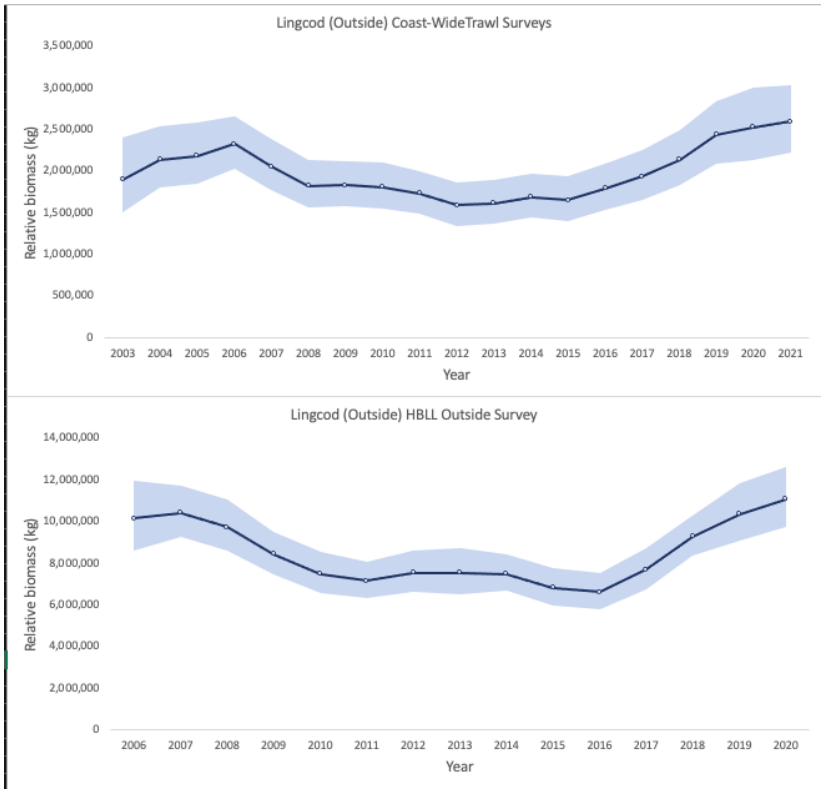

Figure 23: Outside lingcod relative biomass trends in BC waters from coast-wide trawl surveys (top) and the HBLL Outside survey (bottom). Dots represent mean estimates of relative biomass and the shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

Moderate Concern

According to the Strait of Georgia lingcod stock assessment, the scenario-average median estimate of F_{MSY} in 2014 was 0.084, and catch levels since DFO implemented management measures in 2006 have resulted in improved stock status for this stock (Holt et al. 2016). The current commercial allocation (to cover trip limits) of lingcod in Area 4B is 38 t; the trip limit is 400 lbs of lingcod on directed rockfish trips in Area 4B (DFO 2024). Retention of Strait of Georgia lingcod by the commercial hook and line fisheries is prohibited in Areas and Subareas 13 to 19, 20-5, 20-7, 28 and 29 (DFO 2024). But given that the stock assessment is

based on data that are >10 years old, we consider the fishing mortality relative to sustainable levels as unknown, resulting in a moderate concern score.

Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Outside Stock | Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Longnose skate (Raja rhina)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

Moderate Concern

The last stock assessment was not able to generate reliable estimates of longnose skate biomass relative to reference points (DFO 2014d). But that assessment analyzed trawl survey data and found statistically significant declines in longnose skate abundance (DFO 2014d). Multiple stock assessment models were also pursued in 2015, but the results were unreliable (King et al. 2015). The data used in these assessments are >10 years old, so the stock status is considered unknown. Recent survey indices show varying trends in the relative biomass of longnose skate in Inside and Outside waters (Figure 24). Because of the discrepancies between trends in relative biomass from the HBLL Outside survey and and HBLL Inside survey, we defer to the IUCN rating. The IUCN has assessed longnose skate as a species of Least Concern (Bizzarro et al. 2020). This factor is scored a moderate concern based on the the IUCN assessment.

Justification:

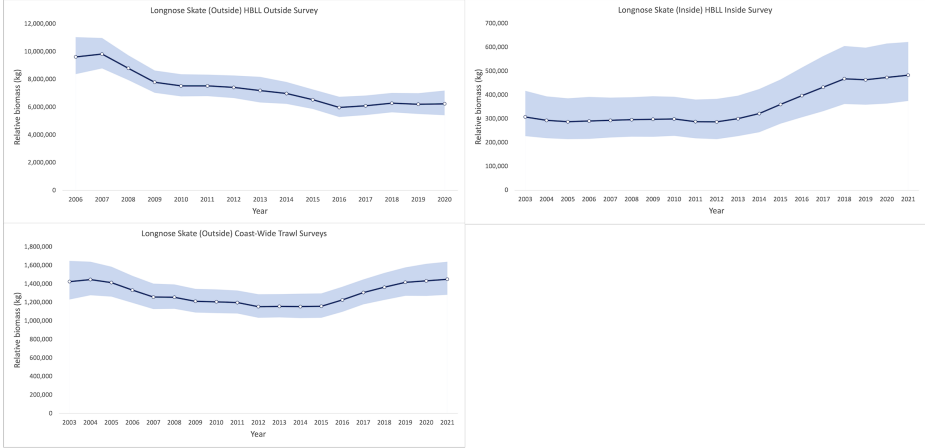

Figure 24: Longnose skate relative biomass in Outside and Inside waters from Outside HBLL (top left), coast-wide trawl (bottom left), and Inside HBLL (top right) surveys. Dots represent mean estimates of relative biomass and the shaded area represents 95% confidence intervals. Data from (DFO 2022c)

Longnose skate ranges from the southeastern Bering Sea to the Pacific Coast of Baja California Sur, Mexico (Bizzarro et al. 2020), no large-scale migrations have been documented, genetic research is needed to understand stock structure, and there is uncertainty regarding the possible movements between U.S. and Canadian waters (Gertseva et al. 2019). Consequently, the PFMC assesses longnose skate as a single stock from Southern California to the United States–Canadian border (Gertseva et al. 2019), and the results are not used to assess longnose skate in BC waters.

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

Moderate Concern

The last stock assessment found that both short-term and long-term catch levels of longnose skate were above the maximum values presented in a range of catch-based MSY estimates; coast-wide, the mean annual catch during the period 2007–11 was 45.6% greater than the maximum catch-based MSY estimate; the long-term (1996–2011) mean annual catch was also well above the maximum catch-based MSY estimate (Table 7 in (King et al. 2015)). But there is uncertainty regarding this reference point, and the data used in the stock assessment are over 10 years old. Recent (2016–21) catch levels have declined to an annual mean of 159 t (Table 8), which is considerably lower than the catch levels during the time of the stock assessment, suggesting a reduced impact from the commercial fishery in recent years. Because fishing mortality has been reduced and there is sufficient uncertainty around the reference point, this factor is scored a moderate concern.

Justification:

Table 8. Longnose skate mean commercial trawl and line catch (t) for long-term, 10-year, and 5-year periods and the range of mean MSY estimates (t) produced across all scenarios from the Catch-MSY approach (King et al. 2015). The 5-year mean catch data were retrieved from DFO Pacific groundfish reports and publications, and from annual hook and line and trawl summaries (DFO 2021).

	Coast-wide (all areas combined) longnose skate catch
Long-term (1996–2011)	409 t
10-year (2002–11)	467 t
5-year (2007–11)	466 t
5-year (2016–21)	159 t
Catch-MSY range	203–320 t

North Pacific spiny dogfish (Squalus suckleyi)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

There is no recent (i.e., <10 years old) stock assessment of North Pacific spiny dogfish in BC waters. COSEWIC found the stock to be relatively abundant in BC waters and that the population did not meet any of the criteria for listing, but that concerns exist because of the biology of the species and the level of uncertainty, so it deemed the population a Special Concern (COSEWIC 2011). The IUCN has assessed North Pacific spiny dogfish as a species of Least Concern because fishing pressure is low throughout its range in the North Pacific Ocean basin and available stock assessments suggest stable or increasing abundance (Bigman et al. 2016). But the IUCN report does caution that the status should be monitored closely due to the quite long generation time of spiny dogfish, uncertain population trends of some stocks, and international demand for fins (Bigman et al. 2016). The North Pacific spiny dogfish stock in U.S. waters is not overfished, and there is a low (≈5%) exchange rate between the U.S. coastal sub-population and that found along WCVI, but more research is necessary to understand transboundary stock dynamics (Gertseva et al. 2021). Therefore, the U.S. stock assessment is not used to score dogfish abundance in BC.

North Pacific spiny dogfish has experienced the steepest decline of the 26 BC stocks surveyed (Anderson and English 2022). The cause of this decline is not well understood, but the species is not heavily affected by any fishery (Anderson and English 2022) and climate change appears to be driving range shifts and changes in seasonal distribution (Kanamori et al. 2022). It is suspected that observed declines in surveys may partly be the result of changes in survey timing and changes to seasonal movement patterns; while other factors may include species interactions (changes in availability or distribution of predators and prey) as well as possible changes to maturity or growth (pers. comm., DFO 2022). The stock's status is scored a moderate concern based on the latest IUCN assessment.

Justification:

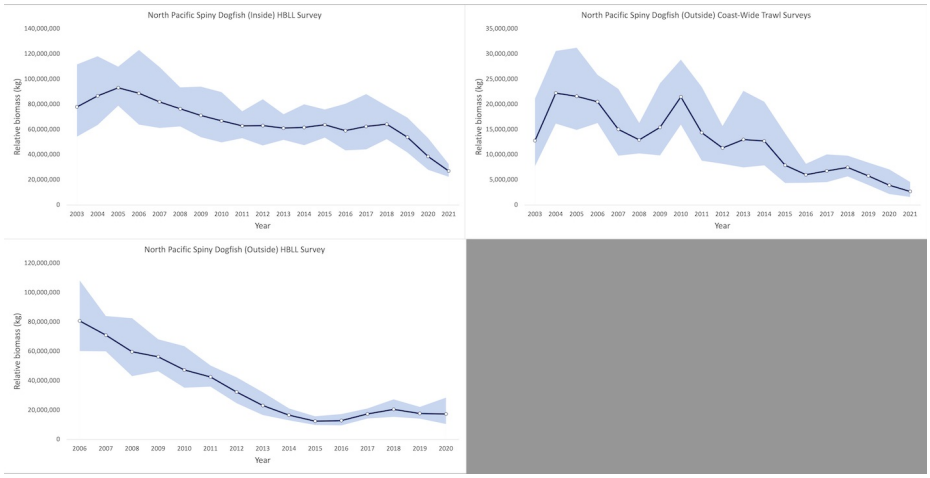

Figure 25: North Pacific spiny dogfish relative biomass trends in BC waters from the Inside HBLL survey (top left), Outside HBLL survey (bottom left), and coast-wide trawl surveys (upper right). Dots represent mean estimates of relative biomass and the shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

Markets for spiny dogfish have essentially collapsed, and recent catches of both Inside and Outside dogfish have been low, relative to historic levels (Figure 26). The commercial catch of spiny dogfish is consistently well below the TAC (e.g., the Trawl and Line groundfish fisheries landed a total of 362 t of spiny dogfish in 2020 (DFO 2020a)(DFO 2020b), out of a TAC of 14,000 t (Cornthwaite & Workman 2021). But there are no model-derived estimates of sustainable yield or recent estimates of fishing mortality rates. Therefore, fishing mortality of spiny dogfish is scored a moderate concern.

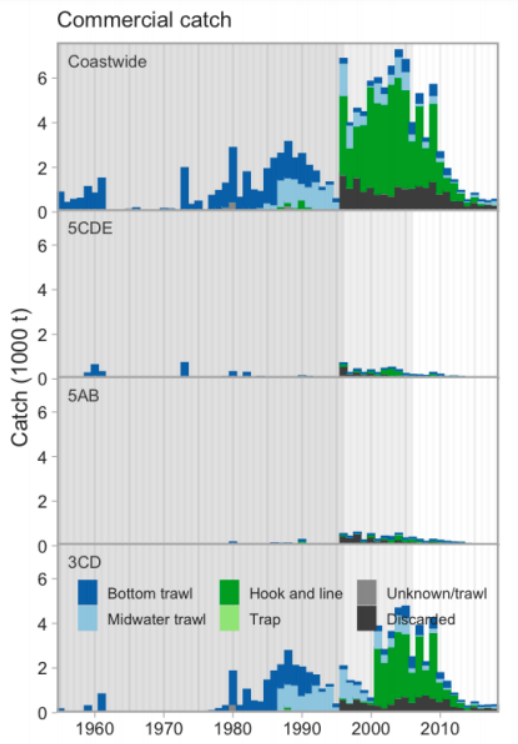

Figure 26: Commercial fishery catch plots for North Pacific spiny dogfish. Catch from various gear types is indicated by color shading. Catch is calculated as the summed weight of landings aggregated by year. Discards include reported discard weights from all fisheries combined; however, bottom trawl discards are considered less reliable prior to 100% observer coverage in 1996, and trap, hook and line, midwater trawl, and Strait of Georgia bottom trawl discards are less reliable prior to fisheries integration in 2006 and are therefore not included. Years before 1996 and 2006 are shaded grey to indicate that catches are considered less reliable than modern data: an at-sea observer program was implemented for bottom and midwater trawl fleets in Outside waters in 1996, and an at-sea observer program was implemented for non-trawl sectors in 2006. Figure from (Anderson et al. 2019).

Pacific cod (Gadus macrocephalus)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

The latest stock assessment for Pacific cod in BC water was completed in 2018; a 2021 stock update determined that both stocks

are in the Cautious Zone (DFO 2021i). The 2018 assessment differs from the previous in that the Queen Charlotte Sound (5AB) and Hecate Strait (5CD) stocks are now combined into a single stock. The Pacific cod biomass in 2021 (B_{2021}) in area 3CD was estimated to be 14,099 t (2.5–97.5 percentiles = 6,008–47,920 t), which is above the LRP (B_{2021}/LRP = 1.640) but below the USR (B_{2021}/USR = 0.507) (Figure 27). Biomass in Area 5ABCD (B_{2021} = 19,634 t; 2.5–97.5 percentiles = 11,318–40,603 t) was also above the LRP (B_{2021}/LRP = 1.960) but below the USR (B_{2021}/USR = 0.592) (Figure 28). It should be noted that no WCVI synoptic survey occurred in 2020, which is of "critical concern" according to the DFO report; in addition, the Area 3CD stock has declined in abundance since the previous assessment to a level closer to the LRP (DFO 2021i). The LRP is the lowest estimated biomass agreed upon as an undesirable state to be avoided (DFO 2021i). Pacific cod is above the limit reference point but below 75% of the target reference point, and scores a moderate concern for abundance.

Justification:

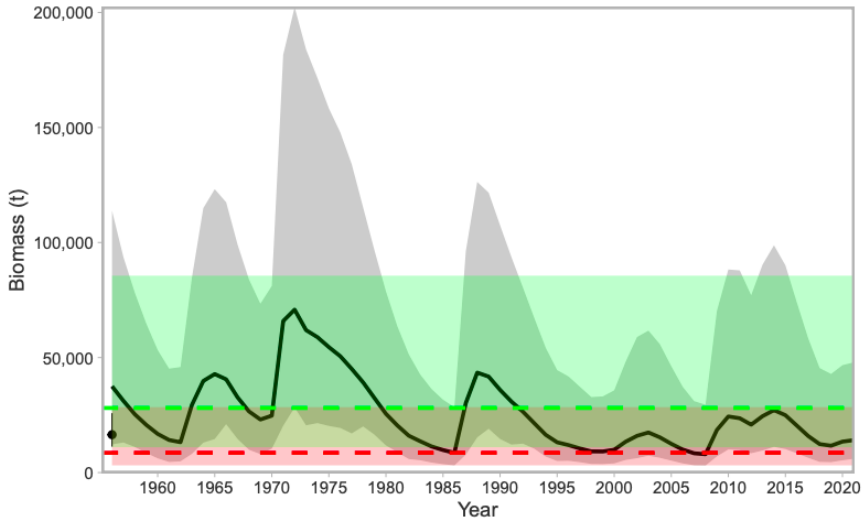

Figure 27: Combined posterior biomass for the model-averaged set for Area 3CD with 95% confidence interval (shaded gray). The green line shows the median USR with 95% confidence interval (shaded green). The red line shows the median LRP with 95% confidence interval (shaded red). Figure from (DFO 2021i).

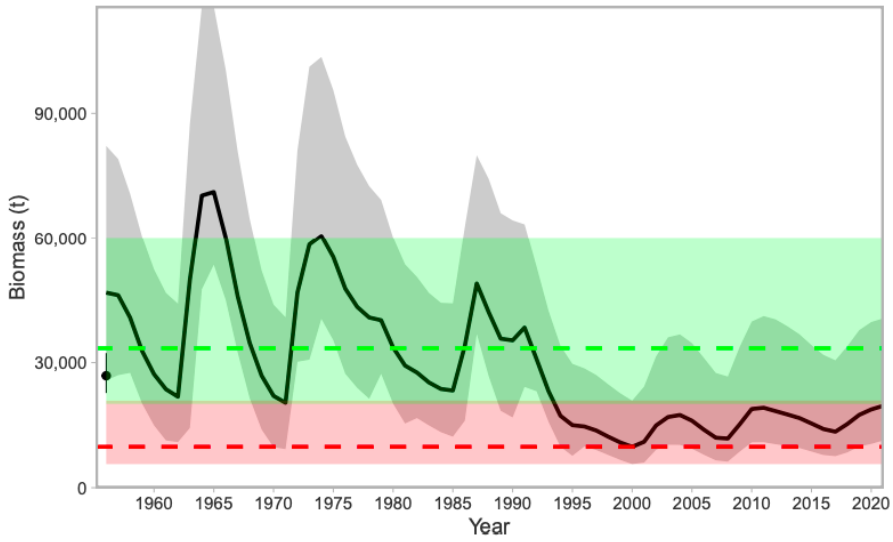

Figure 28: Combined posterior biomass for the model-averaged set for Area 5ABCD with 95% confidence interval (shaded gray). The green line shows the median USR with 95% confidence interval (shaded green). The red line shows the median LRP with 95% confidence interval (shaded red). Figure from (DFO 2021i).

In the recent assessment, MSY-based reference points were highly sensitive to model assumptions and thus were not used (Forrest et al. 2020). Alternative reference points, derived from estimates of historical biomass and removals, were developed instead. The recommended USR for both stocks is the average estimated biomass from 1956 to 2004, and the LRP is the lowest biomass state in the time period (i.e., B_{1986} in Area 3CD and B_{2000} in Area 5ABCD) (Forrest et al. 2020). Despite the considerable uncertainty in these estimates, it appears likely that B_{2021} was less than the USR, but above the LRP for both areas.

The status update was requested in years immediately following the biennial groundfish synoptic bottom trawl survey; DFO requested that CSAS assess both stocks in 2020 because of a low index of abundance in 2018 in Area 3CD and because no survey was performed in 2020 because of the COVID-19 pandemic (DFO 2021i).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Low Concern

Since the mid-1990s, Pacific cod catch has been low in both areas, relative to historic catches. Approximately 59 t were landed from the 3CD stock in 2020, while fishers landed an estimated 425 t from 5ABCD in the same year (DFO 2021i). The groundfish trawl catches close to 99.5% of the total catch of Pacific cod (DFO 2021i). The LRR is set at the average fishing mortality rate from 1956 to 2004. Fishing rates are well below sustainable levels on both stocks: $F_{3CD\ 2020}$/LRR = 0.083 (Figure 29) and $F_{5ABCD\ 2020}$/LRR = 0.174 (Figure 30). Therefore, a low concern score is given.

Justification:

A fully agreed-upon harvest control rule as it relates to DFO's precautionary approach (DFO 2009a) has not been established for Pacific cod (DFO 2021i). While the catch scenarios below describe a low probability that B_{2022} < LRP for either stock, the probabilities do not reflect any adjustment to the LRR when the stock is in the Cautious Zone, and those probabilities would probably be higher if the harvest control rule under the precautionary approach were applied (DFO 2021i). It is recommended that

such a harvest control rule be established before the next assessment update (DFO 2021i).

The 2019/20 TAC for Pacific cod in Area 3CD was 500 t, but recent catch has been well below this level. If the 2021 catch is similar to the 2020 catch, there is a 2% probability that biomass will be below the LRP; if all the TAC is taken, the probability of B_{2022} < LRP is 4% (DFO 2021i). There is a 97–98% probability that B_{2022} will remain in the Cautious Zone, even under a zero catch scenario (DFO 2021i).

The 2019/20 TAC for Pacific cod in Area 5ABCD was 950 t, which is well above recent catches from this stock. If the 2021 catch is similar to the 2020 catch, there is a probability of <1% that biomass will be below the LRP; the probability of B_{2022} < LRP is still <1% if all the TAC is taken (DFO 2021i). Similar to the 3CD stock, there is a 98–99% probability that B_{2022} will remain in the Cautious Zone for the 5ABCD stock, even under a zero catch scenario (DFO 2021i).

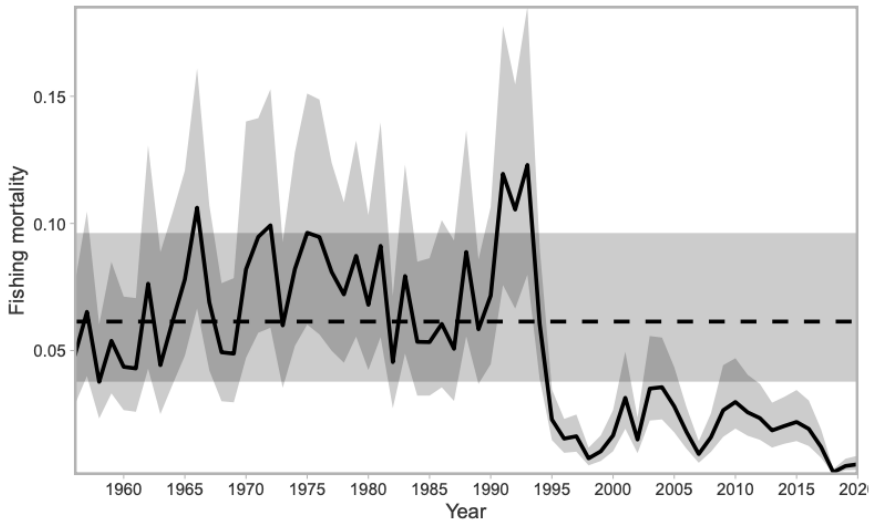

Figure 29: Combined posterior fishing mortality for the model-averaged set for Area 3CD. The thick solid line shows the posterior median and the dashed line shows the median LRR; the shaded regions represents the 95% confidence interval. Figure from (DFO 2021i).

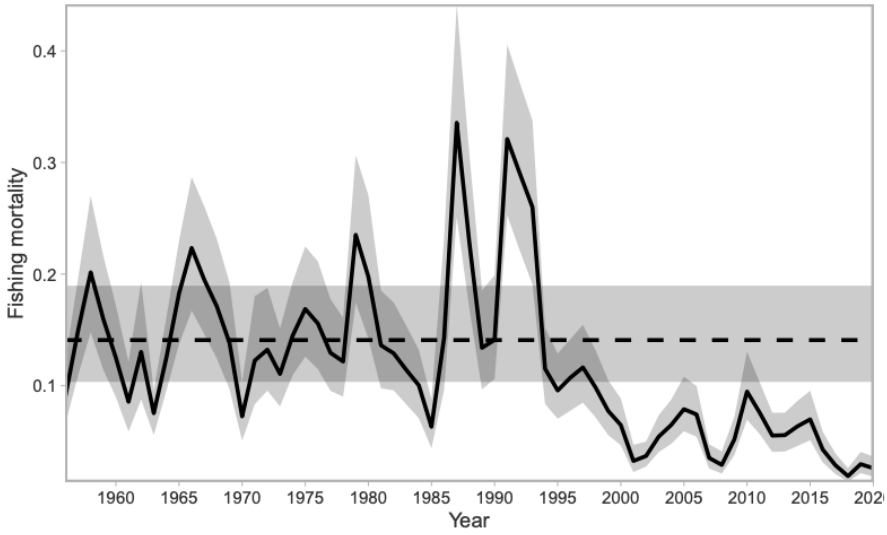

Figure 30: Combined posterior fishing mortality for the model-averaged set for Area 5ABCD. The thick solid line shows the posterior median and the dashed line shows the median LRR; the shaded regions represents the 95% confidence interval. Figure from (DFO 2021i).

Pacific halibut (Hippoglossus stenolepis)

Factor 1.1 - Abundance

Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Low Concern

Pacific halibut is managed by the International Pacific Halibut Commission (IPHC) and is assessed annually as a single stock extending from northern California to Alaska. The 2021 SB is estimated to be 86,600 t. The probability that the stock is below the "trigger" reference point ($SB_{30\%}$) is estimated to be 45%, with less than a 1% chance that the stock is below the limit reference point $SB_{20\%}$ (if a stock drops below $SB_{20\%}$, it is considered overfished by the IPHC) (Stewart and Hicks 2021). The female SB stock is currently estimated to be 33% (95% CI) of specified unfished levels (Figure 31), which is below an appropriate reference point of 0.4 B_0. Pacific halibut is not classified as overfished (NMFS 2021)(Stewart and Hicks 2021) and is within data-driven target management reference points. Because Pacific halibut is at least 75% of 0.4 B_0, this factor is scored a low concern.

Justification:

The results of the 2021 stock assessment indicate that the Pacific halibut stock declined continuously from the late 1990s to around 2010, largely a result of decreasing size-at-age, as well as somewhat weaker recruitment strengths than those observed during the 1980s. Since the estimated female SSB stabilized in 2010, the stock is estimated to have increased gradually through 2022 (Stewart and Hicks 2021).

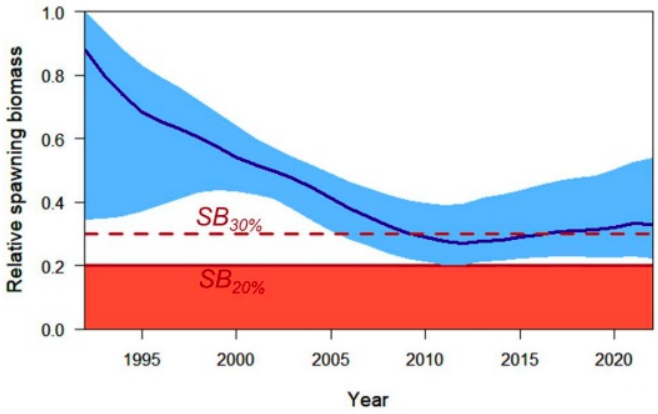

Figure 31: Estimated time-series of relative spawning biomass (compared to the unfished condition in each year) based on the median (dark blue line) and approximate 95% credibility interval (blue shaded area). IPHC management procedure reference points ($SB_{30\%}$ and $SB_{20\%}$) are shown as dashed and solid lines respectively, with the region of biological concern ($<SB_{20\%}$) shaded in red (Stewart and Hicks 2021).

Factor 1.2 - Fishing Mortality

Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Moderate Concern

Pacific halibut is targeted in directed halibut longline fisheries and is taken as bycatch, primarily in Pacific cod and flatfish fisheries. Total mortality in 2021 was roughly 17,100 t, which is below the 100-year average. Although the IPHC does not have a coast-wide formal limit reference point for fishing mortality, a target interim reference level SPR = 43% is used to inform management actions (Stewart and Hicks 2021). The estimated fishing mortality in each of the last two years is below reference levels, and there is a 53% probability that fishing mortality in 2021 was below reference levels.

Although catches in all BC management areas were within limits in 2020/21, retrospective model analyses suggest that coast-wide fishing intensity in recent years has likely moderately exceeded the interim reference level SPR = 46% since 1998 (Stewart and Hicks 2017). Of course, there is some uncertainty with retrospective analyses; also, F has been fluctuating around reference levels, and NMFS considers the overfishing status unknown (NMFS 2021). Therefore, Pacific halibut receives a score of moderate concern for fishing mortality.

Justification:

Over the period 1888 to 2021, removals have totaled 3.3 million t, ranging annually from 16,000 to 45,000 t with an annual average of ≈29,000 t. Annual removals were above this long-term average from 1985 through 2010 and have been relatively stable near 17,500 t since 2017. Coast-wide directed commercial Pacific halibut fishery landings in 2021 were approximately 11,100 t, up 9% from 2020. Bycatch mortality was estimated to be 1,600 t in 2021, down 23% from 2020. Coast-wide fishing intensity exceeded the reference level SPR = 46% from 1998 to 2019, but did not exceed the reference level SPR = 43% in 2020 and 2021 (Stewart and Hicks 2021).

Pacific Ocean perch (Sebastes alutus)

Factor 1.1 - Abundance

3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
3CD Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD| Rockfish Trawl

High Concern

The Pacific Ocean perch is assessed as three stocks in BC waters. The Area 3CD stock (West Coast of Vancouver Island, WCVI) was last assessed in 2013, and the median spawning biomass was above target levels at that time (B_{2013}/B_{MSY} = 1.53) (DFO 2013). But the data used in these assessments are ≥10 years old and Seafood Watch considers the stock status as unknown. The generation length of this species is ≈27 years (G = 10 + 1/0.06; age and mortality data from (Edwards et al. 2014)). Since the terminal year of the stock assessment, there has been a declining trend in the 3CD Pacific Ocean perch abundance index from the fishery-independent survey (see Figure 3 in (Anderson and English 2022)), though the survey does not cover three generations. Given the uncertainty in the current status of 3CD Pacific Ocean perch, abundance is scored with the PSA (Table 9), resulting in high vulnerability and a high concern score.

Justification:

Table 9. Pacific Ocean Perch PSA

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Avg Age @ maturity; Tm (years)	10.2	2	(Edwards et al. 2014)
von Bertalanffy (K) Fish only	0.14	3	(Edwards et al. 2014)
Avg Max Age; Tmax (years) Inverts only when you know Lmax for Finfish (Col. J)	NA		
Fecundity (Eggs/year)	300,000	1	
Avg Max Size; Lmax (cm) (fish only)	45.1	1	(Edwards et al. 2014)
Avg Size @ maturity; Lm (cm) (fish only)	32.1	1	(Edwards et al. 2014)
Reproductive Strategy	Live bearer	3	(Edwards et al. 2014)
Density Dependence (inverts only)	NA		
Productivity Subscore		**1.83**	

Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Areal overlap	>30% of the species concentration is fished, considering all fisheries, OR Default score if unknown	3	
Vertical overlap	Default score for target species	3	
Seasonality	Fisheries overlap with species >6 months/year	3	(Fox et al. 2020) (IPHC Secretariat 2022)
Selectivity	Species is targeted, BUT conditions under high risk do not apply. Default score.	2	
Post-capture Mortality	Default score for retained species	3	
Susceptibility Subscore		**2.80**	

Productivity-Susceptibility Score	3.35
Vulnerability Rating (high, medium or low)	High

5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish

5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish

5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

5ABC Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl

Low Concern

The Pacific ocean perch is assessed as three stocks in BC waters; the 5ABC stock (Queen Charlotte Sound, QCS) was last assessed in 2019. According to the 2019 assessment for 5ABC Pacific ocean perch, the spawning biomass of mature females in 2017 (B_{2017} = 24,302 t) was above B_{MSY} (B_{2017}/B_{MSY} = 1.03) and 27% of the estimated unfished spawning biomass, B_0 (Figure 32). It is probable that Pacific Ocean perch is above the reference points 0.8 B_{MSY} and 0.4 B_{MSY} used under DFO's Sustainable Fisheries Framework. But it is noted in the stock assessment that "no evaluation has been carried out to determine the suitability of these RPs for this stock, nor have acceptable levels of risk been specified" (Haigh et al. 2019).

Because this stock was above an appropriate TRP in the most recent assessment but the assessment is based on data that are between 5 and 10 years old, we award a low concern score, rather than a very low concern score.

Justification:

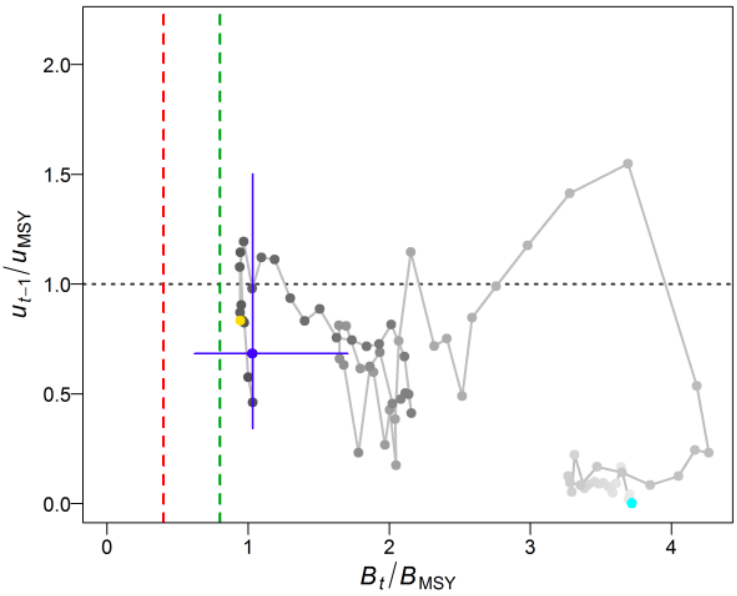

Figure 32: Phase plot through time of the medians of the ratios B_t/B_{MSY} (the spawning biomass at the start of year t relative to B_{MSY}) and u_{t-1}/u_{MSY} (the exploitation rate in the middle of year t relative to u_{MSY}). The filled cyan circle is the starting year (1941). Years then proceed from light grey through to dark grey with the final year (2017) as a filled blue circle, and the blue lines represent the 10% and 90% percentiles of the posterior distributions for the final year. The filled gold circle indicates the status in 2011 (B_{2011}/B_{MSY}, u_{2010}/u_{MSY}), which coincides with the previous assessment of this stock. Red and green vertical dashed lines indicate the Precautionary Approach provisional limit and upper stock reference points of 0.4 B_{MSY} and 0.8 B_{MSY}, and the horizontal grey dotted line indicates u_{MSY}. Figure from (Haigh et al. 2019).

5DE Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
5DE Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl

Moderate Concern

The Pacific ocean perch is assessed as three stocks in BC waters. The Area 5DE stock (West Coast of Haida Gwaii) was last assessed in 2013 and the median spawning biomass was above target levels at that time (B_{2013}/B_{MSY} = 1.61) (DFO 2013). But the data used in these assessments are ≥10 years old and Seafood Watch considers the stock status as unknown. The generation length of this species is ≈27 years (G = 10 + 1/0.06; age at 50% maturity and mortality data from (Edwards et al. 2014)). A fishery-independent survey with an abundance index does not cover three generations, but the previous stock assessment indicated that abundance was well above target levels (DFO 2013) and the abundance index shows a stable-increasing trend since the stock

assessment (Figure 33). Although this species is highly vulnerable, the abundance score is moderated by the available data-limited indicator, resulting in a moderate concern score.

Justification:

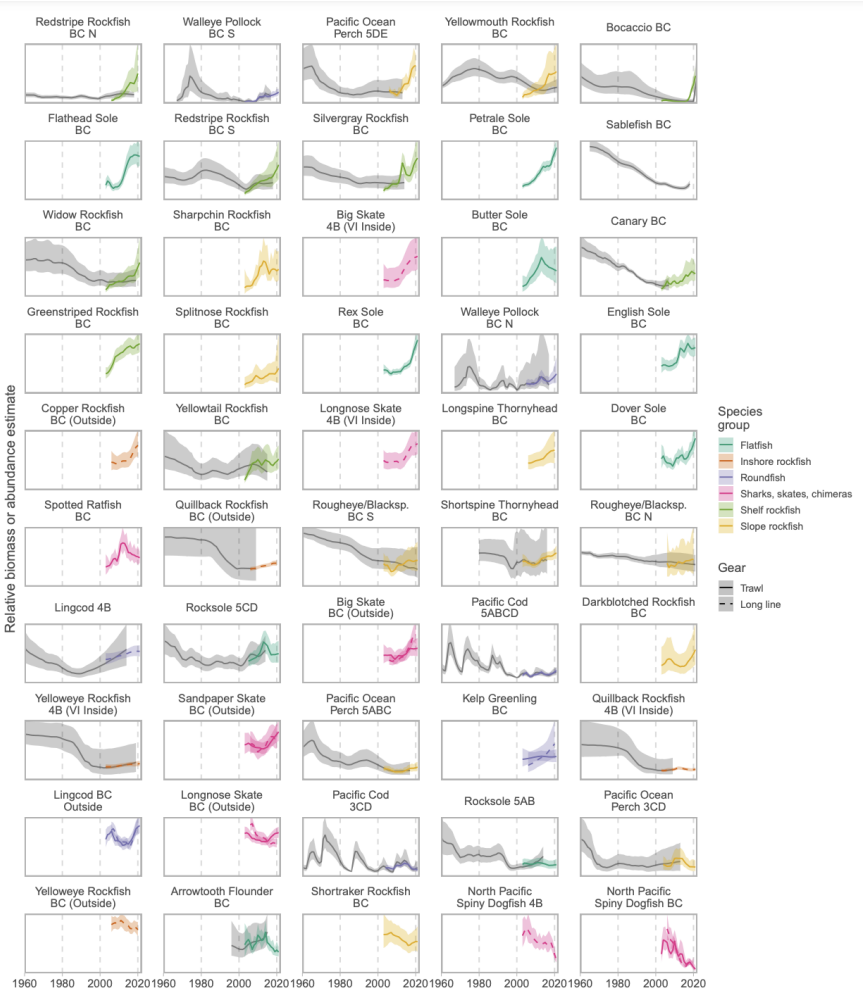

Figure 33: Trends in BC groundfish stocks with assessments in the last ≈15 years or outstanding requests for Science Advice. Dark grey lines and ribbons represent output from stock assessments: trajectories of median B/LRP 95% quantile credible intervals (see citations in Figure 2 caption). Colored lines and ribbons represent model-based indices for the most relevant survey(s) for each stock. Survey trends are scaled to existing assessments based on the geometric mean in overlapping years. Figure from (Anderson and English 2022).

Factor 1.2 - Fishing Mortality

5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
5ABC Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl

Low Concern

The Trawl sector is allocated 99.98% of the Pacific ocean perch TAC (DFO 2021a). The coast-wide 2020 catch of Pacific ocean perch was 2,618 t, which is 50.4% of the available coast-wide quota; no area-specific quotas were exceeded (Cornthwaite &

Workman 2021). The mean annual coast-wide catch from 2012 to 2016 was approximately 4,200 t (Haigh et al. 2019). For the 5ABC stock, the median exploitation rate (ratio of total catch to the vulnerable biomass in the middle of the year) in 2016 was below the exploitation rate at MSY, where u_{2016}/u_{MSY} = 0.684 (5th–95th percentiles = 0.292–1.798) and there is a 75% probability that current exploitation is below that associated with MSY (Cornthwaite & Workman 2021). Because fishing levels are considered sustainable for 5ABC Pacific ocean perch, we award a low concern score.

5DE Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
5DE Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
3CD Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Moderate Concern

The Trawl sector is allocated 99.98% of the Pacific Ocean perch TAC (DFO 2021a). The coast-wide 2020 catch of Pacific Ocean perch was 2,618 t, which is 50.4% of the available coast-wide quota; no area-specific quotas were exceeded (Cornthwaite & Workman 2021). The mean annual coastwide catch from 2012 to 2016 was approximately 4,200 t (Haigh et al. 2019). The assessments of the 3CD and 5DE stocks estimates that exploitation rates were lower than historical levels and lower than estimates of u_{MSY} (DFO 2013). But the most recent stock assessments of 3CD and 5DE Pacific Ocean perch are based on data that are ≥10 years old, and the fishing mortality relative to F_{MSY} is unknown, so this factor is scored a moderate concern.

Petrale sole (Eopsetta jordani)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

There is no recent stock assessment of petrale sole in BC waters. The IUCN has assessed petrale sole as a species of Least Concern because management measures have led to improved stock status in the United States and Canada (Munroe 2021). Although there is no recent assessment for the subpopulation in Canadian waters, it is thought to be in recovery from record lows (Munroe 2021). Survey indices indicate an increasing trend in the relative biomass of petrale sole in BC waters waters (Figure 34), but the surveys do not cover three generations (the petrale sole generation time is 12 years (Munroe 2021b)). Therefore, a moderate concern score is awarded, based on the IUCN status.

Justification:

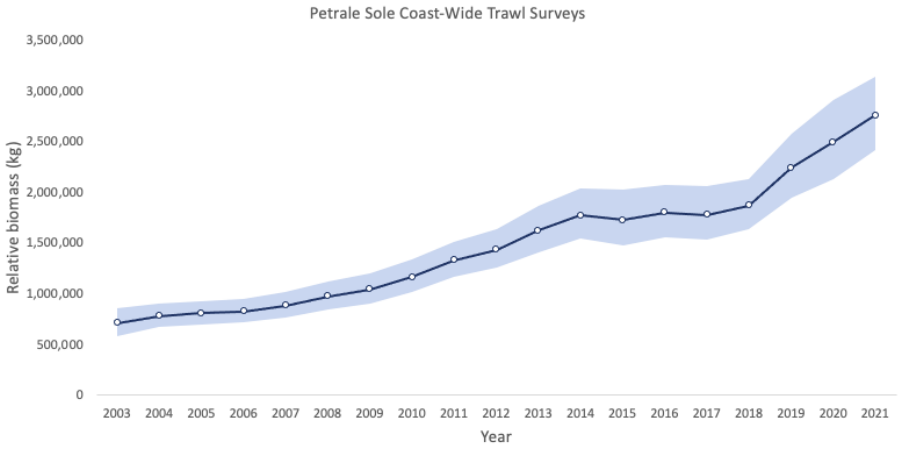

Figure 34: Petrale sole relative biomass trends in BC from all coast-wide trawl surveys combined. Dots represent mean estimates of relative biomass and the shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Quillback rockfish (Sebastes maliger)

Factor 1.1 - Abundance

Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

Low Concern

Groundfish Science used the Management Procedure (MP) framework developed for groundfish species (Anderson et al. 2021b) to evaluate Inside quillback rockfish. The Inside stock was reviewed at a CSAS regional peer-review meeting in December 2022. Analysts developed operating models (i.e., representations of alternative hypotheses about "true" fish population dynamics; OMs) and management procedures (MPs), and used closed loop simulation to find MPs that were able to meet objectives. The project used averaged OMs to evaluate stock status with regard to a Limit Reference Point (LRP) and Upper Stock Reference (USR) of 0.4 B_{MSY} and 0.8 B_{MSY}, respectively. Three OMs assume different levels of mortality, and two "robustness" OMs assumed a future decline in recruitment and the effects of removing a jig survey index (DFO 2023d). The 2021 spawning biomass was estimated to be 88% of B_{MSY} (interquartile range of 46–147% CI), there was a 52% probability that the stock was above the USR, and there was a 79% probability that it was above the LRP (Figure 35). Because the biomass estimate for Inside quillback rockfish is at least 75% of B_{MSY}, this factor is scored a low concern.

Justification:

The value of M for Inside quillback rockfish has not been directly estimated, and the three values used were based on a predictor that used maximum age to predict M. The high M values are considered unlikely for this stock, given the high maximum observed age in BC waters (DFO 2023d).

Figure 35: Probability that the 2021 spawning biomass is above the LRP (40% B_{MSY}) and USR (80% B_{MSY}) for the four operating models (left), and probability that the 2021 spawning biomass is above 0.2 and 0.4 B_0 (right) (DFO 2023d).

Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Very Low Concern

Groundfish Science used the Management Procedure (MP) framework developed for groundfish species (Anderson et al. 2021b) to evaluate Outside quillback rockfish. The Outside stock was reviewed at a CSAS regional peer-review meeting in May 2023. Analysts developed operating models (i.e., representations of alternative hypotheses about "true" fish population dynamics; OMs) and management procedures (MPs), and used closed loop simulation to find MPs that were able to meet objectives. The project used averaged OMs to evaluate stock status with regard to a Limit Reference Point (LRP) and Upper Stock Reference (USR) of 0.4 B_{MSY} and 0.8 B_{MSY}, respectively. The reference OMs differed in the values of mean natural mortality (M), and an OM that assumes lower recreational catch than what is reported; two robustness OMs include an OM with lower steepness (h), and an OM that assumes lower average future recruitment (DFO 2023f). The weighted average biomass across the three reference OMs was greater than B_{MSY} and the USR (B_{2021}/B_{MSY} = 1.89 (SD = 13%) (Figure 36). Because the biomass estimate for Outside quillback rockfish is above target levels, including the B_{MSY} reference point, this factor is scored a very low concern.

Justification:

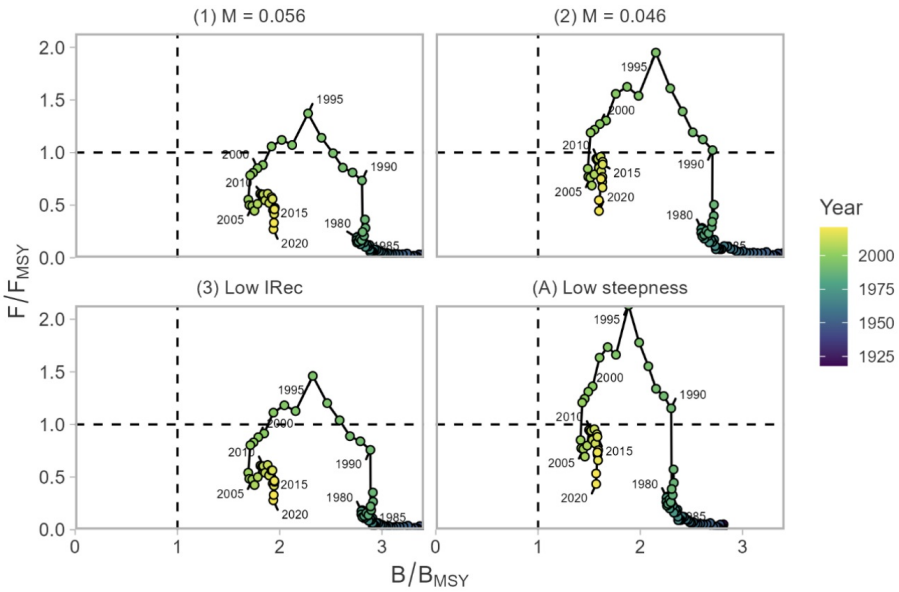

Figure 36: Kobe phase plot for Outside quillback rockfish, showing the historical stock trajectory in terms of B/B_{MSY} and F/F_{MSY} for the reference and robustness set OMs at the maximum posterior density (MPD). Years are indicated in color (DFO 2023f).

Factor 1.2 - Fishing Mortality

Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

Moderate Concern

The average annual catch from 2012 to 2019 of Inside quillback was 33 t (DFO 2023d). There is no current estimate of F relative to F_{MSY}. The sustainability of current fishing levels is unknown, and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Justification:

The conservation objective for Inside quillback is to maintain the stock above the LRP after one generation (24 years) with a minimum probability of 75%; other objectives include maintaining the stock above the USR and maintaining fishery access and catch (DFO 2023d). The MPs that were evaluated included two constant catch MPs and eight MPs based on an index of survey abundance. All MPs met the conservation objective of being above the LRP after one generation, with 75% probability under the OM reference set scenarios (DFO 2023d). The probabilities related to maintaining fishing mortality below F_{MSY} were not provided in the analysis.

Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Low Concern

The average annual catch from 2012 to 2019 of Outside quillback was 81.6 t from 5BCDE and 44 t from 5A3CD (DFO 2023f). According to the 2023 MP for Outside quillback rockfish, the weighted average F/F_{MSY} ratio across the reference OMs was below sustainable levels (F_{2021}/F_{MSY} = 0.38) (DFO 2023f). Fishing mortality is scored a low concern.

Justification:

The objectives are (1) to maintain the stock above the LRP during two generations (54 years) with a minimum probability of 75%, (2) to maintain the stock above the USR with a minimum probability of 50%, and (3) to maintain fishing mortality below the removal reference (i.e., F_{MSY}) with a minimum probability of 50% (DFO 2023f). Other objectives include maintaining fishery access and catch. MPs evaluated included two constant catch MPs and eight MPs based on an index of survey abundance. All MPs met the conservation objective of being above the LRP after one generation, with 75% probability under the OM reference set scenarios.

Redbanded rockfish (Sebastes babcocki)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

High Concern

Redbanded rockfish was assessed for the first time in BC waters in 2014, but the catch-at-age model results were unreliable and the assessment was unable to determine stock status (Edwards et al. 2017). Researchers also explored trend analyses of survey data, but these methods failed to produce reliable results (Edwards et al. 2017). Lastly, the eight survey series were individually investigated for possible trends, but no significant trend was found (i.e., all fitted trends had p-values > 0.05). Overall, the assessment found no significant increase or decrease in relative abundance of redbanded rockfish, and it was noted that catches have remained steady over the last 8 years (Edwards et al. 2017). Abundance of redbanded rockfish is scored against a PSA because there is little confidence in the results of the stock assessment and data-limited assessment methods for redbanded rockfish. According to the PSA (Table 10), this species is highly vulnerable (V = 3.56) and therefore scores a high concern for abundance.

Justification:

Table 10. Redbanded Rockfish PSA

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Avg Age @ maturity; Tm (years)	17.8	3	(Edwards et al. 2017)
von Bertalanffy (K) Fish only	0.07	3	(Edwards et al. 2017)
Avg Max Age; Tmax (years) Inverts only when you know Lmax for Finfish (Col. J)	NA	NA	
Fecundity (Eggs/year)	unknown		
Avg Max Size; Lmax (cm) (fish only)	56	1	(Edwards et al. 2017)
Avg Size @ maturity; Lm (cm) (fish only)	38.5	1	(Froese & Pauly 2021)
Reproductive Strategy	Live bearer	3	(Edwards et al. 2017)
Density Dependence (inverts only)	NA	NA	
Productivity Subscore		**2.2**	

Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Areal overlap	>30% of the species concentration is fished, considering all fisheries, OR Default score if unknown	3	
Vertical overlap	Default score for target species	3	
Seasonality	Fisheries overlap with species >6 months/year	3	(Fox et al. 2020) (IPHC Secretariat 2022)
Selectivity	Default score when conditions under "high risk" do not apply	2	
Post-capture Mortality	Default score for retained species	3	
Susceptibility Subscore		**2.8**	

Productivity-Susceptibility Score	3.56
Vulnerability Rating (high, medium or low)	High

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Moderate Concern

Trawl sector landings of redbanded rockfish in 2020 totaled 129 t, which was below the TAC of 295 t; line sector landings totaled 141 t, which is also under the TAC of 284 t in 2020 (Cornthwaite & Workman 2021). Total landings (all fisheries and all areas) of redbanded rockfish have generally declined since the early 1990s (Figure 37). The recent stock assessment was unable to determine appropriate reference points or management advice for redbanded rockfish; fishing mortality is considered unknown and a moderate concern score is given.

Justification:

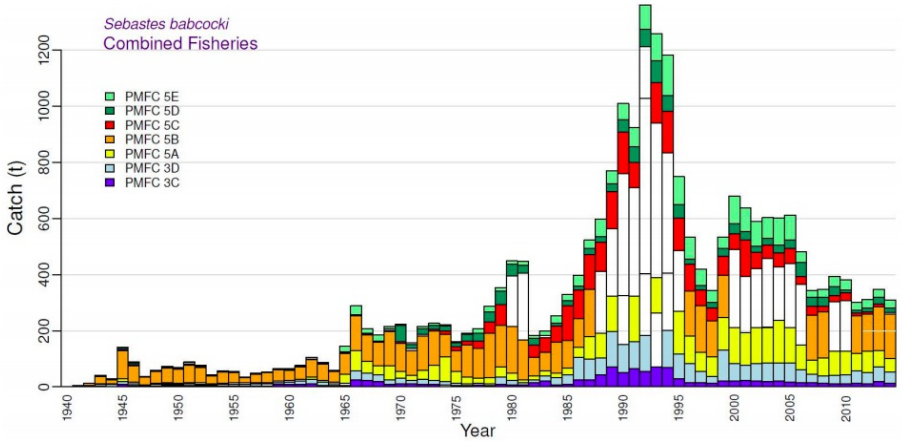

Figure 37: Reconstructed total (landed + discarded) catch (t) for redbanded rockfish from all fisheries and surveys combined in all PMFC major areas along the BC coast. Figure from (Edwards et al. 2017).

Redstripe rockfish (Sebastes proriger)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Very Low Concern

There are two stocks of redstripe rockfish in BC waters, both of which were assessed in 2021 (Starr & Haigh 2021). The BC North (BCN) stock occurs in Areas 5DE and the BC South (BCS) stock occurs in 3CD and 5ABC. Biomass in 2018 (B_{2018}) for both stocks was estimated to be above B_{MSY} [B_{2018}/B_{MSY} for BCN and BCS = 3.156 and 2.429, respectively (Figures 38 and 39)]. In addition, redstripe rockfish biomass is estimated to be above more conservative reference points for long-lived species (B_{2018} > TRP and LRP, where TRP = 0.4 B_0 and LRP = 0.2 B_0) (Table 11). According to a recent stock assessment, both redstripe rockfish stocks are above target reference points with no scientific controversy and the data used in the assessment are <5 years old. Therefore, abundance is scored a very low concern.

Justification:

Redstripe rockfish was assessed with a two-sex catch-at-age model using fishery-independent and fishery-dependent data sources. Both stocks are estimated to be above DFO's provisional reference points of 0.4 B_{MSY} and 0.8 B_{MSY}, with a probability of >99% (Starr & Haigh 2021). Both stocks are estimated to have been in the "healthy zone" over the entire time period (1940–2018) (Starr & Haigh 2021).

Table 11. Redstripe rockfish B_{MSY}- and B_0-based reference points from (Starr & Haigh 2021).

BCN Redstripe Rockfish	Median Value (t)	5–95% Percentiles (t)	B_{2018}/Reference Point (5–95% Percentiles)
B_0	7,216	5,611–10,083	0.914 (0.692–1.129)
B_{2018}	6,500	4,193–11,079	—
B_{MSY}	2,135	1,488–3,411	3.156 (2.015–3.999)
BCS Redstripe Rockfish			
B_0	26,149	21,925–36,390	0.622 (0.469–0.810)
B_{2018}	16,235	10,700–28,967	—
B_{MSY}	6,830	4,553–10,701	2.429 (1.509–3.768)

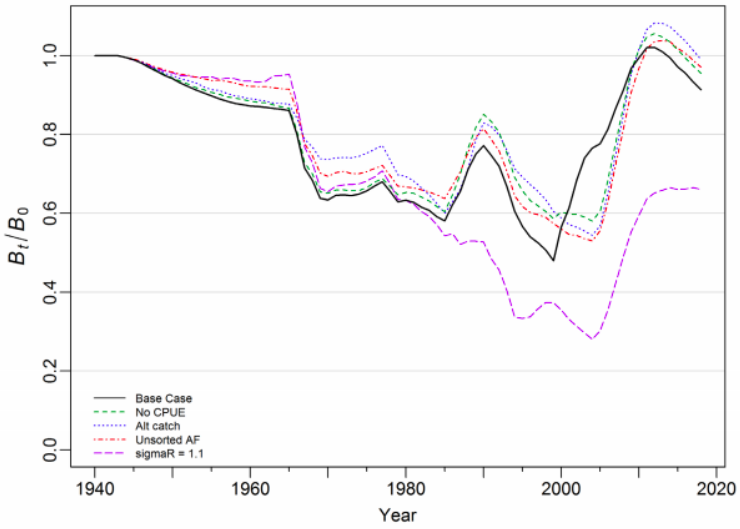

Figure 38: BC North—Model median trajectories of spawning biomass as a proportion of unfished equilibrium biomass (B_t/B_0) for the base case and four sensitivity runs (see legend lower left). Figure from (Starr & Haigh 2021).

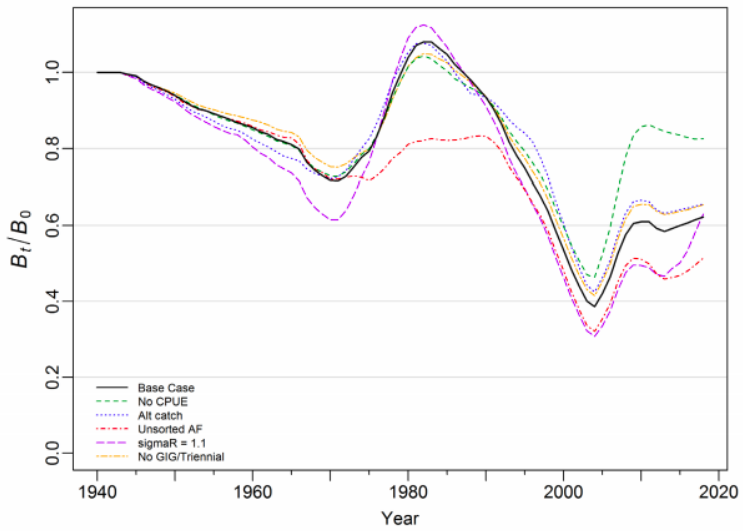

Figure 39: BC South—Model median trajectories of spawning biomass as a proportion of unfished equilibrium biomass (B_t/B_0) for the base case and four sensitivity runs (see legend lower left). Figure from (Starr & Haigh 2021).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Low Concern

The Trawl sector accounts for 97% of the redstripe rockfish TAC (Starr & Haigh 2021). The coast-wide 2019/20 catch of redstripe rockfish (both stocks combined) in the groundfish Trawl sector was roughly 873 t, which was 45% of the available quota (Cornthwaite & Workman 2021). The mean annual coast-wide catch from 2013 to 2017 was approximately 109 t from BCN and 732 t from BCS (Starr & Haigh 2021). The median exploitation rate (ratio of total catch to the vulnerable biomass in the middle of the year) in 2017 on the BCN stock was below the exploitation rate at MSY, where u_{2017}/u_{MSY} = 0.025 (5th–95th percentiles = 0.011–0.154); the exploitation rate on the BCS stock was also below u_{MSY}, with u_{2017}/u_{MSY} = 0.160 (5th–95th percentiles = 0.049–0.496) (Starr & Haigh 2021). There is a high probability that current exploitation rates are below that associated with MSY. While there is no evaluation of whether these RPs are suitable for redstripe rockfish, the stock remains above conservative reference points under recent fishing levels, suggesting that fishing mortality is sustainable. Therefore, a low concern score is awarded.

Justification:

The stock assessment provided decision tables for the DFO provisional reference points, 0.4 B_{MSY}, 0.8 B_{MSY}, and u_{MSY} for projections out to 5 years. If the average catch each year from 2018 to 2023 from the BCN stock is near the average of the previous 5 years (109 t from 2013 to 2017), then it is highly probable that exploitation rates will continue to be below u_{MSY} [$P(u_t < u_{MSY}) = 1$ (Starr & Haigh 2021)]. Likewise, if the average catch from the BCS stock is near the average of the previous 5 years (732 t from 2013–17), then $P(u_t < u_{MSY}) = 1$ each year from 2018 to 2023 (Starr & Haigh 2021).

Rex sole (Glyptocephalus zachirus)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

There is no recent stock assessment for rex sole. The IUCN has assessed rex sole as a species of Least Concern because there are no major threats, the species is considered well managed, and it is considered common off BC (Bryan et al. 2021). Survey indices indicate an increasing trend in the relative biomass of rex sole in BC waters (Figure 40), but the surveys do not cover three generations (the rex sole generation time is 11–12 years (Bryan et al. 2021). Therefore, a moderate concern score is awarded, based on the IUCN status.

Justification:

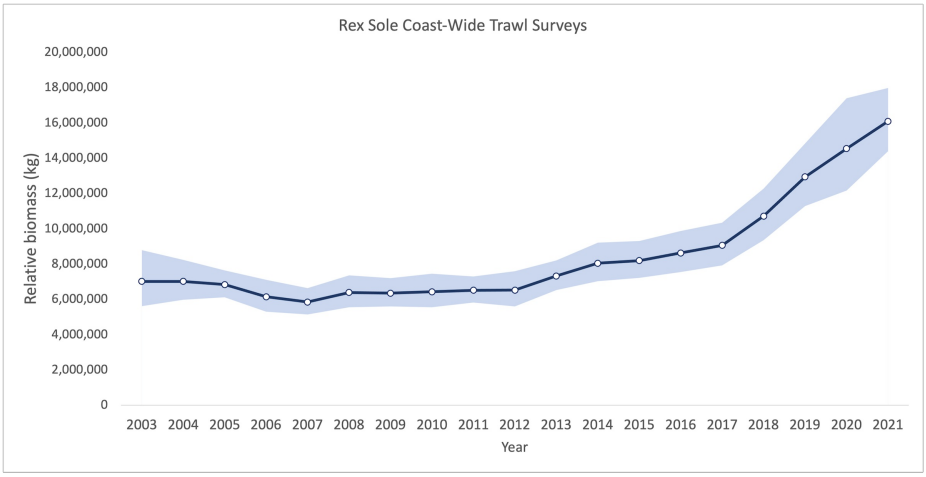

Figure 40: Rex sole trends in relative biomass in BC from all coast-wide trawl surveys combined. Dots represent mean estimates of relative biomass and the shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Rougheye rockfish (Sebastes aleutianus)

Factor 1.1 - Abundance

BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Moderate Concern

Rougheye rockfish (*Sebastes aleutianus*) and blackspotted rockfish (*S. melanostictus*) are assessed as a species complex called the Rougheye/Blackspotted (REBS) rockfish complex. The 2020 assessment used a two-fishery, two-sex catch-at-age model and provided stock status and advice for two identified REBS complex stocks: the northern stock in Area 5DE (REBS north) and the southern stock in Areas 3CD5AB (REBS south) (DFO 2020d).

Advice to managers is based on an LRP of 0.4 B_{MSY} and a TRP of 0.8 B_{MSY} consistent with DFO's Precautionary Approach. But given that an MSY-based approach may not be appropriate for such a long-lived species, alternative reference points are provided relative to unfished biomass, B_0. Both MSY-based and B_0-based reference points are presented in Table 4. REBS north rockfish is above the TRP and LRP under DFO's Precautionary approach (Figure 12, left panel); the stock is also above B_{MSY} (B_{2021}/B_{MSY} = 2.21); REBS south rockfish is slightly above B_{MSY} (B_{2021}/B_{MSY} = 1.07) and above both DFO provisional RPs (Figure 12, right panel).

The recent stock assessment concluded that the REBS north stock appears to be healthy despite a long history of fishing, and the results appear to be robust to a range of assumptions, but the results for the REBS south stock are less definitive and the stock may be at low levels (DFO 2020d). Seafood Watch scores this factor relative to MSY-based reference points, rather than DFO's provisional reference points. Both REBS stocks are above B_{MSY} but there is less certainty for the REBS South stock. Because the two species are managed as a species complex, there is uncertainty around species-specific impacts, so this factor is scored a moderate concern.

Justification:

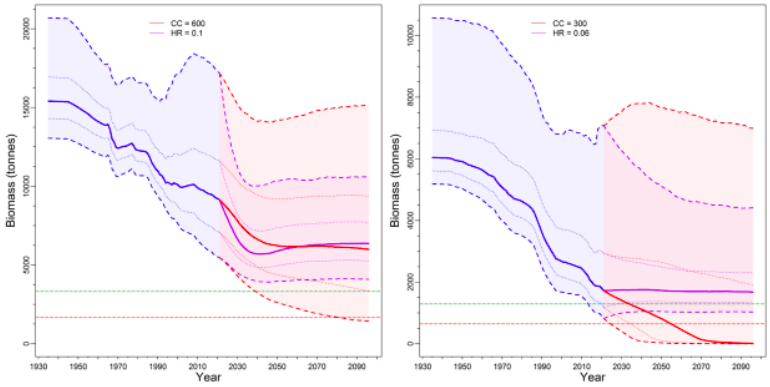

Figure 12: Estimates of spawning biomass Bt (tonnes) from the model posteriors of the REBS north (left, 9,000 samples) and REBS south (right, 6,000 samples) composite base cases. The median biomass trajectory appears as a solid curve surrounded by a 90% credibility envelope (quantiles: 0.05, 0.95) in blue and delimited by dashed lines for years t = 1935–2021; projected biomass appears in light red (constant catch) and purple (harvest rate) for years t = 2022–2096 (1.5 generations). Also delimited is the 50% credibility interval (quantiles: 0.25–0.75) delimited by dotted lines. The horizontal dashed lines show the median LRP (red: 0.4 B_{MSY}) and USR (green: 0.8 B_{MSY}). Figure from (DFO 2020d).

Table 4. Model output with median (50%) values and associated 5% and 95% quantiles from (DFO 2020d).

	Median Value (t)	5–95% Percentiles (t)	B_{2021}/Reference Point (5–95% Percentiles)
REBS North			
B_0	15,413	13,058–20,693	0.595 (0.405–0.840)
B_{2021}	9,153	5,475–17,176	—
B_{MSY}	4,149	3,519–5,519	2.21 (1.5–3.15)
REBS South			
B_0	6,045	5,187–0,574	0.286 (0.155–0.680)
B_{2021}	1,725	818–7,078	—
B_{MSY}	1,611	1,380–2,739	1.07 (0.582–2.61)

Factor 1.2 - Fishing Mortality

BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Moderate Concern

The median exploitation rate on the north stock in 2020 (u_{2020}) did not exceed u_{MSY} for the Trawl sector (u_{2020}/u_{MSY} = 0.06) or Line sector (u_{2020}/u_{MSY} = 0.11) (DFO 2020d). According to the decision table in the recent stock assessment for REBS north, all levels of constant catch—up to 1,200 t—have a >50% probability that $u_t < u_{MSY}$ in every year from 2021 to 2031 (DFO 2020d), suggesting that the TAC of 783 t is lower than the catch at MSY. But there is uncertainty in the exploitation status of each species individually. Because there is no information on regional or species differences in the contribution of each species to the stock complex, fishing mortality on each species is unknown and this factor is scored a moderate concern.

BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

High Concern

According to the most recent assessment, the median exploitation rate on the REBS south stock in 2020 (u_{2020}) exceeded u_{MSY} (u_{2020}/u_{MSY} = 1.17) in the Trawl sector, but not in the commercial non-trawl sector (u_{2020}/u_{MSY} = 0.72) (Figure 13). The south stock predominantly contains rougheye rockfish. Although annual catches of REBS rockfish have remained below the established TAC, it is probable [$P(u_{2020} > u_{MSY} = 0.58)$] that the current harvest rate from the Trawl sector on the south stock is exceeding MSY (DFO 2020d). At current catch levels, the south stock is expected to decline to the "Critical Zone" ($B_t < 0.4\ B_{MSY}$) after 2050 (DFO 2020d). Because this stock is harvested above sustainable levels in the Trawl sector and fishing mortality from all sources is expected to reduce the stock below 0.4 B_{MSY}, fishing mortality is scored a high concern.

Justification:

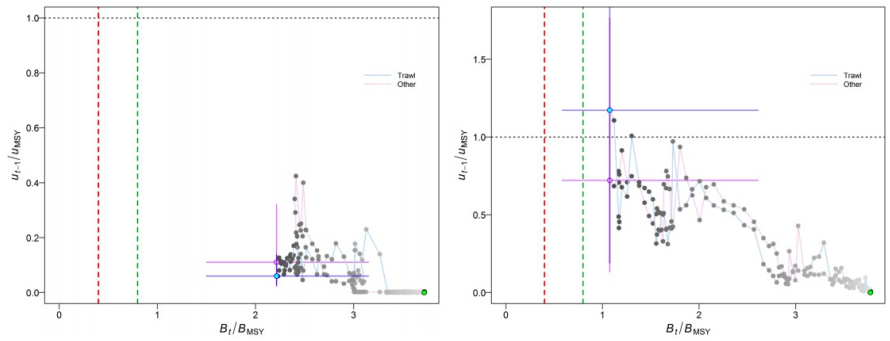

Figure 13: Phase plot through time (REBS north on left, REBS south on right) of the medians of the ratios B_t/B_{MSY} (the spawning biomass at the start of year t relative to B_{MSY}) and two measures of fishing pressure: trawl ($u_{t-1(trawl)}/u_{MSY}$: cyan dot) and "other" ($u_{t-1(other)}/u_{MSY}$: purple dot) (both represent the exploitation rate in the middle of year t–1 relative to u_{MSY} for each fishery) for the composite base cases. The filled green circle is the starting year (1935). Years then proceed from lighter shades through to darker, with the final year (t = 2021) as a filled cyan or purple circle, and the blue/purple cross lines represent the 0.05 and 0.95 quantiles of the posterior distributions for the final year. Red and green vertical dashed lines indicate the PA provisional LRP = 0.4 B_{MSY} and USR = 0.8 B_{MSY}, and the horizontal grey dotted line indicates u_{MSY}. Figure from (DFO 2020d).

$P(u_t < u_{MSY})$

Catch policy	2021	Projection year 2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
0	1	1	1	1	1	1	1	1	1	1	1
50	>0.99	>0.99	>0.99	>0.99	1	1	1	1	1	1	1
100	0.87	0.88	0.89	0.91	0.93	0.94	0.96	0.97	0.98	0.98	0.98
150	0.63	0.63	0.63	0.64	0.65	0.67	0.68	0.7	0.72	0.73	0.74
200	0.49	0.49	0.49	0.49	0.50	0.50	0.51	0.51	0.52	0.52	0.52
250	0.40	0.40	0.40	0.40	0.40	0.41	0.41	0.42	0.42	0.42	0.43
300	0.34	0.33	0.33	0.33	0.33	0.33	0.34	0.34	0.34	0.34	0.34
350	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.28	0.27
400	0.24	0.23	0.23	0.22	0.22	0.22	0.23	0.23	0.23	0.23	0.22
450	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.19
500	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17
550	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15
600	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.14

Figure 14: REBS south decision tables for the reference points u_{MSY} for projections through 2031 for a range of constant catch policies (in tonnes/year) using the composite base case. Values are the probability (proportion of 6,000 MCMC samples) of the exploitation rate of vulnerable biomass in the middle of year t being less than the u_{MSY} reference point. For reference, the average annual catch of REBS south over the last 5 years (2015–19) was 291 tonnes. Table from (DFO 2020d).

Sablefish (Anoplopoma fimbria)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Very Low Concern

Sablefish was most recently assessed in 2022, as part of the management strategy evaluation (MSE) process (DFO 2023c). According to this assessment, female spawning stock biomass was estimated to be well above target levels (B_{2022}/B_{MSY} = 1.32) (Figure 41). Sablefish abundance is estimated to be above an appropriate TRP, and is awarded a score of very low concern.

Justification:

Sablefish stock status and harvest advice are monitored via an MSE process; the process includes refitting the operating model (OM) with updated fishery and survey data (DFO 2023c). The OM scenarios include a base scenario (baseOM) and scenarios for high productivity assumptions (hiProd), low productivity assumptions (loProd), high terminal year biomass (hiRelCV), and low terminal year biomass (loRelCV) (DFO 2023c).

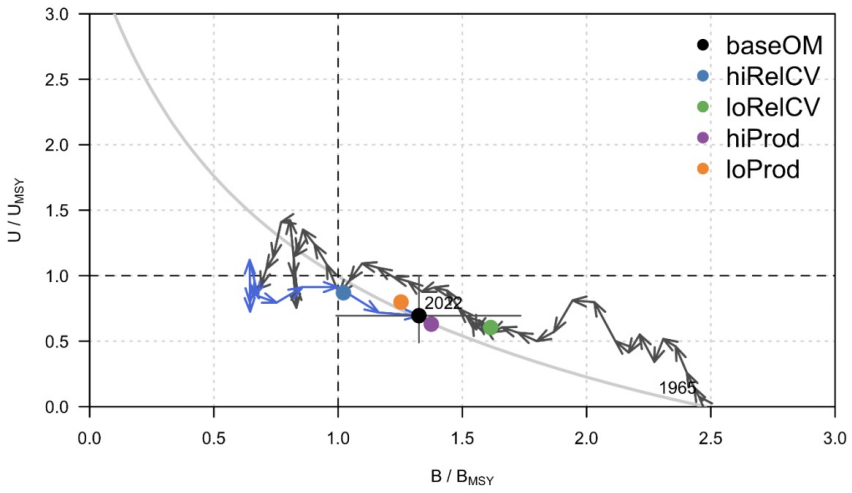

Figure 41: Sablefish phase plot showing posterior median spawning biomass (horizontal axis) and total legal harvest rate (vertical axis) relative to their corresponding MSY-based reference points. Arrows show the direction of time, beginning in 1965 and ending in 2022, with the years since the introduction of a simulation-tested MP in 2011 colored blue. The crosshair indicates the median and 95% credibility intervals for the current stock status under baseOM, and the median values for all other OM updates are shown as colored circles. The theoretical path at equilibrium based on the model is shown as a faint grey curve (DFO 2023c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Low Concern

The 2020 sablefish catch was 2,508 t, or 85.4% of the available TAC (Cornthwaite & Workman 2021). A harvest control rule is adjusted based on estimates of B_t relative to B_{MSY}, and the maximum target fishing mortality rate was recently adjusted from 9.5% in 2017 to 5.5% in 2021 (DFO 2020c); the target was set at 6.4% in 2022, despite evidence that a maximum target rate up to 7.5% could meet the fishery objectives (see Justification). The realized harvest rate in 2021 was 72% of U_{MSY}, resulting in a low concern score.

Justification:

The five primary Fishery Objectives for the BC sablefish fishery (DFO 2023c):

1. *Avoid LRP: Maintain female spawning stock biomass above the limit reference point of LRP = 0.4 B_{MSY} in 95% of years measured over two sablefish generations, where B_{MSY} is the female spawning biomass at maximum sustainable yield (MSY) for each operating model;*
2. *Avoid stock decline when below USR: When female spawning stock biomass is between 0.4 B_{MSY} and 0.8 B_{MSY}, limit the probability of decline over the next 10 years from very low (5%) at 0.4 B_{MSY} to moderate (50%) at 0.8 B_{MSY}. At intermediate stock status levels, define the tolerance for decline by linearly interpolating between the extremes;*
3. *Achieve target biomass: Maintain the 2052 female spawning stock biomass above the target reference point in 50% of simulation replicates, where the target reference point is (a) $B_{Targ} = B_{MSY}$ when $B \geq 0.8\ B_{MSY}$, or (b) $B_{Targ} = 0.8\ B_{MSY}$ when $B < 0.8\ B_{MSY}$;*
4. *Avoid economically unviable catch: Maximize the probability that annual legal-sized catch levels remain above 1,992 tonnes, measured over two sablefish generations;*
5. *Maximize legal-size catch: Maximize annual legal-sized catch over 10 years, subject to Objectives 1–4 being met.*

Sharpchin rockfish (Sebastes zacentrus)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

High Concern

There is no recent stock assessment for sharpchin rockfish, nor has this species been rated by the IUCN or COSEWIC. Coast-wide trawl surveys show a stable trend in the biomass index for sharpchin rockfish in BC waters (Figure 42), but the trends do not cover three generations. Therefore, this factor is scored against the PSA (Table 12). Sharpchin rockfish has high vulnerability (V = 3.44) to fishing pressure, so it is scored a high concern for abundance.

Justification:

Table 12. Sharpchin Rockfish PSA

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk	Reference
Avg Age @ maturity; Tm (years)	10	2	(AFSC 2021)
von Bertalanffy (K) Fish only	0.09	3	(Froese & Pauly 2021)
Avg Max Age; Tmax (years) Inverts only when you know Lmax for Finfish (Col. J)	NA	NA	
Fecundity (Eggs/year)	unknown	—	(AFSC 2021)
Avg Max Size; Lmax (cm) (fish only)	39	1	(Froese & Pauly 2021)
Avg Size @ maturity; Lm (cm) (fish only)	25	1	(Froese & Pauly 2021)
Reproductive Strategy	Live bearer	3	(Froese & Pauly 2021)
Density Dependence (inverts only)	NA	NA	
Productivity Subscore		**2**	

Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Areal overlap	>30% of the species concentration is fished, considering all fisheries, OR Default score if unknown	3	
Vertical overlap	Default score for target species	3	
Seasonality	Fisheries overlap with species >6 months/year	3	(Fox et al. 2020) (IPHC Secretariat 2022)
Selectivity	Default score when conditions under "high risk" do not apply	2	
Post-capture Mortality	Default score for retained species	3	
Susceptibility Subscore		**2.8**	

Productivity-Susceptibility Score	3.44
Vulnerability Rating (high, medium or low)	High

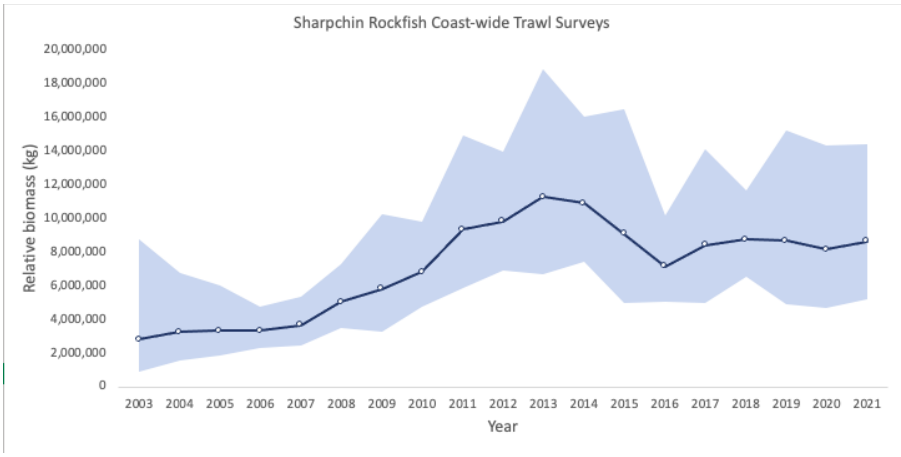

Figure 42: Sharpchin rockfish relative biomass trends in BC waters from coast-wide trawl surveys. Dots represent mean estimates of relative biomass and the shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Shortraker rockfish (Sebastes borealis)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

High Concern

There is no recent stock assessment for shortraker rockfish; the last assessment was in 1998, and there is no new assessment planned (Cornthwaite & Workman 2021). This species has not been rated by the IUCN or COSEWIC. Coast-wide trawl surveys show a stable trend in the biomass index for sharpchin rockfish in BC waters (Figure 43), but the trends do not cover three generations (age at maturity is 21.4 years in the Gulf of Alaska (Echave & Hulson 2017)). In the absence of information on abundance of shortraker rockfish in BC waters, this factor was scored using the Seafood Watch PSA scoring tool (Table 13). Shortraker rockfish has a high vulnerability (V = 3.97) to fishing pressure and is therefore scored a high concern for abundance.

Justification:

Table 13. Shortraker Rockfish PSA

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Avg Age @ maturity; Tm (years)	21.4	3	(Echave & Hulson 2017)
von Bertalanffy (K) Fish only	0.03	3	(Echave & Hulson 2017)
Avg Max Age; Tmax (years) Inverts only when you know Lmax for Finfish (Col. J)	NA	NA	
Fecundity (Eggs/year)	unknown	—	
Avg Max Size; Lmax (cm) (fish only)	120	2	(Echave & Hulson 2017)
Avg Size @ maturity; Lm (cm) (fish only)	49.9	2	(Conrath 2017)
Reproductive Strategy	Live bearer	3	
Density Dependence (inverts only)	NA	NA	

Productivity Subscore		**2.6**	

Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Areal overlap	>30% of the species concentration is fished, considering all fisheries, OR Default score if unknown	3	
Vertical overlap	Default score for target species	3	
Seasonality	Fisheries overlap with species >6 months/year	3	(Fox et al. 2020) (IPHC Secretariat 2022)
Selectivity	Low adult migration	3	(Gunderson 1997) (Matala et al. 2004)
Post-capture Mortality	Default score for retained species	3	
Susceptibility Subscore		**3**	

Productivity-Susceptibility Score	3.97
Vulnerability Rating (high, medium or low)	High

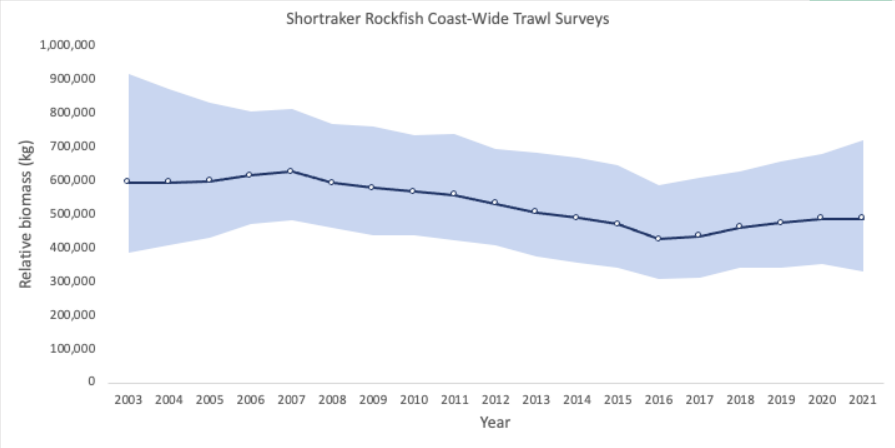

Figure 43: Shortraker rockfish relative biomass trends in BC waters from coast-wide trawl surveys. Dots represent mean estimates of relative biomass and the shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Shortspine thornyhead (Sebastolobus alascanus)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

Low Concern

Shortspine thornyhead was assessed in BC waters in 2016. The estimated stock biomass (B_{2016}) was above both the USR (0.8 B_{MSY}) and LRP (0.4 B_{MSY}) and was estimated to have been above these reference points throughout the history of the fishery (DFO 2016b)(Starr and Haigh 2017). The median value of B_{2016}/B_{MSY} = 1.85 (Figure 44) and there is a probability of 0.98 that the stock was above the USR; the stock was estimated to be 79% of B_0 (DFO 2016b)(Starr and Haigh 2017). But, there were several sources of uncertainty in the assessment (see Justification). Although shortspine thornyhead is above a target reference point, the age of the data (i.e., >5 years old) results in a low concern score, rather than a very low concern score.

Justification:

There are uncertainties in the stock assessment related to growth, natural mortality, and the age of knife-edge selectivity (DFO 2016b). Because of these uncertainties, the assessment modeled 12 scenarios with varying values for growth, natural mortality, and the age of selectivity (DFO 2016b)(Starr and Haigh 2017). Sampling data in BC do not contain many large or old fish, which is distinctly different from samples from neighboring stocks to the north and south of BC (DFO 2016b)(Starr and Haigh 2017). The low numbers of old fish—and high numbers of young fish—in BC samples results in a higher estimate of the instantaneous rate of natural mortality compared to the published literature (DFO 2016b)(Starr and Haigh 2017). Given this uncertainty, CSAS recommends improvements in sampling and aging before the next assessment update (DFO 2016b)(Starr and Haigh 2017).

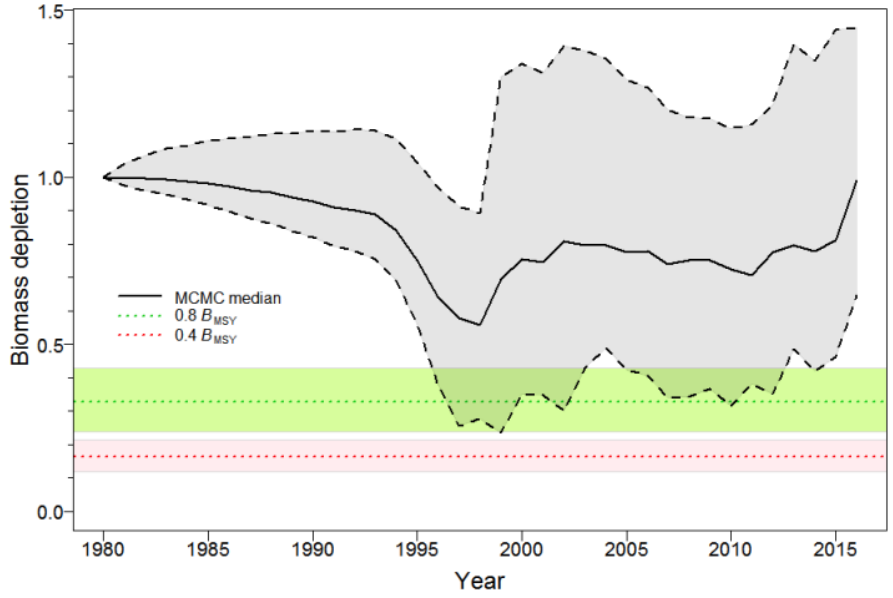

Figure 44: Median estimates (solid black line) and 90% confidence intervals (black dashed lines, grey fill) for the model average B_t/B_0 for shortspine thornyhead, along with the MSY-based reference points (Limit Reference Point, LRP = 0.4 B_{MSY} [red] and the Upper Stock Reference, USR = 0.8 B_{MSY} [green] shown as a green band and line) relative to B_0. Figure from (DFO 2016b).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

High Concern

Shortspine thornyhead is caught by trawl and line gear, but the Trawl sector has historically accounted for the majority of the total catch and is allocated 95.4% of the annual TAC (DFO 2022d). The Trawl sector caught approximately 222.68 t in 2019/20, which

was below the TAC of 754.54 t (DFO 2020a); the Line sector combined caught 214,903 lbs (97.48 t), which also was below the respective TAC of 291,057 lbs (132.02 t) (DFO 2020b).

According to the 2016 stock assessment, the probability that the harvest rate in 2015 (u_{2015}) exceeded u_{MSY} was 0.72 (Figure 45). The model provided 3-year projections under different catch scenarios (Figure 46). Three-year projections (from 2016 to 2018) indicated that TACs of 300 t or greater would result in a 56.3% probability that u_{2018} would exceed u_{MSY} (DFO 2016b). The total catches in 2016/17, 2017/18, and 2018/19 were 328.3 t, 345.6 t, and 358.8 t, respectively (annual catch summaries accessed from (DFO 2021)).

Annual catches of shortspine thornyhead have remained below the established coastwide TAC, but the stock was previously assessed as experiencing harvest rates above MSY, and catches in subsequent years were associated with harvest levels that were projected to be above MSY in 2018. Therefore, fishing mortality is scored a high concern.

Justification:

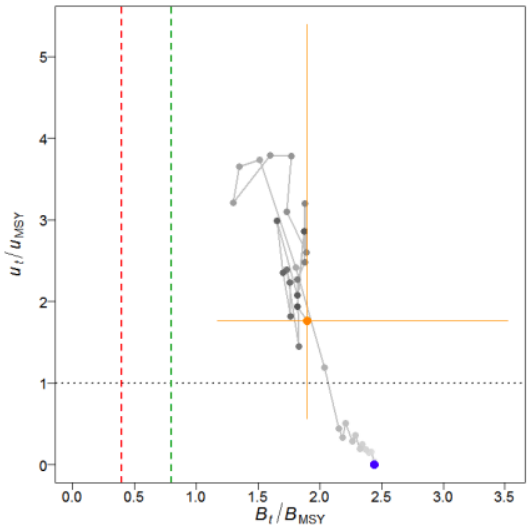

Figure 45: Phase plot through time of the medians of the ratios B_t/B_{MSY} (the spawning biomass in year t relative to B_{MSY}) and u_t/u_{MSY} (the harvest rate in year t relative to u_{MSY}) for the model average. The blue filled circle is the starting year 1980. Years then proceed from light grey through to dark grey with the final year 2016 as a filled orange circle with limit lines representing the 0.1 and 0.9 quantiles of the posterior distributions for the final year. Vertical dashed lines indicate the Precautionary Approach provisional limit (red) and upper stock reference (green) points (0.4, 0.8 B_{MSY}), and the horizontal dotted line indicates u at MSY. Figure from (Starr and Haigh 2017).

TAC	$P(B_{2016} > 0.8B_{MSY})$	$P(B_{2019} > 0.8B_{MSY})$	$P(B_{2016} > 0.4B_{MSY})$	$P(B_{2019} > 0.4B_{MSY})$	$P(u_{2015} > u_{MSY})$	$P(u_{2018} > u_{MSY})$
0	0.9792	0.9964	1	1	0.72	0
100	0.9792	0.9867	1	1	0.72	0.1412
200	0.9792	0.9604	1	0.9998	0.72	0.4002
300	0.9792	0.9158	1	0.9963	0.72	0.5630
400	0.9792	0.8571	1	0.9799	0.72	0.6884
500	0.9792	0.8043	1	0.9388	0.72	0.7758
600	0.9792	0.7605	1	0.8795	0.72	0.8370
700	0.9792	0.7245	1	0.8259	0.72	0.8816
800	0.9792	0.6874	1	0.7849	0.72	0.9135
900	0.9792	0.6463	1	0.7570	0.72	0.9346
1000	0.9792	0.6025	1	0.7318	0.72	0.9526

Figure 46: Model-average decision table for three reference points —the upper stock reference point 0.8 B_{MSY}, the limit reference point 0.4 B_{MSY}, and the harvest rate at maximum sustainable yield u_{MSY}—for end-year biomass B_{2016} and mid-year harvest rate u_{2015} and their respective 3-year projections for a range of constant catch strategies (in tonnes). Each value is the probability that the current or projected biomass or harvest rate is greater than the indicated reference point. The probabilities are the proportion of the 12 pooled MCMC samples, for which $B_t > 0.8\ B_{MSY}$, $B_t > 0.4\ B_{MSY}$, and $u_t > u_{MSY}$. Table from (DFO 2016b).

Silvergray rockfish (Sebastes brevispinis)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Moderate Concern

The most recent full stock assessment of silvergray rockfish used data through 2013 (Starr et al. 2016). At that time, the stock was considered not overfished (B_{2014}/B_{MSY} = 2.04 (5–95% range: 1.22–3.00) (Starr et al. 2016). Because the data used to determine stock status are now ≥10 years old, Seafood Watch considers the current status as uncertain. The generation length of this species is 27 years (G = 10.7 + 1/0.06; age and mortality data from (Starr et al. 2016)). A fishery-independent survey with an abundance index does not cover three generations, but the previous stock assessment indicated that abundance was well above target levels (Starr et al. 2016), and the abundance index shows a stable-increasing trend since the stock assessment (see Figure 3 in (Anderson and English 2022)). Although this species is highly vulnerable, the abundance score is moderated by the available data-limited indicator, resulting in a moderate concern score.

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Moderate Concern

The commercial TAC for silvergray rockfish is allocated mostly to the Trawl sector (88.43% of the total commercial TAC), with Hook and Line Rockfish and Halibut fisheries receiving 10.97% and 0.60% of the commercial TAC, respectively (DFO 2021a). The Trawl sector landed roughly 1,423 t of silvergray rockfish in 2020, which was 73.16% of the available trawl TAC, while the combined line sector landed 24 t, or 9.45% of its TAC (Cornthwaite & Workman 2021). But the most recent stock assessment is based on data that are ≥10 years old and fishing mortality relative to F_{MSY} is unknown, so this factor is scored a moderate concern.

Southern rock sole (Lepidopsetta bilineata)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish

Low Concern

Both northern rock sole (*Lepidopsetta polyxystra*) and southern rock sole (*L. bilineata*) are found in British Columbia's waters, with the southern rock sole being the more prevalent of the two (Holt et al. 2016b). All observations of *L. polyxystra* in BC have been outside of commercially fished areas (Holt et al. 2016b); therefore, the species is not assessed here. For this report, the term "rock sole" will be used to describe *L. bilineata*. There are five discrete rock sole stocks in British Columbia's waters: Areas 5AB, 5CD, 3CD, 4B, and 5E. Stocks 4B and 5E are not assigned TACs because the two stocks are a minor component of total coast-wide landings.

Rock sole in 5AB (Queen Charlotte Sound, QCS) and 5CD (Hecate Strait, HS) were assessed in 2016 against MSY and historical reference points (Figures 47 and 48). The data in the 2016 assessment is more than 10 years old so is not used to score abundance, but the results are below included for historical context. The 3CD stock was not assessed, but the WCVI trawl survey biomass index shows a relatively flat trend throughout five surveys. More recently, biomass estimates for dover sole, English sole, and rock sole were derived from single-species, data-pooling, and hierarchical state-space surplus production models to evaluate management performance under different simulation scenarios (Johnson and Cox 2021). Biomass estimates were based on commercial trawl catch data, commercial catch rates (measured in catch per unit effort, CPUE), and fishery-independent trawl surveys (Johnson and Cox 2021). The value of B_{2016}/B_{MSY} was greater than 1.0 for all assessed rock sole stocks (Figure 20).

Given that the assessed stocks are at or near target reference points but the assessment is based on data more than 5 years old, a score of low concern is given, rather than a very low concern score.

Justification:

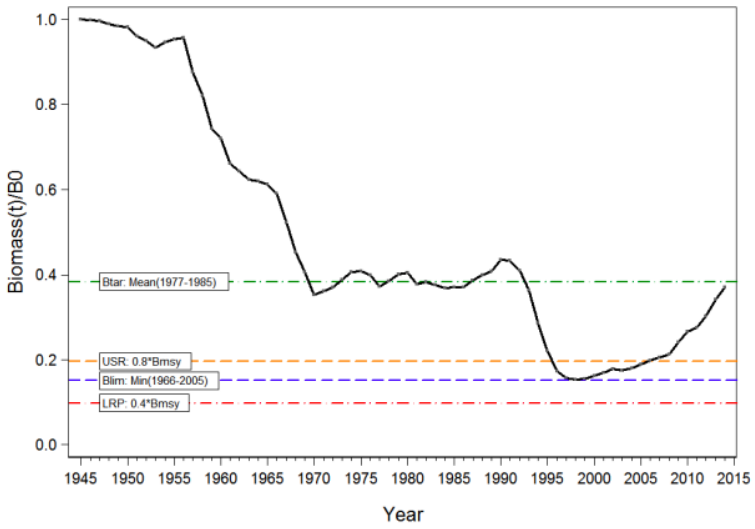

Figure 47: Posterior median estimates of female spawning biomass relative to B_0 by year for the 5AB base case (black line). Also shown are posterior median estimates of MSY-based reference points (Limit Reference Point = 0.4 B_{MSY}; Upper Reference Point = 0.8 B_{MSY}) relative to B_0 and posterior median estimates of historical reference points identified for rock sole in 2006 (B_{Lim} = minimum biomass between 1966 and 2005; B_{Tar} = mean biomass between 1977 and 1985) relative to B_0. Figure from (Holt et al. 2016b).

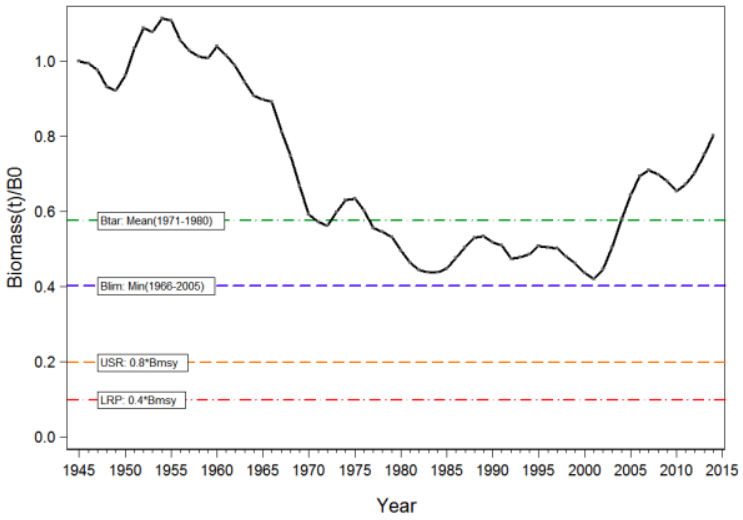

Figure 48: Posterior median estimates of female spawning biomass relative to B_0 by year for the 5CD base case (black line). Also shown are posterior median estimates of MSY-based reference points (Limit Reference Point = 0.4 B_{MSY}; Upper Reference Point = 0.8 B_{MSY}) relative to B_0 and posterior median estimates of historical reference points identified for rock sole in 2006 (B_{Lim} = minimum biomass between 1966 and 2005; B_{Tar} = mean biomass between 1971 and 1980) relative to B_0. Figure from (Holt et al. 2016b).

Stock	B_0	SS reference points			Stock status		q^F	MS reference points		
		$B_{MSY,SS}$	MSY_{SS}	$U_{MSY,SS}$	B_{2016}	$B_{2016}/B_{MSY,SS}$		$B_{MSY,MS}$	MSY_{MS}	$U_{MSY,MS}$
Dover sole										
HSHG	16.51	4.34	1.22	0.28	8.36	1.92	0.022	5.77	1.18	0.20
QCS	5.45	1.46	0.42	0.28	3.36	2.30	0.015	1.91	0.40	0.21
WCVI	13.59	3.58	1.14	0.32	8.45	2.36	0.025	3.60	1.14	0.32
English sole										
HSHG	8.60	2.21	0.87	0.39	4.85	2.20	0.026	2.31	0.87	0.38
QCS	0.57	0.15	0.06	0.39	0.41	2.78	0.016	0.16	0.06	0.36
WCVI	0.86	0.22	0.09	0.39	0.50	2.23	0.020	0.20	0.09	0.43
Rock sole										
HSHG	12.34	3.78	1.07	0.28	7.68	2.03	0.025	2.81	1.03	0.37
QCS	4.33	1.29	0.40	0.31	2.13	1.65	0.014	1.04	0.39	0.38
WCVI	1.12	0.34	0.10	0.29	0.55	1.62	0.012	0.35	0.10	0.28

Figure 20: Unfished biomass B_0; single-species MSY-based reference points $B_{MSY,SS}$, MSY_{SS}, and $U_{MSY,SS}$; stock status as absolute biomass in 2016 B_{2016}; depletion relative to single-species optimal biomass $B_{2016}/B_{MSY,SS}$; commercial trawl catchability scalar q^F; and multispecies reference points including technical interactions $B_{MSY,MS}$, MSY_{MS}, and $U_{MSY,MS}$ for all nine DER complex stocks in 2016. Biomass quantities are given in kilotonnes, and depletion levels and harvest rates are unitless (Johnson and Cox 2021).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Splitnose rockfish (Sebastes diploproa)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

High Concern

There is no recent stock assessment for splitnose rockfish (*Sebastes diploproa*), nor has it been rated by the IUCN or COSEWIC. Coast-wide trawl surveys show a stable trend in the biomass index for splitnose rockfish in BC waters (Figure 50), but the trends do not cover three generations (age at maturity is 6–9 years off California, but somewhat later off BC (Gertseva et al. 2009)). In the absence of information on abundance of splitnose rockfish in BC waters, this factor was scored using the Seafood Watch PSA scoring tool (Table 14). Splitnose rockfish has a high vulnerability (V = 3.33) to fishing pressure, so it is scored a high concern for abundance.

Justification:

Table 14. Splitnose Rockfish PSA

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Avg Age @ maturity; Tm (years)	6	2	(Gertseva et al. 2009)
von Bertalanffy (K) Fish only	0.156	2	(Gertseva et al. 2009)
Avg Max Age; Tmax (years) Inverts only when you know Lmax for Finfish (Col. J)	NA	NA	
Fecundity (Eggs/year)	unknown	—	
Avg Max Size; Lmax (cm) (fish only)	46	1	(Gertseva et al. 2009)
Avg Size @ maturity; Lm (cm) (fish only)	27	1	(Gertseva et al. 2009)
Reproductive Strategy	Live bearer	3	(Gertseva et al. 2009)
Density Dependence (inverts only)	NA	NA	
Productivity Subscore		**1.80**	

Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Areal overlap	>30% of the species concentration is fished, considering all fisheries, OR Default score if unknown	3	
Vertical overlap	Default score for target species	3	
Seasonality	Fisheries overlap with species >6 months/year	3	(Fox et al. 2020) (IPHC Secretariat 2022)
Selectivity	Default score when conditions under "high risk" do not apply	2	
Post-capture Mortality	Default score for retained species	3	
Susceptibility Subscore		**2.80**	

Productivity-Susceptibility Score	3.33
Vulnerability Rating (high, medium or low)	High

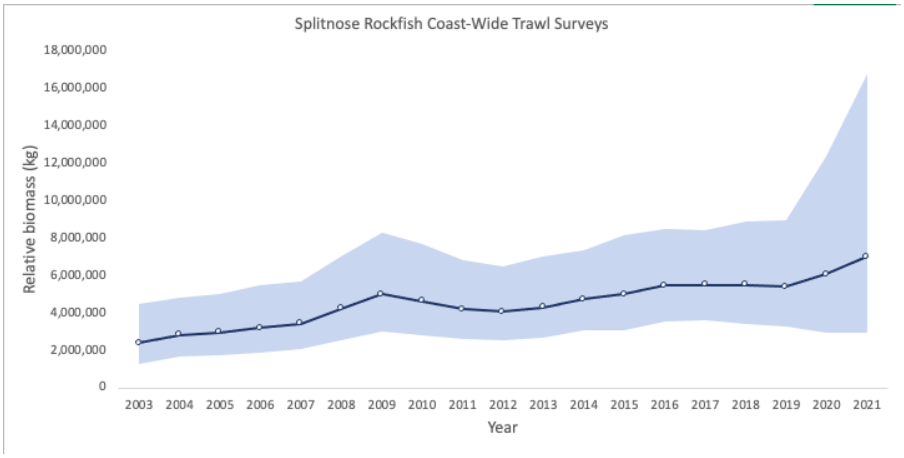

Figure 49: Splitnose rockfish relative biomass trends in BC waters from coast-wide trawl surveys. Dots represent mean estimates of relative biomass and the shaded area represents 95% confidence intervals. Data from (DFO 2022c).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Walleye pollock (Gadus chalcogrammus)

Factor 1.1 - Abundance

BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics

Moderate Concern

Walleye pollock in BC waters comprises two stocks (Figure 51): BC North (PMFC major areas 5C, 5D, 5E) and BC South (PMFC major areas 3C, 3D, 5A, 5B plus minor areas 12 and 20) (DFO 2018c), though it is suspected that the BC North stock is part of a larger Southeast Alaska stock (Starr and Haigh 2021b). The B_{MSY} proxy is based on the average spawning biomass from 1967 to 2016 (B_{avg}), and the LRP is the lowest spawning biomass from which it recovered to B_{avg}, or B_{min} (Starr and Haigh 2021b). The stock assessment also presents USR values, where USR = $2B_{min}$, but this value may not be sufficiently precautionary and an additional USR of 0.8 B_{avg} is advised (Starr and Haigh 2021b). The median spawning biomass estimate for the BC North stock in 2017 was 6,185 t, or 68% of the B_{MSY} proxy (B_{2017}/B_{avg} = 0.683) (Figure 52). We award a moderate concern score, because biomass is above the LRP but below 75% of the TRP for the BC North stock.

Justification:

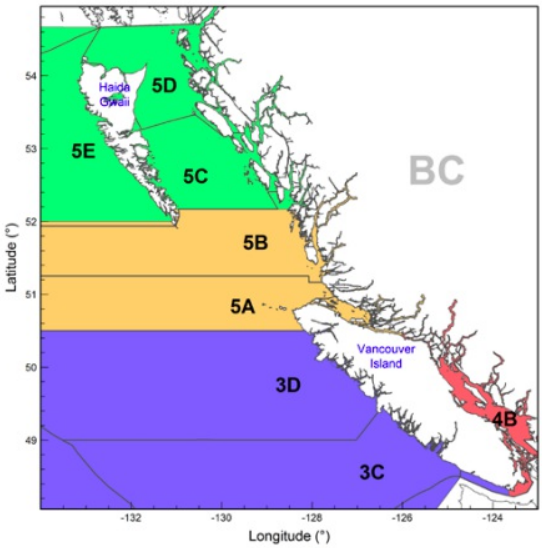

Figure 50: Walleye pollock assessment areas comprising Pacific Marine Fisheries Commission (PMFC) major and minor areas: green for 5CDE, orange for 5AB + minor area 12, blue for 3CD + minor area 20, and red for 4B less minor areas 12 and 20. The Groundfish Management Unit area boundaries, which differ from the PMFC areas, are superimposed for comparison. This assessment is for areas called “North” (5CDE, green) and “South” (5AB3CD, orange + blue). Figure from (DFO 2018c).

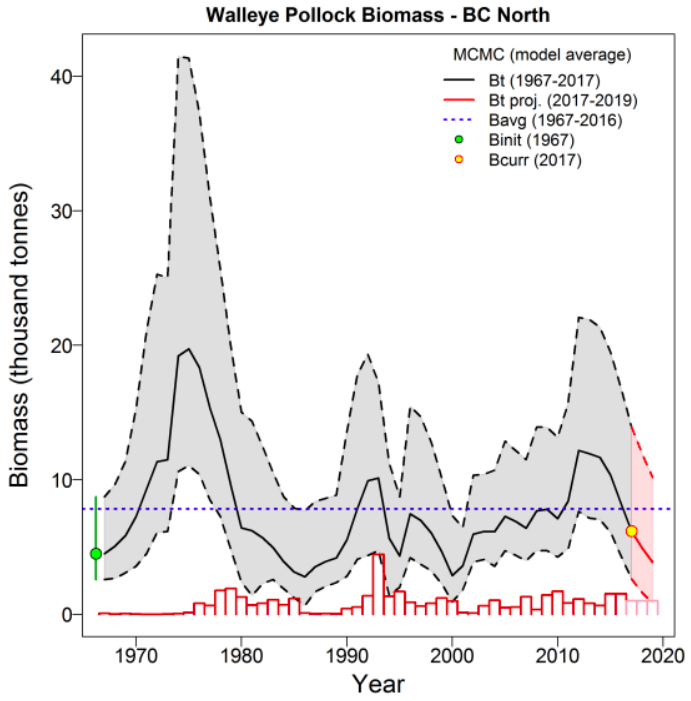

Figure 51: Walleye pollock BC North. Median estimates (solid black line) and 90% credibility intervals (black dashed lines, grey fill) for the model-average B_t (biomass in year t in tonnes) for walleye pollock. Also shown are the initial biomass B_{1967} (green circle), current biomass B_{2017} (yellow circle), two-year projections $B_{2018–19}$ (pink fill), the median of average biomass B_{avg} (blue dotted line), the historical catch (red bars), and the catch strategy (pink bars, 1000 t). Figure from (Starr and Haigh 2021b).

BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics

Low Concern

Walleye pollock BC South includes pollock in PMFC major areas 3C, 3D, 5A, and 5B plus minor areas 12 and 20 (DFO 2018c) (Starr and Haigh 2021b). The B_{MSY} proxy is based on the average spawning biomass from 1967 to 2016 (B_{avg}), and the LRP is the lowest spawning biomass from which it recovered to B_{avg}, or B_{min} (Starr and Haigh 2021b). The stock assessment also presents USR values, where USR = $2B_{min}$, but this value may not be sufficiently precautionary and an additional USR of 0.8 B_{avg} is advised (DFO 2018c)(Starr and Haigh 2021b). The median spawning biomass estimate for the BC South stock in 2017 was 28,923, or 90% of the B_{MSY} proxy (B_{2017}/B_{avg} = 0.899) (Figure 53). We award a low concern score, because biomass is above the LRP and at least 75% of the TRP.

Justification:

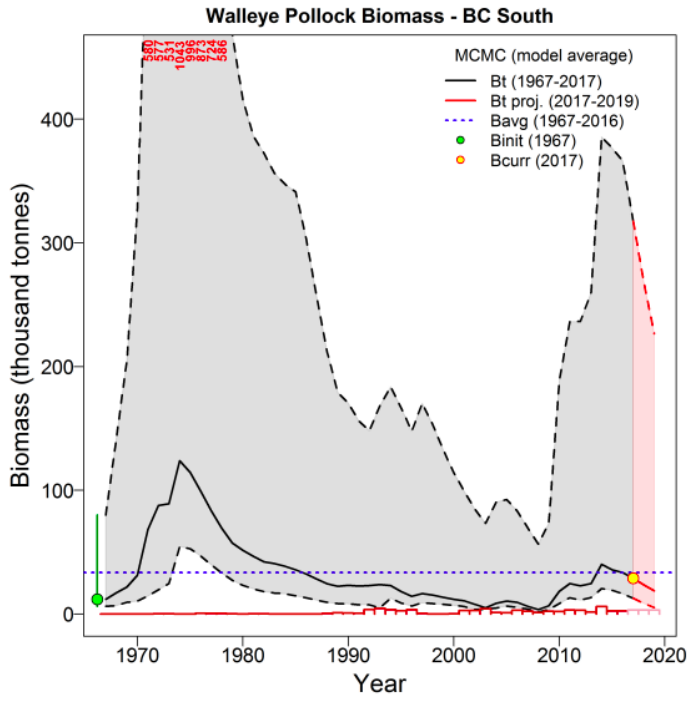

Figure 52: Walleye pollock BC South. Median estimates (solid black line) and 90% credibility intervals (black dashed lines, grey fill) for the model-average B_t (biomass in year t in tonnes) for walleye pollock. Also shown are the initial biomass B_{1967} (green circle), current biomass B_{2017} (yellow circle), two-year projections $B_{2018–19}$ (pink fill), the median of average biomass B_{avg} (blue dotted line), the historical catch (red bars), and the catch strategy (pink bars, 3,250 t). Figure from (Starr and Haigh 2021b).

Factor 1.2 - Fishing Mortality

BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics

High Concern

The majority of the catch of BC walleye pollock is by midwater trawls (≈92% of the catch), while bycatch in bottom trawls accounts for the remainder of the catch (DFO 2018c). The average catch from the BC North stock from 2011 to 2015 was 992 t, or 23% of the *total* catch of BC walleye pollock (DFO 2018c). Fishing levels are assessed against an MSY proxy: the Average Removal Rate from 1967 to 2016 (BC North Stock u_{avg} = 0.150). The median estimate exploitation rate on the BC North stock in 2016 was greater than the MSY proxy (u_{2016}/u_{avg} = 1.79) (Figure 54), and there was a 74% probability that $u_{2016} > u_{avg}$ (Starr and Haigh 2021b). Therefore, this factor is scored a high concern.

Justification:

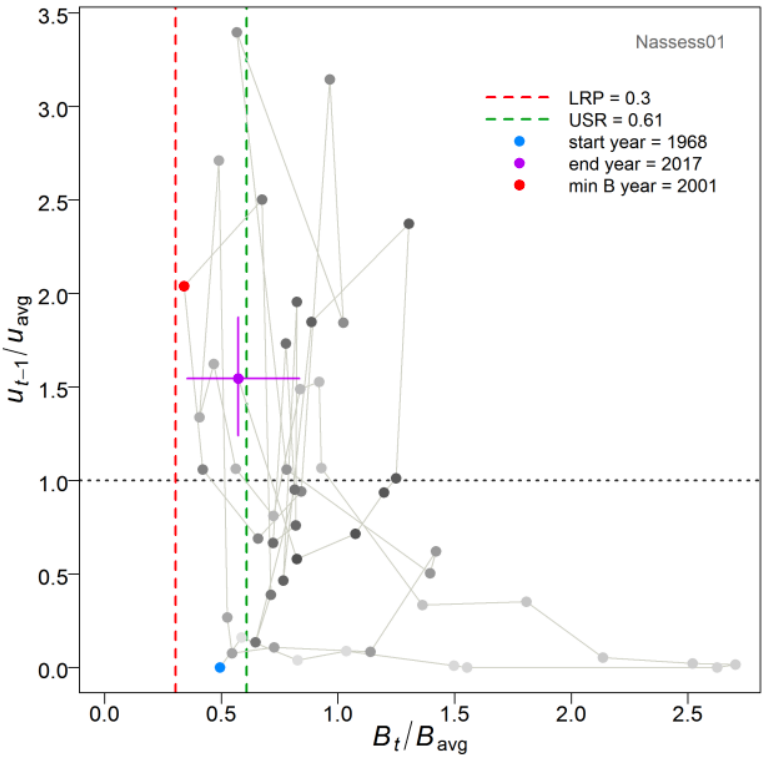

Figure 53: Walleye pollock BC North: Phase plot through time for the example model run of the medians of the ratios B_t/B_{avg} (the biomass in year t relative to B_{avg}) and u_{t-1}/u_{avg} (the exploitation rate in year t–1 relative to u_{avg}). The blue filled circle is the starting year 1967. Years then proceed from light grey through to dark grey, with the final year 2017 as a filled purple circle with limit lines representing the 0.05 and 0.95 quantiles of the posterior distributions for the final year. Vertical dashed lines indicate the historical limit (red) and upper stock reference (green) points (see legend for values), and the horizontal dotted line indicates u_{t-1} at u_{avg}. Figure from (Starr and Haigh 2021b).

BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics

Low Concern

The majority of the catch of BC walleye pollock is by midwater trawls (≈92% of the catch), while bycatch in bottom trawls accounts for the remainder of the catch (DFO 2018c). The average catch from the BC South stock from 2011 to 2015 was 3,256 t, or 77% of the *total* catch of BC walleye pollock (DFO 2018c). Fishing levels are assessed against an MSY proxy: the Average Removal Rate from 1967 to 2016 (BC South Stock u_{avg} = 0.119). The median estimate exploitation rate on the BC South stock in 2016 was less than the MSY proxy (u_{2016}/u_{avg} = 0.70). Therefore, this factor is scored a low concern.

Widow rockfish (Sebastes entomelas)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Very Low Concern

Widow rockfish was assessed in BC waters in 2019 as a single stock. The assessment used a catch-at-age model informed by

fishery-dependent data (standardised CPUE series, age composition data from commercial catch, annual catch estimates) and fishery-independent data (five different trawl survey series) (DFO 2019). Advice to managers is based on an LRP of 0.4 B_{MSY} and a TRP of 0.8 B_{MSY} consistent with DFO's Precautionary Approach. But, given that an MSY-based approach may not be appropriate for such a long-lived species, alternative reference points are provided relative to unfished biomass, B_0 (DFO 2019). Widow rockfish is above the TRP and LRP under DFO's Precautionary Approach (Figure 55); the stock is also above B_{MSY} (B_{2019}/B_{MSY} = 1.51). Therefore, this factor is scored a very low concern.

Justification:

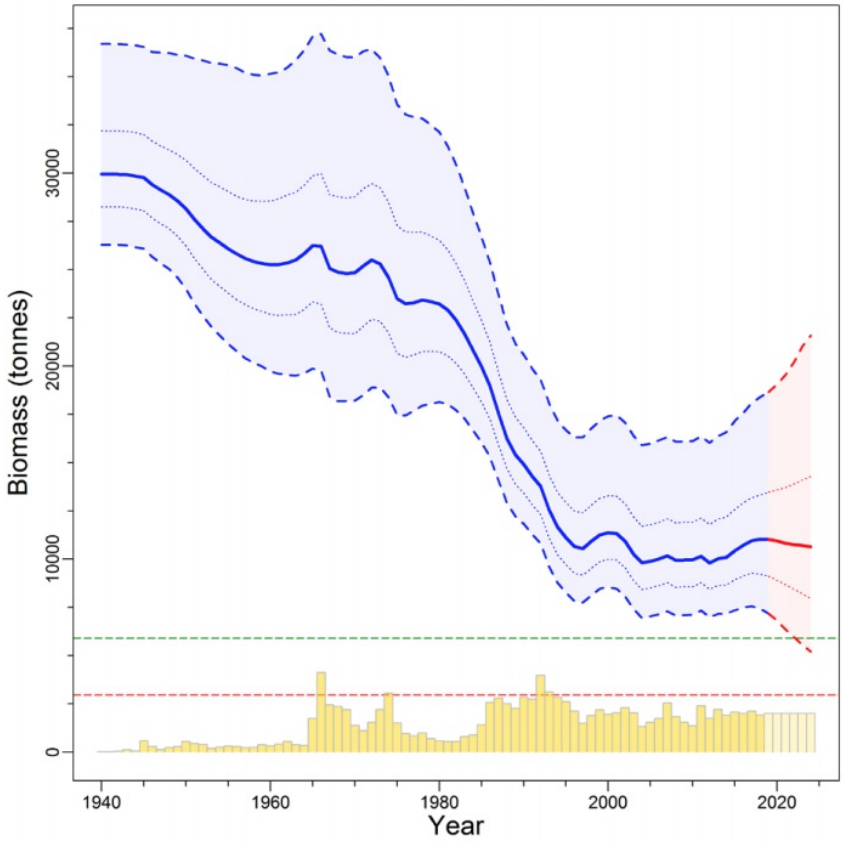

Figure 54: Estimates of widow rockfish spawning biomass B_t (tonnes). The median biomass trajectory appears as a solid curve surrounded with shaded 25% and 95% confidence intervals. The projected biomass appears in light red for years t = 2020–2024. Also delimited is the 50% confidence intervals (25%, 75%). The horizontal dashed lines show the median limit reference point (LRP) and Upper Stock Reference (USR). Catch and assumed catch policy (2000 t/y) are represented as bars along the bottom axis. Figure from (DFO 2019).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Low Concern

The Trawl sector is allocated 98% of the widow rockfish TAC (DFO 2019). The coast-wide 2020 catch of widow rockfish was 1,987 t, which is 78% of the available coast-wide quota; no area-specific quotas were exceeded (Cornthwaite & Workman 2021). The mean annual coastwide catch from 2014 to 2018 was approximately 2,001 t (DFO 2019). The median exploitation rate in 2018 was below the exploitation rate at MSY, where u_{2018}/u_{MSY} = 0.658 (5th–95th percentiles = 0.289–1.350) (Figure 56), and there is an 82% probability that current exploitation is below that associated with MSY (DFO 2019). Therefore, this factor is scored a low concern.

Justification:

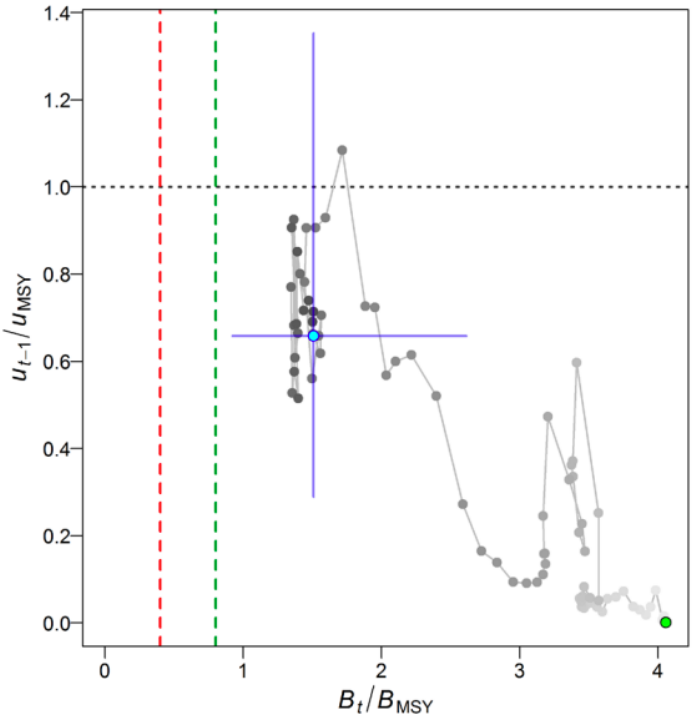

Figure 55: Composite base case: phase plot through time of the medians of the ratios B_t/B_{MSY} (the spawning biomass in year t relative to B_{MSY}) and u_{t-1}/u_{MSY} (the exploitation rate in year t – 1 relative to u_{MSY}). The filled green circle is the starting year (1941). Years then proceed from light grey through to dark grey, with the final year (2019) as a filled cyan circle, and the blue lines represent the 0.05 and 0.95 quantiles of the posterior distributions for the final year. Red and green vertical dashed lines indicate the Precautionary Approach provisional limit and USR points (0.4, 0.8 B_{MSY}), and the horizontal grey dotted line indicates u at MSY. Figure from (DFO 2019).

Yelloweye rockfish (Sebastes ruberrimus)

Factor 1.1 - Abundance

Inside (Area 4B) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

Moderate Concern

Inside yelloweye rockfish has recently been designated by COSEWIC as Threatened, because the population has declined significantly over the last 100 years and recent analyses suggest that the conservation risk is greater than previously assessed (COSEWIC 2020b). But, Inside yelloweye rockfish was not assessed as Endangered because the survey data suggest stable abundance over the last 20 years, and long-term projections are stable (COSEWIC 2020b).

A previous assessment of the Inside yelloweye rockfish population estimated a 90% probability that B_{2009} was less than the LRP, which triggered a rebuilding plan. An updated, data-limited, peer-reviewed assessment in 2020 provided scientific advice through a new MSE framework (DFO 2021a)(Haggarty et al. 2022). The MSE presented five MPs that met the basic performance criteria from the rebuilding plan (i.e., rebuild the stock above the LRP over 1.5 generations with at least a 95% probability of success) (DFO 2021a)(Haggarty et al. 2022). None of the reference OMs from the new assessment estimated $B_{2019} < 0.4\ B_{MSY}$ (Figure 57), and the difference in the 2019 status and the 2009 status was attributed to model structure choices; these models are age-

structured (Haggarty et al. 2022). One of the two robustness OMs, OMScenario (A), used a low mortality/low productivity scenario based on estimates of natural mortality from yelloweye rockfish in Alaska; this is the only OM that estimated B_{2019} < LRP (Haggarty et al. 2022). But, age-structured models are considered more realistic for long-lived species (Cox et al. 2020)(DFO 2020e).

A new biomass TRP needs to be determined because the most recent assessment estimates that the rebuilding objective—to rebuild the stock above the LRP over 56 years (1.5 generations) with at least 95% probability of success—has already been met (DFO 2020e). Biomass relative to more appropriate LRPs, such as 0.5 B_{MSY} or 0.2 B_0, are not available, and the stock status is not explicitly reported in the MP framework (DFO 2020e)(Haggarty et al. 2022). Nonetheless, the age-structured model indicates that the stock is above DFO's LRP of 0.4 B_{MSY} and is likely in the cautious zone. Because Inside yelloweye rockfish is above the LRP but below 75% of the TRP, a moderate concern score is awarded.

Justification:

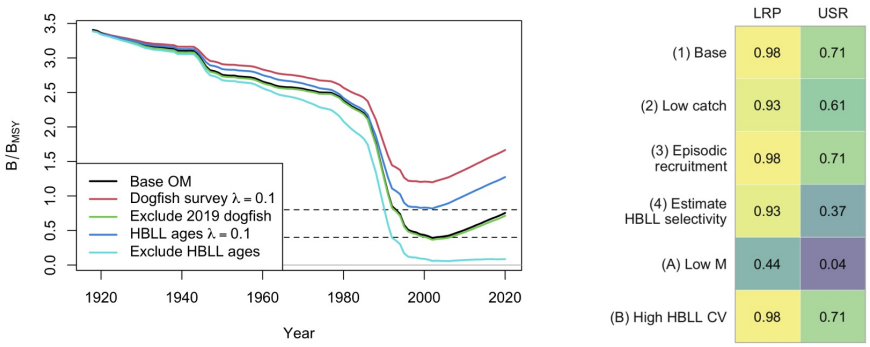

Figure 56: Relative spawning biomass (B/B_{MSY}) from alternative fits to the SRA that downweighted or eliminated data from the likelihood (left). Mean values of natural mortality and steepness were used. Dotted horizontal lines represent the USR (0.8 B_{MSY}) and LRP (0.4 B_{MSY}). The Base and Exclude 2019 dogfish scenarios overlap and the corresponding lines are jittered in the figure for clarity. Probability that the 2019 spawning biomass is above the LRP and USR for the six operating models (right). Figures from (Haggarty et al. 2022).

Management Strategy Evaluation

The final six OMs presented in the 2020 assessment are divided into a "reference set" and a "robustness set" (DFO 2020e) (Haggarty et al. 2022). The former is a core set of OMs that include the most important uncertainties, such as the range of natural mortality values and depletion of the stock, while the latter set includes a wider range of uncertainties that may be less plausible (DFO 2020e)(Haggarty et al. 2022). The reference sets include: "(1) a baseline OM; (2) an OM reflecting an alternative assumption about the magnitude of historical catch during the period 1986–2005; (3) an OM allowing for episodic (rare but large) future recruitment events; and (4) an OM estimating selectivity in the Inside Hard Bottom Longline Survey (HBLL)" (DFO 2020e)(Haggarty et al. 2022). The robustness sets include: "(A) an OM that assumes lower natural mortality than the other OMs; and (B) an OM that assumes a higher coefficient of variation (CV) in the future HBLL survey" (ibid).

Five of the six OMs suggest that it is likely (>75% chance) that Inside yelloweye rockfish is above the LRP, and four of the six OMs estimate that it is probable (>50% chance) that B_{2019} is greater than the USR; only one OM results in a probability of <50% that B_{2019} is greater than the LRP (DFO 2020e).

Outside (remaining areas) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

Very Low Concern

Outside yelloweye rockfish (OYE) was recently designated by COSEWIC as Threatened, which requires DFO to complete a Recovery Potential Analysis (Cornthwaite & Workman 2021). DFO established a rebuilding plan for this stock and published a stock assessment in 2020 that was built on previous work from the 2015 assessment (DFO 2021a). The stock assessment separates OYE into North (5BCDE) and South (3CD5A) units that are assumed to be closed populations (Cox et al. 2020). The

OYE Technical Committee derived 24 operating models (OMs), 4 of which were selected that "represent the broad set of characteristics show across the 24 OMs" (Cox et al. 2020). Biomass estimates from the four models exhibit a wide range (2,600–8,200 t in the North, and 1,900–4,400 t in the South) but none suggest that the OYE stock is either <0.2 B_0 or <0.40 B_{MSY} (Figure 58), despite biomass declines over the last two generations of 49–71% and 57–79% in the South and the North, respectively (Cox et al. 2020). The reference model estimated that, for both OYE North and South stocks, $B_{2018} > B_{MSY}$ and between 0.30–0.31B_0 (Cox et al. 2020)(DFO 2023h). Cox et al. (2020) estimated that OYE is above the B_0-based LRP ($B_{2018} > 0.2\ B_0$) and at least 75% of the B_0-based TRP ($B_{2018}/B_0 > 0.75*[0.4\ B_0]$).

Although OYE is designated Threatened by COSEWIC, there is evidence that the population has been stable for 20 years, and fishing rates are considered sustainable (COSEWIC 2020). The assessment update suggests that, although spawning biomass declined by 49–79% over the last three decades, the stock is currently above B_{MSY}. Therefore, a very low concern score is awarded.

Justification:
Outside yelloweye rockfish was assessed with a two-sex catch-at-age model using fishery-independent and fishery-dependent data sources. Both stocks are estimated to be above DFO provisional reference points. The model used in the most recent assessment employed an age-structured approach, which is different from the previously used coast-wide surplus production model (Cox et al. 2020).

Table 15. Outside yelloweye rockfish B_{MSY}-based and B_0-based reference points (Cox et al. 2020)(DFO 2023h).

OYE North Reference Model	Median Biomass in t (95% CI)	B_{2018}/Reference Point
B_0	14,200 (13,100–15,400)	0.31
B_{2018}	4,500	—
B_{MSY}	3,600	1.23
OYE South Reference Model		
B_0	10,800 (10,000–11,700)	0.30
B_{2018}	3,300	—
B_{MSY}	2,800	1.18
OYE Coastwide		
B_0	25,000 (23,100–27,100)	0.31
B_{2018}	7,800	—
B_{MSY}	6,400	1.22

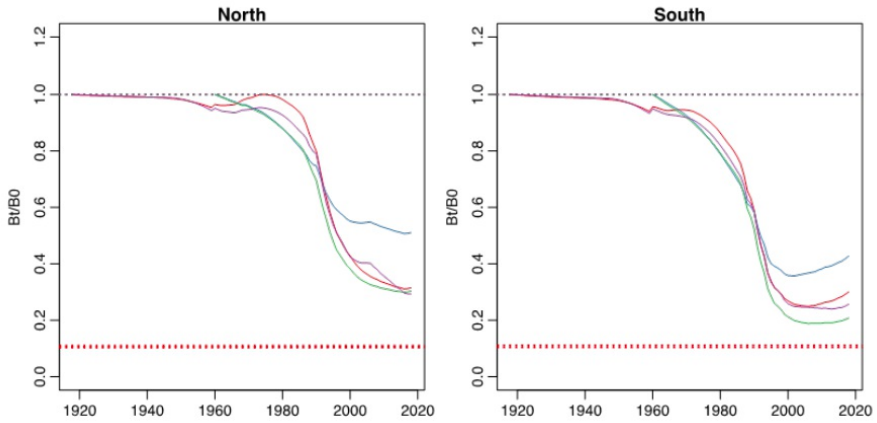

Figure 57: Relative depletion for operating models using i) a 1918 start year and reconstructed commercial catch (OM Base), ii) a 1960 start date and lower bound on commercial catch (OM 2), iii) a 1960 start year and reconstructed commercial catch (OM 3), and iv) a 1918 start year and lower bound on commercial catch (OM4). The red dotted lines indicate the LRP for each OM, which range from 0.10 B_0 to 0.11 B_0. Figure from (Cox et al. 2020).

Factor 1.2 - Fishing Mortality

Inside (Area 4B) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

Low Concern

Only 4,379 lbs (~2 t) of inside yelloweye rockfish was landed in Line fisheries in 2020 (ibid). Annual commercial catch of inside yelloweye rockfish peaked at around 170 t in 1988-1990 and decreased to 10 t or less since 2006 (Keppel & Olsen 2019). DFO established management measures in 2012 intended to restrict total mortality to 15 t, an amount expected to promote stock rebuilding (DFO 2021a). The peer-reviewed evaluation of the rebuilding plan in 2020 advised keeping the TAC cap at 15 t for the 2021 season (ibid). The total estimated commercial catch of inside rockfish in 2020 (~2 t) was well less than the TAC and current TAC levels are expected to allow the stock to rebuild {DFO 2020e). The current level of fishing mortality is projected to allow the stock's biomass to rebuild, with probabilities of attaining certain reference points that are similar to zero-harvest options (see Figure 7 in (DFO 2020e). Therefore, the fishing mortality of inside rockfish is scored "low" concern.

Outside (remaining areas) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

Low Concern

The total commercial catch of all yelloweye rockfish in 2020 was 79 t, or 68.1% of the available TAC (Cornthwaite & Workman 2021). The Line fisheries account for most of the yelloweye rockfish landings; the reported combined Line sector landings of OYE in 2020 were 156,418 lbs (≈71 t) (DFO 2021b). The base OMs from the recent assessment provide the following estimates of F_{MSY} and MSY, respectively: OYE North = 0.053/yr and 210 t; OYE South = 0.052/yr and 160 t (Cox et al. 2020). The use of these default reference points under DFO's precautionary approach will lead to stock declines in the future—which is expected because the OMs estimate B_{2018}>B_{MSY} (Cox et al. 2020). Therefore, the assessment also presents RPs and MPs from a model tuned with fishing mortality rates that do not lead to stock declines and maintain stock levels near B_{2018} until more specific target levels are determined by OYE managers and stakeholders (Cox et al. 2020). Under the tuned model, F and MSY levels that are predicted to maintain stock levels at or near B_{2018} are as follows: OYE F_{North} = 0.035 and MSY = 151 t; OYE F_{South} = 0.036 and MSY = 113 t (Cox et al. 2020). DFO recently implemented an HCR to establish annual TACs through 2026/27 with the objective of maintaining the stock at B_{MSY} (rather than the default 0.8 B_{MSY}) (DFO 2024).

The total estimated commercial catch of OYE rockfish in 2020 (79 t) was less than the TACs under the tuned model (151 t + 113 t), and biomass is not expected to decline below interim target levels (i.e., B_{2018}), so a low concern score is awarded.

Justification:

ONE was assessed as below the LRP in 2014, which triggered a rebuilding plan with two primary objectives:

1. "Grow the spawning stock biomass (SSB) out of the critical zone (i.e., above the LRP of 0.4 B_{MSY}, where B_{MSY} is the operating model biomass at MSY), with a very low (5%) probability of further decline, measured over 1.5 to 2.0 generations" (Cox et al. 2020).
2. "When the SSB is between 0.4 B_{MSY} and 0.8 B_{MSY}, limit the probability of decline over the next 10 years from very low (5%) at the LRP to moderate (50%) at B_{MSY}. At intermediate stock status levels, define the tolerance for decline by linearly interpolating between these probabilities" (Cox et al. 2020).

The 2020 assessment by Cox et al. (2020) used a hierarchical age-structured approach, which provided a different status of OYE compared to the 2018 assessment that used a coast-wide surplus production model (Yamanaka et al. 2018). Specifically, Yamanaka et al. (2018) assessed OYE as below an LRP, while Cox et al. (2020) found that OYE in both North and South areas are currently above B_{MSY} (i.e., above a TRP). Although several MPs were identified in the recent analysis of OYE, no specific MP could be recommended to managers because the original objectives of the rebuilding plan do not apply to current conditions (because the stock is above the LRP of 0.4 B_{MSY}). As a result, Cox et al. (2020) provide an interim target stock level (B_{2018}) and a range of MPs that achieve objective 2 above until further guidance is provided from fishery managers. The 2023 MP update provided additional guidance (DFO 2023h), which was used to update TACs for the next three fishing seasons (DFO 2024).

Yellowmouth rockfish (Sebastes reedi)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl

Very Low Concern

Yellowmouth rockfish biomass sharply increased during the 1990s as a result of strong recruitment, steadily declined into the early 2000s (Edwards et al. 2012), but increased in recent years (DFO 2022a). Yellowmouth rockfish stock was considered to be in DFO's "healthy zone" in the previous assessment (Edwards et al. 2012) and the latest assessment (DFO 2022a). The updated assessment suggests that the stock is above the target reference point (B_{2022}/B_{MSY} = 2.39) and 69% of the equilibrium unfished female spawning biomass (B_0) (Figure 59). Although there is some uncertainty in the absolute stock size, the stock assessment indicates that abundance of yellowmouth rockfish is above target levels. Therefore, this factor is scored a very low concern.

Justification:

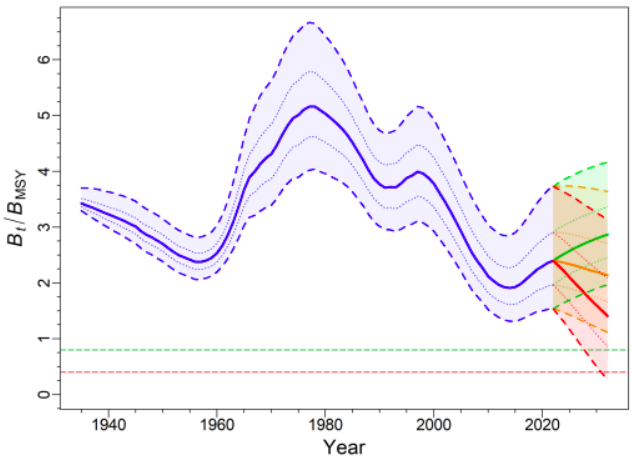

Figure 58: Yellowmouth rockfish estimates of spawning biomass B_t relative to B_{MSY} from the model posteriors (10,000 samples) of the YMR composite base case. The median biomass trajectory appears as a solid curve surrounded by a 90% credibility envelope (quantiles: 0.05, 0.95) in blue and delimited by dashed lines for years t = 1935– 2022; projected biomass using constant catch appears in green (no catch), orange (1250 t/y), and red (2500 t/y) for years t = 2023–2032 (10 years). Also shown is the 50% credibility interval (quantiles: 0.25–0.75) delimited by dotted lines. Figure from (DFO 2022a).

Yellowmouth rockfish was assessed by COSEWIC as Endangered in 2010 (COSEWIC 2010). While the Seafood Watch criteria require a stock status score of high concern for a species that has been assessed as Threatened by a national scientific body such as COSEWIC, it should be recognized that a new stock assessment, conducted since the COSEWIC designation, indicates that yellowmouth rockfish biomass is above the USRP, though there is considerable uncertainty in the absolute stock size (DFO 2022a). The 2022 assessment provided different sensitivity runs to explore uncertainties such as natural mortality (M), productivity assumptions, adjusting abundance indices, and ageing data; and, under all model scenarios, the stock is estimated to lie within the "healthy zone" (DFO 2022a).

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl

Low Concern

The Trawl sector is allocated 96.77% of the yellowmouth rockfish TAC (DFO 2021a). The 2019 Trawl sector catch (1,488 t) was approximately 51% of the available TAC (DFO 2020a). Annual catches of yellowmouth rockfish in recent years have been less than the estimated MSY, and there is a quite high probability that the stock will remain above the USR (0.8 B_{MSY}) over the next decade at current catch levels (DFO 2022a). The exploitation rate from the commercial fishery is less than that at MSY (u_{2021}/u_{MSY} = 0.51; 5–95% credible interval = 0.20–1.00), and fishing mortality is sustainable, so this factor is scored a low concern.

Justification:

The yellowmouth rockfish stock and recovery assessment presents a variety of information regarding exploitation rates and MSY. Estimates of historical exploitation rates indicate that exploitation rates exceeded the MSY level for only one year (1966), declined from the middle 1980s (when rates approached 0.10) through the middle 1990s, and since then have varied between approximately 0.02 and 0.05 (Edwards et al. 2012). The 2022 assessment's estimated median MSYs were 1,039 t (5–95% credible interval = 695.7–1,919 t) (DFO 2022a). The average total commercial trawl catch during 2016–20 was 1,272 t, and projection tables show that there is 99% probability that an annual catch of 1,250 t will result in $B_{2032} > 0.8\ B_{MSY}$ (DFO 2022a).

Yellowtail rockfish (Sebastes flavidus)

Factor 1.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Moderate Concern

The 2015 yellowtail rockfish assessment yielded a median estimate for B_{2015} (18,390 t) that was 49.5% of B_0 (5–95 percentiles = 29.8–75.5%) and approximately 228% of the median estimate for B_{MSY} (8,293 t) (Table 1 in (DFO 2015a)). The most recent full stock assessment of yellowtail rockfish used data through 2014. Because the data used to determine stock status are now ≥10 years old, Seafood Watch considers the current status as uncertain. The generation length of this species is ≈12 years (G = 4 + 1/0.12; age and mortality data from yellowtail rockfish females from the north stock in U.S. waters (Stephens and Taylor 2018)). A fishery-independent survey with an abundance index does not cover three generations, but the previous stock assessment indicated that abundance was well above target levels (DFO 2015a) and the abundance index shows a stable-increasing trend since the stock assessment (see Figure 3 in (Anderson and English 2022)). Although this species is likely vulnerable, the abundance score is moderated by the available data-limited indicator, resulting in a moderate concern score.

Factor 1.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Moderate Concern

According to the stock assessment, fishing mortality is expected to cause yellowtail rockfish abundance to “decline modestly” from 2015 to 2025 if the average annual catch is similar to the average in the years leading up to the 2015 stock assessment (DFO 2015a). The average annual catch in the Trawl sector from 2009 to 2015 was 4,377 t, compared to 3,905 t from 2016 to 2022 (DFO 2023g)(DFO Pacific Region 2021). But the most recent stock assessment is based on data that are ≥10 years old, and fishing mortality relative to F_{MSY} is unknown, so this factor is scored a moderate concern.

Criterion 2: Impacts on Other Species

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

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

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

Guiding principles

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

Criterion 2 Summary

Criterion 2 score(s) overview

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

ARROWTOOTH FLOUNDER			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)

BIG SKATE			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)

BLACKSPOTTED ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.000: < 100%	Red (1.526)
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.000: < 100%	Red (1.526)

BOCACCIO ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.732	1.000: < 100%	Red (1.732)

CANARY ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.732	1.000: < 100%	Red (1.732)

COPPER ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.000: < 100%	Red (1.526)

DARKBLOTCHED ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)

DOVER SOLE			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)

ENGLISH SOLE			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	1.526	1.000: < 100%	Red (1.526)

FLATHEAD SOLE			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	1.000: < 100%	Yellow (2.644)

KELP GREENLING			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	1.732	1.000: < 100%	Red (1.732)

LINGCOD			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	2.644	1.000: < 100%	Yellow (2.644)
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	2.644	1.000: < 100%	Yellow (2.644)
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	1.526	1.000: < 100%	Red (1.526)
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Outside Stock | Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery	5.000	1.000: < 100%	Green (5.000)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)
Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	1.732	1.000: < 100%	Red (1.732)
Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.000: < 100%	Red (1.526)

LONGNOSE SKATE			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)

NORTH PACIFIC SPINY DOGFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)

PACIFIC COD			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)

PACIFIC HALIBUT			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.000: < 100%	Red (1.526)

PACIFIC OCEAN PERCH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.526	1.000: < 100%	Red (1.526)
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
5DE Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.000: < 100%	Red (1.732)
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.526	1.000: < 100%	Red (1.526)
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
5ABC Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	1.000: < 100%	Yellow (2.644)
5DE Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	1.000: < 100%	Yellow (2.644)
3CD Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.732	1.000: < 100%	Red (1.732)

PETRALE SOLE			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)

QUILLBACK ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.000: < 100%	Red (1.526)
Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	1.732	1.000: < 100%	Red (1.732)

REDBANDED ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.000: < 100%	Red (1.526)

REDSTRIPE ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.732	1.000: < 100%	Red (1.732)

REX SOLE			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)

ROUGHEYE ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	3.318	1.000: < 100%	Green (3.318)
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.732	1.000: < 100%	Red (1.732)
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.000: < 100%	Red (1.526)
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.000: < 100%	Red (1.526)

SABLEFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery	5.000	1.000: < 100%	Green (5.000)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	1.526	1.000: < 100%	Red (1.526)

SHARPCHIN ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)

SHORTRAKER ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)

SHORTSPINE THORNYHEAD			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)

SILVERGRAY ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.732	1.000: < 100%	Red (1.732)

SOUTHERN ROCK SOLE			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)

SPLITNOSE ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)

WALLEYE POLLOCK			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.000: < 100%	Red (1.732)
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.732	1.000: < 100%	Red (1.732)
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	1.732	1.000: < 100%	Red (1.732)

WIDOW ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.732	1.000: < 100%	Red (1.732)

YELLOWEYE ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Outside (remaining areas) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	1.526	1.000: < 100%	Red (1.526)
Inside (Area 4B) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	1.732	1.000: < 100%	Red (1.732)

YELLOWMOUTH ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	1.000: < 100%	Yellow (2.644)

YELLOWTAIL ROCKFISH			
REGION / METHOD	SUB SCORE	DISCARD RATE/LANDINGS	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	1.732	1.000: < 100%	Red (1.732)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	1.526	1.000: < 100%	Red (1.526)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	2.644	1.000: < 100%	Yellow (2.644)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	1.732	1.000: < 100%	Red (1.732)

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.

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | BOTTOM TRAWLS | BC CENTRAL (5ABC) | BC SOUTH (3CD) | DEEPWATER FLATFISH			
SUB SCORE: 1.526	DISCARD RATE: 1.000	SCORE: 1.526	
SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Rougheye rockfish	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Pacific Ocean perch	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shortspine thornyhead	3.670: Low Concern	1.000: High Concern	Red (1.916)
Longnose skate	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Petrale sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Rex sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Dover sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific halibut	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific Ocean perch	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Arrowtooth flounder	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Sablefish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | BOTTOM TRAWLS | BC CENTRAL (5ABC) | PELAGICS

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

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lingcod	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Big skate	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Petrale sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Silvergray rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowtail rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific halibut	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Southern rock sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific cod	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Arrowtooth flounder	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Bocaccio rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | BOTTOM TRAWLS | BC NORTH (5DE) | BC CENTRAL (5ABC) | SHALLOW WATER FLATFISH

SUB SCORE: 1.526 | DISCARD RATE: 1.000 | **SCORE: 1.526**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Walleye pollock	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Corals and other biogenic habitats	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lingcod	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Yellowtail rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Big skate	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Spotted ratfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Longnose skate	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Petrale sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Rex sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Dover sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
English sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific halibut	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Southern rock sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific cod	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Pacific Ocean perch	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Bocaccio rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Arrowtooth flounder	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | BOTTOM TRAWLS | BC NORTH (5DE) | DEEPWATER FLATFISH

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

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Rougheye rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Dover sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Arrowtooth flounder	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Sablefish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | BOTTOM TRAWLS | BC NORTH (5DE) | PELAGICS

SUB SCORE: 1.526 DISCARD RATE: 1.000 **SCORE: 1.526**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Walleye pollock	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Lingcod	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Big skate	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Spotted ratfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
English sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific halibut	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific cod	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Arrowtooth flounder	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | BOTTOM TRAWLS | BC SOUTH (3CD) | PELAGICS

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

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lingcod	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific Ocean perch	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Longnose skate	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Petrale sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowtail rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Dover sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
English sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific cod	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Walleye pollock	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Bocaccio rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Canary rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Sablefish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | BOTTOM TRAWLS | BC SOUTH (3CD) | SHALLOW WATER FLATFISH

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

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lingcod	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Flathead sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Longnose skate	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Petrale sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Rex sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Dover sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
English sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific cod	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Walleye pollock	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Arrowtooth flounder	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | BOTTOM TRAWLS | ROCKFISH TRAWL

SUB SCORE: 1.526 | DISCARD RATE: 1.000 | SCORE: 1.526

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Blackspotted rockfish	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Rougheye rockfish	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Pacific Ocean perch	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Splitnose rockfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Corals and other biogenic habitats	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Darkblotched rockfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Sharpchin rockfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lingcod	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Redbanded rockfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shortspine thornyhead	3.670: Low Concern	1.000: High Concern	Red (1.916)
Silvergray rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Rougheye rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Rex sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Petrale sole	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowtail rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific Ocean perch	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
North Pacific spiny dogfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

Longnose skate	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Blackspotted rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Dover sole	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Pacific cod	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Pacific Ocean perch	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Redstripe rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Sablefish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Canary rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Bocaccio rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Widow rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Yellowmouth rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Arrowtooth flounder	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | JIG | TROLLING LINES | LINGCOD FISHERY

SUB SCORE: 5.000 DISCARD RATE: 1.000 **SCORE: 5.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Lingcod	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | MIDWATER TRAWLS | BC NORTH (5DE) | BC CENTRAL (5ABC) | ROCKFISH TRAWL

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

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Pacific Ocean perch	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Silvergray rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowtail rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific Ocean perch	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Bocaccio rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Canary rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Redstripe rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Widow rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Yellowmouth rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | MIDWATER TRAWLS | BC SOUTH (3CD) | ROCKFISH TRAWL

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

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Chinook salmon	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific Ocean perch	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shortspine thornyhead	3.670: Low Concern	1.000: High Concern	Red (1.916)
Silvergray rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowtail rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Bocaccio rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Canary rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Redstripe rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Widow rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | POTS | SABLEFISH POT FISHERY

SUB SCORE: 5.000 | DISCARD RATE: 1.000 | **SCORE: 5.000**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Sablefish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | SET LONGLINES | JIG | TROLLING LINES | INSIDE ROCKFISH FISHERY

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

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Copper rockfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lingcod	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Kelp greenling	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Quillback rockfish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Yelloweye rockfish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | SET LONGLINES | JIG | TROLLING LINES | OUTSIDE ROCKFISH FISHERY

SUB SCORE: 1.526 DISCARD RATE: 1.000 **SCORE: 1.526**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Blackspotted rockfish	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Rougheye rockfish	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Copper rockfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lingcod	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Redbanded rockfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Blackspotted rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Rougheye rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific halibut	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Quillback rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Sablefish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

NORTHEAST PACIFIC | CANADA | BRITISH COLUMBIA | SET LONGLINES | SABLEFISH LONGLINE FISHERY

SUB SCORE: 1.526 DISCARD RATE: 1.000 **SCORE: 1.526**

SPECIES	ABUNDANCE	FISHING MORTALITY	SCORE
Blackspotted rockfish	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Rougheye rockfish	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Lingcod	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Redbanded rockfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shortraker rockfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shortspine thornyhead	3.670: Low Concern	1.000: High Concern	Red (1.916)
Blackspotted rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Longnose skate	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Rougheye rockfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific halibut	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Sablefish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Yelloweye rockfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

Because of the multispecies nature of the integrated groundfish fishery, there are few fish species that exclusively qualify as bycatch in the traditional sense. Grenadier and ratfish are caught during normal fishing operations, but are of no market value. As was the case for Criterion 1, information availability—especially in the form of up-to-date stock assessments—is the primary determinant of many of the Criterion 2 ratings. Table 16 provides a list of species included in the fisheries in this report that are assessed in Criterion 2 only. Pacific halibut is included as a Criterion 2 species in the Bottom Trawl fisheries because halibut is not permitted for retention by trawl gear (DFO 2023). Sablefish caught in the 5DE Deepwater Flatfish fishery is mostly discarded.

There has been a lack of species-level identification and/or underreporting of albatross bycatch incidents in BC commercial longline

fisheries in recent years (Fox et al. 2020), but the black-footed albatross (*Phoebastria nigripes*) was previously reported as the most frequently encountered seabird species in BC longline fisheries (Smith and Morgan 2005). There is no reported bycatch of short-tailed albatross (*P. albatrus*) in BC, but the species overlaps with BC groundfish longline fisheries, bycatch data are uncertain, and this species has been reported as bycatch in similar fisheries (Fox et al. 2020). According to Fox et al. (2020), "… there is elevated conservation concern and need for greater understanding of how many albatrosses are being caught and where, when, and in which specific commercial fisheries they are being caught to direct further mitigation efforts to reduce bycatch." But, we have not included seabirds as a main species group in BC groundfish longline fisheries because it is unlikely that these fisheries are significant contributors to mortality of black-footed and short-tailed albatross. Specifically, it is estimated that there are generally between 6,000 and 10,000 black-footed albatrosses caught as bycatch each year, but only between 25 and 129 albatrosses were estimated to be taken annually between 2006 and 2009 in BC demersal longline groundfish fisheries (BirdLife International 2020). Similarly, there have been no reports of incidental catch of short-tailed albatross in BC longline fisheries, but it has been suggested that one to two birds could be taken each year (COSEWIC 2013). Therefore, we have not included seabirds as a main species group.

Table 16. Main species caught in the fisheries assessed in this report NOT assessed in Criterion 1; see Seafood Watch Standard Version F4 for detailed explanation of main species criteria. "Catch" includes landings + discards and were obtained from DFO (DFO Pacific Region 2021). The percentage of a species' F is based only on commercial catch in groundfish fisheries, because *total* F is unavailable for many species.

Fishery	Main species not assessed in Criterion 1
Rockfish Bottom Trawl	Corals and other biogenic habitats[b,c]
Shallow Water Flatfish Bottom Trawl	Corals and other biogenic habitats[b,c] (5ABC–5DE only), Longnose skate[c] (5ABC–5DE only), Pacific halibut[a] (5ABC–5DE only), Spotted ratfish[c] (5DE only)
Deepwater Flatfish Bottom Trawl	Sablefish[a] (5DE only)
Pelagic Bottom Trawl	Longnose skate[c] (3CD only), Pacific halibut[a] (5DE and 5ABC only), Spotted ratfish[c]
Rockfish Midwater Trawl	Chinook salmon[b] (3CD only)
Lingcod	None
Inside Rockfish	None
Outside Rockfish	None
Sablefish (Longline)	None
Sablefish (Trap)	None

[a] 5% of the fishery's catch
[b] Species/taxa of concern
[c] Fishery is one of the main known sources of fishing mortality for the species

Coldwater Corals and Sponges (CWCS)

Seafood Watch considers CWCS as species of concern because of their susceptibility to the fishery, long lifespans, and slow growth, though there is variation in the number of fishing events catching CWCS and the volume of these taxa caught. Although the catch of these vulnerable taxa has declined since management measures were implemented in 2012 (see Criteria 3 and 4), concerns remain for some fisheries. The rationale of inclusion of CWCS taxa in specific fisheries is based on the relative proportion of impact (by number of CWCS catch events or catch weight; Figures 60 and 61) in BC waters and the evidence of ongoing risk. CWCS are included as a main species in the Rockfish Bottom Trawl fishery and 5ABC–5DE Shallow Flatfish fisheries because these fisheries have the highest proportion of CWCS catch, and there is evidence of ongoing risk. Specifically, areas of continued risk of CWCS bycatch overlap with bottom trawl fishing for mixed rockfish (primarily the catch of silvergray rockfish, Pacific Ocean perch, and yellowtail rockfish), lingcod, shortspine thornyhead, and southern rock sole (Gale et al. 2022), and one or more of these species accounts for >5% of the catch in the two fisheries. Note that there is considerably less CWCS catch in the 3CD Rockfish fishery (Figures 60 and 61).

While there are fishing grounds within subarea 3CD that are categorized as high-risk (Gale et al. 2022), there has been no CWCS catch in the Shallow Flatfish and Pelagic Bottom Trawl fisheries in this subarea over the last 5 years, and just five events with a total catch of 2.7 kg in in the 3CD Deep Flatfish fishery (Figure 61). Because CWCS catch in the 3CD Bottom Trawl fisheries is sporadic and negligible, relative to other portions of the Bottom Trawl sector, these taxa are not a main species in the 3CD fisheries. CWCS are also excluded from the Sablefish Fishery because the fishery has a smaller footprint than other longline and trap gear, and the type of groundline used in the Sablefish Trap Fishery is buoyant and rarely contacts the seafloor (Doherty et al. 2017).

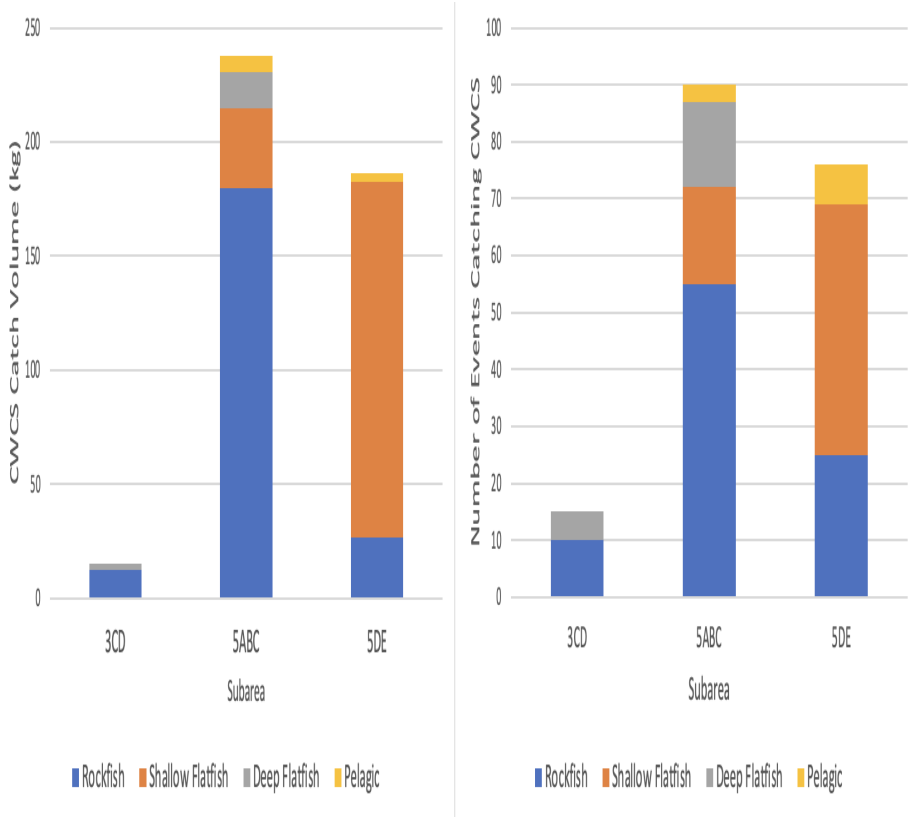

Figure 60: Cumulative catch of coldwater corals, sponges, and sea pens (left) and number of events catching at least one species of these taxa (right) in BC Bottom Trawl fisheries by target species and region from 2019 to 2023. No catch of these taxa were recorded in the 5DE Deep Flatfish, 3CD Pelagic, or 3CD Shallow Flatfish fisheries. Data courtesy of DFO (DFO Pacific Region 2024).

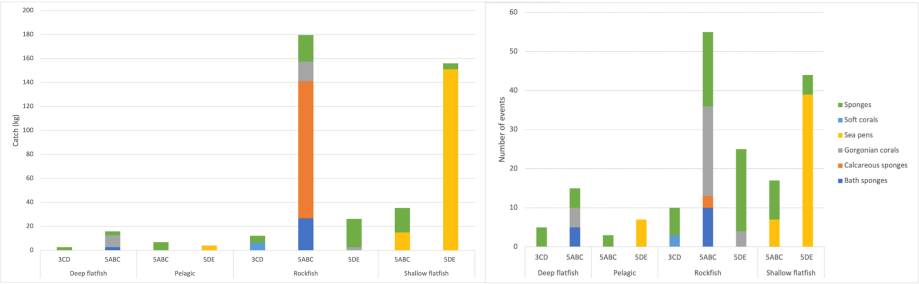

Figure 61: Cumulative catch (left) and catch events (right) of coldwater corals, sponges, and sea pens in BC Bottom Trawl fisheries by target species and region from 2018 to 2023. No catch of these taxa were recorded in the 5DE Deep Flatfish, 3CD Pelagic, or 3CD Shallow Flatfish fisheries. Data courtesy of DFO (DFO Pacific Region 2024).

Humpback Whale

Humpback whale is known to interact with fisheries on the Pacific coast of Canada (Carretta et al. 2021). The North Pacific humpback whale population was first designated as Threatened by COSEWIC in 1982; it was then reassessed and confirmed as Threatened in 2003, and reassessed as Special Concern in 2011 (COSEWIC 2021). In its updated status report, COSEWIC assessed North Pacific humpback whale as Special Concern, and a new management plan is in development (COSEWIC 2023).

In the United States, the species has been listed as Endangered under the U.S. Endangered Species Act (ESA) since 1970; however, in 2016, NMFS revised the humpback whale population designation by splitting it into 14 distinct population segments (DPSs), 3 of which

have the potential to interact with BC fisheries (Carretta et al. 2021). Before 2022, Pacific humpback whales along the U.S. West Coast were assessed by NMFS as three stocks: California–Oregon–Washington, Central North Pacific, and Western North Pacific. In the 2022 draft stock assessment, NMFS designated five stocks ("demographically independent populations" or DIPs) based on genetics, movements, and morphology (Figure 62). The Mainland Mexico–CA/OR/WA stock and Hawai'i–Southeast Alaska/Northern BC stock are the two stocks that commonly occur in southern BC waters during the summer months; the latter stock contains whales from the Hawai'I DPS, which is not listed under the ESA (NMFS 2022). The Mainland Mexico–CA/OR/WA stock contains whales from the Mexico DPS, which is Threatened under the ESA (NMFS 2022). Because of the Threatened status of the Mexico DPS humpback whale, Seafood Watch evaluated whether it should be considered a main species in the BC Sablefish Pot fishery.

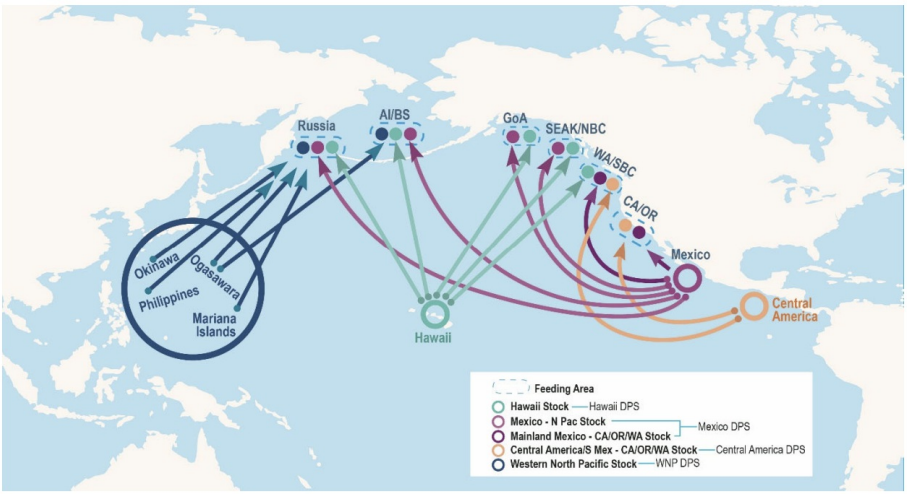

Figure 62: Pacific basin map showing wintering areas of five humpback whale stocks mentioned in this report. Also shown are summering feeding areas mentioned in the text. High-latitude summer feeding areas include Russia, Aleutian Islands/Bering Sea (AI/BS), Gulf of Alaska (GoA), Southeast Alaska/Northern British Columbia (SEAK/NBC), Washington/Southern British Columbia (WA/SBC), and California/Oregon (CA/OR) (NMFS 2022).

Entanglement in pot and trap fisheries is the leading cause of serious injuries and mortalities reported in the waters off the U.S. West Coast (Jannot et al. 2021), and entanglements are known to occur in the U.S. Sablefish Pot fishery (Carretta et al. 2021). But, there have been no documented entanglements in the BC Sablefish Pot fishery (Ford et al. 2009)(COSEWIC 2023). In the latest published U.S. stock assessment for the CA/OR/WA stock, the mean annual mortality and serious injury in the U.S. West Coast Sablefish Pot fishery from 2012 to 2016 was 0.32 (Carretta et al. 2021). According to the draft 2022 stock assessment, the value increased to 1.6 from 2016 to 2020 for whales in the Central America/Southern Mexico–CA/OR/WA stock and Mainland Mexico–CA/OR/WA stock, combined; this total is prorated based on the estimated proportion of U.S. West Coast abundance that is made of the Mainland Mexico–CA/OR/WA stock, such that the mean annual mortality and serious injury on the Mainland Mexico–CA/OR/WA stock from the U.S. Sablefish Pot fishery is estimated to be 1.12 (NMFS 2022). The potential biological removal (PBR) for this stock is 32.5/yr, cumulative commercial fishing mortality and serious injury is 14.6/yr (44.9% of PBR), and the U.S. Sablefish Pot fishery accounts for ≈3.4% of PBR (NMFS 2022).

According to the 2023 draft COSEWIC status report update, there were 134 documented humpback entanglements in B.C. waters from 2000 to 2020; 71% of entanglements had an unknown outcome, 5% resulted in serious injury and mortality, and 24% were freed with minor or no injuries (ibid). Gear type was only identified in 78 reported entanglements and 56 could be traced to a fishery of origin, none of which could be confirmed to the Sablefish Pot fishery (ibid). While trap and pot fisheries in general are known to cause serious injuries and mortalities to humpback whales, and entanglements have been documented in the U.S. Sablefish Pot fishery, there is no evidence that the Threatened Mexican DPS is interacting with the B.C. Sablefish Pot fishery, and the humpback whale is not included as a main species.

Chinook Salmon

The BC groundfish fisheries incidentally capture Chinook salmon stocks, some of which are of conservation concern (see Chinook salmon Factor 2.1). In 2022, managers began enhanced monitoring of groundfish fisheries with the highest potential for impact to salmon stocks of concern, which primarily include midwater trawl gear targeting pelagic species (DFO 2024). Preliminary results of the monitoring work showed a significant level of salmon bycatch northeast of Vancouver Island, resulting in an in-season area closure (DFO 2024). Because the stock composition of Chinook salmon bycatch cannot be determined {DFO 2024), and the 3CD Rockfish Midwater Trawl fishery accounted for 13% of all Chinook bycatch in midwater trawls for groundfish {DFO Pacific Region 2024,} we have included Chinook salmon

as a main species in the fishery.

Steller Sea Lion

Steller sea lion in BC was once subject to culls, but has been protected since 1970 (DFO 2008). Since the 1970s, the abundance of Steller sea lion in BC is estimated to have tripled, and pup production is estimated to have quadrupled (DFO 2008). The species' current abundance in BC is now estimated to be "well past" known historical levels (DFO 2010). The 2013 total BC population size estimate from breeding season surveys was 39,200 (95% CI of 33,600–44,800), which is an increase from the 2010 estimate of 32,500 (CI 28,200–36,800) (DFO 2020g). Winter surveys indicated that abundance has also increased in the nonbreeding season from an influx of animals from rookeries outside of BC (DFO 2020g). Steller sea lion populations have rebounded from historic culling, but current abundance relative to pre-1900 levels is unknown because population levels before the early 1900s are essentially unknown (DFO 2020g). Similar population expansion has occurred in neighboring waters of SE Alaska and Washington (DFO 2020g). The U.S. assesses two stocks of Steller sea lion in the Northeast Pacific; the Eastern stock occurs in Canadian waters (Young et al. 2022). This stock is not listed under the U.S. ESA, it is not considered depleted under the Marine Mammal Protection Act (MMPA), and the COSEWIC status of Steller sea lion is Special Concern (DFO 2020g).

Steller sea lion is caught as bycatch in groundfish bottom and midwater trawls; the average annual catch from 2019 to 2021 was 10.9 t in the Bottom Trawl Fishery and 11.3 t in the Midwater Trawl Fishery (DFO Pacific Region 2021). In the recent Steller sea lion management plan, incidental mortality from fisheries and aquaculture was determined to have "low" population-level impacts and to be a "low" concern (Table 1 in (DFO 2011)). While this management plan does not offer any estimates of sustainable annual removals, it does state that the continued growth of the population in British Columbia suggests that the totality of current impacts is within sustainable limits, with the caveat that any apparently minor increase in anthropogenic mortality would have the potential to have substantial impacts (DFO 2011). Steller sea lion populations have continued to grow since the 2011 management plan report (DFO 2020g), suggesting that fishing levels continue to be sustainable. For these reasons, Steller sea lion is not included as a main species in either the Midwater or Bottom Trawl fisheries.

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

Arrowtooth flounder (Atheresthes stomias)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Big skate (Raja binoculata)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Blackspotted rockfish (Sebastes melanostictus)

Factor 2.3 - Discard Rate/Landings

BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Bocaccio rockfish (Sebastes paucispinis)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Canary rockfish (Sebastes pinniger)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Chinook salmon (Oncorhynchus tshawytscha)

Factor 2.1 - Abundance

Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

High Concern
There are a number of Endangered Chinook salmon stocks that may be encountered by BC groundfish fisheries (see Justification) (DFO 2021a). There is not an accurate estimate of the number of Chinook salmon caught by stock and age in the groundfish fisheries, but new monitoring procedures are underway (DFO 2021a). Because multiple Endangered stocks may be encountered, this factor is scored a high concern.

Justification:
Threatened and Endangered Chinook salmon stocks (DFO 2021a):

Chinook Salmon:

Okanagan DU—Endangered

Southern BC Chinook Salmon:

East Vancouver Island, Stream, Spring population—Endangered
Lower Fraser, Ocean, Fall population—Threatened
Lower Fraser, Stream, Summer (Upper Pitt) population—Endangered
Lower Fraser, Stream, Summer population—Threatened
Middle Fraser, Stream, Fall population—Endangered
Middle Fraser, Stream, Summer population—Threatened
Middle Fraser, Stream, Spring (MFR+GStr) population—Threatened
Middle Fraser, Stream, Spring population—Endangered
North Thompson, Stream, Spring population—Endangered
North Thompson, Stream, Summer population—Endangered
South Thompson, Stream, Summer 1.2 population—Endangered
Upper Fraser, Steam, Spring population—Endangered
Southern Mainland–Boundary Bay Ocean Fall—Threatened
Lower Fraser Ocean Summer—Endangered
South Thompson Stream Summer 1.3—Endangered
Lower Thompson Stream Spring—Endangered
East Vancouver Island Ocean Summer—Endangered
West Vancouver Island Ocean Fall (South)—Threatened
West Vancouver Island Ocean Fall (Nootka & Kyuquot)—Threatened

Factor 2.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Moderate Concern

Over the last five seasons, the Midwater Trawl sector caught an average of 16.6 t of Chinook salmon per year, of which 86.5% was in the Midwater Trawl fisheries for pelagic species such as Pacific hake and walleye pollock and 13% (or 2.1 t/yr) was in the 3CD Rockfish Midwater Trawl fishery (DFO Pacific Region 2024). On average, the total annual catch of Chinook salmon in BC is about 693.7 t (from all reporting areas) (NPAFC 2022). But, Chinook caught as bycatch are 2- to 3-year-olds, making it difficult to compare catch in the Midwater Trawl fishery with the salmon-directed fishery, in terms of adult equivalent mortality (Lagasse et al. 2024). The stock origin of Chinook caught in the Rockfish Midwater Trawl fishery is unknown (DFO 2021a), but research is ongoing (Lagasse et al. 2024). Because we are unable to assess the sustainability of fishing levels on the various stocks of Chinook salmon, this factor is scored a moderate concern.

Copper rockfish (Sebastes caurinus)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Corals and other biogenic habitats (Unknown coral spp.)

Factor 2.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish

High Concern

Coldwater corals and sponges (CWCS) form loose aggregations (i.e., in "groves") and globally unique glass sponge reef ecosystems (Gale et al. 2022). BC is home to at least 300 species of sponges and 60 species of corals, including habitat-forming members of the Primnoidae, Paragorgiidae, and Isididae families (Wallace et al. 2015). The amount of CWCS bycatch and the encounter frequency in the groundfish bottom trawl fishery is well documented thanks to the 100% at-sea monitoring requirement, but species-level catch information is not often available, total fishing mortality is unknown, and population assessments for CWCS are unlikely to occur in the near future (Gale et al. 2022). CWCS are included as a main species on the assumption that the groundfish bottom trawl fishery accounts for 20% or more of total fishing mortality or >5% of a sustainable level of catch.

The stock status and abundance of corals and other biogenic habitats is unknown in BC. Because of basic life-history characteristics and based on the Seafood Watch Unknown Byatch Matrix, corals and other biogenic habitats receive a high concern rating for abundance.

Factor 2.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish

Moderate Concern
The BC groundfish fishery has a CWCS bycatch cap and target; the latter is based on the lowest catch from 1997 to 2009 (Wallace et al. 2015). Since management measures were implemented in 2012, CWCS bycatch has not exceeded the bycatch target (Grønbæk et al. 2022) and the overall frequency of encounters with CWCS and total annual catch have decreased by 31% and 89%, respectively (Gale et al. 2022). Areas that are known to contain sponge reefs are closed to bottom contact fishing, and DFO is actively expanding its efforts to protect these reefs (DFO 2022b)(DFO 2018b). Nonetheless, there is no measure of sustainable levels of fishing mortality, which precludes a low concern score.

Although sustainable levels of fishing mortality for CWCS in BC cannot be determined, there is other available information to override the Seafood Watch unknown bycatch matrix (UBM). Gale et al (2022) note that "creating population assessments for CWCS ecosystems is likely not attainable in the near future, particularly given that CWCS communities are comprised of many species that vary in their life histories, the ITQ system with 100% at-sea monitoring is an effective and complementary tool to the existing spatial management measures for bottom contact fisheries and to spatial ecosystem and biodiversity approaches, such as marine protected areas." Because sponge and coral mortality is unknown and the fishery is managed in a way that reduces impact, a score of moderate concern is awarded.

Justification:
Seafood Watch considers fisheries not to be a substantial contributor to fishing mortality when catch of the species is rare and the fishery operates or is managed in a way that reduces its impact. In recent years, nine sponge reef complexes have been discovered in the Strait of Georgia and Howe Sound. Upon discovery of these sites, DFO requested fishers to voluntarily avoid these areas while the agency consulted with stakeholders on formal protection measures; following the consultation period, DFO closed all nine areas to all bottom-contact fishing (DFO 2018b). In subsequent years, more reefs were discovered and DFO initiated the same process. Effective April 1, 2019, all bottom-contact gear is prohibited within portions of Subareas 28-22 and 28-4 to protect Howe Sound reefs as marine refuges—this brings the current total to 17 closures specifically implemented to protect sponge reefs (DFO 2022d), and DFO continues to survey and identify possible reef sites (Miller et al. 2020). In addition, the Hecate Strait and Queen Charlotte Sound Glass Sponge Reefs MPA was created in 2017 and is closed to all bottom-contact; the MPA covers approximately 2,410 km^2 (DFO 2022d).

There is evidence that management measures have reduced annual fishing mortality in the groundfish bottom trawl fishery (see (Gale et al. 2022) and (Grønbæk et al. 2022)), but we are unable to assess how continued levels of bycatch affect CWCS populations. Additional information on management measures related to CWCS is described in Factor 4.2. Because there are measures in place to reduce the impact of the fishery, the UBM is overridden and the fishery scores a moderate concern, rather than a high concern.

Darkblotched rockfish (Sebastes crameri)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Dover sole (Microstomus pacificus)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

English sole (Parophrys vetulus)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Flathead sole (Hippoglossoides elassodon)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Kelp greenling (Hexagrammos decagrammus)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Lingcod (Ophiodon elongatus)

Factor 2.3 - Discard Rate/Landings

Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Outside Stock | Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard

rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Longnose skate (Raja rhina)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

North Pacific spiny dogfish (Squalus suckleyi)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Pacific cod (Gadus macrocephalus)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Pacific halibut (Hippoglossus stenolepis)

Factor 2.1 - Abundance

Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish

Low Concern
Pacific halibut is managed by the International Pacific Halibut Commission (IPHC) and is assessed annually as a single stock extending from northern California to Alaska. The 2021 SB is estimated to be 86,600 t. The probability that the stock is below the "trigger" reference point ($SB_{30\%}$) is estimated to be 45%, with less than a 1% chance that the stock is below the limit reference point $SB_{20\%}$ (if a stock drops below $SB_{20\%}$, it is considered overfished by the IPHC) (Stewart and Hicks 2021). The female SB stock is currently estimated to be 33% (95% CI) of specified unfished levels (Figure 31), which is below an appropriate reference point of 0.4 B_0. Pacific halibut is not classified as overfished (NMFS 2021)(Stewart and Hicks 2021) and is within data-driven target management reference points. Because Pacific halibut is at least 75% of 0.4 B_0, this factor is scored a low concern.

Justification:
The results of the 2021 stock assessment indicate that the Pacific halibut stock declined continuously from the late 1990s to around 2010, largely a result of decreasing size-at-age, as well as somewhat weaker recruitment strengths than those observed during the 1980s. Since the estimated female SSB stabilized in 2010, the stock is estimated to have increased gradually through 2022 (Stewart and Hicks 2021).

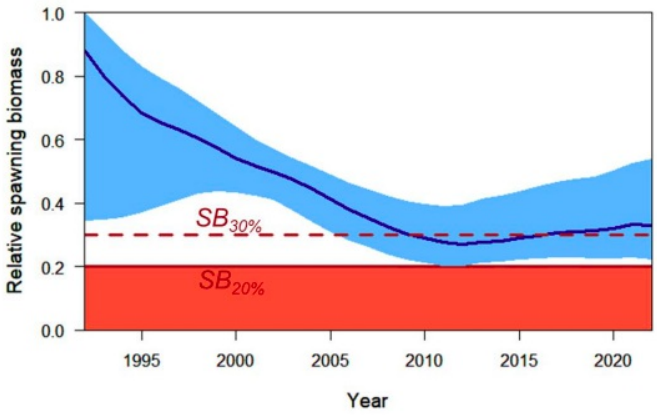

Figure 31: Estimated time-series of relative spawning biomass (compared to the unfished condition in each year) based on the median (dark blue line) and approximate 95% credibility interval (blue shaded area). IPHC management procedure reference points ($SB_{30\%}$ and $SB_{20\%}$) are shown as dashed and solid lines respectively, with the region of biological concern ($<SB_{20\%}$) shaded in red (Stewart and Hicks 2021).

Factor 2.2 - Fishing Mortality

Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish

Moderate Concern

Pacific halibut is targeted in directed halibut longline fisheries and is taken as bycatch, primarily in Pacific cod and flatfish fisheries. Total mortality in 2021 was roughly 17,100 t, which is below the 100-year average. Although the IPHC does not have a coast-wide formal limit reference point for fishing mortality, a target interim reference level SPR = 43% is used to inform management actions (Stewart and Hicks 2021). The estimated fishing mortality in each of the last two years is below reference levels, and there is a 53% probability that fishing mortality in 2021 was below reference levels.

Although catches in all BC management areas were within limits in 2020/21, retrospective model analyses suggest that coast-wide fishing intensity in recent years has likely moderately exceeded the interim reference level SPR = 46% since 1998 (Stewart and Hicks 2017). Of course, there is some uncertainty with retrospective analyses; also, F has been fluctuating around reference levels, and NMFS considers the overfishing status unknown (NMFS 2021). Therefore, Pacific halibut receives a score of moderate concern for fishing mortality.

Justification:

Over the period 1888 to 2021, removals have totaled 3.3 million t, ranging annually from 16,000 to 45,000 t with an annual average of ≈29,000 t. Annual removals were above this long-term average from 1985 through 2010 and have been relatively stable near 17,500 t since 2017. Coast-wide directed commercial Pacific halibut fishery landings in 2021 were approximately 11,100 t, up 9% from 2020. Bycatch mortality was estimated to be 1,600 t in 2021, down 23% from 2020. Coast-wide fishing intensity exceeded the reference level SPR = 46% from 1998 to 2019, but did not exceed the reference level SPR = 43% in 2020 and 2021 (Stewart and Hicks 2021).

Pacific Ocean perch (Sebastes alutus)

Factor 2.3 - Discard Rate/Landings

5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
5DE Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
5ABC Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
5DE Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
3CD Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Petrale sole (Eopsetta jordani)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Quillback rockfish (Sebastes maliger)

Factor 2.3 - Discard Rate/Landings

Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Redbanded rockfish (Sebastes babcocki)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Redstripe rockfish (Sebastes proriger)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard

rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Rex sole (Glyptocephalus zachirus)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Rougheye rockfish (Sebastes aleutianus)

Factor 2.3 - Discard Rate/Landings

BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length

must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Sablefish (Anoplopoma fimbria)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Sharpchin rockfish (Sebastes zacentrus)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

< 100%
Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Shortraker rockfish (Sebastes borealis)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Shortspine thornyhead (Sebastolobus alascanus)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Silvergray rockfish (Sebastes brevispinis)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard

rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Southern rock sole (Lepidopsetta bilineata)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Splitnose rockfish (Sebastes diploproa)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Spotted ratfish (Hydrolagus colliei)

Factor 2.1 - Abundance

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics

Moderate Concern

There is no stock assessment for spotted ratfish. Instead, abundance is scored against the IUCN rating. The IUCN has assessed spotted ratfish as a species of Least Concern because it appears abundant in its core range, has a broad distribution, and there are no major threats (Barnett et al. 2015). Therefore, a moderate concern score is awarded.

Factor 2.2 - Fishing Mortality

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics

Moderate Concern

The sustainability of current fishing levels is unknown and this factor is scored a moderate concern. See the Criterion 1 Summary for a detailed explanation. See Appendix B for a list of management targets and species managed with quotas.

Walleye pollock (Gadus chalcogrammus)

Factor 2.3 - Discard Rate/Landings

BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Widow rockfish (Sebastes entomelas)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length

must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Yelloweye rockfish (Sebastes ruberrimus)

Factor 2.3 - Discard Rate/Landings

Outside (remaining areas) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Inside (Area 4B) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Yellowmouth rockfish (Sebastes reedi)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Yellowtail rockfish (Sebastes flavidus)

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Factor 2.3 - Discard Rate/Landings

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Outside Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Outside Stock | Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Inside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Outside Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Pacific Coast/Alaska Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
5ABC Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
5DE Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
3CD Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
5ABC Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
5DE Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
3CD Stock | Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish

Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery
BC South Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
BC North Stock | Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Outside (remaining areas) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Inside (Area 4B) Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

< 100%

Discard rates (i.e., the ratio of at-sea discards to landings) for all groundfish fisheries were <12% in the 2020/21 fishing season (DFO Pacific Region 2021). The highest discard rate (11.1%) was in the bottom trawl fishery, while all other fisheries had discard rates <3% (DFO Pacific Region 2021). There is a mandatory full retention requirement for all rockfish species, harvesters are required to acquire individual transferrable quota to cover all catch of quota species, and all sablefish under 55 cm in fork length must be released (DFO 2021a).

Discard rates are challenging to determine for the hook and line groundfish fisheries. This is because some of the available logbook data record certain releases as piece counts, rather than by weight. Furthermore, the Seafood Watch criteria require that the bait used in fishing operations be added to the weight of the discards, so that the final ratio is (bait + discards)/landings. There is limited information regarding the quantities of bait used in the groundfish hook and line fisheries, but commercial fishers can use licensed catch as bait (except rockfish). Bait use is recorded in logbooks and counted against the vessel's quota (DFO 2021a). It is highly likely that discard rates are <100% for BC groundfish fisheries.

Criterion 3: Management Effectiveness

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

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

The Criterion 3 rating is determined as follows:

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

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

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

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

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	DATA COLLECTION AND ANALYSIS	ENFORCEMENT	INCLUSION	SCORE
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery	Moderately Effective	Highly effective	Highly effective	Moderately Effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery	Highly effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Green (4.000)
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	Moderately Effective	Highly effective	Highly effective	Highly effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	Moderately Effective	Highly effective	Highly effective	Moderately Effective	Moderately Effective	Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	Moderately Effective	Highly effective	Highly effective	Moderately Effective	Moderately Effective	Yellow (3.000)

Management Strategy Summary

Factor 3.1 for the BC groundfish fisheries is scored for all retained species, while strategies for preventing the catch of nontargeted species and nonretained species are accounted for in Factor 3.2. An overview of management strategies as they relate to Seafood Watch Factor 3.1 follows.

Reference Points

DFO outlines an approach to the management of harvest rates based on stock status relative to reference points in the Sustainable Fisheries Framework (SSF) (DFO 2009a). The approach uses two reference points, a USR (0.8 B_{MSY}) and an LRP (0.4 B_{MSY}), to define stock status into one of three zones: Healthy ($B \geq 0.8\ B_{MSY}$), Cautious ($0.4\ B_{MSY} < B < 0.8\ B_{MSY}$), and Critical ($B \leq 0.4\ B_{MSY}$). The maximum allowable removal rate is set at $\leq F_{MSY}$ while the stock is in the Healthy Zone, is reduced when the stock enters the Cautious Zone, continues to be reduced as the stock approaches the LRP, and becomes zero if the stock is assessed to fall into the Critical Zone. In the absence of estimates of B_{MSY} for a given stock, the following proxies may be used: a) the biomass corresponding to the biomass per recruit at $F_{0.1}$ multiplied by the average number of recruits; b) the average biomass (or index of biomass) over a productive period; or c) the biomass corresponding to 50% of the maximum historical biomass (Annex 1b in (DFO 2009c)).

To score highly effective for Factor 3.1, Seafood Watch requires that more than 70% of the fishery's main targeted retained species have defined appropriate reference points. Limit reference points should be set at 0.5 B_{MSY} or 0.2 B_0, there must be strong scientific justification when lower limit reference points are used, and catch limits should be below MSY and/or scientifically advised levels, accounting for uncertainty, and lowered if $B < B_{MSY}$. In the section of the Framework that specifies the USR and LRP proxy reference points, no reference is made to specific scientific research to support their selection (Annex 1b in (DFO 2009a)). An issue of concern, therefore, is the appropriateness of the reference points for many BC groundfish species, though there are some species that are managed with RPs different from the default RPs. For example, catch advice for Outside yelloweye rockfish was recently updated to set TACs at levels to achieve a TRP of B_{MSY}, rather than 0.8 B_{MSY} (DFO 2024); sablefish has been managed against B_{MSY} target for several years (DFO 2023c); and arrowtooth flounder is managed with an appropriate B_{MSY} proxy of 0.4 B_0 (DFO 2023e). Rockfish are members of the Scorpaeniformes and typically have low levels of recruitment compensation (Thorson et al. 2012). Thus, rockfish and other members of the family have higher estimates of B_{MSY}/B_0, and a TRP may need to be as high as 0.463 B_0 (Thorson et al. 2012). For comparison, Alaska manages its groundfish stocks with target and limit reference points of B_{MSY} (or similar proxy) and 0.5 B_{MSY}, respectively (NPFMC 2020); and U.S. West Coast rockfish are managed with target and limit reference points of 0.40 B_0 and 0.25 B_0, respectively

(PFMC 2011). Therefore, the reference points used to manage most BC groundfish preclude a highly effective score.

Precautionary Policies based on Scientific Advice

The Groundfish IFMP is regularly updated and uses a TAC and IVQ system, with quotas allocated by license type for both targeted and nontargeted species; there are trip limits for species not managed under TACs. Research plans and assessment priorities are updated annually by the DFO Groundfish Management Unit in consultation with First Nations, industry partners, and environmental nongovernmental organizations (DFO 2024). Stock assessments are reviewed by the Canadian Science Advisory Secretariat (CSAS). It is difficult to ascertain the degree to which scientific advice is followed by managers, because the decision-making processes that guide TAC development are not published and, increasingly, the yield advice is being presented in the form of decision tables, with multiple possible choices and probable outcomes. In general, TAC adjustments are a product of an assessment or science response, though there have been a few TAC reductions based on recommendations from the trawl industry due to low abundance, and, in the absence of recent stock assessments, TACs may be adjusted based on survey data and catch indices (pers. comm., B. Turris, Canadian Groundfish Research and Conservation Society 2022).

While there is no evidence of scientific advice being routinely overruled, neither is there publicly available evidence of TACs being consistently set equal to or less than the recommended levels for most species. There is increased transparency around TAC development for some species. DFO has recently used a management-oriented approach for data-limited stocks. This approach proposes management procedures (MPs) that have specified probabilities of meeting fishery and conservation objectives (DFO 2021c). MPs are tested using operating models (OMs) that simulate the biology and fishery dynamics; simulations include feedback between the OM and the MP to generate a probability that a stock will remain above the LRP under a given MP (DFO 2021c). MPs can be used to provide harvest advice and provide transparency of management decisions (DFO 2021c). MPs are available for sablefish, Outside yelloweye rockfish, Outside quillback rockfish, Inside yelloweye rockfish, Inside quillback rockfish, Pacific halibut, Pacific cod, and the rougheye/blackspotted rockfish complex (DFO 2021a).

Strategies for Depleted Species

A policy framework that will allow DFO to effectively identify and set about rebuilding stocks of concern is now in place, because DFO's Precautionary Framework both sets out the criteria for identifying a stock in the "Critical Zone" and requires that rebuilding plans be developed for stocks that fall in this zone. This approach, if implemented across managed stocks, would represent a significant improvement in the management of stocks of concern. But, this approach is data-intensive, and the relatively uneven provision of stock assessment information for BC groundfish species would seem to present a challenge to its implementation across all managed stocks. For example, some species/stocks have never been assessed (e.g., butter sole, darkblotched rockfish, greenstriped rockfish) and others have not been assessed in the last 10 years (e.g., Outside lingcod and spiny dogfish). There is an important distinction between the management of depleted stocks in the United States and in British Columbia, Canada. In the United States, fisheries legislation determines harvest control rules if the stock biomass falls below the lower limit, but in British Columbia, fishery managers have flexibility to consider social and economic factors when deciding on management measures to rebuild depleted stocks (Melnychuk et al. 2013). Rebuilding plans have been developed for Outside yelloweye rockfish, Inside yelloweye rockfish, and bocaccio (DFO 2021a), but several other species/stocks of concern lack recent stock assessments, making it difficult to evaluate the effectiveness of strategies for these stocks.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC)

There are several retained species assessed by COSEWIC to be at risk—such an assessment requires a species to undergo a listing process under the federal Species at Risk Act (SARA) (McDevitt-Irwin et al. 2015). Retained species listed by COSEWIC include bocaccio (Endangered), quillback rockfish (Threatened), darkblotched rockfish (Special Concern), and north Pacific spiny dogfish (Special Concern) (DFO 2021a). Across Canada, the application of SARA to commercially fished species has been considered inadequate (Baum & Fuller 2016), and there is a reported bias against listing commercially valuable marine fish species as Threatened or Endangered (Table S1 in (McDevitt-Irwin et al. 2015)). In BC, SARA status determination is still pending for quillback rockfish, darkblotched rockfish, and north Pacific spiny dogfish, even though these species were assessed by COSEWIC over a decade ago (COSEWIC 2009)(COSEWIC 2011)(COSEWIC 2009b).

Species at Risk Act (SARA)

Retained species in this report listed as SARA Special Concern include the rougheye rockfish, longspine thornyhead, Outside yelloweye rockfish and Inside yelloweye rockfish; the former two were listed in 2007 and the latter two in 2011 (DFO 2012d)(DFO 2021e). There are management plans for species listed under the Species at Risk Act (SARA) as "Special Concern," but this designation does not require a recovery strategy or action plan (McDevitt-Irwin et al. 2015). Rather, management plans for species of Special Concern provide measures that ensure, at a minimum, that a species does not become Threatened or Endangered (DFO 2021e). Management plans differ from action plans, the latter of which are required for Threatened and Endangered species; action plans provides recovery strategies needed to achieve recovery goals and objectives (e.g., see the Atlantic salmon recovery plan in (DFO 2019b)). There is evidence that SARA

management plans have been effective for some stocks (see Criterion 1 for Outside yelloweye rockfish and rougheye/blackspotted rockfish). Longspine thornyhead is under a SARA management plan (DFO 2012d), but its effectiveness is unknown because there is no recent information on stock status.

Spatial Management

There are several management strategies that Seafood Watch considers effective for data-limited fisheries, including setting TACs based on historical catch from a period of no declines. Although TACs are set for most species in this report, including those that lack stock assessments, the rationale for setting TAC levels is unavailable. Another effective strategy is spatial management to protect large proportions of habitat and/or known spawning aggregations. There are currently 162 Rockfish Conservation Areas (RCAs) in BC that are designed to protect inshore rockfish and their habitat; the total area closed to a range of recreational and commercial fisheries is 4,350 km^2 (DFO 2021a). But several commercial fisheries for nongroundfish species are still permitted within RCAs (Table 2 in (Dunham et al. 2020)), including groundfish by mid-water trawl.

There is a target to protect 30% of rockfish habitat in Inside waters and 20% of rockfish habitat in Outside waters; RCAs currently cover an estimated 19% and 14% of available rockfish habitat in Inside and Outside waters, respectively, which is less than the desired targets (Dunham et al. 2020). But because many federal marine conservation target (MCT) areas also provide for protection of rockfish habitat, an estimated 26.7% of total rockfish habitat in Outside waters is protected by RCAs and MCT areas combined (Dunham et al. 2020). For Inside waters, MCT areas only bring the total protected habitat to 19.6%, still well short of the 30% target (Dunham et al. 2020).

Harvest Decision Rules and Buffering against Uncertainty

One avenue through which uncertainty and/or risk are presented is through the use of decision tables, which are included in newer stock assessments. In a decision table, a range of potential outcomes and the probability associated with each outcome are given for each potential harvest strategy. This allows managers to weigh the risks and benefits of different strategies throughout time; however, the degree to which specific harvest decisions are informed by risk aversion and buffering against uncertainty is not always made public. Despite implementing the SFF in 2009, a 2016 audit found that insufficient progress had been made in in important components required for successful fisheries management under the SFF (Commissioner of the Environment and Sustainable Development 2016). Since then, DFO developed the Sustainability Survey for Fisheries (SSF) to monitor progress toward PA compliance. The SSF currently covers 177 stocks that are considered “major stocks,” based on their importance to the economy, culture, and environment; these stocks are used to monitor SFF policy implementation (Archibald et al. 2021). One of the components of the SFF data is whether harvest decision rules (HDRs) have been developed, implemented, and/or evaluated. Of the 16 BC groundfish stocks assessed in this report that are included in the 2022 SSF, HDRs have been *developed* for 100% (16/16), HDRs have been *implemented* for 94% (15/16), and HDRs have been *evaluated* for 25% (4/16) (DFO 2023i).

The Seafood Watch criteria define effective management via a number of guidelines. To be scored “highly effective” for any of the guidelines, a fishery must achieve all of that guideline’s requirements. Due to the multi-species nature of these fisheries, achieving all of the requirements for the ‘management strategy and implementation’ guidelines is challenging. Certain aspects of these fisheries’ management regime are very strong. This is especially true for the at-sea and dockside monitoring requirements that are in place. However, challenges noted in “management strategy and implementation” and “recovery of stocks of concern” preclude a higher score for Criterion 3.

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

Factor 3.4 - Enforcement of Management Regulations

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

Factor 3.5 - Stakeholder Inclusion

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

Factor 3.1 - Management Strategy And Implementation

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

Moderately Effective

As mentioned in the Criterion 3 Summary, the foundation for management of Canadian fisheries is described in DFO's Sustainable Fishery Framework (SFF), which outlines guidelines for rebuilding stocks above the LRP and maintaining stocks above the USR. Although the SFF provides a policy umbrella for fisheries management, the species in this report fall under the purview of the Groundfish IFMP. The IFMP is updated annually through a consultation process with groundfish advisory bodies; among other things, the plan establishes HCRs, communicates basic information to fishery stakeholders, and identifies management measures needed to achieve goals and objectives of the groundfish fishery (DFO 2023). The relatively stable trends in biomass for assessed stocks since the late 1990s (Figure 63) coincided with major management changes, including ITQ implementation, improved fisheries monitoring, and synoptic trawl surveys (Anderson et al. 2021), although changes in markets, processing capacity, and operational costs have also played a role in groundfish catch dynamics since 2007 (Gale et al. 2022).

Other than the Sablefish Pot fishery, none of the assessed fisheries meet the threshold for a highly effective rating, which requires that >70% of the fishery's main targeted and retained species have appropriate reference points and that there is evidence that the strategy is being implemented successfully. Similarly, for at least 70% of the main targeted and retained species/stocks, management measures still exceed those for ineffective or critical management ratings.

Assessed species

A framework for the integration of reference points and a harvest control rule exists, but it has not been widely applied and many stocks are managed without reference points. For those species that have been recently assessed, many are scored Green for abundance, which suggests that management measures are effective for maintaining those species at, near, or above DFO's reference points. But we note that these scores are relative to reference points that, without further scientific justifcation, Seafood Watch deems inappropriate. So, while the reference points used by DFO may not be appropriately precautionary, there is evidence to suggest that management successfully achieves its specified objectives (see the abundance scores for recently assessed species).

Data-limited species and species of concern

DFO employs other alternative strategies (e.g., spatial management, rules that control the intensity of fishing activity, and annual fishery-independent surveys) to manage data-limited species. The status of data-limited species is variable: a few species are rated as Least Concern by the IUCN, which suggests that there is not currently a conservation concern for those species. Species unrated by the IUCN are considered to have highly uncertain stock statuses and tend to score highly vulnerable in the productivity-susceptibility analysis (PSA), but most of the highly vulnerable species are managed with TACs and trip limits (Appendix B). Each of the BC groundfish fisheries scored here targets and retains COSEWIC Threatened and Endangered species; however, stock assessments and data-limited indicators for these species are more recent than COSEWIC designations, and information from these assessments suggests that strategies for rebuilding have been successful.

The reference points used to manage BC groundfish preclude a score of highly effective. The BC groundfish fisheries have the minimal attributes of an appropriate management strategy (e.g., a process for monitoring and conducting assessments, rules that control the intensity of fishing activity, and a process to modify rules according to assessment results) for at least 70% of the main

target and retained species, there is no evidence of systematic noncompliance, and best management strategies that are in place to minimize mortality of stocks of concern are believed to be effective. Therefore, the resulting score is moderately effective.

Justification:

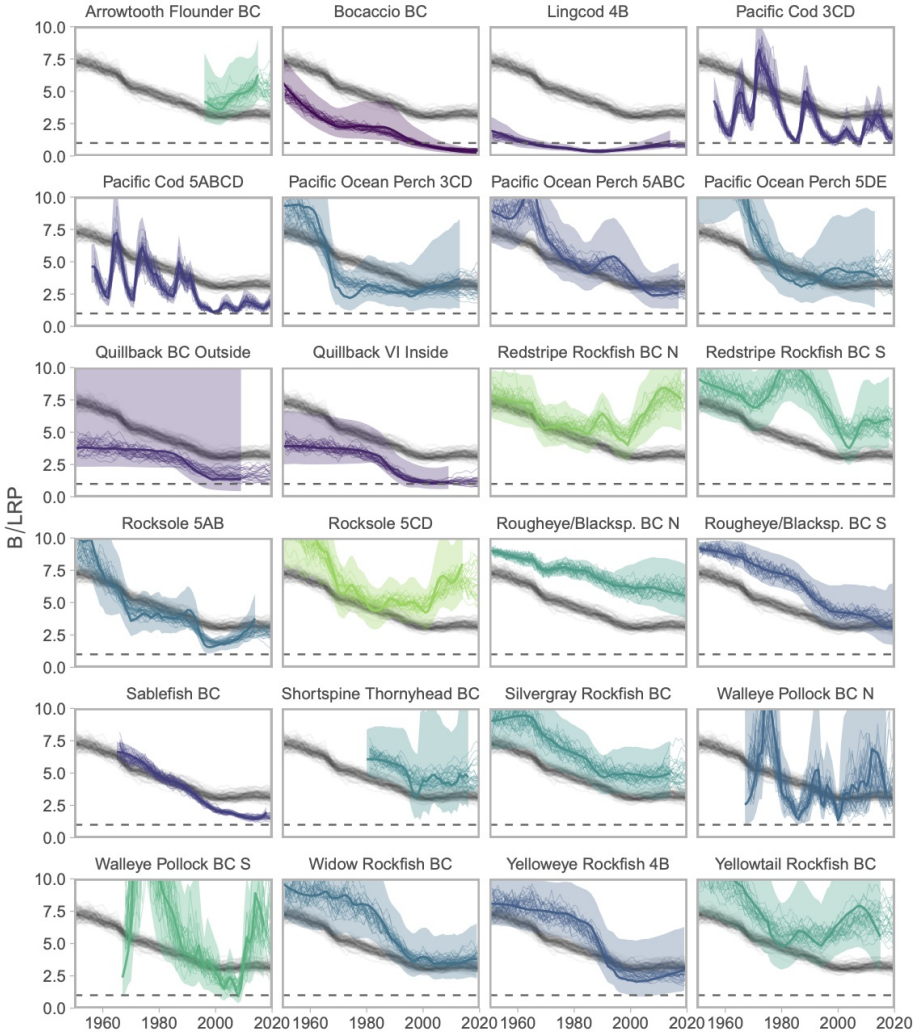

Figure 63: Trends in B/LRP for 24 groundfish stocks in BC. Colored lines and ribbons represent the individual stocks. Colors represent the ratio in the last year of assessment, such that green stocks are highest and purple are lowest. Dark-colored lines and shaded ribbons represent the output from stock assessments: trajectories of median B/LRP 95% quantile credible intervals. Thin lines represent draws from the posterior distribution of $y_{j,t}$ (latent stock-specific mean trends; colors) and x_t (latent overall mean trend; grey). The overall mean trend (x_t; grey) is the same across panels. Figure from (Anderson et al. 2021).

Retained species of concern (COSEWIC Threatened or Endangered)

- Quillback rockfish: The COSEWIC rating is from 2009 (COSEWIC 2009b) and the stock assessment is >10 years old. There are reports by First Nations that the average size of quillback rockfish has declined, and a loss of reproductive potential may be hampering recovery (McGreer and Frid 2017). Quillback rockfish has been COSEWIC Threatened since 2009, but Outside quillback was estimated to be above target levels in the 2023 MP (see Criterion 1).
- Bocaccio: A recent stock assessment indicates that bocaccio is well above B_{MSY} (DFO 2022b); the COSEWIC rating is from 2013 (COSEWIC 2013a).

- Yellowmouth rockfish: A recent stock assessment indicates that yellowmouth rockfish is above B_{MSY} (DFO 2022a); the COSEWIC rating is from 2010 (COSEWIC 2010).
- Canary rockfish: The previous stock assessment suggested that canary rockfish began to rebuild in 2004, the stock was in the Healthy Zone by 2009 (DFO 2009c), and it was above B_{MSY} according to the 2023 stock assessment (DFO 2023a). The COSEWIC rating is from 2007 (COSEWIC 2007a).
- Inside quillback rockfish: There is no recent stock assessment for Inside quillback rockfish, but the previous assessment indicated that the stock was below 0.5 B_{MSY} (B_{2011}/B_{MSY} = 0.493) (Yamanaka et al. 2011). We cannot assess the effectiveness of rebuilding strategies for management of this stock because the last assessment showed that Inside quillback rockfish was not in the Critical Zone (i.e., a 95% probability that $B_{2011} > 0.4\ B_{MSY}$), and no rebuilding plan was required. Quillback rockfish has been a COSEWIC Threatened species since 2009, but Inside quillback was estimated to be above limit levels in the 2023 MP (see Criterion 1).
- Inside yelloweye rockfish: The COSEWIC rating for Inside yelloweye rockfish is from 2020 (COSEWIC 2020b), and the OMs used in the 2020 MSE estimate that the 2019 median stock biomass is above the LRP (DFO 2020e), but Seafood Watch does not consider 0.4 B_{MSY} an appropriate LRP. The current status of Inside yelloweye rockfish relative to 0.5 B_{MSY} is uncertain, but a rebuilding plan was previously implemented for the stock when it was assessed as being below the LRP in 2010, and current fishing levels are expected to allow the population to rebuild (DFO 2020e).
- Outside yelloweye rockfish: The COSEWIC rating is from 2020 (COSEWIC 2020), but a more recent stock assessment indicates that Outside yelloweye rockfish is well above B_{MSY} (DFO 2022b).

Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery

Moderately Effective

There are no other main species in the Lingcod Fishery, so only management of the fishery's impacts on lingcod is considered here. The Lingcod Fishery is managed under the Groundfish IFMP, so the information in the Criterion 3 Summary applies to the Lingcod Fishery. Lingcod-specific management measures include: regulations to control fishing mortality in the commercial, recreational, and First Nation sectors; spatial and temporal closures specific to retention of the lingcod commercial fishery; lingcod bycatch limits in other fisheries; area-specific quotas; and quota allocations cannot be reallocated from one area to another (DFO 2021a).

Lingcod is assessed and managed into separate stocks (four Outside stocks and one Inside stock) (Holt et al. 2016). The Strait of Georgia lingcod stock was assessed in 2014, while the four Outside stocks were assessed in 2011. Both DFO's provisional reference points and MSY-based reference points are provided in lingcod stock assessments, and TACs are adjusted regularly, but it is unclear what reference points are used to manage this species or what information is used to adjust TAC levels. Without a recent stock assessment for the Outside lingcod stocks, Seafood Watch cannot assess management strategy effectiveness, but because measures are in place that are expected to be effective, this factor is scored moderately effective.

Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery

Highly effective

There are no other main species in the Sablefish Trap fishery, so only management of the fishery's impacts on sablefish is considered here. The Sablefish fishery is managed under the Groundfish IFMP, so the information in the Criterion 3 Summary applies to the Sablefish Trap fishery. Sablefish-specific management measures include: regulations to control fishing mortality in the commercial, recreational, and First Nation sectors; spatial and temporal closures specific to retention of the sablefish commercial fishery; area-specific quotas; and quota allocations cannot be reallocated from one area to another (DFO 2021a). Sablefish stock status and harvest advice are monitored via a management strategy evaluation (MSE) process that occurs every 3 years; the process includes refitting the operating model (OM) with updated fishery and survey data (DFO 2020c)(DFO 2023c). The fishery objectives for sablefish are described in the Justification. A harvest control rule is adjusted based on estimates of B_t relative to B_{MSY}, and the maximum target fishing mortality rate was recently adjusted from 9.5% in 2017 to 5.5% in 2021 and 6.4% in 2022 (DFO 2020c)(DFO 2023c). It is probable that the current MPs will result in BC sablefish attaining levels at or near B_{MSY} (median female SSB is at or above B_{MSY} by 2052 with at least a 50% probability) (DFO 2020c)(DFO 2023c). Sablefish is currently managed with appropriate references points (e.g., a target of B_{MSY} rather than 0.8 B_{MSY}) and precautionary policies, and there is evidence that the strategy is being implemented successfully. Therefore, this factor is scored highly effective.

Justification:

The five primary Fishery Objectives for the BC sablefish fishery (DFO 2023c):

1. *Avoid LRP: Maintain female spawning stock biomass above the limit reference point of LRP = 0.4 B_{MSY} in 95% of years measured over two sablefish generations, where B_{MSY} is the female spawning biomass at maximum sustainable yield (MSY) for each operating model;*
2. *Avoid stock decline when below USR: When female spawning stock biomass is between 0.4 B_{MSY} and 0.8 B_{MSY}, limit the probability of decline over the next 10 years from very low (5%) at 0.4 B_{MSY} to moderate (50%) at 0.8 B_{MSY}. At intermediate stock status levels, define the tolerance for decline by linearly interpolating between the extremes;*
3. *Achieve target biomass: Maintain the 2052 female spawning stock biomass above the target reference point in 50% of simulation replicates, where the target reference point is (a) $B_{Targ} = B_{MSY}$ when $B \geq 0.8\ B_{MSY}$, or (b) $B_{Targ} = 0.8\ B_{MSY}$ when $B < 0.8\ B_{MSY}$;*
4. *Avoid economically unviable catch: Maximize the probability that annual legal-sized catch levels remain above 1,992 tonnes, measured over two sablefish generations;*
5. *Maximize legal-size catch: Maximize annual legal-sized catch over 10 years, subject to Objectives 1–4 being met.*

Factor 3.2 - Bycatch Strategy

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery

Highly effective

All commercial groundfish sectors are subject to the individual transferable quota (ITQ) for both directed and nondirected catch (DFO 2021a). The vessel accountability (documenting all catch) and responsibility (acquiring ITQ) approach is designed to create incentives for better utilization of catch, reducing discards, and developing improved fishing practices (DFO 2021a).

Bycatch Mitigation for Species of Concern

- Following an evaluation of rebuilding measures in 2014, trip limits for bocaccio were reduced in hook and line fisheries, the bocaccio TAC in the trawl fishery was reduced, and bocaccio mortality in commercial groundfish fisheries declined by 51% from 2013 to 2017 (DFO 2021a). There was a similar reduction of halibut bycatch mortality in the groundfish fleet following the implementation of the ITQ program, with the fleet reaching an average of 31% of the TAC in the 15 years following implementation {O'Keefe et al. 2014}.
- Eulachon fishing mortality in the midwater trawl fishery is of low concern, primarily the result of avoidance behavior and management measures, including minimum mesh size and spatial closures that benefit eulachon (DFO 2021g). The midwater trawl incidentally catches Chinook salmon, some of those salmon likely come from Endangered stocks, and there is insufficient information to assess the impact that the trawl fishery has on these populations. But, new monitoring procedures were recently developed to improve the understanding of impacts to at-risk Chinook stocks (DFO 2024). Following improved data from increased monitoring, DFO implemented temporary spatial closures to all midwater trawls in specific areas northeast of Vancouver Island to reduce salmon bycatch, and long-term measures are being considered (DFO 2024).
- Coldwater coral and sponge habitats have been identified and protected from bottom-contact fishing (DFO 2018b) in recent years (see Criterion 4), resulting in a significant decline in sponge/coral catch in the bottom trawl fleet (Grønbæk et

al. 2022). The Habitat Conservation Collaboration Agreement was established in 2012 through a collaborative process between different stakeholders; the Agreement established ecosystem-based trawling boundaries, habitat conservation bycatch limits, encounter protocols, and a habitat review committee (Wallace et al. 2015).

- Since 2012, retention of tope (IUCN Critically Endangered) and sixgill shark (IUCN Near Threatened) has been prohibited, and DFO provides guidelines for best handling practices for sharks that encounter fishing gear (DFO 2021a); incidental catch of these species has been less than 0.5 t/yr in the last three years (DFO Pacific Region 2021), and these species are not included in Criterion 2. Green sturgeon (IUCN Near Threatened) also cannot be retained (DFO 2017), and incidental catch of this species has declined dramatically in recent years (DFO Pacific Region 2021). There are additional species and stocks that cannot be retained as described in the Groundfish IFMP (DFO 2021a).
- Starting in 2020, all commercial groundfish vessels must report lost and retrieved fishing gear, along with the date, time, and location of the incident (DFO 2021a). A Ghost Gear Fund was also initiated in 2020, with 10 of the 26 funded projects taking place in Pacific waters (DFO 2021d).
- Canada completed a National Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries in 2007, but the effectiveness of management measures implemented under this plan has not been measured, and compliance monitoring is limited (Environment and Climate Change Canada 2017). A recent study of overlap between albatross and the BC commercial groundfish longline fleet identified albatross–longline hotspot locations in Outside waters (Fox et al. 2020). The researchers conclude that black-footed albatross—an IUCN Near Threatened species (BirdLife International 2020)—likely accounts for the majority of albatross bycatch, because of its abundance in Canada's Pacific waters and its concentration near the shelf break and slope (Fox et al. 2020). In addition, short-tailed albatross—an IUCN Vulnerable species (BirdLife International 2018)—also has a high overlap with BC longline fisheries, and there is a potential for bycatch to occur (Fox et al. 2020). The extent of bycatch of these albatross species is not well understood because of low compliance and species identification issues, leading the authors to note that "[a]lthough this study provides no species-specific resolution, black-footed albatrosses are the most abundant albatross in British Columbia and likely represent much of the reported albatross bycatch in commercial longline fisheries. With a highly vulnerable population of short-tailed albatrosses, possible bycatch of this species remains a serious and poorly understood conservation issue in Canadian waters" (Fox et al. 2020). Although Fox et al. (2020) raised concern about albatross bycatch in BC groundfish longlines, the fisheries in this report are unlikely to be significant contributors to total incidental mortality of either black-footed or short-tailed albatross. The issue of low compliance is addressed in Factor 3.4.

The commercial groundfish sector interacts with species of concern and has strategies in place to minimize impact, *and* there is evidence that these strategies are effective (e.g., recovery of bocaccio as described in Criterion 2, and area/time closures to protect sensitive taxa described in Criterion 4). There is a new initiative aimed at improving technology to reduce gear loss and increasing ghost gear retrieval, which may result in the development of new management measures. Therefore, the Bottom Trawl fishery receives a highly effective score, despite the fishery not being highly selective (i.e., the rate of discards, nontargeted, or unmanaged catch exceeds 5% of landings) (DFO Pacific Region 2021). The Midwater Trawl and Line fisheries have low (<5%) levels of bycatch, and these fisheries also receive a score of highly effective.

Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery

Highly effective

Sablefish traps are considered highly selective, and there is little bycatch in the fishery (Lacko et al. 2020). All commercial groundfish sectors are subject to the individual transferable Quota (ITQ) for both directed and nondirected catch (DFO 2021a). The vessel accountability (documenting all catch) and responsibility (acquiring ITQ) approach is designed to create incentives for better utilization of catch, reducing discards, and developing improved fishing practices (DFO 2021a). Starting in 2020, all commercial groundfish vessels must report lost and retrieved fishing gear, along with the date, time, and location of the incident (DFO 2021a). A Ghost Gear Fund was also initiated in 2020, with 10 of the 26 funded projects taking place in Pacific waters (DFO 2021d).

The Sablefish Trap fishery has little bycatch of fish and invertebrate species, the fishery is not a leading cause of a high level of mortality for any species of concern, and there are measures in place to address ghost fishing. Therefore, the bycatch strategy is scored highly effective.

Factor 3.3 - Scientific Data Collection and Analysis

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery

Highly effective
The management process uses a independent and up-to-date scientific stock assessment for several of the species considered in this report. The stock assessments are peer reviewed, informed by fishery-dependent and fishery-independent data, and include fishing mortality from noncommercial sectors (e.g., (DFO 2018)(DFO 2019)(Forrest et al. 2020)). In addition to conducting formal stock assessments, DFO regularly performs several fishery-independent surveys to monitor groundfish stocks, collect biological data, and distribute information on groundfish species (DFO 2021a). A summary of each survey is outlined in the Justification, from DFO {2021a}.

Bycatch is appropriately monitored through onboard observers, video monitoring, and dockside monitoring, and data on lost gear are collected. All BC commercial groundfish fisheries are subject to 100% at-sea and dockside monitoring, hook and line fisheries are required to have either at-sea observer coverage or an Electronic Monitoring (EM) system, and trawl fisheries *were* required to have 100% at-sea observer coverage (DFO 2021a). But because of the COVID-19 pandemic, there have been no at-sea observers in the Trawl sector since 2020, and all trawl vessels must have a functioning EM system (DFO 2024). The observer and EM programs allow bycatch to be monitored, but most of the incidentally encountered species lack up-to-date stock assessments. For those species without formal stock assessments, DFO has introduced a reproducible report to provide a snapshot of population and fishing trends of 113 groundfish species, using the aforementioned fishery-independent survey data (Anderson et al. 2019). The report is fully automated to facilitate frequent publication and review of abundance trends and to increase data transparency, though there are limitations and caveats (see pp. 9–10 of Anderson et al. (2019)).

Overall, the fisheries in this report on monitored through a robust management process that includes formal stock assessments, data-limited assessments, and stringent monitoring protocols for decidedly complex fisheries. Therefore, a score of highly effective is awarded.

Justification:
Research programs for BC groundfish (DFO 2021a):

1. Groundfish Multispecies Hook and Line Surveys are conducted in Inside waters, Outside waters, and onboard survey vessels during the International Pacific Halibut Commission's (IPHC) annual stock assessment survey.
    a. Inside waters are surveyed over two years and rotate between northern and southern portions of the Strait of Georgia. These surveys are designed to collect biological samples and determine the catch by species.
    b. Outside waters surveys are designed to provide abundance indices in conjunction with coast-wide trawl surveys. These surveys also alternate between northern and southern portions of the Pacific coast and take place over a two-year period.
    c. The Cooperative IPHC survey collects catch information and biological samples to provide an annual relative abundance index of rockfishes.
2. Groundfish Trawl Multispecies Surveys began in 2003 as a collaboration between multiple stakeholders. The surveys are designed to provide usable relative abundance indices for as many fish species as reasonable. The program covers five specific areas that are surveyed on a biennial rotation.
3. Sablefish Research and Assessment Survey Program is a program that uses randomized tagging and catch rate data to derive an index of stock abundance of sablefish.
4. Small-mesh Bottom Trawl Surveys are used to monitor important shrimp grounds in BC, but the surveys also are used to track abundance indices of several groundfish stocks (Cornthwaite & Workman 2021).

Factor 3.4 - Enforcement of and Compliance with Management Regulations

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery

Highly effective
Enforcement is provided by fisheries officers, who take part in vessel patrols and air surveillance of fishing operations. There are approximately 170 fishery officers stationed within the Pacific Region (DFO 2021a). Groundfish sectors are controlled by licenses with specific conditions, dockside surveillance is mandatory, and regulations are regularly enforced and monitored by fishery officers, third-party observers (onboard and dockside), and the Groundfish Enforcement Coordinator (DFO 2021a). A list of annual convictions for fishery offenses is published by DFO; there were 30 convictions in 2022 across all fisheries, including recreational and commercial activities (DFO 2023b). The IFMP outlines enforcement priorities for the upcoming season (see Justification). Enforcement is therefore scored highly effective.

Justification:
Enforcement Priorities (DFO 2021a):

- *Closed area fishing in rockfish conservation areas, sponge reef marine protection areas, and marine conservation areas, and other permanent and in-season fishing closures.*
- *Vessel Masters not providing all reasonable assistance to at-sea and dockside observers.*
- *Owner or any person in charge or in control of a fishing landing station not providing the dockside observer with such assistance as is reasonably necessary to enable observer to perform their duties.*
- *Retention of groundfish caught, retained, or possessed without license authority. Priority will be placed on occurrences where retention for the purpose of sale is indicated.*
- *False and misleading statements to at-sea and dockside observers.*
- *Unauthorized commercial/FSC (dual) fishing.*
- *Nondeployment of seabird avoidance gear.*
- *Noncompliance with hail-out, hail-in, electronic monitoring, and other elements of the 100 percent at-sea and dockside monitoring programs.*

Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery

Moderately Effective
The Sablefish, Outside Rockfish, and Lingcod Line fisheries are subject to the same enforcement regulations as the Trawl and Inside fisheries (see Justification). But management measures to reduce seabird bycatch in these fisheries are not well monitored (Environment and Climate Change Canada 2017), and the extent of bycatch of albatross species is not well understood due to low compliance and species identification issues (Fox et al. 2020). Specifically, there is a lack of species-level identification and/or underreporting of albatross bycatch incidents in BC commercial longline fisheries, and there is a need to better understand the scale of albatross bycatch and the specific longline fisheries involved (Fox et al. 2020). DFO has identified nondeployment of seabird avoidance gear as an enforcement priority (DFO 2021a). Therefore, these fisheries score moderately effective for enforcement.

Justification:
Enforcement is provided by fisheries officers, who take part in vessel patrols and air surveillance of fishing operations. There are approximately 170 fishery officers stationed within the Pacific Region (DFO 2021a). Groundfish sectors are controlled by licenses with specific conditions, dockside surveillance is mandatory, and regulations are regularly enforced and monitored by fishery officers, third-party observers (onboard and dockside), and the Groundfish Enforcement Coordinator (DFO 2021a). The IFMP outlines enforcement priorities for the upcoming season:

- *Closed area fishing in rockfish conservation areas, sponge reef marine protection areas, and marine conservation areas, and other permanent and in-season fishing closures.*
- *Vessel Masters not providing all reasonable assistance to at-sea and dockside observers.*
- *Owner or any person in charge or in control of a fishing landing station not providing the dockside observer with such assistance as is reasonably necessary to enable observer to perform their duties.*
- *Retention of groundfish caught, retained, or possessed without license authority. Priority will be placed on occurrences where retention for the purpose of sale is indicated.*
- *False and misleading statements to at-sea and dockside observers.*
- *Unauthorized commercial/FSC (dual) fishing.*
- *Nondeployment of seabird avoidance gear.*
- *Noncompliance with hail-out, hail-in, electronic monitoring, and other elements of the 100 percent at-sea and dockside monitoring programs.*

Factor 3.5 - Stakeholder Inclusion

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery

Moderately Effective
The management of the fisheries in question is informed by consultations with a number of advisory bodies. The advisory body with the greatest diversity of stakeholders is the Groundfish Integrated Advisory Board (GIAB), which includes representatives from commercial fisheries, processors, unions, various levels of government, First Nations, recreational fisheries, coastal communities, and environmental organizations. But it is unclear if the GIAB is active, given that meeting materials have not been published since 2018. Other advisory committees include the Halibut Advisory Board, Groundfish Trawl Advisory Committee, Sablefish Advisory Committee, Groundfish Hook and Line Subcommittee, and the Commercial Industry Caucus (DFO 2021a). Stock assessments and fishery surveys are performed as a result of collaboration between scientists of the Stock Assessment and Research Division, staff in the Ecosystem Sciences Division of the Science Branch, fishery managers, and industry members (DFO 2021a). An updated IFMP is published annually to communicate basic information to fishery stakeholders, and the Pacific North Coast Integrated Management Plan (PNCIMA) was developed through a collaborative process in 2017 (DFO 2021a). The PNCIMA provides for an ecosystem-based management framework for marine activities and sets the stage for planning the development of the North Shelf Bioregion marine protected area (DFO 2021a).

There are numerous avenues and examples of stakeholder inclusion, but there is still an apparent lack of transparency for management decisions related to TACs. While there is a high level of transparency for stocks that are evaluated under management procedures (MPs), stocks without MPs or stock assessments are assigned TACs without a supporting rationale for catch limits. Therefore, a score of moderately effective is awarded.

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
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish	Score: 2	+1	Moderate Concern		Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics	Score: 2	+1	Moderate Concern		Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish	Score: 2	+1	Moderate Concern		Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish	Score: 2	+1	Moderate Concern		Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics	Score: 2	+1	Moderate Concern		Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics	Score: 2	+1	Moderate Concern		Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish	Score: 2	+1	Moderate Concern		Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl	Score: 1	+1	Moderate Concern		Yellow (2.449)
Outside Stock | Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery	Score: 4	+.5	Moderate Concern		Green (3.674)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl	Score: 3	Score: 0	Moderate Concern		Yellow (3.000)
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery	Score: 2	+.5	Moderate Concern		Yellow (2.739)
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery	Score: 2	+.5	Moderate Concern		Yellow (2.739)
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery	Score: 2	+.5	Moderate Concern		Yellow (2.739)
BC North Stock | Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery	Score: 2	+.5	Moderate Concern		Yellow (2.739)

The groundfish fishing gears used in the British Columbia fisheries are expected to come into contact with the seafloor during their regular use. Thus, the potential for disturbance and destruction of habitat is always present with these gears. The destructive potential of mobile gears is well known, and bottom longlines and pots may also cause damage. Many of the species that the groundfish fisheries pursue are known to associate with hard substrates, which are known to be more susceptible to gear disturbance and damage than soft substrates in high-energy areas.

Spatial management measures such as the sponge reef trawl closures have helped to minimize the potential for damage to certain habitats, and beginning in 2012, new management measures for the trawl fishery were implemented to minimize and manage this fishery's bycatch of corals and sponges (see Figure 64 in Factor 4.2) (Wallace et al. 2015). DFO has established Rockfish Conservation Areas (RCAs) to protect habitat for rockfish species; there are currently 162 RCAs covering approximately 4,350 km^2 (see Figure 65 in Factor 4.2) (Thornborough et al. 2020). There is a target to protect 30% of rockfish habitat in Inside waters and 20% of rockfish habitat in Outside waters; RCAs currently cover an estimated 19% and 14% of available rockfish habitat in Inside and Outside waters, respectively, which is less than the desired targets (Dunham et al. 2020). But because many federal marine conservation target (MCT) areas also provide for protection of rockfish habitat, an estimated 26.7% of total rockfish habitat in Outside waters is protected by RCAs and MCT areas combined (Dunham et al. 2020). For Inside waters, MCT areas only bring the total protected habitat to 19.6%, still well short of the 30% target (Dunham et al. 2020).

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

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics

Score: 2

Sinclair et al. (2005) identified species-specific affinities to various substrate types in the BC groundfish fishing areas. Species strongly associated with shallow sand and gravel include big skate, English sole, Pacific cod, rock sole, lingcod, Pacific halibut, petrale sole, and spotted ratfish; those strongly associated with deeper water dominated by mud, till, and outwash sand and gravel include arrowtooth flounder, longnose skate, spiny dogfish, Dover sole, rex sole, and sablefish; and those strongly associated with deeper water dominated by Glaciomarine mud include bocaccio, yellowtail rockfish, Pacific Ocean perch, redbanded rockfish, redstripe rockfish, and yellowmouth rockfish (Sinclair et al. 2005).

The Shallow Water Flatfish fisheries mainly catch rex sole, petrale sole, Dover sole, and flathead sole, which are species known to associate with sand and mud habitats (Starr and Fargo 2004)(Bryan et al. 2021)(Bryan et al. 2021f)(Bryan et al. 2021b).

The Pelagic Bottom Trawl fisheries catch a mix of species that are strongly associated with shallow sand and gravel (Pacific cod and lingcod), deepwater mud, till, outwash sand and gravel (arrowtooth flounder and sablefish), and deepwater mud (bocaccio and silvergray rockfish) (Sinclair et al. 2005).

The Deepwater Flatfish fisheries are included in this score because the main targeted species include arrowtooth flounder, Dover sole, and sablefish. Dover sole is generally found on mud or mud-sand bottom (Wetzel & Berger 2021)(Bryan et al. 2021f); sablefish is typically associated with soft substrates (Bystrom and Jurado Molina 2021), and though the species is also found in complex habitats consisting of boulder outcrops and rocky reefs on the continental slope and shelf, these complex habitats are inaccessible to trawl gear (Doherty et al. 2017); and arrowtooth flounder is considered a habitat generalist, ranging from shallow shelf to deep slopes (Shotwell et al. 2021), often on soft bottom substrate (Spies et al. 2021).

The Seafood Watch Standard for Fisheries requires a score of 2 for a fishery that uses bottom trawl gear over mud and sand, or shallow gravel.

Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl

Score: 1

The Rockfish Bottom Trawl fishery targets many species, some of which are known to associate with cobble, rock, boulder, or other hard habitats, but trawlers try to avoid rough and rocky areas to reduce gear damage (Du Preez and Tunnicliffe 2011). Main species include yellowtail rockfish, Pacific Ocean perch, canary rockfish, silvergray rockfish, bocaccio, redstripe rockfish, yellowtail rockfish, and rougheye rockfish. Sinclair et al. (2005) identified species-specific affinities to various substrate types in the BC groundfish fishing areas, and species strongly associated with deeper water dominated by Glaciomarine mud include bocaccio, yellowtail rockfish, Pacific Ocean perch, redbanded rockfish, redstripe rockfish, and yellowmouth rockfish (Sinclair et al. 2005). While several of the main species associate with mud substrate, there is evidence that the Rockfish Bottom Trawl fishery continues to impact sensitive habitat, even though incidental catch of corals and sponges has declined since management measures were implemented in 2015, and continued encounters may be from areas containing nonreef sponge aggregations (Gale et al. 2022). Therefore, this factor is scored 1.

Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery

Score: 4

Fishers on directed lingcod trips may only use troll and jig gear (DFO 2022d). Lingcod is known to associate with rock and boulder substrates (Holt et al. 2016). The lingcod fishery scores 4 because the fishery uses vertical lines to fish for benthic or reef-associated species.

Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Score: 3

In recent years, trawl vessels equipped with midwater trawl gear have targeted a suite of rockfish species. Midwater trawls can touch the bottom, but there are no data on the impact when this occurs in Canadian fisheries (DFO 2019e). The SFW criteria require a score of 3 for midwater trawl gear that contacts the bottom <25% of trawling time; although the percentage of time that the midwater gear is in contact with the bottom is not known for this fishery, the gear is not designed for bottom contact, so it is assumed that such contact is only "occasional" (i.e., <25% of the time). The score for all Midwater Trawl fisheries is 3.

Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery

Score: 2

The Inside Rockfish fishery uses jig and longline gear and primarily catches quillback and lingcod, which are known to associate with rock and boulder substrates {Yamanaka et al. 2012}(Holt et al. 2016). Although jig gear is expected to have minimal impact to bottom habitats, the Inside Rockfish fishery also uses bottom longline gear, which scores 2 when used on rock reef/boulder habitats. Because these gears are combined into one fishery, this factor is scored 2, based on the lowest-scoring gear type.

Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery

Score: 2

The Outside rockfish fishery catches redbanded rockfish, rougheye rockfish, quillback rockfish, and several other rockfish species, along with lingcod and sablefish. Several of these species associate with cobble, rock, and/or boulder habitats (e.g., quillback rockfish {Yamanaka et al. 2012} and lingcod (Holt et al. 2016)). Longline, troll, and jig gear are used in this fishery (DFO 2022d). Although troll and jig gear are expected to have minimal impact to bottom habitats, the Outside Rockfish fishery also uses bottom longline gear, which scores 2 when used on rock reef/boulder habitats. Because these gears are combined into one fishery, this factor is scored 2, based on the lowest-scoring gear type.

Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery

Score: 2

Although sablefish is typically associated with soft substrates (Bystrom and Jurado Molina 2021), the species is also found in complex habitats consisting of boulder outcrops and rocky reefs (Doherty et al. 2017). Longline and trap gear are deployed on the continental slope and shelf in these complex habitats that are inaccessible to trawl gear (Doherty et al. 2017). Because sablefish traps and longlines may be set over boulders and reefs, the sablefish fishery scores 2 for this factor.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics

+1

There are several initiatives in BC to protect sensitive and critical habitats from bottom-contact gear and other activities. A list of areas and their restrictions related to groundfish fisheries is provided in the Justification section. Mitigation measures related to the groundfish fishery broadly fall into three strategies: 1) freezing the trawl footprint, 2) protecting rockfish habitat and other sensitive areas, and 3) meeting Canada's goal of conserving 30% of marine and coastal areas by 2030.

1. *Freezing the trawl footprint* (Figure 64): As part of an agreement in 2012, the BC bottom trawl fishery footprint is restricted to

areas previously trawled between 1996 and 2011 (DFO 2021a). The amount of area open to trawling was set at 31,628 km^2, which is 21.9% less than the historically trawled area (Wallace et al. 2015). The deep-sea bottom trawl closure covers 88% of the 800 to 1,500 m depth stratum (Wallace et al. 2015).

2. *Sensitive and important habitats* (Table 17): Restrictions on bottom contact fishing activities have been implemented In accordance with the Sensitive Benthic Areas Policy and its Ecological Risk Assessment Framework (ERAF) for Cold-water Corals and Sponge Dominated Communities. Rockfish Conservation Areas (RCAs) were established in 2007 to act as fishery closures or marine refuges for inshore rockfishes (DFO 2019d).
3. *Marine protected areas (MPAs)* (Table 17): Canada surpassed its initial target of conserving 10% of marine and coastal areas in 2019. It is estimated that 1,941 km^2 of rockfish habitat is protected within areas under provisional and federal protection; however, rockfish are not protected from fishing pressure in provincial protected areas (DFO 2019d).

These mitigation measures (along with active avoidance of areas of high CWCS density) have been effective at mitigating the impact to CWCS. Specifically, over the last 12 years, there has been a decrease in encounter frequency (by 31%), mean catch weight (by 76%), and total annual catch (by 89%) of CWCS in the Bottom Trawl sector (Gale et al. 2022).

In summary, the groundfish trawl fishery prohibits expansion of the fishery's footprint, and vulnerable habitats are protected through area closures; the fishery employs measures that have been demonstrated to be highly effective in reducing the impact of the fishing gear, and this factor is scored +1.

Justification:

Trawl Habitat Conservation Measures

The freeze on the trawl footprint was negotiated over a 3-year period with the goal of limiting impacts to any single habitat type; more specifically, the objective was to close >50% of the area of each habitat type to bottom trawling (Wallace et al. 2015). Before the footprint freeze, trawling occured in >50% of the area of 32 of 78 identified habitat types; after the trawl boundary was set, 22 of the habitat types exceeded the 50% trawled threshold (Wallace et al. 2015).

The Habitat Bycatch Conservation Limit implemented a fleet-wide Habitat Bycatch Conservation Limit (HBCL) of 4,500 kg. The HBCL acts as a fleet-wide cap on sponges and corals caught incidentally in the fishery. The fleet-wide HBCL is allocated to vessels, and all catch of coral and sponge counts against the vessel's individual HBCL. Any vessel that exceeds its individual HBCL is barred from trawling for the rest of that fishing year, unless sufficient HBCL can be acquired from another vessel.

The third and final management measure is an encounter protocol. This protocol establishes a procedure that is followed if and when a trawl vessel catches >20 kg of coral and/or sponge in a single tow. Essentially, the protocol ensures creating a priority on data collection and the timely transmission of relevant information regarding the incident (e.g., location, amount caught) to the rest of the trawl fleet. The vessels in the rest of the fleet, operating under the restrictive limits of their individual HBCL holdings, will presumably avoid trawling in the location of the catch.

Effectiveness of current RCAs

RCAs were modeled to protect an estimated 28% of rockfish habitats (defined as rocky reef, kelp forest, eelgrass bed, and glass sponge reef) in Inside waters and 15% of rockfish habitats in Outside waters (DFO 2019d). But a recent analysis found that the proportion of RCA area that contains actual rockfish habitat is just 26%, suggesting that many RCAs may provide limited conservation benefit to inshore rockfish and some RCA boundaries may need to be expanded (DFO 2019d). According to a recent risk assessment of RCAs, currently permitted activities within RCAs may prevent RCAs from effectively conserving the ecological components of interest, but the authors suggest that more information is needed (DFO 2019e).

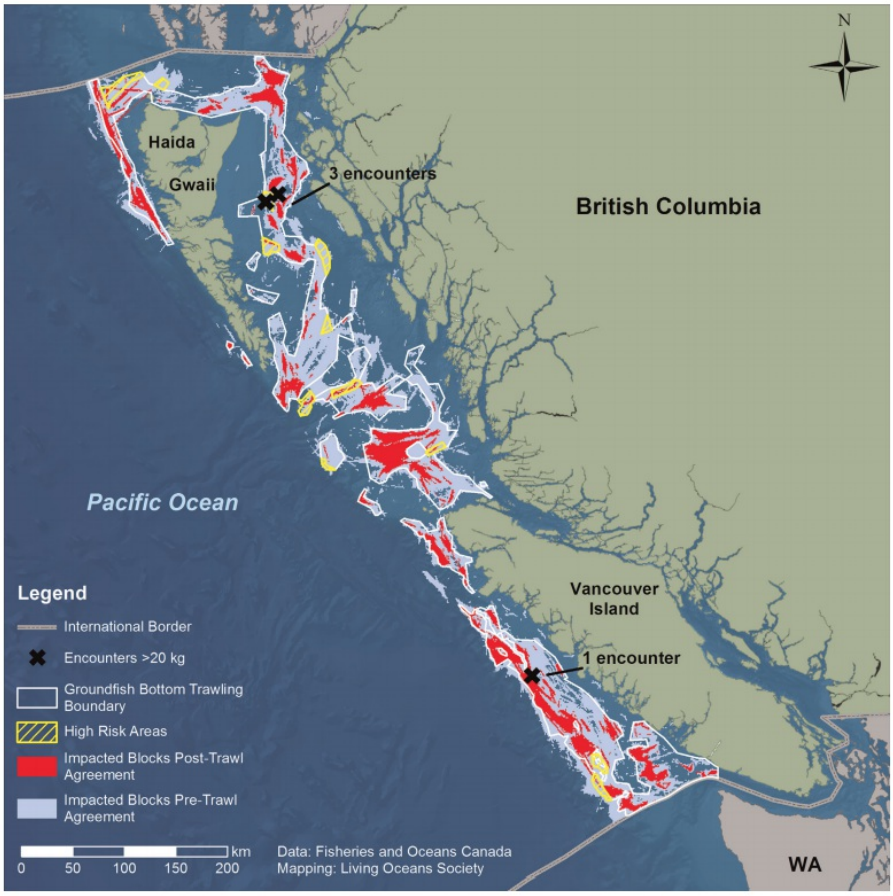

Figure 64. Map showing historical area trawled from 1996 to 2011 (light blue), negotiated groundfish bottom trawling boundary, area bottom trawled in the two fishing years since the agreement, location of encounters greater than 20 kg (x), and identified high coral and sponge areas (yellow). Figure from (Wallace et al. 2015).

Table 17. Conservation and protected areas, their size, and restrictions that apply to groundfish fisheries

Protected Area	Approximate Size	Notes
Rockfish Conservation Areas	4,350 km^2	Closed to all groundfish gear except midwater trawl (DFO 2021a).
SGaan Kinghlas-Bowie Seamount Marine Protected Area (MPA)	6,103 km^2	Closed to all bottom-contact fishing (DFO 2021a).
Hecate Strait and Queen Charlotte Sound Glass Sponge Reefs MPA	2,410 km^2	Core Protection Zones closed to all fishing. Vertical Adaptive Management Zones and Adaptive Management Zones closed to all bottom-contact fishing (DFO 2021a).
Strait of Georgia and Howe Sound Glass Sponge Reef Marine Refuges	32.6 km^2	Closed to bottom-contact fishing for groundfish (DFO 2021a).

Endeavour Hydrothermal Vents MPA	97 km^2	Closed to all bottom-contact fishing fishing (DFO 2021a).
Offshore Pacific Area of Interest (AOI)	133,019 km^2	First step in the MPA establishment process. Seven different commercial licenses have occurred within the AOI since 2006, including groundfish trawl, halibut hook and line, halibut and sablefish license, lingcod hook and line, and Outside rockfish (DFO 2019c). The Offshore Pacific Seamounts and Vents Closure applies to all bottom-contact fishing and covers an area of 83,000 km^2 (DFO 2021a).
Offshore Pacific Seamounts and Vents Closure	83,000 km^2	Closed to all bottom-contact fishing (DFO 2021a).
Gwaii Haanas National Marine Conservation Area Reserve	3,500 km^2	Closed to all commercial and recreational fishing within strict protection zones and restricted access zones (Haida Nation 2018).

Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl

Score: 0

There are few habitat-related spatial limits placed on the midwater trawl fishery. Midwater trawling is not subject to the suite of habitat management measures implemented for bottom trawling, as described previously. Furthermore, midwater trawling is allowed in Rockfish Conservation Areas. This results in no mitigation.

Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery

+.5

There are several initiatives in BC to protect sensitive and critical habitats from bottom-contact gear and other activities. A list of areas and their restrictions related to groundfish fisheries is provided in the Justification section. Mitigation measures related to the non-trawl fisheries broadly fall into two strategies: 1) protecting rockfish habitat and other sensitive areas, and 2) meeting Canada's goal of conserving 30% of marine and coastal areas by 2030.

1. *Sensitive and important habitats* (Figure 65): Restrictions on bottom contact fishing activities have been implemented In accordance with the Sensitive Benthic Areas Policy and its Ecological Risk Assessment Framework (ERAF) for Cold-water Corals and Sponge Dominated Communities. Rockfish Conservation Areas (RCAs) were established in 2007 to act as fishery closures or marine refuges for inshore rockfishes (DFO 2019d).
2. *Marine protected areas (MPAs)* (Table 19): Canada surpassed its initial target of conserving 10% of marine and coastal areas in 2019. It is estimated that 1,941 km^2 of rockfish habitat is protected within areas under provisional and federal protection; however, rockfish are not protected from fishing pressure in provincial protected areas (DFO 2019d).

Vulnerable habitats are protected through area closures, and RCAs are protected from all bottom contact gears in the groundfish fishery. But other bottom contact fisheries are still permitted to fish inside RCAs (Table18) (DFO 2019e). While large areas of habitat are protected from bottom trawls, groundfish line and sablefish trap fisheries occur in regions of the continental slope and shelf that are inaccessible by bottom trawl (Doherty et al. 2017). These measures are reasonably expected to be effective, but RCA boundaries may need to be expanded to accomplish conservation goals (see Justification). Therefore, a +0.5 score is awarded.

Justification:

Effectiveness of current RCAs

RCAs were modeled to protect an estimated 28% of rockfish habitats (defined as rocky reef, kelp forest, eelgrass bed, and glass sponge reef) in Inside waters and 15% of rockfish habitats in Outside waters (DFO 2019d). But a recent analysis found that the proportion of RCA area that contains actual rockfish habitat is just 26%, suggesting that many RCAs may provide limited conservation benefit to inshore rockfish and some RCA boundaries may need to be expanded (DFO 2019d). According to a recent risk assessment of RCAs, currently permitted activities within RCAs may prevent RCAs from effectively conserving the ecological components of interest, but the authors suggest that more information is needed (DFO 2019e).

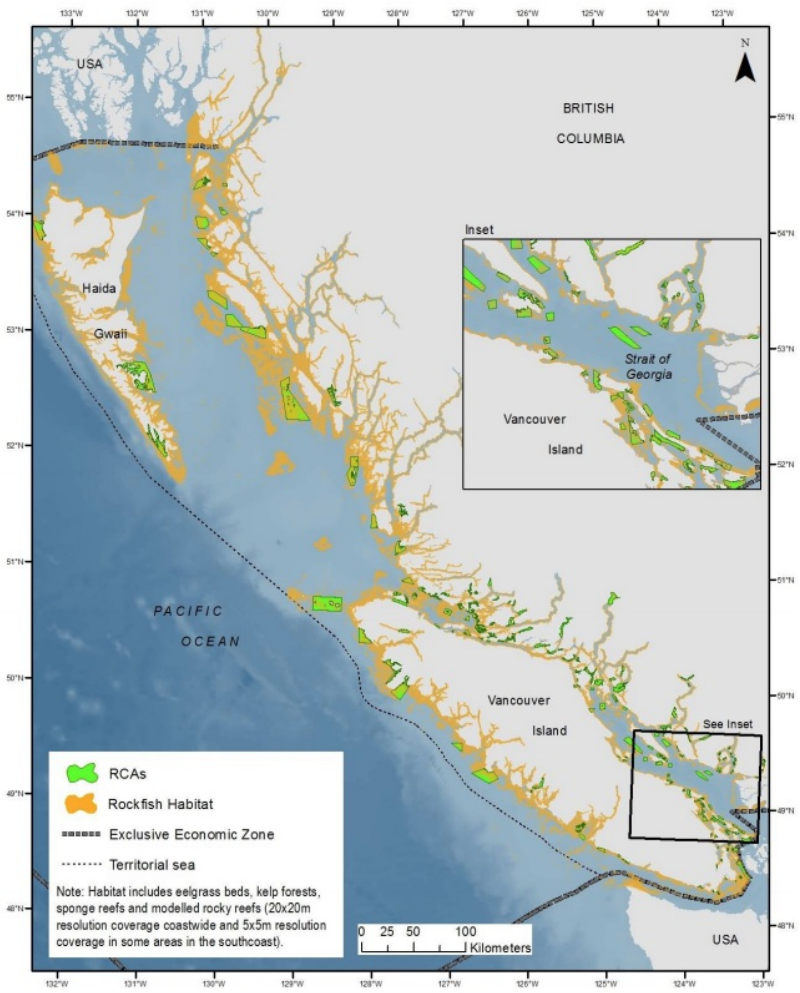

Figure 65: RCAs and rockfish habitat (includes rocky reefs, eelgrass beds, kelp forests and sponge reefs). Figure from (DFO 2019e).

Table 18. Permitted fishing activities within RCAs (DFO 2019e)

Commercial fishing	Recreational Fishing	First Nations
• Invertebrates by hand picking or dive • Crab by trap • Shrimp/prawn by trap • Scallops by trawl • Salmon by seine or gillnet • Herring by gillnet, seine, and spawn-on-kelp • Sardine by gillnet, seine, and trap (fishery closed since 2015—may reopen) • Smelt by gillnet (fishery closed since 2012—may reopen) • Euphausiid (krill) by midwater trawl • Groundfish by midwater trawl	• Invertebrates by hand picking or dive • Crab by trap • Shrimp/prawn by trap • Smelt by gillnet	• Food, social, ceremonial fishing

Table 19. Conservation and protected areas, their size, and restrictions that apply to groundfish fisheries

Protected Area	Approximate Size	Notes
Rockfish Conservation Areas	4,350 km^2	Closed to all groundfish gear except midwater trawl (DFO 2021a).
SGaan Kinghlas-Bowie Seamount Marine Protected Area (MPA)	6,103 km^2	Closed to all bottom-contact fishing (DFO 2021a).
Hecate Strait and Queen Charlotte Sound Glass Sponge Reefs MPA	2,410 km^2	Core Protection Zones closed to all fishing. Vertical Adaptive Management Zones and Adaptive Management Zones closed to all bottom-contact fishing (DFO 2021a).
Strait of Georgia and Howe Sound Glass Sponge Reef Marine Refuges	32.6 km^2	Closed to bottom-contact fishing for groundfish (DFO 2021a).
Endeavour Hydrothermal Vents MPA	97 km^2	Closed to all bottom-contact fishing fishing (DFO 2021a).
Offshore Pacific Area of Interest (AOI)	133,019 km^2	First step in the MPA establishment process. Seven different commercial licenses have occurred within the AOI since 2006, including groundfish trawl, halibut hook and line, halibut and sablefish license, lingcod hook and line, and Outside rockfish (DFO 2019c). The Offshore Pacific Seamounts and Vents Closure applies to all bottom-contact fishing and covers an area of 83,000 km^2 (DFO 2021a).
Offshore Pacific Seamounts and Vents Closure	83,000 km^2	Closed to all bottom-contact fishing (DFO 2021a).
Gwaii Haanas National Marine Conservation Area Reserve	3,500 km^2	Closed to all commercial and recreational fishing within strict protection zones and restricted access zones (Haida Nation 2018).

Factor 4.3 - Ecosystem-based Fisheries Management

Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC Central (5ABC) | BC South (3CD) | Deepwater flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | BC Central (5ABC) | Shallow water flatfish
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC North (5DE) | Pelagics
Northeast Pacific | Canada | British Columbia | Bottom trawls | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Sablefish Longline Fishery
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Outside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Bottom trawls | BC South (3CD) | Pelagics
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC North (5DE) | BC Central (5ABC) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Midwater trawls | BC South (3CD) | Rockfish Trawl
Northeast Pacific | Canada | British Columbia | Set longlines | Jig | Trolling lines | Inside Rockfish Fishery
Northeast Pacific | Canada | British Columbia | Jig | Trolling lines | Lingcod fishery
Northeast Pacific | Canada | British Columbia | Pots | Sablefish Pot Fishery

Moderate Concern

Although groundfish as a whole are of significant importance to food webs as predators, competitors, and prey, the diversity found in groundfish diets (e.g., (Pearsall & Fargo 2007)) and in the relevant food webs themselves (DFO 2007) suggests that highly specialized relationships are not expected for many particular species. As a result, the trophic webs are thought to be more stable

and resilient than those that have “wasp-waist” characteristics (DFO 2007). There is limited evidence to suggest that many of the main species caught in the seven groundfish fisheries play an outsized (aka “keystone”) role, relative to their abundance, in ecosystem functioning or food web structure and function, though there are some exceptions. For example, due to their large size, lingcod and yelloweye rockfish may be top predators in temperate rocky reef ecosystems (Olson et al. 2020); a declining trend in average body size of quillback and yelloweye rockfish could have food web impacts (McGreer and Frid 2017); and having fewer large lingcod in these ecosystems may release rockfish and kelp greenling from predation risk (Frid et al. 2012).

Currently, there are no programs or management measures in place that are meant specifically to manage groundfish fisheries according to the target species’ ecological roles. The development of tools for ecosystem-based management is an ongoing effort in other branches of DFO (e.g., research initiative in the Strait of Georgia). Federal fisheries policies (i.e., the Fisheries Act) give the Minister of Fisheries and Oceans discretionary power over fisheries management decisions, which may hinder fisheries sustainability (Hutchings et al. 2020). The Minister may consider an ecosystem approach, but there is no mandate to do so under the Fisheries Act (Hutchings et al. 2020). There is a lack of ecological data needed for food web models, which can limit the implementation of ecosystem-based fishery management (EBFM) (Bizzarro et al. 2017). Management of BC groundfish currently uses one of the EBFM components used in the U.S. West Coast groundfish fishery (i.e., establishing restricted-take zones or marine protected areas), but there are no known initiatives to identify habitat associations or to incorporate trophic information into groundfish fishery management, which are considered crucial components of EBFM (Bizzarro et al. 2017).

According to the Groundfish IFMP, the specific strategies that are considered to protect ecosystem functioning include: 1) the Policy for Managing the Impacts of Fishing on Sensitive Benthic Areas, 2) the creation of the Hecate MPA, 3) rebuilding plans under the Precautionary Approach Framework that should consider a broader ecosystem context for rebuilding, 4) the implementation of the Land-Sea-People plan for Gwaii Haanas, and 5) the creation of the Pacific North Coast Integrated Management Area (PNCIMA) Plan (DFO 2021a). DFO uses temporal and spatial management to protect sensitive habitats, as detailed in Factor 4.2. In addition to year-round closures for sensitive areas and rockfish habitats, some areas are closed seasonally to protect stocks during the spawning period. A main component of the Habitat Conservation Collaboration Agreement referenced previously was to establish ecosystem-based trawling boundaries to address the impacts of trawling on bottom habitats (Wallace et al. 2015). The boundaries were designed “to prevent further spatial expansion, exclude areas of historically high coral and sponge bycatch, and to ensure that the area opened to bottom trawling did not disproportionately impact any single habitat type” (Wallace et al. 2015). Supplemental closures for the 2021 season that are specifically related to groundfish species are also outlined in the Justification section. Recent research indicates that groundfish management measures may have been an important contributor to an overall increase in species density and community biomass of BC groundfish observed from 2003 to 2018 (Thompson et al. 2022).

Because detrimental food web impacts due to harvesting are possible for some species, but spatial and temporal management measures are in place that are likely to be effective, a score of moderate concern is awarded.

Justification:
Information for main species with ecological roles that could cause food web impacts

There are numerous targeted and retained species considered in this report, many of which are considered data-limited or data-poor. Therefore, it is unsurprising that there is scant information on the ecological roles of the majority of the species in the BC groundfish fishery. Studies from the Gulf of Alaska and the U.S. West Coast may provide insight into the ecological role of a few groundfish species. Examples of research examining the trophic roles of retained species include:

- Overexploitation of large rockfish (e.g., yelloweye rockfish) can result in an alternative stable state in which smaller rockfish species dominate the ecological community as a result of predator release (Baskett et al. 2006). Spatial protection measures such as MPAs can restore predator abundance and enhance species richness and abundance (Freeman 2021).
- Recent research suggests that yelloweye rockfish, quillback rockfish, and lingcod potentially exert top-down control on prey communities (Olson et al. 2020). There is evidence that smaller-bodied rockfish species can have significant ecological roles and that removal of large individuals may degrade trophic structures (Olson et al. 2020).
- A study in the Gulf of Alaska suggests that arrowtooth flounder exhibits strong top-down control over walleye pollock (*Gadus chalcogrammus*) (Barnes et al. 2020). Arrowtooth flounder has been shown to exert broad predation pressure in the Gulf of Alaska, and the species competes with other top-level predators for prey resources; thus, a small change in arrowtooth flounder survival may have potentially large effects on multiple species (Doyle et al. 2018).
- In Alaska, Pacific cod and Pacific Ocean perch have an important predation impact in their ecosystems (Livingston et al. 2017).
- In the California Current Ecosystem, common murre frequently consumes juvenile rockfish, but this bird will shift to northern

anchovy and Chinook salmon when ocean conditions are unfavorable for rockfish; this negatively affects Chinook salmon survival (Wells et al. 2017).

- The ecological role of shortspine thornyhead is not well understood (Taylor and Stephens 2014), and little is known about the impacts from fish and marine mammal predators (Echave et al. 2022).
- Food web modeling in Alaska suggests that arrowtooth flounder and halibut predation accounted for 47% of adult sablefish mortality in the Aleutian Islands (AI), while salmon shark accounted for 32% of mortality in Gulf of Alaska (GOA); 60% of sablefish juvenile mortality is due to predation, primarily from Pacific cod in AI and arrowtooth flounder in the GOA and fur seals in the eastern Bering Sea (Aydin et al. 2007). Sablefish is an important predator of rockfish and jellyfish in the GOA and of pollock and other forage fish in the eastern Bering Sea (Aydin et al. 2007). Along the U.S. West Coast, approximately 60% of the diet of adult sablefish comprises deep small rockfishes, Pacific hake, and squid (Haltuch et al. 2019).

Additional Temporal and Spatial Closures for 2021–22 (DFO 2021a)

- Hecate Strait/Dixon Entrance closed to all trawling from January 1 to April 30 to protect the spawning biomass of Pacific cod found in this area.
- Lower West Coast Vancouver Island is closed to trawling from January 1 to March 31 to reduce harvesting pressure on Pacific cod during spawning.
- Tide Marks closed to all trawling from February 21 to May 31 and from October 1 to March 31 to reduce harvesting pressure on Pacific ocean perch during spawning.
- 800 line/Circle Tow Seasonal Expansion Closure occurs from November 1 to March 31 to protect arrowtooth flounder and halibut spawning aggregations.
- In-Season Groundfish trawl closures occur in a number of Subareas within Inside waters to protect herring spawn areas and salmon/herring holding areas, and to reduce harvesting pressure on localized groundfish stocks.

Other Effective Area-Based Conservation Measures (OEABCM)

In addition to MPAs, the Government of Canada has implemented OEABCMs, which are spatially defined management measures that meet a set of criteria defined under DFO guidance (DFO 2016). The criteria are used to determine if management measures provide the biodiversity and conservation goals; if all five criteria are met, then the management measures are considered OEABCMs (DFO 2016). The five criteria from DFO (2016) are:

1. Clearly defined geographic location;
2. Conservation or stock management objectives;
3. Presence of ecological component of interest;
4. Long-term duration of implementation; and
5. Ecological components of interest are effectively conserved.

DFO recently evaluated RCAs against the above criteria, including a qualitative risk assessment to determine if permitted human activities inhibit RCAs from meeting criterion 5 (DFO 2019e). The assessment focuses on the effects to Inshore rockfish, their prey, and rocky reef habitat (DFO 2019e). Rockfish are still susceptible to fishing mortality inside RCAs because recreational fisheries and some commercial fisheries are permitted in these protected areas (McGreer et al. 2020)(DFO 2019e). While these permitted activities are unlikely to significantly impact rockfish *habitat*, the efficacy of RCAs relative to the ecology of rockfish stocks is uncertain.

The Pacific North Coast Integrated Management Area Plan (DFO 2021a)

“Endorsed in February 2017, the Pacific North Coast Integrated Management Area (PNCIMA) plan was developed, in collaboration with the Province of British Columbia, First Nations and stakeholders to help coordinate various ocean management processes and to complement existing processes and tools including IFMPs. High level and strategic, the plan provides direction on integrated, ecosystem-based and adaptive management of marine activities and resources in the planning area as opposed to detailed operational direction for management. The plan outlines an ecosystem-based management (EBM) framework for PNCIMA that has been developed to be broadly applicable to decision-makers, regulators, community members and resource users alike, as federal, provincial and First Nations governments, along with stakeholders, move together towards a more holistic and integrated approach to ocean use in the planning area.”

Land-Sea-People Plan for Gwaii Haanas

The Land-Sea-People Plan was recently implemented through a collaboration between the Canadian government and the Council of the Haida Nation. The plan involves cooperative management of fisheries using an ecosystem-based management framework (DFO 2021a).

Acknowledgements

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

Seafood Watch would like to thank the consulting researcher and author of this report, Gabe Andrews from The Safina Center, as well as five anonymous reviewers for graciously reviewing this report for scientific accuracy.

References

AFSC. 2021. Life Hisory database. Resource Ecology and Fisheries Management Division, Alaska Fisheries Science Center.

Anderson, S.C. and English, P.A. 2022. DRAFT Trends in Pacific Canadian groundfish stock status and surveys.

Anderson, S.C., Connors, B.M., English, P.A., Forrest, R.E., Haigh, R., and Holt, K.R. 2021. Trends in Pacific Canadian groundfish stock status in Fisheries and Oceans Canada State of the Pacific Ocean report in 2021.

Anderson, S.C., Forrest, R.E., Huynh, Q.C., and Keppel, E.A. 2021b. A management procedure framework for groundfish in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2021/007. vi + 139 p.

Anderson, S.C., Keppel, E.A., Edwards, A.M. 2019. A reproducible data synopsis for over 100 species of British Columbia groundfish. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/041. vii + 321 p

Archibald, D.W., McIver, R., and Rangeley, R. 2021. The implementation gap in Canadian fishery policy: Fisheries rebuilding and sustainability at risk. *Marine Policy* Volume 129,
2021, 104490.

Aydin, K., S. Gaichas, I. Ortiz, D. Kinzey, and N. Friday. 2007. A comparison of the Bering Sea, Gulf of Alaska, and Aleutian Islands large marine ecosystems through food web modeling. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-178, 298 p.

Barnes, C. L., A. H. Beaudreau, M. W. Dorn, K. K. Holsman, and F. J. Mueter. 2020. Development of a predation index to assess trophic stability in the Gulf of Alaska. Ecological Applications 30(7): e02141. https://doi.org/10.1002/eap.2141

Barnett, L.A.K., Ebert, D.A. & Dagit, D.D. 2015. *Hydrolagus colliei. The IUCN Red List of Threatened Species* 2015: e.T60191A80678052

Baskett, M. L., M. Yoklavich, and M. S. Love. 2006. Predation, competition, and the recovery of overexploited fish stocks in marine reserves. Canadian Journal of Fisheries and Aquatic Sciences 63(6):1214-1229. DOI: 10.1139/f06-013.

Baum, J.K. & Fuller, S.D. 2016. Canada's Marine Fisheries: Status, Recovery Potential and Pathways to Success. A Report Prepared by the University of Victoria for Ocean Canada. 154 pp.

Bigman, J.S., Ebert, D.A. & Goldman, K.J. 2016. *Squalus suckleyi. The IUCN Red List of Threatened Species* 2016: e.T195488A2382480

BirdLife International. 2018. *Phoebastria albatrus. The IUCN Red List of Threatened Species* 2018: e.T22698335A132642113.

BirdLife International. 2020. *Phoebastria nigripes. The IUCN Red List of Threatened Species* 2020: e.T22698350A181896323.

Bizzarro, J.J., Ebert, D.A., Herman, K. & Kyne, P.M. 2020. *Beringraja rhina. The IUCN Red List of Threatened Species* 2020: e.T161595A80677015

Bizzarro, J.J., Yoklavich, M.M., and Wakefield, W.W. 2017. Diet composition and foraging ecology of U.S. Pacific Coast groundfishes with applications for fisheries management. Environ Biol Fish (2017) 100:375–393.

Bryan, M., Orlov, A., Spies, I., Stevenson, D., Volvenko, I. & Munroe, T.A. 2021b. *Hippoglossoides elassodon. The IUCN Red List of Threatened Species* 2021.

Bryan, M., Spies, I., Stevenson, D. & Munroe, T.A. 2021. Glyptocephalus zachirus. The IUCN Red List of Threatened Species 2021: e.T158625570A158637966.

Bryan, M., Spies, I., Stevenson, D. & Munroe, T.A. 2021f. *Microstomus pacificus. The IUCN Red List of Threatened Species* 2021: e.T158632595A158638061. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T158632595A158638061.en. Accessed on 09 May 2022.

Bystrom, A. and Jurado Molina, J. 2021. US North Pacific Halibut and Sablefish Fishery MSC Fishery reassessment Public Certification Report August 9, 2021.

Carretta, J.V., Erin M. Oleson, Karin. A. Forney, Marcia M. Muto, David W. Weller, Aimee R. Lang, Jason Baker, Brad Hanson, Anthony J. Orr, Jay Barlow, Jeffrey E. Moore, and Robert L. Brownell Jr. 2021. U.S. Pacific Marine Mammal Stock Assessments: 2020, U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-646.

Commissioner of the Environment and Sustainable Development, Report 2—Sustaining Canada's Major Fish Stocks—Fisheries and Oceans Canada, 2016.

Conrath, C.L.. 2017. Maturity, Spawning Omission, and Reproductive Complexity of Deepwater Rockfish, Transactions of the American Fisheries Society, 146:3, 495-507.

Cope, J., Dick, E.J., MacCall, A., Monk, M., Soper, B., and Wetzel, C. 2015. Data-moderate stock assessments for brown, China, copper, sharpchin, stripetail, and yellowtail rockfishes and English and rex soles in 2013. Pacific Fishery Management Council.

Cope, J.M. & Berger, A.M. 2020. *Hexagrammos decagrammus. The IUCN Red List of Threatened Species* 2020: e.T158882453A158883838.

Cope, J.M., and A.D. MacCall. 2006. Status of Kelp Greenling (Hexagrammos decagrammus) in Oregon and California Waters as assessed in 2005. In Volume 5: Status of the Pacific Coast Groundfish Fishery Through 2005, Stock Assessment and Fishery Evaluation Portland, OR: Pacific Fishery Management Council.

Cornthwaite, M. and Workman, G. 2021. British Columbia Groundfish Fisheries and Their Investigations in 2020. April 2021 Fisheries and Oceans Canada Science Branch, Pacific Biological Station, Nanaimo, British Columbia V9T 6N7.

COSEWIC. 2007a. COSEWIC assessment and status report on the canary rockfish (Sebastes pinniger) in Canada. Committee on the Status of Endangered Wildlife in Canada.

COSEWIC. 2007c. COSEWIC assessment and status report on the longspine thornyhead *Sebastolobus altivelis* in Canada. Committee on the Status of Endagered Wildlife in Canada. Ottawa. vi + 27 pp.

COSEWIC. 2009. COSEWIC assessment and status report on the darkblotched rockfish Sebastes crameri in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa.

COSEWIC. 2009b. COSEWIC assessment and status report on the Quillback Rockfish *Sebastes maliger* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa.

COSEWIC. 2010. COSEWIC Assesment and status report on the yellowmouth rockfish Sebastes reedi in Canada. Committee on the Status of Endangered Wildlife in Canada.

COSEWIC. 2011. COSEWIC assessment and status report on the North Pacific spiny dogfish Squalus suckleyi in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2013. Short-tailed albatross (Phoebastria albatrus) COSEWIC assessment and status report 2013.

COSEWIC. 2013a. COSEWIC assessment and status report on the Bocaccio Sebastes paucispinis in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 49 pp.

COSEWIC. 2020. Species Profile: Yelloweye Rockfish Pacific Ocean outside waters population.

COSEWIC. 2020b. Species Profile: Yelloweye Rockfish Pacific Ocean inside waters population.

COSEWIC. 2021. Humpback Whale (Megaptera novaeangliae kuzira), North Pacific population: Species summary.

COSEWIC. 2023. COSEWIC Assessment and Status Report on the Humpback Whale Megaptera novaeangliae kuzira, North Pacific population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 62 pp.

Cox, S.P., Doherty, B., Benson, A.J., Johnson, S.D.N., and Haggarty, D.R. 2020. Evaluation of potential rebuilding strategies for Outside Yelloweye Rockfish in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/069. viii + 135 p.

DFO Pacific Region. 2021. British Columbia groundfish fishery catch data, 2018-2021: Dataset in fulfillment of data request

DFO Pacific Region. 2024. British Columbia groundfish fishery catch data by target species, 2019-2023: Dataset in fulfillment of data request.

DFO. 2001. Fish stocks of the Pacific coast. Fisheries and Oceans Canada. ISBN 0-662-30042-4.

DFO. 2007. Ecosystem overview: Pacific North Coast Integrated Management Area (PNCIMA). Canadian Technical Report of Fisheries and Aquaculture Sciences, Report 2667. Fisheries and Oceans Canada.

DFO. 2008. Population assessment: Steller sea lion (Eumetopias jubatus). Canadian Science Advisory Secretariat Science Advisory Report 2008/047.

DFO. 2009a. A fishery decision-making framework incorporating the precautionary approach

DFO. 2009c. Stock assessment update for British Columbia canary rockfish. Canadian Science Advisory Secretariat Science Response, 2009/019.

DFO. 2010. Assessment of spiny dogfish (Squalus acanthias) in British Columbia in 2010. Canadian Science Advisory Report 2010/057.

DFO. 2011. Management plan for the Steller sea lion (Eumetopias jubatus) in Canada. Fisheries and Oceans Canada.

DFO. 2011c. Lingcod (Ophiodon elongatus) stock assessment and yield advice for outside stocks in British Columbia. Canadian Science Advisory Secretariat Science Advisory Report 2011/051.

DFO. 2012d. Management plan for the rougheye/blackspotted rockfish complex (Sebastes aleutianus and S. melanostictus) and longspine thornyhead (Sebastolobus altivelis) in Canada. Species At Risk Act Management Plan Series.

DFO. 2013. Pacific Ocean Perch (Sebastes alutus) stock assessments for the west coast of Vancouver Island and the north and west coasts of Haida Gwaii, British Columbia. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/038.

DFO. 2014d. Big skate (Raja binoculata) and longnose skate (R. rhina) stock assessments for British Columbia. Canadian Science Advisory Secretariat SAR 2014/027.

DFO. 2015a. Yellowtail Rockfish (Sebastes Flavidus) Stock Assessment for the Coast of British Columbia, Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/010.

DFO. 2015b. Proceedings of the Pacific regional peer review on Stock assessment for Yellowtail Rockfish (Sebastes flavidus) in British Columbia; November 18-19, 2014. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2015/020.

DFO. 2016. Operational Guidance for Identifying “Other Effective Area-Based Conservation Measures” in Canada’s Marine Environment.

DFO. 2016b. Stock assessment of the coastwide population shortspine thornyhead (*Sebastolobus alascanus*) for British Columbia, Canada in 2015. Canadian Science Advisory Secretariat Science Advisory Report 2016/016.

DFO. 2017. Management Plan for the Green Sturgeon (Acipenser medirostris) in Canada. Species at Risk Act Management Plan Series. Fisheries and Oceans Canada, Ottawa. v + 36 pp.

DFO. 2018. Redstripe Rockfish (Sebastes propiger) stock assessments for British Columbia in 2018. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/049.

DFO. 2018b. Glass sponge aggregations in Howe Sound: locations, reef status, and ecological significance assessment. DFO Can. Sci. Advis. Sec. Sci. Resp. 2018/032.

DFO. 2018c. Walleye Pollock (Theragra chalcogramma) stock assessment for British Columbia in 2017. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/020.

DFO. 2019. Widow Rockfish (Sebastes entomelas) stock assessment for British Columbia in 2019. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2019/044

DFO. 2019b. Action Plan for the Atlantic Salmon (Salmo salar), inner Bay of Fundy population in Canada. Species at Risk Act Action Plan Series. Fisheries and Oceans Canada, Ottawa. vii + 59pp.

DFO. 2019c. Biophysical and Ecological Overview of the Offshore Pacific Area of Interest (AOI). DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/011.

DFO. 2019d. A Regional Assessment of Ecological Attributes in Rockfish Conservation Areas in British Columbia. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/022.

DFO. 2019e. Risk Assessment of Permitted Human Activities in Rockfish Conservation Areas in British Columbia. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2019/057

DFO. 2020. Bocaccio (*Sebastes paucispinis*) stock assessment for British Columbia in 2019, including guidance for rebuilding plans. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/025.

DFO. 2020. Status of Steller Sea Lions (Eumetopias jubatus) in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/046.

DFO. 2020a. Groundfish trawl catch and TAC summaries.

DFO. 2020b. Groundfish hook and line catch and TAC summaries.

DFO. 2020c. Evaluating the robustness of candidate management procedures in the BC Sablefish (*Anoplopoma fibria*) fishery for 2019-2020. DFO Can. Sci. Advis. Sec. Sci. Resp. 2020/025.

DFO. 2020d. Rougheye/Blackspotted Rockfish (Sebastes aleutianus/melanostictus) Stock Assessment for British Columbia in 2020. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/047.

DFO. 2020e. Evaluation of Management Procedures for the Inside Population of Yelloweye Rockfish Rebuilding Plan in British Columbia. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/056.

DFO. 2021. Pacific groundfish reports and publications: Archived year-to-date catch - Hook and line, Archived summary of catch vs weight - Trawl. April 4, 2021.

DFO. 2021a. Pacific Region Integrated Fisheries Management Plan: Groundfish (Effective February 21, 2021). Fisheries and Oceans Canada.

DFO. 2021b. Groundfish hook and line catch and TAC summaries.

DFO. 2021c. A Management Procedure Framework for Groundfish In British Columbia. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2021/002.

DFO. 2021d. Ghost Gear Fund: combatting marine litter. Date modified: 2021-07-12.

DFO. 2021e. Management Plan for the Yelloweye Rockfish (Sebastes ruberrimus) in Canada. Species at Risk Act Management Plan for the Yelloweye Rockfish (*Sebastes ruberrimus*) in Canada. Species at Risk Act Management Plan Series. Fisheries and Oceans Canada, Ottawa. v + 31 pp.

DFO. 2021g. Pacific Region Integrated Fisheries Management Plan: Fraser River Eulachon (Effective January 1, 2021). Fisheries and Oceans Canada.

DFO. 2021i. Status update of Pacific cod (Gadus macrocephalus) for West Coast Vancouver Island (Area 3CD), and Hecate Strait and Queen Charlotte Sound (Area 5ABCD) in 2020. Canadian Science Advisory Secretariat Science Response 2021/002.

DFO. 2021j. Groundfish trawl catch and TAC summaries. Effective Date: 14-Mar-2021 01:40:00 PM

DFO. 2022. A data synopsis for British Columbia groundfish: 2021 data update. DFO Can. Sci. Advis. Sec. Sci. Resp. 2022/020.

DFO. 2022a. Yellowmouth Rockfish (Sebastes reedi) Stock Assessment for British Columbia in 2021. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2022/001.

DFO. 2022b. Update of the 2019 Bocaccio (Sebastes paucispinis) stock assessment for British Columbia in 2021. DFO Can. Sci. Advis. Sec. Sci. Resp. 2022/001.

DFO. 2022c. Modelled-based biomass indices from relevant surveys. Supplied by Sean Anderson, April 21, 2022.

DFO. 2022d. Pacific Region Integrated Fisheries Management Plan: Groundfish (Effective February 21, 2022). Fisheries and Oceans Canada.

DFO. 2022e. Groundfish trawl catch and TAC summaries. Effective Date: 16-Mar-2022 01:40:00 PM.

DFO. 2023. Pacific Region Integrated Fisheries Management Plan, Eulachon Fraser River, January 1, 2023 to December 31, 2023. DFO number: 22-2229.

DFO. 2023a. Canary Rockfish (Sebastes pinniger) Stock Assessment for British Columbia in 2022. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2023/002.

DFO. 2023b. Pacific region convictions under the *Fisheries Act*. Date modified: 2023-01-11

DFO. 2023c. A Revised Operating Model for Sablefish in British Columbia in 2022. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2023/010.

DFO. 2023d. Application of the Management Procedure Framework for Inside Quillback Rockfish (Sebastes maliger) in British Columbia in 2021. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2023/033.

DFO. 2023e. Arrowtooth Flounder (*Atheresthes stomias*) Stock Assessment for British Columbia in 2021. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2023/042.

DFO. 2023f. Application of the Management Procedure Framework for Outside Quillback Rockfish (Sebastes maliger) in British Columbia in 2021. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2023/041

DFO. 2023g. Groundfish trawl catch and TAC summaries. Effective Date: 18-Mar-2023 09:49:00 AM

DFO. 2023h. Management Procedures Update and Catch Advice for 2023/24- 2026/27 Fishing Seasons for Outside Yelloweye Rockfish (Sebastes ruberrimus) in the Pacific Region. DFO Can. Sci. Advis. Sec. Sci. Resp. 2023/037.

DFO. 2023i. Sustainability Survey for Fisheries: 2022 dataset. Available for download at https://open.canada.ca/data/en/dataset/49f25051-3946-426e-a589-b7063f75bbd5.

DFO. 2024. Groundfish Integrated Fisheries Management Plan 2024/25. 23-2317.349 p.

Dick, E.J., Monk, M., Taylor, l., Haltuch, M., Tsou, T-S., and Mirick, P. 2016. Status of China rockfish off the U.S. Pacific Coast in 2015. Pacific Fishery Management Council. April 2016.

Doherty, B., Johnson, S.D.N., and Cox, S.P. 2017. Using autonomous video to estimate the bottom contact area of longline trap gear and presence-absence of sensitive benthic habitat. Canadian Journal of Fisheries and Aquatic Sciences 75(5).

Doyle, Miriam & Debenham, Casey & Barbeaux, Steven & Buckley, Troy & Pirtle, Jodi & Spies, Ingrid & Stockhausen, William & Shotwell, Kalei & Wilson, Matt & Cooper, Dan. (2018). A full life history synthesis of Arrowtooth Flounder ecology in the Gulf of Alaska: Exposure and sensitivity to potential ecosystem change. Journal of Sea Research. 142. 10.1016/j.seares.2018.08.001.

Du Preez, C. and V. Tunnicliffe. 2011. Shortspine thornyhead and rockfish (Scorpaenidae) distribution in response to substratum, biogenic structures and trawling. Marine Ecology Progress SEries 425: 217-231.

Dunham, J.S., Yu, F., Haggarty, D., Deleys, N. and Yamanaka, L. 2020. A Regional Assessment of Ecological Attributes in Rockfish Conservation Areas in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/026. vii + 86 p

Echave, K.B. & Hulson, P.J.F. 2017. Assessment of Shortraker Rockfish Stock in the Gulf of Alaska. NPFMC Gulf of Alaska SAFE, December 2017.

Echave, KB, Siwicke, KA, Sullivan, J, Ferris, B, and PJF Hulson. 2022. Assessment of the Thornyhead stock complex in the Gulf of Alaska; November 2022 Plan Team Draft.

Edwards, A.M., Haigh, R. & Starr, P.J. 2012. Stock assessment and recovery potential assessment for yellowmouth rockfish (Sebastes reedi) along the Pacific coast of Canada. Canadian Science Advisory Secretariat Research Document 2012/095.

Edwards, A.M., Haigh, R., and Starr, P.J. 2014. Pacific Ocean Perch (Sebastes alutus) stock assessment for the west coast of Vancouver Island, British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/093. vi + 135 p.

Edwards, A.M., Haigh, R., and Starr, P.J. 2017. Redbanded Rockfish (Sebastes babcocki) stock assessment for the Pacific coast of Canada in 2014. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/058. v + 182 p.

Environment and Climate Change Canada. 2017. Management Plan for the Black-footed Albatross (*Phoebastria nigripes*) in Canada. Species at Risk Act Management Plan Series. Environment and Climate Change Canada, Ottawa. iv+ 30 pp.

Fargo, J., MacDougall, L., Pearsall, I. 2007. Appendix G: Groundfish. In Ecosystem overview: Pacific North Coast Integrated Management Area (PNCIMA). Edited by Lucas, B.G., Verrin, S., and Brown, R. Can. Tech. Rep. Fish. Aquat. Sci. 2667: vi + 28 p.

Farrugia, T.J., Goldman, K.J., King, J.R. & Ormseth, O.A. 2016. *Beringraja binoculata*. *The IUCN Red List of Threatened Species* 2016: e.T44183A80679344.

Fawcett-Atkinson, Marc. “B.C. harvests 196,000 tonnes of fish a year. Most of it is exported and that's a problem, advocates say.” *Canada's National Observer*. September 25, 2020.

FDA. 2022. Acceptable seafood market names.

Ford J.K.B., A.L. Rambeau, R.M. Abernethy, M.D. Boogaards, L.M. Nichol, and L.D. Spaven. 2009. An Assessment of the Potential for Recovery of Humpback Whales off the Pacific Coast of Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/015. 33 p.

Forrest, R.E., Anderson, S.C., Grandin, C.J., and Starr, P.J. 2020. Assessment of Pacific Cod (Gadus macrocephalus) for Hecate Strait and Queen Charlotte Sound (Area 5ABCD), and West Coast Vancouver Island (Area 3CD) in 2018. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/070. v + 215 p.

Fox, CH, Robertson, C, O'Hara, PD, Tadey, R, and Morgan, KH. 2020. Spatial assessment of albatrosses, commercial fisheries, and bycatch incidents on Canada’s Pacific coast. *Marine Ecology Progress Series* 672: 205-222.

Freeman, JB. 2021. Spatiotemporal trends and environmental drivers of larval rockfish species richness and community assemblages in the Southern California Bight. A thesis submitted in partial satisfaction of the requirements for the degree Master of Science in Marine Biology at the University of California San Diego.

Frid A, Marliave J, Heithaus MR. 2012. Interspecific variation in life history relates to antipredator decisions by marine mesopredators on temperate reefs. PLOS ONE 7: e40083

Froese, R., Pauly, D., 2021. FishBase. World Wide Web electronic publication.

Gale, K., Forrest, R., Rooper, C., Nephin, J., Wallace, S., Driscoll, J., and Rubidge, E.. 2022. Evaluation of collaboratively-developed management measures to reduce coral and sponge bycatch in a fully-monitored multispecies trawl fishery. Canadian Journal of Fisheries and Aquatic Sciences. 10.1139/cjfas-2021-0274.

Gertseva, V. Matson, S., Taylor, I. Bizzarro, J, Wallace, J. 2019. Stock assessment of the Longnose Skate (Beringraja rhina) in state and Federal waters off California, Oregon and Washington. Pacific Fishery Management Council, Portland, OR.

Gertseva, V. Taylor, I.G., Wallace, J.R., Matson, S.E. 2021. Status of the Pacific Spiny Dogfish shark resource off the continental U.S. Pacific Coast in 2021. Pacific Fishery Management Council, Portland, OR. Available from http://www.pcouncil.org/groundfish/stock-assessments/.

Gertseva, V.V., Cope, J.M., and D.E. Pearson. 2009. Status of the U.S. splitnose rockfish (Sebastes diploproa) resource in 2009. Final - SAFE version. October 28, 2009.

Grandin, C. & Forrest, R. 2017. Arrowtooth Flounder (Atheresthes stomias) Stock Assessment for the West Coast of British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/025. v + 87 p.

Grønbæk, L., Lindroos, M., Munro, G., Pintassilgo, P., and Turris, B. 2022. The avoidance of unwanted catch and cooperation: the case of the British Columbia groundfish trawl fishery, *ICES Journal of Marine Science.*

GSGislason & Associates. 2010. Economic impacts from a reduced groundfish trawl fishery in British Columbia.

Gunderson, D.R. 1997. Spatial patterns in the dynamics of slope rockfish stocks and their implications for management. Fish. Bull. 95:219–230

Haggarty, D.R., Huynh, Q.C., Forrest, R.E., Anderson, S.C., Bresch, M.J., Keppel, E.A. 2022. Evaluation of potential rebuilding strategies for Inside Yelloweye Rockfish (*Sebastes ruberrimus*) in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2021/008. vi + 139 p.

Haida Nation. 2018. Gwaii Haanas Gina 'Waadluxan KilGuhlGa Land-Sea-People Management Plan 2018. 36 pp.

Haigh, R. & Starr, P. 2008b. A review of darkblotched rockfish (Sebastes crameri) along the Pacific coast of Canada: biology, distribution, and abundance trends. Canadian Science Advisory Secretariat Research Document 2008/056.

Haigh, R., Starr, P.J., Edwards, A.M., King, J.R., and Lecomte, J.-B. 2019. Stock assessment for Pacific Ocean Perch (Sebastes alutus) in Queen Charlotte Sound, British Columbia in 2017. DFO Can. Sci. Advis. Sec. Res. Doc. 2018/038. v + 227 p

Haltuch, M.A., Johnson, K.F., Tolimieri, N., Kapur, M.S., and Castillo-Jordán, C.A. 2019. Status of the sablefish stock in U.S. waters in 2019. Pacific Fisheries Management Council, 7700 Ambassador Place NE, Suite 200, Portland, OR. 398 p.

Holt, K., King, J. R., and Krishka, B.A. 2016. Stock Assessment for Lingcod (Ophiodon elongatus) in the Strait of Georgia, British Columbia in 2014. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/013. xi + 186 p.

Holt, K.R., Starr, P.J., Haigh, R. and Krishka, B. 2016b. Stock Assessment and Harvest Advice for Rock Sole (Lepidopsetta spp.) in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/009. ix + 256 p.

Hutchings, J.A., Baum, J.K., Fuller, S.D., Laughren, J., and David, L. VanderZwaag. 2020. Sustaining Canadian marine biodiversity: Policy and statutory progress. *FACETS*. **5**(1): 264-288.

IPHC Secretariat. 2022. Fisheries Data Overview (2022): Preliminary statistics IPHC-2022-IM098-07 Rev_1.

IUCN 2021. The IUCN Red List of Threatened Species. Version 2021-1. Accessed August 25, 2021.

IUCN 2024. IUCN Standards and Petitions Committee. 2024. Guidelines for Using the IUCN Red List Categories and Criteria. Version 16. Prepared by the Standards and Petitions Committee. Downloadable from https://www.iucnredlist.org/documents/RedListGuidelines.pdf

Jannot, JE, Ward, EJ, Somers, KA, Feist, BE, Good TP, Lawson, D, and Carretta, JV. 2021. Using Bayesian Models to Estimate Humpback Whale Entanglements in the United States West Coast Sablefish Pot Fishery. Front. Mar. Sci., Volume 8 - 2021.

Johnson, S.D.N. and S.P. Cox. 2021. Hierarchical surplus production stock assessment models improve management performance in

multi-species, spatially-replicated fisheries. Fisheries Research 238.

Kanamori, Y., Yano, T., Okamura, H., and Yagi, Y. 2022. Spatio-temporal model and machine learning method reveal process of phenological shift under climate change of North Pacific spiny dogfish. bioRxiv. doi: https://doi.org/10.1101/2022.03.01.482455.

Keppel , E.A. and Olsen, N. 2019. Pre-COSEWIC review of Yelloweye Rockfish (Sebastes ruberrimus) along the Pacific coast of Canada: biology, distribution and abundance trends. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/014. ix + 109 p.

King, J.R., Surry, A.M., Garcia, S., and Starr, P.J. 2015. Big Skate (Raja binoculata) and Longnose Skate (R. rhina) stock assessments for British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/070. ix + 329 p.

Lacko, L.C., Acheson, S.M. and Connors, B.M. 2020. Summary of the annual 2018 and 2019 sablefish (*Anoplopoma fimbria*) trap surveys, October 9 - November 19, 2018 and October 8 - November 25, 2019. Can. Tech. Rep. Fish. Aquat. Sci. 3396: vii + 66 p.

Lagasse, C.R., Fraser, K.A., Houtman, R., Grundmann, E., Komick, N., O'Brien, M., Braithwaite, E., Cornthwaite, A. M. 2024. Review of Salmon Bycatch in the Pacific Region 2022/23 Groundfish Trawl Fishery and Preliminary Results of an Enhanced Monitoring Program. Can. Manuscr. Rep. Fish. Aquat. Sci. 3273: v + 35 p.

Livingston, P., Aydin, K., Buckley, T., Lang, G., Yang, M.-S., & Miller, B. 2017. Quantifying food web interactions in the North Pacific – a data-based approach. *Environmental Biology of Fishes*, *100*. https://doi.org/10.1007/s10641-017-0587-0

Lucas, B.G., Verrin, S., and Brown, R. (Editors). 2007. Ecosystem overview: Pacific North Coast Integrated Management Area (PNCIMA). Can. Tech. Rep. Fish. Aquat. Sci. 2667: xiii + 104 p.

Marine Stewardship Council (MSC). 2014. MSC Fisheries Certification Requirements and Guidance, version 2.0. Marine Stewardship Council, London, UK. 120 p.

Matala, A.P., Gray, A.K., Heifetz, J. and Gharrett, A.J. 2004. Population structure of Alaskan shortraker rockfish, *Sebastes borealis*, inferred from microsatellite variation. Environmental Biology of Fishes 69: 201–210, 2004.

McDevitt-Irwin, J.M., Fuller, S.D., Grant, C., and Baum, J.K. 2015. Missing the safety net: evidence for inconsistent and insufficient management of at-risk marine fishes in Canada. *Canadian Journal of Fisheries and Aquatic Sciences*. **72**(10): 1596-1608.

McGreer M, Frid A. 2017. Declining size and age of rockfishes (Sebastes spp.) inherent to Indigenous cultures of Pacific Canada. Ocean Coast Manag 145: 14−20

McGreer, M., Frid, A., Blaine, T., Hankewich, S., Mason, E., Reid, M., and Kobluk, H. 2020. Growth parameter k and location affect body size responses to spatial protection by exploited rockfishes. PeerJ 8:e9825.

Melnychuk, M.C., Banobi, J.A., and Hilborn, R. 2013. Effects of Management Tactics on Meeting Conservation Objectives for Western North American Groundfish Fisheries. PLoS ONE 8(2): e56684.

Miller A, Chapman J, Dearden A, Ross P (Editor). 2020. Ocean Watch Átl'ka7tsem/Txwnéwu7ts/Howe Sound Edition 2020. Ocean Wise Research Institute, Ocean Wise Conservation Association, Vancouver, B.C., Canada. 388 pp. ISBN: 978-1- 7772408-2-0.

Ministry of Agriculture. 2012. 2012 Export Highlights British Columbia Agrifoods. British Columbia Ministry of Agriculture.

Ministry of Agriculture. 2019. British Columbia seafood industry year in review: 2018.

Ministry of Agriculture. 2020. British Columbia 2019 Agriculture, Seafood, Food and Beverage International Export Highlights Year in Review

Munroe, T.A. 2021. *Eopsetta jordani*. *The IUCN Red List of Threatened Species* 2021: e.T154977A157644072.

Munroe, T.A. 2021b. *Lyopsetta exilis*. *The IUCN Red List of Threatened Species* 2021: e.T154845A157645178.

Murie, D.J. 1991. Comparative ecology and interspecific competition between the sympatric congeners *Sebastes caurinus* (copper rockfish) and *S. maliger* (quillback rockfish). Doctor of Philosophy Dissertation in the Department of Biology, University of Victoria.

NMFS 2022. Draft U.S. Pacific Marine Mammal Stock Assessments: 2022.

NMFS. 2021. NMFS Summary of Stock Status for FSSI Stocks. 4th Quarter 2021 Update.

NOAA. 2021. U.S. annual commercial fisheries landing statistics query tool. Accessed August 23, 2021.

North Pacific Anadromous Fish Commission (NPAFC). 2022. NPAFC Pacific salmonid catch statistics (updated June 2022). North Pacific Anadromous Fish Commission, Vancouver. Accessed Month, Year. Available: https://npafc.org. Downloaded June 2022.

NPFMC (North Pacific Fishery Management Council). 2020. Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area

Olson, A.M., Frid, A., Quintela dos Santos, J.B., and Juanes, F. 2020. Trophic position scales positively with body size within but not among four species of rocky reef predators. Mar Ecol Prog Ser 640: 189–200.

Patrick, W. S., P. Spencer, O. Ormseth, J. Cope, J. Field, D. Kobayashi, T. Gedamke, E. Cortés, K. Bigelow, W. Overholtz, J. Link, and P. Lawson. 2009. Use of productivity and susceptibility indices to determine stock vulnerability, with example applications to six U.S. fisheries. U.S. Department of Commerce, NOAA Tech. Memo. NMFSIF/SPOI101, Seattle, WA.

Pearsall, I.A. & Fargo, J.J. 2007. Diet composition and habitat fidelity for groundfish assemblages in Hecate Strait, British Columbia. Canadian Technical Report of Fisheries and Aquaculture Sciences, 2692.

PFMC. 2011. Proposed harvest specifications and management measures for the 2011-2012 Pacific coast groundfish fishery and Amendment 16-5 to the Pacific coast groundfish fishery management plan to update existing rebuilding plans and adopt a rebuilding plan for Petrale sole; Final Environmental Impact Statement. Pacific Fishery Management Council.

SARA Registry. 2021. Species at Risk Public Registry: Advanced Search. Accessed August 25, 2021.

Shotwell, SK, Spies, I, Ianelli, JN, Aydin, K, Hanselman, DH, Palsson, W, Siwicke, K, Sullivan, J, and E Yasumiishi. 2021. Assessment of the Arrowtooth flounder stock in the Gulf of Alaska. Alaska Fisheries Science Center National Marine Fisheries Service November 2021.

Sinclair, A., Schnute, J., Haigh, R., Starr, P., Stanley, R., Fargo, J. & Workman, G. 2003. Feasibility of multispecies groundfish bottom trawl surveys on the BC coast. Canadian Science Advisory Secretariat Research Document 2003/049.

Sinclair, AF, Coway, KW, and Crawford, WR. 2005. Associations Between Bathymetric, Geologic and Oceanographic Features and the Distribution of the British Columbia Bottom Trawl Fishery. The Spatial Dimension of Ecosystem Structure and DynamicsCM. 2005/L:25.

Smith J, Morgan KH. 2005. An assessment of seabird bycatch in longline and net fisheries in British Columbia. Tech Rep Ser 401, Canadian Wildlife Service, Pacific and Yukon Region, Delta.

Spies, I., Bryan, M., Stevenson, D. & Munroe, T.A. 2021. *Atheresthes stomias. The IUCN Red List of Threatened Species* 2021: e.T158624714A158637931

Starr, P.J. and Haigh, R. 2017. Stock assessment of the coastwide population of Shortspine Thornyhead (Sebastolobus alascanus) in 2015 off the British Columbia coast. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/015. ix + 174 p.

Starr, P.J. and Haigh, R. 2021. Redstripe Rockfish (Sebastes proriger) stock assessment for British Columbia in 2018. DFO Can. Sci. Advis. Sec. Res. Doc. 2021/014. vii + 340 p.

Starr, P.J. and Haigh, R. 2021b. Walleye Pollock (Theragra chalcogramma) stock assessment for British Columbia in 2017. DFO Can. Sci. Advis. Sec. Res. Doc. 2021/004. vii + 265 p.

Starr, P.J. and Haigh, R. 2021c. Widow Rockfish (Sebastes entomelas) stock assessment for British Columbia in 2019. DFO Can. Sci. Advis. Sec. Res. Doc. 2021/039. viii + 238 p.

Starr, P.J. and Haigh, R. 2022. Rougheye/Blackspotted Rockfish (Sebastes aleutianus/melanostictus) stock assessment for British

Columbia in 2020. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/020. vii + 384 p.

Starr, P.J. and Haigh, R. 2022b. Bocaccio (Sebastes paucispinis) stock assessment for British Columbia in 2019, including guidance for rebuilding plans. DFO Can. Sci. Advis. Sec. Res. Doc. 2022/001. vii + 292 p.

Starr, P.J. and Haigh, R. 2022c. Yellowmouth Rockfish (Sebastes reedi) stock assessment for British Columbia in 2021. DFO Can. Sci. Advis. Sec. Res. Doc. 2022/010. viii + 288 p

Starr, P.J. and Haigh, R. 2023. Canary Rockfish (Sebastes pinniger) Stock Assessment for British Columbia in 2022. DFO Can. Sci. Advis. Sec. Res. Doc. 2023/070. vi + 293 p.

Starr, P.J., Haigh, R., and Grandin, C. 2016. Stock assessment for Silvergray Rockfish (Sebastes brevispinis) along the Pacific coast of Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/049. v + 170 p.

Starr, PJ and Fargo, J. 2004. Petrale sole assessment 2003 and Recommendations for Management in 2004. Research Document 2004/036.

Stephens, A. and Taylor, I.G. 2018. Status of Yellowtail Rockfish (*Sebastes flavidus*) Along the U.S. Pacific Coast in 2017.

Stewart, I., Hicks, A. 2021. Assessment of the Pacific halibut (Hippoglossus stenolepis) stock at the end of 2021. IPHC-2022-SA-01.

Talloni-Álvarez, N.E. 2021. Climate change impacts on Canadian fishing and seafood supply. Doctorates Thesis for the University of British Columbia. Submitted March 2021.

Taylor, IG and Stephens, A. 2014. Stock Assessment of Shortspine Thornyhead in 2013. SAFE – Final Version February 12, 2014. Northwest Fisheries Science Center.

Thompson, P.L., Anderson, S.C., Nephin, J., Haggarty, D.R., Pena, M.A., English, P.A., Gale K.S.P., and Rubidge, E. 2022. Disentangling the impacts of environmental change and commercial fishing on demersal fish biodiversity in a northeast Pacific ecosystem. Mar Ecol Prog S er 689: 137-154.

Thornborough, K.J., Lancaster, D., Dunham, J.S., Yu, F., Ladell, N., Deleys, N., Yamanaka, L. 2020. Risk assessment of permitted human activities in Rockfish Conservation Areas in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/020. ix + 280 p

Thorson, JT, Cope, JM, Branch, TA, and Jensen, OP. 2012. Spawning biomass reference points for exploited marine fishes, incorporating taxonomic and body size information. Canadian Journal of Fisheries and Aquatic Sciences 69(9):1556-1568.

Wallace, S., Turris, B., Driscoll, J., Bodtker, K., Mose, B. and Munro, G. 2015. Canada's pacific groundfish trawl habitat agreement: A global first in an ecosystem approach to bottom trawl impacts. Marine Policy 60 (2015) 240–248.

Wells, B., J. Santora, M. Henderson, P. Warzybok, J. Jahncke, R. Bradley, and coauthors. 2017. Environmental conditions and prey-switching by a seabird predator impact juvenile salmon survival. Journal of Marine Systems 174. DOI: 10.1016/j.jmarsys.2017.05.008.

Wetzel, C.R., A.M. Berger. 2021. Status of Dover sole (Microstomus pacificus) along the U.S. West Coast in 2021. Pacific Fisheries Management Council, Portland, Oregon. 280 p

Yamanaka, K.L., McAllister, M.K., Etienne, M.-P., and Flemming, R. 2011. Stock Assessment and Recovery Potential Assessment for Quillback Rockfish (Sebastes maliger) on the Pacific Coast of Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/135. vii + 151 p.

Yamanaka, K.L., McAllister, M.M., Etienne, M., Edwards, A.M., and Haigh, R. 2018. Stock Assessment for the Outside Population of Yelloweye Rockfish (Sebastes ruberrimus) for British Columbia, Canada in 2014. DFO Can. Sci. Advis. Sec. Res. Doc. 2018/001. ix +150 p.

Young, N. C., Brower, A. A., Muto, M. M., Freed, J. C., Angliss, R. P., Friday, N. A., Boveng, P. L., Brost, B. M., Cameron, M. F., Crance, J. L., Dahle, S. P., Fadely, B. S., Ferguson, M. C., Goetz, K. T., London, J. M., Oleson, E. M., Ream, R. R., Richmond, E. L., Shelden, K. E. W., Sweeney, K. L., Towell, R. G., Wade, P. R., Waite, J. M., and Zerbini, A. N. 2023. Alaska marine mammal stock assessments, 2022. U.S. Department of Commerce, NOAA Technical Memorandum NMFSAFSC-474, 316 p.

Appendix A: Review Schedule

- Bocaccio: DFO Science team recommends doing another assessment update in 2023 (DFO 2022b).
- Lingcod (inside rockfish) stock assessment data are from 2014, and the outcome then was borderline high concern. Review in 2024/2025.
- Shortspine thornyhead assessment based on data from 2015.
- New harvest advice is anticipated for the following species/stocks in 2024/25: Pacific Ocean perch, Outside lingcod, petrale sole, and Pacific Gulf hake, with anticipated updates provided for bocaccio rockfish, arrowtooth flounder, and sablefish (DFO 2024).

Appendix B: Management Metrics by Species

Management targets for retained groundfish species in BC. The fisheries listed are only those that Seafood Watch has rated (see Introduction).

Species	Stock Assessment (Year)	Reference Points	Quota	Harvest Decision Rules Developed, Implemented, Evaluated (DFO 2023i)
Arrowtooth flounder	Yes (2023)	Yes	Yes	No
Big skate	Not recent* (2014)	No	Yes	No
Blackspotted rockfish	Yes (2020)	Yes	Yes	Yes, Yes, No
Bocaccio	Yes (2022)	Yes	Yes	Yes, Yes, No
Canary rockfish	Yes (2023)	Yes	Yes	Yes, Yes, No
Copper rockfish	No	No	Yes	No
Darkblotched rockfish	No	No	No	No
Dover sole	Yes (2021)	Biomass only	Yes	No
English sole	Yes (2021)	Biomass only	Yes	No
Flathead sole	No	No	No	No
Kelp greenling	No	No	Trip limits	No
Inside Lingcod	Not recent* (2016)	Yes	Yes	No
Outside Lingcod	Not recent* (2011)	Yes	Yes	Yes, Yes, No
Longnose skate	Not recent* (2014)	No	Yes	No
North Pacific spiny dogfish	Not recent* (2010)	Yes	Yes	Yes, Yes, No
Pacific cod	Yes (2021)	Yes	Yes	No
Pacific halibut	Yes (2021)	Yes	Yes	Yes, Yes, Yes
Pacific Ocean perch 3CD	Not recent* (2013)	Yes	Yes	Yes, Yes, No
Pacific Ocean perch 5ABC	Yes (2019)	Yes	Yes	Yes, Yes, No
Pacific Ocean perch 5DE	Not recent* (2013)	Yes	Yes	Yes, Yes, No
Petrale sole	Not recent* (2009)	Yes	Yes	No
Quillback rockfish Inside	Yes (2023)	Yes	Yes	Yes, Yes, No
Quillback rockfish Outside	Yes (2023)	Yes	Yes	Yes, Yes, No
Redbanded rockfish	Not recent* (2017)	Yes	Yes	No
Redstripe rockfish	Yes (2021)	Yes	Yes	No
Rex sole	No	No	No	No
Rougheye rockfish	Yes (2020)	Yes	Yes	Yes, Yes, No
Sablefish	Yes (2022)	Yes	Yes	Yes, Yes, Yes
Sharpchin rockfish	No	No	No	No
Shortraker rockfish	No	No	Yes	No
Shortspine thornyhead	Yes (2016)	Yes	Yes	No
Silvergray rockfish	Not recent* (2016)	Yes	Yes	No
Southern rock sole	Yes (2016)	Yes	Yes	No
Splitnose rockfish	No	No	No	No
Walleye pollock	Yes (2021)	Yes	Yes	No
Widow rockfish	Yes (2019)	Yes	Yes	No
Inside Yelloweye rockfish	Yes (2022)	Yes	Yes	Yes, Yes, Yes
Outside Yelloweye rockfish	Yes (2020)	Yes	Yes	Yes, Yes, Yes
Yellowmouth rockfish	Yes (2022)	Yes	Yes	Yes, No, No
Yellowtail rockfish	Not recent* (2015)	Yes	Yes	No

* “Not recent” includes stock assessments that contain data that are >10 years old as of the writing of this report in 2024. The year of *publication* is in parentheses.

Appendix C: COSEWIC, SARA, and IUCN statuses of rockfish species

COSEWIC, SARA, and IUCN statuses of rockfish species of concern and of spiny dogfish (COSEWIC/SARA statuses: (SARA Registry 2021); IUCN statuses: (IUCN 2021)).

Species	COSEWIC (Year Assessed)	SARA	IUCN	Notes
Bocaccio	Endangered (2002)	NA	Critically Endangered	Stock assessment more recent than COSEWIC status
Canary rockfish	Threatened (2007)	Not listed	NA	Stock assessment more recent than COSEWIC status
Darkblotched rockfish	Special Concern (2010)	Under consideration for status change	NA	
North Pacific spiny dogfish	Special Concern (2011)	NA	Least Concern	
Quillback rockfish	Threatened (2009)	Under consideration for status change	NA	Stock assessment more recent than COSEWIC status
Rougheye rockfish Types I and II	Special Concern (2007)	Special Concern	NA	Stock assessment more recent than COSEWIC status
Yelloweye rockfish (Inside)	Threatened (2020)	Special Concern	NA	Stock assessment more recent than COSEWIC status
Yelloweye rockfish (Outside)	Threatened (2020)	NA	NA	Stock assessment more recent than COSEWIC status
Yellowmouth rockfish	Threatened (2010)	NA	NA	Stock assessment more recent than COSEWIC status

Appendix D: Main Species Determinations

We use the term “fishery sector” to identify the target species and gear type, and use the term “specific fishery” (or “fishery”) to identify the target species, gear type, and region(s) fished. Main species in each fishery includes those species that account for >5% of the fishery’s catch, or if the fishery is a main source of fishing mortality (F) for the species (>20% of total F), or if the fishery regularly catches species of conservation concern.

The 5% threshold applies to the specific fishery (e.g., 5DE Deep Flatfish Bottom Trawl); see the Introduction for catch composition figures. If a species accounts for >5% of a fishery’s catch in each of the fisheries in a fishery sector, the cell is yellow and no superscript is used. If the species account for >5% of the fishery’s catch in one or two specific fisheries, the cell is yellow and a superscript identifies those specific fisheries.

The 20% threshold applies to the fishery sector (e.g., Deep Flatfish Bottom Trawl). A species is included in a specific fishery (e.g., 5DE Deep Flatfish Bottom Trawl) if the fishery sector accounts for >20% of total F and the specific fishery accounts for >5% of total F. Note that only fishing catch from the commercial groundfish fisheries is included here. See the Introduction for the breakdown of main species in the trawl fisheries by region. In the following table, the color coding is based on the proportion of catch (landings plus discards) averaged across fishing seasons from 2018 to 2022 (DFO Pacific Region 2021) for non-trawl fisheries. The data for the trawl fisheries are based on the annual average from 2019 to 2023; data for the Midwater Trawl fishery only include fishing events targeting rockfish species (i.e., the walleye pollock and Pacific hake targeted fisheries are excluded) (DFO Pacific Region 2024). Numerical values are average annual catch (mt); average catches of <1.0 mt are excluded from the table. Coldwater corals and sponges include baths sponges, calcareous sponges, unspecified sponges, gorgonian corals, soft corals, and sea pens.

The catch of the species in the fishery under assessment composes >5% of that fishery’s catch, or

The fishery causes >20% of the species’ total mortality across all fisheries, or

The species is overfished, endangered, threatened, undergoing overfishing, or otherwise a species of concern, where mortality of the species caused by the fishery is >5% of a sustainable level

Species	Average annual catch (mt) 2019–2023					Average annual catch (mt) 2019–2022				
	Deep Flatfish Bottom Trawl	Shallow Flatfish Bottom Trawl	Pelagic Bottom Trawl	Rockfish Bottom Trawl	Rockfish Midwater Trawl	Lingcod	Inside Rockfish	Outside Rockfish	Sablefish Line	Sablefish Trap
Arrowtooth Flounder	3,105.9	756.8	192.7	218.7	2.0					
Big Skate	2.0	119.8	48.7[5DE]	3.6					1.5	
Bocaccio		19.0	95.3[5ABC]	331.8[3CD]	198.8	1.9				
Canary Rockfish		7.3	21.6	517.9	260.6[3CD]	1.7		2.3		
Chinook Salmon	0.1 mt	0.1 mt	0.3 mt	0.8 mt	2.2 mt					
Coldwater Corals & Sponges	3.7 kg	38.3 kg	2.2 kg	43.6 kg						
Copper Rockfish							1.3	22.1		
Darkblotched Rockfish	10.7		1.2	38.6	1.4					
Dover Sole	588.2	554.5	30.3	139.6	3.5					
English Sole	1.2	297.0[5DE]	78.3[5DE]	11.6						
Eulachon		8.8 kg	12.7 kg	42.2 kg	5.6 kg					
Flathead Sole		80.2[3CD]	8.1	4.0						
Kelp Greenling							1.3	1.6		
Lingcod	2.0	45.9	405.6[3CD] & 5ABC	108.8	8.1	517.2	2.0	27.8	39.9	1.2
Longnose Skate	27.1	33.1	13.5	27.9				3.6	20.1	
North Pacific Spiny Dogfish	13.7	31.0	26.7	99.6	3.2					
Pacific Cod		236.3[5ABC] & 5DE	331.9	49.1						
Pacific Hake	11.9	20.0	129[3CD]	34.2	229.2					
Pacific Ocean Perch	103.8	38.4[5ABC]	20.2	2,420.1	92.7					
Pacific Halibut	171.3[5ABC]	157.9	87.8[5ABC] & 5DE	32.4		16.2	1.3	77.4	615.4	9.1
Petrale Sole	224.0[3CD]	167.9	144.3[3CD] & 5ABC	90.9						
Quillback Rockfish							14.0	38.9		
Redbanded Rockfish	6.7	12.5	1.9	128.2				27.7	63.9	1.2
Redstripe Rockfish		4.4	10.5	312.5[3CD]	182.8					
Rex Sole	24.6	318.4	26.1	83.4						

Rougheye/Blackspotted Rockfish Complex (REBS)	50.5[5DE]		3.5	284.6[4DE]				45.7	147.1	11.2
Sablefish	301.1[3CD & 5DE]	49.0	41.8[3CD]	140.9	6.1			23.1	869.1	1,296.6
Sharpchin RockfishOCKFISH			7.8	131.4						
Shortraker Rockfish	16.7		1.1	7.4				10.5	61.9	2.8
Shortspine Thornyhead	50.6[3CD & 5ABC]	12.4	3.9	61.1	14.1			2.7	62.5	4.2
Silvergray Rockfish	1.7	10.4	86.9[5ABC]	1,241.3	61.9	1.6		5.9	7.4	
Southern Rock Sole		155.1[5ABC]	41.2	1.5						
Splitnose Rockfish	5.7		3.5	121.3	2.6					
Spotted Ratfish	2.8	125.7	49.9[5DE]	32.8						
Walleye Pollock		162.8[5DE]	43.8[5DE]	36.7	10.7					
Widow Rockfish		3.8	5.8	158.1	1,829.9					
Yelloweye Rockfish				5.0		5.9	2.0	10.7	10.9	
Yellowmouth Rockfish		1.3	5.2	948.9[5ABC]	342.8[5ABC]			1.3	2.0	
Yellowtail Rockfish		24.3	51.6	1,012.0[3CD & 5ABC]	2,079.8[3CD & 5ABC]		1.2	1.6	1.0	
Fishery total (all species) average annual catch	**4,735**	**3,530**	**2,056**	**8,878**	**5,384**	**547**	**25**	**323**	**1,921**	**1,328**

Appendix E: Bottom Trawl Fisheries Description and Species Co-occurrence

The Bottom Trawl Fishery occurs in different regions and depths, depending on the target species. For example, yellowmouth rockfish inhabits gullies in Queen Charlotte Sound (QSC), but the species is also associated with other rockfish along shelf regions and the shelf-slope boundary (Starr and Haigh 2022c); rougheye and blackspotted rockfish (REBS) are common along the shelf break, and high numbers of these species are caught in Quatsino Sound (Area 5E) and South Hogback (Area 3D) (Starr and Haigh 2022). Some flatfish species such as English sole and rex sole are targeted over soft-bottom habitats in the shallow regions, particularly in Area 5C (Haigh et al. 2019); arrowtooth flounder is typically caught in offshore waters along the edges of the continental shelf and along the QSC gullies (DFO 2023e). Thornyheads are caught in deeper waters (as deep as 750 m) during the winter and early spring fishery (DFO 2023c) and these species are commonly caught in Areas 3CD and 5CD (Starr and Haigh 2017). Pacific cod mainly is caught in a directed fishery in Area 5CD at depths from 60 to 200 m (Forrest et al. 2020).

Additional supporting information includes models used to predict fish community variation (probability of occurrence and biomass) across depth strata (Figure 9) (Thompson et al. 2022), fish community information by bathymetry and habitat type (Fargo et al. 2007), co-occurrence data from recent stock assessments (e.g., Appendix G in (Starr and Haigh 2023)), and life history information (e.g., (Lucas et al. 2007)). To account for fishing mortality across the Bottom Trawl fleet, we included species as "main species" if the target fishery (e.g., Shallow Flatfish) accounts for >20% of total fishing mortality (Appendix D) *and* if the subregion (e.g., 3CD Shallow Flatfish) accounts for >5% of total fishing mortality, and/or available information suggests that the species is likely to be caught in a subdivision of the Bottom Trawl fishery. We have included figures from recent stock assessments to provide additional context for understanding the nature of the Bottom Trawl fisheries in this report.

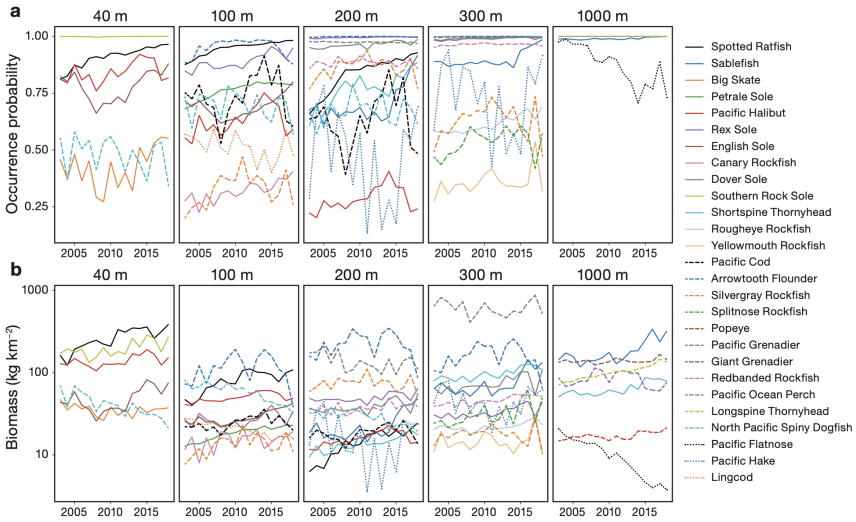

Figure 66: Time series of median estimated (a) species occurrences and (b) biomass at five representative bottom depths (40, 100, 200, 300, and 1000 m). Solid lines: species that were estimated to have increased in occurrence regionally during study period; dashed lines: species with no estimated directional occurrence trend; and dotted lines: species with estimated declines in occurrence (Thompson et al. 2022).

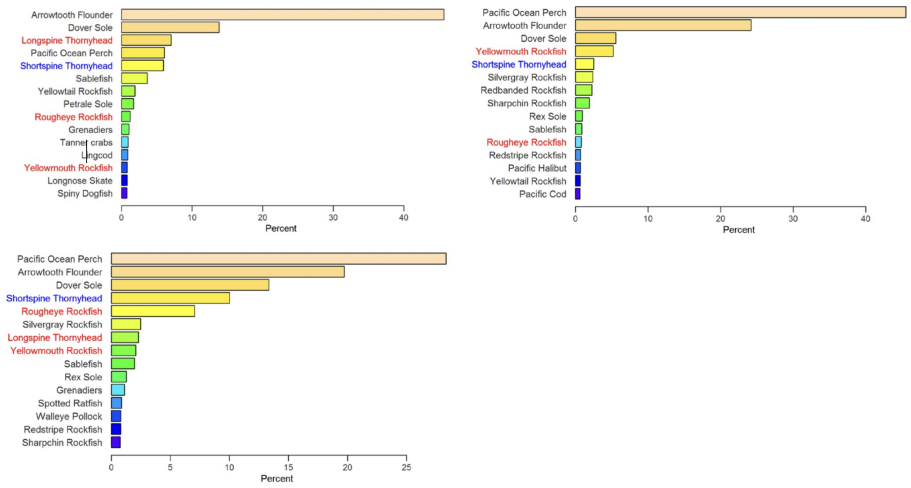

Figure 67: Distribution of catch weights in 3CD (top left panel), 5ABC (top right panel), and 5CD (bottom left panel) summed over the period February 1996 to September 2015 for important finfish species in bottom tows that caught at least one shortspine thornyhead. Coastwide tows were selected over a depth range between 164 and 1,065 m (3CD), 170 and 823 m (5ABC), and 128 and 914 m (5CD); depth ranges are the 1% and 99% quantile range. Relative concurrence is expressed as a percentage by species relative to the total catch weight summed over all finfish species in the specified period. Shortspine thornyhead is indicated in blue on the y-axis; other species of interest to SARA are indicated in red. Figure modified from (Starr and Haigh 2017).

There is quite a bit of variation in the specific target species in the Rockfish Bottom Trawl fishery. High-volume target species include Pacific Ocean perch, yellowtail rockfish, and yellowmouth rockfish (Haigh et al. 2019)(DFO 2015b)(Starr and Haigh 2022c). REBS is targeted in Area 5DE and is taken as bycatch elsewhere (Starr and Haigh 2022); widow rockfish is rarely targeted by bottom trawls, but it is regularly retained as bycatch on trips targeting other rockfish species (Starr and Haigh 2021c); redstripe rockfish is likely entirely a bycatch species (Starr & Haigh 2021); canary rockfish is both a target and a bycatch species (Starr and Haigh 2023); silvergray rockfish is typically caught with Pacific Ocean perch, canary rockfish, yellowtail rockfish, and lingcod (Starr et al. 2016). Bocaccio strongly associates with redstripe and redbanded rockfish and also commonly occurs with silvergray, yellowtail, and canary rockfish (Starr and Haigh 2022b). Arrowtooth flounder and Dover sole are common co-occurring species when at least one canary rockfish, yellowmouth rockfish, REBS, and Pacific Ocean perch is caught (Figure 11).

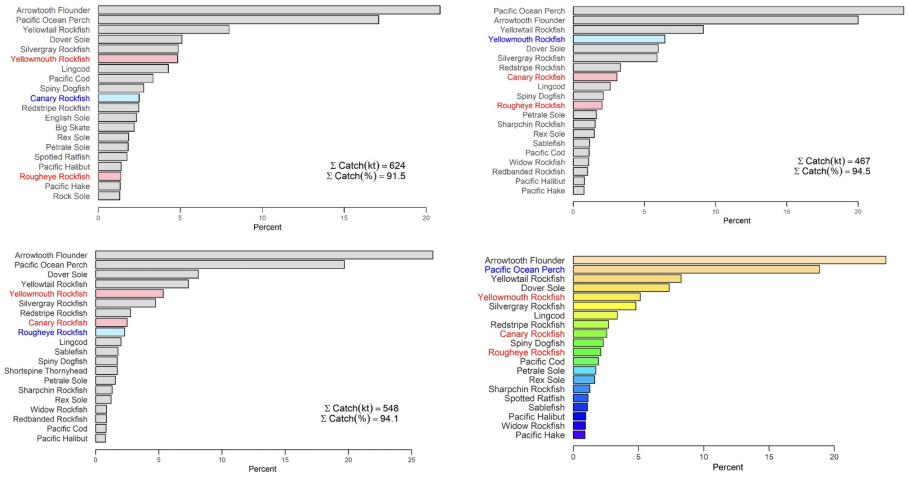

Figure 68: Distribution of catch weights summed over the periods ranging from 1996 to 2021 for important finfish species from fishing events that caught at least one canary rockfish (top left), one yellowmouth rockfish (top right), one REBS (bottom left), and one Pacific Ocean perch (bottom right) in PMFC areas 3CD5ABCDE by bottom trawl. Fishing events were selected over a depth range between 68 and 391 m (canary rockfish), 130 and 402 m (yellowmouth rockfish), 137 and 845 m (REBS), and 101 and 501 m (Pacific Ocean perch); depth ranges are the 1% and 99% quantile range. Figure modified from (Starr and Haigh 2023)(Starr and Haigh 2022c)(Starr and Haigh 2022)(Haigh et al. 2019).