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New Zealand Orange Roughy

Announcement Comment Draft Report

Conformity Assessment Body (CAB)	MRAG Americas, Inc.
Assessment team	Andre Punt, Robert Trumble, Amanda Stern-Pirlot
Fishery client	Deepwater Group, Ltd.
Assessment type	First Reduced Reassessment
Date	30 September 2021

Document Control Record

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ACDR	AP, BT, ASP	25 September 2021	ASP	29 September 2021

1 Contents

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2 Glossary

ACE	Annual Catch Entitlement
B0	Unfished Equilibrium Biomass
AEEF	Assessment of the Enviromental Effects of Fishing
ALC	Automatic Location Communicator
BPA	Benthic Protection Area
CAY	Current Annual Yield
CITES	Convention on International Trade in Endangered Species
CLR	Catch Landing Return
CPUE	Catch Per Unit Effort
DOC	New Zealand Department of Conservation
DWG	Deepwater Group Limited
DFAWG	Deepwater Fisheries Assessment Working Group
ETP	Endangered, Threatened, Protected Species

FARs	Fishery Assessment Reports
FAWGs	Fishery Assessment Working Groups
FCV	Foreign Charter Vessel
HCR	Harvest Control Rule
HSS	Harvest Strategy Standard for New Zealand Fisheries
LFR	Licensed Fish Receiver
LMA	Large Marine Reserve
MFish	Ministry of Fisheries. MFish merged with the Ministry of Agriculture and Forestry (MAF) in July 2011 to become part of the Ministry for Primary Industries (MPI).
MLS	Minimum Legal Size
MPA	Marine Protected Area
MPI	Ministry for Primary Industries (representing the Crown and its statutory obligations to the public). Formery the Ministry of Agriculture and Forestry and before that the Ministry of Fisheries.
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
nm	Nauticle Mile
NGO	Non-Governmental Organisation
NIWA	National Institute of Water and Atmospheric Research
NPA	National Plan of Actions
NZ	New Zealand
ORH3B	ESCR UoA The UoA within the ORH3B QMA within the designated area known as the East and South Chatham Rise management area east of 179° 30' W on the southern Chatham Rise (see Figure 2)
ORH3B	NWCR UoA The UoA within the ORH3B QMA managed as a separate stock unit within the designated area known as the North West Chatham Rise (see Figure 2)
ORH7A UoA	The UoA including the orange roughy 7A QMA along with that area known as the Westpac Bank immediately adjacent to and outside of the New Zealand EEZ boundary – recognised as a straddling stock under UNCLOS
QMA	Quota Management Area
QMS	Quota Management System
SPRFMO	South Pacific Regional Fisheries Management Organisation
TAC	Total Allowable Catch
TACC	Total Allowable Commercial Catch
TCEPR	Trawl Catch Effort and Processing Returns
TCER	Trawl Catch Effort Returns
TOKM	Te Ohu Kai Moana
UoA	Unit of Assessment (see MSC-MSCI Vocabulary for MSC defined terms)
UoC	Unit of Certification
UTF	Underwater Topographic Features (including hills, knolls, and seamounts)
VMS	Vessel Monitoring System

3 Executive summary

3.1 Changes since previous assessment

Draft determination to be completed at Public Comment Draft Report stage

This is the preliminary, Announcement Comment Draft Report (ACDR), accompanying the announcement of the New Zealand orange roughy fishery into reassessment against the MSC Fisheries Standard. The information in this ACDR is a combination of existing information about the fishery as collected and reported in the previous full certification reports (MRAG Americas 2015), and subsequent surveillance reports, with some areas further updated with more recent information available to the assessment team at the time of writing. This is a "reduced" reassessment, for which the fishery is eligible because there were no conditions open following the completion of the third surveillance audit.

A thorough summary of changes since the previous full assessment, and strengths and weaknesses will be reported in subsequent drafts of this report, following the information gathering phase and site visit. The site visit will take place remotely, via videoconferencing, the week of November 1st 2021.

4 Report details

4.1 Authorship and peer review details

Peer reviewer information to be completed at Public Comment Draft Report stage

Ms. Amanda Stern-Pirlot will serve as team leader for the assessment. Amanda is an M.Sc graduate of the University of Bremen, Center for Marine Tropical Ecology (ZMT) in marine ecology and fisheries biology. Ms. Stern-Pirlot joined MRAG Americas in mid-June 2014 as MSC Certification Manager (now Director of the Fishery Certification Division) and is currently serving on several different assessment teams as team leader and team member. She has worked together with other scientists, conservationists, fisheries managers and producer groups on international fisheries sustainability issues for over 15 years. With the Institute for Marine Research (IFM-GEOMAR) in Kiel, Germany, she led a work package on simple indicators for sustainable fishing within the EU-funded international cooperation project INCOFISH, followed by five years within the Standards Department at the Marine Stewardship Council (MSC) in London, developing standards, policies and assessment methods informed by best practices in fisheries management around the globe. Most recently she has worked with the Alaska pollock industry as a resources analyst, within the North Pacific Fisheries Management Council process, focusing on bycatch and ecosystem-based management issues, and managing the day-to-day operations of the offshore pollock cooperative. She has co-authored a dozen publications on fisheries sustainability in the developing world and the functioning of certification as an instrument for transforming fisheries to a sustainable basis.

Dr. Robert Trumble has wide-ranging experience in marine fish science and management, fishery habitat protection, and oceanography. He retired from MRAG Americas at the end of 2017 and works independently for various clients. Dr. Trumble joined MRAG Americas in 2000 as a senior research scientist and became Vice President in 2005. Previously, he served 14 years as Senior Biologist of the International Pacific Halibut Commission in Seattle, Washington, 10 years in various research and management positions at the Washington Department of Fisheries, and six years with the US Naval Oceanographic Office. At MRAG, Dr. Trumble performed project planning, assembled research teams, and conducted research, with a focus on improving management of aquatic ecosystems and the resources and fisheries they support. His projects have included managing the Pacific herring fishery for Washington state, preparation and review of fishery management and habitat management plans, review of technology to support or replace on-board observers, provision of observer services, development of bycatch management and control, preparation of environmental assessments and environmental impact statements, conducting workshops on fishery issues, and manager of certifications for Marine Stewardship Council and other sustainability and traceability assessments. Dr. Trumble has extensive experience working with government agencies, commercial and recreational fisheries groups, Indian tribes, and national and international advisory groups. Dr. Trumble has published in peer-reviewed journals and symposium proceedings, presented invited papers at national and international meetings, and written reports for government agencies. Dr. Trumble received a B.S. degree in Oceanography from the Department of Oceanography, University of Washington, an M.S. degree in Fisheries from the College of Fisheries, University of Washington, and a Ph.D. in Fisheries from the College of Fisheries, University of Washington.

Dr. Andre Punt is a Professor at the University of Washington and Director of the School of Aquatic and Fisheries Sciences. He is a quantitative scientist with a specialty of providing quantitative scientific advice for fisheries management, focusing on new methods for assessing fish and marine mammal populations; Bayesian assessment and risk analysis methods; and evaluating the performance of existing methods for assessing and managing renewable resource populations. He uses methods for assessing fish and marine mammal populations that are tailored specifically to the situation in question. Current areas of interest are spatial models, multispecies models, and stage-structured models. He has worked on population models for the Benguela Current in South Africa, a resource modeler at CSIRO in Australia, and at the University of Washington. He has a Ph.D. from the University of Cape Town in South Africa.

A discussion between team members regarding conflict of interest and biases was held and none were identified.

4.2 Version details

Table 1– Fisheries program documents versions

Document	Version number
MSC Fisheries Certification Process	**Version 2.2**
MSC Fisheries Standard	**Version 2.01**
MSC General Certification Requirements	**Version 2.4.1**
MSC Reduced Reassessment Reporting Template	**Version 2.2**

5 Unit(s) of Assessment and Unit(s) of Certification and results overview

5.1 Unit(s) of Assessment and Unit(s) of Certification

5.1.1 Unit(s) of Assessment

MRAG Americas has confirmed that this fishery is within scope for MSC fisheries certification through the following determinations (FCP v2.2 7.4):

7.4.2.1 The following taxa are not target species under Principle 1:
- a. Amphibians
- b. Reptiles
- c. Birds
- d. Mammals

7.4.2.2 The fishery does not use poisons or explosives.

7.4.2.3 The fishery is not conducted under a controversial unilateral exemption to an international agreement.

7.4.2.4 No member of the client group has been successfully prosecuted for a forced or child labour violation in the last 2 years.

7.4.2.10 The fishery has not been convicted for a shark finning violation in the last 2 years.

7.4.2.11 The fishery has a mechanism for resolving disputes and disputes do not overwhelm the fishery.

7.4.2.12 The fishery is not enhanced.

7.4.2.13 The fishery is not based on introduced species.

Table 2 - Unit(s) of Assessment (UoA)

UoA 1	Description
Species	Orange Roughy (*Hoplostethus atlanticus*)
Stock	ORH7A including Westpac Bank
Fishing gear type(s) and, if relevant, vessel type(s)	Demersal trawl

Client group	Deepwater Group Limited
Other eligible fishers	The three units of assessment represent three of the nine management units of orange roughy in New Zealand. Eligible fishers are DWG shareholders with authorization from the New Zealand government to fish for orange roughy.
Geographical area	FAO Area 81 (Pacific, Southwest), ORH7A, including Westpac Bank which is outside the NZ EEZ.
UoA 2	Description
Species	Orange Roughy (*Hoplostethus atlanticus*)
Stock	ORH3B East & South Chatham Rise
Fishing gear type(s) and, if relevant, vessel type(s)	Demersal trawl
Client group	Deepwater Group Limited
Other eligible fishers	The three units of assessment represent three of the nine management units of orange roughy in New Zealand. Eligible fishers are DWG shareholders with authorization from the New Zealand government to fish for orange roughy.
Geographical area	FAO Area 81 (Pacific, Southwest), ORH3B East and South Chatham Rise (ESCR), east of 179° 30' W
UoA 3	Description
Species	Orange Roughy (*Hoplostethus atlanticus*)
Stock	ORH3B Northwest Chatham Rise
Fishing gear type(s) and, if relevant, vessel type(s)	Demersal trawl
Client group	Deepwater Group Limited
Other eligible fishers	The three units of assessment represent three of the nine management units of orange roughy in New Zealand. Eligible fishers are DWG shareholders with authorization from the New Zealand government to fish for orange roughy.
Geographical area	FAO Area 81 (Pacific, Southwest), ORH3B Northwest Chatham Rise (NWCR)

5.1.2 Unit(s) of Certification

Table 3 - Unit(s) of Certification (UoC)

UoC 1	Description
Species	Orange Roughy (*Hoplostethus atlanticus*)
Stock	ORH7A including Westpac Bank

Fishing gear type(s) and, if relevant, vessel type(s)	Demersal trawl
Client group	Deepwater Group Limited
Geographical area	FAO Area 81 (Pacific, Southwest), ORH7A, including Westpac Bank which is outside the NZ EEZ.
UoC 2	Description
Species	Orange Roughy (*Hoplostethus atlanticus*)
Stock	ORH3B East & South Chatham Rise
Fishing gear type(s) and, if relevant, vessel type(s)	Demersal trawl
Client group	Deepwater Group Limited
Geographical area	FAO Area 81 (Pacific, Southwest), ORH3B East and South Chatham Rise (NWCR)
UoC 3	Description
Species	Orange Roughy (*Hoplostethus atlanticus*)
Stock	ORH3B Northwest Chatham Rise
Fishing gear type(s) and, if relevant, vessel type(s)	Demersal trawl
Client group	Deepwater Group Limited
Geographical area	FAO Area 81 (Pacific, Southwest), ORH3B Northwest Chatham Rise (NWCR)

5.1.3 Scope of assessment in relation to enhanced or introduced fisheries

Not applicable—this is not an enhanced or introduced fishery.

5.2 Assessment results overview

5.2.1 Determination, formal conclusion and agreement

To be drafted at Public Comment Draft Report stage

The CAB shall include in the report a formal statement as to the certification determination recommendation reached by the assessment team on whether the fishery should be certified.

The CAB shall include in the report a formal statement as to the certification action taken by the CAB's official decision-makers in response to the determination recommendation.

Reference(s): FCP v2.2, 7.20.3.h and Section 7.21

5.2.2 Principle level scores

To be drafted at Client and Peer Review Draft Report stage

The CAB shall include in the report the scores for each of the three MSC principles in the table below.

Reference(s): FCP v2.2 Section 7.17

Table 4 - Principle level scores

Principle	UoA 1	UoA 2	UoA 3	UoA 4
Principle 1 – Target species				
Principle 2 – Ecosystem impacts				
Principle 3 – Management system				

5.2.3 Summary of conditions

To be drafted at Client and Peer Review Draft Report stage

The CAB shall include in the report a table summarising conditions raised in this assessment. Details of the conditions shall be provided in the appendices. If no conditions are required, the CAB shall include in the report a statement confirming this.

Reference(s): FCP v2.2 Section 7.18

Table 5 - Summary of conditions

Condition number	Condition	Performance Indicator (PI)	Deadline	Exceptional circumstances?	Carried over from previous certificate?	Related to previous condition?
				Yes / No	**Yes / No / NA**	**Yes / No / NA**
				Yes / No	**Yes / No / NA**	**Yes / No / NA**
				Yes / No	**Yes / No / NA**	**Yes / No / NA**

5.2.4 Recommendations

To be drafted at Client and Peer Review Draft Report stage

If the CAB or assessment team wishes to include any recommendations to the client or notes for future assessments, these may be included in this section.

6 Traceability and eligibility

6.1 Eligibility date

As this fishery is currently certified and it is anticipated that, this reassessment will conclude prior to the expiration of the current certificate. So, if this reassessment is successful, the product will remain continuously eligible. However, if there is a lapse in certification, the new eligibility date will be upon publication of the new Public Comment Draft Report, or expiration of the current certificate, whichever is later. The necessary systems for traceability and segregation are already in place.

6.2 Traceability within the fishery

Table 6 - Traceability within the fishery

Factor	Description
Will the fishery use gears that are not part of the Unit of Certification (UoC)? If Yes, please describe: - If this may occur on the same trip, on the same vessels, or during the same season; - How any risks are mitigated.	No. The fisheries use only bottom trawl gear. No other types of fishing gear are used.
Will vessels in the UoC also fish outside the UoC geographic area? If Yes, please describe: - If this may occur on the same trip; - How any risks are mitigated.	Yes. Vessels regularly fish outside the UoC and may do so during a single voyage. Factory vessels are equipped with fully integrated weighing and labelling systems in which every carton is barcoded on production and before storage in the hold. This system allows non-certified product to be barcoded as non-certified and to be trackable and separable by scanning at any subsequent stage. In port, vessel product data are reconciled with landing figures to arrive at a final inventory. Fresher vessels land their fish whole, and standard practice involves all fish bins being labelled as per MPI and NZFSA requirements. These outer markings are used to separate and inventory all product on landing.
Do the fishery client members ever handle certified and non-certified products during any of the activities covered by the fishery certificate? This refers to both at-sea activities and on-land activities. - Transport - Storage - Processing - Landing - Auction If Yes, please describe how any risks are mitigated.	All fish and fish product is landed to Licenced Fish Receivers who hold Chain of Custody certification requiring strict, approved procedures to ensure certified and non-certified products are separately stored and are identifiable as certified or non-certified throughout the landing, processing, storage and transportation stages. In addition, MPI regulations require all packaged fish on a LFR's premises to be labelled such that the species name, date of landing, LFR name, processed state and area caught are clearly displayed. The process is considered to be well managed.
Does transhipment occur within the fishery? If Yes, please describe: - If transhipment takes place at-sea, in port, or both; - If the transhipment vessel may handle product from outside the UoC; - How any risks are mitigated.	There is no transhipment of catches at sea within the EEZ by New Zealand vessels.
Are there any other risks of mixing or substitution between certified and non-certified fish? If Yes, please describe how any risks are mitigated.	If there is any doubt whether orange roughy landed into an LFR is from a certified fishery the product is treated as non-certified.

6.3 Eligibility to enter further chains of custody

To be drafted at Client and Peer Review Draft Report stage

Traceability of fishing activity within New Zealand is largely provided by the statutory requirements to record and report estimated catches in near-real-time via the Ministry's Electronic Reporting (ELR) system and through the Ministry's monitoring and compliance programmes. All vessels in the three UoA are equipped with Geospatial Position Reporting (GPR) equipment as well as being subject to monitoring by MPI observers and fisheries enforcement officers. Extensive record keeping is required for reporting landings and processing activity and this information is reported electronically to MPI. Fishing beyond the New Zealand EEZ requires special permitting prior to the activity of fishing and MPI observers on board during fishing operations. All EEZ and high seas fishing activities must be reported to MPI. No transhipment or motherships are used and no change of ownership of any orange roughy (raw or finished product) occurs prior to landing.

Information for each trawl tow is recorded on-board providing, for each fishing operation, the start and finish time, start and finish tow positions, start and finish depth, and the intended target species. Catch information is recorded in an electronic logbook (e-logbooks) after each haul. Vessel locations are tracked by GPR at all times. The information specifically contains reference to species caught (estimated catch (kg), time and date of haul, and location). Target and bycatch species are retained (unless prohibited by law) and reported with the same level of detail. Since MPI collects all catch and landing information from all orange roughy harvests, fishery-wide data collection for traceability or reconciliation purposes could be obtained from MPI, if required.

Further traceability is provided by the client's own internal systems that record the date and time of fishing activities against the date and time of packaging (if processed). All of the landed product from the UoA can be traced back to the particular fishing activities. The identification and quantities of catch can be cross-checked by observers at sea and upon landing. Vessels and companies are routinely monitored. Any alleged breaches are investigated and prosecutions for misrepresentation of landing and/or processing data may follow.

The majority of orange roughly landed in New Zealand has been processed at sea by catcher/processor vessels. At-sea processing operations are similar to onshore primary processing operations with an emphasis on IQF products. Product is processed immediately upon catch, frozen, packaged and held in cold storage for the duration of the voyage. Some vessels also produce fish meal from a mix of species and fish meal is not considered as part of the certified fishery. Product labelling information includes pertinent product form and species information and can be traced back to harvest date, fishing period, vessel name and processing characteristics via bar code or lot codes.

Fresh product is also traceable to the same harvesting information and is physically segregated on board (largely for food safety reasons). Physical segregation of fresh fish is inspected for compliance purposes.

If a vessel only fishes from within the UoA area during a single trip, there would be minimal risks to traceability of the product. This is most likely to occur within the smaller fresh fleet due to limitations on holding capacity and reduced trip length (in order to provide fresh product to markets). Larger vessels may fish inside and outside the UoA during a single trip. GPR will determine if they move outside or between UoA. The unit of certification is determined in part by the target species of a tow, and vessels must record the intended target species in advance of a set. Therefore, no after-the-fact determinations of targets are allowed.

All orange roughy harvested in New Zealand must be landed to a licensed fish receiver. Catches can be inspected by enforcement bodies upon landing. The main ports used by the orange roughy fleets of the UoAs are Nelson and Timaru in the South Island, although landings may occur in Auckland and Gisborne in the North Island. The scope of the fishery certification would end at the point of landing to any LFR within New Zealand and all LFRs would require chain of custody.

There are no major traceability risk factors associated with the broader orange roughy fishery (particularly if the vessels only harvest from within the UoA during the trip). The overall risk to traceability onboard the fishing vessels is also very low. Current systems operating within the fishery and onboard the vessels are sufficient to identify, segregate, and track all certified fish. The fishing vessels do not require CoC. The highest risk factor is species identification at the beginning of production. Proper identification is critically important to ensuring non-orange roughy stocks are not processed as orange roughy. However, the harvest and compliance incentives (including ACE balancing, food safety requirements, observers, etc.) both reduce and detect mistakes in species identification. Once the processed product is packaged, there is no realistic opportunity for non-certified product to mix with the certified product. Equally, once fresh product is sorted, labelled and stored, cross-contamination is likely very low.

Because of the detailed traceability within the fishery and onboard vessels, all fish and fish products from the UoA would be eligible to enter into further certified chains of custody and carry the MSC logo. The scope of this certification ends at the point of landing to any LFR within New Zealand, and all LFRs would require chain of custody. Downstream certification of the product would require appropriate certification of storage and handling facilities at these locations.

6.4 Eligibility of Inseparable or Practicably Inseparable (IPI) stock(s) to enter further chains of custody

There are no IPI stocks in this fishery.

7 Scoring

7.1 Summary of Performance Indicator level scores

Principle	Component	Performance Indicator (PI)		Score UoA1	Score UoA2	Score UoA3
1	Outcome	1.1.1	Stock status	≥ 80	≥ 80	≥ 80
		1.1.2	Stock rebuilding			
	Management	1.2.1	Harvest strategy	≥ 80	≥ 80	≥ 80
		1.2.2	Harvest control rules & tools	≥ 80	≥ 80	≥ 80
		1.2.3	Information & monitoring	≥ 80	≥ 80	≥ 80
		1.2.4	Assessment of stock status	≥ 80	≥ 80	≥ 80
2	Primary species	2.1.1	Outcome	≥ 80	≥ 80	≥ 80
		2.1.2	Management	≥ 80	≥ 80	≥ 80
		2.1.3	Information	≥ 80	≥ 80	≥ 80
	Secondary species	2.2.1	Outcome	≥ 80	≥ 80	≥ 80
		2.2.2	Management	≥ 80	≥ 80	≥ 80
		2.2.3	Information	≥ 80	≥ 80	≥ 80
	ETP species	2.3.1	Outcome	≥ 80	≥ 80	≥ 80
		2.3.2	Management	≥ 80	≥ 80	≥ 80
		2.3.3	Information	60-79	60-79	60-79
	Habitats	2.4.1	Outcome	≥ 80	≥ 80	≥ 80
		2.4.2	Management	60-79	60-79	60-79
		2.4.3	Information	≥ 80	≥ 80	≥ 80
	Ecosystem	2.5.1	Outcome	≥ 80	≥ 80	≥ 80
		2.5.2	Management	≥ 80	≥ 80	≥ 80
		2.5.3	Information	≥ 80	≥ 80	≥ 80
3	Governance and policy	3.1.1	Legal & customary framework	≥ 80	≥ 80	≥ 80
		3.1.2	Consultation, roles & responsibilities	≥ 80	≥ 80	≥ 80
		3.1.3	Long term objectives	≥ 80	≥ 80	≥ 80
	Fishery specific management system	3.2.1	Fishery specific objectives	≥ 80	≥ 80	≥ 80
		3.2.2	Decision making processes	≥ 80	≥ 80	≥ 80
		3.2.3	Compliance & enforcement	≥ 80	≥ 80	≥ 80
		3.2.4	Monitoring & management performance evaluation	≥ 80	≥ 80	≥ 80

7.2 Principle 1

7.2.1 Principle 1 background

7.2.1.1 Overview of the fisheries

Background and history

New Zealand's deepwater fisheries are those fisheries that occur in offshore waters out to the 200 nm limit of New Zealand's Exclusive Economic Zone (EEZ). The management of New Zealand's deepwater fisheries is a collaborative initiative between the Ministry for Primary Industries (MPI, representing the Crown and its statutory obligations to the public) and Deepwater Group Limited (DWG, representing the owners of deepwater quota).

New Zealand fisheries are managed within Fishery Management Areas (FMAs) (Figure 1). FMAs may be combined or subdivided to account for the different ranges of biological stocks for specific fisheries. For example, the boundaries of the Quota Management Areas (QMA) for orange roughy stocks (Figure 2) differ from the default FMA areas. Separate total allowable catch (TACs) and total allowable commercial catch (TACCs) are set for each of these orange roughy QMAs, which in some cases have been further combined or subdivided into Designated Areas to enable discrete management of recognised stocks. Overall, nine orange roughy stocks are managed as separate fisheries within New Zealand's EEZ, of which three are the subject of this assessment. One (ORH7A) is recognized under UNCLOS as a straddling stock with a portion of its management area extending outside of the New Zealand EEZ into an area known as the Westpac Bank (Figure 2).

MPI and DWG contract a range of science and monitoring programmes to routinely assess the status of orange roughy stocks and to monitor the orange roughy fisheries. Orange roughy quota owners pay the full cost for the majority of science and monitoring on these fisheries, either through a Government cost recovery levy or through direct payment through DWG.

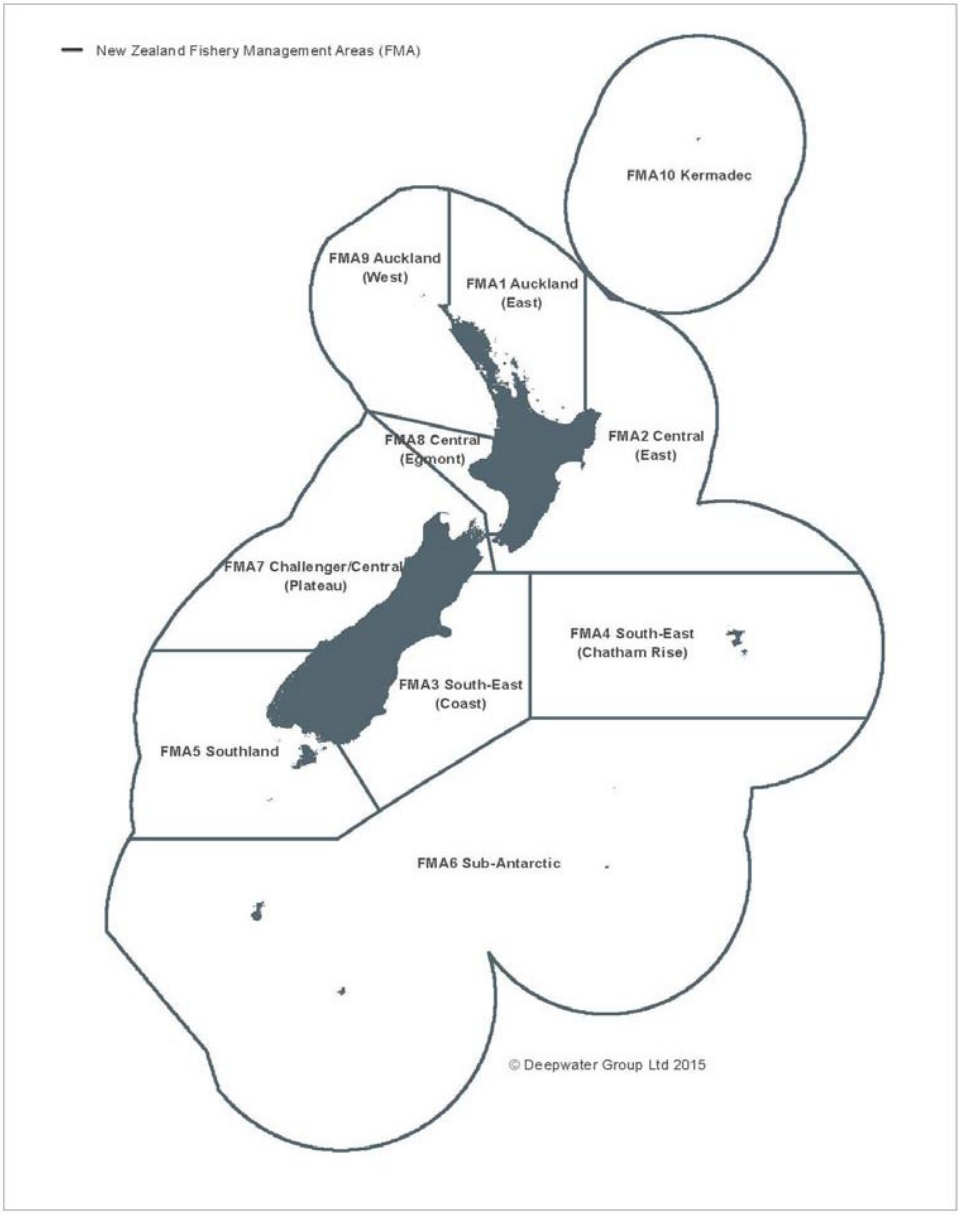


Figure 1. Generic Fishery Management Areas for New Zealand (Source DWG)

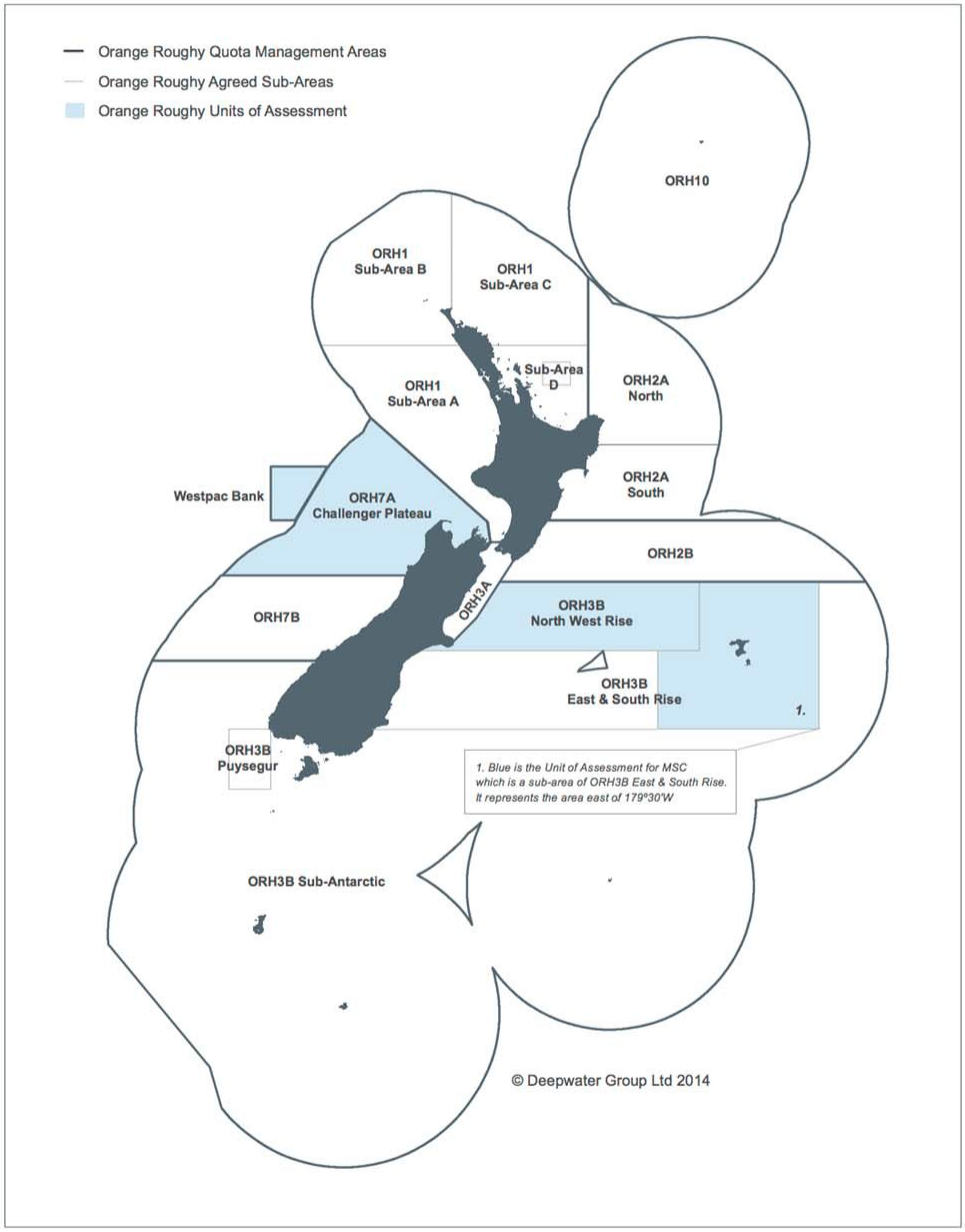


Figure 2. Orange roughy Quota Management Areas and the three Units of Assessment for New Zealand (Source DWG).

Fishing gear and methods[1]

The New Zealand high seas bottom fisheries are well-developed fisheries that have been in operation for about the past three decades. While fishing areas have expanded over time, and fishing methods and gear have been steadily refined and improved, the current fisheries operate in much the same way as they have for the past two decades or so. Descriptions and analyses presented in this assessment have been based on data for the period from 1990 onwards, when fishery development started to increase significantly, to 2019/20, with emphasis on the years from 2015/16.

Bottom Trawling Methods

New Zealand flagged bottom trawling vessels generally target orange roughy, alfonsino, cardinalfish and oreo species using specific deepwater bottom trawl nets and fishing methods developed since the early 2000s, and which are currently used both within and beyond the New Zealand EEZ, to specifically target these species.

Modern deepwater trawling is an aimed method of trawling, usually targeting relatively dense aggregations of fish, which are often located and targeted acoustically. This differs from the herding type trawl fishing of, for example, flatfish, hake or cod that are fished using long, non-aimed tows on flat, muddy seabed. To reduce damage to fishing gear on the hard ground typical of areas inhabited by species such as orange roughy, and to enable nets to be rapidly and accurately aimed at fish aggregations, deepwater trawling methods have evolved in various ways towards agile net systems that minimize groundrope length, net size and unnecessary ground contact, particularly by non-fishing gear components such as trawl doors.

Some typical deepwater trawl net designs currently used in these fisheries are shown in Figure 3. Nets are manufactured from braided nylon twines, typically ranging in thickness from 4mm for the wings, to 5mm for the end sections, doubled for areas of the net belly subject to abrasion. Codends attached to these nets are made of heavier rope meshes. Net headropes are equipped with hard floats to provide the buoyancy needed to maintain the net opening during trawling, while the footrope may be equipped with a variety of ground-gear, depending on the seabed type to be trawled. The nets used are designed to provide net mouth openings (groundrope lengths) between wing-tips of 15 - 20 m under optimal towing conditions, with headline heights of 5 m - 6 m above the footrope. Nowadays, nets are also equipped with netsounders and headline sensors to monitor the net opening, to determine position of the net relative to the seabed, and to facilitate accurate targeting of nets at acoustic fish targets.

[1] This section adapted from MPI (2008).

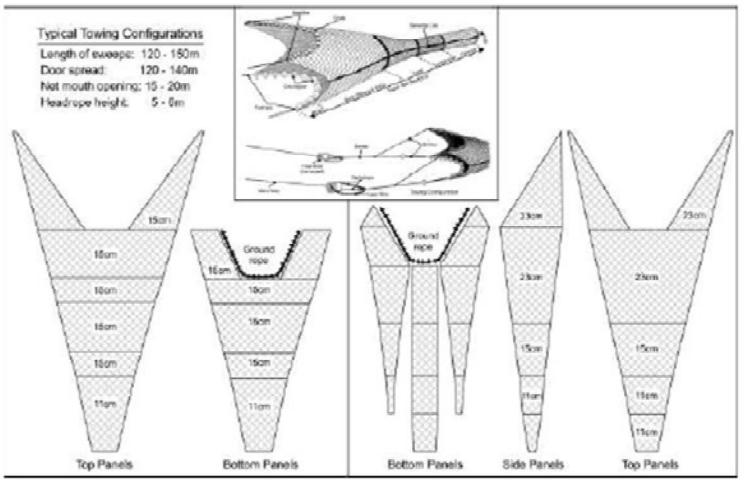


Figure 3. Stylised net construction diagrams for typical bottom trawl nets used in the New Zealand deepwater orange roughy targeted bottom trawl fishery.

Two alternate simplified net designs are shown, using different mesh sizes and net wing configurations. Inset shows an illustration of the configuration of a typical bottom trawl net during trawling.

Trawl doors and towing configurations

Trawl doors used in New Zealand deepwater bottom trawl fisheries were initially of the older style 'vee-door', to maximise the stability of doors during towing. Vee doors have a low aspect ratio, with their length being greater than their height, which results in greater stability. However, these doors are dependent on bottom contact (ground sheer forces) to create their net spreading force. With the move to better winch systems and increased use of electronics to accurately target fish aggregations, there has been a move to high aspect ratio doors, in which the height is 1.5 to 1.8 times length. These doors do not require bottom contact and depend solely on hydrodynamic forces to generate spread. Efforts to reduce drag and increase control of trawl doors has also resulted in a move to smaller, more efficient doors from producers of high-technology doors, such as Nichimo, Hampidjan and Morgere.

The trawl doors currently used by New Zealand deepwater bottom trawlers typically range from ~1,200kg - 2,000kg in weight, and from ~4m2 – 8m2 in size, depending on the vessel engine power and net design. Modern doors are generally designed and rigged to operate off the bottom, being set to minimise the risk of digging in should there be any contact with the seabed. Deepwater trawl nets rigged in this way are ideally 'flown' such that the net contacts the seabed only in the area of the aggregated fish shoals, with the doors themselves preferably not touching the seabed. Lengths of sweeps and bridles (the towing and herding wires connecting the trawl doors and the net opening) are relatively short, to provide better control over the gear and reduced seabed contact. The combination of sweeps and bridles connecting the doors to the nets on current orange roughy targeted trawls typically range in length from 120m - 140m, the combination of doors and sweep lengths being set to achieve net openings of 15m - 20m between wingtips. Under these configurations, distance achieved between trawl doors during towing (door spread) is maximally 120m - 150m under optimal towing conditions. In areas where operators wish to accurately target fish aggregations and require maximal control of the net, they may even operate with very short bridles and no sweeps.

Ground gear configuration

For bottom trawling on hard ground, net footropes are equipped with some form of ground-gear to protect the footrope, and to enable the net to maneuver over rough terrain or minor obstacles. Initially, deepwater trawlers used steel bobbins on the groundrope when fishing hard ground, these being standard at the time on Northern Hemisphere cod trawlers. It has been found that these are not necessary, and that gear efficiency is improved and bottom contact reduced by incorporating rubber components in the ground rope. Initially, steel bobbins were replaced by smaller 40 cm - 60 cm diameter rubber bobbins. More recently, there has been a shift to the use of 60cm rubber discs separated by spacers along the footrope to create 'rockhopper' gear. Whereas bobbins are designed

to allow the footrope to roll over rough ground, the groundrope in a rockhopper system is rigged under tension, causing the net to 'hop' over encountered obstacles, rather than attempting to drag through or roll over them.

Bottom trawling fishing depths

New Zealand vessels are required to report seabed depth on catch return forms for each fishing trip, enabling the frequency of trawl tows in different depth ranges to be analysed. For the period 2015-16-2019-20, 18,210 tows reported bottom depth. 7% of these tows were conducted in depths less than 700 m, 11% in depths greater than 1,100 m, with 82% of tows being conducted in the depth range 700 m - 1,100 m. Just over half the tows were conducted over the depth range 800 m - 1,000 m, with a strong mode in the 900 m - 1,000 m depth range. The participants, fishing methods and fishing areas have not changed since the 2002 - 2006 reference period, and bottom trawling continues to occur over the same depth ranges.

Effort

The assessed orange roughy stocks are fished by New Zealand domestic vessels using demersal trawl gear. Eleven vessels have caught orange roughy from the UoAs during the period between 2015-16 to 2019-20 (Table 7). These vessels range in size from 27 m to 66 m registered length. Vessel tonnage ranges from 113 t to 2,483 t, with hold capacity ranging from 112 m3 to 1,000 m3.

Five of the vessels are 'freshers', in that they store their catch onboard in ice and land this as fresh chilled. These vessels generally do not process catch at sea and land whole fish, which may be processed on land or exported whole. The remaining six vessels are factory-freezers, which freeze product on-board and generally remain at sea for longer periods. These vessels either process to the 'dressed' (head, guts and pectoral fins removed) or 'gutted' state at-sea. Three of the factory vessels also have onboard fishmeal plants,and process most offal and non-commercial bycatch species into fishmeal and fish oil.

Table 7. Number of vessels by length in the three orange roughy UoAs over the past five years (2015-16 to 2019-20) (registered overall length in metres). Note: The same vessels fish in all three fisheries, but not all vessels fish in all fisheries in all years. (Source: MPI, pers. Comm., 2021)

UoA	2015-16			2016-17			2017-18			2018-19			2019-20		
	<30	30-40	>40	<30	30-40	>40	<30	30-40	>40	<30	30-40	>40	<30	30-40	>40
ORH3B NWCR	0	5	6	0	2	8	0	4	5	0	3	6	0	2	6
ORH3B ESCR	0	1	4	0	1	4	0	0	5	0	1	6	0	2	5
ORH7A	2	3	3	2	2	3	2	3	3	2	2	4	2	4	4

All vessels fishing in New Zealand are required to report all fish caught, except those fish under a set Minimum Legal Size (MLS). There are no retained or bycatch species caught in orange roughy fisheries that have a MLS.

Reporting requirements are set out in the Fisheries (Reporting) Regulations 2001, most notably in sections 5 and 6. It is illegal under the Fisheries Act 1996 to discard any species in the Quota Management System (QMS) at-sea unless the species is listed on Schedule 6 (of the Fisheries Act), the return to the sea is recorded, and the specified conditions are met, or an MPI observer on the vessel authorises the discard.

The majority of the vessels involved in the three UoA orange roughy fisheries are trawlers greater than 28m. These vessels are required to record fishing effort and estimated catch on Trawl Catch Effort and Processing Returns (TCEPRs). Some orange roughy fishing is also carried out by trawlers under 28m. These smaller vessels are required to record fishing effort on Trawl Catch Effort Returns (TCERs). These forms require reporting of effort statistics as well as estimates of catch for either the top five (TCEPR) or the top eight species (TCER) in the catch. From 1 October 2017, all trawl vessels greater than 28 m have been required to report their catches electronically, using an e-loogbook, in near-real-time (i.e. within 8 hours of a catch

landing on deck). Fishers are required to report landings for a trip on Catch Landing Returns (CLRs) regardless of the type of return (TCEPR or TCER) upon which effort information is reported. CLRs require all fish taken on a trip to be reported, including non-QMS species that were returned to the sea (discarded bycatch).

All fishers are required to furnish accurate monthly returns on locations fished, fishing gear used, catches of main species, information on processing and landing of catches and to reconcile these against Annual Catch Entitlement (ACE).

Outline of fishery resources

Orange roughy (*Hoplostethus atlanticus*) has an almost worldwide distribution (Branch, 2001). However, the bulk of the world catch of this species has been taken from New Zealand. In New Zealand, orange roughy are assessed and managed in several areas, each of which may contain one or more stocks of orange roughy (Figure 2). Orange roughy are also fished in international waters on Westpac Bank (Figure 2). The fisheries in international waters are managed under the auspices of the South Pacific Regional Fisheries Management Organization (SPRFMO) of which New Zealand is a member.

The UoAs are the following populations of orange roughy (Figure 2):

1) ORH3B Northwest Chatham Rise (ORH3B NWCR);
2) ORH3B East and South Chatham Rise (ORH3B ESCR) east of 179º 30' W; and,
3) ORH7A Challenger Plateau, including Westpac Bank (ORH7A).

Table 8. Summary of the stock status of the 3 UoA based on the base model runs.

Stock	Most recent assessment	Depletion [Year]	P < Limit	P > Lower end of the Management Target range
ORH 3B NCWR	2018	38 (31-48) (2017)	<1%	>95%
ORH 3B ESCR	2020	36 (30-41) (2020)	<1%	>95%
ORH 7A	2019	47 (39-55) (2019)	<1%	>95%

Stock structure life history

Stock structure

Genetic data have been used to define stock boundaries, both within QMAs and between them (FNZ, 2021a; Smith and Benson, 1997; Smith *et al*., 1997). Considerable differences have been found between fish from the Puysegur area and those from adjacent Cook Canyon and Chatham Rise. Allozyme studies have shown that orange roughy from within the Richie Bank (ORH 2A) are distinct from those on the Chatham Rise (Smith *et al*., 1997). These data also suggested multiple stocks on the Chatham Rise but also that allozyme frequencies varied as much as over time and among areas (FNZ, 2021a).

Five sub-stocks of orange roughy are recognized for management purposes within the ORH3B QMA (NWCR, ESCR, Arrow Plateau, Puysegur and Sub-Antarctic) (Figure 3). However, only two stocks (Chatham Rise and Puysegur) have been distinguished using genetics (Smith and Benson, 1997). Given the large size of the ORH3B QMA, as well as discontinuities in the distribution of catches, it is *a priori* likely that there are several stocks of orange roughy in this QMA (FNZ, 2021b). The most comprehensive evaluation of the stock structure of orange roughy on the Chatham Rise was conducted during 2008 (Dunn and Devine, 2010). Dunn and Devine (2010) evaluated a variety of sources of information for the ORH3B QMA, including (a) catch distribution and catch-rate patterns, (b) locations of spawning and nursery grounds, (c) inferred migrations, (c) size, maturity and condition data, (d) genetic studies, and (e) habitat and natural boundaries.

Dunn and Devine (2010) found evidence that a separate stock of orange roughy occurs on the Northwest Chatham Rise. The evidence in support of this includes a substantive spawning ground as well as nursery grounds in the Graveyard Hills area on the Northwest Chatham Rise (Figure 4). Other evidence suggesting that orange roughy on the Northwest Chatham Rise and in the Spawning Box on the East Chatham Rise constitute separate stocks include: (a) a gap in the

distribution of juveniles between these sub-areas; (b) evidence for a westerly post-spawning migration from the Graveyard Hills area; (c) differences in the median length among sub-areas; and, (d) differences in trends in the size-of-50%-maturity among sub-areas. The only information that suggests that the Northwest Chatham Rise may not be separate from the Spawning Box is an indication from patterns in commercial catch rates that some of the fish that arrive to spawn in the Spawning Box may come from the west. Oceanographic models suggest that a gyre to the east of the Graveyard may lead to a separation between the Northwest Chatham Rise and the East Rise.

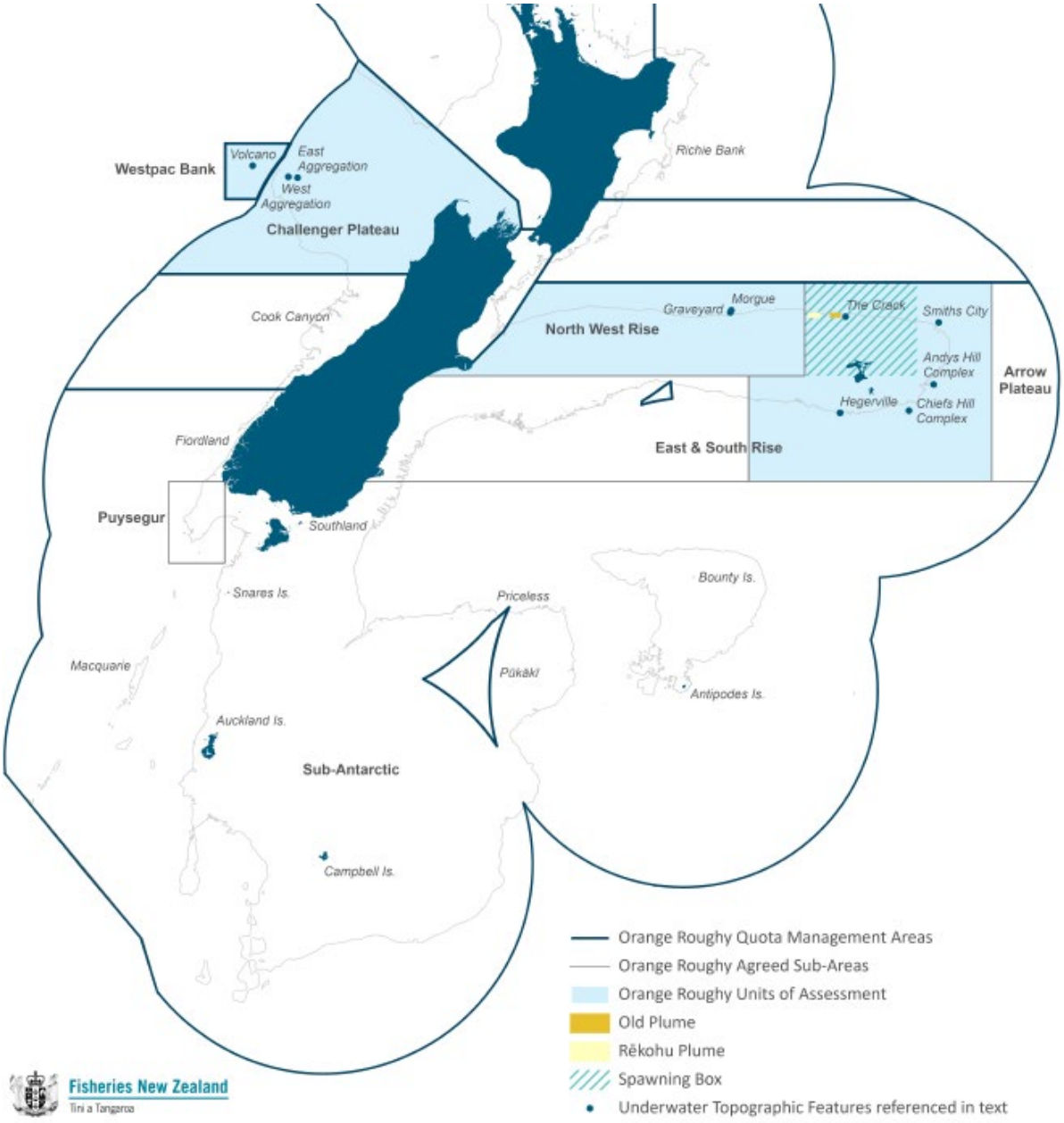


Figure 4. Designated Sub-Area Boundaries for Orange Roughy in the ORH3B QMA and locations with ORH7A. The Spawning Box is within the western part of the East Chatham Rise (i.e. to the east of 175°W). The sub-Antarctic is all areas below 46°S on the east coast, and 44°16'S on the west coast, except Puysegur. (Source: DWG).

Spawning occurs simultaneously on the Northeast Hills and the Andres Hills complex (East Rise) and the Spawning Box and Eastern Flats and the trend in standardized CPUE differs between these areas. However, a single stock on the Spawning Box and East Rise is supported by a

continuous nursery ground throughout the area, similar trends in size of 50% maturity in each area, the essentially continuous habitat with similar environmental conditions, no obvious differences in median length from commercial catches between areas and inferred post-spawning migrations from the Spawning Box to the East Rise (FNZ, 2021b). The spawning aggregation on the Northeast Hills has also exhibited an increase in mean length and catch rates, suggesting that fish spawning on these hills are not resident, and thus are not separate from the surrounding area. Based on the available data, FNZ (2021b) considered fish on the Northeast Hills and the Andes Hills complex to be from the same stock as the Spawning Box and Eastern Flats.

Dunn and Devine (2010) found weak evidence that the area west of and including 'Hegerville' (on the South Chatham Rise) is a separate stock. This evidence included that a median length analysis indicated a split in the area, and an oceanographic front at 177^0W. In contrast, the few catches of orange roughy in the area west of Hegerville and the lack of a nursery ground on the South Chatham Rise supported the hypothesis that orange roughy on the East and South Chatham Rise do not constitute separate stocks. Moreover, The South Rise could provide feeding habitat for the stock, which is estimated to have had an initial biomass of over 300,000t, an amount that was probably too large to inhabit only the East Rise. FNZ (2021b) concluded that there is more evidence to support the idea of orange roughy in this area being part of the East Rise stock than there is to the contrary. Based on the available information FNZ (2021b) conducted stock assessments for the Chatham Rise assuming two separate stocks (ORH3B NWCR; and, ORH3B ESCR). Management advice is provided separately for these areas (see Figure 4).

ORH7A covers the Challenger Plateau (Figure 2), which includes both the New Zealand EEZ and waters outside of the EEZ. Orange roughy on the southwest Challenger Plateau are regarded as a single stock, separate from other regions around New Zealand. This is supported by differences in size structure, parasite composition, flesh mercury levels, allozyme frequency and mitochondrial DNA from other major fisheries (FNZ, 2021c). Moreover, spawning on the Challenger Plateau occurs at a similar time to fish on the Chatham Rise, Puysegur Bank, Ritchie Banks, Cook Canyon and Lord Howe Rise.

Life history and ecology[2]

Orange roughy is a deepwater species and is found from 700 to at least 1,500m (FNZ, 2021a). The maximum depths that orange roughy inhabit are unknown (FNZ, 2021a). Orange roughy in New Zealand waters reach a maximum size of about 50cm standard length (SL), and 3.6kg in weight, but the maximum size appears to vary among local populations. Average size is around 35cm SL, although there is variation between areas. Orange roughy are considered to be long-lived (otolith ring count and radiometric isotope studies suggest that orange roughy may live up to 120-130 years; FNZ, 2021a). Several methods have been applied to age orange roughy. Age determination from otolith rings has been validated by length-mode analysis for juveniles up to four years of age in one study, and adult ages has been validated using radiometric techniques (FNZ, 2021a). Routine ageing of orange roughy has proven difficult. Specifically, biases in estimates of age have been identified. A new ageing protocol was developed for orange roughy in 2007, associated with an international ageing workshop for this species (Tracey *et al.*, 2007)

Orange roughy otoliths have a marked transition zone in banding, which is believed to be associated with the onset of maturity (Francis and Horn, 1997). The estimates of transition-zone maturity range from 23 to 31.5 years for fish from various New Zealand fishing grounds (Horn et al., 1998, Seafood Industry Council/NIWA unpublished data). However, spawning fish appear to be an older subset of the transition-zone mature fish as evidenced by the older ages and the larger sizes of fish caught on the spawning grounds. The transition-zone maturity estimates are not used in current stock assessments as maturity was estimated in each of the models.

Natural mortality, *M*, has been estimated to be $0.045yr^{-1}$ based on otolith data from a 1984 trawl survey of the Chatham Rise. A similar estimate of *M* was obtained in 1998 from a lightly fished population in the Bay of Plenty (FMZ, 2021a). The base runs in the assessments use this value for *M*. The implications of *M* differing from $0.045yr^{-1}$ on stock status are included in the assessment reports, and explicitly accounted for in the Management Strategy Evaluation (MSE) analyses (Cordue, 2014a). Cordue (2014a) notes that it is not clear whether the models are

[2] Much of this section is taken from FNZ (2021a).

obtaining 'genuine' information on *M*, in particular because the signals are driven by information or the assumption of average recruitment for the cohorts that are poorly represented in the age data. Lower estimates of *M* could consequently be due to above average year strengths, sampling vagaries, errors in selectivity, as well as because *M* is less than $0.045yr^{-1}$. Given this, and the bias-variation trade-off associated with estimating *M*, assessments prefer to fix rather than estimate *M*, at least at present.

The larval biology of orange roughy, in common with that for most deepwater marine species, is poorly known. Fishing during spawning may disrupt spawning activity or success. Morgan *et al.* (1999) concluded that Atlantic cod (*Gadus morhua*) "exposed to a chronic stressor are able to spawn successfully, but there appears to be a negative impact of this stress on their reproductive output, particularly through the production of abnormal larvae". Morgan *et al*. (1999) also reported that "Following passage of the trawl, a 300-m-wide "hole" in the [cod spawning] aggregation spanned the trawl track. Disturbance was detected for 77 min after passage of the trawl." There is no research on the disruption of spawning orange roughy by fishing in New Zealand.

The relationship between spawning biomass and recruitment for orange roughy is poorly known owing to a lack of data on recruitment strength and, in particular, the long lag between spawning and subsequent recruitment to the fishable stock, although it has been possible to update a prior for the steepness of the stock-recruitment relationship using the results from the assessment of the MEC orange roughy stock (Cordue, 2014a,b, 2019c). Assessments of orange roughy have assumed that the stock-recruitment relationship is of the Beverton-Holt form, that the steepness of the stock-recruitment relationship is 0.75, and that the extent of inter-annual variation in recruitment is very high (σ_R=1.1) (FNZ, 2021a).

The main prey species of orange roughy include mesopelagic and benthopelagic prawns, fish and squid, with other organisms such as mysids, amphipods and euphausiids occasionally being important (Rosecchi *et al.*, 1988). Ontogenetic shifts occur in their feeding preferences, with the smaller fish (up to 20 cm) feeding on crustaceans, and larger fish (31 cm and above) feeding on teleosts and cephalopods (Stevens *et. al.*, 2011). Dunn and Forman (2011) inferred from diet analysis that juveniles feed more on the benthos compared with the benthopelagic foraging of adults. Predators of orange roughy are likely to change with fish size. Larger smooth oreo, black oreo and orange roughy have been observed with healed soft flesh wounds, typically in the dorso-posterior region. Wound shape and size suggest they may be caused by deepwater dogfishes. (Dunn *et al*., 2010). Giant squid and sperm whales have also been found to prey on orange roughy.

History of the fisheries

Table 9 lists the catches for the three UoAs (ORH3B NWCR, ORH3B ESCR, and ORH7A). The first orange roughy fishery began in 1978 with moderate catches (Table 9). New Zealand catches of orange roughy progressively increased during the 1980s as more fishing grounds were discovered and developed. By 1992 it became evident that orange roughy are slower growing, longer lived, and less productive than previously thought. As a result, the stock assessment parameters, estimated sustainable yields and TACCs were adjusted downwards. As stocks were progressively 'fished down' from B_0 towards B_{MSY}, and at times to below B_{MSY}, the management response has been to reduce the TACCs. During the 1990s, catches were subsequently reduced, at times to zero, to promote stock size rebuilding.

A Total Allowable Commercial Catch (TACC) is set for each of the ORH3B and ORH7A QMAs. TACCs and corresponding catches (as provided by MPI) during the period 2005-06 to 2020-21 for the three UoAs are provided in Table 10.

The spatial distribution of orange roughy catches within the ORH3B QMA is currently managed within four designated sub-areas, each of which is considered to have a separate fisheries stock and is assessed and managed accordingly. Management of each designated sub-area, including the two UoAs: ORH3B NWCR and ORH3B ESCR, is implemented through catch limit agreements between the Minister of Primary Industries and quota owners. These non-regulatory sub-area catch limits are implemented by MPI and industry. Each quota owner apportions their holdings of ORH3B ACE according to the agreed sub-area catch limits, trades ACE, and manages catches as if each sub-area was a separate QMA.

In instances where catch reductions are required within a designated sub-area, but where government and industry agree that these catch reductions will be implemented by quota owners rather than by TACC reductions, quota owners agree to collectively transfer (or to 'shelve') the requisite quantity of ACE to be held in trust by a neutral third party, Commercial Fisheries Services Ltd (FishServe). Catch limits for each of the designated sub-areas, and the corresponding catches during the period 2005-06 to 2020-21 for ORH3B ESCR and ORH3B NWCR are provided in Table 10.

MPI monitors DWG's catch reports and operators' fishing patterns to audit the agreed catch spreading. Catches have been within the agreed catch limits, which allow for an over-run of not more that 10% in any one year, as is the case for catches against TACCs in the QMS (Table 10).

Table 9. Summary of orange roughy UoA catches (tonnes). GIS-based from 1978-79 to 2012-13; Industry-report-based from 2013-14 to 2019-20. (Source: DWG, pers commn).

Fishing Year	ORH 3B ESCR			ORH 3B NWCR			ORH 7A		
	Commercial	Research[1]	Total	Commercial	Research[1]	Total	Commercial	Research[1]	Total
1978-79	10,126		10,126						
1979-80	17,861		17,861	747		747			
1980-81	18,221		18,221	8,333	0	8,333	1		1
1981-82	9,503		9,503	3,825		3,825	3,940		3,940
1982-83	17,159	0.1	17,159	8,670	0	8,670	11,941		11,941
1983-84	20,830	37	20,867	2,971	0	2,971	9,287		9,287
1984-85	24,804		24,804	1,839		1,839	5,077		5,077
1985-86	24,605	0.2	24,605	3,691	3	3,694	7,414		7,414
1986-87	25,851		25,851	3,035		3,035	10,407		10,407
1987-88	12,674	0.7	12,675	737	1	738	10,092		10,092
1988-89	13,878	2	13,880	1,762	0	1,762	5,171		5,171
1989-90	19,104	0.4	19,104	2,524	3	2,527	3,329		3,329
1990-91	16,471	0	16,471	1,529	2	1,531	1,294		1,294
1991-92	14,031	215	14,246	304	14	318	1,898		1,898
1992-93	8,910	55	8,965	3,499	9	3,508	1,973		1,973
1993-94	9,009	297	9,306	3,314	116	3,430	1,634		1,634
1994-95	5,326	275	5,601	2,253	2	2,255	1,679		1,679
1995-96	4,356	61	4,417	2,167	231	2,398	1,772		1,772
1996-97	4,069	0.01	4,069	1,967	16	1,983	1,241		1,241
1997-98	5,619	152	5,771	2,327	-	2,327	1,427		1,427
1998-99	4,638	2	4,640	2,603	115	2,718	1,238		1,238
1999-00	5,569	0.1	5,569	2,296	0	2,296	627		627
2000-01	5,063	0.3	5,063	2,627	0	2,627	2		2
2001-02	7,586	0.1	7,586	2,276	129	2,405	4		4
2002-03	8,428	0.1	8,428	2,351	0	2,351	5		5
2003-04	7,579	7	7,586	2,072	0	2,072			
2004-05	8,031		8,031	1,685	8	1,693	0	158	158
2005-06	8,143	46	8,189	1,610	0	1,610	0	199	199
2006-07	8,048	126	8,174	813	0	813	0		0
2007-08	6,988	200	7,188	734	0	734	2		2
2008-09	6,019	144	6,163	620	95	715	0	231	231
2009-10	4,706	203	4,909	668	38	706	0	322	322
2010-11	2,694	97	2,791	45	4	49	136	345	481
2011-12	1,757	650	2,407	19	67	86	387	132	519
2012-13	1,859	327	2,186	19	92	111	513	192	705
2013-14	3,039	2	3,041	811	1	812	497	54	551
2014-15	3269		3,269	824		824	1594		1594
2015-16	3092	276	3,368	581	38	619	1568		1568
2016-17			0			0	1623		1623
2017-18	3328		3,328	724		724	1601	180	1781
2019-19	4143		4,143	294		294	1589		1589
2019-20	4769		4,769	223		223	1897		1897

[1] Catches taken by MPI and/or Industry during ORH acoustic biomass surveys and wide area trawl surveys

ORH3B Chatham Rise and Southern New Zealand (ORH 3B)

The fishery for orange roughy within the ORH3B QMA started on the Chatham Rise in the late 1970s. The bulk of the catches of orange roughy in the early years was taken from the Spawning Box region on the Northeast Chatham Rise, although the fishery quickly expanded to the Northwest and South Chatham Rise areas. Until 1982, most of the catch was taken from areas of relatively flat bottom, between mid-June and late July, when fish form spawning aggregations. The Spawning Box was closed to fishing for the 1992-93 and 1994-95 fishing seasons to facilitate rebuilding, and the fishery moved to the hills, first to Smith's City and adjacent hills (in the north-east Chatham Rise), then to the Andes and Chiefs hill complexes (in the south-east Chatham Rise, Figure 4). The non-spawning fishery contracted to hill complexes, particularly on the south-east Chatham Rise where new fishing locations were found (discovery of new fishing grounds, followed by apparent rapid depletion is a common feature of fisheries for orange roughy worldwide).

Since 1992-93, the distribution of the catch within ORH 3B has been affected by agreements between the fishing industry of the relevant Minister. A full description of the changes in the fishery across the entire ORH3B QMA is given in MPI (2021b).

Challenger Plateau (ORH7A)

The fishery for orange roughy within ORH7A began in the early 1980s (Table 9), with most fishing taking place during winter when orange roughy form aggregations. Catches prior to 1988-89 regularly exceeded 10,000t (the peak catch of over 12,000t occurred during 1987-88 fishing season). The TACC was reduced to 2,500t for the 1989-90 fishing season and then to 1,900t for the 1990-91 fishing season. The fishery was closed for the 2000-01 fishing season following a further reduction in TACC to 1,425t for the 1999-2000 fishing season. Catches were below the TACC for most years between 1986-87 and 1999-20. Catches were minimal (<5t) between the 2000-01 and 2009-10 fishing seasons when the fishery was re-opened with a TACC of 500t for the 2010-11 fishing season. The TACC was increased to 1,600t for the 2014-15 fishing season and to 2,058t for the 2019-20 fishing season. Catches and TACCs for ORH7A are listed in Table 10.

Table 10. Recent catches and agreed catch limits (tonnes) for the three units of assessment. GIS analysis of catch locality from 2005-06 to 2012-13; Industry-reported from 2013-14 to 2019-20. (Source: DWG, pers commn).

Fishing year	Catch limit	Research	Total	Commercial	Research[4]	Total	(Under) / over	Under / over as % of total catch allowance	Fishing year
NWCR									
2005-06	1,500		1,500		1,610		1,610	110	7%
2006-07	750		750		813		813	63	8%
2007-08	750		750		734		734	-16	-2%
2008-09	750		750		620	95	715	-35	-5%
2009-10	750		750		668	38	706	-44	-6%
2010-11	750		750		45[3]	4	49	-701	-93%
2011-12	750		750		19[3]	67	86	-664	-89%
2012-13	750		674[2]		19[3]	92	111	-563	-84%
2013-14	750		750		811	1	812	62	8%
2014-15	1,043		1,043		824		824	-219	-21%
2015-16	1,043	50[1]	1,093		581	38	619	-474	-43%
2016-17	1,043		1,043		646		646	-397	-38%
2017-18	1,043		1,043		724		724	-319	-31%
2018-19	1,149		1,149		294		294	-855	-74%
2019-20	1,150		1,150		223		223	-927	-81%
2020-21	1,150								
ESCR									
2005-06	8,650	250[5]	8,900		8,143	46	8,189	-711	-8%
2006-07	8,650	250[5]	8,900		8,048	126	8,174	-726	-8%
2007-08	7,650	250[5]	7,900		6,988	200	7,188	-712	-9%
2008-09	6,570	250[5]	6,820		6,019	144	6,163	-657	-10%
2009-10	5,100	250[5]	5,350		4,706	203	4,909	-441	-8%
2010-11	2,960	250[6]	3,210		2,694	97	2,791	-419	-13%
2011-12	1,950	653[6,7]	2,603		1,757	650	2,407	-196	-8%
2012-13	1,950	326[6,8]	2,276		1,859	327	2,186	-90	-4%
2013-14	3,100		3,100		3,039	2	3,041	-59	-2%
2014-15	3,100		3,100		3269		3,269	169	5%
2015-16	3,100	264[9]	3,364		3092	276	3,368	4	0%
2016-17	3,100		3,100		3300		3,300	200	6%
2017-18	3,100		3,100		3328		3,328	228	7%
2018-19	4,095		4,095		4143		4,143	48	1%
2019-20	4,775		4,775		4769		4,769	-6	0%
2020-21	5,970								
ORH7A-WB[10]									
2005-06	1	250	251			199	199	-52	-21%
2006-07	1		1				0	-1	-100%
2007-08	1		1		2		2	1	100%
2008-09	1	400	401			231	231	-170	-42%
2009-10	1	400	401			322	322	-79	-20%
2010-11	500	No Limit[11]	500+		136	345	481	-364[12]	-43%
2011-12	500	No Limit[11]	500+		387	132	519	-113[12]	-18%
2012-13	500	No Limit[11]	500+		513	192	705	13[12]	2%
2013-14	500	50	550		497	54	551	1	0%
2014-15	1600		1600		1594		1594	-6	0%
2015-16	1600		1600		1568		1568	-32	-2%
2016-17	1600		1600		1623		1623	23	1%
2017-18	1600	205	1805		1601	180	1781	-24	-1%
2018-19	1600		1600		1589		1589	-11	-1%
2019-20	2058		2058		1897		1897	-161	-8%
2020-21	2058								

1 50 t shelved NWCR ACE transferred for research use
2 76 t NWCR ACE transferred for research use in ESCR
3 Industry agreement to 'rest' fishery to provide for rebuild - no target fishing
4 Research catches taken by MPI and/or industry during biomass surveys
5 Research allowance of 250 t applies to all of ORH 3B
6 Research allowance of 250 t applies to ESCR only
7 Transfer of 403 t Sub-Antarctic ACE to ESCR for biomass survey
8 76 t of NWCR ACE transferred to ESCR for biomass survey
9 132 t shelved NWCR ACE and 132 t Puysegur research ACE transferred to ESCR for biomass survey
10 ORH 7A-WB UoA comprises the ORH 7A QMA and the adjacent designated area known as Westpac Bank
11 In 2010-11, 2011-12 and 2012-13 an MFish Special Permit provided for unlimited research catch to be taken during biomass surveys
12 The research catch limit was assumed equal to the survey catch

Monitoring and Stock assessment

The information needed to assess stock status relative to the limit reference point and the management target range, and to apply the harvest control rule is an estimate of F_{MSY}, an estimate of current fishing mortality, an estimate of recent abundance, $B_{current}$, and an estimate of the unfished biomass B_0. This information is obtained from quantitative stock assessments based on fitting population dynamics models to monitoring data. The stock assessment process is open to anyone who elects to participate. The process is managed by FNZ and supported by orange roughy quota owners through DWG.

The review of stock assessments has been conducted primarily though meetings of the MPI Deep Water Working Group (DWWG), which consists of scientists from NIWA, FNZ, representatives of environmental NGOs, and industry (FNZ, 2021d).

The objectives of the FNZ Fishery Assessment Working Groups (FAWGs) are to:

review new research information on stock structure, productivity, abundance and related topics for each fish stock/issue under the purview of individual FAWGs.

Where possible, to derive appropriate MSY-compatible reference points for use as reference points for determining stock status, based on the Harvest Strategy Standard for New Zealand Fisheries (the Harvest Strategy Standard).

Conduct stock assessments or evaluations for selected fish stocks in order to determine the status of the stocks relative to MSY-compatible reference points and associated limits, based on the "Guide to Biological Reference Points for Fisheries Assessment Meetings", the Harvest Strategy Standard, and relevant management reference points and performance measures set by fisheries managers.

For stocks where the status is unknown, FAWGs should use existing data and analyses to draw logical conclusions about likely future trends in biomass levels and/or fishing mortality (or exploitation) rates if current catches and/or TACs/TACCs are maintained, or if fishers or fisheries managers are considering modifying them in other ways.

Where appropriate and practical, to conduct projections of likely future stock status using alternative fishing mortality (or exploitation) rates, or catches, or other relevant management actions, based on the Harvest Strategy Standard and input from the FAWG and fisheries managers.

For stocks that are deemed to be depleted or collapsed, to develop alternative rebuilding scenarios based on the Harvest Strategy Standard and input from the FAWG and fisheries managers.

For fish stocks for which new stock assessments or analyses are not conducted in the current year, to review the existing Fisheries Assessment Plenary report text on the “Status of the Stocks” in order to determine whether the latest reported stock status summary is still relevant; else to revise the evaluations of stock status based on new data or analyses, or other relevant information.

The DWWG reports are available through annual summaries, with the results of detailed analyses reported in Fishery Assessment Reports (FARs). Independent stock assessment scientists from New Zealand (1), Australia (2), USA (1), and Canada (1) familiar with stock assessment of orange roughy participated in MPI’s 2014 DWWG and Plenary meetings that considered and reviewed the orange roughy stock assessments. However, no formal comprehensive external review of the current assessment framework has been undertaken.

Recent stock assessments were based on the stock assessment package CASAL (Bull et al., 2012). Specifically, orange roughy in each area were represented as a single stock and a single sex was modelled. The population in each area was modelled using an age-structured model in which animals that spawn were modelled separately from those that have not yet entered the spawning biomass. Maturity was estimated within the model from age-frequencies of spawning fish and, if available, from female proportion spawning-at-age data from pre-spawning wide-area trawl surveys (available for ORH 3B NWCR). All mature fish were assumed to spawn each year as this was consistent with the estimates of female proportion spawning at age.

The assessments for the Northwest Chatham Rise and the Challenger Plateau assumed that fisheries were for spawning fish while the assessment for the East and South Chatham Rise included four fleets (although the selectivity patterns for the four fleets were all very similar, Cordue, 2014d, 2021). The assessments were based on conducting model runs by maximizing the posterior density function (MPD estimates) and capturing parameter uncertainty using

Bayesian methods. The results based on Bayesian methods formed the basis for the management advice. In general, sensitivity was explored relative to natural mortality, the biomass indices included in the assessment, and the means of the priors for the acoustic catchability coefficients.

In New Zealand, the point estimate from the assessment is the posterior median (rather than posterior mean – which can be substantially higher than the median if the posterior is skewed to the right), while uncertainty for a given model structure is based on posterior percentiles. The posterior median is usually between the posterior mode and the posterior mean for the typically right-skewed posterior distributions. Consequently, the posterior mode (which is the quantity typically reported for age-structured assessments owing to the speed with which it can be computed) is often lower than the posterior medians. Assessments in New Zealand typically only conduct full Bayesian assessments for a subset of the assessment variants explored.

A key input to any Bayesian assessment is the specification of the prior distributions for the parameters. Prior probability distributions are specified for survey catchability (q) for some of the surveys. The acoustic estimates of abundance are assumed to be relative indices of abundance, with informative prior distributions constructed taking into account uncertainty about target strength (with the best estimate assumed to be unbiased) and the proportion of the spawning biomass available to the acoustic survey (modelled using a beta distribution to reflect that the biomass available to the acoustic survey will be less than the total spawning biomass).

A variety of sources of data are available for assessing the current biomass and stock status of orange roughy. These data sources include catch-rates from the commercial fishery (following standardization), acoustic estimates of biomass, trawl survey estimates of biomass, and egg production estimates of biomass. The assessment process aims to impose a high quality threshold on data before they are used in an assessment. In particular, CPUE indices were not used in any of the assessments because they are considered unlikely to be monitoring stock-wide abundance (e.g., non-spawning season catch rates from a single hill feature or complex within a large area cannot be monitoring stock wide abundance as the fishery would not have been sampling a large proportion of the stock; at best, such CPUE indices may index localised abundance; during the spawning season catches from a single hill or aggregation may be sampling a large proportion of the stock but the catch rates will depend on how the aggregation is fished rather than how much biomass is present). Also, estimates of biomass from egg surveys are not used as it was found that the available estimates were from surveys where the assumptions of the survey design were not met and/or there were major difficulties in analyzing the survey data. Finally, acoustic-survey estimates of biomass are only used when mainly single-species aggregations were surveyed with suitable equipment. Estimates of spawning orange roughy biomass were accepted for plumes on the flat surveyed using hull-mounted transducers or towed systems. On underwater features estimates were accepted when the shadow zone estimate was no more than about 10% of the total estimate. For hull-mounted transducers, this requires that the plumes are high in the water column or near the top of the feature (and not on the side of the feature where shadow zone corrections are often large)

In principle, changes in age- and length-composition from the fisheries and surveys provide some information on recruitment trends and these data were included in the recent stock assessments.

Cordue (2014d) outlines the approach used for data-weighting. In general, and following Francis (2011), the composition data (age and length-frequencies) are down-weighted so that the biomass indices can be the primary source of information on scale and trend.

Chatham Rise (ORH 3BNWCR)

The most recent assessment for ORH 3B NWCR was conducted during 2018 (FNZ,2021b; Dunn and Doonan, 2018), which updated the last assessment conducted during 2014 (Cordue, 2014d). The 2018 stock assessment was based on CASAL (Bull et al., 2012). It was based on a single-sex, age-structured model that tracked mature and immature animals separately. A single fishery was modelled. Spawning was assumed to occur after 75% of natural mortality and 100% of mature fish were assumed to spawn each year. The 2018 assessment estimated year-classes up to 1992. Natural mortality was set to 0.045yr^{-1} and stock-recruit steepness to 0.75.

The model was fitted to acoustics survey estimates of spawning biomass from the main spawning hills (Graveyard and Morgue; Figure 4), proportion-at-age and proportion-spawning-at-age data from a

1994 wide-area trawl survey and targeted trawling on the Morgue in 2016, and length-frequencies from the commercial fishery for 1989-2005.

Three types of acoustic estimates were available: AOS estimates (from a multi-frequency towed system); 38 kHz estimates from a towed body system; and 38 kHz estimates from a hull-mounted system. Only the data from the AOS and towed body system were in the base model, but sensitivity was explored to including these estimates in sensitivity analyses. The assessment assigned informed priors for the proportionality coefficient (q) for the acoustic indices. The priors for the acoustic estimates for 1999, 2012, and 2016 were based on the assumption that surveys would cover "most" (80%) of the biomass. The prior for the 2013 Graveyard estimate was modelled as relative biomass with an informed prior on q of with a mean of 0.3 (CV 0.19), where 0.3 is the relative proportions of the Graveyard and Morgue in the 2012 estimates plus the 80% assumption. Although a wide-area trawl survey was conducted in 1994, the estimate from survey could not be included in the assessments.

Table 11. Acoustic survey estimates of spawning used in the base model (excluded 2002 and 2004) and the sensitivity run 'Extra Acoustics' (uses all data). 'GY' = Graveyard, 'M' = Morgue, 'O' = other hills. The CVs are those used in the model and do not include any process error. (Source: FNZ, 2021b)

Year	System	Areas	Estimate (CV)
1999	Towed-body	GY+M+O	8,126 (0.22)
2002	Towed—body	GY+O	9,414 (0.20)
2004	Hull mounted	GY	2,717 (0.16)
2012	AOS	GY	5,550 (0.17)
	AOS	M	9,087 (0.11)
2013	AOS	GY	6,656 (0.31)
2016	AOS	GY	0 (N/A)
	AOS	M	14,051 (0.13)

Assessment results

The assessment involved a base model run and several sensitivity tests. The base model fitted the acoustic estimates from 1999, 2012, 2013 and 2016. The age data from 2016 were excluded owing to concerns about representativeness (FNZ, 2021b). The fits to the various data sources were generally good, with the prior for the Morgue+Graveyard being updated to lower values. As expected, the fit to the Morgue age data were poor (far fewer old animals in the model that the sample).

Virgin biomass, B_0, was estimated (posterior median) to be between 64,000-67,300t for all runs (Table 12), larger than that estimated during the 2014 assessment (64,000-68,000t). Current stock status varied between $0.29B_0$ and $0.48B_0$, with the most pessimistic result when the value for natural mortality (M) was reduced and the means of the priors for acoustic catchability were increased (the "Low M-high q" run), but for all but that run, current status was estimated to within (or above) the management target range of $0.3\text{-}0.5B_0$. The base model depletion was virtually identical to that from the 2014 assessment ($0.37B_0$ in 2014). For the base model, there was a 98% probability that the stock was about $0.3B_0$ in 2017. For the sensitivity runs, the probability of being above $0.3B_0$ in 2017 was 0.98 (Extra acoustics), 0.97 (include Morgue age-frequencies), 0.36 (Low M-high q), and 1.00 (High M-low q).

Table 12. MCMC estimates of virgin biomass (B0) and stock status (B2017 as %B0) for the base model and four sensitivity runs for ORH3B NWCR (source: FNZ, 2021b).

Run	M	B_0 (1,000t)	B_{2017} (%B_0)
Base	0.045	65.2 (59.9-75.0)	38 (31-48)
Extra acoustics	0.045	64.0 (60.0-76.7)	36 (31-43)
Include Morgue AF	0.045	65.1 (58.6-76.5)	38 (30-48)
Low M-high q	0.036	67.3 (63.0-73.9)	29 (23-36)
High M-low q	0.054	65.5 (58.2–77.7)	48 (40-58)

The spawning biomass declined from 1980 to 2004, when it was close to the soft limit ($0.2B_0$) and has rebuilt since (Figure 5). Fishing intensity was above those corresponding to the target management range for most of the history of the fishery (1981-2009) and within and below this range thereafter (Figure 6).

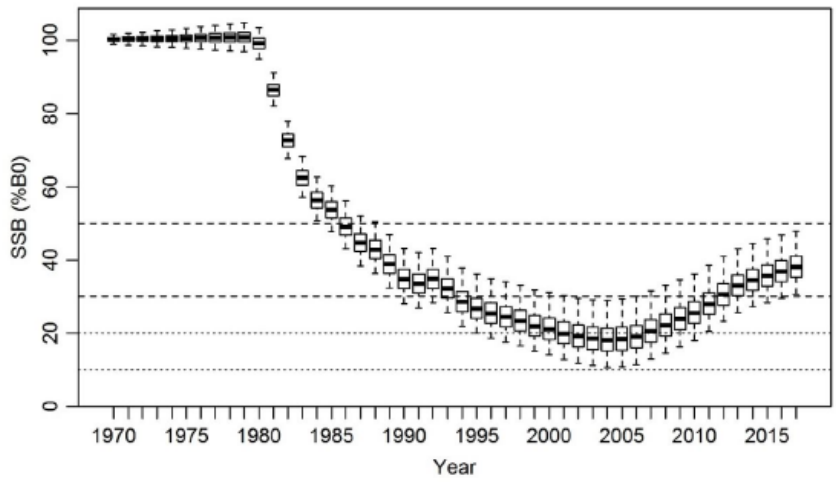


Figure 5. Base, MCMC estimated spawning-stock biomass trajectory for ORH3B NWCR. The box in each year covers 50% of the distribution and the whiskers extend to 95% of the distribution. The hard limit 0.1B0, soft limit 0.2B0, and biomass target range 0.3–0.5B0 are marked by horizontal lines (Source: FNZ, 2021b).

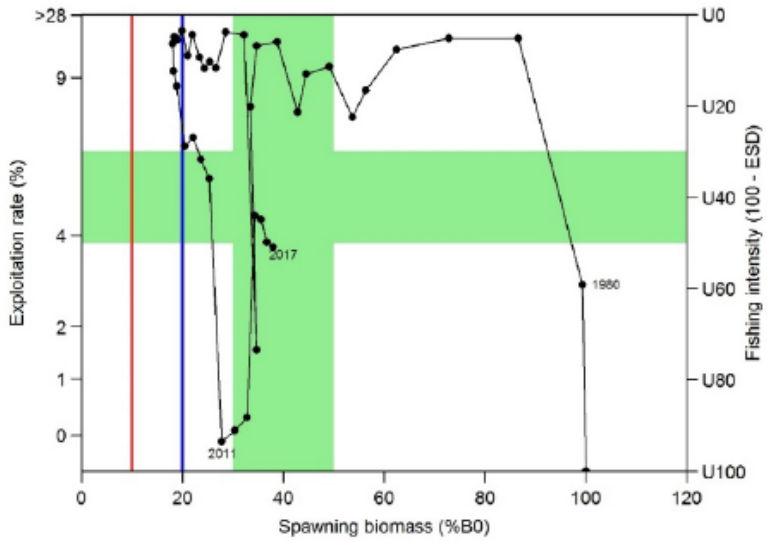


Figure 6. Historical trajectory of spawning biomass (%B0) and fishing intensity (exploitation rate) for ORH 3B NWCR (base model, medians of the marginal posteriors). The biomass target range of 0.3–0.5B_0 and the corresponding exploitation rate (fishing intensity) target range are

marked in green. The soft limit ($0.2B_0$) is marked in blue and the hard limit ($0.1B_0$) in red. (Source: FNZ, 2021b)

Chatham Rise (ORH 3B ECSR)

The most recent stock assessment for ORH 3B ECSR was conducted during 2020 (Cordue, 2021), which updated assessments conducted in 2018 and 2019 (Dunn and Doonan, 2018; Cordue, 2018) (FNZ, 2021b). The 2020 and earlier stock assessments were based on CASAL (Bull et al., 2012). These assessments were based on a single-sex, age-structured model that tracked mature and immature animals separately. There were four fisheries (Spawning Box & flats, Eastern Hills, Andes, and South Rise; Figure 4) in the 2020 assessment. Given lack of data for the South Rise, selectivity for the fishery on the South Rise was assumed to be the same as that for the fishery on the Andres. Spawning was assumed to occur after 75% of natural mortality and 100% of mature fish were assumed to spawn each year. The 2020 assessment estimated year-class strengths from 1930 to 2002. Natural mortality was set to $0.045yr^{-1}$ and stock-recruit steepness to 0.75.

The model was fitted to biomass estimates from Old-plume (in the Spawning Box; 2002-2014; 2016), Rekohu (2011-2014; 2016), and the Crack (2012, 2013, and 2016), trawl survey indices of biomass; age-frequencies from the spawning areas (2012, 2013, and 2016); length-frequencies from the trawl surveys; and catch length-frequencies. Acoustic surveys of orange roughy have been conducted in the ESCR region since 1996, but there has been a lack of consistency. Therefore, only the time-series for the Old plume (Figure 4) from 2002 was included in the assessment. Time-series of acoustic estimates of biomass are available for the Rekohu plume (only first noticed in 2010 and first surveyed in 2011) and the Crack. Rekohu and the Crack need to be surveyed using a towed-body or trawl-mounted system whereas the Old plume can be surveyed using a hull-mounted system. The estimates used in the 2014, 2018, 2019 and 2020 assessments were all obtained using 38 kHz transducers for comparability. It was intended to conduct a survey of ORH 3B ECR during 2020 but this did not occur due to the COVID pandemic.

A key question evaluated in 2014 assessment was how long the Rekohu plume had been in existence – if it had always existed the Old plume index would be a consistent index of biomass but if it formed recently survey catchability for the Old plume would be time-varying. The assessment is based on the assumption that the Old plume cannot be relied on to provide a consistent index of abundance. Thus, the acoustic estimates (Table 13) were treated as follows:

- The estimates for 2011, 2012 and 2016 were summed to provide a combined index. The prior for the acoustic q was based on the assumption that "most" (80%) of the spawning biomass was surveyed, leading to a prior q_1~ LN(0.8, 0.19).
- The 2012 and 2014 estimates for Rekohu and the Old plume were summed to provide two comparable indices. The prior for acoustic q, q_2~LN(0.7, 0.30) for these indices was based on the proportion of total biomass in 2011, 2012 and 2016 in these areas and that 80% of the biomass was surveyed in these years across all three areas.
- The Old plume indices for 2002-2010 were each assigned a prior. These priors were based on assuming that the mean of the prior for survey q for 2002 was 0.7 (the Rekohu plume did not exist and excluding biomass on the Crack) and the mean for the survey q prior in 2010 was 0.3, with a linear change in the mean of the acoustic q prior between 2002 and 2010. The CV for these priors was 0.3.

The trawl indices for the Spawning Box (1986-1994) were computed based on a consistent area. The indices for each vessel were assigned a separate q (with uninformative priors), and treated as independent indices. The surveys in 2004 and 2007 covered a wider area (from the western edge of the Spawning Box to around the northern edge of the Andes) but did not survey the Old plume, the Northeast Hills or the Andes Hills complex. These indices were also fitted as measures of relative biomass with uninformative priors on q.

Table 13. Acoustic estimates (and CVs in parenthesis) of average pluming spawning biomass in the three main spawning areas as used in the assessment of ORH3B ESCR (all estimates were obtained from surveys on *FV San Waitaki* from 38 kHz transducers; each estimate is the

average of several snapshots) and the trawl survey indices of abundance. (Source: Cordue, 2021).

Year	Old plume	Rekohu	Crack	Trawl surveys
1984				130,000 (0.17)[1]
1985				111,000 (0.15)[1]
1986				77,000 (0.16)[1]
1987				60,000 (0.15)[1]
1988				73,000 (0.25)[2]
1989				54,000 (0.18)[2]
1990				34,000 (0.19)[2]
1992				22,000 (0.34)[3]
1994				61,000 (0.67)[3]
2002	63,950 (0.06)			
2003	44,316 (0.06)			
2004	44,968 (0.08)			16,878 (0.10)[4]
2005	43,968 (0.04)			
2006	47,450 (0.10)			
2007	34,427 (0.05)			17,000 (0.13)[4]
2008	31,668 (0.08)			
2009	28,199 (0.05)			
2010	21,205 (0.07)			
2011	16,422 (0.08)	28,113 (0.18)	6,794 (0.21)	
2012	19,392 (0.07)	27,212 (0.10)		
2013	15,554 (0.14)	33,348 (0.10)	5,471 (0.16)	
2014	19,360 (0.18)	44,421 (0.25)		
2016	11,192 (0.13)	27,027 (0.13)	5,341 (0.10)	

1: *FV Otago Buccaneer*; 2: *FV Cordella*; 3: *FV Tangaroa. FV Tangaroa* wide-area surveys

Assessment results

The assessment involved a base model run and several sensitivity tests. The base model (denoted the 'updated model' by FNZ [2021b]) thus matches the assumptions of the 2018 base model. Two sensitivity analyses are reported in FNZ (2021b). The 'q-ratio model' places a prior on the ratio q_1/q_2 of LN(1.14=0.8/0.7,0.075) to encourage the q_1/q_2 ratio to exceed 1. This model only considered a single fishery. There was no agreement in the DWWG as to whether the updated base model or the q-ratio model was to be preferred (FNZ, 2021b). The second sensitivity analysis ('Low *h*-high *q*') involved increasing the means of the priors for acoustic *q* by 20% and reducing the value of *M* by 20% (from $0.045yr^{-1}$ to $0.036yr^{-1}$).

The models fitted the data well (FNZ, 2021b; Cordue, 2021), although the posterior for the ratio q_1/q_2 for the base model was 0.39, which seems unlikely. Nevertheless, adding a prior on q_1/q_2 did not lead to markedly more optimistic results (B_{2020}/B_0 of 0.38 [95% CI 0.32-0.44] compared 0.36 [0.30-0.41]) (Table 14). The estimate of B_0 from the updated assessment is (as expected) essentially identical to

that from the 2018 and 2014 assessments, although the updated model suggests a further increase in biomass (a posterior for B_{2020}/B_0 of 0.36 [95% CI 0.30-0.41] compared to a posterior for B_{2017}/B_0 of 0.33 [95% CI 0.28-037] from the 2018 assessment and a posterior for B_{2014}/B_0 of 0.30 [95% CI 0.25-0.34]). There are, however, no additional data beyond those used in the 2018 assessment.

The spawning biomass shows a decline in biomass from the start of the fishery to around 1991, followed by stability and then an increase in biomass starting around 2010. The stock is assessed never to have dropped below the soft limit of $0.2B_0$ (Figure 7). Fishing intensity was above those corresponding to lower bound of management target range for most of the years from the start of the fishery to 1994 and then again from 2002 to 2009. Fishing intensity since 2011 has been at or below that corresponding to the upper bound of the management range (Figure 8 and Figure 9).

Table 14. MCMC estimates of virgin biomass (B0) and stock status (B2020 as %B0) for the base model and two sensitivity runs for ORH3B ESCR (source: FNZ, 2021b).

Run	M	B_0 (1,000t)	B_{2020} (000t)	B_{2020} (%B_0)
Current model	0.045	312 (281-346)	111 (91-135)	36 (30-41)
q-ratio mode	0.045	354 (331-380)	135 (109-164)	38 (32-44)
Low M-high q	0.036	337 (308-363)	90 (71-111)	27 (22-32)

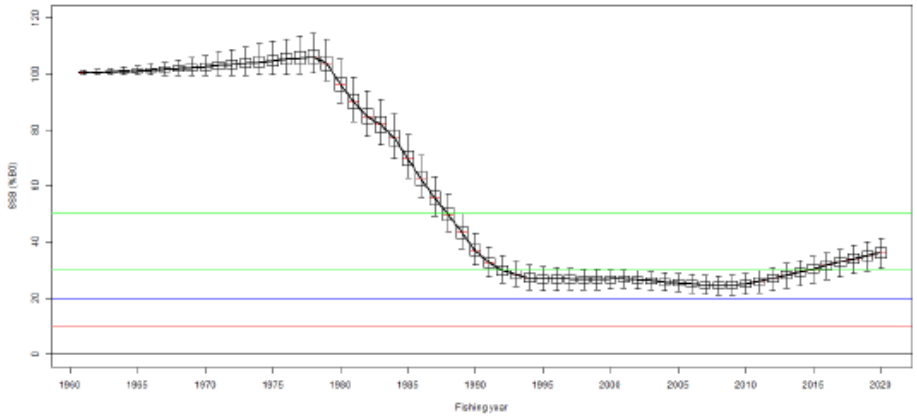


Figure 7. ESCR current model, MCMC estimated spawning-stock biomass trajectory. The box in each year covers 50% of the distribution and the whiskers extend to 95% of the distribution. Horizontal lines are plotted at the hard limit ($0.1B_0$), the soft limit ($0.1B_0$), and the biomass target range ($0.3\text{-}0.5B_0$). (Source: FNZ, 2021b).

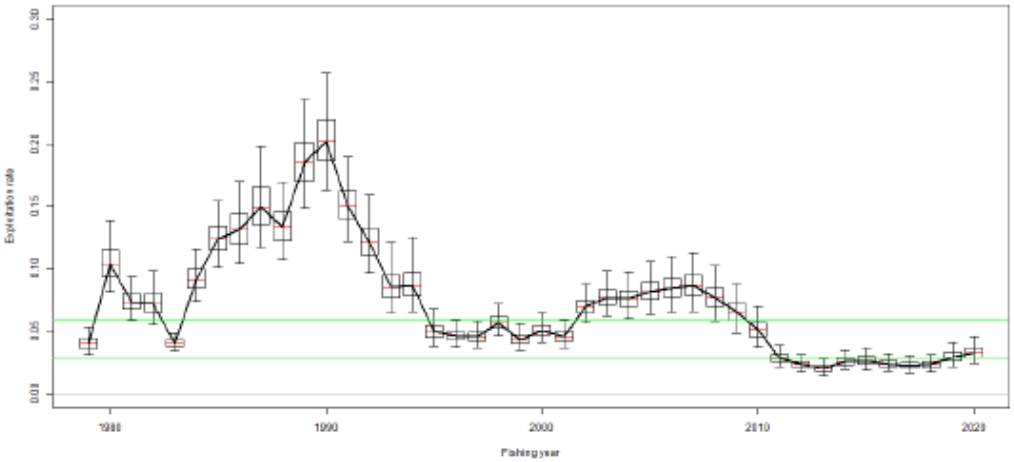


Figure 8. ESCR current model, MCMC estimated exploitation rates. The box in each year covers 50% of the distribution and the whiskers extend to 95% of the distribution. The exploitation rates associated with the biomass target of 0.3-0.5B_0 are marked by horizontal lines at *U30%*B_0 and *U50%*B_0. (Source: FNZ, 2021b).

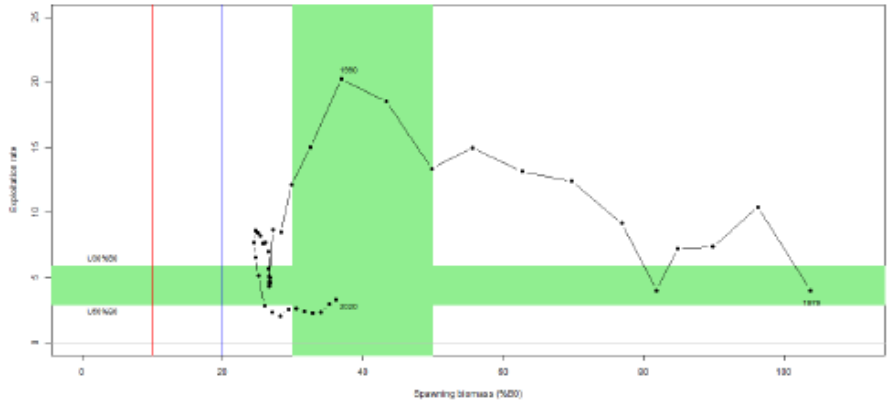


Figure 9. Historical trajectory of spawning biomass (%B0) and exploitation rate (%) for ESCR (current model, medians of the marginal posteriors). The biomass target range of 0.3-0.5B_0 and the corresponding exploitation rate range are marked in green. The soft limit (0.2B_0) is marked in blue and the hard limit (0.1B_0) in red. (Source: FNZ, 2021b).

Challenger Plateau (ORH7A)

The most recent stock assessment for ORH 7A was conducted during 2019 (Cordue, 2019a; FNZ, 2021c), which updated the last assessment conducted in 2014 (Cordue, 2014d). The 2019 stock assessment was based on CASAL (Bull *et al.*, 2012). It was based on a single-sex, age-structured model that tracked mature and immature animals separately. It was fitted to acoustic and trawl survey indices of abundance and age-frequency data. The 2019 stock assessment modelled two fisheries, one in the NZ EEZ and one on the Westpac Bank where slightly older fish are caught. The assessment assumed that selectivity was uniform on spawning fish but allowed for a logistic selectivity pattern for the fishery on Westpac Bank. The 2019 assessment estimated year-classes up to 1995. Natural mortality was set to 0.045yr^{-1} and stock-recruit steepness to 0.75.

Data included in the assessment

Table 15 and Table 16 summarize the index data included in the assessment. Many surveys have been undertaken or ORH7A but the variety of survey vessels and surveys strata makes comparisons problematic (Dunn *et al.,* 2010). Consequently, only surveys conducted since 1987, which are based "comparable area" time-series based on the *FV Amaltal Explorer* (Clark and Tracy, 1994) were

included in the assessment. Combined trawl and acoustic surveys started in 2005 using the *FV Thomas Harrison.* The 2005 survey does not appear to have covered an appropriate area unlike the later surveys. The 2019 assessment involved re-analyzing the survey data and selecting the most appropriate acoustic snapshots (Cordue 2019a). An estimate of biomass was obtained during the 2018 survey for Volcano (Ryan *et al*., 2019) but not used in the assessment owing to concerns whether the biomass pertained to spawning fish (FNZ, 2021c). The assessment assigned informed priors for acoustic *q*. The priors were based on the assumption that surveys of all three aggregations (West, East and Volcano) would cover "most" (80%) of the biomass. This prior was split into three components (each with the same CV) leading to priors by area of LN(0.41, 0.3), LN(0.22, 0.3), and LN(0.18, 0.13) respectively. The estimates of biomass for the *FV Thomas Harrison* were assumed a prior with mean 0.95 (CV 0.3). Age-frequency data were available from the 1987, 2009, 2006, and 2018 surveys.

Table 15. Acoustic biomass estimates of spawning aggregated surveyed on Volcano, and the West and East within the EEZ. The CV (in parenthesis) is the observation error CV with an additional 20% of process error in the years when the vessel motion correction was unknown (2005, 2011, and 2013). (Source: FNZ, 2021c).

Year	West	East	Volcano
2005	4,210 (0.53)		2,682 (0.39)
2006	4,383 (0.59		6,329 (0.39)
2009	13,555 (0.22)	8.471 (0.61)	
2010	8.114 (0.14)	1,707 (0.34)	
2011	13,340 (0.33)		
2013	10,183 (0.22)	5,365 (0.26)	4.559 (0.34)
2014			3.954 (0.29)
2018	9,966 (0.09)		

Table 16. Biomass indices from trawl surveys used in the stock assessment for ORH 7A. The CV (in parenthesis) is the observation error CV with an additional 20% of process error. (Source: FNZ, 2021c).

Vessel	Year	Biomass (CV)
Amaltal Explorer	1987	75,040 (0.33)
	1988	28,954 (0.34)
	1989	11,062 (0.23)
Thomas Harrison	2006	13,987 (0.23)
	2009	34,864 (0.31)
	2011	18,425 (0.33)
	2012	22,451 (0.27)
	2013	18,993 (0.55)
	2018	48,038 (0.55)

Assessment results

The assessment involved a base model run and several sensitivity tests. The base model fitted the indices of abundance adequately, but the fit to the age data for Volcano in 2018 (which was down-weighted) was quite poor owing to the presence of older individuals (Cordue 2019a; FNZ, 2021c). The priors for catchability were updated.

Virgin biomass, B_0, was estimated (posterior median) to be between 94,000-107,000t for all runs (Table 17), larger than that estimated during the 2014 assessment (64,000-67,300t). Current stock status varied between $0.37B_0$ and $0.57B_0$, with the most pessimistic result when the value for natural mortality was reduced and the means of the priors for acoustic *q* increased (the "Low *M*-High *q*" run), but for all runs, current status was estimated to within (or above) the management target range of 0.3-$0.5B_0$.

Table 17. MCMC estimates of virgin biomass (B_0) and stock status (B_{2019} as $\%B_0$) for the base model and four sensitivity runs (source: FNZ, 2021c).

Run	M	B_0 (1,000t)	95% CI	B_{2019} ($\%B_0$)	95% CI
Base	0.045	94	86-104	47	39-55
All trend	0.045	107	94-126	57	46-57
Estimate M	0.037	97	89-106	40	31-51
Low M-High q	0.036	95	88-103	37	30-45
High M-Low q	0.054	94	85-106	56	48-65

Figure 10 shows the estimated time-trajectory for spawning biomass, illustrating that the stock declined to around $0.15B_0$ in 1990 and the recovered under lower catches, with biomass peaking in 2015. Stock biomass is in the management target range ($0.47B_0$) while fishing intensity is in the range corresponding to the management target range (nearly the lower limit), having been well above the target range until the 2001 closure of the fishery (Figure 11).

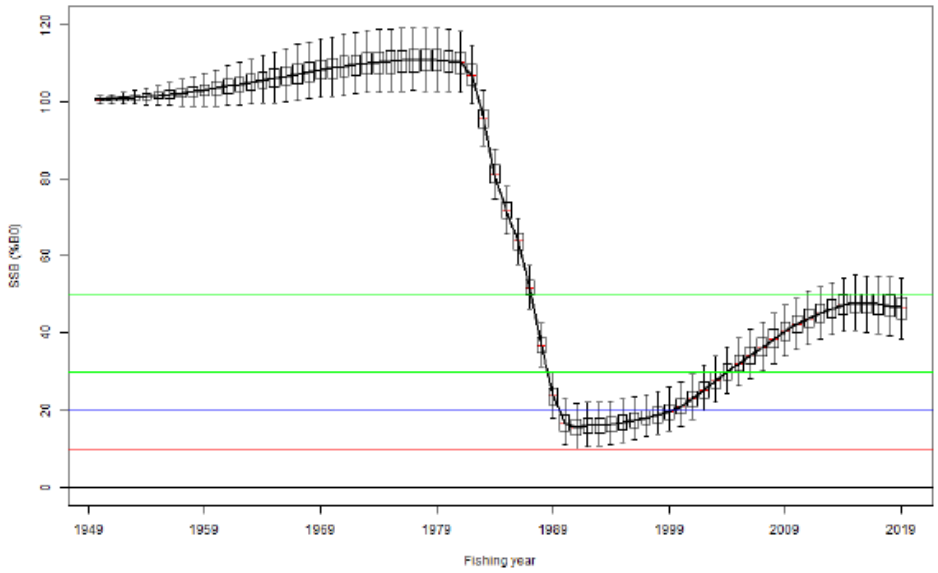


Figure 10. Base, MCMC estimated spawning-stock biomass trajectory for ORH 7A. The box in each year covers 50% of the distribution and the whiskers extend to 95% of the distribution. The hard limit $0.1B_0$ (red), soft limit $0.2B_0$ (blue), and biomass target range $0.30–0.5B_0$ (green) are marked by horizontal lines (source: FNZ, 2021c).

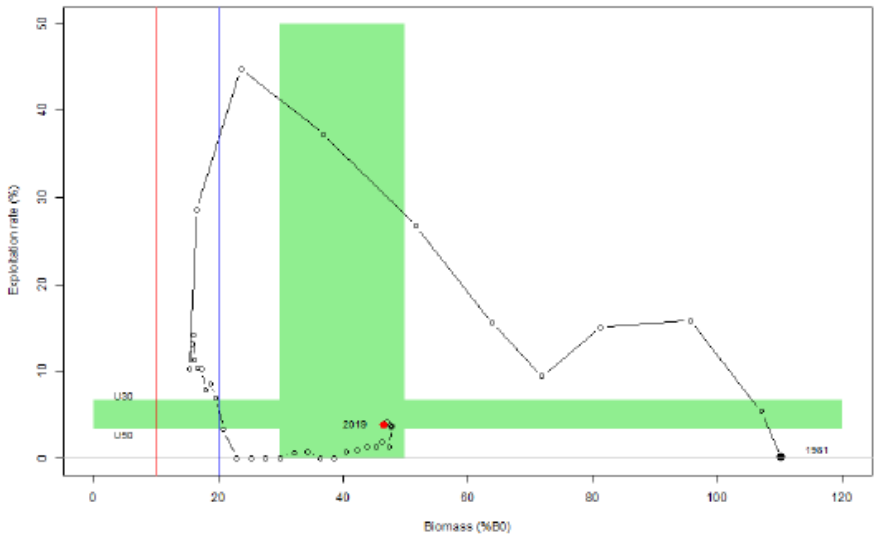


Figure 11. Historical trajectory of spawning biomass (%B_0) and fishing intensity (exploitation rate) for ORH7A (base model, medians of the marginal posteriors). The biomass target range of 0.3–0.5B_0 and the corresponding exploitation rate (fishing intensity) target range are marked in green. The soft limit (0.2B_0) is marked in blue and the hard limit (0.1B_0) in red (source: FNZ, 2021c).

Stock status summary

Table 14 provides a summary of the estimates of the stock status for each of the three UoAs, as reported by the MPI Stock Assessment Plenary (FNZ, 2021b,c).

Table 18. Summary of stock status of each UoA relative to the hard limit and the management target range (MPI, 2021b,c).

	ORH 3B NWCR	ORH 3B ESCR	ORH 7A
Below Hard Limit[1]	Exceptionally unlikely	Exceptionally unlikely	Exceptionally unlikely
Below Soft Limit[1]	Exceptionally unlikely	Very unlikely	Exceptionally unlikely
Below lower Limit of Management Target[1]	Very Unlikely	As Likely as Not	Very Unlikely
Overfishing[1]	Exceptionally unlikely	Exceptionally unlikely	Very Unlikely
$P(B_{current}<0.2B_0)$[2]	<0.01	<0.01	<0.01
$P(B_{current}<0.3B_0)$[2]	<0.01	0.025	0.02

Exceptionally unlikely (<1%); Very unlikely (< 10%); Unlikely (<40%), As Likely as Not (40-60%), Very Likely (> 90%). 1: qualitative appraisal based on the assessment models; 2: based on the base model

Figure 12 compares the results of the most recent and 2014 assessments. The results of the two assessments are very similar for ORH 3B NWCR and ORH 3B ESCR while the 2019 assessment for ORH 7A is more optimistic than the 2014 assessment.

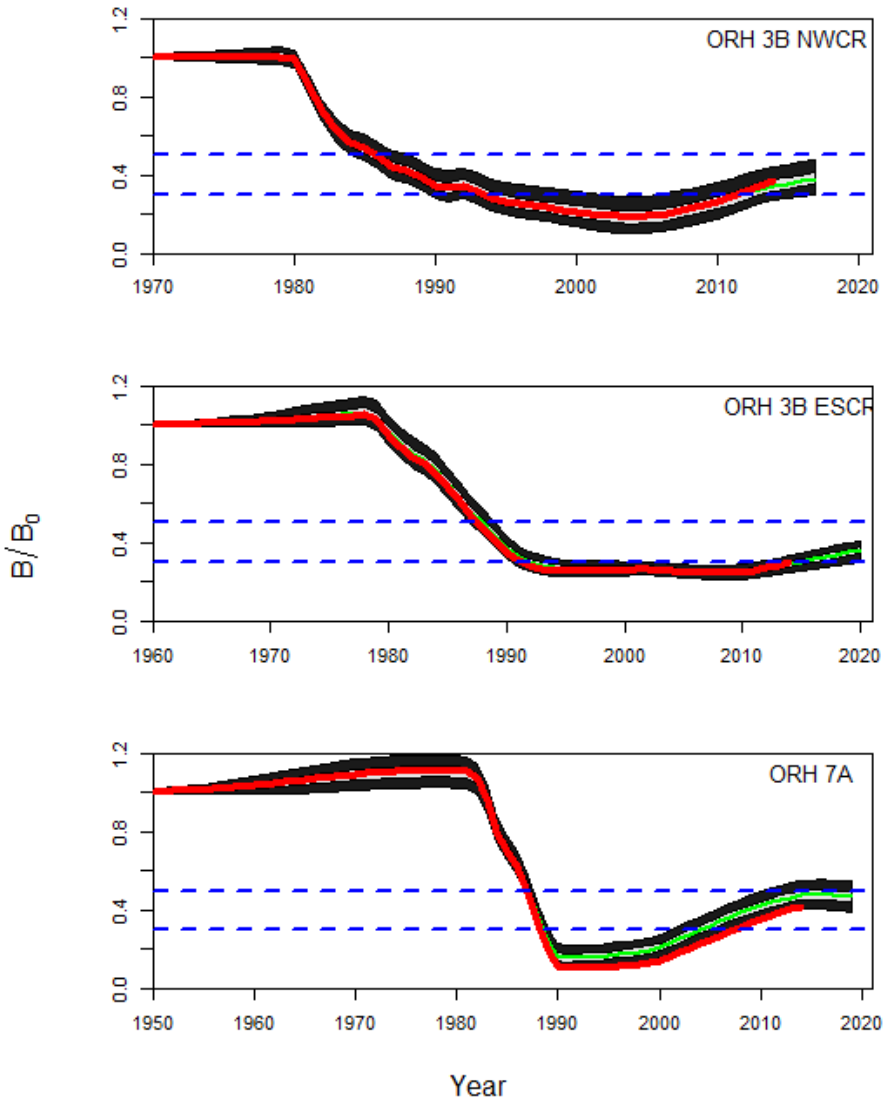


Figure 12. Posterior distributions for B/B_0 for the three UoC for the 2014 (median red line) and most recent assessments. The green line is the posterior median for the most recent assessments and light and dark shading cover 50% and 95% of the distributions. The blue lines indicate the management target range.

Harvest strategy

Reference points and harvest strategy

Management advice on setting TACs for orange roughy has to be broadly consistent with the Harvest Strategy Standard for New Zealand Fisheries (HSS). The HSS (MPI, 2008, 2011) aims to:

> *"provide a consistent and transparent framework for setting fishery and stock targets and limits and associated fisheries management measures, so that there is a high probability of achieving targets, a very low probability of breaching limits, and acceptable probabilities of rebuilding stocks that nevertheless become depleted, in a timely manner"*.
> The HSS specifies probabilities for each of these outcomes. The HSS is consistent with the

2008 Amendments to the Fisheries Act 1996. The Standard (i.e., not the Fisheries Act) includes the need for a target reference point, a soft limit and a hard limit. Stocks that are assessed to be depleted to below the soft limit require a formal, time-constrained rebuilding plan, while stocks that are depleted to below the hard limit should be considered for closure. Under the HSS, stocks

depleted to below the soft limit should be rebuilt (with an acceptable probability) to at least the target level/range between T_{MIN} and 2xT_{MIN} where T_{MIN} is the theoretical minimum number of years required to rebuild a stock to the target level/range in the absence of fishing (MPI, 2008). The HSS was established following extensive consultation and review (including international peer-review of a draft of the standard). The Standard is not, however, a management strategy because it does not specify, for example, the form of the HCR, and the monitoring requirements, although both monitoring and some form of a HCR are needed to implement the HSS.

The TAC is set by the Minister for Oceans and Fisheries (who executes the responsibilities of the Minister of Fisheries) through a public process. The Minister, under Section 13 of the Fisheries Act 1996, sets a TAC for a quota management species that:

a) maintains the stock at or above a level that can produce the maximum sustainable level; or,

b) enables the level of any stock whose current level is below that which can produce the maximum sustainable level to be altered:

i. in a way and at a rate that will result in the stock being restored to or above a level that can produce the maximum sustainable level and

ii. within a period appropriate to the stock, having regard to the biological characteristics of the stock and any environmental conditions affecting the stock or

c) enables the level of any stock whose current level is above that which can produce maximum sustainable level to be altered in a way and at a rate that will result in the stock moving towards or above a level that can produce the maximum sustainable yield.

The Fisheries Act 1996 does not refer to harvest strategies or HCRs. However, the HSS refers to both. The process for setting TACs first involves Fisheries New Zealand providing a discussion document that outlines a set of options for the TAC (and other management controls including TACCs and other catch limits), and provides the context for the Minister's decision and other relevant background material such as previous management decisions and the results of the stock assessment, including the main uncertainties (e.g., FNZ, 2018a, 2019a, 2019b, 2020a). The discussion document also outlines for orange roughy how each option is consistent with the Fisheries Act 1996 and with the harvest strategy (FNZ 2018b, 2019c, 2020b).

The discussion document is then released for a four to six week public consultation period during which submissions are received from stakeholders, including industry and non-governmental organizations. These submissions are incorporated into a decision document, which forms the basis for the Minister's decision (see Minister of Fisheries, 2018, 2019, 2020).

Management Strategy Evaluation

The limit reference point, the management target range, and harvest strategy (HCR) were developed using a MSE framework parameterized for orange roughy of New Zealand (Cordue, 2014a,b,d). The MSE framework is based on the assessments conducted during 2014. However, the base models from those assessments were based on pre-specified values for two key parameters: steepness; and, natural mortality. In contrast, the MSE analyses allowed for uncertainty in both steepness and natural mortality throughout the analyses.

The steepness of the stock-recruitment relationship and natural mortality are related directly to the fishing mortality rate at which MSY is achieved (Punt *et al.*, 2008). The steepness parameter was consequently treated as uncertain in the projections, with a distribution based on a Bayesian assessment. The 2014 MSE based the distribution for steepness on the MEC stock (i.e., ORH2A South, ORH2B and ORH3A) based on a prior for steepness for US West Coast rockfishes developed by Forrest *et al.* (2010). The posterior distribution for natural mortality was based on combining the estimated distributions for natural mortality from the assessments for four orange stocks (the three included in this report and the MEC). The MSE did not simulate the actual assessment method owing to computational limitations. Instead, estimates of stock status (B/B_0) and vulnerable biomass were simulated with error that was highly temporally correlated (ρ=0.95) and subject to annual variation with a coefficient of variation based on the actual assessment. The TAC was updated every third year and set to the TACC plus 5% to allow for estimated incidental catch.

The key uncertainties considered in the MSE were:

- the form of the stock-recruitment relationship (Ricker or Beverton-Holt);
- whether fishing is restricted to spawning fish or independent of maturity status;
- the extent of variation and temporal correlation in recruitment about the assumed stock-recruitment relationship; and,
- bias in the estimates of stock status and vulnerable biomass as well as a higher level of error in the estimates on which the HCR is based.

A concern with orange roughy fisheries is the potential for spawning success to be disrupted by fishing of spawning aggregations. Given the nature of the fishery, it is not possible to directly measure this impact (if it exists) and consequently it is not modelled explicitly in the MSE. However, Cordue (2014b) argued that the posterior distribution for steepness used in the MSE was taken from an assessment of the MEC stock that historically has had substantial fishing on spawning plumes (Dunn, 2011). Consequently, any effect that such fishing has had would have been passed through to the posterior on steepness, and the distribution would be shifted to the left because of it (i.e., lower values of steepness estimated because of lower spawning success caused by fishing on plumes – if such an effect exists). The most recent estimated year class strength was in 1996 for the stock assessment conducted for the MEC where steepness was estimated. Cordue (2014b) noted that it is probably the last 10 year class strengths estimated that would have the most influence on the estimate of steepness (as they have the lowest stock status of those years for which year class strengths were estimated). Dunn (2011) estimated the spawning season (June-July) catch for the MEC stock. The estimated catch exceeded 1,500t (with a maximum of 3,000t) during seven out of the ten fishing years from 1986-87 to 1995-96. Cordue (2014b) notes that this probably represents a much greater level of spawning disruption than could be expected for the regions under assessment in the future under the HCR. This is especially true for Northwest Rise, which has one of the main spawning plumes contained within a closed area (i.e., Morgue).

The performance metrics on which the MSE was based were:

- mean annual mid-season spawning biomass;
- mean annual yield;
- probability of spawning biomass being above the limit reference point ($0.2B_0$; LRP risk); and,
- probability of the mid-season spawning biomass being above the lower bound of the management target range ($0.3B_0$; Depletion risk).

Cordue (2014b) recognized that there is a need to re-evaluate the agreed upon HCR every five years given collection of new data that might inform key parameters such as steepness and natural mortality. Cordue (2019b) conducted a review of the 2014 HCR using essentially the same MSE framework but with updated distributions for natural mortality (now based on five stocks - ESCR, NWCR, Puysegur, MEC, and ORH7A – and using the then most recent assessments rather than the 2014 assessments) and steepness (now based on two stocks – MEC and ORH7A – and using the most recent assessments). The posterior for natural mortality was shifted slightly to lower values (posterior median 0.036; 95% CI [0.027-0.048] and compared to 0.037 [0.028-0.049] while there was reduction in the value of steepness compared to 2014 MSE (Beverton Holt: 0.68 [0.39-0.93] to 0.57 [0.27-0.90]' Ricker: 0.53 [0.28-0.99] to 0.47 [0.24-01.07]).

Informing B_{MSY} and the limit reference point

A distribution for both B_{MSY} and the limit reference point were constructed from the results of long-term projections by Cordue (2014a) and reviewed by Cordue (2019b) based on the updated assessments. The limit reference point was defined as $0.2B_0$ or $0.5B_{MSY}$ whichever was higher. Values for B_{MSY} and the limit reference point were computed for a grid of values for steepness and natural mortality under the assumption of deterministic recruitment. The value for B_{MSY} was sensitive to the form of the stock-recruitment relationship, steepness and to a lesser extent natural mortality. Table 19 lists Bayesian estimates of B_{MSY} as a fraction of B_0. The management target range is 30-50% of the unfished spawning stock biomass ($0.3–0.5B_0$). The mid-point of this range balances the low estimate of B_{MSY} from the Beverton-Holt stock-recruitment relationship with the higher estimate based on the Ricker stock- recruitment relationship. Cordue (2014c)

notes that the management target range should be broad enough to accommodate the sustained trends in stock status that can occur due to good or poor recruitment and that based on the projections conducted, a range of approximately 20% is appropriate.

Table 19. Original (2014) and updated (2019) Bayesian estimates (medians and 95% CIs in brackets) of B_{MSY} and the limit reference point for the base model assuming a Beverton-Holt or a Ricker stock recruitment relationship. The median and 95% CIs are given as a percentage of virgin mid-season mature biomass (B_0). (Source: Cordue, 2019).

	B_{MSY}		Limit reference point	
	Beverton Holt	Ricker	Beverton Holt	Ricker
Previous	26 [12-39]	42 [37-47]	20 [20-20]	21 [20-24]
Update	31 [16-45]	43 [36-48]	20 [20-22]	22 [20-24]

In summary, the proposed reference points for the two fisheries are a limit reference point of 20% of the spawning stock biomass ($0.2B_0$), while the management target range is 30-50% of the unfished spawning stock biomass. The lower bound of management target range is essentially equal to the estimate of spawning stock biomass corresponding to maximum sustainable yield ($0.31B_0$) computed under the assumption of deterministic dynamics and the stock-recruitment relationship on which the stock assessment is based. Thus, the limit reference point is larger than half of this estimate of B_{MSY}. Given the assumed stock-recruitment relationships, it is reasonable to conclude a limit reference point of $0.2B_0$ should be above the point at which recruitment is impaired.

Recommendation: The sensitivity of the values for B_{MSY} and the limit reference point to the results of the assessment should continue to be evaluated.

Harvest control rule

The proposed harvest strategy for orange roughy (Cordue, 2014a) is given in Figure 13. This HCR sets the fishing mortality to $0.045yr^{-1}$ (the value for M used in assessments at a stock size of $0.4B_0$), with fishing mortality ranging between $0.034yr^{-1}$ and $0.056yr^{-1}$ between $0.3B_0$ and $0.5B_0$. The rate over which fishing mortality is reduced for stock sizes below $0.3B_0$ is higher than the rate of change in fishing mortality between $0.3B_0$ and $0.5B_0$. Fishing mortality is set to set to zero at $0.1B_0$ (the Hard Limit in the HSS).

A rescaling procedure is applied if the stock size is estimated to be below $0.3B_0$ or larger than $0.6B_0$ (Figure 14).

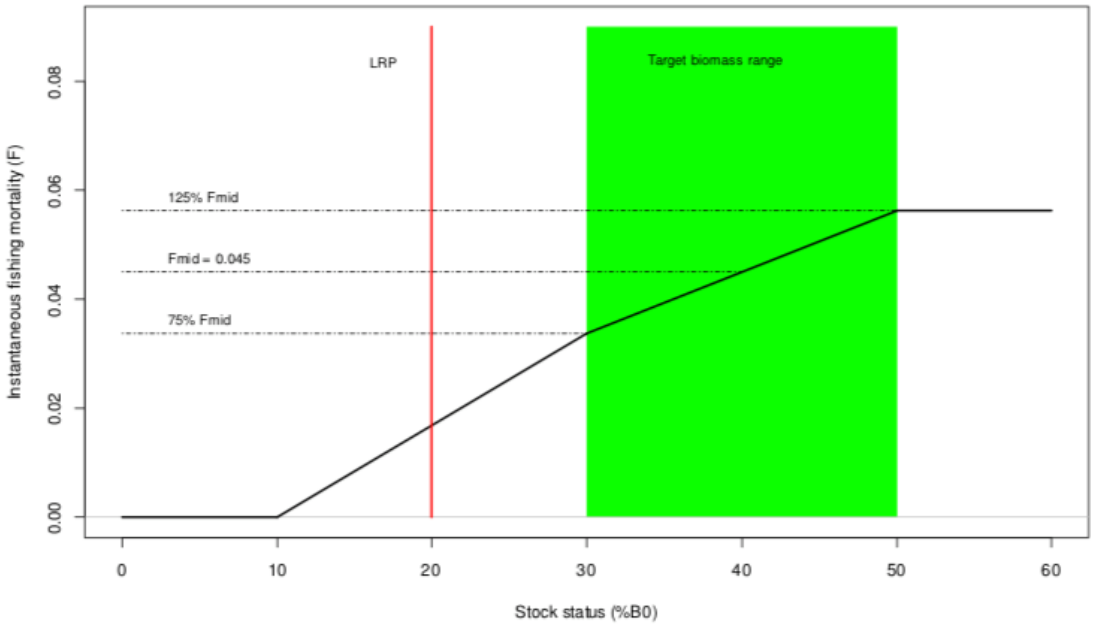


Figure 13. Proposed harvest control rule, dynamic HCR10: LRP = 0.2B_0, target biomass range = 30-50% B_0, initial F_{mid} = 0.045, slope within the target range: p = 25%; ramps down to zero at 0.1B_0; rescaling limit points: l = 0.2 B_0, r = 60% B_0; k = 0.9, m = 10, p_{limit} = 0.3. (Source: Cordue, 2014a).

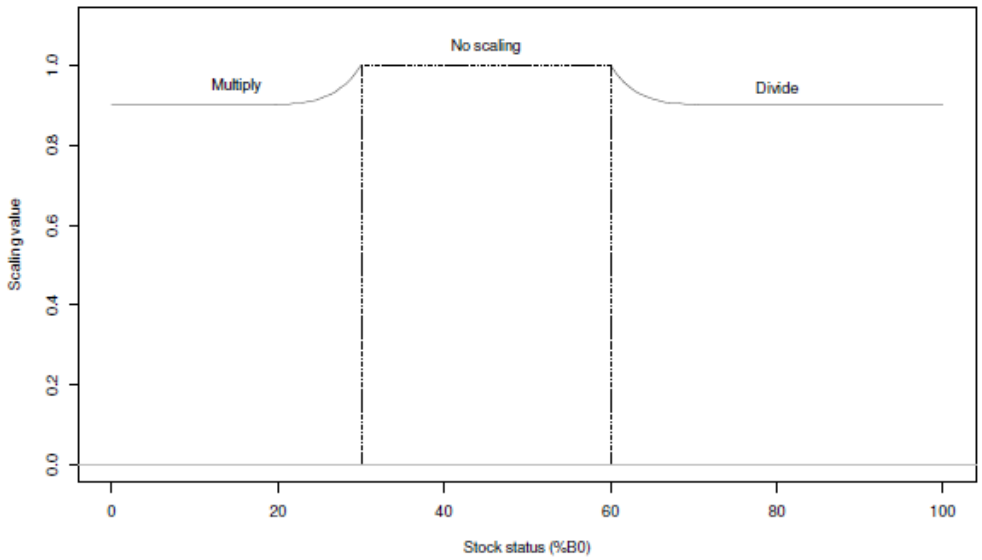


Figure 14. The scaling function for the fishing mortality used in the control rule. (Source: Cordue, 2014a).

The HCR in Figure 13, combined with the rescaling approach in Figure 14, was tested using the MSE process. In general, the proposed harvest strategy has a high probability of maintaining stocks in the management target range (Cordue, 2014a). Cordue (2019b) explored the impact of changes to the assessments of orange roughy and hence MSE on the performance of the HCR. The changes to the posteriors for natural mortality and steepness (see above) lead to the conclusion that risk is higher than that assessed to be the case in 2014 (Table 20), but the expected (median) biomass is unchanged from the 2014 MSE.

Table 20. Original (2014) and updated (2019) Bayesian estimates of LRP and depletion risk for the HCR for the base operating model (Beverton-Holt), the Ricker operating model, and the operating model with a 20% positive bias for current stock status and start of year vulnerable biomass. (Source: Cordue, 2019b)

	Base		Ricker		Bias	
	LRP risk	Depletion risk	LRP risk	Depletion risk	LRP risk	Depletion risk
Previous	0	0	2	3	0	1
Updated	3	5	8	11	4	9

The HCR has been applied to provide advice on the TACCs for the NWCR, ESCR and ORH 7A stocks since 2014.

Table 21. The outcomes of the HCR for each of the three stocks and the catch limits agreed by the Minister of Fisheries.

Stock	Year	Outcome of HCR	TACC / catch limit
ORH 3B (ECSR)	2018-19	5,670 t (FNZ, 2018a)[1]	4,095 t
	2019-20		4,775 t
	2020-21		5,970 t
ORH 3B (NWCR)	2018-19	1,150 t (Cordue, 2018)	1,149 t
	2019-20		1,150 t
	2020-21		1,150 t
ORH 7A	2019-20	2,448 t (Cordue, 2019a)	2,058 t
	2020-21		2,058 t

1: Should have been 5,970t.

Application of the HCR

ORH 3B NWCR and ESCR

During the 2018-19 sustainability review, MPI's advice provided the Minister of Fisheries with three options for the TAC and TACC for ORH 3B and for the agreed ORH 3B NWCR and ORH 3B ESCR sub-area catch limits (FNZ, 2018a):

- Option 1: The status quo (i.e., a TACC for ORH 3B of 5,197 t for the 2018-19 fishing year, with sub-area catch limits of 1,250 t for NWCR and 3,100 t for ESCR).
- Option 2: An increase to the values from the HCR (i.e., a TACC for ORH 3B of 7,667t for the 2018-19 fishing year, with sub-area catch limits of 1,150t for NWCR and 5,670t for ESCR).
- Option 3. An increase to the values from the HCR for the ORH 3B ESCR fishery over three fishing years and an immediate change to the HCR output for NWCR (i.e., a TACC for ORH 3B of 6,091 t for the 2018-19 fishing year, with sub-area catch limits of 1,150 t for NWCR and 4,095 t for ESCR).

Option 3 was recommended by MPI based on the rationale that it is a prudent approach in light of the large proposed increase in the TACC and that doing so will allow monitoring of any fishing impacts associated with increasing fishing effort to determine if any impacts on Endangered, Threatened or Protected (ETP) species are adverse and, therefore, additional management action may be required (FNZ, 2018a). The staged increase in the agreed catch limit for ORH3B ESCR would allow Fisheries New Zealand to make subsequent adjustments to their advice to the Minister should the biomass estimates be too optimistic. The options were consulted on and submissions were received from industry, conservation groups and Iwi (FNZ, 2018b). The Minister of Fisheries decided on Option 3, noting that he would consult further with stakeholders prior to making separate TAC and TACC decisions for the 2019-20 and 2020-21 fishing years (Minister of Fisheries, 2018).

During 2019, Fisheries New Zealand provided advice to set the TACC for 2019-20 based on Option 3 as agreed by the Minister of Fisheries in 2018 (FNZ, 2019a). Following consultation, the Minister agreed with the FNZ recommendation and set the TAC for ORH 3B to 7,116t (TACC 6,772t), with catch limits of 1,150t for the NWCR and 4,775t for the ESCR (FNZ, 2019c; Minister of Fisheries, 2019). During 2020, Fisheries New Zealand provided advice to set the TACC ORH3B for 2020-21 (FNZ, 2020a). Following consultation, the Minister agreed with the FNZ recommendation and set the TAC for ORH 3B to 8,355t (TACC 6,772t), with the catch limit for the ESCR increased to 5,970t (FNZ, 2020b; Minister of Fisheries, 2020).

ORH 7A
During the 2019-20 decision making process, the Minister of Fisheries was provided with four options regarding the TAC and TACC for ORH7A (FNZ, 2019c):

- Option 1: The status quo (i.e., a TACC for ORH 7A of 1,600 t for the 2019-2020 fishing year).
- Option 2: An increase to the TACC of 29% (i.e., a TACC for ORH 7A of 2,060 t for the 2019-2020 fishing year).
- Option 3: An increase to the TACC of 38% (i.e., a TACC for ORH 7A of 2,220 t for the 2019-2020 fishing year).
- Option 4: An increase to the value from the HCR (i.e., a TACC for ORH 7A of 2,433 t for the 2019-2020 fishing year).

The options were consulted on and submissions were (FNZ, 2019b). The Minister of Fisheries selected a TACC of 2,058t which is option 2, with an allowance for Māori customary harvest of 2t. (Minister of Fisheries, 2019).

Monitoring and assessment

FNZ has a 5-year plan that identifies a work programme for research and monitoring for orange roughy (FNZ, 2020c). The plan outlines acoustic surveys for orange roughy to take place in winter. Therefore, the surveys in Table 22 are reflected in the year they will be contracted with dates of completion shown in the table. The length frequency and age compositions are based on observers. Observer coverage is aimed for 30% effort coverage for ORH 3B NWCR, ORH 3B ECSR, and ORH 7A (FNZ, 2020c) with 50 length-frequencies (300 otoliths) for each of the three stocks (two length-frequencies each day; FNZ, 2020c). Age data for the assessments come from surveys (with an aim of 900 otoliths per survey)[FNZ, 2020c]. This plan was not followed as intended owing to COVID-19 with the 2020 surveys for ORH 3B taking place in 2021 so that the next assessment for ORH3B NWCR and ECSR should take place in 2022.

Table 22. Orange roughy survey schedule (Source: FNZ, 2020c).

	2020/21	2021/22	2022/23	2023/24	2024/24
ORH 1					
ORH 2A North		June 2022			June 2025
ORH MEC	June 2021			June 2024	
ORH 3B NWCR			July 2023		
ORH 3B ECSR			July 2023		
ORH 3B Puysegur		July 2021			July 2024
ORH 7A		July 2022			July 2025
ORH 7B	July 2020	July 2021			

Orange roughy stock assessments are scheduled to align with the relevant acoustic surveys (Table 23).

Table 23. Orange roughy survey schedule (Source: FNZ, 2020c).

	2020/21	2021/22	2022/23	2023/24	2024/24
ORH 2A North			Assessment		
ORH MEC		Assessment			
ORH 3B NWCR	Assessment				Assessment
ORH 3B ECSR	Assessment				Assessment
ORH 3B Puysegur		Assessment			
ORH 7A			Assessment		July 2025
ORH 7B		Assessment			

7.2.2 Catch profiles

7.2.3 Total Allowable Catch (TAC) and catch data

Table 24 – Total Allowable Commercial Catch (TACC) and catch data – ORH 7A-WB

TACC	Year	**2020-21**	Amount	**2,058 t**
UoA share of TACC	Year	**2020-21**	Amount	**2,058 t**
UoA share of total TACC	Year		Amount	**n, unit**
Total green weight catch by UoC	Year (most recent)	**2019-20**	Amount	**1,897 t**
Total green weight catch by UoC	Year (second most recent)	**2018-19**	Amount	**1,589 t**

Table 25 - Total Allowable Commercial Catch (TACC) and catch data - ORH 3B ESCR

TACC*	Year	**2020-21**	Amount	**5,970 t**
UoA share of TACC	Year	**2020-21**	Amount	**5,970 t**
UoA share of total TACC	Year		Amount	**n, unit**
Total green weight catch by UoC	Year (most recent)	**2019-20**	Amount	**4,769 t**
Total green weight catch by UoC	Year (second most recent)	**2018-19**	Amount	**4,143 t**

* Note that this is a sub-area catch limit, not a TACC

Table 26 - Total Allowable Commercial Catch (TACC) and catch data - ORH 3B NWCR

TACC*	Year	**2020-21**	Amount	**1,150 t**
UoA share of TACC	Year	**2020-21**	Amount	**1,150 t**
UoA share of total TACC	Year		Amount	**n, unit**
Total green weight catch by UoC	Year (most recent)	**2019-20**	Amount	**223 t**
Total green weight catch by UoC	Year (second most recent)	**2018-19**	Amount	**294 t**

* Note that this is a sub-area catch limit, not a TACC

7.2.4 Principle 1 Performance Indicator scores and rationales

PI 1.1.1 – Stock status

PI 1.1.1		**The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing**		
Scoring Issue		SG 60	SG 80	SG 100
a	Stock status relative to recruitment impairment			
	Guide post	It is **likely** that the stock is above the point where recruitment would be impaired (PRI).	It is **highly likely** that the stock is above the PRI.	There is a **high degree of certainty** that the stock is above the PRI.
	Met?	**Yes (all three UoC)**	**Yes (all three UoC)**	**Yes (all three UoC)**
Rationale				

For the purposes of this assessment, the PRI is taken to be the limit reference point. This was set to $0.2B_0$ by Cordue (2014a) who defined the limit reference point to be the maximum of $0.2B_0$ and $0.5B_{MSY}$ (based on a deterministic yield analysis), accounting for uncertainty in natural mortality M and stock-recruitment steepness h. Cordue (2019b) revised the analysis on which the limit reference point was based taking into account the results of new assessments. The new assessments imply greater probability for low values for stock-recruitment steepness and hence higher values for the limit reference point (update to $0.22B_0$; Table 19).

The base models for the stock assessments estimate the probability that recent spawning biomass is less than $0.2B_0$ (Table 18). The probabilities exceed 0.99 for all stocks. SG100 is likely to be met.

b	Stock status in relation to achievement of Maximum Sustainable Yield (MSY)			
	Guide post		The stock is at or fluctuating around a level consistent with MSY.	There is **a high degree of certainty** that the stock has been fluctuating around a level consistent with MSY or has been above this level over recent years.

	Met?		**Yes (all three UoC)**	**Yes (all three UoC)**

Rationale

The estimates of B_{MSY} based on deterministic considerations (the usual basis for estimating B_{MSY} when conducting stock assessment) are not considered reliable for orange roughy and range from $0.31B_0$ to $0.43B_0$ depending on whether the Beverton-Holt or Ricker stock-recruitment relationships is assumed (Table 19). The management target range adopted for orange roughy in New Zealand is $0.3\text{-}0.5B_0$ and encompasses the estimates in Table 19. The stock assessments provide estimates of biomass relative to B_0 (Figure 6 Figure 9 Figure 11; Table 11,Table 14 and Table 17). For the base model, the stocks are assessed to have been above the lower end of the management target range ($0.3B_0$) since 2012 (ORH3B NWCR), 2015 (ORH 3B ESCR), and 2005 (ORH 7A) based on the most recent assessments. The probability that the stocks were above the lower end of the management in the year of the last assessment exceeds 0.95 for all three stocks based on the base models. The SG100 is likely to be met.

References:

FNZ (2021b, 2021c); Cordue (2014a, 2019b)
Confidential information

Stock status relative to reference points

	Type of reference point	Value of reference point	Current stock status relative to reference point
Reference point used in scoring stock relative to PRI (SIa)	*Spawning biomass*	*0.2 B_0*	*ORH 3B NWCR: 0.38 B_0 (2017)* *ORH 3B ESCR: 0.36 B_0 (2020)* *ORH 7A: 0.47 B_0* (2019)
Reference point used in scoring stock relative to MSY (SIb)	*Spawning biomass*	*0.3 – 0.5 B_0*	*(Relative to $0.3B_0$)* *ORH 3B NWCR: 0.38 B_0 (2017)* *ORH 3B ESCR: 0.36 B_0 (2020)* *ORH 7A: 0.47 B_0* (2019)

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 1.2.1 – Harvest strategy

PI 1.2.1	**There is a robust and precautionary harvest strategy in place**		
Scoring Issue	SG 60	SG 80	SG 100
a	Harvest strategy design		

	Guide post	The harvest strategy is **expected** to achieve stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy **work together** towards achieving stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and is **designed** to achieve stock management objectives reflected in PI 1.1.1 SG80.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The harvest strategy for orange roughy (Cordue, 2014a) is well-defined and is responsive to the state of the stock. It is consistent with the New Zealand Harvest Strategy Standard as well as the Fisheries Act. It was designed using a Management Strategy Evaluation that considered a fairly broad range of uncertainties (Cordue, 2014a, 2019b) and was adopted by industry and the Ministry for Primary Industry (Reeve, 2014). The set of uncertainties to which the HCR was evaluated is narrower than is the case for other applications of MSE. The final harvest control rule was selected to achieve a desirable trade-off between risk to the resource and catches.

The harvest strategy was developed using MSE. As such, the values for the parameters of the control rule were selected accounting for the frequency of assessments, as well the choices for the limit reference point and the management target.

	Harvest strategy evaluation			
b	Guide post	The harvest strategy is **likely** to work based on prior experience or plausible argument.	The harvest strategy may not have been fully **tested** but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been **fully evaluated** and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The harvest strategy for orange roughy (Cordue, 2014a) is well-defined and is responsive to the state of the stock. It is consistent with the New Zealand Harvest Strategy Standard as well as the Fisheries Act. It was designed using a Management Strategy Evaluation that considered a fairly broad range of uncertainties (Cordue, 2014a, 2019) and was adopted by industry and the Ministry for Primary Industry (Reeve, 2014). The set of uncertainties to which the HCR was evaluated is narrower than is the case for other applications of MSE. The final harvest control rule was selected to achieve a desirable trade-off between risk to the resource and catches.

The harvest strategy was developed using MSE. As such, the values for the parameters of the control rule were selected accounting for the frequency of assessments, as well the choices for the limit reference point and the management target.

The MSE provides strong (but indirect) evidence that the harvest strategy is achieving its objectives. Cordue (2019) reports updated probabilities that the spawning biomass will exceed the limit reference point and the lower limit of the management target range (both exceed 66% which is the value for Ricker stock-recruitment relationship) and the mean biomass is 42% for the base-case specifications. This conclusion is robust to the frequency with which assessments are conducted, the form of the stock-recruitment relationship, and the extent of recruitment variability. The probability of being above the lower limit of the management target is less than 90% (78-80%) if biomass is positively biased by 20% and this bias in not reduced over time (Cordue, 2014a, 2019b).

The harvest strategy has been applied during the process to set the TAC/TACC for ORH 3B since

2018-19 and for ORH 7A since 2019-20. The assessments indicate that the stock sizes of all three stocks are in the management target range and should remain there if TACs/TACCs are set using the harvest strategy. The SG80 is likely to be met but not SG100 because the performance of the harvest strategy has not been fully evaluated and evidence to show it's meeting its objectives is indirect.

c	Harvest strategy monitoring			
	Guide post	Monitoring is in place that is expected to determine whether the harvest strategy is working.		
	Met?	**Yes**		
Rationale .				

The harvest strategy relies on information from catch, surveys, and age compositions. The medium-term research plan for deepwater fisheries (FNZ, 2020c) includes data collection at the level expected given the MSE. The research plan has generally been followed except that no survey of ORH 3B was conducted in 2020 owing to COVID-19 and consequently no benchmark assessments were conducted for ORH 3B NWCR and ORH 3B ESCR in 2021. The surveys planned for 2020 were conducted during June/July 2021. SG60 is likely to be met.

d	Harvest strategy review			
	Guide post			The harvest strategy is periodically reviewed and improved as necessary.
	Met?			**Yes**
Rationale				

Cordue (2019b) reviewed the basis for the 2014 MSE and conducted updated projections that reflect the inferences from new assessments regarding the distribution for natural mortality and stock-recruit steepness. SG100 is likely to be met.

e	Shark finning			
	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**NA**	**NA**	**NA**
Rationale				

N/A Orange roughy are not sharks.

f	Review of alternative measures			
	Guide post	There has been a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock and	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock, and

			they are implemented as appropriate.	they are implemented, as appropriate.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

NA - There is no discard of the target species in the orange roughy fisheries.

Cordue (2014a, 2019b); FNZ. (2020c).

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	***The Status of the HCR in relation to management decision making is needed. The previous assessment was based on comments by Reeves (2014) but a more formal statement is needed on how the HCR feeds into the management process.***

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 1.2.2 – Harvest control rules and tools

PI 1.2.2		There are well defined and effective harvest control rules (HCRs) in place		
Scoring Issue		SG 60	SG 80	SG 100
a	HCRs design and application			
	Guide post	**Generally understood** HCRs are in place **or available** that are **expected** to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached.	**Well defined** HCRs are **in place** that **ensure** that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock **fluctuating around** a target level consistent with (or above) MSY, or for key LTL species a level consistent with ecosystem needs.	The HCRs are expected to keep the stock **fluctuating at or above** a target level consistent with MSY, or another more appropriate level taking into account the ecological role of the stock, **most** of the time.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The New Zealand system is well structured to ensure that catches remain below the catch limits (see also PI 3.2). The harvest control rule (Figure 13 and Figure 14) is fully-specified. The exploitation rate is reduced to zero when stock size is estimated to be below $0.1B_0$. The exploitation rate drops with lower stock sizes between the lower limit of the management target range and $0.1B_0$, as well as within the management target range (albeit it at a different rate). The harvest control rule is based on a default target fishing mortality rate of $0.045yr^{-1}$ (equal to the base model estimate of M). However, this fishing mortality can be adjusted over time through the 'scaling' feature of the harvest control rule if productivity is estimated to differ from $0.045yr^{-1}$.

The MSE did not explicitly account for the impact of spawning on recruitment success (Cordue, 2014c), but by parameterizing the stock-recruitment relationship using model outputs for a stock (MEC) that was fished substantially during spawning, the posterior for steepness accounts to some extent for this effect (which should be less into the future given lower intended levels of fishing morality).

The harvest control rule is in place. It is consistent with the harvest strategy and ensures that the exploitation rate is reduced as limit reference point is approached. The MSE suggests that the spawning biomass will remain above the lower limit of management target range ($0.3B_0$), with the probability between 0.78 and 0.97 depending on the stock-recruitment relationship and whether the estimates of abundance are biased (Cordue, 2019b). The probability of dropping below the limit reference point is estimated to be very low (Cordue, 2019b). SG100 is likely to be met.

b	HCRs robustness to uncertainty			
	Guide post		The HCRs are likely to be robust to the main uncertainties.	The HCRs take account of a **wide** range of uncertainties including the ecological role of the stock, and there is **evidence** that the HCRs are robust to the main uncertainties.
	Met?		**Yes**	**No**

Rationale

The harvest control rule was developed using Management Strategy Evaluation (Cordue 2014a, 2019b). The MSE was consistent with how this technique is used elsewhere, with the exception that the assessment (a Bayesian integrated analysis method) had to be approximated given the computational demands of simulation testing such a method and a projection period that was longer than is typical. This is not an uncommon practice when applying MSE. The MSE was tailored to the biology of orange roughy and integrated the impact of uncertainties due to parameter uncertainty, in particular that due to steepness and natural mortality (which are pre-specified in the base model).

While it is never possible to account for all uncertainties in an MSE, the MSE for orange roughy considered many of the uncertainties that are known to impact the performance of a harvest control rule, specifically:

- the form of the stock-recruitment relationship (Ricker or Beverton-Holt);
- whether fishing is restricted to spawning fish or independent of maturity status;
- the extent of variation and temporal correlation in recruitment about the assumed stock-recruitment relationship; and,
- bias in the estimates of stock status and vulnerable biomass as well as a higher level of error in the estimates on which the HCR is based.

The MSE summarized results in terms of performance metrics that evaluate performance in terms of yield as well the probabilities of being below the limit reference point and above the lower bound of the management target range.

The harvest control rule was based on MSE. The MSE took several (likely the main) sources of uncertainty into account but did not cover a very wide spectrum of uncertainties. Specifically, the uncertainty associated with the assessment was only approximately accounted for and at least one key uncertainty (stock structure) was not accounted for. The evaluation also did not consider the impacts of climate change.

	HCRs evaluation			
c	Guide post	There is **some evidence** that tools used **or available** to implement HCRs are appropriate and effective in controlling exploitation.	**Available evidence indicates** that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.	**Evidence clearly shows** that the tools in use are effective in achieving the exploitation levels required under the HCRs.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

Catches in New Zealand orange roughy fisheries are at or below agreed catch limits (Table 10). Thus, the evidence clearly shows that the tools in use are effective in achieving the exploitation levels required under the control rules.

References

Cordue (2014a,c); Cordue (2019b)

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 1.2.3 – Information and monitoring

PI 1.2.3		Relevant information is collected to support the harvest strategy		
Scoring Issue		SG 60	SG 80	SG 100
a	Range of information			
	Guide post	**Some** relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	**Sufficient** relevant information related to stock structure, stock productivity, fleet composition and other data are available to support the harvest strategy.	A **comprehensive range** of information (on stock structure, stock productivity, fleet composition, stock abundance, UoA removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.
	Met?	**Yes**	**Yes**	**No**
Rationale				

The data required to support the harvest strategy include information on stock structure, basic population dynamics parameters and fleet structure, removals from the stocks, and information on abundance and age-structure. There is in general a substantial amount of information on the biology of orange roughy (notwithstanding the difficulties associated with conducting biological studies for a species that occurs at considerable depth) and surveys to collect data on abundance are conducted regularly.

Knowledge about the population dynamics of orange roughy is sufficient to the support the harvest strategy, but several sources of uncertainty remain (e.g., environmental influences) and stock structure is clearly not fully understood. There is a plan for when surveys and assessments should be conducted (FNZ, 2020c), but no such plan exists focused on improving biological and ecological knowledge, including stock structure and environmental impacts on population dynamics.

b	Monitoring			
	Guide post	Stock abundance and UoA removals are monitored and **at least one indicator** is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and UoA removals are **regularly monitored at a level of accuracy and coverage consistent with the harvest control rule**, and **one or more indicators** are available and monitored with sufficient frequency to support the harvest control rule.	**All information** required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent **uncertainties** in the information [data] and the robustness of assessment and management to this uncertainty.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

Acoustic surveys of the three stocks are planned to occur on a 3-year schedule, with the survey results feeding into stock assessments that then can be used to apply the harvest control rule (FNZ, 2020c,Table 22 and Table 23). The proposed schedule of surveys and assessments is more frequent than was indicated to be necessary from the MSE. In addition to estimates of biomass, age-

frequencies are obtained from surveys (primarily) and commercial catches.

Reporting requirements are set out in the Fisheries (Reporting) Regulations 2001, most notably in sections 5 and 6. It is illegal under the Fisheries Act 1996 to discard any species in the Quota Management System (QMS) at-sea unless the species is listed on Schedule 6 (of the Fisheries Act), the return to the sea is recorded, and the specified conditions are met, or an MPI observer on the vessel authorizes the discard. As orange roughy is a QMS species, all catch of orange roughy is recorded and reported with a high degree of accuracy.

The key input to the assessment on which the harvest control rule is based are the survey estimates of abundance, and catch and survey age-structure. These data will be collected at the rate anticipated in the design of the harvest control rule. Although the surveys are not annual, given the biology of the orange roughy, and the fact that there is regular observer and catch monitoiring, the data collection scheme can be considered to be high frequency. The uncertainties associated with the data are well studied and the assessment considers sensitivity to how the data are included in the assessment.

	Comprehensiveness of information			
c	Guide post		There is good information on all other fishery removals from the stock.	
	Met?		**Yes**	
Rationale				

As a QMS species, orange roughy removals are monitored and reported across all sectors that take orange roughy – reporting removals is required in the Fisheries (Reporting) Regulations 2001. Therefore, there is good information on all removals (achieves SG80).

References

FNZ (2020c, 2021a, 2021b, 2021c)

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 1.2.4 – Assessment of stock status

PI 1.2.4		There is an adequate assessment of the stock status		
Scoring Issue		SG 60	SG 80	SG 100
a	Appropriateness of assessment to stock under consideration			
	Guide post		The assessment is appropriate for the stock and for the harvest control rule.	The assessment takes into account the major features relevant to the biology of the species and the nature of the UoA.
	Met?		**Yes**	**Yes**
Rationale				

The most recent assessments involved fitting an age-structured population dynamics model to catch and monitoring data. The key biological parameters of the model (natural mortality and growth) were pre-specified based on auxiliary information, while the steepness of the stock-recruitment relationship was set to a default value (0.75). Sensitivity was explored, inter alia, to changing the assumed value for natural mortality and steepness, with a “worst case” scenario defined in terms of lower (more pessimistic) values for these parameters (FNZ, 2021a, 2021b).

The assessment was based on ageing data, but only ageing data based on the new approach while the set of acoustic and trawl survey estimates used in the assessment were selected based on criteria developed by the DWWG. A key input for the assessments was the priors for the catchability coefficients for the surveys. Some of these priors were assumed to be uninformative (e.g. for the trawl surveys), but those for the acoustic surveys were informative. The (informative) priors for catchability for the acoustic surveys accounted for uncertainty in target strength as well as in the proportion of the population available to be surveyed.

The assessment was configured within the CASAL package to take key specifics, including the biology of the species and the nature of the fishery, into account.

b	Assessment approach			
	Guide post	The assessment estimates stock status relative to generic reference points appropriate to the species category.	The assessment estimates stock status relative to reference points that are appropriate to the stock and can be estimated.	
	Met?	**Yes**	**Yes**	
Rationale				

The assessment estimates stock status relative to the reference points included in the harvest control rule as well as those required under the Harvest Strategy Standard.

c	Uncertainty in the assessment			
	Guide post	The assessment **identifies major sources** of uncertainty.	The assessment **takes uncertainty into account**.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a **probabilistic** way.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

As is common in New Zealand, the assessment method is Bayesian and the results are expressed in terms of posterior distributions for quantities of management interest such as current spawning biomass and current spawning biomass relative to B_0. The uncertainty in the assessment is also quantified using sensitivity tests, and some of those sensitivity tests are carried forward to form the basis for projections.

The number of sensitivity tests reported in the assessment FARs and the plenary report are fairly low compared to the numbers that would be seen in other assessments based on similar methods.

The assessments provide the ability to assess stock status in probabilistic terms using Bayesian methods as well as the information needed to apply the harvest control rule for orange roughy. The assessment is Bayesian. Consequently, it takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic way.

	Evaluation of assessment			
d	Guide post			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
	Met?			**No**

Rationale

The basic assessment method (integrated analysis) is used for many fisheries around the world and simulation studies have led to an understanding of how assessment methods of this type perform. However, no formal evaluations of an assessment method that is identical to that used for orange roughy have been undertaken. In particular, no evaluation of the implications of errors in specifying priors for key parameters has been undertaken.

The assessment method (CASAL) has yet to be formally tested using simulations and hence not tested the way it is configured for orange roughy.

	Peer review of assessment			
e	Guide post		The assessment of stock status is subject to peer review.	The assessment has been **internally and externally** peer reviewed.
	Met?		**Yes**	**Yes**

Rationale

The assessment is reviewed by the DWWG which has a broad range of members, including those from government, industry and NGOs. However, the assessment has not recently been formally reviewed by scientists external to the New Zealand assessment process.

References

FNZ (2021a,b)

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

7.3 Principle 2

7.3.1 Principle 2 background

7.3.1.1 Principle 2 Component Definitions and Classifications

Species categorization in P2:

Primary species in Principle 2 are those that meet the following criteria:

- Species in the catch that are not covered under P1 because they are not included in the UoA;
- Species that are within scope of the MSC program as defined in FCR 7.4.1.1; and
- Species where management tools and measures are in place, intended to achieve stock management objectives reflected in either limit or target reference points.

Secondary species are classified as follows:

- They are not considered 'primary' as defined in SA 3.1.3; or
- They are out of scope for MSC certification (i.e., birds, reptiles or mammals) but are not ETP species.

The team determined that catches averaging below approximately 0.05% of total catch would have little impact on the status of incidental species, considered smaller catches as *de minimis,* and did not further consider them.

We designate "main" primary and secondary species as those which comprise at least 5% of the total catch, or at least 2% of the total catch for "more vulnerable/less resilient" species, whose life history characteristics may make them more prone to overexploitation. All "out of scope" secondary species must be classified as "main."

The definition of Endangered, Threatened, or Protected (ETP) species includes those protected by national or international legislation, and names a number of international lists/agreements where, if a species is listed, it must be considered as ETP, regardless of other national protection. The list of agreements is as follows:

- Annex 1 of the Convention on International Trade in Endangered Species (CITES) unless it can be shown that the particular stock of the CITES listed species impacted by the UoA is not endangered;
- Annex 1 of the Agreement on Conservation of Albatross and Petrels (ACAP);
- Table 1 Column A of the African-Eurasian Migratory Waterbird Agreement (AEWA);
- Agreement on the Conservation of Small Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS);
- Wadden Sea Seals Agreement; and
- Any other binding agreements that list relevant ETP species concluded under the Convention on Migratory Species (CMS).
- Any out of scope species (birds, mammals or reptiles) not otherwise protected under the above or national legislation, but with a status of Critically Endangered, Endangered, or Threatened on the IUCN red list.

Habitats categorization in P2:

MSC requires that if a fishery interacts with benthic habitats, they shall be categorized according to the characteristics "substratum, geomorphology, and biota," and requires that encountered habitats are classified as "commonly encountered, VME, or minor/other" according to the following definitions:

- "A commonly encountered habitat shall be defined as a habitat that regularly comes into contact with a gear used by the UoA, considering the spatial (geographical) overlap of fishing effort with the habitat's range within the management area(s) covered by the governance body(s) relevant to the UoA; and
- A VME shall be defined as is done in paragraph 42 subparagraphs (i)-(v) of the FAO Guidelines (definition provided in GSA3.13.3.22) [as having one or more of the following characteristics: uniqueness or rarity, functional significance, fragility, Life-history traits of

component species that make recovery difficult, and/or structural complexity]. This definition shall be applied both inside and outside EEZs and irrespective of depth."

Both commonly encountered and VME habitats are considered 'main 'habitats for scoring purposes.

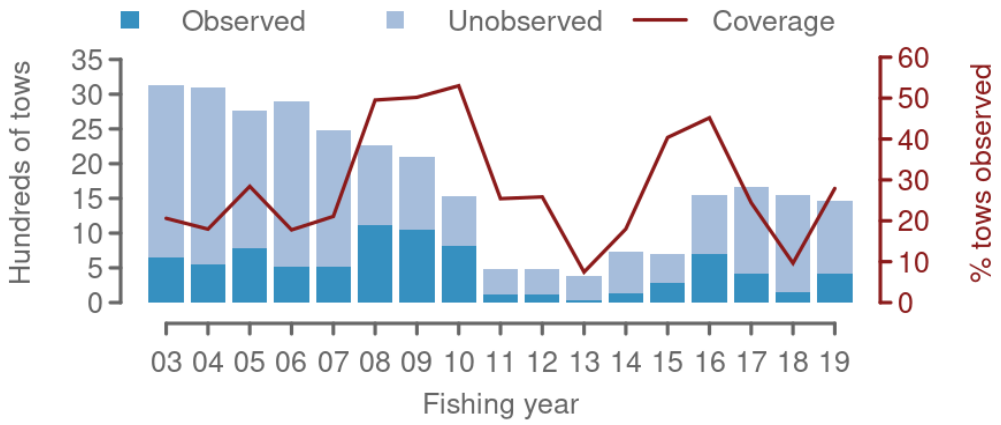
7.3.1.2. Principle 2 Context and Monitoring

Orange roughy (Hoplostethus atlanticus) occur in deepwater habitats on and below the continental slope. Clark and Anderson (2013) have reviewed and summarised the ecosystem that orange roughy inhabit. While orange roughy are considered demersal, as they are caught on/near the seabed in demersal trawls, their diet indicates they forage into the bentho-pelagic and, as a species without a swim bladder, they would appear to be well adapted to this. Juvenile orange roughy occur most frequently on gently sloping areas of the upper continental slope at depths of 850–900 m (Dunn et al., 2009a, b). Adults are found at depths of 850 m to at least 1500 m. Larger orange roughy may aggregate around Underwater Topographic Features (UTFs), such as ridges, hills, knolls, and seamounts as well as canyons for spawning and feeding (Branch, 2001; Dunn and Devine, 2010). Orange roughy fishing in New Zealand takes place over areas of flat seabed on the continental slope and on UTFs. UTFs include seamounts, knolls and hills defined on the elevation measured as the height from base to summit (seamount > 1,000 m; knoll 500 to 1,000 m; hill <500m) (United States National Geospatial-Intelligence Agency, 2015). Compared to UTFs, less is known about the ecosystems of the benthic areas of the upper continental slope. The upper continental slope has lower benthic biomass per unit area compared to UTFs but is not homogenous. Biodiversity and habitats do vary over large spatial scales (Compton et al., 2013) but the primary driver of this variability is likely to be environmental such as depth, substrate and oceanographic conditions (Dunn, 2013).

A Government fisheries observer programme (https://www.mpi.govt.nz/fishing-aquaculture/commercial-fishing/operating-as-a-commercial-fisher/fisheries-observer-services/) in New Zealand waters has provided an overall level of observer coverage in the orange roughy fishery (MPI Observer Programme) generally more than 20% (in terms of hauls observed) and over 50% in some years (Figure 15). The MPI Observer Programme is specifically designed to address the need for accurate species identification (retained, bycatch and ETP species) and obtain independent estimates of catch weights or numbers. The objective of the SOP is to collect data from fisheries for the following purposes:

- As an input to monitor key fisheries against harvest strategies
- As an input to monitor biomass trends for target and bycatch species
- To enable reliable estimations and nature of ETP species interactions and captures
- To enable timely responses to sustainability and environmental impact issues
- To provide a high level of confidence in fishers' at sea compliance with regulatory and non-regulatory measures.

ORH3B Chatham Rise



ORH 7A

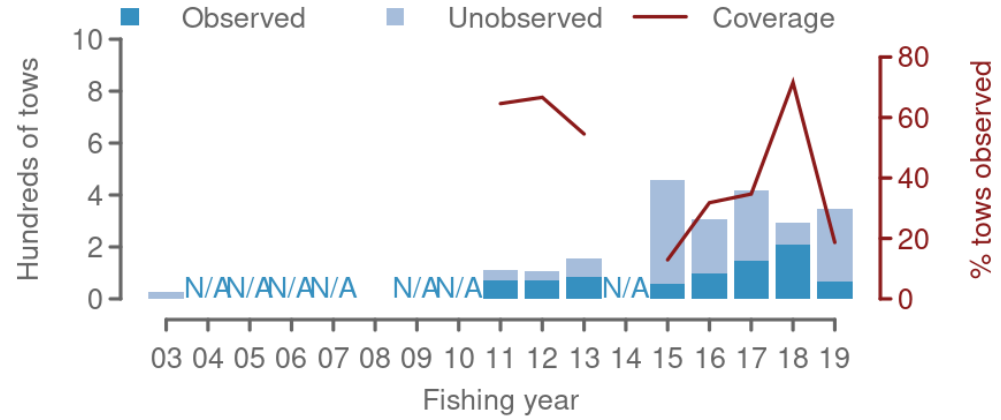


Figure 15. Observer coverage and fishing effort in orange roughy fisheries in ORH 3B Chatham Rise and in ORH 7A (MPI, 2021). Note: the ORH 7A Fishery Management Area was closed to commercial fishing prior to 2011. The most recent fishing year for which data are presented is 2018-19.

MPI's Scientific Observer Programme monitors each of the deepwater fisheries, with coverage prioritised based on the needs of each different fishery. FNZ considers that 35-45% coverage is sufficient for most fisheries/sectors but implements high (80-100%) coverage for fisheries where there may be what are deemed by management to be high-risk ETP species (e.g. squid and southern blue whiting trawl fisheries where operations overlap with sea lions). MPI's planned observer coverage for the ORH 3B Chatham Rise and ORH 7A deepwater fisheries in 2020-21, as specified in the Annual Operational Plan for Deepwater Fisheries 2020/21, is 250 and 60 days respectively, equivalent to ~35-45% coverage (FNZ, 2020). Performance against targeted observer coverage in previous years is reviewed in the Annual Review Report (FNZ, 2020a).

Each year, MPI and DOC agree an observer deployment plan for the number of observer sea days and the duties of the observers (https://www.mpi.govt.nz/fishing-aquaculture/commercial-fishing/operating-as-a-commercial-fisher/fisheries-observer-services/#DW-fisheries). For the past 5 years (2016-17 to 2020-21), the number of planned and achieved sea days has fluctuated (Table 27). Observer coverage in the UoA for the fishing years 2015-2016 to 2019-2020 have generally ranged from 20-40%, with excursions higher and lower (Table 28).

Table 27. Number of observer sea days planned for the Deepwater Fishery for the Chatham Rise and West Coast and the total delivered from 2016-17 to 21 July 2021.

(https://www.mpi.govt.nz/fishing-aquaculture/commercial-fishing/operating-as-a-commercial-fisher/fisheries-observer-services/#DW-fisheries)

Year	Chatham Rise sea days		West Coast sea days	
	Planned	Achieved	Planned	Achieved
2020-21	250	233	60	97
2019-20	300	266	100	45
2018-19	220	261	60	21
2017-18	220	161	40	65
2016-17	270	146	70	62

Table 28. Observer coverage for orange roughy fishing vessels in the Units of Assessments, 2015-2016 to 2019-2020 (FNZ data).

	2015-16	2016-17	2017-18	2018-19	2019-20	5-year Average
NWCR						
Tows	392	456	385	220	171	325
Obs tows	91	100	106	61	61	84
% Observed	23%	22%	28%	28%	36%	26%
ESCR						
Tows	1229	1179	1151	1247	1358	1233
Obs tows	690	324	30	350	411	361
% Observed	56%	27%	3%	28%	30%	29%
ORH7A-WB						
Tows	560	533	547	478	555	535
Obs tows	242	153	304	108	193	200
% Observed	43%	29%	56%	23%	35%	37%

7.3.2 Primary and secondary species

Estimation of annual bycatch and discard levels of non-protected species in New Zealand orange roughy fisheries have been undertaken at regular intervals since 1998 (e.g., Clark *et al.*, 2000; Anderson *et al.*, 2001; Anderson, 2009, 2011, 2013; Finucci et al. 2019). In a New Zealand context, and in most New Zealand publications referred to above, the term 'bycatch' is of all non-target catch and is roughly analogous to the MSC 'secondary species' category. Target fishing for orange roughy catches a relatively small amount of bycatch (MRAG Americas, 2016), with around 96% of the catch consisting of either orange roughy or other species managed under the QMS (i.e. 'primary species'), such as oreo (Family Oreosomatidae). All catches of species managed under the QMS are required by law to be accurately recorded, reported and landed with a few prescribed exceptions for landings. Deemed values prevent an incentive for dumping. Deemed values are payable for QMS species caught without balancing ACE. Where deemed values are payable for QMS species taken without balancing ACE, the deemed value is set at a level to remove any financial benefit to industry to catch but at a level that will not incentivise what would be illegal discarding. The penalties for discarding QMS species without authorisation are severe, further reducing the incentives to discard. There is no restriction on discarding non-QMS species. There was a notable decrease in total non-commercial bycatch during 2010-11 and 2011-12 (MPI & DWG, 2013) as a result of a decrease in fishing effort and decreases in catch limits. Finucci et al. (2019) reported declining trends in non-target catch of the eight most commonly caught species for all orange roughy fisheries combined; smooth oreo (*Pseudocyttus maculatus*), black oreo (*Allocyttus niger*), unidentified sharks (Elasmobranchii), rattails (Macrouridae), seal sharks (*Dalatias licha*), hoki (*Macruronus novaezelandiae*), and ribaldo

(*Mora moro*) had significantly declining trends, and slickheads (family Alepocephalidae) had a non-significant declining trend.

For orange roughy trawls since 2001–02, orange roughy accounted for 85% of the total observed catch and the remainder comprised mainly smooth oreo (7%), black oreo (1.6%), hoki (0.6%), and cardinalfish (*Epigonus telescopus*) (0.3%) (FNZ 2021). More than 700 species or species groups were recorded by observers, including various deepwater dogfishes (2%), morid cods (Moridae) (1%), rattails (<1%), and slickheads (0.5%). Total annual bycatch between 2001–02 and 2009–10 ranged from 3090 t to 6075 t per year and declined to less than 1100 in subsequent years following decline in catch in the fishery. Total annual discards also decreased over time, from about 2120 t in 2001–02 to about 184 t in 2013–14 and were almost entirely of non-QMS or invertebrate species (rattails, shovelnose dogfish, and other deepwater dogfishes, all discarded at a rate of 50% or more). From 2001–02 to 2014–15, the overall discard fraction value was 0.07 kg (range of 0.02-0.13 kg) and tended to be lower in recent years.

Although only a few species make up the total catch in the orange roughy fisheries, a large number of species have been observed in low numbers, most being non-commercial species, including invertebrate species. Squid (mostly warty squid, *Onykia* spp.) were the largest component of the invertebrate catch, followed by various groups of coral, echinoderms (mainly starfish) and crustaceans (mainly king crabs, Family *Lithodidae*). Although the catch composition varies among the three orange roughy UoAs, a general trend of declining bycatch and discards has occurred. Total annual catch of other species (i.e. everything except orange roughy) in all New Zealand orange roughy fisheries since 1990–91 ranged from about 2,300 t to 27,000 t, and has declined over time along with that of the catch and effort in the New Zealand orange roughy fisheries to be less than 4,000 t in each of the last four years (Figure 16). Catch volumes mostly consist of QMS species, with non-commercial species accounting for only 5 – 10% by weight of the total non-orange roughy catch from the 2000s. Estimated total annual discards also decreased over time, from about 3,400 t in 1990–91 to about 300 t in 2007–08, and, since about 2000, discards were almost entirely non-commercial non-QMS species, as required by regulations (MPI, 2012).

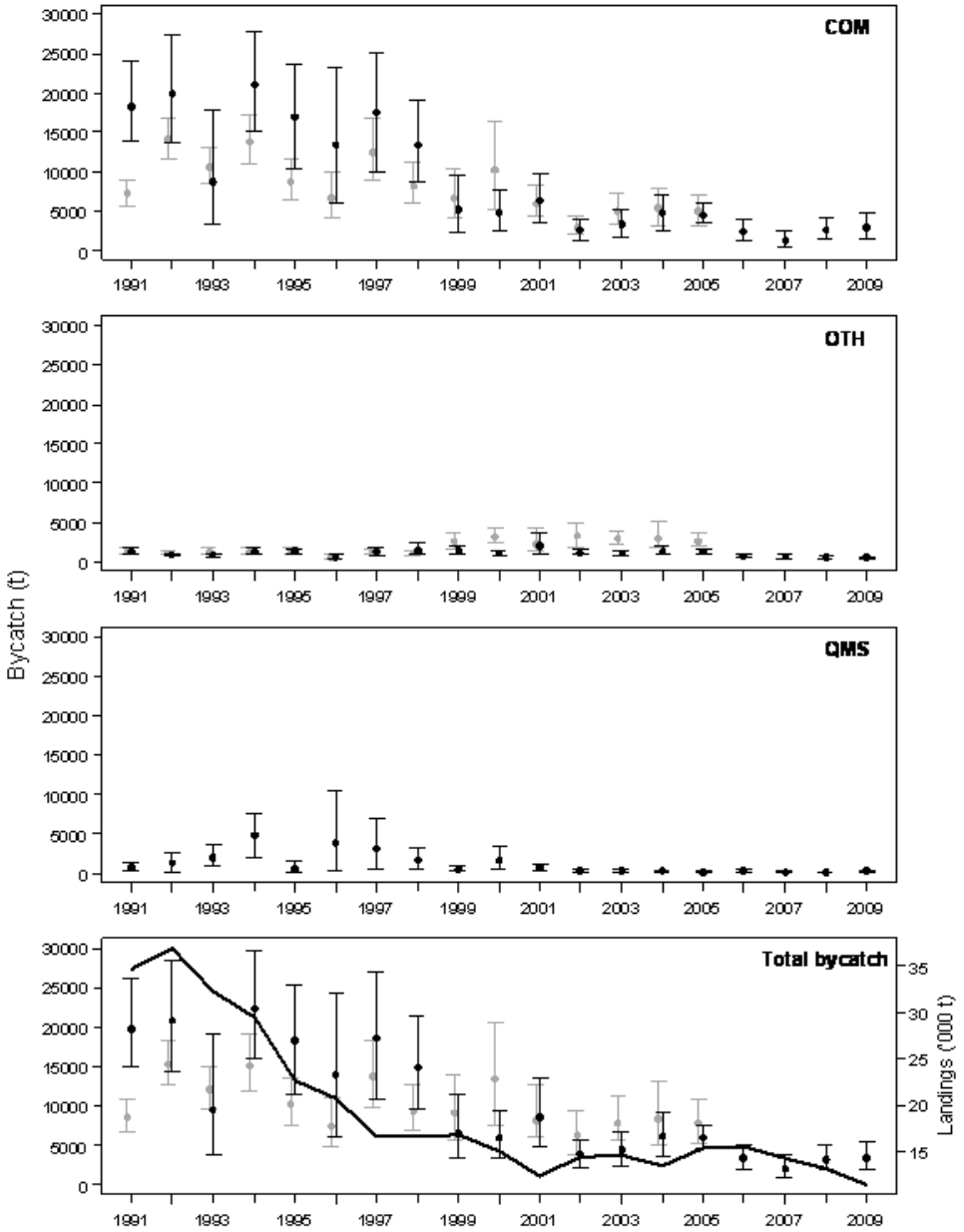


Figure 16 Annual estimates of non-orange roughy catch (called bycatch in this figure, but not the same as the MSC definition of bycatch) in the orange roughy trawl fisheries, calculated for commercial species (COM), non-commercial species (OTH), QMS species, and overall for 1990–91 to 2008–09 (black points). Also shown (grey points) are earlier estimates of bycatch in each category (excluding QMS) calculated for 1990–91 to 2004–05 (Anderson *et al.* 2001, Anderson 2009). Error bars show the 95% confidence intervals. The black line in the bottom panel shows the total annual estimated landings of orange roughy (O. Anderson and M. Dunn (NIWA), unpublished data). (From Figure 6.13, MPI, 2013).

Secondary (non-retained, non-QMS) species are those with little or no commercial value that are rarely the focus of fishing effort and are usually discarded. They account for only a small proportion of the total catch from the orange roughy target fisheries. The primary management approach for secondary species, including deepwater shark species, is to actively monitor catch levels through the National Deepwater Plan. If the annual catch or retention of bycatch species changes significantly, either up or down, then management intervention may be considered (MPI, 2010a). If catch levels are deemed to be impacting on the sustainability of a secondary species population then this species may be considered for possible introduction into the QMS, or other management measures may be implemented, such as catch limits, gear restrictions or closed fishing areas (MPI, 2010a).

The increasing number of species managed under quota within the QMS demonstrates that substantial catches of non-QMS species tends to lead to the establishment of their QMS status, and hence become subject to more formalised monitoring and a requirement for retaining them onboard vessels. Species can be added to the QMS under Section 17B of the Fisheries Act (the Act) and/or the species managed under Section 11 of the Act. Section 17B of the Act requires adding stocks or species to the QMS if the existing management does not ensure sustainability or does not provide for utilization. Under the Act, 'ensuring sustainability' means:

'Maintaining the potential of fisheries resources to meet the reasonably foreseeable needs of future generations and avoiding, remedying, or mitigating any adverse effects of fishing on the aquatic environment.'

while 'utilisation' means:

'Conserving, using, enhancing, and developing a fisheries resource to enable people to provide for their social, economic, and cultural wellbeing'.

A QMS Introduction Process Standard (Mfish, 2008) provides a framework formalising the procedure for moving non-QMS species within the QMS framework, and monitoring 'minor' QMS species status and trends. The management system introduced two species into the QMS in 2010: Patagonian toothfish (MFish, 2010a) and attached bladder kelp (Mfish, 2010b). The latter was added to the QMS *inter alia* because MFish concluded that there was increasing demand for the species. A QMS Introduction Process Standard provides a framework formalising the procedure for moving non-QMS species within the QMS framework, and monitoring lower tier QMS species status and trends.

MPI's medium term research plan for deepwater fisheries (MTRP) is intended to reflect research needs to inform management of New Zealand's deepwater fisheries (MPI 2021). The research MTRP addresses surveys, stock assessments and monitoring, management information, and the aquatic environment.

Shark management

Management of shark species in New Zealand is driven by the National Plan of Action for Sharks (NPOA-Sharks) 2013 (https://www.mpi.govt.nz/fishing-aquaculture/sustainable-fisheries/protecting-marine-life/shark-conservation-and-management/). Orange roughy fishing is also known to interact with several species of sharks, many reported using genetic codes for 'other sharks and dogfish' and 'deepwater dogfish'. It is considered that these species may have life history characteristics that make them vulnerable to overfishing.

As part of the implementation of the NPOA-Sharks 2013, an expert-based assessment (Ford et al. 2018) provides a formal qualitative analysis for shark vulnerability to prioritize actions for species estimated to be at higher risk from fishing activities. Any additional catches of deepwater sharks will be taken into account through the risk assessment process. Fishery managers are working with observers and the industry to increase species-specific reporting of these shark catches to better inform their management in conjunction with the risk assessment framework.

The management of individual shark species depends on the scale of catch, and such other factors as how vulnerable they are to fishing (https://www.mpi.govt.nz/dmsdocument/3642-Conservation-and-management-of-New-Zealand-sharks). MPI has set four categories: QMS; non-QMS; Protected; and CITES-listed but not otherwise protected. QMS species consist of:

- Blue shark (*Prionace glauca*)
- Elephant fish *(Callorhinchus milii)*
- Dark ghost shark (*Hydrolagus novaezelandiae*)
- Mako shark (*Isurus* spp)
- Pale ghost shark (*Hydrolagus bemisi*)
- Porbeagle shark (*Lamna nasus*)
- Rig (*Mustelus lenticulatus*)
- School shark (Galeorhinus galeus)
- Spiny dogfish (*Squalus acanthias*)

All QMS sharks must be retained like any other QMS species, unless they are listed on Schedule 6 of the Fisheries Act 1996. Spiny dogfish must have fins naturally attached, blue shark may have fins

removed, but reattached before landing, and remaining shark fin retention calculated by the ratio method. Non-QMS species consist of all other shark species.

MPI will continue to monitor interactions with sharks in orange roughy fisheries and considers that the risk assessment and additional management actions under the NPOA-Sharks 2013 will mitigate any risks posed by increased orange roughy fishing effort.

Shark finning. The Fisheries (Commercial Fishing) Regulations 2001 prohibit shark finning and require that any shark fins landed must be naturally attached to the remainder of the shark, or artificially in the case of blue shark (MPI 2014 shark). However, an exception to the fins attached requirement is provided for seven QMS species to allow at-sea processing to continue. Since 1 October 2014 for species processed at sea, fishermen must store and land the fins separately by species. Fins must be landed wet to assure that fishermen are not retaining any more shark fins than the trunks they come from.

The ban requires all shark fins to be landed attached to the body of the shark for all non-Quota Management System (QMS) species and two QMS species (spiny dogfish and blue shark). In most cases, limited processing is allowed (e.g. removal of the head) but the fins still need to be attached to the body through some portion of uncut skin.

For seven QMS species (elephantfish, ghost shark, mako shark, pale ghost shark, porbeagle shark, rig, and school shark) fishers are able to land shark fins separately to the body of the shark but only in accordance with a gazetted fin to greenweight ratio. Francis (2014) reported research to develop the ratios of fins to body weight. The ratio means that the weight of fins for a species of shark landed for a trip will be compared to the greenweight (whole weight) of that species of shark landed for that trip. For example, if sharks are landed that weigh a total of 100 kgs and the gazetted ratio is 3.50, the fins of that species landed must not weigh more than 3.5 kgs. There is a legal requirement that fins are separately stored and landed by species.

Approach	Species
Ratio	Elephantfish Ghost shark Mako shark Pale ghost shark Porbeagle shark Rig School shark
Fins artificially attached	Blue shark
Fins naturally attached	Spiny dogfish All non-QMS species

Fishers may return some QMS sharks, dead or alive to the sea. All are reported and counted against the total allowable catch for the species and against a fisher's annual catch entitlement. This assures receiving good data on shark mortalities.

7.3.2.1 Fishery-specific primary and secondary

QMS stocks are considered as "primary species" when they have reference point management, and "secondary species" for QMS species without reference point management and for non-QMS species. The assessment team considered main species as those that make up ≥5% of the total catch in a UoA, except for vulnerable species that reach or exceed 2% of the total catch; in an effort to accommodate stakeholder requests during the original assessment (MRAG Americas 2016), the assessment team made an additional exception for shark species, which are considered main at ≥1% of the total catch). Species less abundant than main species but ≥0.5% of the catch are considered as

minor species. Species less than 0.5% are considered *di minimis* and not considered further, because the catch amounts to a few tens of tons.. Species < 0.05% of the total catch are not presented.

Catch composition by weight for each of the three UoAs was determined based on observer sampling data sourced from FNZ for the three-year period 2017-18 to 2019-20. The observer catches are scaled up to estimated total catch by dividing by the observer coverage rate.

7.3.2.2 ORH3B Northwest Chatham Rise

Targeted orange roughy trawl tows in the NWCR account for 54.2% of the total estimated catch by weight (Table 29). The elasmobranch with the highest catch is the seal shark at 0.81%, while the most abundant chimaerid is the longnosed chimaera (*Harriotta raleighana*, Rhinochimaeridae) at 1.00% of the catch. Several species of starfish together comprise 1.26% of the catch. Non-living material brought up in the nets consist of small quantities of rocks and wood.

Table 29. NWCR UoA composition of QMS and non-QMS catch based on observer data, 2017-18 to 2019-20 (R. Tinkler, FNZ pers. comm.). Only catches ≥0.05% of the total are provided. Shading represents Main or P1, Minor, not minor but more than 0.05%.

Observer coverage %	28%			28%			36%				
	2017-18			2018-19			2019-20			3-yr Average	
QMS species	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Orange roughy	165,118	589,707	56.0%	66,075	235,982	45.3%	124,659	346,275	59.0%	390,655	54.2%
Hoki	13,354	47,693	4.5%	5,334	19,050	3.7%	1,096	3,044	0.5%	23,262	3.2%
Smooth oreo	7,983	28,511	2.7%	4,871	17,396	3.3%	18,571	51,586	8.8%	32,498	4.5%
Hake	1,915	6,839	0.6%	718	2,564	0.5%	173	481	0.1%	3,295	0.5%
Pale ghost shark	1,697	6,061	0.6%	337	1,204	0.2%	84	233	0.0%	2,499	0.3%
Ribaldo	627	2,239	0.2%	65	232	0.0%	17	47	0.0%	840	0.1%
Ling	555	1,982	0.2%	15	54	0.0%		-	0.0%	679	0.1%
Black oreo	342	1,221	0.1%	6	21	0.0%	31	86	0.0%	443	0.1%
Smooth skate	225	804	0.1%	140	500	0.1%	18	50	0.0%	451	0.1%
Spiky oreo	150	536	0.1%	13	46	0.0%	802	2,228	0.4%	937	0.1%
Ghost shark	11	39	0.0%		-	0.0%	435	1,208	0.2%	416	0.1%
Swgment Total	**191,977**	**685,632**	**65%**	**77,574**	**277,050**	**53%**	**145,886**	**405,239**	**69%**	455,974	
Elasmobranchs Non-QMS	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Long-nosed chimaera	3018	10,779	1.0%	2504	8,943	1.7%	996	2,767	0.5%	7,496	1.0%
Smooth skin dogfish	2683	9,582	0.9%		-	0.0%	32	89	0.0%	3,224	0.4%
Deepwater dogfish	2525	9,018	0.9%	1712	6,114	1.2%	225	625	0.1%	5,252	0.7%
Widenosed chimaera	2303	8,225	0.8%	89	318	0.1%	815	2,264	0.4%	3,602	0.5%
Shovelnose spiny dogfish	1832	6,543	0.6%	1088	3,886	0.7%	1493	4,147	0.7%	4,859	0.7%
Baxters lantern dogfish	1578	5,636	0.5%	2	7	0.0%	830	2,306	0.4%	2,649	0.4%
Longnose velvet dogfish	1481	5,289	0.5%	307	1,096	0.2%	500	1,389	0.2%	2,592	0.4%
Plunket's shark	1386	4,950	0.5%	40	143	0.0%	76	211	0.0%	1,768	0.2%
Seal shark	1284	4,586	0.4%	1648	5,886	1.1%	2360	6,556	1.1%	5,676	0.8%
Spiny dogfish	957	3,418	0.3%		-	0.0%		-	0.0%	1,139	0.2%
Giant chimaera	446	1,593	0.2%	5	18	0.0%	74	206	0.0%	605	0.1%
Leafscale gulper shark	228	814	0.1%	10	36	0.0%	142	394	0.1%	415	0.1%
Longnosed deepsea skate	197	704	0.1%	15	54	0.0%	601	1,669	0.3%	809	0.1%
Chimaera, brown	70	250	0.0%	40	143	0.0%	1123	3,119	0.5%	1,171	0.2%
Lucifer dogfish	16	57	0.0%		-	0.0%	567	1,575	0.3%	544	0.1%
Segment Total	**20004**	**71,443**	**6.8%**	**7460**	**26,643**	**5.1%**	**9834**	**27,317**	**4.7%**	41,801	
Finfish Non-QMS	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Rattails	38576	137,771	13.1%	40924	146,157	28.0%	11244	31,233	5.3%	105,054	14.6%
Johnson's cod	12614	45,050	4.3%	8089	28,889	5.5%	17389	48,303	8.2%	40,747	5.7%
Slickhead	7782	27,793	2.6%	5383	19,225	3.7%	3722	10,339	1.8%	19,119	2.7%
Smallscaled brown slickhead	4190	14,964	1.4%		-	0.0%	1081	3,003	0.5%	5,989	0.8%
Morid cods	3304	11,800	1.1%	1062	3,793	0.7%	512	1,422	0.2%	5,672	0.8%
Basketwork eel	1396	4,986	0.5%	529	1,889	0.4%	1070	2,972	0.5%	3,282	0.5%
Javelin fish	1327	4,739	0.4%	1208	4,314	0.8%	7506	20,850	3.6%	9,968	1.4%
Pseudostichopus mollis	420	1,500	0.1%		-	0.0%		-	0.0%	500	0.1%
Psychrolutes	234	836	0.1%	2	7	0.0%	227	631	0.1%	491	0.1%
Black slickhead		-	0.0%		-	0.0%	505	1,403	0.2%	468	0.1%
Segment Total	**69843**	**249,439**	**23.7%**	**57197**	**204,275**	**39.2%**	**43256**	**120,156**	**20.5%**	191,290	
Other Non-QMS	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Warty squid	3500	12,500	1.2%	734	2,621	0.5%	1788	4,967	0.8%	6,696	0.9%
Asteroid (starfish)	535	1,911	0.18%		-	0.00%		-	0.00%	637	0.1%
Brisingida (Order)	1144	4,086	0.39%		-	0.00%		-	0.00%	1,362	0.2%
Starfish	35	125	0.01%	730	2,607	0.50%	7440	20,667	3.52%	7,800	1.1%
Rocks stones	4848	17,314	1.6%	1720	6,143	1.2%	2163	6,008	1.0%	9,822	1.4%
Wood	438	1,564	0.1%	10	36	0.0%		-	0.0%	533	0.1%
Segment Total	**5286**	**18,879**	**1.8%**	**1730**	**6,179**	**1.2%**	**2163**	**6,008**	**1.0%**	26,850	
Segment Totals	**287,110**	**1,025,393**	**0.97**	**143,961**	**514,146**	**0.99**	**201,139**	**558,719**	**0.95**	**715,914**	
Grand Total	**294,984**	**1,053,514**		**145,980**	**521,357**		**211,413**	**587,258**		**720,709**	

Primary species

The most abundant QMS bycatch species are smooth oreo (4.5%), hoki (3.2%), and hake (0.5%). All have reference point management making them primary species. Both hoki and hake (*Merluccius australis)* are MSC certified as being managed within biologically sustainable limits. No other species reached 0.5%, so are not further considered. Smooth oreo, hoki, and hake are minor species as they do not the 5% of total catch threshold.

Smooth Oreo. The OEO4 management area for smooth oreo (reporting code SSO) overlaps the NWCR and ESCR UoAs. A 2019 stock assessment of SSO in OEO4 estimated B_{2018} at 40%B_0 for the base model (FNZ 2021). B_{2018} is 'About as Likely as Not (40-60%)' to be at or above the target of 40%B_0. Stock projections indicate there would be little change in biomass over the next five years at annual catches of 2,300 – 3,000 t (Cordue, 2019). The catch limit for SSO in OEO4 is currently 2,600 t (DWG, 2021). Smooth oreo was assessed in 2018 using a CASAL age-structured population model with Bayesian estimation, incorporating stochastic recruitment, life history parameters, and catch history up to 2017–18 (FNZ 2021). In 2012, the Deepwater Working Group decided that using CPUE to index abundance should be discontinued, due to changes in fishing patterns over time within the stock area. With no CPUE indices, the 2012 assessment was simplified to a single area model using only the observations of vulnerable biomass from acoustic surveys carried out in 1998, 2001, 2005, and 2009. The biomass in OEO4 had declined since the 1980s (Figure 17), and for the 2015-15 fishing year, the catch was reduced by about half, from ~6000 t per year to ~2000-3000 t per year subsequently.

For the base model, and all of the sensitivities, *B0 in OEO4* was estimated at about 140 000 t with 95% CIs ranging from about 110 000 t to 210 000 t (Table 30). Current stock status is estimated to be at the target level of 40% for the base case. However, it is estimated to be just above 30% *B0* for the LowM-Highq and Fixed M runs (Table 30). For all of the runs the estimated probability of current stock status being below the soft limit of 20% *B0* is less than 5%. The probability of current stock status being below the hard limit of 10% *B0* was estimated at 0 for all runs (Table 30).

Table 30. Bayesian estimates of M, *B0*, and current stock status (*B18/B0*) for the smooth oreo base model and sensitivities (the median and 95% CIs are given). The probability of current stock status being below 10% or 20% *B0* is also given.

	M (yr^{-1})	B_0 (000 t)	ss_{18} (%B_0)	P(ss_{18} < 10%)	P(ss_{18} < 20%)
Base	0.079 (0.057–0.01)	138 (111–184)	40 ((23–59)	0.00	0.01
LowM-Highq	0.0632	138 (118–173)	31 (19–46)	0.00	0.04
HighM-Lowq	0.0948	146 (111–208)	50 (33–67)	0.00	0.00
Incl. LFs	0.085 (0.067–0.011)	133 (111–172)	42 (26–60)	0.00	0.00
Fixed M	0.063	143 (121–184)	33 (21–50)	0.00	0.02

The spawning biomass trajectory for the base model shows a decreasing trend from the start of the fishery in the 1980s with a flattening off in 2015–16 when catches were substantially reduced (Figure 17). Current stock status is estimated to be at the target biomass although the 95% CIs are very wide (Figure 17, Table 30).

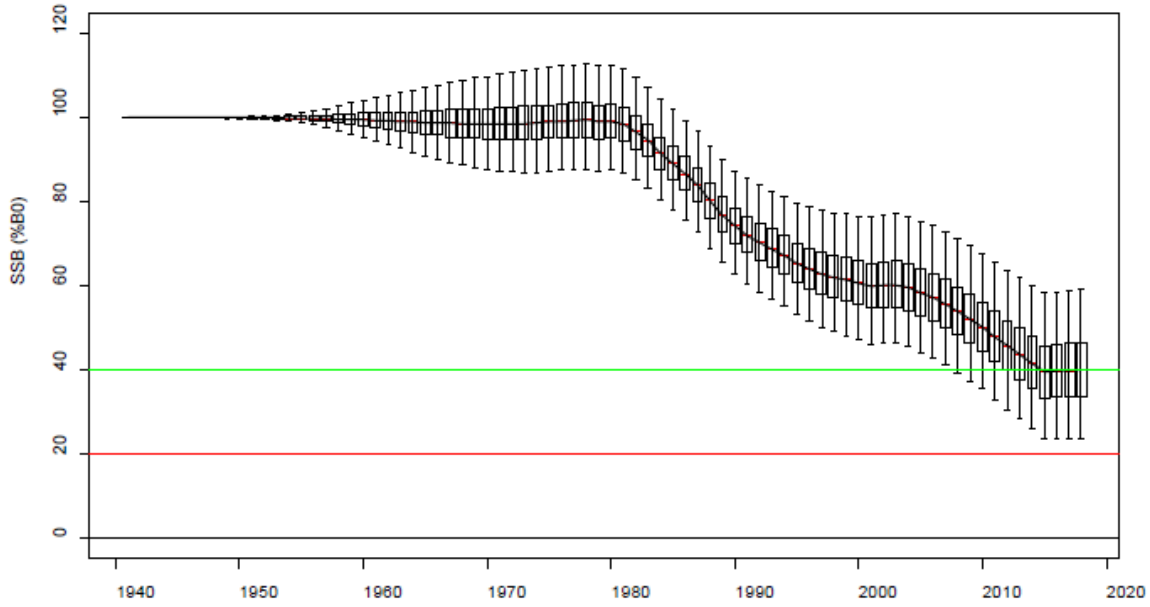


Figure 17. Base, MCMC estimated smooth oreo spawning-stock biomass trajectory. The box in each year covers 50% of the distribution and the whiskers extend to 95% of the distribution. The soft limit (red) and target biomass (green) are marked by horizontal lines.

Hoki. Stock assessments for hoki are undertaken annually, using research time series of abundance indices (trawl and acoustic surveys), proportions at age data from the commercial fisheries and trawl surveys, and estimates of biological parameters. For the 2020–21 stock assessment, the fisheries were redefined into units within which the exploitation patterns were more consistent (FNZ 2021). The main regions (WCSI, Chatham Rise, Sub-Antarctic, and Cook Strait) were split into fisheries, with estimation of length and age frequencies produced for each fishery. The Chatham Rise region was structured using depth, with effort depth greater than or equal to 475 m defined as CR_deep, and shallower than 475 m as CR_shallow, because larger fish are predominantly found in deeper water. Hoki, hake, ling, silver warehou, and white warehou are frequently caught together, and trawl fisheries targeting these species are, as of 2018, considered one combined trawl fishery. The most recent stock assessment was completed in 2021, and replaces the 2019 assessment; there was no assessment completed in 2020. The 2021 assessment differs from 2019 substantially, in having different assumptions for natural mortality, maturation, and migrations, and spatially restructured fisheries dependent data with revised selectivity assumptions.

The general-purpose stock assessment program, CASAL, was used, and the assessment approach, which used Bayesian estimation, was similar to that in the 2013 assessment. The model partitioned the population into two sexes, 17 age groups (1 to 16 and a plus group, 17+), two stocks [east (E) and west (W)], and four areas [Chatham Rise (CR), West Coast South Island (WC), Sub-Antarctic (SA), and Cook Strait (CS)]. It is assumed that the adult fish of the two stocks do not mix: those from the Western stock spawn off the WC and spend the rest of the year in SA; the Eastern stock fish move between their spawning ground, CS, and their home ground, CR. Deterministic *BMSY* estimates are no longer calculated. Instead, the target range of 35% *B0* to 50% *B0* is used as a proxy for the likely range of credible *BMSY* estimates. Current eastern biomass estimates were 48% *B0* for the base model, and 49% for an alternate model. The current total biomass was estimated to be 40% *B0* for the base model and 38% *B0* for alternate models. Exploitation rates for the eastern stock (Figure 18) consistently fall in or the below the target fishing intensities that would cause the spawning biomass to tend to 35% *B0* and 50% *B0*, respectively. Five-year projections were carried out for the base and alternate model runs by randomly selecting future recruitments based on three scenarios: (i) recruitments estimated for 2008–2017 (recent recruitment), (ii) recruitments estimated for 1975–2019 (long-term recruitment), and (iii) recruitments estimated for 1995–2001 (low recruitment). Total future annual catches were assumed to be constant at 95 000 t (45 000 t western stock; 50 000 t eastern stock), based on ACE (annual catch entitlement) in 2021. The projections indicated that the eastern biomass would remain fairly constant over the next 5 years and towards the top of the target range

providing recruitment was not low. For the eastern stock, the estimated probability of being less than the soft or the hard limit at the end of the five-year projection period was less than 10%.

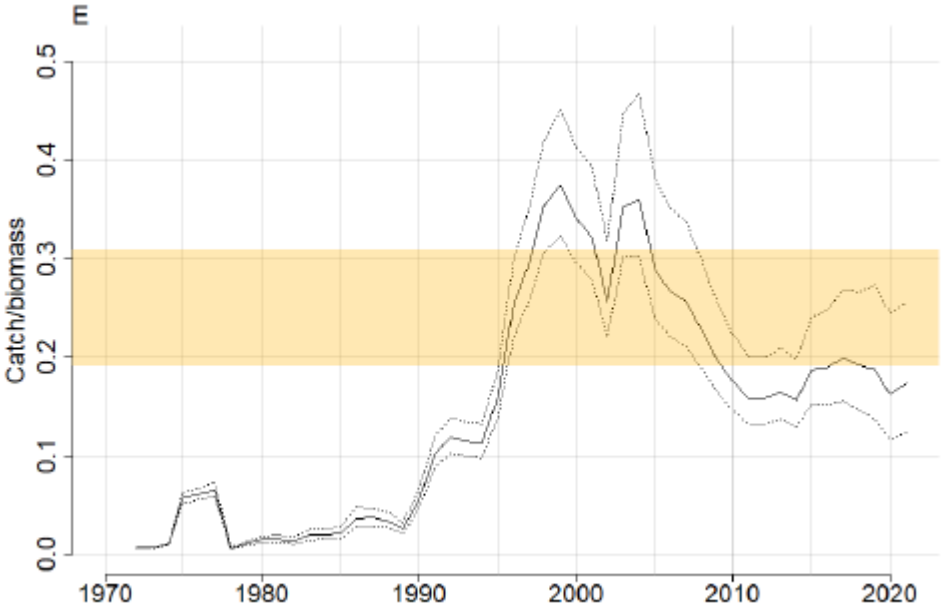


Figure 18. Fishing intensities, *U* (from MCMCs) for the base model and eastern stock of hoki. Shown are medians (solid black line) with 95% confidence intervals (dotted lines). Also shown shaded in orange is the management range where the upper bound is the reference level *U35%Bo* and the lower bound *U50%Bo* which are the fishing intensities that would cause the spawning biomass to tend to 35% *B0* and 50% *B0*, respectively.

Hake. Hake is not considered to be main primary species in any of the UoA but is a minor species in ORH 3B NWCR and ESCR. B_{2020} for hake in this area was estimated to be about 55%% B_0 (Table 8), and Likely (> 99%) to be at or above the target (FNZ 2021). B_{2020} is Exceptionally Unlikely (< 1%) to be below the Soft or Hard Limits.

Table 31. Bayesian median and 95% credible intervals of *B0*, *B2020* and *B2020* for hake as a percentage of *B0* for the Chatham Rise model runs.

Model run	B_0	B_{2020}	B_{2020} (%B_0)	P(B_{2020} > 0.4 B_0)
Base case	32 838 (28 280–42 721)	18 150 (13 204–27 258)	55.1 (45.7–65.9)	0.99
Double normal	32 859 (27 998–43 444)	18 237 (13 175–27 659)	55.4 (45.4–66.8)	0.996
CPUE	34 367 (29 504–44 113)	20 035 (15 096–28 979)	58.0 (49.6–68.1)	1.0

Secondary Species

For ORH3B NWCR, a suite of non-QMS species, none of which have reference point management, make up ≥2% of the total catch: rattail (13.91%), Johnson's cod (*Halargyreus johnsonii*) (5.84%), and slickhead (2.59%) (Table 29). No sharks reached the 1% threshold for main species set for shark species. No other species reached the main status.

Elasmobranchs Blackwell (2010) concluded that commercial catch records do not reflect abundance of deepwater sharks. Trawl survey data and observer data are generally of better quality. Observer data are essentially limited to areas where deepwater fisheries operate. Trawl surveys cover areas outside of the fishing grounds and also collect length and maturity stage data for deepwater sharks and other non-QMS species (Stevens *et al.,* 2018). In spite of the low-medium productivity of deepwater sharks (e.g., PSA Productivity score = 2.57 for Baxter's dogfish), Blackwell (2010) reviewed trawl survey data to conclude that deepwater sharks appear to be relatively resilient to the levels of fishing effort associated with the target hoki and orange roughy fisheries on the Chatham Rise.

Blackwell (2010) reviewed research trawl survey estimates for core hoki depths (600-800 m) and deeper waters (750-1,500 m) on the Chatham Rise. Over the course of the 1990s to 2006, Baxter's lantern dogfish ranged in annual estimated abundance from 6,000 to 12,000 t, consisting of 800-2,000 t in the core hoki depth, 200-700 t on the Northwest Chatham Rise, 200-700 t on the Northeast Chatham Rise, and 5,000-10,000 t on the South Chatham rise. Stevens *et al.* (2014, 2015) reported similar amounts in the hoki core depth and the deep zone, excluding the South Chatham Rise. Stevens *et al.* (2018) present figures of trawl estimates of abundance for several deepwater dogfish, including Baxter's dogfish, that show no temporal pattern (Figure 19). Stevens *et al.* (2018) further demonstrate that the length frequency of these dogfish extends up to lengths expected for the adult sizes. For example, Baxter's dogfish reach lengths at and beyond 75 cm, the theoretical expected maximum length for the species. This demonstrates that the adult component has not been fished down. The lower lengths observed, to 20 cm, demonstrate that recruiting year classes are entering the stock. Relative abundance of rattails, Johnson's cod, and slickheads as observed in the trawl surveys also showed no temporal patterns (Figure 20, Figure 21, Figure 22).

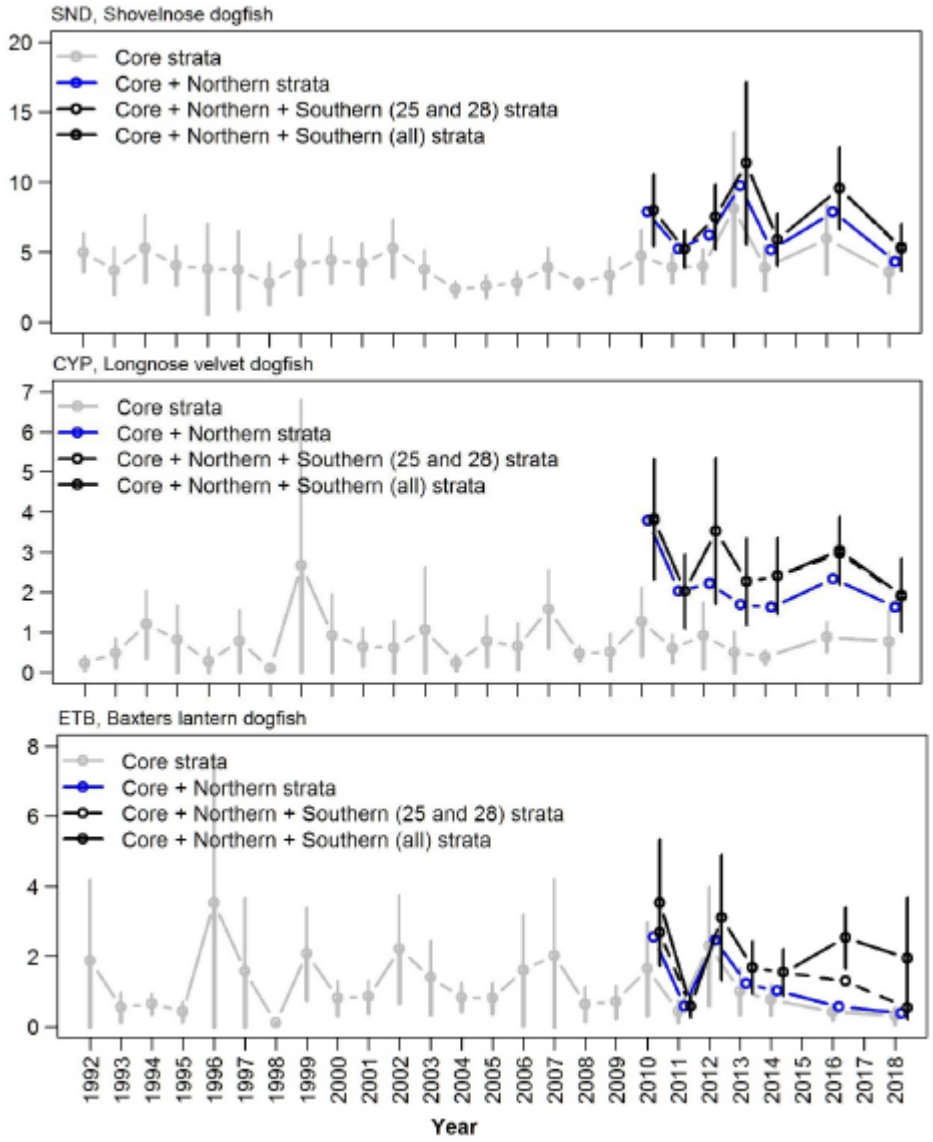


Figure 19 Relative biomass estimates (thousands of tonnes) of selected deepwater dogfish sampled by annual trawl surveys of the Chatham Rise, January 1992–2018. Black lines show fish from core (200–800 m) strata. Blue lines show fish from core strata plus the northern deep (800–1,300 m) strata. Error bars show ± 2 standard errors (Stevens *et al.*, 2018).

Non-QMS finfish. Of the non-QMS finfish bycatch species, the rattail species complex (family Macrouridae), makes up 14.6% of the catch (Table 29, Figure 23). Over 30 species of macrourid rattails are known to occur in the north Chatham Rise area (Roberts et al., 2015, Vol. 3), while a recent acoustic biomass survey in NWCR recorded nine rattail species taken during target identification tows on orange roughy spawning aggregations (Ryan & Tilney, 2017, Table 20). Rattail bycatch in all orange roughy fisheries in the EEZ has been variable over the 10-year period 2007-08 to 2016-17 (Figure 24). Johnson's cod (family Moridae), of which two species occur on the Chatham Rise, make up 5.7% of the catch (Table 29, Figure 23). Johnson's cod bycatch showed a moderate increase over the most recent two years for which data are available (Figure 24), (Finucci et al., 2019).

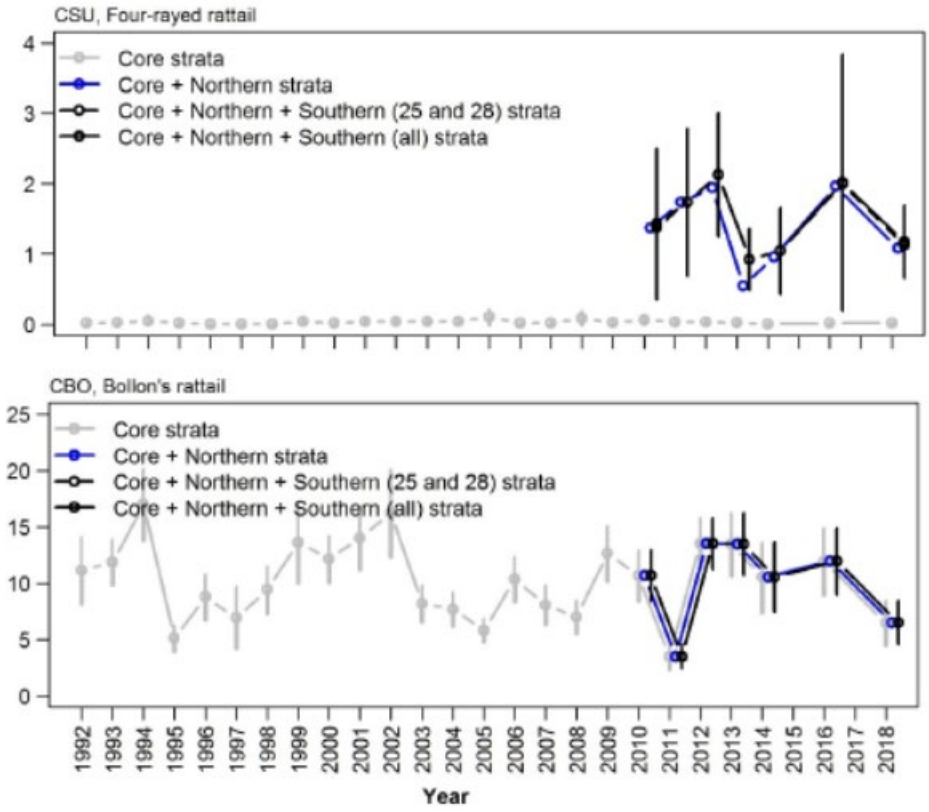


Figure 20. Relative biomass estimates (thousands of tonnes) of selected rattail sampled by annual trawl surveys of the Chatham Rise, January 1992–2018. Black lines show fish from core (200–800 m) strata. Blue lines show fish from core strata plus the northern deep (800–1,300 m) strata. Error bars show ± 2 standard errors (Stevens *et al.*, 2018).

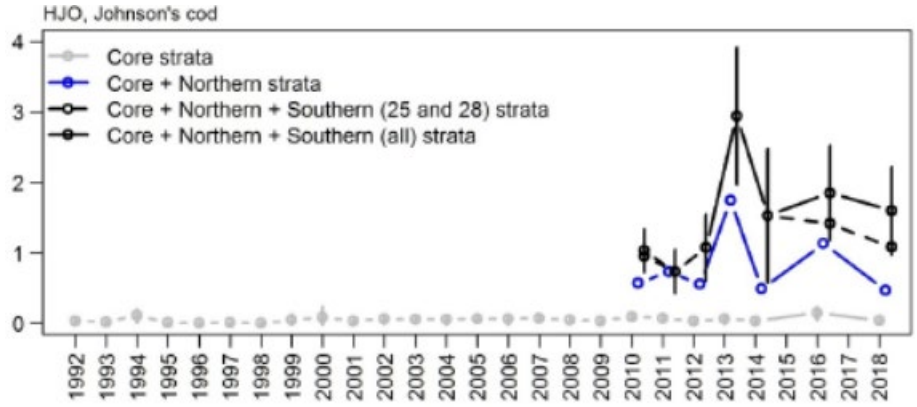


Figure 21. Relative biomass estimates (thousands of tonnes) of Johnson's cod sampled by annual trawl surveys of the Chatham Rise, January 1992–2018. Black lines show fish from core (200–800 m) strata. Blue lines show fish from core strata plus the northern deep (800–1,300 m) strata. Error bars show ± 2 standard errors (Stevens *et al.*, 2018).

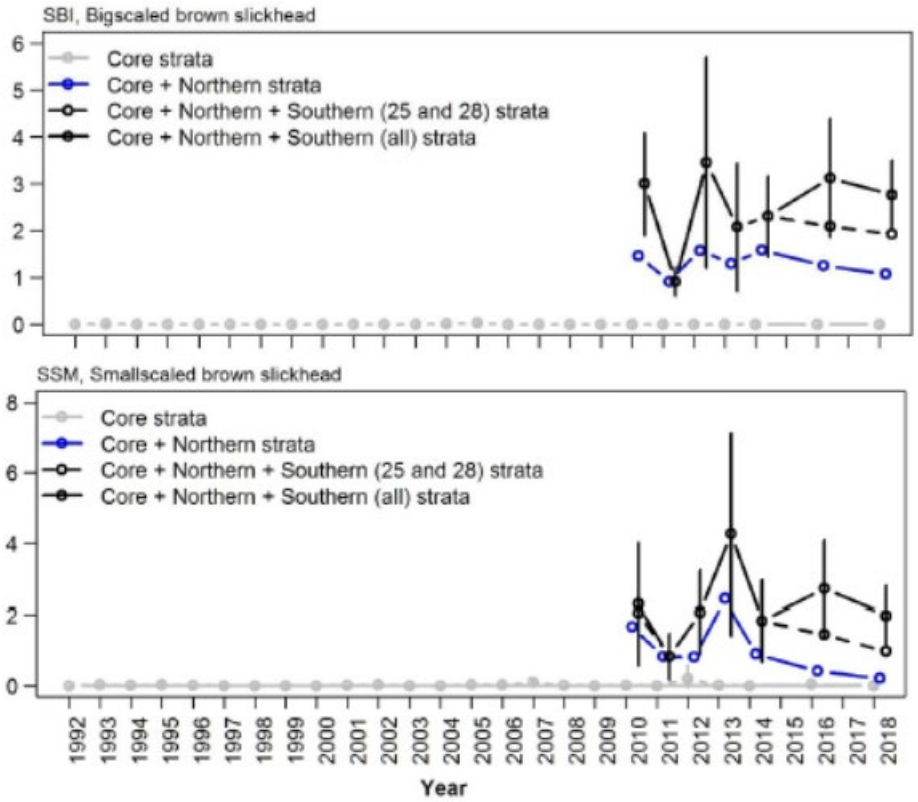


Figure 22. Relative biomass estimates (thousands of tonnes) of selected slickheads sampled by annual trawl surveys of the Chatham Rise, January 1992–2018. Black lines show fish from core (200–800 m) strata. Blue lines show fish from core strata plus the northern deep (800–1,300 m) strata. Error bars show ± 2 standard errors (Stevens *et al.*, 2018).

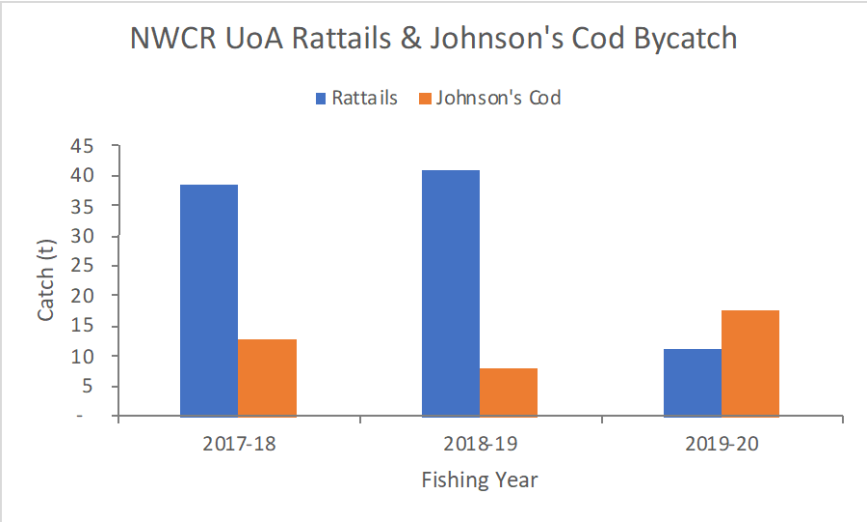


Figure 23. Bycatch of rattails and Johnson's cod in the NWCR UoA 2017-18 to 2019-20.

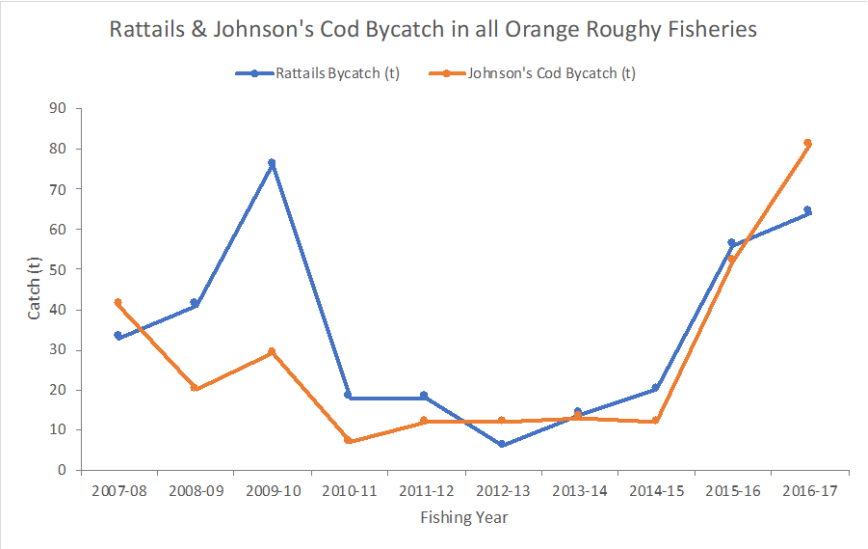


Figure 24. Bycatch of rattails and Johnson's cod in all New Zealand orange roughy fisheries 2007-08 to 2016-17.

7.3.2.3 ORH3B East and South Chatham Rise

Orange roughy in targeted orange roughy trawl tows account for 93.5% of the total estimated catch by weight (Table 32). The next-most abundant QMS species is smooth oreo at 2.3% of the catch. No other QMS species make up over 0.5% of the catch. The most abundant non-QMS finfish species, Johnson's cod, makes up 0.3% of the catch (Table 32). No other single species exceeds 0.5% of the overall catch. Unidentified deepwater sharks make up the largest elasmobranch catch, but none exceed 0.5%. Warty squid, at 0.4% of the catch, is the most abundant invertebrate species. Non-living material brought up in the nets includes small quantities of rocks and stones and miscellaneous rubbish and fishing textiles.

Table 32. ESCR UoA composition of QMS and non-QMS catch based on observer data, 2017-18 to 2019-20 (R. Tinkler, FNZ pers. comm.). Only catches ≥0.05% of the total are provided. Shading represents Main or P1, Minor, not minor but more than 0.05%.

Observer coverage %	3%			28%			30%				
	2017-18			2018-19			2019-20			3-yr average	
QMS species	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Orange roughy	468,397	15,613,233	97.9%	2,076,191	7,414,968	89.9%	1,509,374	5,031,247	86.2%	9,353,149	93.5%
Smooth oreo	102	3,400	0.0%	120,539	430,496	5.2%	74,364	247,880	4.2%	227,259	2.3%
Black oreo	46	1,533	0.0%	14,899	53,211	0.6%	10,070	33,567	0.6%	29,437	0.3%
Ribaldo	1,283	42,767	0.3%	13,509	48,246	0.6%	3,468	11,560	0.2%	34,191	0.3%
Hoki	712	23,733	0.1%	12,722	45,436	0.6%	9,415	31,383	0.5%	33,517	0.3%
Spiky oreo	508	16,933	0.1%	6,946	24,807	0.3%	3,308	11,027	0.2%	17,589	0.2%
Alfonsino	2,916	97,200	0.6%	62	221	0.0%		-	0.0%	32,474	0.3%
Segment total	473,964	15,798,800		2,244,868	8,017,386		1,609,999	5,366,663	92.0%	9,727,616	97.2%
Elasmobranchs Non-QMS	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Other sharks and dogs		-	0.0%	7,028	25,100	0.3%	7,019	23,397	0.4%	16,166	0.2%
Shovelnose spiny dogfish	815	27,167	0.2%	5,371	19,182	0.2%	6,451	21,503	0.4%	22,617	0.2%
Deepwater dogfish	1,301	43,367	0.3%	5,105	18,232	0.2%	2,470	8,233	0.1%	23,277	0.2%
Seal shark		-	0.0%	4,286	15,585	0.1%	1,860	6,200	0.1%	7,262	0.1%
Baxters lantern dogfish		-	0.0%	3,215	11,691	0.1%	2,921	9,737	0.2%	7,143	0.1%
Segment total	2,116	70,533		25,005	89,791		20,721	69,070		76,465	
Finfish Non-QMS	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Johnson's cod		-	0.0%	6745	24,089	0.3%	20015	66,717	1.1%	30,269	0.3%
Morid cods	410	13,667	0.1%	4558	16,279	0.2%	15094	50,313	0.9%	26,753	0.3%
Smallscaled brown slickhead		-	0.0%	2375	8,482	0.1%	13743	45,810	0.8%	18,097	0.2%
Slickhead	23	767	0.0%	6127	21,882	0.3%	10185	33,950	0.6%	18,866	0.2%
Javelin fish	461	15,367	0.1%	1224	4,371	0.1%	6510	21,700	0.4%	13,813	0.1%
Basketwork eel	131	4,367	0.0%	1600	5,714	0.1%	5519	18,397	0.3%	9,493	0.1%
Rattails	311	10,367	0.1%	2946	10,521	0.1%	3198	10,660	0.2%	10,516	0.1%
Segment total	1336	44,533		25575	91,339		74264	247,547		127,806	
Other Non-QMS	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Warty squid	440	14,667	0.1%	1207	4,311	0.1%	27115	90,383	1.5%	36,454	0.4%
All Segment Totals	**477,416**	**15,913,867**	99.8%	**2,287,947**	**8,171,239**	99.1%	**1,700,203**	**5,667,343**	**97.108%**		
Grand Total Raised		**15,941,533**			**8,246,224**			**5,836,101**		**10,007,953**	

Primary species

QMS species with reference point management comprise the primary species. As none of the QMS species in the ESCR UoA reached 5% of the total catch or 2% of the catch for vulnerable species (Table 32), no main primary species occur in ESCR. Minor species include only smooth oreo. Other species occur at less than 0.5% so are not considered further. Stock assessments for smooth oreo presented for NWCR apply here.

Secondary species

As none of the non-QMS, elasmobranch/chimaerid, invertebrate, or inanimate species or materials reached 5% of the total catch or 2% of the catch for vulnerable species (Table 32), no main secondary species occur in ESCR. No non-QMS species reach 0.5% of total catch, so no minor species occur.

7.3.2.4 ORH 7A (including Westpac Bank)

Targeted orange roughy trawl tows account for 93.17% of the total estimated catch by weight (Table 33). The next-most abundant QMS species is spiky oreo (*Neocyttus rhomboidalis*) at 1.28% of the catch and ribaldo (*Moro moro*) at 0.81%.

The largest non-QMS finfish component is the rattail species complex which makes up 0.91% of the catch (Table 33). Unidentified deepwater sharks (0.40%) make up the largest elasmobranch catch, while the most abundant chimaerid is the longnosed chimaera at 0.28% of the catch.

Unidentified octopus species (*Octopus* spp), at 0.05% of the catch, are the most abundant of the invertebrates (Table 33). Non-living material brought up in the nets includes small quantities of rocks and stones and miscellaneous rubbish (Table 33).

Table 33. 7A/WB UoA composition of QMS and non-QMS catch based on observer data, 2017-18 to 2019-20 (R. Tinkler, FNZ pers. comm.). Only catches ≥0.05% of the total are provided. Shading represents Main or P1, Minor, not minor but more than 0.05%.

	2017-18			2018-19			2019-20			3-yr Average	
QMS species	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Orange roughy	1,009,145	1,802,045	91.9%	691,905	3,008,283	96.5%	584,015	1,668,614	91.6%	2,159,647	93.9%
Spiky oreo	17,401	31,073	1.6%	8,618	37,470	1.2%	5,285	15,100	0.8%	27,881	1.2%
Ribaldo	8,958	15,996	0.8%	4,346	18,896	0.6%	6,535	18,671	1.0%	17,855	0.8%
Hake	4,212	7,521	0.4%	811	3,526	0.1%	3,150	9,000	0.5%	6,683	0.3%
Pale ghost shark	2,326	4,154	0.2%	138	600	0.0%	692	1,977	0.1%	2,244	0.1%
Cardinalfish	2,242	4,004	0.2%	18	78	0.0%	57	163	0.0%	1,415	0.1%
Hoki	982	1,754	0.1%	556	2,417	0.1%	446	1,274	0.1%	1,815	0.1%
Segment Total	**1,045,266**	**1,866,546**	**95.2%**	**706,392**	**3,071,270**	**98.6%**	**600,180**	**1,714,800**	**94.1%**	**2,217,539**	**96.4%**
Elasmobr Non-QMS	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Other sharks and dogs	8,977	16,030	0.8%	385	1,674	0.1%	345	986	0.1%	6,230	0.3%
Long-nosed chimaera	5,387	9,620	0.5%	145	630	0.0%	1,311	3,746	0.2%	4,665	0.2%
Shovelnose spiny dogfish	2,694	4,811	0.2%	879	3,822	0.1%	4,575	13,071	0.7%	7,235	0.3%
Deepwater dogfish	2,555	4,563	0.2%	1,416	6,157	0.2%	2,032	5,806	0.3%	5,508	0.2%
Leafscale gulper shark	1,050	1,875	0.1%	304	1,322	0.0%	851	2,431	0.1%	1,876	0.1%
Smooth skin dogfish	973	1,738	0.1%	402	1,748	0.1%	565	1,614	0.1%	1,700	0.1%
Baxters lantern dogfish	683	1,220	0.1%	547	2,378	0.1%	1,026	2,931	0.2%	2,176	0.1%
Seal shark	548	979	0.0%	300	1,304	0.0%	2,186	6,246	0.3%	2,843	0.1%
Plunket's shark	283	505	0.0%	1,415	6,152	0.2%	211	603	0.0%	2,420	0.1%
Segment total Total	**23,150**	**41,339**	**2.1%**	**5,793**	**25,187**	**0.8%**	**13,102**	**37,434**	**2.1%**	34,654	1.5%
Finfish Non-QMS	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Rattails	14,581	26,038	1.3%	518	2,252	0.1%	7,198	20,566	1.1%	16,285	0.7%
Black slickhead	4,085	7,295	0.4%	246	1,070	0.0%	262	749	0.0%	3,038	0.1%
Smallscaled brown slickh	2,744	4,900	0.2%	84	365	0.0%	1,548	4,423	0.2%	3,229	0.1%
Johnson's cod	877	1,566	0.1%	435	1,891	0.1%	1,665	4,757	0.3%	2,738	0.1%
Morid cods	688	1,229	0.1%	403	1,752	0.1%	2,370	6,771	0.4%	3,251	0.1%
White rattail	400	714	0.0%	410	1,783	0.1%	2,781	7,946	0.4%	3,481	0.2%
Slickhead	227	405	0.0%	181	787	0.0%	1,655	4,729	0.3%	1,974	0.1%
Segment Total	**23,602**	**42,146**	**2.1%**	**2,277**	**9,900**	**0.3%**	**17,479**	**49,940**	**2.7%**	33,995	1.5%
Other Non-QMS	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Observed**	**Raised**	**%**	**Raised**	**%**
Octopus	11	20	0.0%	31	133	0.0%	1304	3,726	0.2%	1,293	0.1%
Anemones	15	27	0.0%	42	183	0.0%	339.4	970	0.1%	393	
Segment Total	**26**	**47**	**0.0%**	**73**	**316**	**0.0%**	**1,643**	**4,695**	**0.3%**	1,686	
All Segment Totals	**1,092,044**	**1,950,079**	**99.4%**	**714,535**	**3,106,673**	99.7%	**632,404**	**1,806,870**	99.2%		
Grand Total Raised		**1,961,234**			**3,115,957**			**1,821,690**		2,299,627	

Primary species

QMS species with reference point management comprise the primary species. As none of the QMS species reached 5% of the total catch or 2% of the catch for vulnerable species (Table 33), no main primary species occur in 7AWB. Minor species include spikey oreo and ribaldo. Other species occur at less than 0.5% of the total catch so are not considered further.

Secondary species

As none of the non-QMS, elasmobranch/chimaerid, invertebrate, or inanimate species or materials reached 5% of the total catch or 2% of the catch for vulnerable species (Table 33), no main secondary species occur in 7A WB. Rattails at 0.7% of the total catch, are the only species to exceed 0.5% and are the only minor species considered.

7.3.3 Endangered, Threatened, and Protected Species

The strategic framework for managing protected species interactions with deepwater fisheries in New Zealand currently includes:

- legislation: the Fisheries Act, Wildlife Act, and Marine Mammals Protection Act;
- the National Plan of Action – Sharks (MPI 2013);
- the National Plan of Action—Seabirds (MPI 2020);
- the Annual Operational Plan for Deepwater Fisheries (FNZ, 2020);
- the National Fisheries Plan for Deepwater and Middle-depth Fisheries: Part 1B, orange roughy chapter (Ministry of Fisheries 2010); and,
- the Marine Conservation Services Programme (e.g., Annual Plan, DOC 2020).

All fishing vessels are required by law to report all captures of Endangered, Threatened and Protected (ETP) species to the Ministry for Primary Industries on Non-Fish Protected Species forms (FNZ, 2019).

Information on incidental captures of ETP species, reported by vessels and by MPI observers, is summarised in the Aquatic Environment and Biodiversity Annual Review report (FNZ 2020c), and for ETP species other than corals on MPI's Protected Species website (MPI, 2021). The latter provides open access to multi-year records of ETP species captures by fishery sector and fishing method, based on MPI observer data, and is updated annually through FNZ's Science Working Group process.

In addition to MPI's scientific observer programme, a range of management measures, including some industry-led, non-regulatory initiatives, are employed to monitor environmental interactions in deep water fisheries and to reduce the risk of any adverse effects on protected species populations. Responsibilities relating to the mitigation and monitoring of ETP species are described in DWG's Operational Procedures (DWG, 2021) and Vessel Management Plans for mitigating seabird captures. Ministry Operational Plans additionally prescribe mitigation requirements for application in fisheries at high risk of capturing ETP species. For example, in the squid and southern blue whiting trawl fisheries these include a limit on the number of sea lion mortalities during the fishing season and a requirement for the use of sea lion excluder devices in (DWG, 2019a). The orange roughy trawl fisheries are deemed to be low-risk in relation to captures of ETP seabirds, marine mammals and sharks.

The Expert Panel for the Assessment of the Environmental Effects of Fishing (AEEF, Boyd, 2013) assessed the following species or species groups protected under the provisions of the New Zealand Wildlife Act 1953 (note: not all of these groups occur in the UoA):

1. Protected fishes
    a. Oceanic whitetip shark (*Carcharhinus longimanus*)
    b. Basking shark (*Cetorhinus maximus*)
    c. Deepwater nurse shark (*Odontaspis ferox*)
    d. White pointer shark (*Carcharodon carcharias*)
    e. Whale shark (*Rhincodon typus*)
    f. Manta ray (*Manta birostris*)
    g. Spinetail devil ray (*Mobula aponica*)
    h. Giant grouper (*Epinephelus lanceolatus*)
    i. Black grouper (*Epinephelus daemelii*)
2. Reptiles
3. All seabirds except black backed gull
4. All marine mammals
5. Corals:
    a. Black corals – all species in the order Antipatharia
    b. Gorgonian corals—all species in the order Gorgonacea
    c. Stony corals— all species in the order Scleractinia
    d. Hydrocorals.

A review of CITES Appendix 1 indicated that there are no relevant marine species not included in the current list of New Zealand protected marine species and there are no relevant listed species that are not protected under New Zealand legislation.

When impacts of fishing are such that they are causing an adverse effect on the Marine Environment (Fisheries Act s 2, s8), measures are to be taken pursuant to the Conservation Act 1987 and the Director-General of the Department of Conservation will implement measures, including:

- research relating to those effects on protected species;
- research on measures to mitigate the adverse effects of commercial fishing on protected species; and,
- the development of population management plans under the Wildlife Act 1953 and the Marine Mammals Protection Act 1978.

DWG Liaison Programme for ETP Species Risk Management

DWG employs an Environmental Liaison Officer (ELO) who visits factory vessels and fresh fish trawlers involved in all deepwater fisheries to:

- Deliver PowerPoint-assisted training courses to senior crew (and at times vessel managers) on the need for ETP species capture mitigation and on best practice mitigation methods
- Provide training material on best practice environmental operations and procedures and ensure updated versions of all OPs are on each vessel
- Check that VMP's are updated and appropriate for each vessel's fishing operations

- Physically check their seabird mitigation equipment is fit-for-purpose and functional and ensure officers and crew are aware of the need to maintain conformance with offal control and mitigation systems to reduce seabird interactions.
- Be on-call 24/7 for any communications or requests for support, including trigger capture events
- Compare fishery information with that from observers to ensure the best information is available regarding the nature of significant capture events.

The ELO additionally visits any vessel that has reported trigger-point captures to assess the possible reasons for the captures, whether they could have been prevented, and to educate the skipper on how to reduce the risk of such events re-occurring (Cleal, 2019, 2020). While all deepwater trawl vessels are visited each year, including orange roughy vessels, the orange roughy fleet is not singled out for any specific attention as it is not associated with a high level of ETP seabird or marine mammal interactions.

7.3.3.1 Protected fishes

Deepwater trawling for orange roughy and oreo typically exceeds the depth at which protected fish species are usually found (FNZ 2021). Fisheries-reported records include the capture of a basking shark (*Cetorhinus maximus*) in 2019, a species classified as "Endangered" by IUCN in 2013 and as "Threatened – Nationally Vulnerable" in 2016, under the New Zealand Threat Classification System (Duffy et al 2018). Basking shark has been a protected species in New Zealand since 2010, under the Wildlife Act 1953, and is also listed in Appendix II of the CITES convention. However, basking sharks have been occasionally confused with bluntnose sixgill shark (*Hexanchus griseus*), a "Not Threatened" species according to the DOC latest assessment (Duffy et al 2018), and this report is being verified. An observer reported capture includes the smalltooth sandtiger shark (deepwater nurse shark) *Odontaspis ferox* in 2012, classified as "Critically Endangered" by the IUCN Red List and "At Risk- Naturally Uncommon" under the New Zealand Threat Classification System.

The NPOA—sharks contains explicit long-term and short-term objectives for minimizing fisheries related mortality for these ETP species groups and include practical operational measures to support overarching policy objectives. The NPOA also has a built-in system for analysis of data collected through fishery dependent and independent sources on an ongoing basis, and regular review of this analysis designed to feedback to management for further action if necessary (NPOA-Sharks, 2013)

7.3.3.2 Seabirds and Marine Mammals

Orange roughy fishing vessels in the three orange roughy UoA catch relatively few seabirds or marine mammals (Plenary 2021). All orange roughy fishing vessels >28 m are required to comply with regulations that ban the use of net sonde cables and require the deployment of devices to keep birds away from the fishing gear (FNZ 2020). Industry standards, supported by MPI, require all orange roughy vessels to agree to a Vessel Management Plan that specifies the management of the disposal of fish waste to minimise it as an attractant to seabirds (DWG 2020).

Seabirds

The NPOA Seabirds 2020 (https://www.mpi.govt.nz/dmsdocument/3962/direct#:~:text=The%20National%20Plan%20of%20Action,of%20seabirds%20in%20our%20fisheries.&text=The%20NPOA%20Seabirds%202020%20is,a%20national%20plan%20of%20action) is New Zealand's third iteration of a national plan of action. NPOA Seabirds 2020 focuses on education, partnering to find innovative solutions to bycatch mitigation, and ensuring that all fishers know how and are taking all practicable steps to avoiding seabird bycatch.

Observed incidental seabird captures are used to model the estimated number of annual captures based on the total number of trawl tows undertaken. The estimated number of captures does not discriminate between birds killed and birds released alive. The proportion of birds released alive has increased in recent years as the main type of interaction has shifted from warp strikes (all fatal) to net captures (varying degrees of mortality but rarely less than 30% released alive. It is acknowledged that some birds released alive may not survive injuries sustained and, for modelling purposes, the Spatially Explicit Fisheries Risk Assessment (SEFRA) (Richard et al., 2017) assumes 50% of released alive birds will not survive. Net captures frequently involve birds foraging on top of the net when it's on the surface on hauling and getting their heads or feet tangled in the meshes. Practical solutions are being sought to resolve these net captures.

The orange roughy fisheries have a negligible impact on seabird populations, with only ten observed captures in the Chatham Rise UoAs and three observed captures in the ORH 7A UoA over the recent 5-year period. In 2018–19 the six observed seabird captures in the ORH 3B UoAs were four Chatham Island albatross (of which two were released alive), one white-chinned petrel, and one common diving petrel (released alive). In 2018–19 there were no observed captures of seabirds in the ORH 7A UoA and no estimates of total captures were made (Figure 25).

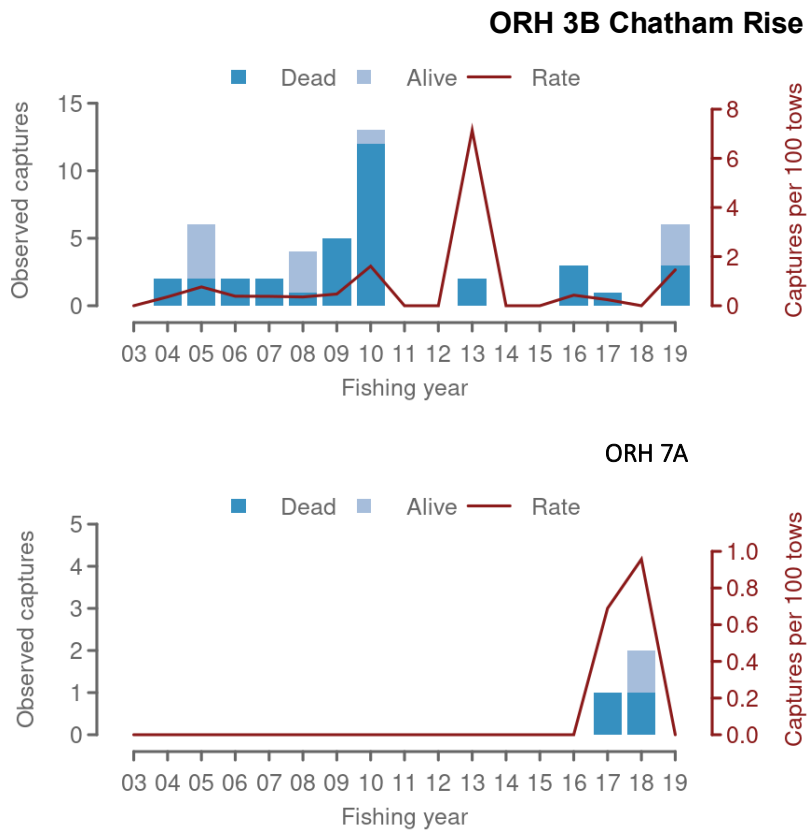


Figure 25. Observed seabird captures in the ORH 3B UoAs on the Chatham Rise (top) and in the ORH 7A UoA (bottom), (MPI, 2021).

Annual observed seabird capture rates in the orange roughy, oreo and cardinalfish trawl fisheries have ranged from 0 to 0.9 per 100 tows between 2002–03 and 2017–18 (Table 34) (FNZ 2021). The average observed capture rate in deepwater trawl fisheries (including orange roughy, oreo and cardinalfish) for the period from 2002–03 to 2017–18 is about 0.31 birds per 100 tows, a very low rate relative to other New Zealand trawl fisheries, e.g., for scampi (4.43 birds per 100 tows) and squid (13.79 birds per 100 tows) over the same years.

Table 34. Number of tows by fishing year and observed seabird captures in orange roughy, oreo, and cardinalfish trawl fisheries, 2002–03 to 2017–18. 2018-19 and 2019-20 data were unavailable at time of publication. No. obs, number of observed tows; % obs, percentage of tows observed; Rate, number of captures per 100 observed tows. Estimates are based on methods described in Abraham et al (2016) and Abraham & Richard (2017, 2018, 2020) and available via http://www.fish.govt.nz/en-nz/Environmental/Seabirds/. Observed and estimated protected species captures in this table derive from the PSC database version PSCV4.

	Fishing effort			Observed captures		Estimated captures	
	Tows	No. obs	% obs	Captures	Rate	Mean	95% c.i.
2002–03	8 870	1 382	15.6	0	0.0	34	20–52
2003–04	8 007	1 262	15.8	3	0.2	32	19–47
2004–05	8 427	1 619	19.2	7	0.4	43	28–62
2005–06	8 291	1 359	16.4	8	0.6	39	25–55
2006–07	7 379	2 324	31.5	1	0.0	20	10–31
2007–08	6 731	2 811	41.8	7	0.2	23	14–33
2008–09	6 133	2 372	38.7	7	0.3	23	15–34
2009–10	6 012	2 132	35.5	19	0.9	35	27–46
2010–11	4 177	1 205	28.8	1	0.1	16	8–26
2011–12	3 655	923	25.3	2	0.2	12	6–21
2012–13	3 099	346	11.2	2	0.6	14	7–23
2013–14	3 608	434	12.0	2	0.5	16	8–26
2014–15	3 818	978	25.6	0	0.0	14	6–23
2015–16	4 084	1 421	34.8	4	0.3	14	8–22
2016–17	3 967	1 226	30.9	2	0.2	13	6–21
2017–18	3 748	903	24.1	4	0.4	16	9–25

Salvin's albatross was the most frequently captured albatross (46% of observed albatross captures) but seven other albatross species have been observed captured since 2002–03 (FNZ 2021). Cape petrels were the most frequently captured other taxon (35% of other taxon observed caught not including albatross species). Seabird captures in the orange roughy, oreo, and cardinalfish fisheries have been observed mostly around the Chatham Rise and off the east coast South Island. These numbers should be regarded as only a general guide on the distribution of captures because the observer coverage is not uniform across areas and may not be representative. The deepwater trawl fisheries contribute to the total risk posed by New Zealand commercial fishing to seabirds. The two species to which the fishery poses the most risk are Chatham Island albatross and Salvin's albatross, with this suite of fisheries posing 0.06 and 0.022 respectively of Population Sustainability Threshold (PST). Chatham albatross and Salvin's albatross were assessed at high risk (Richard et al 2020).

Mitigation methods such as streamer (tori) lines, Brady bird bafflers, warp deflectors, and offal management are used in the orange roughy, oreo, and cardinalfish trawl fisheries (FNZ 2021). Warp mitigation was voluntarily introduced from about 2004 and made mandatory in April 2006 (Department of Internal Affairs 2006). The 2006 notice mandated that all trawlers over 28 m in length use a seabird scaring device while trawling (being "paired streamer lines", "bird baffler" or "warp deflector" as defined in the notice).

When compared with the total estimated numbers of fisheries-related mortalities of protected seabirds and mammals, the numbers in the three orange roughy UoAs are negligible (FNZ 2021).

The NPOA-Seabirds contains explicit long-term and short-term objectives for minimizing fisheries related mortality for these ETP species groups and include practical operational measures to support overarching policy objectives. The NPOA also has a built-in system for analysis of data collected through fishery dependent and independent sources on an ongoing basis, and regular review of this analysis designed to feedback to management for further action if necessary (NPOA-Seabirds, 2020). New Zealand's regulatory requirements for seabird mitigation, for application by all vessels 28 metres or greater in length, include:

- Deployment of at least one type of seabird scaring device during all tows (i.e. bird bafflers, tori lines or warp deflectors)
- Management of fish waste discharge so as not to attract seabirds to risk areas (i.e. no discharge during shooting/hauling; mincing and batch-discharge while towing; installation of mincers/hashers/batching tanks/meal plants; gratings/trap systems to reduce fish waste discharge through scuppers/sump pumps)

- Seabird risk associated with trawl nets is minimised by:
  - Removal of stickers before shooting
  - Minimising the time fishing gear remains at/near the surface
  - Seabirds caught alive in/on the net are correctly handled and released to ensure maximum chance of survival.
- Seabird risk associated with deck landings and vessel impacts is minimised by:
  - Ensuring deck lighting does not attract/disorientate seabirds
  - Prompt removal of fish waste from the deck
  - Seabirds that land on the deck or impact with the vessel are correctly handled and released to ensure maximum chance of survival (FNZ, 2020b).

Marine Mammals

Marine mammals of concern for the deepwater fisheries focus on New Zealand fur seals. Trawlers targeting orange roughy, oreo, and black cardinalfish occasionally catch New Zealand fur seal (which were classified as "Not Threatened" under the New Zealand Threat Classification System in 2010 (FNZ 2021). Between 2002–03 and 2007–08, there were 15 observed captures of New Zealand fur seal in deepwater (orange roughy, oreo, and black cardinalfish) trawl fisheries. There has been one observed capture in the period between 2008–09 and 2017–18, during which time the average level of annual observer coverage was 26.7%. Corresponding mean annual estimated captures in this period ranged 0–3 (mean 1.25) based on statistical capture models (Table 35). All observed fur seal captures occurred in the Sub-Antarctic region. Across the different target fisheries, the highest relative fur seal capture rates were in mackerel and southern blue whiting fisheries, with the lowest capture rate in trawl fisheries targeting deepwater species (Abraham et al 2021). FNZ (2019) reports no interactions with marine mammals in ORH 7A in the last ten years. FNZ (2021) further reports one observed fur seal capture between the 2013/14 and 2017/18 fishing years (average observer coverage was 27% over the five years).

Table 35. Annual fishing effort (tows), and observer coverage (%) in deepwater trawl fisheries; number of observed captures and observed capture rate (captures per hundred tows) of New Zealand fur seal; estimated captures and capture rate of New Zealand fur seal (mean and 95% credible interval). Abraham et al 2021.

Fishing year	Effort	Observed			Est. captures		Est. capture rate	
		% obs.	Cap.	Rate	Mean	95% c.i.	Mean	95% c.i.
2002–03	8 871	15.6	0	0.00	4	0–12	0.04	0.00–0.14
2003–04	8 005	15.8	2	0.16	9	3–23	0.12	0.04–0.29
2004–05	8 425	19.2	4	0.25	14	6–28	0.16	0.07–0.33
2005–06	8 289	16.4	2	0.15	10	3–23	0.13	0.04–0.28
2006–07	7 368	31.5	2	0.09	3	2–7	0.05	0.03–0.10
2007–08	6 730	41.8	5	0.18	8	5–13	0.12	0.07–0.19
2008–09	6 134	38.7	0	0.00	2	0–7	0.03	0.00–0.11
2009–10	6 011	35.5	0	0.00	3	0–8	0.05	0.00–0.13
2010–11	4 178	28.8	0	0.00	3	0–10	0.08	0.00–0.24
2011–12	3 654	25.2	0	0.00	1	0–5	0.04	0.00–0.14
2012–13	3 098	11.2	0	0.00	0	0–2	0.02	0.00–0.06
2013–14	3 606	12.0	0	0.00	1	0–3	0.02	0.00–0.08
2014–15	3 812	25.7	1	0.10	2	1–4	0.04	0.03–0.10
2015–16	4 083	34.8	0	0.00	1	0–3	0.01	0.00–0.07
2016–17	3 972	30.9	0	0.00	0	0–2	0.01	0.00–0.05
2017–18	3 744	24.1	0	0.00	1	0–3	0.01	0.00–0.08

In recent years, only one observed fur seal capture by an orange roughy vessel has occurred (Figure 26). No orange roughy vessels have records of capture of whales, dolphins, or sea turtles during the period 2003-03 to 2018-19.

The Department of Conservation administers the Marine Mammals Protection Act 1978, which provides for the conservation, protection and management of marine mammals (https://www.doc.govt.nz/about-us/our-role/managing-conservation/marine-mammal-conservation/). A permit is required under the Act for anyone to 'take' a marine mammal. The definition of 'take' includes actions that harm, harass, injure and attract. The development of the commercial fisheries resource in New Zealand has resulted in the incidental take (by-catch) of a number of marine mammal species. It is a requirement under the Act to report all events whereby a marine mammal is incidentally caught in the act of fishing. Observers further monitor for takes. In addition to monitoring, establishment of the marine mammal sanctuaries with no-fishing zone and by-catch limits set by the Minister of Fisheries have occurred in response to marine mammal takes.

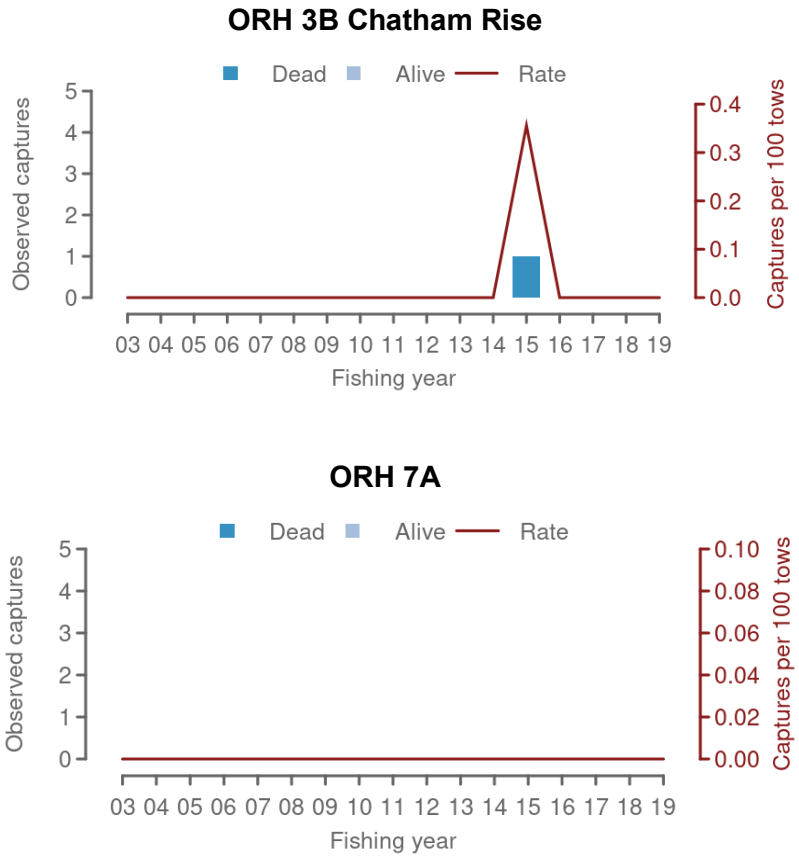


Figure 26. Observed New Zealand fur seal captures by orange roughy trawl fisheries on the Chatham Rise (top) and in ORH 7A (bottom), 2002-03 to 2018-19 (MPI, 2021).

Corals

Although the MSC's ETP species component in Principle 2 doesn't appear to have anticipated habitat forming benthos such as cold water corals being assessed here, because four coral groups are expressly protected under the Wildlife Act, they must be classified as ETP for this assessment.

Observed and estimated ETP coral catches in the three UoAs during 2018-19 and 2019-20, based on observer records, show the following (Tables 18 – 20) [data provided by R. Tinkler, FNZ):

- NWCR – an average annual estimated ETP coral catch of 20 kg and an average annual catch per tow of 0.101 kg
- ESCR – an average annual estimated ETP coral catch of 149 kg and an average annual catch per tow of 0.039 kg
- ORH7B-WB - an average annual estimated ETP coral catch of 74 kg and an average annual catch per tow of 0.144 kg.

Note that the catchability of corals by trawl nets has yet to be reliably established. The above estimates may be conservative given that some captured coral is likely to fall through the meshes. Work is ongoing to establish a credible catchability coefficient for trawl nets (e.g. by SPRFMO), (Pitcher et al., 2019).

Table 36. ORH3B NWCR observed and estimated ETP coral catch in 2018-19 and 2019-20.

ETP Corals	2018-19	2019-20	Average
Bamboo coral		3	1.5
Golden coral		1	0.5
Gorgonian coral		1	0.5
Solitary bowl coral	6		3
Stony cup corals		2	1
Observed ETP coral totals (kg)	**6**	**5**	**5.5**
No. observed tows	**61**	**61**	**61**
Observer coverage (% of tows)	**23%**	**35%**	**31%**
No. tows	**220**	**171**	**196**
Estimated coral catch (kg)	**26.1**	**14.3**	**20**
Estimated coral catch /tow (kg)	**0.119**	**0.084**	**0.101**

Table 37. ORH3B ESCR observed and estimated ETP coral catch in 2018-19 and 2019-20.

ETP Corals	2018-19	2019-20	Average
Antipathes spp.		2	2
Bamboo coral	4	12	8
Bathypathes spp.		1	1
Black coral	2	5	3.5
Bubblegum coral	3	8	5.5
Bushy hard coral	3	1	2
Coral (unspecified)	11	5	8
Coral rubble	1	1	1
Deepwater branching coral		1	1
Gorgonian coral	3	4	3.5
Leiopathes secunda	2		2
Madrepora oculata	1		1
Primnoa spp.		1	1
Solenosmilia variabilis		2	2
Solitary bowl coral	2	10	6
Stony branching corals	7		7
Stony corals		1	1
Stony cup corals	1	7	4
Observed ETP coral totals (kg)	**40**	**61**	**50.5**
No. observed tows	**411**	**472**	**442**
Observer coverage (% of tows)	**33%**	**35%**	**34%**
No. tows	**1247**	**1358**	**1303**
Estimated coral catch (kg)	**121.4**	**175.5**	**149.0**
Estimated coral catch /tow (kg)	**0.032**	**0.045**	**0.039**

Table 38. ORH7A-WB observed and estimated ETP coral catch in 2018-19 and 2019-20.

ETP Corals	2018-19	2019-20	Average
Bamboo coral	1	4	2.5
Bathypathes spp.	7		3.5
Black coral	3	10	6.5
Bottlebrush coral		3	1.5
Callogorgia spp.		1	0.5
Coral (unspecified)	4		2
Dendrobathypathes spp.		1	0.5
Golden coral	1		0.5
Gorgonian coral		3	1.5
Leiopathes spp.	1		0.5
Solitary bowl coral		3	1.5
Stony corals		1	0.5
Observed ETP coral totals (kg)	**17**	**26**	**21.5**
No. observed tows	**108**	**193**	**150.5**
Observer coverage (% of tows)	**23%**	**35%**	**29%**
No. tows	**478**	**555**	**517**
Estimated coral catch (kg)	**73.9**	**74.3**	**74.1**
Estimated coral catch /tow (kg)	**0.155**	**0.134**	**0.144**

Vessel-reported coral catches:

Vessels are required by Regulation to report all protected species captures using Non-Fish Protected Species forms, whether or not an observer is aboard. NFPS records for 2018-19 and 2019-20 show that for ESCR, vessels reported considerably more coral catch than observers, while in NWCR and ORH7A-WB the raised observer-reported catches were higher (Table 39).

Table 39. Observer-reported and vessel-reported coral catch, 2018-19 and 2019-20.

	Observer-reported (raised)			Vessel-reported		
UoA	**2018-19**	**2019-20**	**Average**	**2018-19**	**2019-20**	**Average**
NWCR	26.1*	14.3	**20.0**	7.5	2.0	**4.8**
ESCR	121.4	175.5	**149.0**	690.7	592.3	**641.5**
ORH7A-WB	73.9	74.3	**74.1**	11.9	9.2	**10.5**

*Note: Excludes a single catch comprising rocks, mud, sponges, corals and bryozoans, estimated at 2.5 t and erroneously reported using code CUB 'mixed corals and sponges'.

EEZ coral catch:

The estimated average annual coral catch by ORH/OEO targeted fisheries over the entire EEZ over the last three years, calculated using observed coral captures raised on the basis of observer coverage rates, amounts to ~2,135 kg. Averaged over all tows, the estimated coral capture per tow amounts to 650 g on UTFs and 350 g on slope habitat. Averaged over tows that caught coral, the estimated coral capture per tow amounts to 4.8 kg on UTFs and 3.5 kg on slope habitat. For the HOK/HAK/LIN targeted fisheries, averaged over all tows the estimated coral catch per tow was 10 g, and 1.4 kg if averaged over tows that caught coral (Table 40).

Table 40. Estimated average annual coral capture by ORH/OEO and HOK/HAK/LIN fisheries in the entire EEZ, 2017-18 to 2019-20.

Category	ORH/OEO		HOK/HAK/LIN
	UTFs	flats/slope	flats/slope
No. tows	1,020	4,199	13,332
Observer coverage (%)	18%	23%	36%
Observed tows with coral (%)	13%	10%	1%
Estimated coral capture (kg)	662	1,473	139
Estimated coral capture per tow (kg)	0.649	0.351	0.010
Estimated coral capture per coral tow (kg)	4.837	3.534	1.352

Assessment of trawling interactions

A key tool for assessing the probable effects of trawl fishing on ETP coral communities on the Chatham Rise has been to assess the extent of overlap between the fishery footprint and areas where corals are known to occur (i.e. the observed coral distribution). Bottom trawl records for all tows that targeted ORH, OEO and HOK within the UoA areas over the recent three-year period 2017-18 to 2019-20 were plotted against Observer and Research coral datasets using GIS to determine the overlap within the ORH habitat depth range of 800 – 1,600 m.

The method involves coral capture localities being expressed as areas of 1 km x 1 km extent, which are then overlaid with the recent trawl footprint to provide an indication of probable fishery impact. However, the Observer coral dataset is not representative of the overall distribution of corals as all the records are from the fishing grounds.

The Research dataset, while not restricted to the trawl grounds, similarly cannot be assumed to be representative of the distribution over the entire extent of the Chatham Rise UoAs, either by area or depth, as it is predominantly based on trawl survey records, which have the objective of assessing the biomass of fished stocks and not the nature and extent of epibenthic fauna. These are strong reasons not to rely solely on the Observer or Research coral datasets as a basis for assessing the impact of UoA fisheries on corals. There is evidence that many of New Zealand's deepwater protected corals occur deeper than the maximum depths currently fished (i.e. ~1,400 m), with maximum depth records as follows:

- Black corals – 2,440 m
- Gorgonian octocorals - ~2,990 m
- Scleractinian stony corals - 2,860 m
- Hydrocorals - ~2,530 m

Global databases show depth distributions down to 5,000 m for coral genera that occur in the New Zealand region (Finucci et al., 2019). Given the comparatively narrow depth range used in the assessment of fishery impacts on protected New Zealand deepwater corals, the estimated fishery impact will be over-estimated in relation to their overall distribution.

The combined trawl footprint for the 2017-18 to 2019-20 fishing years was assessed against the updated Observer and Research coral locality datasets (the 'observed' distribution) for the period 2013-14 to 2019-20.

The overlap of the 2017-18 to 2019-20 trawl footprint with the updated observed coral distribution is very similar to that previously considered by the assessment team (Clark et al., 2015). For the NWCR UoA the assessed overlap with black corals has increased from 14.4% to 18.8% but has remained largely unchanged for gorgonian and stony corals at 5.4% and 8.0% respectively (Table 41).

The combined trawl footprint for ORH/OEO-targeted and HAK/HOK/LIN-targeted tows ≥800 m for the 2017-18 to 2019-20 fishing years was assessed against updated observer-reported and vessel-reported coral data and the Research coral locality dataset (the 'observed' distribution) for the period 2017-18 to 2019-20.

The overlap of the 2017-18 to 2019-20 trawl footprint with the updated 'observed' coral distribution is greater than that previously considered by the assessment team (Black, 2021). This is due to the inclusion of HAK/HOK/LIN-targeted trawl tows that occurred within the ORH/OEO fishery depth range, as is required by the MSC Standard. (Table 41). It

is important to note, however, that as much of the 'observed' coral distribution records originate from the fishing vessels themselves, the trawl footprint overlap will be significantly biased on the high side.

Table 41. Observer-reported coral captures (2017-18 to 2019-20), vessel-reported coral captures (2017-18 to 2019-20) and Research coral dataset (2017-18 and 2018-19) expressed as a 1 km square, centred at the reported location/tow. Trawl footprint is for ORH/OEO targeted tows and HOK/HAK/LIN targeted tows ≥ 800 m depth. (Black, 2021).

UoA	Coral Group	Estimated coral distribution from observed records (km^2)	Overlap of 2017-20 footprint with observed coral distribution (km^2)	Overlap with observed coral distribution (%)
ORH3B NWCR	Black corals – O. Antipatharia	3.00	1.35	44.97%
	Gorgonian corals – O. Alcyonacea	10.00	4.58	45.80%
	Stony corals – O. Scleractinia	36.77	8.85	24.06%
	Hydrocorals – O. Anthoathecata	4.00	0.00	0.00%
ORH3B ESCR	Black corals – O. Antipatharia	13.73	8.88	64.67%
	Gorgonian corals – O. Alcyonacea	31.06	16.90	54.43%
	Stony corals – O. Scleractinia	42.00	13.43	31.98%
	Hydrocorals – O. Anthoathecata	3.00	0.91	30.33%
ORH7A-WB	Black corals – O. Antipatharia	19.81	12.54	63.31%
	Gorgonian corals – O. Alcyonacea	36.63	18.45	50.36%
	Stony corals – O. Scleractinia	7.00	3.05	43.57%
	Hydrocorals – O. Anthoathecata	2.00	0.00	0.00%

In the knowledge of the deficiencies and biases of analyses based on the observed coral distribution for assessing fishery impact, models have been developed to produce predicted coral habitat distributions (e.g. Anderson et al., 2014, 2015, 2019; Bowden et al., 2019, 2019a).

Predicted distribution modelling for benthic biodiversity in the New Zealand EEZ has developed rapidly over recent years. While earlier models used faunal distribution data to predict distributions in unsampled areas, they were deficient in that they used presence-only data from museum and trawl datasets and did not incorporate population density data. For these reasons their predictions were considered uncertain. In more recent modelling a new, merged benthic invertebrate occurrence dataset from five seabed photographic surveys has been used to inform development of improved predictive models at both single taxon levels, using Random Forest RF) and Boosted Regression Tree (BRT) decision-tree methods, and at community levels, using Gradient Forest (GF) and Regions of Common Profile (RCP) methods (Bowden et al., 2019). The use of these new, quantitative datasets with true absences and resolution at a finer scale, represent major refinements on the earlier models. The approach used in all of these modelling exercises is essentially to define relationships between point-sampled (i.e. observed) faunal data and environmental gradients to predict how individual benthic taxa and communities vary spatially over large areas (e.g. Chatham Rise).

The accuracy and spatial resolution of these models is dependent on the quality and consistency of fine-scale information on the sediment types and topography of the seabed. This is significant because the distribution of sessile fauna such as corals and other habitat-forming fauna is defined by the availability of hard substrata, which is highly patchy (Bowden et al., op cit.). The resolution of both the input data and the predicted outputs from the recent modelling are at a reasonably fine scale of 1 x 1 km cells and the predicted abundances of benthic taxa are presented as the number of individuals per 1000 m^{-2}. The relative confidence in the predictions was assessed using a

bootstrapping technique, at the scale of individual cells, to produce spatially explicit uncertainty measures. Model uncertainties were calculated as the coefficient of variation (CV) of the bootstrap output (Bowden et al., op cit.).

The trawl footprint for the 2017-18 and 2018-19 fishing years was plotted against the Anderson et al. (2015) predicted coral distributions at the >50th percentile level for each of the four protected coral groups (Table 42). Note that substantial areas of suitable habitat are projected to exist across the EEZ at depths greater than that of the predicted distributions (Anderson et al., 2019).

Table 42. Overlap of the combined 2017-18 and 2018-19 trawl footprint against the updated predicted habitat distribution of Anderson et al. (2015) for black, gorgonian and stony corals.

Coral Group	UoA	Predicted coral distribution >50th percentile (km^2)	Overlap of 2017-19 footprint with predicted coral distribution (km^2)	% overlap with predicted coral distribution
Black corals – O. Antipatharia	ORH3B NWCR	9,620	113	1.18%
Gorgonian corals – O. Alcyonacea		7,008	325	0.96%
Stony corals – O. Scleractinia		33,906	11	0.15%
Black corals – O. Antipatharia	ORH3B ESCR	26,637	847	3.18%
Gorgonian corals – O. Alcyonacea		33,058	589	1.78%
Stony corals – O. Scleractinia		15,312	90	0.59%
Black corals – O. Antipatharia	ORH7A - WB			
Gorgonian corals – O. Alcyonacea				
Stony corals – O. Scleractinia				

The trawl footprint overlaps with the very conservative 'observed' coral distributions are between 0% and 64.67%, while the overlaps with the modelled coral distributions range between 0.12% and 3.18%. The biases inherent in both the observed and predicted coral distributions need to be acknowledged and the 'truth' probably lies somewhere between.

Coral recovery

A towed camera study conducted on a group of fished and unfished UTFs on the Chatham Rise, involving surveys in 2001, 2006, 2009 and 2015, showed very little evidence of stony coral recovery on any of these UTFs, notably one that had been closed to trawling for 15 years (Morgue Hill), (Clark et al., 2019). A more recent survey in 2020 did, however, find evidence of new clumps of stony coral polyps growing on coral rubble near the summit, and on a rocky outcrop below the summit, of a heavily fished UTF (Graveyard Hill). New polyps were also found on the adjacent Morgue Hill (Clark et al., in press). This study has produced evidence that corals do recover from the effects of trawling, albeit on a decadal scale.

Coral diversity will be maintained on fished UTFs in areas that are too rough or too steep to trawl or in gullies and crags where trawl nets cannot reach them, providing a potential source for coral recovery should trawling cease (Consalvey et al., 2006). While around 80% of UTFs in the EEZ within fishable depths (i.e. 0 – 1,600 m) have been fished by trawl (Clark & O'Driscoll, 2003), far fewer are currently fished due to TACCs having been considerably reduced from a peak during the early 1980s. There is, therefore, considerable scope for corals to recover on many previously fished UTFs, the majority of which are found on the Chatham Rise.

Connectivity between coral assemblages is thought to be feasible over ranges of ~100 km, particularly for those practicing sexual reproduction, such as the stony corals, which are thought to be capable of wide distribution. Recent experiments in aquaria have demonstrated that the stony coral *Goniocorella dumosa* is a brooder with the capability of incubating gametes for extended periods and for larvae to be released and 'free-swimming' for up to 88 days in the water column prior to settling, potentially allowing for considerable dispersal distances (Tracey et al., 2021).

Indirect effects

Potential indirect effects include sedimentation from trawling operations, which it is speculated could potentially smother coral colonies. A recent study by NIWA on the Chatham Rise has involved an experiment in which vast clouds of sediment were created using a towed plough-like apparatus in the vicinity of known coral beds, with the

intention of monitoring any adverse effects on the corals. Results from the study have yet to be published. However, a large reef system on the shelf break off the mouth of the Amazon River has been found to support a range of cnidarians including stony corals, black corals and octocorals, which live in an environment of high suspended sediment (Moura, et al., 2016). Corals clearly have some ability to cleanse themselves of sediments. Trawling on UTFs will produce variable levels of sedimentation depending on the nature of the substratum, while elevated currents associated with these topographic features will serve to move the sediment along fairly rapidly. The effects of sedimentation will likely be greater on slope habitat where clumps of coral occur on rocky patches within otherwise sandy or muddy habitat.

Management strategy

The management of ETP species in New Zealand falls under the Wildlife Act 1953. The Wildlife Act provides for partial protection of all species of corals in the orders Antipatharia (black corals), Gorgonacea (gorgonian corals), Scleractinia (stony corals) and of all species in the family Stylasteridae (hydrocorals). It is, however, not an offense to catch these corals in areas outside of designated protected areas (i.e. MPAs, BPAs, SCAs), and no catch limits are prescribed. Captures are required to be reported and are not allowed to be retained.

The purpose of the Fisheries Act 1996 (s8) is 'to provide for the utilisation of fisheries resources while ensuring sustainability', where ensuring sustainability entails 'avoiding, remedying, or mitigating any adverse effects of fishing on the aquatic environment'. The environmental principles of the Act require that 'associated and dependent species should be maintained at a level that ensures their long-term viability' and that the 'biological diversity of the aquatic environment should be maintained'.

When impacts of fishing are such that they are causing an adverse effect on the Marine Environment (Fisheries Act s2, s8), measures are to be taken pursuant to the Conservation Act 1987 and the Director-General of where the Department of Conservation will implement measures, including:

- Research relating to those effects on protected species
- Research on measures to mitigate the adverse effects of commercial fishing on protected species
- The development of population management plans under the Wildlife Act 1953 and the Marine Mammals Protection Act 1978.

While Government policy is not well developed to determine when adverse impacts might collectively constitute adverse effects, effective policy has been implemented for some ETP species, such as seabirds and marine mammals, to manage impacts on a population basis, not based on impacts to individual animals. DWG has urged the development of effective policies on this basis for ETP corals and similar epibenthic organisms, to manage any adverse impacts on their populations, rather than a focus on zero captures (DWG, 2021).

Recognising that the need to allow for the utilisation of fisheries resources will entail interactions between bottom fisheries and corals, given the scattered and widespread coral distribution of corals, and given the susceptibility of corals to damage by trawl gear, New Zealand has opted to introduce area closures to provide protection to corals and similar sessile benthic fauna. Over 31% of the seabed within the Territorial Sea and EEZ is protected from bottom trawling and dredging (Helson et al., 2010), (Fig. 15).

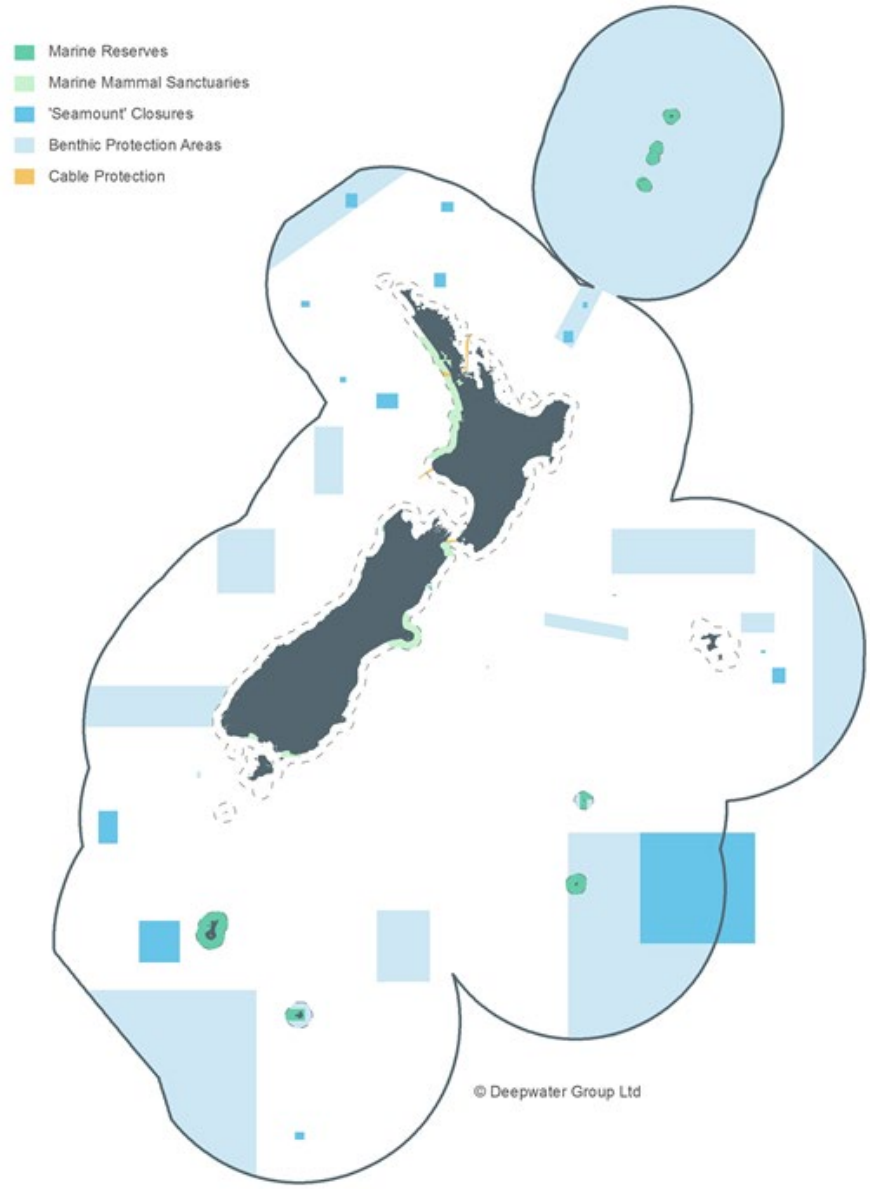


Figure 27. New Zealand's Marine Protected Areas. Dark blue = Seamount Closures, Light blue = Benthic Protection Areas, Green = Marine Protected Areas.

Evidence of management strategy implementation

Fishing vessel locality is electronically monitored by the Ministry on a 24/7 basis and any transgressions by bottom trawlers into protected areas draw large penalties and automatic vessel forfeiture. Three such transgressions by orange roughy trawlers in recent years have resulted in prosecutions, none of them in the UoAs, providing evidence that the management strategy is being implemented successfully.

Review of management effectiveness

Annual Review Reports for Deepwater Fisheries, Aquatic Environment & Biodiversity Annual Reviews monitor coral captures and trawl footprint – not increasing; consistent and adequate level of observer coverage; Corals Medium Term Research Plan updates research requirements; Compliance reviews of any transgressions.

Information

DWG has recently completed an agreement to purchase $4.4 m of science from Australia's Commonwealth Science and Industrial Research Organisation (CSIRO) over the next five years (funded one third by CSIRO and two thirds by industry) to further our understanding of the deepwater benthic biodiversity and biogenic habitats. There are two main themes to give effect to this:

1. **Habitat mapping of the benthic biodiversity within selected areas**

   Mapping in detail the benthic habitats of selected Underwater Topographic Features (UTFs) using CSIRO's underwater towed video system (with real-time connectivity to the survey vessel). The objective is to

quantitatively map and assess the habitat types and the benthic biodiversity within each survey area (e.g., mud, sand, rock, biogenic) and to quantify species' occurrences within biogenic habitats (i.e., areas containing corals, sponges and other epibenthic invertebrate communities) using CSIRO's Artificial Intelligence (AI) capabilities.

Over five years, the plan is to survey the benthic habitats of up to 25 of the key UTFs. The survey information will then be analysed with other data, such as trawl paths, enabling assessments of any risks posed by trawling and the extent of areas untouched by trawling.

2. **Industry trawl camera systems**

DWG and vessel owners have contracted CSIRO to develop and deploy bespoke SMART-cam technology (Seafloor Monitoring, Automated Recording of Trawls). This robust underwater hardware and software will be routinely deployed during commercial trawling to collect high-resolution digital imagery of the seabed along trawl pathways that will be analysed to identify and quantify the benthic habitat types and their biodiversity. We will apply CSIRO's proven solutions for deepwater engineering, automated data download, data management and analyses using their proven Artificial Intelligence capabilities in New Zealand waters.

It is anticipated that the results from this project will provide a basis for an informed strategy for assessing and managing risks to ETP corals and to benthic communities from deepwater trawling.

Research projects

The Department of Conservation's Conservation Services Programme (CSP) has ongoing projects aimed at improved understanding of fishery impacts on protected corals (Weaver, 2020) These include:

- Project INT2015-03 - identifying corals collected by observers aboard trawlers to species level to better understand coral diversity and distribution
- Project INT2018-01 – purchase of observer services from FNZ to ensure ongoing monitoring of protected species interactions, including with corals, towards developing and improving mitigation methods
- Project POP2018-01 - modelling of habitat suitability for protected corals to estimate the probable distribution of coral groups in poorly sampled areas beyond the trawl grounds
- Project POP2018-06 - investigating the nature of reproduction and dispersal by corals to estimate connectivity between coral populations within and between geographic regions.

In 2020-21, a new project has been developed aimed at identifying gaps in mitigation technology/practice towards achieving reductions of protected coral species bycatch (DOC, 2020):

- Project MIT2020-03 – mitigation gaps analysis towards reducing protected species bycatch.
- For 2021-22, two new protected coral-related projects are planned (DOC, 2021). These are:
- Project INT2021-02 – characterisation of protected coral interactions towards an improved understanding of coral bycatch across multiple fisheries and fishing methods and to inform the development of a risk assessment for protected corals
- Project POP2021-02 – identification of protected coral hotspots based on analysis of towed camera transects and application of these data in species distribution models towards an improved understanding of the historical effects of fishing on coral distribution and relative abundance.

Monitoring

Information collected through observers, vessel monitoring systems, research surveys and other research projects, such as analyses making use of existing datasets to understand fishery interactions with protected species or sensitive habitats, is sufficient to measure trends and support the above-described strategy for managing impacts on ETP species. Regular monitoring and reporting of the ORH/OEO trawl footprint in relation to coral habitat provides trend data relevant for evaluation of the likely impact of the fishery on these protected species. In addition, ongoing and new research projects, as described above, provide for improved knowledge as a basis for assessing and managing the effects of fishing on ETP corals.

7.3.3 Habitat

Orange roughy fishing in New Zealand takes place over areas of flat seabed on the continental slope and on Underwater Topographic Features (UTFs). UTFs are defined as seamounts, knolls or hills based on the elevation measured as the height from base to summit (i.e., seamount >1,000 m; knoll 500 - 1,000 m; hill <500 m, Black et al., 2015). Compared to UTFs, less is known about the ecosystems of the benthic areas of the upper continental slope.

Biodiversity and habitats do vary over large spatial scales (Compton et al., 2013) but the primary drivers of variability at these depths is understood to most likely be environmental factors such as depth, substrate and oceanographic conditions (Dunn, 2013).

As mentioned earlier in this section, MSC requires that if a fishery interacts with benthic habitats, they shall be categorized according to the characteristics “substratum, geomorphology, and biota,” and requires that encountered habitats are classified as “commonly encountered, VME, or minor/other.” On this basis, two major habitat types have been identified as important for this fishery: continental slope areas, and UTFs. Continental slope areas are flatter, and although substrate does vary over larger spatial scales, slope areas are more commonly characterized by lack of erect epifauna, and muddy or sandy substrates. Regarding UTFs, the NIWA “Seamounts” database holds information on 1,517 known UTFs, with 892 of these inside the New Zealand EEZ and 625 outside the EEZ (Clark, 2013). Pitcher *et al.* (2007), Clark *et al.* (2010) and Rowden and Clark (2010) summarized the ecological role of UTFs. The UTFs are well known as aggregation sites for pelagic, mesopelagic and demersal species and may provided important benthic habitats for fish species (enhanced numbers and/or biomass) and invertebrates. UTF benthic biomass has been reported as four times that of the adjacent slope (Rowden & Clark 2010). The drivers of these differences include: the wide depth ranges offered by UTF elevation; variable substrates that include hard substrates (which provide suitable attachment surfaces for sessile epibenthic invertebrates, such as corals); and stronger current flows around UTFs (that may act to reduced sediment settlement and to increase/concentrate food supplies). The UTF habitat type at depths encountered by this fishery also qualify as VME habitats according to the MSC definition of such because they have functional significance, fragility, life-history traits of component species (cold water corals and sponges) that make recovery difficult, and structural complexity. VME habitat types receive separate consideration within the MSC assessment framework. It is noted that not all UTFs are comprised of hard sediments that support sessile epibenthic invertebrates.

Outcome
Approximately 34% of the New Zealand EEZ is considered 'fishable', meaning seabed areas shallower than 1,600 metres and open to fishing (i.e. not within a Benthic Protection Area (BPA) or a Seamount Closure Area (SCA)).

New Zealand’s strategy to guard against adverse effects on the benthic environment, as is required by the Fisheries Act 1996, includes multiple area closures in the EEZ. A total of 17 BPAs, representatively distributed around the EEZ (Helson et al., 2010), and 19 SCAs, collectively close 31% of the EEZ to bottom trawling (FNZ, 2019b). These closures protect:

- 28 percent of underwater topographic features (including seamounts)
- 50 percent of true seamounts (i.e. UTFs over 1,000 metres in elevation)
- 88 percent of known active hydrothermal vents.

Of the 142 known seamounts in the EEZ, 15 have ever been fished (i.e. 10.5%) and nine have been fished over the most recent 10-year period 2009-10 to 2018-19 (i.e. 6.3%). Thirty three percent of the fished seamounts are known to support coral.

Of the 535 known UTFs (comprising hills, knolls and seamounts, classified according to height from base to summit) in the New Zealand EEZ, 144 (27%) have been fished in recent years.

There are over 530 known UTFs in the New Zealand EEZ, representing approximately 103,000 km^2 of seafloor, and over 812 known UTFs including the broader New Zealand region, representing approximately 250,000 km^2 of sea floor in total. Within the EEZ, the latitude band with the greatest concentration of UTFs occurs between 44˚ – 46˚S, which includes the Chatham Rise (Rowden et al., 2005), (Figure 16).

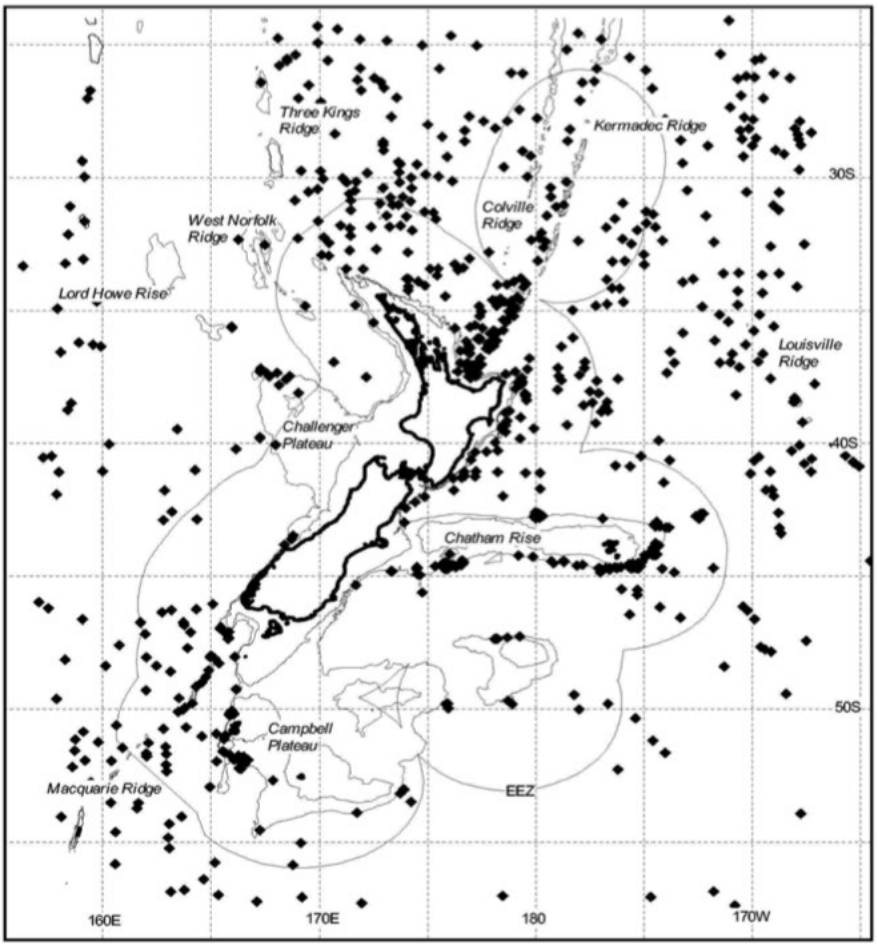


Figure 28. Known UTFs in the New Zealand region (from Rowden et al., 2005).

This information serves to illustrate the amount of UTF habitat that exists within the New Zealand region, of which orange roughy and oreo-targeted fishing contacts only a very small proportion.

Not all of the UTFs in the UoAs are contacted by trawl. Over the recent three-year period, 2017-18 to 2019-20, under half of the 26 known UTFs in NWCR have been fished and just over half of the 99 known UTFs in ESCR have been fished. There are only five known UTFs in ORH7A-WB, of which four have been fished. Similarly, not all of the fished UTFs support corals; two in each of NWCR and ORH7B-WB and 26 in ESCR have had reported coral captures over the recent three-year period (Table 43).

Table 43. Numbers of UTFs, fished UTFs and UTFs with coral capture records in the NWCR, ESCR and ORH7A-WB UoAs over the period 2017-18 to 2019-20.

Category	ORH7A - WB	ORH3B NWCR	ORH3B ESCR
Number of UTFs	5	26	99
Number of UTFs with tows	4	12	57
% of UTFs with tows	80%	46%	58%
Number of UTFs with coral tows	2	2	26
% of UTFs with coral tows	50%	17%	46%

UTF habitat, expressed as the sum of their estimated basal areas (i.e. a conservative estimate), in each of the NWCR, ESCR and ORH7A-WB UoAs amounts to 99 km^2, 3,890 km^2 and 15 km^2 respectively, which in aggregate accounts for only 4% of the UTF area in the EEZ. In addition, in recent years not all of the UTFs in the three UoAs have been fished. Of the UTFs that have been fished over the last three years, the aggregate of the contacted areas ranges from 14% in NWCR, to 29% in ESCR and to 38% in ORH7A-WB. The areas contacted by trawl gear, as a proportion of total UTF habitat in each of the UoAs, ranges from 2% in ESCR, to 7% in NWCR and to 26% in ORH7A-WB (Table 44).

Table 44. Basal areas of UTF habitat and proportions of UTF habitat contacted by ORH/OEO-targeted trawls in each of the UoAs over the period 2017-18 to 2019-20.

Category	ORH7A - WB	ORH3B NWCR	ORH3B ESCR
Basal area of UTFs (km^2)	15.44	98.93	3,889.93
Basal area of UTFs with tows (km^2)	10.40	47.87	306.98
Footprint of UTF tows inside basal polygon (km^2)	3.94	6.49	88.54
Footprint on UTFs with tows (%)	38%	14%	29%
Footprint in relation to basal area of all UTFs (%)	26%	7%	2%

Orange roughy and oreo are distributed throughout the New Zealand EEZ at depths of between 800 – 1.600 m. The median tow depth of ORH-targeted trawls ranges from 895 m in ORH7A-WB, to 1,100 m in NWCR and to 1,042 m in ESCR. The average number of tows per annum in each of the UoAs ranges from 269 in NWCR, to 411 in ORH7A-WB and to 1.369 in ESCR. Fishing occurs on both slope and UTF habitat. In ESCR, effort is spread equally between slope habitat and UTFs, while in NWCR and ORH7A-WB 76% and 91% of tows respectively occur on slope habitat (Table 45).

Table 45. Median tow depths and fishing effort on slope and UTF habitat in each of the three UoAs over the period 2017-18 to 2019-20.

Category	ORH7A - WB	ORH3B NWCR	ORH3B ESCR
Tow depth - median (m)	895	1,100	1,042
Average annual no. tows	411	269	1,369
Average annual no. UTF tows	36	63	684
% of tows on UTF habitat	9%	24%	50%
Average annual no. slope tows	376	206	684
% of tows on slope habitat	91%	76%	50%

Trawl footprint analysis

The trawl footprint of orange roughy and oreo fisheries is monitored annually to assess the extent of their interactions with the benthic habitat (Baird & Mules, in press). The 2017-18 fishing year marked the commencement of catch locality reporting by vessels at a finer resolution (i.e. longitude and latitude to 4 decimal places, or less than 20 m), (FNZ, 2019), than previously (i.e. to the nearest minute of arc, or about 1.852 nm). This new reporting regulation has negated the requirement for random jittering of tow start and finish positions, which was previously applied to trawl datasets to provide a more realistic spread of effort and has improved the precision of the trawl footprint estimate. The outcome for orange roughy and oreo fisheries has been a slightly reduced estimated trawl footprint.

Baird & Mules (op. cit.) estimated that in 2018-19, all New Zealand OEO and ORH fisheries traversed 0.2% and 1.2% respectively of the EEZ fishable area between 800-1,600 m.

Within the three UoAs, ORH/OEO trawl footprint analyses indicate that the fisheries have traversed between 4.2% and 7.6% of the fishable area over the most recent three-year period 2017-18 to 2019-20. These are considerably smaller areas than were fished during the period of peak orange roughy fishing in the late 1980s and early 1990s. During the recent three-year period, new areas trawled have amounted to between 1.6% and 2.3% of the respective fishable grounds (Table 46).

Table 46. ORH/OEO trawl footprint by UoA for all years (1989-90 to 2018-19), recent three-year period (2017-18 to 2019-20), new footprint and area closures for each UoA (km^2 and %).

UoA	UoA Area (km^2)	UoA Habitat 800-1,600 m	Footprint 1989-90 to 2018-19	Footprint 2017-18 to 2019-20	New Footprint 2017-18 to 2019-20	UoA Closed Area

NWCR	137,929	17,398	7,125	41.0%	1,326	7.6%	332	1.9%	52	0.3%
ESCR	195,884	38,148	11,622	30.5%	2,439	6.4%	629	1.6%	1,755	4.6%
ORH 7A-WB	212,351	78,870	10,296	13.1%	3,332	4.2%	1,785	2.3%	12,304	15.6%

The major bottom trawl fishery in New Zealand targets hoki, hake and ling at depths between ~250 – 750 m. A small proportion of tows occur at depths greater than 800 m (within the ORH/OEO fishery areas). Including the HOK/HAK/LIN trawl fishery footprint in the analyses results in small increases to the overall trawl footprints within the 800-1,600 m fishable grounds under consideration.

Within the three UoAs, ORH/OEO and HAK/HOK/LIN trawl footprint analyses indicate that the fisheries have traversed 10.4%, 6.5% and 4.2% of the NWCR, ESCR and ORH7A-WB UoAs respectively over the three-year period 2017-18 to 2019-20 (Table 47).

Table 47. ORH/OEO/HAK/HOK/LIN trawl footprint by UoA for all years (1989-90 to 2018-19), for the recent three-year period (2017-18 to 2019-20), new footprint and area closures for each UoA (km^2 and %).

UoA	UoA Area (km^2)	UoA Habitat 800-1,600 m	Footprint 1989-90 to 2018-19		Footprint 2017-18 to 2019-20		New Footprint 2017-18 to 2019-20		UoA Closed Area	
NWCR	137,929	17,398	14,504	83.4%	1,805	10.4%	415	2.4%	52	0.3%
ESCR	195,884	38,148	12,145	31.8%	2,475	6.5%	648	1.7%	1,755	4.6%
ORH 7A-WB	212,351	78,870	11,189	14.2%	3,332	4.2%	1,785	2.3%	12,304	15.6%

Maps showing the extent of the trawl footprints in relation to the orange roughy habitat areas for each of the UoAs are provided below. Notable updates since the previous full assessment are as follows:

- In NWCR, most fishing has occurred on slope habitat to the south and west of the 180˚ hills in recent years (Figs. A1 & A2).
- In ESCR, the fishery has remained spread between UTF and slope habitat and much of the new area traversed has involved in-filling between existing trawl tracks within the traditional fishing grounds (Figs. A3 & A4).
- In ORH 7A-WB, there has been an expansion of the fishery towards the south-east, reflective of the fishery increasingly operating outside of the spawning aggregations as abundance has increased (the spawning area is in the extreme western part of ORH7A-WB), (Figs. A5 & A6).

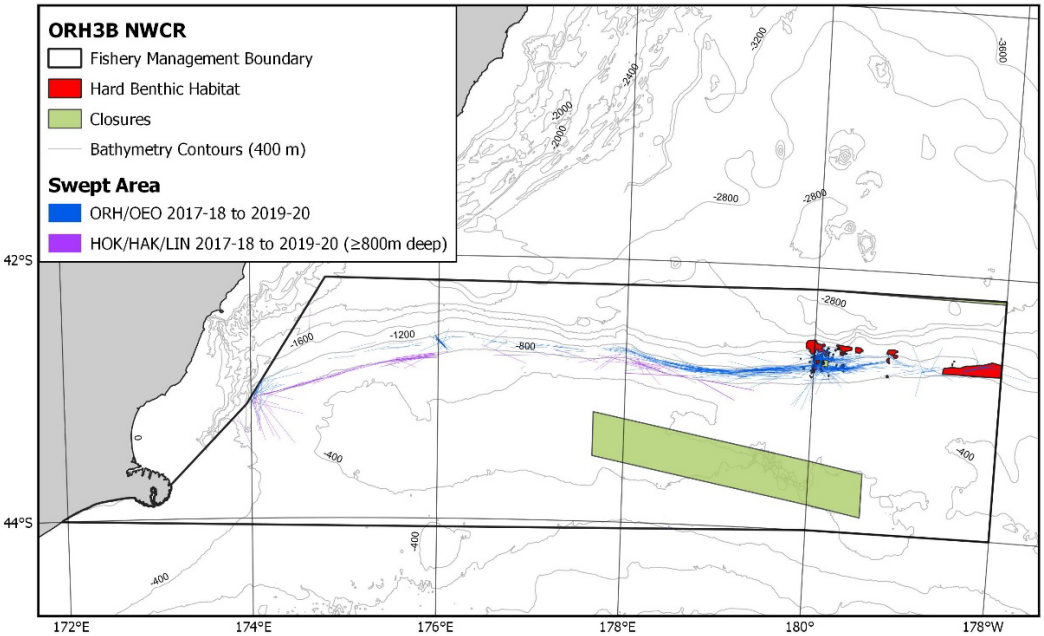


Figure A1: NWCR UoA trawl footprint for tows with starting depths ≥ 800 m, 2017-18 to 2019-20.

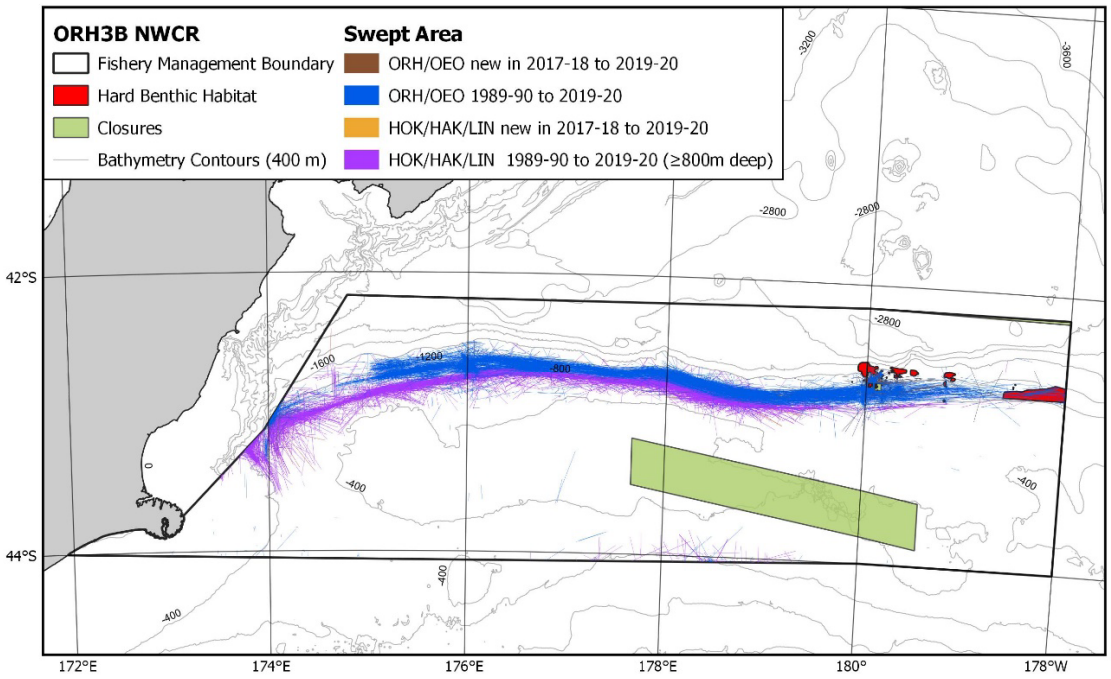


Figure A2: NWCR UoA trawl footprint for tows with starting depths ≥ 800 m, 1989-90 to 2019-20.

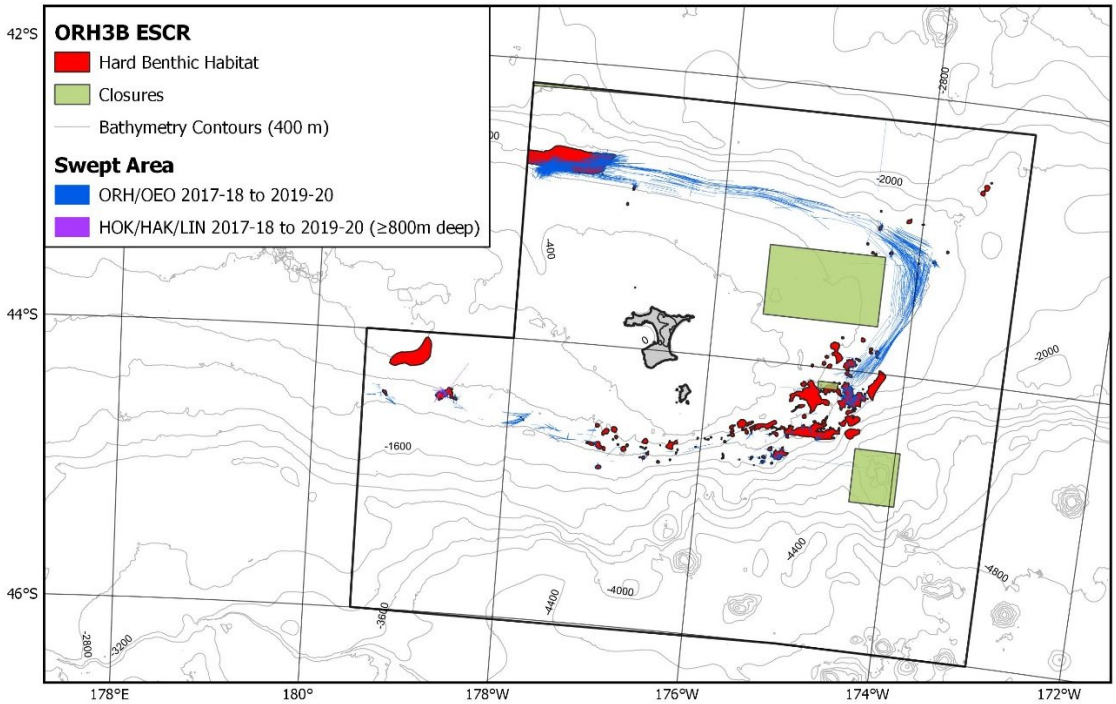


Figure A3: ESCR UoA trawl footprint for tows with starting depths ≥ 800 m, 2017-18 to 2019-20.

Management strategy

Area closures provide habitat protection to over 31% of the EEZ and to 14% of the fishable area shallower than 1,600 m within the EEZ (Table 48Table 48).

Table 48. The EEZ area, the fishable area less than 1,600 m, and the proportions of these areas protected from bottom trawling.

Category	EEZ	EEZ Fishable Area
Total area (km^2)	3,924,602	1,435,765
Protected area (%)	31%	14%

Observer monitoring of around 30% of trawl tows in the UoAs provides a good estimation of the impact of the fisheries on vulnerable habitats and mandatory Global Position Reporting by vessels enables the Ministry to monitor vessel compliance with regard to area closures on a 24/7 basis. DWG's Benthic Operational Procedures, due to be implemented from 1 October 2021, will ensure that vessels are cognisant of the requirement to accurately measure, record and report all captures of benthic biota to the Ministry and to their shore managers. DWG's Environmental Liaison Officer is at hand to assist in providing response management advice for implementation in real-time (DWG, 2021a).

Information

Within the NZ EEZ and Kermadec Bioregion there is excellent information on the location and features of UTFs available from the Seamounts database managed by NIWA (SEAMOUNT V2 as described by Rowden et al. 2008). In addition, there is excellent information on the distribution of protected coral species within these areas broadly, and in the UoA areas specifically from a NIWA dataset of protected coral captures (both fisheries dependent and independent) that have been used to model observed and predicted coral distributions across fished and unfished areas (Baird et al., 2013; NIWA 2015). Particularly vulerable habitat types such as seamounts and hydrothermal vents are well mapped and monitored. There is also excellent data on the extent of interaction between the orange roughy fisheries in the three UoAs and the bioregion as a whole with slope habitats (Black et. al. 2015).

Research projects:

Aquatic environment and biodiversity research initiatives related to the benthic effects of fishing are detailed in the Annual Operational Plan for Deepwater Fisheries. Projects to monitor seabed contact by bottom trawling are ongoing (FNZ, 2020, p. 34). These include:

- BEN2020-021 Extent and intensity of seabed contact by mobile bottom fishing in the New Zealand Territorial Sea and Exclusive Economic Zone (trawl footprint)
- BEN2020-07 Extent and intensity of trawl effort on or near underwater topographic features in New Zealand's Exclusive Economic Zone
- BEN2019-05 Towards the development of a spatial decision support tool for managing the impacts of bottom fishing on in-zone, particularly vulnerable or sensitive habitats.

7.3.4 Ecosystem

Orange roughy occur in deepwater habitats on the upper continental shelf. Dunn (2013) and Clark and Anderson (2013) have reviewed and summarized the ecosystem that orange roughy inhabit. Although orange roughy are often considered to be demersal species, as they are caught on/near the seabed in demersal trawls, their diet indicates that they forage into the bentho-pelagic and, as a species without a swim bladder, they would appear to be well adapted to live in a bentho-pelagic habitat. Acoustic marks interpreted as orange roughy are often found up to several hundreds of metres above the seabed.

Juvenile orange roughy occur most frequently on gently sloping areas of the upper continental slope at depths of 850-900 m (Dunn et al., 2009 a, b). Adults are found at depths of 850-1,500 m at least. Larger orange roughy may aggregate around UTFs, such as ridges, hills, knolls, and seamounts as well as canyons for spawning and feeding (Branch, 2001; Dunn & Devine, 2010).

For the purpose of defining the ecosystem "scoring elements" for this assessment, it is reasonable to consider the orange roughy ecosystem as the area over which orange roughy is distributed within the Kermadec bioregion.

There is a body of research on trophic interactions for orange roughy fisheries generally and trophic models have been developed that include orange roughy. Pinkerton (2008, 2011) presented results of a balanced trophic model of the Chatham Rise. The results showed macrobenthos (benthic invertebrates), macrozooplankton, and mesopelagic fish had high ecological importance. Trophic modelling will continue, including use of stable isotopes for validation of the model and further development of the model. There is no evidence of loss of functional components or species in the ecosystem or significant changes in the composition of orange roughy prey, predators or competitors based on catch composition in research trawls, fishery-dependant data, and stomach analyses (Dunn 2013). In addition, monitoring of meso-pelagic biomass on the Chatham Rise suggests no significant changes between 2001 and 2010 (O'Driscoll *et al.* 2011). Although these wide area trawl and acoustic research surveys predominantly sample depths shallower than the main orange roughy fishing grounds, it is likely that the meso-pelagic resources overlap with the orange roughy distribution depth range.

In addition, the low level of bycatch in the fisheries indicates direct ecosystem effects from removals are likely to be small, and the footprint of the orange roughy fishery in the three UoA areas is small relative to the orange roughy distribution area within the bioregion. and there are also areas that are currently fully protected from trawl impacts through the BPA approach.

The New Zealand Fisheries Act 1996 provides for "*the utilisation of fisheries resources while ensuring sustainability*." Ecosystem-based management is achieved through a multi-layered approach that considers fishery management (e.g., QMS), vulnerable species needs (e.g., NPOA-Sharks), ETP management (a host of protected species and related initiatives such as NPOA-Seabirds, NPOA-Sharks, the protection of marine mammals, and habitat considerations e.g. BPAs). Vessel management plans deal specifically with achieving avoidance and mitigation, and Marine Mammal Operational Procedures reduce the risk of interactions with marine mammals.

Legislated protection of areas of sea bottom from fishing activities, coupled with good quality monitoring of all fisheries removals that might impact on trophic structure and function and management of fishery removals (e.g. through TACCs), although not with the explicit objective of maintaining ecosystem structure and function, do represent a partial strategy to ensure the fishery does not pose a risk of serious or irreversible harm to ecosystem structure and function.

Data from the fishery, including observer data together with fishery independent surveys and other research projects, are taken into account in the management of the fishery, such as for designation of BPAs, setting of TACCs, management of ETP species interactions, etc.

The Fisheries Act 1996 is required to consider the various impacts of fishing, to seek to deliver better management through, for example, the fisheries management objectives of the fisheries management plans, and to seek to reduce the environmental effects of fishing through such tools as monitoring and managing ETP, bycatch, and other fisheries impacts to the ecosystem. In addition, research outcomes are fed back into management, although in the areas of ecosystem structure and function, stronger links could be developed. Where unacceptable impacts are detected, the current framework allows them to be addressed, including through fishery management measures.

Management responses so far have addressed individual ecosystem components (e.g. target or other QMS species stock status, bycatch levels, habitat impacts) rather than broader ecosystem effects. Fishing impacts are increasingly being considered through a risk assessment framework (e.g. seabirds, sharks) that takes into account both direct and indirect impacts on substantive groups of key ecosystem indicator species. While not specifically focused on addressing ecosystem impacts themselves, this effective constitutes a partial strategy that both monitors and evaluates fishing impacts on a broad range if top predators, which are typically used as indicators of ecosystem health. Moreover the framework is also designed to trigger management action should unacceptable impacts of key species be defected. Therefore, management measures work together across a range of the most important ecosystem components/functions, even though this is not through a specific ecosystem design.

Strategic and operational measures that are in place are considered likely to work, based on information about the fishery and ecosystem components involved (e.g. target and retained species, some ETP species, habitat). For example, target species stocks have been actively managed, fish species brought under the QMS structure, and seabird bycatch mitigation measures introduced, to address sustainability concerns specifically, while BPAs have been put in place to protect a representative range of deepwater benthic ecosystems.

Annual review of the Annual Operational Plan for Deepwater Fisheries provides a forum for reviewing the effectiveness of measures, and identifying ongoing and new issues (MPI, 2015). Detailed monitoring of many aspects of the fishery (e.g. catches of target, retained species, and bycatch (including coral bycatch) allows such review.

There is specific information about the fishery with regards to the impact of orange roughy fishing on ecosystem structure and function including time series of species/ functional group composition. However, much of the information indicating that this strategy is working is based on theory or comparison with similar fisheries/ecosystems (Clark *et al.* 1989, Heymanns *et al.*, 2011, O'Driscoll et al. 2011).

With particular reference to individual ecosystem components and key indicator groups (seabirds and sharks), there is evidence that the strategy is being implemented successfully.

For example, stock assessments of the target and retained species and monitoring of incidental mortalities of ETP species are ongoing, combined with fishery-independent surveys for many areas. TACCs and other control mechanisms are being monitored and adjusted for the main species where necessary. BPAs are monitored through observer and VMS coverage, and as part of the partial management strategy provide protection for benthic components of the orange roughy ecosystem. There is a high level of compliance with management limits on TACC species, ETP species and bycatch mitigation measures, and BPAs. More data are being collected for data deficient species considered to be high risk (e.g. some species of sharks and seabirds) and risk profiles are being subsequently updated. There is therefore evidence that the approaches are being implemented successfully.

Principle 2 Scoring elements

Component	Scoring elements	Designation	Data-deficient
P2 Primary	Hoki	Minor	No
P2 Primary	Hake	Minor	No
P2 Primary	Smooth oreo	Minor	No
P2 Primary	Spikey oreo	Minor	Yes
P2 Primary	Ribaldo	Minor	Yes
P2 Secondary	Rattails	Main (NWCR) Minor (other UoA)	Yes
P2 Secondary	Johnson's cod	Main (NWCR) Minor (other UoA)	Yes
P2 Secondary	Long-nosed chimaera	Minor	Yes
P2 Secondary	Deepwater dogfish	Minor	Yes
P2 Secondary	Widenosed chimaera	Minor	Yes
P2 Secondary	Shovelnosed dogfish	Minor	Yes
P2 Secondary	sealshark	Minor	Yes
P2 Secondary	slickhead	Minor	Yes
P2 Secondary	Smallscaled brown slickhead	Minor	Yes
P2 Secondary	Morid cod	Minor	Yes
P2 Secondary	Basketwork eel	Minor	Yes
P2 Secondary	Javelinfish	Minor	Yes
P2 Secondary	Rattails	Minor	Yes
P2 Secondary	Johnson's cod	Minor	Yes
P2 Secondary	Warty squid	Minor	Yes
P2 Secondary	Starfish	Minor	Yes
P2 ETP	Basking shark		No
P2 ETP	Chatham Island albatross		No
P2 ETP	Salvin's albatross		No

Component	Scoring elements	Designation	Data-deficient
P2 ETP	New Zealand fur seal		No
P2 ETP	Corals (4 groups)		No
P2 Habitat	Continental Slope characterized by fine substrate, flat or low relief, and dominated by no fauna, though some small erect fauna may be present in patches.	Commonly encountered	No
P2 Habitat	UTFs characterized by hard substrate/outcrop, outcrop, and large and small erect biota.	VME	No
P2 Ecosystem	Kermedic Bioregion	Ecosystem	No

7.3.5 Principle 2 Performance Indicator scores and rationales

PI 2.1.1 – Primary species outcome

PI 2.1.1		The UoA aims to maintain primary species above the point where recruitment would be impaired (PRI) and does not hinder recovery of primary species if they are below the PRI		
Scoring Issue		SG 60	SG 80	SG 100
a	Main primary species stock status			
	Guide post	Main primary species are **likely** to be above the PRI. OR If the species is below the PRI, the UoA has measures in place that are **expected** to ensure that the UoA does not hinder recovery and rebuilding.	Main primary species are **highly likely** to be above the PRI. OR If the species is below the PRI, there is either **evidence of recovery** or a demonstrably effective strategy in place **between all MSC UoAs which categorise this species as main**, to ensure that they collectively do not hinder recovery and rebuilding.	There is a **high degree of certainty** that main primary species are above the PRI **and are** fluctuating around a level consistent with MSY.
	Met?	NWCR – Y ESCR – Y 7A-WB - Y	NWCR – Y ESCR – Y 7A-WB - Y	NWCR – Y ESCR – Y 7A-WB - Y
Rationale				

QMS stocks are considered as “primary species” when they have reference point management, and “secondary species” for QMS species without reference point management and for non-QMS species. The assessment team considered main species as those that make up ≥5% of the total catch in a UoA, except for vulnerable species that reach or exceed 2% of the total catch; in an effort to accommodate stakeholder requests, the assessment team made an additional exception for shark species, which are considered main at ≥1% of the total catch).

Catch composition by weight for each of the three UoAs was determined by MPI based on observer sampling data sourced from FNZ for the three-year period 2017-18 to 2019-20. Observed catches are scaled up to estimated total catches using observer coverage rates, but catch proportions would remain the same for observed or scaled up catches.

See Section 7.3.2 for more details on primary species in the UoA.

NWCR
Targeted orange roughy trawl tows account for 54.2% of the total estimated catch by weight (Table 29). No primary species reached the 2% or 5% threshold for main species. NWCR main species default to SG100.

ESCR
Targeted orange roughy trawl tows account for 93.5% of the total estimated catch by weight (Table 32). No species reached the threshold for main species, so no main species are considered for this UoA. Main species default to SG100

7A-WB
Targeted orange roughy trawl tows account for 93.9% of the total estimated catch by weight (Table 33). No other species met the threshold for main species. The next-most abundant QMS species is spiky oreo at 1.2% of the catch and ribaldo at 0.8%. No other species met 0.5% of the total catch for primary species. With no main species, the score defaults to SG100.

b	Minor primary species stock status

	Guide post			Minor primary species are highly likely to be above the PRI. OR If below the PRI, there is evidence that the UoA does not hinder the recovery and rebuilding of minor primary species.
	Met?			NWCR – Y ESCR – Y 7A-WB – N
Rationale				

NWCR
Minor species consist of hoki, smooth oreo and hake. For more detail on status of the minor species, see section 7.3.2.1.

The OEO4 management area for smooth oreo (reporting code SSO) overlaps the NWCR and ESCR UoAs. A 2019 stock assessment of SSO in OEO4 estimated B_{2018} at 40%B_0 for the base model (FNZ 2021). B_{2018} is 'About as Likely as Not (40-60%)' to be at or above the target of 40%B_0. Stock projections indicate there would be little change in biomass over the next five years at annual catches of 2,300 – 3,000 t (Cordue, 2019). The catch limit for SSO in OEO4 is currently 2,600 t (DWG, 2021). The probability that the status of SSO in OEO4 is less than 20% B0 is about 0.01, and 0.00 probability that the status is less than 10% B0. These probabilities provide evidence that smooth oreo is highly likely above PRI.

The hoki HOK1 management area incorporates all three UoA. Two subpopulations (Eastern and Western) occur, and apparently do not mix, although both may occur on Chatham Rise. Morphometric and ageing studies have found consistent differences between adult hoki taken from the two main dispersion areas (Chatham Rise and Sub-Antarctic), and from the two main spawning grounds in Cook Strait and WCSI (FNZ 2021). These differences demonstrate that there are likely two sub-populations (eastern and western) of hoki that may represent genetic differences between the two sub-populations, or just the result of environmental differences between the Chatham Rise and Sub-Antarctic. Deterministic *BMSY* estimates are no longer calculated for hoki. Instead, the target range of 35% *B0* to 50% *B0* is used as a proxy for the likely range of credible *BMSY* estimates. The base model shows eastern and western subpopulations within the management range of 35-50% BMSY. For the eastern stock, the estimated probability of being less than the soft or the hard limit at the end of the five-year projection period was less than 10%. Current eastern biomass estimates were 48% *B0* for the base model, and 49% for an alternate model. The current total biomass was estimated to be 40% *B0* for the base model and 38% *B0* for alternate models. Exploitation rates for the eastern stock (Figure 4) consistently fall in or the below the target fishing intensities that would cause the spawning biomass to tend to 35% *B0* and 50% *B0*, respectively. These probabilities provide evidence that hoki is highly likely above PRI.

Hake is a minor species in ORH 3B NWCR and ESCR. B_{2020} for hake in this area was estimated to be about 55%% B_0 (

Table 31), and Likely (> 99%) to be at or above the target (FNZ 2021). B_{2020} is Exceptionally Unlikely (< 1%) to be below the Soft or Hard Limits. These probabilities provide evidence that hake is highly likely above PRI. This meets the SG100.

ESCR
Orange roughy in targeted orange roughy trawl tows account for 89.33% of the total estimated catch by weight (Table 32). The next-most abundant QMS species is smooth oreo at 2.3% of the catch, so is considered in secondary species. No other QMS species make up over 0.5% of the catch. The discussion of smooth oreo above for NWCR applies also for the ESCR. Smooth oreo has substantially more than 80% likelihood of exceeding the hard and soft limits (20% and 10% B0), so exceed the threshold for highly likely that the species are above PRI (FNZ 2021). This meets the SG100.

7A-WB
The next-most abundant QMS species after orange roughy is spiky oreo at 1.28% of the catch and ribaldo at 0.81% (Table 33). These species meet the definition of minor species. No other QMS species met 0.5% of the total catch,

so none are considered further. Neither spikey oreo nor ribaldo is highly likely above PRI (FNZ 2021), so do not meet SG100.

References

FNZ 2021. https://www.mpi.govt.nz/science/fisheries-science-research/about-our-fisheries-research/;
AEBR 2018 http://www.mpi.govt.nz/news-and-resources/publications/;

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**More information sought:** The species composition of primary, secondary, and ETP species for each UoA was given to the assessment team in a different format from that received for the initial assessment, resulting in a three year average rather than a five year average. The assessment team requests species composition data as catch data for the past five years.

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.1.2 – Primary species management strategy

PI 2.1.2		There is a strategy in place that is designed to maintain or to not hinder rebuilding of primary species, and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place for the UoA, if necessary, that are expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are likely to be above the PRI.	There is a **partial strategy** in place for the UoA, if necessary, that is expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are highly likely to be above the PRI.	There is a **strategy** in place for the UoA for managing main and minor primary species.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

See Section 7.3.2 for more details on primary species management in the UoA.

No main primary species occur in any UoA, so they default to SG80. The QMS requires assessment of all managed species and requires vessels in the QMS to report all catches. As no discards are allowed, catches represent total removals. Based on the assessments, MPI establishes TAC and TACC for each QMS species. MPI tracks landings against the TACC to assure compliance. Observer coverage in the fishery generally exceeds 20% (Table 27, Table 28), commonly reaches 50%. The minor retained species fall under the same QMS requirements. This requires keeping landings within TACCs, a strategy for maintaining species within biological limits or rebuilding them if necessary. This meets the SG60, SG80, and SG100 levels.

b	Management strategy evaluation			
	Guide post	The measures are considered **likely** to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/species).	There is some **objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the fishery and/or species involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly about the fishery and/or species involved.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

It is very clear that the strategy will work as designed. Many fisheries around the world use TAC-based management for assuring reasonable harvest rates that work to keep harvest at levels that keep stocks within biological limits, representing evidence that testing supports high confidence that the strategy will work. MSC certified hoki, hake and ling using the same management system further demonstrate the successful management of QMS species. MPI will add additional species to the QMS if information suggests that those species may need direct management; thereby extending the strategy as necessary. This meets the SG60, SG80, and SG100 levels.

c	Management strategy implementation			
	Guide post		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is **clear evidence** that the partial strategy/strategy is being **implemented successfully and is achieving its overall objective as set out in scoring issue (a).**

	Met?		**Yes**	**No**
Rationale				

The management system has kept catches within quotas and stocks at or near target reference points. The successfully certified hoki, hake, and ling fishery using the same management system provides further evidence that the strategy has been implemented successfully. A number of species have been added to the QMS in the past several years. All primary species fall under the requirements of the QMS, but implementation has been uneven, with some species not receiving the same level of attention as others. This meets the SG 80 level, but not SG100.

	Shark finning			
d	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The Fisheries (Commercial Fishing) Regulations 2001 prohibit shark finning and require that any shark fins landed must be naturally attached to the remainder of the shark, or artificially in the case of blue shark (MPI 2014 shark). However, an exception to the fins attached requirement is provided for seven QMS species to allow at-sea processing to continue. Since 1 October 2014 for species processed at sea, fishermen must store and land the fins separately by species. Fins must be landed wet to assure that fishermen are not retaining any more shark fins than the trunks they come from.

The ban requires all shark fins to be landed attached to the body of the shark for all non-Quota Management System (QMS) species and two QMS species (spiny dogfish and blue shark). In most cases, limited processing will be allowed (e.g. removal of the head) but the fins will still need to be attached to the body through some portion of uncut skin.

For seven QMS species (elephantfish, ghost shark, mako shark, pale ghost shark, porbeagle shark, rig, and school shark) fishers may land shark fins separately to the body of the shark but only in accordance with a gazetted fin to greenweight ratio. The ratio means that the weight of fins for a species of shark landed for a trip will be compared to the greenweight (whole weight) of that species of shark landed for that trip. Fishers may return some QMS sharks, dead or alive to the sea. All are reported and counted against the total allowable catch for the species and against a fisher's annual catch entitlement. This assures receiving good data on shark mortalities. The Minister's letter to stakeholders https://www.mpi.govt.nz/fishing-aquaculture/sustainable-fisheries/protecting-marine-life/shark-conservation-and-management/shark-finning-ban/) explaining the decision to ban shark finning stated that most sharks are fully utilized, and gave examples of accommodations in the regulations to encourage utilization; e.g., allowing artificial attachment of fins for blue sharks to avoid discarding.

Observer coverage averages above 25% in all areas except from 2015-16 through 2019-20. The close relationship between DWG and MPI means that the industry has committed to the MPI conservation requirements that prohibit finning. The catch of sharks is small, in the range of tens of tons (Table 29, Table 32, and Table 33). The amount of value in shark fins relative to the penalties for violations provides strong disincentives against occurrence of shark finning. The fishery enforcement in New Zealand puts a focus on preventing violations, including monitoring catches, both in person and electronically.

As a member of the West and Central Pacific Fisheries Commission (WCPFC), New Zealand has agreed to comply with WCPFC Conservation and Management Measure 2019-04 (https://www.wcpfc.int/doc/cmm-2019-04/conservation-and-management-measure-sharks), which requires full utilization of sharks and prohibits shark finning.

There is onboard observer coverage (Table 27, Table 28) and other equivalent evidence that shark finning is not taking place. The observer coverage in all areas exceeds the 20% level for 'good external validation' observer coverage at the SG80 level. All UoA have other elements that add assurance that shark finning does not occur. Under CB3.6.6.2 d. the SG100 requirement states: "There is onboard observer coverage of all operations to provide evidence that shark finning is not taking place. Under GCR V1.3:
GCB2.5.4, the Guidance gives examples of electronic monitoring and port sampling as examples of alternatives to onboard observers. MPI has confirmed that compliance with shark finning regulations, in addition to at-sea monitoring, is monitored through in-port inspections, inspections of licensed fish receivers, detailed analysis of data collected through the comprehensive reporting requirements of the QMS, and retrospective analysis across all data sources.

The assessment team concluded that for all UoA the extra monitoring conducted by MPI meets the requirement of CB2.5.7.2d “There is onboard observer coverage of all operations to provide evidence that shark finning is not taking place,” consistent with GCB2.5.4. The combination of regulations, observer coverage well above default levels in OHR 3B NWCR and ORH 7, on-board record keeping, and monitoring by enforcement agents provide evidence such that the assessment team considers a high degree of certainty that shark finning does not occur on any vessel in any UoA, reaching the SG60, SG80, and SG100.

e	Review of alternative measures			
	Guide post	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of all primary species, and they are implemented, as appropriate.
	Met?	**Yes**	**Yes**	**No**

Rationale

No main primary species occur in the fishery. This scoring issue defaults to SG80. Fishery regulations have undergone modification to simplify gear improvements. Regulations allow the use of innovative new trawl technologies on commercial fishing boats if they are demonstrated to have less impact on the environment, and can reduce by-catch of undersized fish, seabirds, and mammals. Nets must perform at least as well as an existing net in providing for the utilisation of fisheries resources while ensuring sustainability. The way fishers use the new net must also be consistent with any relevant fisheries plans. Therefore, regular review occurs as new designs are submitted for approval. This meets SG80. It is not clear that biennial review of alternative measures for all species occurs, thus not meeting SG100.

References

https://www.mpi.govt.nz/fishing-aquaculture/commercial-fishing/fisheries-change-programme/
https://www.mpi.govt.nz/fishing-aquaculture/sustainable-fisheries/protecting-marine-life/shark-conservation-and-management/shark-finning-ban/

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**More information sought.** The assessment team has received information to assure that no vessels or other entities in the fishery have been convicted of shark finning. The team received verbal assurance of no convictions, and expects written confirmation. The team has requested more information on review of alternative measures.

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.1.3 – Primary species information

PI 2.1.3		Information on the nature and extent of primary species is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage primary species		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impact on main primary species			
	Guide post	Qualitative information is **adequate to estimate** the impact of the UoA on the main primary species with respect to status. **OR** **If RBF is used to score PI 2.1.1 for the UoA:** Qualitative information is adequate to estimate productivity and susceptibility attributes for main primary species.	Some quantitative information is available and is **adequate to assess** the impact of the UoA on the main primary species with respect to status. **OR** **If RBF is used to score PI 2.1.1 for the UoA:** Some quantitative information is adequate to assess productivity and susceptibility attributes for main primary species.	Quantitative information is available and is **adequate to assess with a high degree of certainty** the impact of the UoA on main primary species with respect to status.
	Met?	**Yes**	**Yes**	**No**
Rationale				

No main primary species occur for any UoA. All QMS species must be retained, with logbook and landings records required, and observer coverage generally exceeds 25%. Therefore, accurate and verifiable information is available for all QMS species, meeting the SG80. However, the consequences of the catch are not known for all retained species, so not meeting the SG100 level.

b	Information adequacy for assessment of impact on minor primary species			
	Guide post			Some quantitative information is adequate to estimate the impact of the UoA on minor primary species with respect to status.
	Met?			**Yes**
Rationale				

The minor primary species – hoki, smooth oreo, and hake (NWCR) and smooth oreo (ESCR) – have outcome status estimates with respect to biological limits, as described in Performance Indicator 2.1.1. All three minor species have outcome status estimated with a high degree of certainty as above PRI and fluctuating around the target reference point (see Section 7.3.2 and Performance Indicator 2.1.1 for more detail). This meets SG100.

c	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage **main** primary species.	Information is adequate to support a **partial strategy** to manage **main** primary species.	Information is adequate to support a **strategy** to manage **all** primary species, and evaluate with a **high degree of certainty** whether the strategy is achieving its objective.
	Met?	**Yes**	**Yes**	**No**

Rationale

All QMS species must be retained, so the information (logbook and observer data) required for all species is high. Surveys further track key primary species. All QMS species are monitored against a TACC, which keeps exploitation to a set level. This meets the SG 80 level. However, the TACC is not based on an assessment for all species, leaving a gap in information for evaluating with a high degree of certainty whether the strategy is achieving its objective, thereby not meeting SG100.

References

The CAB shall list any references here, including hyperlinks to publicly-available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.2.1 – Secondary species outcome

PI 2.2.1		The UoA aims to maintain secondary species above a biologically based limit and does not hinder recovery of secondary species if they are below a biological based limit		
Scoring Issue		SG 60	SG 80	SG 100
	Main secondary species stock status			
a	Guide post	Main secondary species are **likely** to be above biologically based limits. OR If below biologically based limits, there are **measures** in place expected to ensure that the UoA does not hinder recovery and rebuilding.	Main secondary species are **highly likely** to be above biologically based limits. OR If below biologically based limits, there is either **evidence of recovery** or a **demonstrably effective partial strategy** in place such that the UoA does not hinder recovery and rebuilding. AND Where catches of a main secondary species outside of biological limits are **considerable**, there is either **evidence of recovery** or a, **demonstrably effective strategy in place between those MSC UoAs that have considerable catches of the species**, to ensure that they collectively do not hinder recovery and rebuilding.	There is a **high degree of certainty** that main secondary species are above biologically based limits.
	Met?	**Rattail – Y** **Johnson's cod – Y**	**Rattail – Y** **Johnson's cod – Y**	**Rattail – N** **Johnson's cod – N**
Rationale				

For ORH3B NWCR, two non-QMS species, none of which have reference point management, make up ≥5% of the total catch: rattail (14.6%), Johnson's cod (5.7%) (Table 29). No other species reached main status. The assessment team expects that rattail and Johnson's cod will require assessment using RBF, because neither is assessed to or managed with target or limit reference points. However, other information suggests that the stocks will meet the SG80, and can be used to adjust results from the RBF.

Although stock assessments are not conducted for rattails and Johnson's cod, trawl surveys have monitored relative abundance on the Chatham Rise since 1992, including Bollon's rattail. In 2010, the surveys added a number of species, including four-rayed rattail and Johnson's cod. Bollon's rattail has shown no trends in abundance for the period since 1992, and four-rayed rattail no trends since 2010 (Figure 20). Johnson's cod (Figure 21, Figure 23, and Figure 24) has shown no trends in abundance for the period since 2010. The lack of trends provides evidence that fishing is not jeopardizing the stocks, as they continue to reproduce at consistent levels over the time series available, qualitatively equivalent to 80% probability that they are above biological limits. The available evidence does not meet the threshold for high degree of certainty, so does not meet SG100. The team may use this information to adjust scores if the RBF is used.

	Minor secondary species stock status			
b	Guide post			Minor secondary species are highly likely to be above biologically based limits. OR

				If below biologically based limits', there is evidence that the UoA does not hinder the recovery and rebuilding of secondary species
	Met?			**No**

Rationale

NWCR
The minor species consist of slickhead (2.59%), javelinfish (1.54%), smallscale brown slickhead (0.84%, and morid cods (0.75%), long-nosed chimaera (1.00%), seal shark (0.81%), deepwater dogfish (0.68%), and shovelnosed dogfish (0.68%) (Table 29). No other species reached the 0.5% threshold for further consideration. The assessment team may score minor secondary species with RBF.

Lack of stock assessments precludes a determination that the minor species are highly likely to be above biologically based limits, so the SG100 is not reached.

ESCR
The most abundant non-QMS finfish species, Johnson's cod (family Moridae), makes up 0.59% of the catch (Table 32). No other single species exceeds 0.5% of the overall catch.

Unidentified deepwater sharks (0.31%) make up the largest elasmobranch catch (Table 32). The single elasmobranch species with the greatest catch is shovelnose spiny dogfish (0.28%). The most abundant chimaerid is the long-nosed chimaera at 0.04% of the catch. As all elasmobranchs and chimaerids are less than 0.5% of the total catch, none are considered further.

Warty squid, at 0.63% of the catch, is the most abundant invertebrate species (Table 32) and is considered as a minor species. No other species made up 0.5% of the catch. Non-living material brought up in the nets includes small quantities of rocks and stones and miscellaneous rubbish and fishing textiles (Table 32The assessment team may score minor secondary species with RBF. Lack of stock assessments precludes a determination that the minor species are highly likely to be above biologically based limits, so the SG100 is not reached.

7A-WB
The largest non-QMS finfish component is the rattail species complex which makes up 0.7% of the catch (Table 33). Unidentified deepwater sharks (0.40%) make up the largest elasmobranch catch, while the most abundant chimaerid is the longnosed chimaera at 0.28% of the catch (Table 33). Unidentified octopus species, at 0.05% of the catch, are the most abundant of the invertebrates (Table 33). Non-living material brought up in the nets includes small quantities of rocks and stones and miscellaneous rubbish (Table 33). All non-QMS species are minor, and only rattail reach the 0.5% threshold for further consideration.

The assessment team may score minor secondary species with RBF. Lack of stock assessments precludes a determination that the rattail species are highly likely to be above biologically based limits, so the SG100 is not reached.

References

The CAB shall list any references here, including hyperlinks to publicly-available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**More information sought. The assessment team expects that RBF may used**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.2.2 – Secondary species management strategy

PI 2.2.2		There is a strategy in place for managing secondary species that is designed to maintain or to not hinder rebuilding of secondary species and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place, if necessary, which are expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be above biologically based limits or to ensure that the UoA does not hinder their recovery.	There is a **partial strategy** in place, if necessary, for the UoA that is expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be above biologically based limits or to ensure that the UoA does not hinder their recovery.	There is a **strategy** in place for the UoA for managing main and minor secondary species.
	Met?	**Yes**	**Yes**	**No**
Rationale				

There is a partial strategy in place consisting of monitoring non-QMS species with catch, observer, and survey data, and moving them to QMS as necessary. Species can be added to the QMS under Section 17B of the Fisheries Act and/or the species managed under Section 11 of the Act. Section 17B of the Act requires adding stocks or species to the QMS if the existing management does not ensure sustainability or does not provide for utilization. A QMS Introduction Process Standard (Mfish, 2008) provides a framework formalising the procedure for moving non-QMS species within the QMS framework, and monitoring 'minor' QMS species status and trends. The management system introduced two species into the QMS in 2010: Patagonian toothfish (Ministry of Fisheries, 2010a) and attached bladder kelp (Ministry of Fisheries, 2010b). The latter was added to the QMS in part because the Ministry of Fisheries concluded that there was increasing demand for the species.

New Zealand has implemented a National Plan of Action – Sharks (MPI 2013) that sets policy for utilization and protection of sharks. The Deepwater Group has produced shark Operational Procedures (DWG 2021) to implement the NPOA. The NPOA and the shark Operational Procedures focus on protection of protected sharks, prohibition of shark finning, proper release of sharks to maximize survival, and improved identification. There was a notable decrease in non-commercial bycatch in 2010-11 and 2011-12 (MPI & DWG 2013) as a result of a decrease in fishing effort and decreases in catch limits. The low density but widespread distribution of some sharks make avoiding catch difficult. The fisheries are unlikely to hinder recovery because of the small amounts of sharks and other elasmobranchs taken annually. Therefore, all UoA fisheries reach both the SG 60 and SG 80 guideposts. No strategy for direct management occurs, precluding the SG100.

The NPOA Seabirds 2020 is New Zealand's third iteration of a National Plan of Action. NPOA Seabirds 2020 focuses on education, partnering to find innovative solutions to bycatch mitigation, and ensuring that all fishers know how and are taking all practicable steps to avoiding seabird bycatch. Mitigation methods such as streamer (tori) lines, Brady bird bafflers, warp deflectors, and offal management are used in the orange roughy, oreo, and cardinalfish trawl fisheries (FNZ 2021). Warp mitigation was voluntarily introduced from about 2004 and made mandatory in April 2006 (Department of Internal Affairs 2006). The 2006 notice mandated that all trawlers over 28 m in length use a seabird scaring device while trawling (being "paired streamer lines", "bird baffler" or "warp deflector" as defined in the notice).

New Zealand's regulatory requirements for seabird mitigation, for application by all vessels 28 metres or greater in length, include:

- Deployment of at least one type of seabird scaring device during all tows
- Management of fish waste discharge so as not to attract seabirds
- of seabird risk associated with trawl nets
- Minimisation of seabird risk associated with deck landings and vessel impacts
- Correct handling of seabirds that land on the deck or impact with the vessel (FNZ, 2020b).

Therefore, all UoA fisheries reach both the SG 60 and SG 80 guideposts. No strategy for direct management occurs, precluding the SG100.

	Management strategy evaluation			
b	Guide post	The measures are considered **likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar UoAs/species).	There is **some objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the UoA and/or species involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly about the UoA and/or species involved.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Moving non-QMS species to QMS will work to protect species if the monitoring demonstrates ability to detect sustainability or utilisation issues. Elasmobranchs, rattails, and Johnson's cod make up the bulk of the non-orange roughy catch. Elasmobranchs, rattails, and Johnson cod on the Chatham Rise have not shown marked increases or decreases in trawl surveys (Section 7.3.2), suggesting that a partial strategy of monitoring and reacting as necessary has worked (Figure 19, Figure 20, Figure 21, and Figure 22). FNZ will continue to monitor interactions with sharks by the orange roughy fisheries and considers that the planned risk assessment and additional management actions under the NPOA-Sharks 2013 will mitigate any risks. Orange roughy fishing effort has decreased over the past decade or so, which further reduces pressure on secondary species. The fact of ongoing transfers to QMS and the observation that abundance of secondary species remains at safe abundance provide some objective basis that the partial strategy will work, reaching the SG80. There is not high confidence in the strategy due to uncertainty in the non-QMS monitoring, therefore not reaching the SG100.

	Management strategy implementation			
c	Guide post		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is **clear evidence** that the partial strategy/strategy is being **implemented successfully and is achieving its objective as set out in scoring issue (a).**
	Met?		**Yes**	**No**
Rationale				

FNZ clearly monitors many non-QMS species through catch data, observer data, and surveys. The monitoring has led to movement of non-QMS species to QMS as necessary. Available evidence points out that New Zealand has prohibited shark finning and has implemented release protocols of sharks to maximize survival. Even though identification of deepwater dogfish is not completely effective, the DWG Operational Procedures manual has provided information to vessel operators that improved identification. FNZ continues to monitor catches of dogfish and other non-QMS species with a commitment to implement protective measures when and if necessary. Elasmobranchs, rattails, and Johnson cod on the Chatham Rise have not shown marked increases or decreases in trawl surveys (Section 7.3.2), suggesting that partial strategy of monitoring and reacting as necessary has worked (Figure 19, Figure 20, Figure 21, and Figure 22). This reaches the SG60 and SG80 levels. However, it is not clear that all non-QMS species that may need protection get moved to QMS with adequate management measures due to some uncertainty in the monitoring, thereby not reaching SG100.

	Shark finning			
d	Guide post	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The Fisheries (Commercial Fishing) Regulations 2001 prohibit shark finning and require that any shark fins landed must be naturally attached to the remainder of the shark, or artificially in the case of blue shark (MPI 2014 shark). However, an exception to the fins attached requirement is provided for seven QMS species to allow at-sea processing to continue. Since 1 October 2014 for species processed at sea, fishermen must store and land the fins separately by species. Fins must be landed wet to assure that fishermen are not retaining any more shark fins than the trunks they come from.

The ban requires all shark fins to be landed attached to the body of the shark for all non-Quota Management System (QMS) species and two QMS species (spiny dogfish and blue shark). In most cases, limited processing will be allowed (e.g. removal of the head) but the fins will still need to be attached to the body through some portion of uncut skin.

For seven QMS species (elephantfish, ghost shark, mako shark, pale ghost shark, porbeagle shark, rig, and school shark) fishers may land shark fins separately to the body of the shark but only in accordance with a gazetted fin to greenweight ratio. The ratio means that the weight of fins for a species of shark landed for a trip will be compared to the greenweight (whole weight) of that species of shark landed for that trip. Fishers may return some QMS sharks, dead or alive to the sea. All are reported and counted against the total allowable catch for the species and against a fisher's annual catch entitlement. This assures receiving good data on shark mortalities. The Minister's letter to stakeholders https://www.mpi.govt.nz/fishing-aquaculture/sustainable-fisheries/protecting-marine-life/shark-conservation-and-management/shark-finning-ban/) explaining the decision to ban shark finning stated that most sharks are fully utilized, and gave examples of accommodations in the regulations to encourage utilization; e.g., allowing artificial attachment of fins for blue sharks to avoid discarding.

Observer coverage averages above 25% in all areas except from 2015-16 through 2019-20. The close relationship between DWG and MPI means that the industry has committed to the MPI conservation requirements that prohibit finning. The catch of sharks is small, in the range of tens of tons (Table 29, Table 32, and Table 33). The amount of value in shark fins relative to the penalties for violations provides strong disincentives against occurrence of shark finning. The fishery enforcement in New Zealand puts a focus on preventing violations, including monitoring catches, both in person and electronically.

As a member of the West and Central Pacific Fisheries Commission (WCPFC), New Zealand has agreed to comply with WCPFC Conservation and Management Measure 2019-04 (https://www.wcpfc.int/doc/cmm-2019-04/conservation-and-management-measure-sharks), which requires full utilization of sharks and prohibits shark finning.

There is onboard observer coverage (Table 27, Table 28) and other equivalent evidence that shark finning is not taking place. The observer coverage in all areas exceeds the 20% level for 'good external validation' observer coverage at the SG80 level. All UoA have other elements that add assurance that shark finning does not occur. Under CB3.6.6.2 d. the SG100 requirement states: "There is onboard observer coverage of all operations to provide evidence that shark finning is not taking place.
Under GCR V1.3:
GCB2.5.4, the Guidance gives examples of electronic monitoring and port sampling as examples of alternatives to onboard observers. MPI has confirmed that compliance with shark finning regulations, in addition to at-sea monitoring, is monitored through in-port inspections, inspections of licensed fish receivers, detailed analysis of data collected through the comprehensive reporting requirements of the QMS, and retrospective analysis across all data sources. The assessment team concluded that for all UoA the extra monitoring conducted by MPI meets the requirement of CB2.5.7.2d "There is onboard observer coverage of all operations to provide evidence that shark finning is not taking place," consistent with GCB2.5.4. The combination of regulations, observer coverage well above default levels in OHR 3B NWCR and ORH 7, on-board record keeping, and monitoring by enforcement agents provide evidence such that the assessment team considers a high degree of certainty that shark finning does not occur on any vessel in any UoA, reaching the SG60, SG80, and SG100.

	Review of alternative measures to minimise mortality of unwanted catch			
e	Guide post	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of main secondary species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of main secondary species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of all secondary species, and they are implemented, as appropriate.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Fishery regulations have undergone modification to simplify gear improvements. Regulations allow the use of innovative new trawl technologies on commercial fishing boats if they are demonstrated to have less impact on the environment, and can reduce by-catch of undersized fish, seabirds, and mammals. Nets must perform at least as well as an existing net in providing for the utilisation of fisheries resources while ensuring sustainability. The way fishers use the new net must also be consistent with any relevant fisheries plans. Therefore, regular review occurs as new designs are submitted for approval. This meets SG80. It is not clear that biennial review of alternative measures for all species occurs, thus not meeting SG100.

References

https://www.mpi.govt.nz/dmsdocument/3962/direct#:~:text=The%20National%20Plan%20of%20Action,of%20seabirds%20in%20our%20fisheries.&text=The%20NPOA%20Seabirds%202020%20is,a%20national%20plan%20of%20action).

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**More information sought.** The assessment team has requested information to assure that no vessels or other entities in the fishery have been convicted of shark finning. The team received verbal assurance of no convictions and expects written confirmation. The team has requested more information on review of alternative measures.

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.2.3 – Secondary species information

PI 2.2.3		Information on the nature and amount of secondary species taken is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage secondary species		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impacts on main secondary species			
	Guide post	Qualitative information is **adequate to estimate** the impact of the UoA on the main secondary species with respect to status. OR **If RBF is used to score PI 2.2.1 for the UoA:** Qualitative information is adequate to estimate productivity and susceptibility attributes for main secondary species.	Some quantitative information is available and **adequate to assess** the impact of the UoA on main secondary species with respect to status. OR **If RBF is used to score PI 2.2.1 for the UoA:** Some quantitative information is adequate to assess productivity and susceptibility attributes for main secondary species.	Quantitative information is available and **adequate to assess with a high degree of certainty** the impact of the UoA on main secondary species with respect to status.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Catches of the top three non-QMS species are required to be reported in e-logbooks. Landings of all species are required to be reported, and observer coverage generally exceeds 25% in each UoA. Trawl surveys track key secondary species. Therefore, accurate and verifiable information is available for all non-QMS species, meeting the SG80. However, the consequences of the catch are not known for all secondary species, so not meeting the SG100 level.

RBF may be used to score some secondary species, and the logbook, landings, and survey data may be used to adjust RBF scores.

b	Information adequacy for assessment of impacts on minor secondary species			
	Guide post			Some quantitative information is adequate to estimate the impact of the UoA on minor secondary species with respect to status.
	Met?			**No**
Rationale				

The three top non-QMS species require logbook and landings records, and observer coverage generally exceeds 25% in each UoA. Trawl surveys track key secondary species. Therefore, accurate and verifiable information is available for all non-QMS species, meeting the SG80. However, the consequences of the catch are not known for all secondary species, so not meeting the SG100 level.

RBF may be used to score some secondary species, and the logbook, landings, and survey data may be used to adjust RBF scores.

c	Information adequacy for management strategy

	Guide post	Information is adequate to support **measures** to manage **main** secondary species.	Information is adequate to support a **partial strategy** to manage **main** secondary species.	Information is adequate to support a **strategy** to manage **all** secondary species, and **evaluate** with a **high degree of certainty** whether the strategy is **achieving its objective**.
	Met?	**Yes**	**Yes**	**No**

Rationale

The overall objective of the bycatch management strategy is to monitor non-QMS species and protect them by moving them to QMS if sustainability or utilisation issues arise. Trends in secondary species logbook, observer, and survey data are sufficient to point out issues of concern for secondary species. These trends and other analyses of the data will provide the management system with information to use in determining whether to move species from non-QMS to QMS. This supports the partial strategy for managing secondary species, meeting SG60 and 80. A high degree of certainty on the status of secondary species does not exist, precluding SG100.

Logbook, observer, and survey data may be used with RBF to adjust RBF scores.

References

The CAB shall list any references here, including hyperlinks to publicly-available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**More information sought** – The team may use RBF for analysis of secondary species.

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.3.1 – ETP species outcome

PI 2.3.1		The UoA meets national and international requirements for the protection of ETP species The UoA does not hinder recovery of ETP species		
Scoring Issue		SG 60	SG 80	SG 100
a	Effects of the UoA on population/stock within national or international limits, where applicable			
	Guide post	Where national and/or international requirements set limits for ETP species, the **effects of the UoA** on the population/ stock are known and **likely** to be within these limits.	Where national and/or international requirements set limits for ETP species, the **combined effects of the MSC UoAs** on the population /stock are known and **highly likely** to be within these limits.	Where national and/or international requirements set limits for ETP species, there is a **high degree of certainty** that the **combined effects of the MSC UoAs** are within these limits.
	Met?	**NA**	**NA**	**NA**
Rationale				

NA – No National or International limits set for ETP species encountered.

b	Direct effects			
	Guide post	Known direct effects of the UoA are likely to not **hinder recovery** of ETP species.	Direct effects of the UoA are **highly likely** to not **hinder recovery** of ETP species.	There is a **high degree of confidence** that there are no **significant detrimental direct effects** of the UoA on ETP species.
	Met?	All areas: Mammals -Y Birds-Y Reptiles-Y Fishes-Y Coral-Y	All areas: Mammals -Y Birds-Y Reptiles-Y Fishes-Y Coral: Y	All areas: Mammals-Y Birds-Y Reptiles-Y Fishes-Y Coral-N
Rationale				

Fishes. Deepwater trawling for orange roughy and oreo typically exceeds the depth at which protected fish species are usually found (FNZ 2021). Fisheries-reported records include the capture of a single basking shark (*Cetorhinus maximus*) in 2019, a species classified as "Endangered" by IUCN in 2013 and as "Threatened – Nationally Vulnerable" in 2016, under the New Zealand Threat Classification System (Duffy et al 2018). Basking shark has been a protected species in New Zealand since 2010, under the Wildlife Act 1953, and is also listed in Appendix II of the CITES convention. However, basking sharks have been occasionally confused with bluntnose sixgill shark (*Hexanchus griseus*), a "Not Threatened" species according to the DOC latest assessment (Duffy et al 2018), and this report is being verified. An observer-reported capture includes a single smalltooth sandtiger shark (deepwater nurse shark) *Odontaspis ferox* in 2012, classified as "Critically Endangered" by the IUCN Red List and "At Risk- Naturally Uncommon" under the New Zealand Threat Classification System. Therefore, one each of two protected shark species has been reported since 2012, representing a *di minimis* quantity. For practical purposes, ETP fishes are not an issue. Therefore, there is high degree of certainty that no significant detrimental impacts occur for ETP fishes.

Seabirds. Orange roughy fishing vessels in the three orange roughy UoA have relatively few seabird or marine mammal captures (FNZ 2021). Salvin's albatross was the most frequently captured albatross (46% of observed albatross captures) but seven other albatross species have been observed captured since 2002–03 (FNZ 2021). Cape petrels were the most frequently captured other taxon (35% of other taxon observed caught not including albatross species). Seabird captures in the orange roughy, oreo, and cardinalfish fisheries have been observed mostly around the Chatham Rise and off the east coast South Island. The orange roughy fisheries have a negligible impact on seabird populations, with only ten observed captures in the Chatham Rise UoAs and three observed captures in the ORH 7A UoA over the recent 5-year period. In 2018–19 the six observed seabird captures in the ORH 3B UoAs were four Chatham Island albatross (of which two were released alive), one white-chinned petrel, and one common diving

petrel (released alive). In 2018–19 there were no observed captures of seabirds in the ORH 7A UoA and no estimates of total captures were made (Figure 25).

Annual observed seabird capture rates in the orange roughy, oreo and cardinalfish trawl fisheries have ranged from 0 to 0.9 per 100 tows between 2002–03 and 2017–18 (Table 34) (FNZ 2021). The average observed capture rate in deepwater trawl fisheries (including orange roughy, oreo and cardinalfish) for the period from 2002–03 to 2017–18 is about 0.31 birds per 100 tows, a very low rate relative to other New Zealand trawl fisheries, e.g., for scampi (4.43 birds per 100 tows) and squid (13.79 birds per 100 tows) over the same years.

Mammals. Orange roughy fishing vessels in the three orange roughy UoA have relatively few marine mammal captures (FNZ 2021). Marine mammals of concern for the deepwater fisheries focus on New Zealand fur seals. Trawlers targeting orange roughy, oreo, and black cardinalfish occasionally catch New Zealand fur seal (which were classified as "Not Threatened" under the New Zealand Threat Classification System in 2010, Baker et al 2016; Baker et al 2019) (FNZ 2021). Between 2002–03 and 2007–08, there were 15 observed captures of New Zealand fur seal in deepwater (orange roughy, oreo, and black cardinalfish) trawl fisheries. There has been one observed capture in the period between 2008–09 and 2017–18, during which time the average level of annual observer coverage was 26.7%. Corresponding mean annual estimated captures in this period ranged 0–3 (mean 1.25) based on statistical capture models (Table 35). All observed fur seal captures occurred in the Sub-Antarctic region. Across the different target fisheries, the highest relative fur seal capture rates were in mackerel and southern blue whiting fisheries, with the lowest capture rate in trawl fisheries targeting deepwater species (Abraham et al 2021). FNZ (2019) reports no interactions with marine mammals in ORH 7A in the last ten years. FNZ (2021) further reports one observed fur seal capture between the 2013/14 and 2017/18 fishing years (average observer coverage was 27% over the five years).

Coral. A key tool used for assessing the probable effects of trawl fishing on protected coral communities on the Chatham Rise has been to assess the extent of overlap between the fishery footprint and areas where coral is known to occur, using coral capture locality records collected by MPI's Scientific Observer Programme and using coral locality data from New Zealand's Research Database (MRAG, 2016).

The method involves coral capture localities being expressed as areas of 1 km x 1 km extent which are then overlaid with the recent trawl footprint to provide an indication of probable fishery impact. However, the observer and research datasets are both deficient in areal coverage as noted in in MRAG (2016).

The observer capture localities are collected entirely from within the fishing grounds, and as the NWCR and ESCR ORH/OEO fisheries have swept only 5% and 6% of these UoAs respectively over the 30-year period 1989-90 to 2018-19, the potential for underestimation of coral distribution is evident (i.e. more than 94% has not been "sampled" for corals). This brings a very conservative bias to an analysis of the extent of overlap of the trawl fishery footprint against the observer coral dataset.

The research dataset, while not restricted to the trawl grounds, similarly cannot be assumed to be representative of the distribution over the entire extent of the Chatham Rise UoAs, either by area or depth, as it is predominantly based on trawl survey records, which have the objective of assessing the biomass of fished stocks and not the nature and extent of epibenthic fauna. These are strong reasons not to rely solely on the observer or research coral datasets as a basis for assessing the impact of UoA fisheries on corals, and the reason for the conservative evaluation by the assessment team during the full assessment (i.e. this was the best information we had at the time).

The combined trawl footprint for ORH/OEO-targeted and HAK/HOK/LIN-targeted tows ≥800 m for the 2017-18 to 2019-20 fishing years was assessed against updated observer-reported and vessel-reported coral data and the Research coral locality dataset (the 'observed' distribution) for the period 2017-18 to 2019-20. Importantly, the 2017-18 fishing year marked the commencement of catch locality reporting at a finer resolution (i.e. longitude and latitude to 4 decimal places, or less than 20 m) (FNZ, 2019), than previously (i.e. to the nearest minute of arc, or about 1.852 nm). This new reporting regulation has negated the requirement for random jittering of tow start and finish positions, which was previously applied to trawl datasets to provide a more realistic spread of effort and should improve the precision of the trawl footprint estimate.

The overlap of the 2017-18 to 2019-20 trawl footprint with the updated 'observed' coral distribution is greater than that previously considered by the assessment team (Black, 2021). This is due to the inclusion of HAK/HOK/LIN-targeted trawl tows that occurred within the ORH/OEO fishery depth range, as is required by the MSC Standard. (Table 1). It is important to note, however, that as much of the 'observed' coral distribution records originate from the fishing vessels themselves, the trawl footprint overlap will be significantly biased on the high side.

Table 1: Observer-reported coral captures (2017-18 to 2019-20), vessel-reported coral captures (2017-18 to 2019-20) and Research coral dataset (2017-18 and 2018-19) expressed as a 1 km square, centred at the reported location/tow. Trawl footprint is for ORH/OEO targeted tows and HOK/HAK/LIN targeted tows ≥ 800 m depth.(Black, 2021).

UoA	Coral Group	Estimated coral distribution from observed records (km^2)	Overlap of 2017-20 footprint with observed coral distribution (km^2)	Overlap with observed coral distribution (%)
ORH3B NWCR	Black corals – O. Antipatharia	3.00	1.35	44.97%
	Gorgonian corals – O. Alcyonacea	10.00	4.58	45.80%
	Stony corals – O. Scleractinia	36.77	8.85	24.06%
	Hydrocorals – O. Anthoathecata	4.00	0.00	0.00%
ORH3B ESCR	Black corals – O. Antipatharia	13.73	8.88	64.67%
	Gorgonian corals – O. Alcyonacea	31.06	16.90	54.43%
	Stony corals – O. Scleractinia	42.00	13.43	31.98%
	Hydrocorals – O. Anthoathecata	3.00	0.91	30.33%
ORH7A-WB	Black corals – O. Antipatharia	19.81	12.54	63.31%
	Gorgonian corals – O. Alcyonacea	36.63	18.45	50.36%
	Stony corals – O. Scleractinia	7.00	3.05	43.57%
	Hydrocorals – O. Anthoathecata	2.00	0.00	0.00%

In the knowledge of the deficiencies and biases of analyses based on the observed coral distribution for assessing fishery impact, a lot of time and effort has been applied to the development of models to produce predicted coral habitat distributions (e.g. Anderson et al., 2014, 2015, 2019).

Although the assessment team determined that the Anderson et al. (2014) predicted habitat distribution model could not be relied upon as an indicator of true coral distribution at the time of the full assessment, the predicted coral distributions have been subsequently twice revised and updated through incorporation of additional data and model types (Anderson et al., 2015, 2019). These revisions have advanced the methodologies used and have produced modified predicted coral distributions in the UoA areas.

The Anderson et al. (2015) predicted habitat distribution differed from the Anderson et al. (2014) outputs in that the methodology used was slightly different in consideration of real coral absence data from the benthic stations dataset (i.e. as opposed to 'pseudo-absence' data used in the 2014 study), and in interpolating the models to the resolution of the true sea floor topography rather than the modelled sea floor.

The predicted coral distributions were broadly similar to those in Anderson et al. (2014) but were more in alignment with sea floor bathymetry. The trawl footprint for the 2017-18 and 2018-19 fishing years was plotted against the Anderson et al. (2015) predicted coral distributions at the >50th percentile level for each of the four protected coral groups (Table 2).

Table 2: Overlap of the combined 2017-18 and 2018-19 trawl footprint against the updated predicted habitat distribution of Anderson et al. (2015) for black, gorgonian and stony corals. Note: determination of 50th percentile occurrence is based on the predicted coral distribution across the entire New Zealand region (Black, 2020).

Coral Group	UoA	Predicted coral distribution >50th percentile (km^2)	Overlap of 2017-19 footprint with predicted coral distribution (km^2)	% overlap with predicted coral distribution
Black corals – O. Antipatharia	ORH 3B NWC R	9,620	113	1.18%
Gorgonian corals – O. Alcyonacea		7,008	325	0.96%
Stony corals – O. Scleractinia		33,906	11	0.15%
Black corals – O. Antipatharia	ORH 3B ESC R	26,637	847	3.18%
Gorgonian corals – O. Alcyonacea		33,058	589	1.78%
Stony corals – O. Scleractinia		15,312	90	0.59%

Although the biases (in opposite directions) inherent in both the observed and predicted coral distributions are acknowledged, the 'truth' probably lies somewhere between the two, and with updated methods and data, the assessment team is more confident in the more recent predicted coral distribution data as compared with the initial assessment, particularly as cross-verified by the data generated through the swath mapping research described in 2, below.

1. Swath mapping assessment of areas of hard benthic habitat (HBH)

The Orange Roughy Management Company conducted a side-scan sonar survey on the Chatham Rise in 1994 using the industry vessel FV *Arrow* (Figure 1) (Patchell, 2019). The purpose of the survey was to identify areas of interest for orange roughy fishing, primarily UTFs. The survey followed the 1,000 m depth contour around the Chatham Rise and provided coverage of depths between 800 and 1,400 m on average (i.e. the main orange roughy fishery depths). The survey system recorded digital bathymetry and acoustic backscatter data from which swath maps were generated (Figure 2).

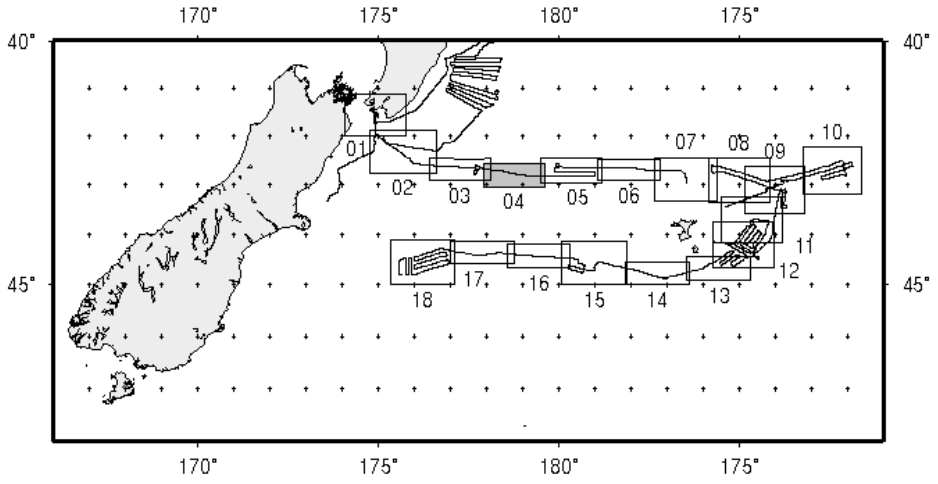


Figure 1: Side-scan survey tracks on the Chatham Rise from the 1994 survey aboard FV *Arrow*.

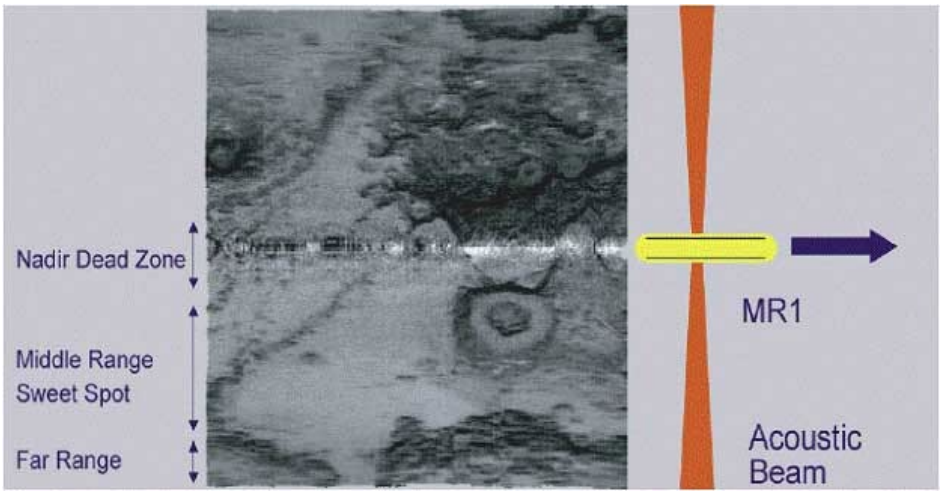


Figure 2: Swath image from side-scan sonar data showing volcanic cones and other bathymetric features. Harder benthic substrata have stronger acoustic reflectivity and show up as darker grey shades. Softer sediments (mud and sand) show up as lighter grey shades.

Interpretation of the swath imagery was supported using skippers' local knowledge of the grounds. The side-scan sonar imagery from the 1994 survey was made available to fishing vessels in printed and digital form, the latter being loaded onto plotters for real-time use while trawling. Interviews with over 20 skippers, who had used the imagery over many years while fishing and who had accumulated knowledge and detailed experiences of the fishing grounds, were used to ground-truth the side-scan imagery and to delineate areas of soft and hard substrate on the Chatham Rise. In combination, the bathymetry, swath maps and skippers' knowledge enabled the identification of large areas of rocky substratum interspersed within the broader sandy and muddy substrata that make up much of the Chatham Rise. Analysis of the swath-mapped acoustic data over the range of fishable depths enabled the characterisation of large areas of HBH, which are assumed likely to support coral growth.

A total of 772 km2 of HBH was identified in the NWCR UoA and 3,517 km2 in the ESCR UoA, amounting to 4.4% and 9.2% of the respective UoA areas. Less than 7% of this identified HBH area on the Chatham Rise has been traversed by trawl (Table 3). This, in combination with the fact that the survey covered only a small portion of the Chatham Rise, further reduces the uncertainty associated with the probability of unacceptable impacts of these fisheries on ETP corals.

A substantial part of the Kermadec Bioregion that supports the ETP coral groups discussed here, lies outside of the New Zealand EEZ (Figure 19). There are, therefore, substantial areas of coral habitat and coral abundance outside of the EEZ (e.g. Clark et al., 2015). While parts of the area outside of the EEZ have also been fished for orange roughy, as evidenced by the fishery on the Westpac Bank, the fishing is managed by the conservation and management measures (CMMs) set by the non-tuna RFMO, SPRFMO3, and implemented by its members. The vast majority of the SPRFMO Convention Area (>98%) is not fishable, being deeper than 2,000m (Table 3.1.1.1. Williams et al., 2011). Of the 1.1% of the SPRFMO Convention Area that is shallower than 2,000 m, about 0.5% is deeper than 1,500 m and thus deeper than orange roughy fisheries normally operate, has never been fished and is not within any footprint declared to SPFRMO. This means that >99% of the SPRFMO Convention Area is either outside of the combined Australian and NZ footprint and therefore formally closed to bottom fishing by the binding bottom fishing CMM implemented by SPRFMO, or effectively inaccessible to bottom fishing due to depth.

In 2019, DWG commissioned analyses to determine the depth distributions for the four protected coral groups both in New Zealand waters and internationally (Finucci et al., 2019). The analysis for the New Zealand region revealed that they had a wide depth distribution ranging from very shallow depths down to 2,500 m and beyond. Antipatharia (black corals), Alcyonacea (gorgonian corals) and Scleractinia (stony corals) were frequently encountered at orange roughy fishery depths (800 – 1,200 m), with the latter also prevalent at shallower depths. Anthoathecata (hydrocorals) were less abundant at orange roughy depths and more abundant in shallower waters. Note that these records are largely from commercial trawl and research trawl and dredge catches and that there has been very little sampling at depths greater than ~1,600 m. DWG knowledge of the relative coral abundance deeper than this in New Zealand waters is poor. The analysis of the international databases revealed broadly similar overall depth distributions but with differences in abundance of records by depth compared to New Zealand. The international databases showed a higher abundance of records at depths greater than 1,000 m for Antipatharia (black corals) and Alcyonacea (gorgonian corals), and fewer for Scleractinia (stony corals) and Anthoathecata (hydrocorals) (Figure 5).

[3] www.sprfmo.int

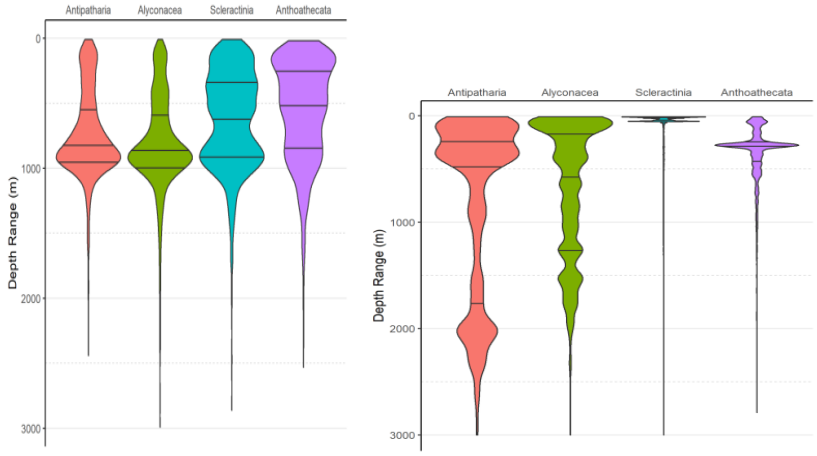


Figure 5: Violin plots illustrating coral capture records by 10 m depth bins for the four ETP coral groups from the New Zealand database (left) and the international database (right). Widths are representative of the numbers of coral records at each depth interval. Horizontal lines represent inter-quartile ranges. Note that these shapes are indicative rather than determinative as there will be sampling biases in the source data.

The analysis from the New Zealand database show that all four ETP coral groups occur both shallower and deeper than the depths prosecuted by Chatham Rise orange roughy fisheries and may well prove to be more abundant at depths greater than the depths fished in the NWCR and ESCR UoAs than (Figure 6 in Condition 2 results).

It is apparent from these analyses that the depth distribution of protected corals, in New Zealand waters and internationally, extends well beyond, both shallower and deeper, than the ~800 m to 1,200 m operational depths of the two UoA fisheries on the Chatham Rise and that trawling in each of the two UoAs will have only limited overlap with the known habitat ranges of these four coral groups in New Zealand.

In addition, Scleractinian corals are found at depths below those at which the orange roughy fisheries operate (see Figure 54 in Clark *et al.*, 2015). For depth distribution of tows see Figure 4 in MFish, 2008). Williams *et al.* (2011) provide estimates of areas by depth zone, with the area in South Pacific Regional Fisheries Management Organisation (SPRFMO) Convention Area between 1,500 m and 2,000 m deep, which has seen very little fishing. Within the SPRFMO Convention Area, the unfished area was estimated at 273,389 km^2 which represents about 43% of the area between 200 m and 2,000 m (Williams *et al.*, 2011). This represents a considerable area for coral to exist without disturbance from fishing.

However, according to Clark *et al.* (2011) connectivity of fauna between UTFs is important for maintaining the productivity of the system. The dispersal capabilities of benthic invertebrates are not well known, but a review of inshore invertebrate taxa indicated most were able to disperse less than 100 km (Kinlan and Gaines 2003). So while it is true that a substantial area of coral habitat within the bioregion as a whole is unimpacted by fishing, it is possible that fished UTFs isolated by 100 km or more from other UTFs will have slower recolonization that more connected UTFs. The time scale of the recolonization would depend on what recruitment could occur from more distant features and on the amount or coral remaining on the fished UTF.

In 2019 DWG commissioned an analysis to determine the degree of spatial connectivity between individual UTFs known to have coral in the NWCR and ESCR UoAs. The analysis showed that coral-bearing UTFs in the NWCR UoA are separated by a few tens of km at most. In the ESCR UoA there is only one UTF (Mt Muck), which is more than 100 km from the nearest coral-bearing UTF. There is, however, a very large area of slope habitat known to support coral just to the west of Mt Muck, as well as in areas to the east of it (Figure 7), (B. de Jong, pers. comm.). All of the rest of the ESCR UTFs are well clustered and interspersed with known areas of coral on slope habitat between them. This information on the distances between known coral locations on UTF and slope habitat within the UoAs is suggestive of reasonably good connectivity between them and leads to the assumption that coral larval dispersal between the identified coral habitat may be possible given favourable ocean current conditions.

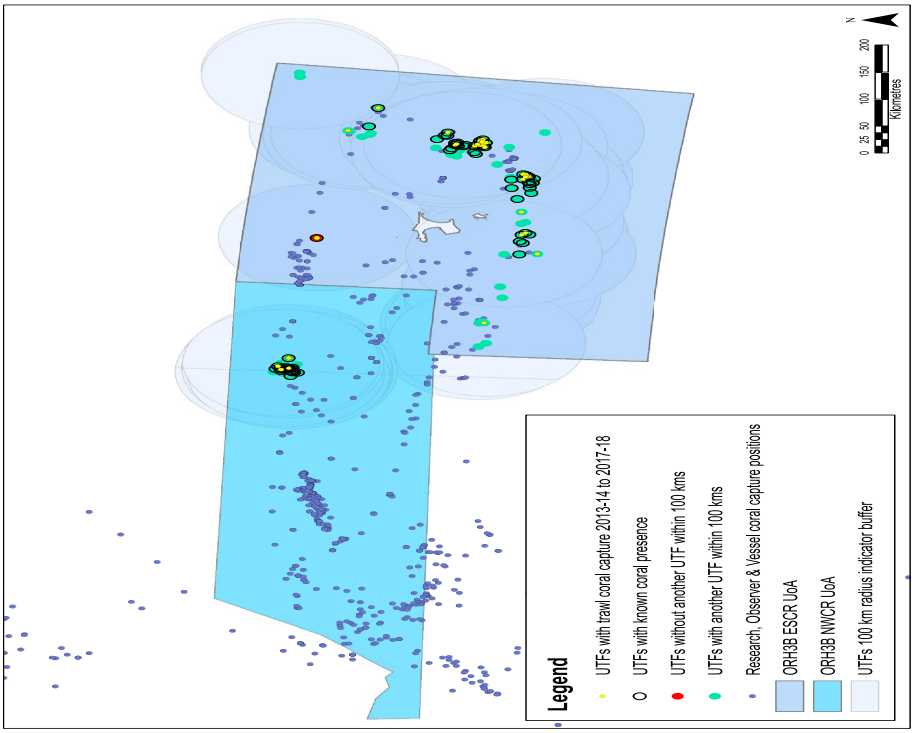


Figure 7: UTF localities (small circles), 100 km radius buffer areas around UTFs (large circles) and coral capture positions (blue dots) within the NWCR and ESCR UoA areas. The red dot in ESCR indicates the Mt Muck UTF.

Dunn & Devine (2010) showed that there was a general, eastward current flow along the north-west Chatham Rise at 900 m depth and postulated that a gyre situated to the north of the Graveyard UTF complex at ~180^0 longitude could help to retain orange roughy eggs and larvae spawned there.

It is not unreasonable to suggest that these currents could have a similar effect on coral propagules. In the NWCR UoA, they would likely be dispersed from west to east along the north Rise until they encountered the gyre, and then be retained. Further to the east, in the ESCR UoA, coral propagules could similarly be dispersed by these deep currents in an easterly and then southerly direction around the eastern edge of the Rise (Figure 8).

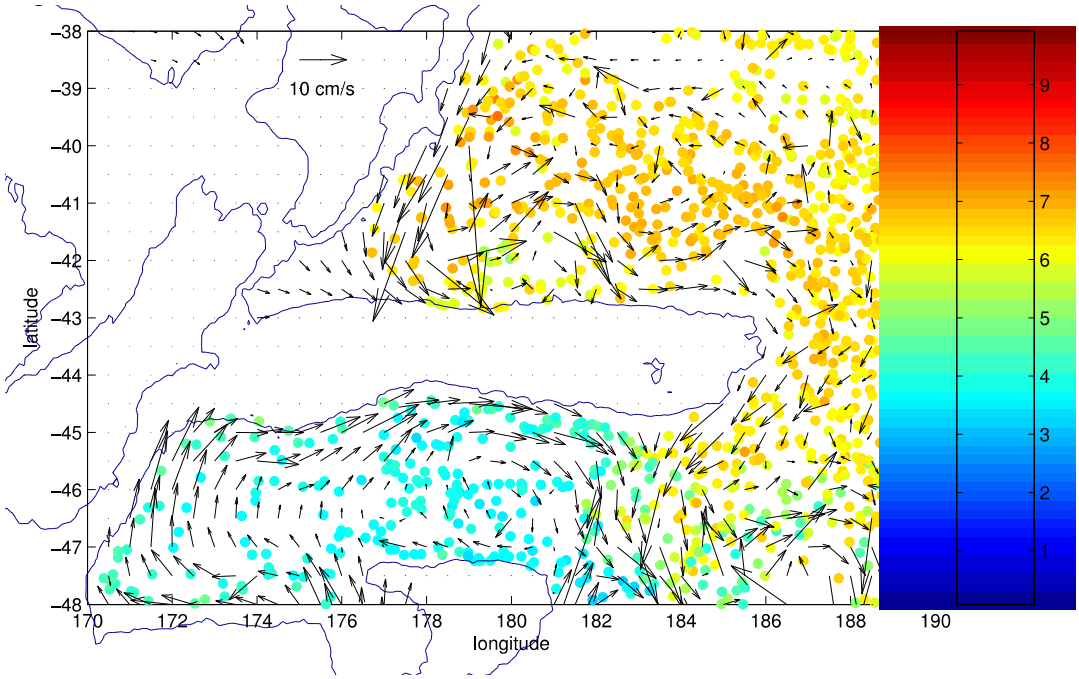


Figure 8: The Chatham Rise showing sea temperature (°C) measured at 900 m from Argo profiles (dots) with estimates of current velocity at 900 m overlaid (arrows). A gyre is evident on the northern edge of the Rise at ~180^{0}E. Further eastwards the currents are easterly and then southerly around the eastern edge of the Rise. A cold, easterly current flows along the southern edge of the Chatham Rise (After Dunn & Devine, 2010).

Potential evidence for dispersal distances for propagules of sessile invertebrates on the Chatham Rise is provided by a genetic study on a non-planktotrophic, benthic quill worm *Hyalinoecia longibranchiata*. A high degree of genetic connectivity was detected between samples taken from individuals on the northeast Chatham Rise approximately 240 km apart, and between samples taken from individuals on the southwest Chatham rise up to 400 km apart, but samples from the northeastern and southwestern areas, separated by an average distance of approximately 750 km, were genetically distinct. It was noted that the Sub-Tropical Front current system may have presented a barrier to genetic connectivity between the two sampling sites (Bors et al., 2012).

Zeng et al. (2017), suggested that dispersal distances of deepwater stony coral species may be related to oocyte size, where species with larger oocytes may have greater dispersal capability due to their greater energy resources resulting in longer larval stages. In a study involving three Scleractinian corals they found that *Madrepora oculata*, which has the largest mean oocyte size (2-3 times larger than other two species), was the only species for which significant differentiation amongst populations on large geomorphic features such as the Chatham Rise was not observed. The two other species, *Goniocorella dumosa* and *Solenosmilia variabilis*, which have smaller mean oocyte diameter, exhibited less connectivity on individual geomorphic features.

While coral connectivity is a complex issue, being dependent on a number of factors such as reproductive mode, current patterns and the scale of geographic separation, indications are that at the scale of the Chatham Rise UoAs there is a high likelihood of reasonably good connectivity for corals exhibiting sexual reproduction.

A project aimed at investigating the extent of genetic connectivity for New Zealand deep water corals is currently underway (POP 2018-06). The project will review the literature on genetic connectivity focussing on species highlighted by the pilot ERA (Clark et al., 2014) as being 'high risk'. The information will be used to inform and support the identification of coral populations for management purposes should this prove necessary. It is envisaged that the data and information from the project will be used in a benthic risk assessment for trawl fisheries (CSP, 2018).

Therefore, it can be said, for NWCR and ESCR, that direct effects of orange roughy fishing are highly unlikely to create unacceptable impacts to ETP species and the SG80 is met.

c	Indirect effects			
	Guide post		Indirect effects have been considered for the UoA and are thought to be **highly likely** to not create unacceptable impacts.	There is a **high degree of confidence** that there are no **significant detrimental indirect effects** of the UoA on ETP species.
	Met?		**All areas Fishes, Seabirds, and Marine Mammals – Yes Coral - Y**	**No**
Rationale				

No ETP species have been identified where orange roughy is a significant element of its diet, and the levels of by-catch are low, thus competition between the fishery and ETP species for food is extremely unlikely (Dunn 2013). This provides evidence that ETP fishes, seabirds, and marine mammals do not experience indirect impacts, meeting SG80. Studies have not been sufficient to document a high degree of confidence that indirect impacts do not occur, so the fishery does not meet SG100 for ETP fishes, seabirds, and marine mammals.

Regarding corals, studies as reported in MPI (2015) show the possibility of indirect trawl impacts on corals created from the trawl 'sediment plume,' particularly over soft substrates.

UTFs considered to be heavily fished still contain diverse assemblages of corals and other epibenthic fauna and no difference in species numbers or community structures in coral-dominated UTFs within or outside of protected areas (coral dominance indicated no or only light fishing) has been observed (Consalvey, 2006; Clark et al., 2015b). This suggests that coral diversity continues to be maintained on fished UTFs, as most UTFs are fished only on established tow lines, leaving areas of many UTFs unfished because the seabed is too rough or steep to trawl, or where orange roughy do not aggregate. Recent information from trawl surveys supports a conclusion that coral will remain well established on fished UTFs, although not at the density prior to trawling.

However, as there are no known studies specifically examining sediment mobilization by fishing gear in deep-sea fisheries and its effects, there is not a high degree of confidence that there are no significant detrimental indirect effects of the fisheries on ETP species in the UoCs under assessment. SG100 is not likely to be met for corals.

References

https://www.mpi.govt.nz/dmsdocument/3962/direct#:~:text=The%20National%20Plan%20of%20Action,of%20seabirds%20in%20our%20fisheries.&text=The%20NPOA%20Seabirds%202020%20is,a%20national%20plan%20of%20action;

Dunn 2013; O'Driscoll et al 2011

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.3.2 – ETP species management strategy

PI 2.3.2		The UoA has in place precautionary management strategies designed to: - meet national and international requirements; - ensure the UoA does not hinder recovery of ETP species. Also, the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of ETP species		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place (national and international requirements)			
	Guide post	There are **measures** in place that minimise the UoA-related mortality of ETP species, and are expected to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **strategy** in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **comprehensive strategy** in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to **achieve above** national and international requirements for the protection of ETP species.
	Met?	**All groups-Yes**	**All groups-Yes**	**All groups-No**
Rationale				

National requirements for protection and rebuilding are described at length in the ETP background section, though none of these requirements set limits, as is required under 2.3.1 a.

The strategic framework for managing protected species interactions with deepwater fisheries currently includes:
- Legislation: the Fisheries Act, Wildlife Act, and Marine Mammals Protection Act
- The National Plan of Action – Sharks (MPI 2013)
- The Annual Operational Plan for Deepwater Fisheries (MPI 2020)
- The National Fisheries Plan for Deepwater and Middle-depth Fisheries (Ministry of Fisheries 2020)
- The Marine Conservation Services Programme (e.g., Conservation Services Programme Annual Plan 2021/22)
- The National Plan of Action—Seabirds (MPI 2020)

When impacts of fishing are such that they are causing an adverse effect on the Marine Environment (Fisheries Act s 2, s8), measures are to be taken pursuant to the Conservation Act 1987 and the Director-General of where the Department of Conservation will implement measures, including:
- research relating to those effects on protected species:
- research on measures to mitigate the adverse effects of commercial fishing on protected species:
- the development of population management plans under the Wildlife Act 1953 and the Marine Mammals Protection Act 1978.

DWG employs an Environmental Liaison Officer (ELO) who visits factory vessels and fresh fish trawlers involved in all deepwater fisheries to provide training on mitigation and best practices, check vessel management plans, and check seabird mitigation equipment. The ELO is on 24 hour call, and monitors observer data for significant capture events. See Section 7.33 for more details.

Fish The NPOA—sharks contains explicit long-term and short-term objectives for minimizing fisheries related mortality for these ETP species groups and include practical operational measures to support overarching policy objectives. The NPOA also has a built-in system for analysis of data collected through fishery dependent and independent sources on an ongoing basis, and regular review of this analysis designed to feedback to management for further action if necessary (NPOA-Sharks, 2013).

Seabirds The NPOA-Seabirds contains explicit long-term and short-term objectives for minimizing fisheries related mortality for these ETP species groups and include practical operational measures to support overarching policy objectives. The NPOA also has a built-in system for analysis of data collected through fishery dependent and independent sources on an ongoing basis, and regular review of this analysis designed to feedback to management for further action if necessary (NPOA-Seabirds, 2013). New Zealand's regulatory requirements for seabird mitigation, for application by all vessels 28 metres or greater in length, include itigation methods such as streamer (tori) lines,

Brady bird bafflers, warp deflectors, and offal management are used in the orange roughy, oreo, and cardinalfish trawl fisheries (FNZ 2021). Warp mitigation was voluntarily introduced from about 2004 and made mandatory in April 2006 (Department of Internal Affairs 2006). The 2006 notice mandated that all trawlers over 28 m in length use a seabird scaring device while trawling (being “paired streamer lines”, “bird baffler” or “warp deflector” as defined in the notice).

Mammals The Department of Conservation administers the Marine Mammals Protection Act 1978, which provides for the conservation, protection and management of marine mammals (https://www.doc.govt.nz/about-us/our-role/managing-conservation/marine-mammal-conservation/). A permit is required under the Act for anyone to 'take' a marine mammal. The definition of 'take' includes actions that harm, harass, injure and attract. The development of the commercial fisheries resource in New Zealand has resulted in the incidental take (by-catch) of a number of marine mammal species. It is a requirement under the Act to report all events whereby a marine mammal is incidentally caught in the act of fishing. Observers further monitor for takes. In addition to monitoring, establishment of the marine mammal sanctuaries with no-fishing zone and by-catch limits set by the Minister of Fisheries have occurred in response to marine mammal takes.

The Plans and Measures described at the beginning of this scoring issue combined with protected fish-, seabird-, and marine mammal-specific plans and measures form a comprehensive strategy for management and protection of fish, seabirds, and marine mammals. This meets the requirements of SG60 and 80, but because they are not designed to achieve “above” national requirements, SG100 is not met.

Coral. The management of ETP coral species (and all other ETP species) in New Zealand falls under the Wildlife Act 1953. The Wildlife Act provides for partial protection of all species of corals in the orders Antipatharia (black corals), Gorgonacea (gorgonian corals), Scleractinia (stony corals) and of all species in the family Stylasteridae (hydrocorals). However, it is not prohibited to catch these corals in areas outside of designated protected areas (i.e. MPAs, BPAs, SCAs), and no catch limits are prescribed. Captures are required to be reported and are not allowed to be retained. Enforcement, including VMS, data, and reporting records confirm that protection requirements are being achieved with high likelihood, thus SG80 is met. As with the other ETP groups, SG100 is not met because this strategy is not designed to achieve above national requirements.

b	Management strategy in place (alternative)			
	Guide post	There are **measures** in place that are expected to ensure the UoA does not hinder the recovery of ETP species.	There is a **strategy** in place that is expected to ensure the UoA does not hinder the recovery of ETP species.	There is a **comprehensive strategy** in place for managing ETP species, to ensure the UoA does not hinder the recovery of ETP species.
	Met?	**NA**	**NA**	NA
Rationale				

Scoring issue A is scored for all ETP, so scoring issue b is not scored.

c	Management strategy evaluation			
	Guide post	The measures are **considered likely** to work, based on **plausible argument** (e.g. general experience, theory or comparison with similar fisheries/species).	There is an **objective basis for confidence** that the measures/strategy will work, based on **information** directly about the fishery and/or the species involved.	The strategy/comprehensive strategy is mainly based on information directly about the fishery and/or species involved, and a **quantitative analysis** supports **high confidence** that the strategy will work.
	Met?	**Yes**	**Yes**	**N-all groups**
Rationale				

There is an objective basis of confidence that the above-described strategy will work based on information directly about the fishery and species involved. Interactions between the orange roughy fisheries in the three UoC areas and protected mammals, seabirds, and sharks are minimal, particularly when compared with overall interactions with these species groups across NZ. This is at least in part owing to the strategy above with clear objectives and corresponding

operational procedures in place to minimize interactions between the orange roughy fisheries and ETP species. This meets the SG60 and SG80. Quantitative analyses are in partial use, but it is not clear that they produce high confidence, so not meeting SG100.

For ETP coral, VMS, observer and logbook records confirm that the strategy for achieving national requirements for protection is working. Fishing does not occur in protected areas, and coral encounters are recorded as required. SG80 is met. However, a lack of quantitative analysis, and noted issues with quantification of coral capture rates in trawl fisheries precludes a score of 100.

	Management strategy implementation			
d	Guide post		There is some **evidence** that the measures/strategy is being implemented successfully.	There is **clear evidence** that the strategy/comprehensive strategy is being implemented successfully and **is achieving its objective as set out in scoring issue (a) or (b).**
	Met?		**Y**	**Y-mammals, birds, sharks** **N-corals**
Rationale				

Good observer and VMS data on fishery interactions with protected species (including avoidance of protected corals inside and outside of BPAs; and the 100% observer coverage and VME-focused move-on rule outside the EEZ), and compliance with vessel operational procedures such as those designed to minimize capture of seabirds, provides clear evidence that the strategies described above are being implemented successfully. In addition, monitoring and review components of the strategies contained in the NPOAs for sharks and seabirds ensure the implementation of the strategies remain effective over time. This meets the SG60, SG80, and SG100 for mammals, birds, and sharks. For corals, the overarching management strategy is conceptually the same as for other ETP groups, however, there is not sufficient evidence that the strategic objectives are being met to score SG100. This is because, though data on coral encounters is collected and reported, there are noted issues with this data, and they may not be sufficient to determine whether the objectives of coral protection are being met.

	Review of alternative measures to minimise mortality of ETP species			
e	Guide post	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality ETP species, and they are implemented, as appropriate.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Fishery regulations have undergone modification to simplify gear improvements. Regulations allow the use of innovative new trawl technologies on commercial fishing boats if they are demonstrated to have less impact on the environment, and can reduce by-catch of undersized fish, seabirds, and mammals. Nets must perform at least as well as an existing net in providing for the utilisation of fisheries resources while ensuring sustainability. The way fishers use the new net must also be consistent with any relevant fisheries plans. Therefore, regular review occurs as new designs are submitted for approval. This meets SG80. It is not clear that biennial review of alternative measures for all species occurs, thus not meeting SG100.

References

The CAB shall list any references here, including hyperlinks to publicly-available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**

Information gap indicator	**More information sought** The team has requested more information on review of alternative measures.

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.3.3 – ETP species information

PI 2.3.3		Relevant information is collected to support the management of UoA impacts on ETP species, including: - Information for the development of the management strategy; - Information to assess the effectiveness of the management strategy; and - Information to determine the outcome status of ETP species		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impacts			
	Guide post	Qualitative information is **adequate to estimate** the UoA related mortality on ETP species. **OR** **If RBF is used to score PI 2.3.1 for the UoA:** Qualitative information is **adequate to estimate productivity and susceptibility** attributes for ETP species.	Some quantitative information is **adequate to assess** the UoA related mortality and impact and to determine whether the UoA may be a threat to protection and recovery of the ETP species. **OR** **If RBF is used to score PI 2.3.1 for the UoA:** Some quantitative information is **adequate to assess productivity and susceptibility attributes** for ETP species.	Quantitative information is available to assess with a high degree of certainty the **magnitude of UoA-related impacts, mortalities and injuries and the consequences for the status** of ETP species.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Sufficient information is available to allow fishery related mortality and the impact of fishing to be quantitatively estimated for all ETP species groups. This information includes interactions between the fishery and protected species from observer data, VMS tracks (in relation to coral habitat and BPAs), supported by ecological risk assessments pertaining to the likely effects of orange roughy fishing on ETP species (e.g. Boyd 2013). The MPI protected species bycatch database contains good records and analysis of fisheries interactions by gear, vessel size, and ETP bird, mammal and reptile species across NZ commercial fisheries. In addition, regular analysis and monitoring of the ORH fishery trawl footprint in relation to ETP coral groups is a relevant quantitative proxy for fishery related mortality on these benthic species. This provides quantitative information to assess impacts and track threats. However, there are only quantitative estimates of outcomes status for some ETP species and this is not sufficient to reach a high degree of certainty for consequences at the SG100 level.

b	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage the impacts on ETP species.	Information is adequate to measure trends and support a **strategy** to manage impacts on ETP species.	Information is adequate to support a **comprehensive strategy** to manage impacts, minimise mortality and injury of ETP species, and evaluate with a **high degree of certainty** whether a strategy is achieving its objectives.
	Met?	**Yes -All groups**	**Yes-Birds, mammals, reptiles** **No-Corals**	**No-All groups**
Rationale				

The strategic framework for managing protected species interactions with deepwater fisheries is described under PI 2.3.1.

When impacts of fishing are such that they are causing an adverse effect on the Marine Environment (Fisheries Act s2, s8), measures are to be taken pursuant to the Conservation Act 1987 and the Director-General of where the Department of Conservation will implement measures, including:

- research relating to those effects on protected species:
- research on measures to mitigate the adverse effects of commercial fishing on protected species:
- the development of population management plans under the Wildlife Act 1953 and the Marine Mammals Protection Act 1978.

Information collected through observers, vessel monitoring systems, research surveys, and other research projects, such as analyses in MPI (2015) making use of existing datasets to understand fishery interactions with protected species or sensitive habitats is sufficient to measure trends and support the above-described strategy for managing impacts on ETP species. This is sufficient to measure trends and support a strategy, meeting SG60 and 80 for birds, mammals and reptiles. However, it is not clear that information allows for analysis to demonstrate a high degree of certainty in achieving objectives, thus not meeting SG100 for these groups.

Regarding protected coral species, regular monitoring and reporting of the ORH trawl footprint in relation to coral habitat, trawl survey and fishery-reported coral captures provide trend data relevant for evaluation of the likely impact of the fishery on these protected species, meeting SG60. However, as described previously, there are known issues with the accuracy of this data, and the extent to which they can be used to meaningfully inform management decisions within the framework established by the Wildlife Act. Therefore at this time, though the SG60 is met, the SG80 is not.

References

The CAB shall list any references here, including hyperlinks to publicly available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**60-79**
Information gap indicator	**More information sought on coral population distributions, trends and fishery interactions.** **Information sufficient to score PI Fish, Seabirds, Marine Mammals**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.4.1 – Habitats outcome

PI 2.4.1		The UoA does not cause serious or irreversible harm to habitat structure and function, considered on the basis of the area covered by the governance body(s) responsible for fisheries management in the area(s) where the UoA operates		
Scoring Issue		SG 60	SG 80	SG 100
a	Commonly encountered habitat status			
	Guide post	The UoA is **unlikely** to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.	The UoA is **highly unlikely** to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.
	Met?	**Yes**	**Yes**	**No**
Rationale				

According to MSC definitions, a commonly encountered habitat is one with which the fishing gear used in the UOAs regularly comes in contact, considering the spatial overlap of fishing effort with the habitat's range within the management area(s) covered by the governance body relevant to the UoA. This definition instructive because it provides a guide on how to determine the geographical extent of the habitat relative to the fishing footprint of the UOAs. The commonly encountered habitat in this assessment is continental slope at depths between 700 and 1,200 meters, characterized by fine sediments such as mud or sand, flat or low relief geomorphology, and not fauna dominated, though some small and large erect fauna may be present in patches. Recent trawl footprints in relation to orange roughy habitat areas for each of the three UoAs are presented in the background section to Principle 2. Notable updates since the previous full assessment are as follows:

- In NWCR, most fishing has occurred on slope habitat to the south and west of the 180˚ hills in recent years
- In ESCR, the fishery has remained spread between UTF and slope habitat and much of the new area traversed has involved in-filling between existing trawl tracks within the traditional fishing grounds
- In ORH 7A-WB, there has been an expansion of the fishery towards the south-east, reflective of the fishery increasingly operating outside of the spawning aggregations as abundance has increased (the spawning area is in the extreme western part of ORH7A-WB)

While less is known about the ecosystems and habitats of continental slope areas at fishable depths for orange roughy, they are widespread, and extend well beyond the recent trawl footprint all the UoA areas, as well as across the New Zealand EEZ where orange roughy are known to occur. MSC requires at the 80 level that UoAs are "highly unlikely" to reduce structure and function of commonly encountered habitats to the point of serious or irreversible harm. They define serious or irreversible harm as reductions in habitat structure and function such that the habitat would be unable to recover at least 80% of its structure and function within 20 years if fishing on the habitat were to cease entirely. They define "highly unlikely" as less than a 30% chance. Given what is known about the spatial extent of slope habitat at these depths within the orange roughy distribution area inslde and outside the UoA areas, and the spatial extent of the fishery footprint, the SG80 is likely to be met. A lack of more detailed characterization of this habitat type, particularly evidence of recovery in previously fished areas, precludes a score of 100.

b	VME habitat status			
	Guide post	The UoA is **unlikely** to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.	The UoA is **highly unlikely** to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.
	Met?	**All UoAs-Yes**	**All UoAs Yes**	**All UoAs- No**
Rationale				

At this preliminary stage of assessment (ACDR), the assessment team has determined that UTFs should be classified as a VME habitat type, according to MSC's definitions, noting not all UTFs support vulnerable habitats but the

assessment team does not have the information necessary presently to decern this. This is elaborated more fully in the background section of P2. In the case of VMEs, MSC's definition of "serious or irreversible harm" is different to that of commonly encountered habitats,and defines this harm relative to "unimpacted level." Unimpacted level is again relative. MSC guidance says the following:

For VMEs the pre-existing historical extent of the habitat should be considered in the calculation of the current state of the VME in relation to unimpacted levels if the historical extent is known and if recovery in those areas of historical extent would be possible. If the habitat has been altered completely so that the pre-existing state does not exist, recovery of that state is not expected; however if recovery of the pre-existing state is possible, this should be considered.

The trawl footprint of orange roughy and oreo fisheries is monitored annually to assess the extent of their interactions with the benthic habitat (Baird & Mules, in press). The 2017-18 fishing year marked the commencement of catch locality reporting by vessels at a finer resolution (i.e. longitude and latitude to 4 decimal places, or less than 20 m), (FNZ, 2019), than previously (i.e. to the nearest minute of arc, or about 1.852 nm). This new reporting regulation has negated the requirement for random jittering of tow start and finish positions, which was previously applied to trawl datasets to provide a more realistic spread of effort and has improved the precision of the trawl footprint estimate. The outcome for orange roughy and oreo fisheries has been a slightly reduced estimated trawl footprint.

Baird & Mules (op. cit.) estimated that in 2018-19, all New Zealand OEO and ORH fisheries traversed 0.2% and 1.2% respectively of the EEZ fishable area between 800-1,600 m.

Within the three UoAs, ORH/OEO trawl footprint analyses indicate that the fisheries have traversed between 4.2% and 7.6% of the fishable area over the most recent three-year period 2017-18 to 2019-20. These are considerably smaller areas than were fished during the period of peak orange roughy fishing in the late 1980s and early 1990s. During the recent three-year period, new areas trawled have amounted to between 1.6% and 2.3% of the respective fishable grounds. Some of this fishing has occurred and continues to occur on UTFs, which can contain VME.

However, within and outside of the UoA areas within the New Zealand EEZ, only approximately 34% of "fishable" seabed areas shallower than 1,500m are open to fishing, and the rest is within BPAs and SCAs, and therefore not accessible to fishing.

New Zealand's strategy to guard against adverse effects on the benthic environment, as is required by the Fisheries Act 1996, includes multiple area closures in the EEZ. A total of 17 BPAs, representatively distributed around the EEZ (Helson et al., 2010), and 19 SCAs, collectively close 31% of the EEZ to bottom trawling (FNZ, 2019b). These closures protect:

- 28 percent of underwater topographic features (including seamounts)
- 50 percent of true seamounts (i.e. UTFs over 1,000 metres in elevation)
- 88 percent of known active hydrothermal vents.

Of the 142 known seamounts in the EEZ, 15 have ever been fished (i.e. 10.5%) and nine have been fished over the most recent 10-year period 2009-10 to 2018-19 (i.e. 6.3%). Thirty three percent of the fished seamounts are known to support coral.

Of the 535 known UTFs (comprising hills, knolls and seamounts, classified according to height from base to summit) in the New Zealand EEZ, 144 (27%) have been fished in recent years.

Given the relatively small spatial extent of fishing in the UoAs relative to the number and extent of UTFs that support VME, in addition to the low overlap between the fishery footprint and protected coral distributions (discussed more thoroughly in the ETP component), the UoAs individually and collectively are highly unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm and SG80 is likely to be met. Further analysis and information gathering is necessary to confirm this evaluation.

c	Minor habitat status			
	Guide post			There is **evidence** that the UoA is highly unlikely to reduce structure and function of the minor habitats to a point where there would be serious or irreversible harm.
	Met?			**No**

Rationale

Minor habitats have not been considered, thus the SG100 is not met.

References

The CAB shall list any references here, including hyperlinks to publicly-available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**More information sought on trends in fishery footprint and the extent to which increases in that footprint extend to UTF areas not previously or not recently fished, and evidence (e.g. coral captures) of VME on newly-fished UTFs.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.4.2 – Habitats management strategy

PI 2.4.2		There is a strategy in place that is designed to ensure the UoA does not pose a risk of serious or irreversible harm to the habitats		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place, if necessary, that are expected to achieve the Habitat Outcome 80 level of performance.	There is a **partial strategy** in place, if necessary, that is expected to achieve the Habitat Outcome 80 level of performance or above.	There is a **strategy** in place for managing the impact of all MSC UoAs/non-MSC fisheries on habitats.
	Met?	**Yes**	**Commonly encountered habitat-Yes** **VME-No**	**No**
Rationale				

Area closures as VME habitat protection, observers, and compliance monitoring all comprise at least a partial strategy expected to achieve the habitat outcome level of 80. SG 80 is likely to be met for commonly encountered habitats. For VME habitats, the "partial strategy" must include at least:

a. Requirements to comply with management measures to protect VMEs (e.g., designation of closed areas).

b. Implementation by the UoA of precautionary measures to avoid encounters with VMEs, such as scientifically based, gear- and habitat-specific move-on rules or local area closures to avoid potential serious or irreversible harm on VMEs.

For UTF habitats that may contain VME, point (a) is met (see background for a full discussion of closed area management). However, it is unclear at the time of writing the ACDR that point b is also met, because there is evidence that the trawl footprint is increasing, albeit slowly, and it could be possible that VME areas are encountered. Only the SPRFMO management area containing part of UOA 3 has relevant move-on rules, whereas the assessment team is unaware of any similar management measure in the Chatham Rise UoAs. Therefore, it is unknown whether the SG 80 is met for VME habitats.

b	Management strategy evaluation			
	Guide post	The measures are **considered likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar UoAs/habitats).	There is some **objective basis for confidence** that the measures/partial strategy will work, based on **information directly about the UoA and/or habitats** involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on **information directly about the UoA and/or habitats** involved.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Objective basis for confidence that the partial strategy will work/is working includes evidence that the restrictions on bottom fishing in MPAs and BPAs are effectively enforced. Orange roughy fishing in the UoA areas and elsewhere within the NZ EEZ is fully monitored through VMS and observer coverage and there have been no violations since the implementation of closed areas to bottom trawling by vessels targeting orange roughy. In addition, the quality of UTF and slope habitats, specifically coral composition and density is well mapped, studied and regularly monitored such that the objectives of the Fisheries Act 1996 which focuses on avoidance, mitigation or remedy of "any adverse effects of fishing on the aquatic environment" can be achieved. In addition, there are a series of criteria in development under the habitat protection standard that will be based around an assessment of the risk that fishing poses to each habitat type in question (MPI 2015).

The habitat assessment under this standard will take into account:

- how sensitive the biological and physical components of each habitat are;
- the reversibility of the likely impacts; and
- the relative importance of the habitat to ecosystem function.

And these criteria will be used on an ongoing basis to identify any new areas that are in need of protection based on research and monitoring results. Together, this meets the SG80. However, the partial strategy has not been tested.

c	Management strategy implementation			
	Guide post		There is **some quantitative evidence** that the measures/partial strategy is being implemented successfully.	There is **clear quantitative evidence** that the partial strategy/strategy is being implemented successfully and is achieving its objective, as outlined in scoring issue (a).
	Met?		**Yes**	**No**
Rationale				

Orange roughy fishing in the UoA areas and elsewhere within the NZ EEZ is fully monitored through VMS and observer coverage and there have been no violations since the implementation of closed areas to bottom trawling by vessels targeting orange roughy in any of the UoA areas. In addition, the quality of UTF and slope habitats, specifically coral composition and density is well mapped, studied and regularly monitored such that the objectives of the Fisheries Act 1996 which focuses on avoidance, mitigation or remedy of "any adverse effects of fishing on the aquatic environment" can be achieved. This provides evidence of successful implementation, and achieves the SG80. However, without better information on whether new VME habitat is encountered with a slowly expanding footprint within the UoAs, at the time of preparing the ACDR it is not clear that SG100 is met.

d	Compliance with management requirements and other MSC UoAs'/non-MSC fisheries' measures to protect VMEs			
	Guide post	There is **qualitative evidence** that the UoA complies with its management requirements to protect VMEs.	There is **some quantitative evidence** that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant.	There is **clear quantitative evidence** that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

All MSC and non-MSC fisheries within New Zealand are subject to the same management requirements and protection measures afforded to VMEs, and, as stated previously, there is clear quantitative evidence that these measures are complied with by the orange roughy fisheries.

References

The CAB shall list any references here, including hyperlinks to publicly-available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**60-79**
Information gap indicator	**More information sought to determine whether SG80 is met for scoring issue a for VME habitats.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.4.3 – Habitats information

PI 2.4.3		Information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat		
Scoring Issue		SG 60	SG 80	SG 100
a	Information quality			
	Guide post	The types and distribution of the main habitats are **broadly understood**. **OR** **If CSA is used to score PI 2.4.1 for the UoA:** Qualitative information is adequate to estimate the types and distribution of the main habitats.	The nature, distribution and **vulnerability** of the main habitats in the UoA area are known at a level of detail relevant to the scale and intensity of the UoA. **OR** **If CSA is used to score PI 2.4.1 for the UoA:** Some quantitative information is available and is adequate to estimate the types and distribution of the main habitats.	The distribution of all habitats is known over their range, with particular attention to the occurrence of vulnerable habitats.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Within the NZ EEZ and Kermadec Bioregion there is excellent information on the location and features of UTFs available from the Seamounts database managed by NIWA (SEAMOUNT V2 as described by Rowden et al. 2008). In addition, there is excellent information on the distribution of protected coral species within these areas broadly, and in the UoA areas specifically from a NIWA dataset of protected coral captures (both fisheries dependent and independent) that have been used to model observed and predicted coral distributions across fished and unfished areas (Baird et al., 2013; NIWA 2015). Particularly vulerable habitat types such as seamounts and hydrothermal vents are well mapped and monitored. There is also excellent data on the extent of interaction between the orange roughy fisheries in the three UoAs and the bioregion as a whole with slope habitats (Black et. al. 2015). Therefore, the distribution of commonly encountered and VME habitat types is known over the range, meeting SG60, SG80, but not SG100 because the distribution of all habitat types (including minor ones) is not known.

b	Information adequacy for assessment of impacts			
	Guide post	Information is adequate to broadly understand the nature of the main impacts of gear use on the main habitats, including spatial overlap of habitat with fishing gear. OR **If CSA is used to score PI 2.4.1 for the UoA:** Qualitative information is adequate to estimate the consequence and spatial attributes of the main habitats.	Information is adequate to allow for identification of the main impacts of the UoA on the main habitats, and there is reliable information on the spatial extent of interaction and on the timing and location of use of the fishing gear. OR **If CSA is used to score PI 2.4.1 for the UoA:** Some quantitative information is available and is adequate to estimate the consequence and spatial attributes of the main habitats.	The physical impacts of the gear on all habitats have been quantified fully.
	Met?	**Yes**	**Yes**	**No**

Rationale

Sufficient data on trawl footprint within the UoA areas under assessment are available to allow the nature of the impacts of the fishery on UTF and slope habitat types to be identified. And there is reliable information on the spatial extent of the interaction when considering the trawl footprint analysis and trawl tow location information (NIWA 2014) in combination with the habitat mapping described above under Scoring Issue A. While the physical impacts of the gear on habitat types have not been fully quantified, there is on-going collection of relevant data from observer, vessel monitoring and research programs providing robust information on trawl footprint and the impact of trawling on slope and UTF habitats for the fisheries. This meets the SG60 and SG80, but not the SG100.

c	Monitoring			
	Guide post		Adequate information continues to be collected to detect any increase in risk to the main habitats.	Changes in all habitat distributions over time are measured.
	Met?		**Yes**	**Yes**

Rationale

While the physical impacts of the gear on habitat types have not been fully quantified, there is on-going collection of relevant data from observer, vessel monitoring and research programs providing robust information on trawl footprint and the impact of trawling and recovery for the fisheries.

Through the implementation of MPIs benthic impacts/habitats strategy, habitat distributions are monitored on a regular basis with specific studies designed to measure the impacts of fishing and identify new areas potentially in need of protecting based on a fixed set of criteria (MPI 2015). This meets the requirements for detecting changes in risk, and changes in habitat distributions, meeting the SG 80 and SG100.

References

MPI, 2015c; NIWA 2014; NIWA 2015; Rowden et al. 2008; Baird et al. 2013

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**More information sought: updates on available information still need to be analyzed by the assessment team. The current text and scoring is from the 2016 full assessment.**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.5.1 – Ecosystem outcome

PI 2.5.1		The UoA does not cause serious or irreversible harm to the key elements of ecosystem structure and function		
Scoring Issue		SG 60	SG 80	SG 100
a	Ecosystem status			
	Guide post	The UoA is **unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	The UoA is **highly unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

According to the MSC, serious or irreversible harm in the ecosystem context should be interpreted in relation to the capacity of the ecosystem to deliver ecosystem services. Examples include trophic cascades, severely truncated size composition of the ecological community, gross changes in species diversity of the ecological community, or changes in genetic diversity of species caused by selective fishing.

As with the habitat component, it is reasonable to consider the orange roughy ecosystem as the area over which orange roughy is distributed within the Kemadec bioregion. The orange roughy fisheries in the three UoA areas are highly unlikely (<30% likelihood) to disrupt the key elements underlying ecosystem structure and function to a point where there would be serious or irreversible harm, based on evidence from species composition time series and trophic models.

There is a body of research on trophic interactions for orange roughy fisheries generally and trophic models have been developed that include orange roughy, and there is no evidence of loss of functional components or species in the ecosystem or significant changes in the composition of orange roughy prey, predators, or competitors based on catch composition in research trawls, fishery-dependant data, and stomach analyses (Dunn 2013). In addition, monitoring of mesopelagic biomass on the Chatham Rise has suggested no significant change between 2001 and 2010 (O'Driscoll *et al.*, 2011). Although this survey is predominantly at depths shallower than orange roughy, it is likely that the mesopelagic resources overlap with the orange roughy distribution depth range.

In addition, the low level of by-catch in the fisheries indicates direct ecosystem effects from removals are likely to be small, and the footprint of the orange roughy fishery in the three UoC areas is small relative to the orange roughy distribution area within the bioregion. Also, benthic impact that may damage ecosystem structure and function are restricted to <20% of the fishery management areas, and there are also areas that are currently fully protected from trawl impacts through the BPA approach. This provides evidence that the fishery is highly unlikely to disrupt structure and function to the point of serious harm, meeting the SG60, SG80, and SG100.

References

Dunn 2013; O'Driscoll et al 2011

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.5.2 – Ecosystem management strategy

PI 2.5.2		There are measures in place to ensure the UoA does not pose a risk of serious or irreversible harm to ecosystem structure and function		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place, if necessary which take into account the **potential impacts** of the UoA on key elements of the ecosystem.	There is a **partial strategy** in place, if necessary, which takes into account **available information and is expected to restrain impacts** of the UoA on the ecosystem so as to achieve the Ecosystem Outcome 80 level of performance.	There is a **strategy** that consists of a **plan**, in place which contains measures to **address all main impacts of the UoA** on the ecosystem, and at least some of these measures are in place.
	Met?	**Yes / No**	**Yes / No**	**Yes / No**
Rationale				

The New Zealand Fisheries Act 1996 s 8 provides for "the utilisation of fisheries resources while ensuring sustainability." Ecosystem-based management is achieved through a multi-layered approach that considers fishery management (e.g., QMS), vulnerable species needs (e.g., NPOA sharks), ETP management (a host of protected species and related initiatives such as NPOA Seabirds, NPOA Sharks, the protection of marine mammals, and habitat considerations (e.g. BPAs)). Vessel management plans deal specifically with achieving how avoidance and mitigation, and Marine Mammal Operational Procedures seek to minimise interactions with marine mammals.

Legislated protection of areas of sea bottom to fishing activities, coupled with good quality monitoring of all fisheries removals that might impact on trophic structure and function and management of fishery removals (e.g. through TACCs), and management of impacts to ETP species, although not with the explicit objective of maintaining ecosystem structure and function, work together to accomplish these objectives. Therefore they can be considered as a strategy that consists of a plan that is in place to ensure the fishery does not pose a risk of serious or irreversible harm to ecosystem structure and function, meeting the SG 60, SG80, and SG100.

b	Management strategy evaluation			
	Guide post	The **measures** are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar UoAs/ ecosystems).	There is **some objective basis for confidence** that the measures/ partial strategy will work, based on some information directly about the UoA and/or the ecosystem involved.	**Testing** supports **high confidence** that the partial strategy/ strategy will work, based on information directly about the UoA and/or ecosystem involved.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Data from the fishery, including observer data together with fishery independent surveys and other research projects are taken into account in the management of the fishery, such as for designation of BPAs, setting of TACCs, management of ETP species interactions, etc.

The measures listed under PI 2.5.1 either require some consideration of impacts (e.g. the Fisheries Act), take account of them with the intent of delivering better management (e.g. fisheries management objectives), or seek to manage them to reduce the environmental effects of fishing (e.g. ETP bycatch measures). In addition, research outcomes are fed back into management, although in the areas of ecosystem structure and function, stronger links could be developed. Where unacceptable impacts are detected, the current framework allows them to be addressed, including through fishery management measures.

However, management responses so far have addressed individual ecosystem components (e.g. target or other QMS species stock status, bycatch levels, habitat impacts) rather than broader ecosystem effects. Therefore, although

management measures naturally work together, this is not through a specific ecosystem design; they are currently not developed across ecosystem components/functions to the level required for the SG100 level. A score of 80 is therefore given.

	Management strategy implementation			
c	Guide post		There is **some evidence** that the measures/partial strategy is being **implemented successfully**.	There is **clear evidence** that the partial strategy/strategy is being **implemented successfully and is achieving its objective as set out in scoring issue (a).**
	Met?		**Yes**	**Yes**
Rationale				

With particular reference to individual ecosystem components (rather than functions), there is evidence that the strategy is being implemented successfully.

For example, stock assessments of the target and retained species and monitoring of incidental mortalities of ETP species are ongoing, combined with fishery-independent surveys for many areas, while TACCs and other control mechanisms are being monitored and for the main species adjusted where necessary. BPAs are monitored through observer and VMS coverage, and as part of the partial management strategy provide protection for benthic components to the orange roughy ecosystem inside and outside the EEZ. There is a high level of compliance with management limits on TACC species, ETP and bycatch mitigation measures, and BPAs. There is therefore evidence that the approaches are being implemented successfully. This meets the SG 80 and SG100.

References

Dunn 2013; Heymanns et. al 2011; Clark et al 1989; O'Driscoll et. al. 2011

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 2.5.3 – Ecosystem information

PI 2.5.3		There is adequate knowledge of the impacts of the UoA on the ecosystem		
Scoring Issue		SG 60	SG 80	SG 100
a	Information quality			
	Guide post	Information is adequate to **identify** the key elements of the ecosystem.	Information is adequate to **broadly understand** the key elements of the ecosystem.	
	Met?	**Yes**	**Yes**	
Rationale				

Dietary analyses and trophic models provide information to adequately understand the functions of the key elements of the ecosystem (Stevens et al 2011).

The lack of significant levels of retained and discarded by-catch, limited ETP interactions, and potentially limited benthic impacts (based on the trawl foot-prints) indicate a limited ecosystem impact. There is information on trawl footprint, and the impact of trawling and the slow recovery for some UTF habitats (e.g. reef-building stony coral habitat). This shows information leading to a broad understanding of key ecosystem elements, meeting SG60 and SG80.

b	Investigation of UoA impacts			
	Guide post	Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, but **have not been investigated** in detail.	Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, and **some have been investigated in detail**.	Main interactions between the UoA and these ecosystem elements can be inferred from existing information, and **have been investigated in detail**.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The main impacts of the fishery on the ecosystem elements such as structure and function can be inferred from the stock assessments (for most fished species), QMS catch trends, observer data, and surveys that cover the target species, related species, as well as specific research related to trawl impacts on habitat structure and function. Some of these impacts have been investigated in detail, as summarized by Dunn (2013) and there is ongoing research and data collection aimed at continuing to inform management with the aim of fulfilling the ecosystem objectives stated in the Fisheries Act. This meets the SG 60 and SG80. The trophic model for the Chatham Rise developed Pinkerton (2008, 2011) is direct investigation of the main interactions. All of the main interactions have been investigated, therefore meeting SG100.

c	Understanding of component functions			
	Guide post		The main functions of the components (i.e., P1 target species, primary, secondary and ETP species and Habitats) in the ecosystem are **known**.	The impacts of the UoA on P1 target species, primary, secondary and ETP species and Habitats are identified and the main functions of these components in the ecosystem are **understood**.
	Met?		**Yes**	**No**
Rationale				

The main functions of the components of the ecosystem have been identified and studied (e.g. Rosecchi et all 1998; Dunn and Forman 2011; Stevens et al 2011; Dunn 2013; O'Driscoll *et al.* 2011) to an extent where they can be

considered to be known (noting studies and models on the Chatham Rise are more abundant than those west of NZ (ORH7A).

The main functions of ecosystem components are known, though not in detail for some species. Diet studies have been integral to the development of this knowledge.

The impacts of the fishery on target, bycatch, retained, and ETP species are identified and have been described in background sections of this report as well as under the Performance Indicator justifications for the respective components. These are monitored on an ongoing basis through the fishery management regime, also described previously for individual components. This meets the SG80. However, for some protected benthic species in particular, knowledge of ecosystem functions is minimal and the knowledge of the potential for trawl fisheries to affect the productivity of benthic communities is not well studied, thereby not meeting the SG100.

d	Information relevance			
	Guide post		Adequate information is available on the impacts of the UoA on these components to allow some of the main consequences for the ecosystem to be inferred.	Adequate information is available on the impacts of the UoA on the components **and elements** to allow the main consequences for the ecosystem to be inferred.
	Met?		**Yes**	**No**
Rationale				

Information provided in the background sections on Principle 2 and in the scoring issue justifications in P2 component performance indicators demonstrates that sufficient information is available on the impacts of the fishery on ecosystem compoents to allow some of the main consequences for the ecosystem to be inferred. This reaches the SG80. However, as there are limited studies on fishery impacts to actual ecosystem elements that comprise structure and function in the MSC context (see rationales above under other ecosystem component PIs), it is not possible to determine that sufficient information is available in the impacts of the fishery on the components AND elements to allow the main consequences for the ecosystem to be inferred, thereby not reaching the SG100.

e	Monitoring			
	Guide post		Adequate data continue to be collected to detect any increase in risk level.	Information is adequate to support the development of strategies to manage ecosystem impacts.
	Met?		**Yes**	**No**
Rationale				

Catch information, observer information, trawl survey information, and VMS information are sufficient to detect increased risks levels, reaching the SG60 and SG80 levels. The footprint of the fishery is well identified, but the distribution of protected coral is sufficiently uncertain that reliance on predicted distribution could lead to overestimates of the range, and possibly higher than anticipated impacts. This also leads to some uncertainties in developing a strategy for maintaining structure and function of coral and benthic components of the ecosystem, thereby not meeting SG100.

References

Rosecchi et all 1998; Dunn and Forman 2011; Stevens et al 2011; Dunn 2013; O'Driscoll et al. 2011

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	

Condition number (if relevant)	

7.4 Principle 3

7.4.1 Principle 3 background

The management system consists of a highly structured public-private partnership consisting of agreements between MPI and DWG, with a high level of stakeholder involvement (Figure 29). This overall structure forms the basis for operation of the fishery in terms of goals and objectives, fishing rights, planning, consultations, decision making, monitoring and enforcement, and regulation. New Zealand has implemented one of the most extensive quota-based fisheries management systems in the world, with over a 100 species or species-complexes of fish, shellfish and seaweed now being managed within this framework. Almost all commercially targeted fish species within New Zealand's waters are now managed within the Quota Management System (QMS).

MPI is responsible for the utilisation of New Zealand's fisheries resources while ensuring sustainability in accordance with its governing legislation - the Fisheries Act 1996. Under the Fisheries Act, sustainability means:
(a) maintaining the potential of fisheries resources to meet the reasonably foreseeable needs of future generations, which addresses P1 and
(b) avoiding, remedying, or mitigating any adverse effects of fishing on the aquatic environment, which addresses P2.
Utilisation means conserving, using, enhancing, and developing fisheries resources to enable people to provide for their social, economic, and cultural well-being.

The Fisheries Act binds the Crown. Decisions made under power given by the Act are judicially reviewable by the Courts in the event of disputes. Procedures and processes that apply to disputes about the effects of fishing on the fishing activities of any person that has a current fishing interest provided for under the Act, are set out under Part 7 of the Fisheries Act. MPI's fisheries management responsibilities extend to the 200 nautical mile limit of the NZ EEZ. MPI provides management, licencing (where applicable) research and compliance and education services for commercial, recreational and customary fishing. MPI assists the Minister of Primary Industries in the administration of the relevant Acts. The Government's commitment to wide consultation and engagement is set out in Section 12 of the Act. MPI is required to consult with those classes of persons having an interest (including, but not limited to, Maori, environmental, commercial and recreational interests) in the stock or the effects of fishing on the aquatic environment in the area concerned. MPI do this in a number of ways eg through regular meeting of working groups. These meetings are open to everyone, and consider fish stocks and the effects of fishing on the aquatic environment.

The Fisheries Act provides opportunities to negotiate and resolve disputes. The Minister may appoint a Dispute Commissioner and the Minister makes the final determination. The consultation process is an attempt to avoid unresolved disputes by ensuring all interested parties have an opportunity to participate and have an input into decisions. There have been occasions when there has not been a satisfactory outcome and then this has gone to litigation and the Court has made a decision. The Memorandum of Understanding between DWG and MPI has encouraged better working relationships and avoided the need for litigation between the Ministry and the industry. The management system incorporates or is subject by law to a transparent mechanism for the resolution of legal disputes that is appropriate to the context of the fishery and has been tested and proven to be effective.

Fisheries New Zealand (FNZ) is the Government's principal adviser for New Zealand fisheries management, operating under the Fisheries Act 1996 and a range of other legislation relating to fisheries management (https://www.mpi.govt.nz/legal/legislation-standards-and-reviews/fisheries-legislation/introduction-to-fisheries-legislation/). FNZ (FNZ 2021) deals specifically with the Fisheries Act 1996 – NZ Legislation, fisheries regulations, and the Quota Management System. This involves, *inter alia*, Maori fisheries, Treaty of Waitangi (Fisheries Claims) Settlement Act 1992, allocation of fish stocks, and international fisheries.

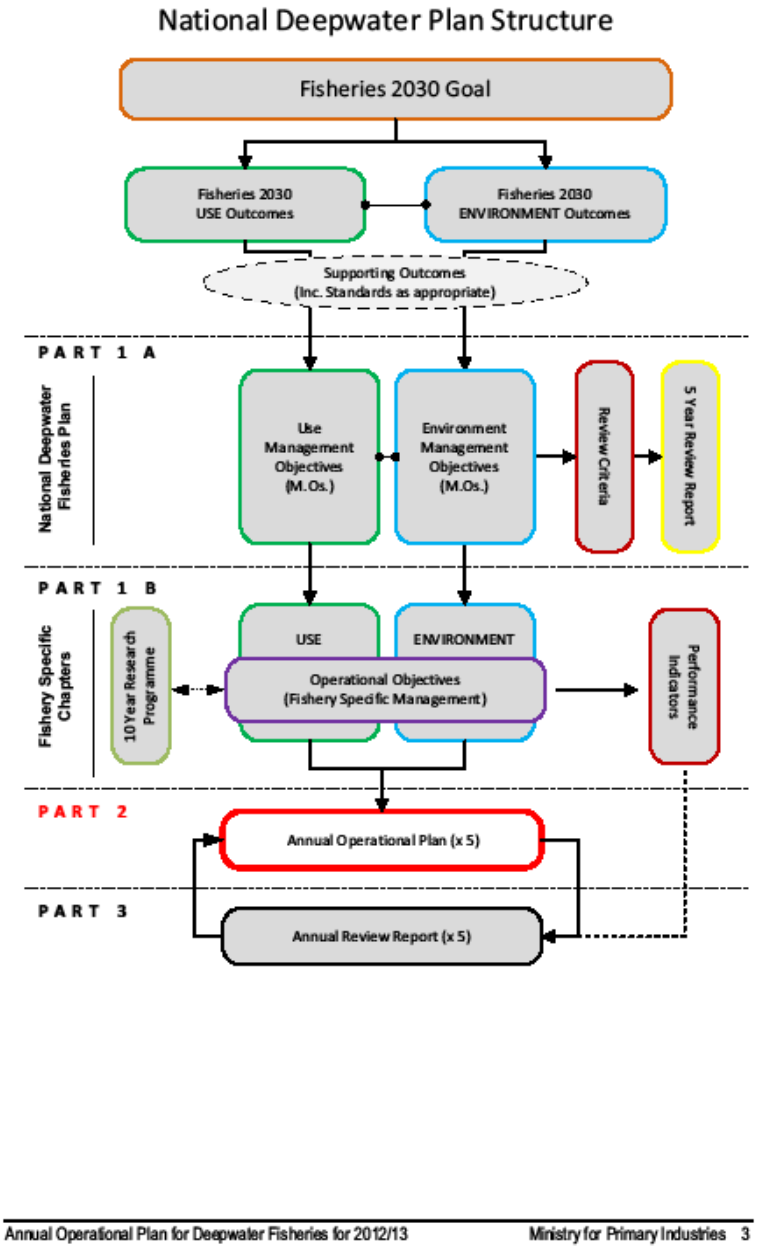


Figure 29. Structure of the management system for New Zealand deepwater fisheries.

7.4.1.1 Area of operation of the fishery and under which jurisdiction it falls

The three UoAs operate in the Exclusive Economic Zone (EEZ) of New Zealand from within the 12 nautical mile (nm) limit of the territorial sea out to the 200 nm limit of New Zealand's EEZ (MPI, 2012). A small area on the New Zealand west coast in Area ORH7A extends beyond the New Zealand EEZ (Figure 2). No foreign fishing for orange roughy has occurred adjacent to New Zealand in the recent past and none is expected in the foreseeable future. The three UoA fisheries, including the region of ORH7A beyond the New Zealand EEZ, fall under the authority of the New Zealand government. The area beyond the New Zealand EEZ is also subject to management arrangements determined the SPRFMO. The management of New Zealand's deepwater fisheries is undertaken through a collaborative initiative between the MPI and the owners of orange roughy quota (represented by DWG, DWG-MFish, 2010). This arrangement allows for collaborative Management Objectives to be achieved by drawing on the combined knowledge, experience, capabilities and perspectives of both public and private sectors – through MPI and the seafood industry. MPI is also responsible for administration of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992, which implements the 1992 Fisheries Deed of Settlement under which historical Treaty of Waitangi claims relating to commercial fisheries have been fully and finally settled, and for administration of the Maori Fisheries Act

2004, which provides that the Crown allocates 20% of quota for any new quota management stocks brought into the QMS to the Treaty of Waitangi Fisheries Commission.

Between 2015-16 and 2019-20, 11 vessels ranging in size from 27 m to 66 m registered length have caught orange roughy from the UoAs (MPI, 2021). Vessel tonnages range from 113 – 2,483 t and hold capacities range from 112 m^3 to 1,000 m^3. Five of the vessels do not have onboard freezers and store catch on ice until landing. These vessels generally do not process catch at sea and land whole fish which may be processed on land in New Zealand or exported whole. The remaining six vessels are factory-freezers, which freeze product onboard and generally remain at sea for longer periods. These vessels either process to the 'dressed' (head, guts and pectoral fins removed) or 'gutted' state at-sea, or land the fish whole. Three of the factory vessels also have onboard fishmeal plants and will process most offal and non-QMS bycatch species into fishmeal and fish oil.

7.4.1.2 Particulars of the recognised groups with interests in the fishery and individuals or groups granted rights of access

The primary groups with direct interest in the fishery are MPI and the deepwater fishing industry (represented by DWG). Both are involved in the fishery through a partnership for management and science-based monitoring. MPI has the responsibility for sustainable harvest under the requirements of the Fisheries Act 1996. Through policy, MPI and DWG work closely together through a Memorandum of Understanding (DWG 2010) with a goal to ensure New Zealand's deepwater fisheries are sustainably managed. The New Zealand Department of Conservation (DoC) Conservation Services Programme (CSP) monitors the impact of commercial fishing on protected species, studies species populations and looks at ways to limit bycatch (DoC 2021a. https://www.doc.govt.nz/our-work/conservation-services-programme/about-csp/). Protected marine species include all marine mammals and reptiles; sea birds (except black backed gulls); seven species of fish; all black corals, gorgonian corals, stony corals and hydrocorals (DoC 2021b. https://www.doc.govt.nz/our-work/conservation-services-programme/). MPI and DWG coordinate with DoC in management of the fisheries. However, managing the effects of fishing on these species remains the responsibility of MPI.

New Zealand is a member of the South Pacific Regional Fisheries Management Organization (SPRFMO), which has Conservation Management Measures (CMM) binding on members (https://www.sprfmo.int/measures/). CMM 03-2021 and 03a-2021 specifically deal with international requirements for bottom fishing in the SPRFMO area, with an objective "through the application of the precautionary approach and an ecosystem approach to fisheries management, to ensure the long-term conservation and sustainable use of deep sea fishery resources, including target fish stocks as well as non-target or associated and dependent species, and, in doing so, to safeguard the marine ecosystems in which these resources occur, including *inter alia* the prevention of significant adverse impacts on vulnerable marine ecosystems." SPRFMO agreed to a new management measure for bottom fishing in the Convention Area, which includes the Westpac Bank portion of the ORH 7A-WB UoA (SPRFMO, 2021). The measure defines areas open to bottom trawling and implements requirements for move-on rules should vulnerable species be encountered. A catch limit for the NW Challenger (which includes the Westpac Bank area) was considered by the Commission in February 2021 on the basis of a 2020 stock assessment. The catch limit remained unchanged at 396 t (SPRFMO, 2020).

The terms of the Maori Treaty Settlement for their rights to commercial fisheries have included delivery of commercial quota to Maori (FNZ 2021). MPI delivers the Crown's obligations to Māori under the:

- Treaty of Waitangi (Fisheries Claims) Settlement Act 1992
- Māori Commercial Aquaculture Claims Settlement Act 2004
- Māori Fisheries Act 2004

The Treaty of Waitangi guarantees the "Chiefs, Tribes and peoples of New Zealand" the "undisturbed possession" of their fisheries until they wished to dispose of them to the Crown. Recognition of their Treaty rights to commercial fisheries was agreed in the early 1990s, resulting in the Crown delivering a comprehensive settlement to Maori in three major components. The first was to purchase 10 percent of the quota shares from the market and to transfer these to the Treaty of Waitangi Fisheries Commission, set up as a transitional trust for the benefit of Maori. The second was a cash settlement that was in part used to buy half of New Zealand's largest fishing company – Sealord Limited. The third was an undertaking to deliver to Maori 20% of the commercial quota shares for any new species brought into the QMS in future.

Through their purchase of Sealord, Maori gained access to additional deepwater quota, including for orange roughy in the three UoA. Maori have since invested in the seafood industry to increase their commercial stake to a point where they now control or influence more than 30 percent of New Zealand's commercial fisheries. The Treaty of Waitangi Fisheries Commission has reached agreement on the beneficiaries of these settlement assets and accorded each a beneficial interest. The final step in this process was completed in 2004 when Parliament approved the distribution to

iwi (tribes) of the fisheries assets and this being implemented by Te Ohu Kai Moana (TOKM), the Maori Fisheries Trust.

The Māori Fisheries Act 2004 has the purpose of implementing the agreements made in the Deed of Settlement dated 23 September 1992; and to provide for the development of the collective and individual interests of iwi in fisheries, fishing, and fisheries-related activities in a manner that is ultimately for the benefit of all Maori. To achieve the purposes of this Act, provision is made to establish a framework for the allocation and management of settlement assets through the allocation and transfer of specified settlement assets to iwi as provided for by or under this Act; and the central management of the remainder of those settlement assets.

Active participation in New Zealand's commercial fisheries by Iwi, TOKM and other Maori interests occurs through several mechanisms, including through membership in DWG and through active engagement with MPI and Ministers.

A number of NGOs participate in consultations on the science and management of orange roughy fisheries. WWF-NZ, WWF-US, WWF-AU, Royal Forest and Bird Protection Society of New Zealand, Greenpeace, and Environment and Conservation Organisations of New Zealand (ECO) are participants. Other organisations may also participate selectively such as the New Zealand Marine Sciences Society and TRAFFIC.

7.4.1.3 Details of consultations leading to the formulation of the management plan

The 1996 Fisheries Act requires consultation with stakeholders. To affect this, the Minister has established consultation standards (MPI, https://fs.fish.govt.nz/Doc/21817/consultation_standard%5B1%5D.pdf.ashx) that set out:

- Best practice consultation process to be followed by fisheries managers;
- Minimum performance measures where appropriate; and
- A nationally consistent approach.

This process standard has been developed taking into account relevant obligations, including the provisions of s 12 of the Fisheries Act 1996, administrative law requirements, and the MFish Statement of Intent 2006-2011. These standards recognize that consultation leading to decisions must occur in accordance with law; in a reasonable manner; and fairly, in accordance with the principles of natural justice. The Minister is the decision maker in fisheries management matters and his decisions are bound by the law, and are therefore open to legal review. The law requires identification of stakeholders "with an interest" in each fishery, and the identification of those who represent stakeholders with an interest. In general, the policy recommends setting a wide range of stakeholders with an interest. The Minister must notify stakeholders in advance of the consultation, and to subsequently inform them of his decisions (See also Section 3.5.4).

The primary non-government stakeholders are the owners of orange roughy quota represented by DWG. DWG-MFish (2010) outlines the consultations undertaken by the industry and MPI. MPI has established open and direct involvement of all stakeholders in their science assessment processes. All of the Science Working Groups, including the annual stock assessment Plenary, are open to the public and the papers and meeting records are available to all participants. DWG invites discussions with MSC stakeholders through presentations and participation in conferences and documentaries (Clement, 2021); through direct meetings; through the public release of all information pertaining to the MSC assessment process online; and, through inviting all participants to attend any meeting between the MSC, CAB and DWG.

7.4.1.4 Arrangements for ongoing consultations and decision-making processes

A process standard for stakeholder consultation has been developed to set out how MPI meets its obligations to consult with stakeholders before providing advice to the Minister, based on requirements of the of the Fisheries Act 1996 (MPI, https://fs.fish.govt.nz/Doc/21817/consultation_standard%5B1%5D.pdf.ashx). This standard sets out best practice consultation processes to be followed by fisheries managers; minimum performance measures where appropriate; and a nationally consistent approach with reference to relevant legislation and guidelines. Within this process, it is necessary to identify both who has an interest and who are representative of those having an interest. MPI provides an initial consultation plan and the manner of consultation, including the timeframe for the consultation and the decision. MPI distributes the decision and subsequently reviews the process to assure that their consultation meets all requirements.

When management changes are proposed to meet sustainability requirements (such as a change to a TAC/TACC), MPI prepares a discussion document that provides the Ministry's initial proposals for issues needing decision and a range of management options. In orange roughy fisheries such proposals primarily relate to changes in TACCs/catch limits. The proposals outlined in MPI's discussion document are preliminary and are provided as the basis for consultation with stakeholders. Subsequently, MPI prepares a decision document, which summarises stakeholders'

views on their proposals and makes recommendations to the Minister. The decision document and the Minister's letter setting out his final decisions are posted on MPI's website as soon as they become available.

The Fisheries Act 1996 requires a precautionary approach. The MSC vocabulary defines the precautionary as: "The precautionary approach shall be interpreted to mean being cautious when information is uncertain, unreliable or inadequate and that the absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures." Section 10 of the Fisheries Act 1996 specifies four information principles, which encompass the precautionary principle, that must be taken into account in relation to the utilisation of fisheries resources or ensuring sustainability:

All persons exercising or performing functions, duties, or powers under this Act, in relation to the utilisation of fisheries resources or ensuring sustainability, shall take into account the following information principles:

- decisions should be based on the best available information:
- decision makers should consider any uncertainty in the information available in any case:
- decision makers should be cautious when information is uncertain, unreliable, or inadequate:
- the absence of, or any uncertainty in, any information should not be used as a reason for postponing or failing to take any measure to achieve the purpose of this Act.

A decision to consult or not to consult, and any decision made after consultation, must be made in accordance with the principles of administrative law, and in accordance with Fisheries Act 1996 obligations. These principles require decision-makers to act:

- in accordance with law;
- reasonably; and
- fairly, in accordance with the principles of natural justice.

Decisions that do not follow requirements are open to legal challenge.

7.1.4.5 Details of non-fishery users or activities and arrangements for liaison and co-ordination

Other deepwater fisheries, primarily those for the targeting smooth oreo and black oreo, occur in the three UoA. The MPI-DWG joint management MOU covers these fisheries and provides liaison and coordination. The relative offshore remoteness of the orange roughy fisheries precludes non-fishery users. However, those stakeholders with potential interest in the fisheries have opportunities to participate through the consultation procedures set by the government and by DWG.

7.4.1.6 Objectives for the fishery

Fisheries 2030, MPI's overarching vision for New Zealand fisheries established in 2009, states that by 2030, New Zealand's fisheries will be:

- world-leading and recognised for achieving a track record of environmental and commercial leadership and success, both domestically and internationally;
- a sector that New Zealanders are proud of, in that they understand that a precious but limited national resource is being responsibly managed, in the interests of all, for both the present and the future;
- based on healthy and abundant aquatic environments that are ecologically sustainable, about which we have reliable and dynamic information;
- a sector in which there are positive Crown-Maori partnerships, balancing and optimising cultural and commercial value;
- profitable and efficient, with a strong focus on long-term economic value;
- characterised by high trust and high accountability relationships amongst both use and non-extractive use interests and between stake/rights holder entities and Government; and,
- a dynamic system in which transparent and robust decisions about allocation and trading-off are being made by stake/rights holders themselves, within a more enabling legislative and regulatory framework.

Fisheries 2030 specifies an overarching goal for New Zealand's fisheries and two outcomes:

> **Goal**: New Zealanders maximising benefits from the use of fisheries within environmental limits.
>
> **Use Outcome:** Fisheries resources are used in a manner that provides greatest overall economic social and cultural benefit.

Environment Outcome: The capacity and integrity of the aquatic environment, habitats and species are sustained at levels that provide for current and future use.

The Orange Roughy Public Certification Report (MRAG 2016) identified an area that fell behind schedule and continued behind schedule through the second surveillance: updating the National Deepwater Fisheries Plan (National Deepwater Plan). The National Deepwater Plan provides an integrated, transparent way of defining management objectives, actions, and services required to meet relevant legislative obligations and strategic directions for managing New Zealand's deepwater fisheries. The plan also provides a reporting mechanism to measure progress towards meeting objectives. The purpose of national fisheries plans is to provide clear management objectives to support the purpose and principles of the Fisheries Act 1996 and to identify key deliverables for MPI over the medium term (5 years). Work on the revision began in 2016. In May 2019, MPI approved the plan (https://www.mpi.govt.nz/dmsdocument/18779/direct). The National Deepwater Plan consists of three parts:

- Fisheries management framework and objectives:

  Part 1A - strategic direction for deep water fisheries

  Part 1B - fishery-specific chapters and management objectives at the fishery level

- Annual Operational Plan (AOP) – detailing the management actions for delivery during the financial year (FNZ, 2019)
- Annual Review Report (AAR) – reporting on progress towards meeting the five-year plan and on the annual performance of the deepwater fisheries against the AOP (FNZ, 2019a).

MPI published a Medium Term Research Plan (MTRP) for the period 2018-19 to 2022-23 (https://www.mpi.govt.nz/dmsdocument/21746). This MTRP outlines the scientific monitoring and research needs to inform management of New Zealand's deepwater fisheries.

The science needs in this MTRP are based on the longer-term planning that has previously been consulted on with stakeholders, but not provided publicly with descriptions, context and rationale for the planned work. The MTRP remains a living document and will be updated regularly to reflect changes in management priorities where these occur, and identification of new areas of research. Annual research plans will be consulted with stakeholders through the National Deepwater Fisheries Plan forums and reported in the Annual Operational Plans (AOP) and Annual Review Reports for deepwater fisheries. The 2018-19 AOP describes proposed research in section 9.3.1.

The National Deepwater Plan 2019 (https://deepwatergroup.org/wp-content/uploads/2020/01/2019-Deepwater-Fisheries-Plan.pdf) updates the National Deepwater Plan of 2009, and sets out updated high level Management Objectives for all of New Zealand's deepwater fisheries (Table 49). The current National Deepwater Plan contains a third outcome: Governance. This is then supported by a species specific Fisheries Plan that describes Operational Objectives for the orange roughy fisheries in New Zealand.

These Objectives drive annual work plans, which are set out in the Annual Operational Plan for deepwater fisheries. The progress against the actions in the Annual Operational Plan and the objectives is reviewed in the Annual Review Report produced at the end of each year.

The DWG-MPI MOU (DWG-MFish, 2010) further lays out specific objectives for implementing the National Deepwater Plan.

Table 49 Management objectives from the National Deepwater Plan (MPI 2019)

Use Outcome	1	Ensure the deepwater and middle-depth fisheries resources are managed so as to provide for the needs of future generations
	2	Ensure excellence in the management of New Zealand's deepwater and middle-depth fisheries, so they are consistent with, or exceed, international best practice
	3	Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust information
	4	Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points
Environment Outcome	**5**	Ensure that maintenance of biological diversity of the aquatic environment and protection of habitats of particular significance for fisheries management are explicitly considered in management
	6	Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the adverse effects of these fisheries on associated or dependent and incidentally caught fish species
	7	Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the adverse effects of these fisheries on the benthic habitat
	8	Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the adverse effects of these fisheries on the long-term viability of endangered, threatened and protected species populations
Governance Outcome	**9**	Ensure the management of New Zealand's deepwater and middle-depth fisheries meets the Crown's obligations to Māori
	10	Ensure there is consistency and certainty of management measures and processes in the deepwater and middle-depth fisheries
	11	Ensure New Zealand's deepwater and middle-depth fisheries are transparently managed

The current National Deepwater Plan contains for each objective:

- **Description**: What does the objective mean?
- **Current Status**: What is the current status of deepwater fisheries in relation to the objective?
- **Management Initiatives**: What actions or initiatives are proposed to progress towards achievement of the objective?
- **Key Performance Indicators**: What would deepwater fisheries look like when the objectives were achieved?

7.4.1.7 Measures agreed upon for the regulation of fishing

MPI and the DWG work in partnership to agreed strategic outcomes within aligned work plans and operational procedures to ensure New Zealand's deepwater fisheries are managed sustainably. The two parties have developed a single joint-management framework with agreed strategic and operational priorities and work plans and timeframes (DWG-MFish, 2010).

The partnership was formed to:

- advise the Minister of Fisheries on clear and agreed objectives for the deepwater fisheries;
- advise the Minister of Fisheries on management measures to support these objectives;
- define service requirements to support these objectives;
- ensure efficient delivery and value from these services; and
- provide consistent and agreed advice to the Minister wherever possible.

The partnership is focused on determining the maximum economic yield of the deepwater fisheries by setting catch limits that maximise returns over the long-term within the constraints of ecological sustainability. This collaborative

approach to fisheries management has an industry-wide impact on the behaviour of seafood companies by way of creating a "self-management" responsibility amongst industry participants.

This co-operation between seafood companies replaces historical competitive behaviours, improves industry-wide management initiatives and subsequent compliance with standards and outcomes set, monitored and audited by government.

7.4.1.8 Monitoring, control and surveillance and enforcement

The orange roughy management system has documented a comprehensive and effective monitoring, control and surveillance system through:

1. compulsory use of satellite-based Vessel Monitoring System (VMS) with an onboard automatic location communicator (ALC);
2. government observers who may be placed on board to observe fishing, transhipment and transportation to collect any information on orange roughy fisheries resources. This includes information to monitor the effects of orange roughy fishing on the aquatic environment; and,
3. accurate recordkeeping and recording requirements to establish auditable and traceable records to ensure all catches are counted and do not exceed the ACE held by each operator.

New Zealand introduced the VMS in 1994 which requires by law all vessels over 28 metres and all vessels that target orange roughy to carry and operate a registered ALC at all times. Paper-based catch reporting was also required by all fishing vessels operating in NZ's EEZ. These systems have now been replaced by near real time Geospatial Position Reporting and daily Electronic Catch Reporting. FNZ still combines this functionality with at-sea and aerial surveillance, supported by the New Zealand Defence Force. This independently provides surveillance of activities of deep-water vessels through inspection and visual capability to ensure these vessels are fully monitored and verified to ensure compliance with both regulations and with industry-agreed Operational Procedures.

In combination with at-sea and air surveillance supported by the New Zealand joint forces, vessel activities in the three UoAs are monitored and verified to ensure compliance with regulations and with industry-agreed operational procedures. Commercial fishermen face prosecution and risk severe penalties, which include automatic forfeiture of vessel and quota upon conviction of breaches of the fisheries regulations (unless the court rules otherwise). Financial penalties are also imposed in the form of deemed values to discourage fishermen from over-catching their ACE holdings.

The extensive regulations governing these fisheries are complemented by additional industry-agreed non-regulatory measures, known as the New Zealand Deepwater Fisheries Operational Procedures. The Minister for Fisheries relies on the effectiveness of both regulatory and non-regulatory measures to ensure the sustainable management of these fisheries. As part of DWG's Operational Procedures, DWG has an Environmental Liaison Officer whose role is to liaise with vessel operators, skippers and FNZ to assist with the effective implementation of these Operational Procedures (Cleal, 2019, Cleal, 2020). DWG personnel and vessel operators meet with MPI's Management and Compliance teams annually to discuss and evaluate any issues that may have arisen (DWG, 2020, 2020a, MPI, 2019a). Any identified risks are communicated to the fleet along with proposed remedial action to be undertaken (DWG, 2019).

All vessels fishing in New Zealand are required to report all fish caught except those fish under a set minimum legal size (MLS) (MPI, 2014). There are no retained or bycatch species caught in orange roughy fisheries that have an MLS in place. Reporting requirements are set out in the Fisheries (Reporting) Regulations 2001, most notably in section 5 and section 6. Note also that it is illegal under the Fisheries Act 1996 to discard any species in the QMS unless the species is listed on Schedule 6 of the Fisheries Act 1996, all returns to the sea are recorded, and the specified conditions are met, or an MPI observer on the vessel authorises the discard. The majority of vessels involved in the three orange roughy UoAs are trawlers greater than 28 m. These vessels are required to record fishing effort and estimated catch on TCEPR. Some orange roughy fishing is also carried out by trawlers under 28m. These smaller vessels are required to record fishing effort on TCER. These returns require reporting of effort statistics as well as estimates of catch for either the top five (TCEPR) or the top eight species (TCER) in the catch. In all of the above cases, fishers are required to report landings for a trip on CLR form regardless of the type of return (TCEPR or TCER) upon which effort information was reported. These returns require all fish taken on a trip to be reported, including any non-QMS species that were returned to the sea (discarded bycatch).

A comprehensive reporting regime requires catch reports submitted by commercial fishers, including the estimated catch per tow, the location and depth of every tow and the total landed catch for each trip undertaken; landings only to Licensed Fish Receivers (LFRs), who must also report all catch received. MPI verification through auditing and

reconciliation analysis across multiple sources ensures all catches are reported and documented correctly. Data collected by onboard MPI Observers greatly assist the catch verification and auditing process. Observers collect catch and effort data, biological data, fishery operations information, data on interactions with ETP species, and other information as needed (https://www.mpi.govt.nz/fishing-aquaculture/commercial-fishing/operating-as-a-commercial-fisher/fisheries-observer-services/#DW-fisheries). Observer coverage of orange roughy target fishing effort across the Chatham Rise and ORH7A (including Westpac Bank) has ranged widely (Table 27, Figure 15) depending on availability of observers and allocation of observers across fisheries depending on priorities set. In the past five years, the observer coverage for deepwater fisheries of Chatham Rise and the West Coast did not achieve scheduled the planned days at sea more often than not (Table 49Table 27) Additional quayside inspections may also be undertaken by MPI to verify reported landings. Commercial fishers face prosecution and risk severe penalties, including automatic vessel and quota forfeiture, upon conviction of breaches in fisheries regulations. Financial penalties also exist to discourage commercial fishers from over-catching their ACE holdings, in the form of a deemed value regime.

The deepwater fishing industry in New Zealand works closely with government to ensure compliance with all agreed management measures. A co-management approach to New Zealand's deepwater and middle-depth fisheries has been in place since 2006, encouraging open collaboration between quota holders (represented by DWG) and MPI. This collaborative approach to management has enabled the development of shared reporting and monitoring processes that allow both parties to utilise their own operational expertise to ensure ongoing adherence to the non-statutory management measures that are in place. Relevant measures to the orange roughy fisheries include the management of catches within designated sub-QMA catch limits within the overall ORH TACC, where fisheries biology recognises these to be distinct stocks for management purposes. DWG works directly with vessel managers and skippers to administer the reporting and monitoring of catches against the sub-QMA catch limits, while MPI performs an auditing and verification role to ensure that reliable data is being reported by industry vessels. The industry and MPI also hold regular meetings to increase understanding by industry of the agreed requirements.

The Ministry for Primary Industries (MPI) strongly encourages voluntary compliance across all the areas we regulate including biosecurity, food, animal welfare and fisheries (https://www.mpi.govt.nz/legal/paying-your-fine/prosecutions-and-infringements/). MPI recognises most people follow the rules and want to comply but there will always be some who don't. For that reason, in certain circumstances the agency may need to take appropriate action – sometimes including prosecution. MPI has an organisational policy for employees to use to guide them when managing a potential prosecution (https://www.mpi.govt.nz/dmsdocument/16279-MPI-Organisational-Prosecutions-and-Infringements-Policy). The policy sets out what are – and aren't – valid reasons for deciding whether to prosecute and the process that needs to be followed. Crown Law has also published guidelines for government departments like MPI and other prosecuting agencies (http://www.crownlaw.govt.nz/assets/Uploads/Prosecution-Guidelines/prosecution-guidelines-2013.pdf).

New regulations and monitoring requirements for New Zealand fisheries call for a digital system for tracking, monitoring and reporting of commercial fishing (https://www.mpi.govt.nz/protection-and-response/sustainable-fisheries/strengthening-fisheries-management/fisheries-change-programme/digital-monitoring-of-commercial-fishing/).

The digital monitoring system is made up of:

- electronic catch reporting via an e-log book – to give better and more timely information on commercial catch and effort;
- electronic position reporting – to verify (when used with electronic catch reporting) where and when fishing happened; and
- on-board cameras – to verify what is being reported.

The aim is to:

- maximise the recreational, customary, commercial, and environmental value of New Zealand's fisheries;
- give New Zealanders, and consumers from around the world, confidence that fish from New Zealand waters are being managed and caught sustainably; and
- allow Fisheries New Zealand to verify information being reported and encourage compliance.

It should be noted that the deepwater fleet (including those vessels catching orange roughy) have already implemented position reporting since 1994 and electronic reporting since 2010. These data are transmitted to MPI to monitor fishing activity. The new system, however, provides MPI faster (daily) access to data, which will provide greater opportunity to target compliance risk, and as a consequence further reduce the potential for unreported catch and area misreporting.

The Minister of Fisheries is considering options for the implementation of on-board cameras and no decisions have been made yet. Therefore, an exemption from complying with Part 1 of the Fisheries (Electronic Monitoring on Vessels) Regulations is in place such that permit holders and vessel masters are not required to install or operate cameras on fishing vessels until further notice. Further work is required before cameras can be introduced, including clarifying camera specifications and how they can be introduced.

MPI has the philosophy of informed and assisted compliance: that most fishermen will follow the regulations; that some engage in opportunistic non-compliance unless kept in check; and, that a few will actively seek advantage with illegal fishing.

MPI's compliance strategy is underpinned by the VADE compliance operating model. VADE is focussed on all elements in the compliance spectrum. Enforcement is but one of the tools utilised to ensure compliance, however it is the intervention that sets the conditions and incentives for voluntary compliance. There are four components to the VADE compliance operating model:

1. **Voluntary Compliance:** The voluntary component commences well before the involvement of compliance interventions as part of the regulatory setting process. MPI ensures that the consequence for non–compliance is proportionate to the effect to be achieved. Accordingly, sensible rules and sanctions ensure high voluntary compliance once those who need to comply are aware of their obligations. Within the compliance directorate, outcomes are achieved through education, engagement and communication of expectations and obligations.

2. **Assisted Compliance:** Assisted compliance is that range of activities that re-enforce obligations and give the organisation confidence that the desired purpose of the Fisheries Act 1996 is being achieved. This is heavily reliant on monitoring, inspection, responding and business intelligence activities. It requires feedback loops and compliments the voluntary component to determine if stakeholders are attempting to comply, are aware of their obligations or indeed choosing not to comply. Determined upon what observations are deduced an appropriate intervention is then considered. Assisted compliance remains heavily focussed on reminding individuals their compliance is being monitored and if no discernible behaviour change formal direction or sanction will occur.

3. **Directed Compliance:** Directed Compliance is that range of tools that Compliance Officers apply to direct a desired behavioural change. It ranges from those powers that allow directed activity such as infringement notices, official sanctions such as warnings and in some cases regulatory or lower threshold prosecutions.

4. **Enforced Compliance:** Enforced compliance is where the full extent of the law is applied. While it can be the decision as a consequence of no noticeable behavioural change despite Voluntary, Assisted and Directed interventions, it is also for those entities or individuals who deliberately choose to break the law and where a lesser intervention is inappropriate. This is for either serious offending or where legislation requires an enforcement action. These cases are formally investigated with a view to prosecution.

The VADE model gives a framework for stakeholders to understand the discretionary powers and approach regardless of sectors. It gives some confidence to compliance officers to apply discretion at the frontline and allows for calibration across sectors for national consistency.

7.4.1.9 Jurisdictional category

Two of the orange roughy UoAs (NWCR and ESCR) fall under single jurisdiction management, with the fishing area within the New Zealand EEZ. The third UoA (7A-WB) falls mainly within the EEZ but with a relatively small portion (Westpac Bank adjacent to ORH7A) extending into international waters, under the management jurisdiction of New Zealand and the SPRFMO as a straddling stock.

7.4.1.10 Details of any planned education and training for interest groups.

DWG and MPI have ongoing outreach and education for vessel captains, fishermen and other interested parties. MPI has the activities of the informed and assisted compliance that assures understanding by industry with regulations and other requirements. DWG has implemented a range of non-regulatory measures and supplementary measures for avoiding or mitigating interactions with ETP species. As part of this, DWG has an Environmental Liaison Officer whose role is to work with fishing vessels to help implement voluntary measures. DWG invites representatives of NGOs to discuss issues important to them and to work on collaborative solutions.

7.4.1.11 Date of next review and audit of the management plan

The AAR for Deepwater Fisheries 2018-2019 (MPI 2020) provides a record of the annual reviews of the fisheries, including orange roughy.

Part 3A describes the progress that has been made during the 2018/19 financial year (1 July 2018 – 30 June 2019) towards delivering the management actions set out in the 2018/19 AOP. Achievement of these annual priorities contributes to meeting the high level management objectives set out in Part 1A of the National Deepwater Plan.
Part 3B provides detail on delivery of fisheries service's relevant to Deepwater Fisheries Management that are planned by financial year. These processes include the planning and contracting of fisheries and conservation research projects, planning observer coverage on the deepwater fleet and the cost recovery regime.
Part 3C provides a summary report of the combined environmental impacts of deepwater fishing activity, and the deepwater fleet's adherence to the suite of non-regulatory management measures in place during the 2018/19 October fishing year (1 October 2018 – 30 September 2019).

The AAR also contains several appendices:

- Appendix I summarises the catch of deepwater stocks during the 2018/19 fishing year. Also included, where available, are observer coverage details, the amount of deemed values invoiced and export earnings during the 2018 calendar year;
- Appendix II summarises the results of the October 2018 and April 2019 sustainability rounds;
- Appendix III summarises landings of all Tier 3 (non-QMS) species by the core deepwater fleet7 between the 2014/15 and 2018/19 fishing years;
- Appendix IV comprises The Deepwater Fish Plan Advisory Group (FPAG) Terms of Reference;
- Appendix V summarises cost recovery levies for deepwater stocks for the 2018/19 financial year; and
- Appendix VI comprises the observer Interim Trip Report template.

The 2018/19 AAR Part 3A identified 17 management actions that aimed to progress delivery of the management objectives specified in Part 1A of the National Deepwater Plan 2019, and summarised progress relating to each of these management actions. The 2018/19 AOP also identified Management Actions that the Deepwater Fisheries Management team contributed towards delivery of, but were led by other directorates within Fisheries New Zealand or MPI branches/directorates outside of Fisheries New Zealand. This AOP also identified Management Actions that the Deepwater Fisheries Management team contributed towards delivery of, but that were initiated by industry. It also reviewed implementation of the national Plan of Action – Seabirds, reviewed the status of seabirds at high risk from deepwater and mid-depth fisheries (and noted that orange roughy did not contribute in a substantial way to mortality of these seabirds), examined the capture rate reduction targets for seabirds, and reviewed the deepwater and mid-depth fishery management approach and actions achieved.

The 2018/19 AAR Part 3B provides detail on Fisheries New Zealand fisheries and conservation services that are relevant to Deepwater Fisheries Management and are planned by financial year (1 July – 30 June). These processes include the planning and contracting of fisheries and conservation research projects, planning observer coverage on the deepwater fleet and the cost recovery regime. The AOP noted that a number of Ministerial directives requiring high levels of observer coverage in a number of inshore fisheries resulted in re-priorization from the deepwater fisheries. Research needs for deepwater fisheries are driven from the Objectives within the National Deepwater Plan and are primarily delivered through the research programme for deepwater fisheries. All research projects are reviewed by Fisheries New Zealand Science Working Groups and are assessed against the Research and Science Information Standard for New Zealand Fisheries. This review process aims to ensure the quality of the research is sufficient to underpin Deepwater Fisheries Management. Delivery of quality research is driven through Management Objective 3 within the National Deepwater Plan which aims to ensure the effective management of deepwater and middle-depth fisheries through the availability of appropriate, accurate and robust information. Successfully delivering on Management Objectives for deepwater fisheries depends on high levels of compliance with the various sustainability and environmental regulations defined in legislation. MPI's Compliance Directorate is responsible for providing the intervention services to achieve cost-effective compliance with all regulations. Research, compliance activities, observers, and registry services are funded, at least partially, by levies recovered from the fishing industry. The cost recovery regime enables the Crown to recover its costs in respect of the provision of fisheries and conservation services, as far as practicable, from those people who have requested services, who benefit from the provision of those services or cause the adverse effects that the services are designed to avoid, remedy or mitigate.

The 2018/19 AAR Part 3C summarises the overall impacts of deepwater fishing on the marine environment, and reports adherence to non-regulatory environmental mitigation measures for the 2018/19 fishing year. New Zealand's deepwater fisheries are known to interact with the marine environment including protected species, the benthic habitat, and other bycatch species. DWG and Fisheries New Zealand work together to monitor adherence to non-regulatory management measures and environmental interactions.

This review encompasses all parts of the management system. Progress against the objectives in the National Fisheries Plan for Deepwater and the Annual Operational Plan is internally reviewed annually and reported in the Annual Review Report. MPI conducts an extensive review of performance of the deepwater fisheries (e.g., MPI 2015)

that incorporates consultations with industry and other stake holders. Parts of the management system, specifically science and enforcement, undergo external review. The internal review is very comprehensive and parties external to MPI participate. In 2018, MPI completed an external review of the Deepwater Fisheries Management conducted by Independent Quality Assurance New Zealand (IQANZ 2018). The review covered the relevant parts of fishery management.

7.4.1.2 Description of fishery's research plan.

Research in New Zealand must meet the MPI's Research and Science Information Standard for NZ Fisheries (the Science Standard). MPI has developed and implemented the Science Standard based on international best practices for science quality assurance, adapted to New Zealand's requirements. This Standard recognizes and ensures that only high-quality scientific information is used to inform policy formulation and decision-making, including the need for independent scientific peer review to ensure the relevance, integrity, objectivity and reliability of information. MPI determines what research is needed for New Zealand fisheries through the fisheries plan processes; the fisheries management 5-year operational plans; and the fisheries management annual tactical plans (https://www.mpi.govt.nz/science/fisheries-research-and-science/fisheries-research-processes/). MPI runs technical and science working groups as needed to evaluate research and review outcomes. Technical working groups consider, *inter alia,* environmental issues, stock assessments, and biodiversity. Science workshops consider, *inter alia*, the environment, biodiversity, deep and mid-water depths, stock assessment methods, and plenary. These groups follow a peer-review process to ensure the research is accurate. MPI has set out the orange roughy stocks will assessed at 3 year intervals using:

- trawl surveys;
- acoustic surveys;
- regular length-frequency sampling by Observers and during trawl surveys; and,
- routine catch-at-age analysis of otoliths collected by Observers and during trawl surveys.

Research needs for deep water fisheries are driven by the objectives of the National Fisheries Plan for Deepwater Fisheries and delivered through the Medium-Term Research Plan for deep water fisheries (MTRP), (MPI, 2017). MPI published the medium-term term research plan (MTRP) for 2018/19 - 2022/23 **(**https://www.mpi.govt.nz/dmsdocument/21746). The MTRP is intended to reflect research needs to inform management of New Zealand's deepwater fisheries. The MTRP remains a living document and will be updated regularly to reflect changes in management priorities where these occur, and identification of new areas of research. The MTRP rolling five-year plan for deepwater fisheries forms the basis of the annual research programme. Key research in the current MTRP consists of:

- Benthic risk assessment;
- Annual trawl footprint (in-house development);
- Identification of benthic samples; and
- Habitat suitability modelling benthic taxa

The MTRP provides a five-year schedule of science and monitoring projects (e.g. biomass surveys and stock assessments), required to support the sustainable management of deepwater fisheries. The schedule of surveys and stock assessments for the orange roughy UoA fisheries is being adhered to, although the 2020 acoustic biomass survey of ORH 3B NWCR and ESCR was re-scheduled and is being undertaken during June-July 2021 (Ryan & Tilney, 2021). Revised stock assessments of these two UoAs will follow in 2022.

All research projects are reviewed by FNZ's Science Working Groups and assessed against FNZ's Research and Science Information Standard for New Zealand Fisheries (MFish, 2011).

FNZ's Annual Operational Plan 2020/21 provides details of the research projects relating to deepwater fisheries to be undertaken during 2020/21 (see Tables 8-12, pp. 33-34), (FNZ, 2020).

7.4.3 Principle 3 Performance Indicator scores and rationales

PI 3.1.1 – Legal and/or customary framework

PI 3.1.1		The management system exists within an appropriate legal and/or customary framework which ensures that it: - Is capable of delivering sustainability in the UoA(s); - Observes the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; and - Incorporates an appropriate dispute resolution framework		
Scoring Issue		SG 60	SG 80	SG 100
a	Compatibility of laws or standards with effective management			
	Guide post	There is an effective national legal system **and a framework for cooperation** with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2	There is an effective national legal system and **organised and effective cooperation** with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2.	There is an effective national legal system and **binding procedures governing cooperation with other parties** which delivers management outcomes consistent with MSC Principles 1 and 2.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

This section is based on Acoura (2018), the assessments of New Zealand hoki, hake, and ling. To assure harmonization, the Intertek rationale forms the base for orange roughy scores. The Acoura 2018 assessments are conducted under FCR 1.3; as this orange roughy assessment is conducted under FS 2.01, harmonization is not required; however, the orange roughy used the Acoura report as the base to maintain harmonization and because of the similarity of the fisheries.

The management system consists of a highly structured public-private partnership consisting of agreements between MPI and DWG, with a high level of stakeholder involvement (Figure 29). This overall structure forms the basis for operation of the fishery in terms of goals and objectives, fishing rights, planning, consultations, decision making, monitoring and enforcement, and regulation. New Zealand has implemented one of the most extensive quota-based fisheries management systems in the world, with over a 100 species or species-complexes of fish, shellfish and seaweed now being managed within this framework. Almost all commercially targeted fish species within New Zealand's waters are now managed within the Quota Management System (QMS).

MPI is responsible for the utilization of New Zealand's fisheries resources while ensuring sustainability in accordance with its governing legislation - the Fisheries Act 1996. The Fisheries Act binds the Crown. Decisions made under power given by the Act are judicially reviewable by the Courts in the event of disputes. Procedures and processes that apply to disputes about the effects of fishing on the fishing activities of any person that has a current fishing interest provided for under the Act, are set out under Part 7 of the Fisheries Act. MPI's fisheries management responsibilities extend to the 200 nautical mile limit of the New Zealand EEZ.

The terms of the Maori Treaty Settlement for their rights to commercial fisheries have included delivery of commercial quota to Maori (MPI, 2021). MPI delivers the Crown's obligations to Māori under the:

- Treaty of Waitangi (Fisheries Claims) Settlement Act 1992
- Māori Commercial Aquaculture Claims Settlement Act 2004

Māori Fisheries Act 2004

The New Zealand Department of Conservation (DoC) Conservation Services Programme (CSP) monitors the impact of commercial fishing on protected species, studies species populations and looks at ways to limit bycatch. Protected marine species include all marine mammals and reptiles; sea birds (except black backed gulls); seven species of fish; all black corals, gorgonian corals, stony corals and hydrocorals (DoC 2016). MPI and DWG coordinate with DoC in management of the fisheries.

New Zealand is a member of the South Pacific Regional Fisheries Management Organization (SPRFMO), which has Conservation Management Measures (CMM) binding on members (https://www.sprfmo.int/measures/). CMM 03-2021 and 03a-2021 specifically deal with international requirements for bottom fishing in the SPRFMO area, with an objective "through the application of the precautionary approach and an ecosystem approach to fisheries management, to ensure the long-term conservation and sustainable use of deep sea fishery resources, including target fish stocks as well as non-target or associated and dependent species, and, in doing so, to safeguard the marine ecosystems in which these resources occur, including *inter alia* the prevention of significant adverse impacts on vulnerable marine ecosystems."

There is an effective national and international legal system and binding procedures governing cooperation with other parties that deliver management outcomes consistent with MSC Principles 1 and 2. This SI meets SG60, SG80 and SG100.

	Resolution of disputes			
b	Guide post	The management system incorporates or is subject by law to a **mechanism** for the resolution of legal disputes arising within the system.	The management system incorporates or is subject by law to a **transparent mechanism** for the resolution of legal disputes which is **considered to be effective** in dealing with most issues and that is appropriate to the context of the UoA.	The management system incorporates or is subject by law to a **transparent mechanism** for the resolution of legal disputes that is appropriate to the context of the fishery and has been **tested and proven to be effective**.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The Fisheries Act provides opportunities to negotiate and resolve disputes. The Minister may appoint a Dispute Commissioner and the Minister makes the final determination. The consultation process is an attempt to avoid unresolved disputes by ensuring all interested parties have an opportunity to participate and have an input into decisions. There have been occasions when there has not been a satisfactory outcome and then this has gone to litigation and the Court has made a decision. The Memorandum of Understanding between DWG and MPI has encouraged better working relationships and avoided the need for litigation between the Ministry and the industry. The management system incorporates or is subject by law to a transparent mechanism for the resolution of legal disputes that is appropriate to the context of the fishery and has been tested and proven to be effective. This meets the requirements of SG60, 80, and 100.

	Respect for rights			
c	Guide post	The management system has a mechanism to **generally respect** the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to **observe** the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to **formally commit** to the legal rights created explicitly or established by custom of people dependent on fishing for food and livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The terms of the Maori Treaty Settlement for their rights to commercial fisheries have included delivery of commercial quota to Maori (MPI, 2021). MPI delivers the Crown's obligations to Māori under the:

- Treaty of Waitangi (Fisheries Claims) Settlement Act 1992
- Māori Commercial Aquaculture Claims Settlement Act 2004
- Māori Fisheries Act 2004

The Treaty of Waitangi guarantees the “Chiefs, Tribes and peoples of New Zealand” the “undisturbed possession” of their fisheries until they wished to dispose of them to the Crown. Recognition of their Treaty rights to commercial fisheries was agreed in the early 1990s, resulting in the Crown delivering a comprehensive settlement to Maori in three major components. The first was to purchase 10 percent of the quota shares from the market and to transfer these to the Treaty of Waitangi Fisheries Commission, set up as a transitional trust for the benefit of Maori. The second was a cash settlement that was in part used to buy half of New Zealand’s largest fishing company – Sealord Limited. The third was an undertaking to deliver to Maori 20% of the commercial quota shares for any new species brought into the QMS in future.

The Māori Fisheries Act 2004 has the purpose of implementing the agreements made in the Deed of Settlement dated 23 September 1992; and to provide for the development of the collective and individual interests of iwi in fisheries, fishing, and fisheries-related activities in a manner that is ultimately for the benefit of all Maori. To achieve the purposes of this Act, provision is made to establish a framework for the allocation and management of settlement assets through the allocation and transfer of specified settlement assets to iwi as provided for by or under this Act; and the central management of the remainder of those settlement assets.

See Section 7.4.1.2 for more details.

The management system clearly commits to rights of customary fishing, reaching SG60, 80 and 100.

References

The CAB shall list any references here, including hyperlinks to publicly-available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 3.1.2 – Consultation, roles and responsibilities

PI 3.1.2		The management system has effective consultation processes that are open to interested and affected parties The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties		
Scoring Issue		SG 60	SG 80	SG 100
a	Roles and responsibilities			
	Guide post	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **generally understood**.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **explicitly defined and well understood for key areas** of responsibility and interaction.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **explicitly defined and well understood for all areas** of responsibility and interaction.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The primary groups with direct interest in the fishery are MPI and the deepwater fishing industry (represented by DWG). Both are involved in the fishery through a partnership for management and science-based monitoring. MPI has the responsibility for sustainable harvest under the requirements of the Fisheries Act 1996. Through policy, MPI and DWG work closely together through a Memorandum of Understanding (DWG 2010) with a goal to ensure New Zealand's deepwater fisheries are sustainably managed. The New Zealand Department of Conservation (DoC) Conservation Services Programme (CSP) monitors the impact of commercial fishing on protected species, studies species populations and looks at ways to limit bycatch (DoC 2021a). MPI and DWG coordinate with DoC in management of the fisheries. However, managing the effects of fishing on these species remains the responsibility of MPI.

New Zealand is a member of the South Pacific Regional Fisheries Management Organization (SPRFMO), which has Conservation Management Measures (CMM) binding on members (https://www.sprfmo.int/measures/). CMM 03-2021 and 03a-2021 specifically deal with international requirements for bottom fishing in the SPRFMO area.

The Treaty of Waitangi guarantees the "Chiefs, Tribes and peoples of New Zealand" the "undisturbed possession" of their fisheries until they wished to dispose of them to the Crown. Recognition of their Treaty rights to commercial fisheries was agreed in the early 1990s, resulting in the Crown delivering a comprehensive settlement to Maori in three major components.

A number of NGOs participate in consultations on the science and management of orange roughy fisheries. WWF-NZ, WWF-US, WWF-AU, Royal Forest and Bird Protection Society of New Zealand, Greenpeace, and Environment and Conservation Organisations of New Zealand (ECO) are participants. Other organisations may also participate selectively such as the New Zealand Marine Sciences Society and TRAFFIC.

Organizations and individuals involved in the fishery have been identified, with roles and responsibilities well laid out, meeting the SG60, 80, and 100.

b	Consultation processes			
	Guide post	The management system includes consultation processes that **obtain relevant information** from the main affected parties, including local knowledge, to inform the management system.	The management system includes consultation processes that **regularly seek and accept** relevant information, including local knowledge. The management system demonstrates consideration of the information obtained.	The management system includes consultation processes that **regularly seek and accept** relevant information, including local knowledge. The management system demonstrates consideration of the information and **explains how it is used or not used**.

	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The 1996 Fisheries Act requires consultation with stakeholders. To affect this, the Minister has established consultation standards (MPI, https://fs.fish.govt.nz/Doc/21817/consultation_standard%5B1%5D.pdf.ashx) that set out:

- Best practice consultation process to be followed by fisheries managers;
- Minimum performance measures where appropriate; and
- A nationally consistent approach.

This process standard has been developed taking into account relevant obligations, including the provisions of s 12 of the Fisheries Act 1996, administrative law requirements, and the MFish Statement of Intent 2006-2011. These standards recognize that consultation leading to decisions must occur in accordance with law; in a reasonable manner; and fairly, in accordance with the principles of natural justice. The law requires identification of stakeholders "with an interest" in each fishery, and the identification of those who represent stakeholders with an interest. In general, the policy recommends setting a wide range of stakeholders with an interest. The Minister must notify stakeholders in advance of the consultation, and to subsequently inform them of his decisions.

Within this process, it is necessary to identify both who has an interest and who are representative of those having an interest. MPI provides an initial consultation plan and the manner of consultation, including the timeframe for the consultation and the decision. MPI distributes the decision and subsequently reviews the process to assure that their consultation meets all requirements.

When management changes are proposed to meet sustainability requirements (such as a change to a TAC/TACC), MPI prepares a discussion document that provides the Ministry's initial proposals for issues needing decision and a range of management options. In orange roughy fisheries such proposals primarily relate to changes in TACCs/catch limits. The proposals outlined in MPI's discussion document are preliminary and are provided as the basis for consultation with stakeholders. Subsequently, MPI prepares a decision document, which summarises stakeholders' views on their proposals and makes recommendations to the Minister. The decision document and the Minister's letter setting out his final decisions are posted on MPI's website as soon as they become available.

The primary non-government stakeholders are the owners of orange roughy quota represented by DWG. DWG-MFish (2010) outlines the consultations undertaken by the industry and MPI. MPI has established open and direct involvement of all stakeholders in their science assessment processes. All of the Science Working Groups, including the annual stock assessment Plenary, are open to the public and the papers and meeting records are available to all participants. DWG invites discussions with MSC stakeholders through presentations and participation in conferences and documentaries (Clement, 2021); through direct meetings; through the public release of all information pertaining to the MSC assessment process online; and, through inviting all participants to attend any meeting between the MSC, CAB and DWG.

See also Section 7.4.1.3 and 7.4.1.4 for more details.

The management system includes ongoing consultation processes that seek and use inputs, and provide information on the use of the inputs, meeting SG 60, 80, and 100.

	Participation			
c	Guide post		The consultation process **provides opportunity** for all interested and affected parties to be involved.	The consultation process provides **opportunity and encouragement** for all interested and affected parties to be involved, and **facilitates** their effective engagement.
	Met?		**Yes**	**Yes**
Rationale				

A process standard for stakeholder consultation has been developed to set out how MPI meets its obligations to consult with stakeholders before providing advice to the Minister, based on requirements of the of the Fisheries Act 1996 (MPI, https://fs.fish.govt.nz/Doc/21817/consultation_standard%5B1%5D.pdf.ashx). This standard sets out best practice consultation processes to be followed by fisheries managers; minimum performance measures where appropriate; and a nationally consistent approach with reference to relevant legislation and guidelines. Within this

process, it is necessary to identify both who has an interest and who are representative of those having an interest. Decision-makers should (https://fs.fish.govt.nz/Doc/21817/consultation_standard%5B1%5D.pdf.ashx):

- start consultation early
- consult widely when appropriate
- listen to what others have to say
- be informative
- be prepared to wait
- balance the issues
- ask for feedback
- conduct consultation in mutual good faith
- keep consultation a two way process
- be open minded

These procedures assure opportunity and encouragement for effective stakeholder engagement meeting SG80 and 100.

References

The CAB shall list any references here, including hyperlinks to publicly-available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 3.1.3 – Long term objectives

PI 3.1.3		The management policy has clear long-term objectives to guide decision-making that are consistent with MSC Fisheries Standard, and incorporates the precautionary approach		
Scoring Issue		SG 60	SG 80	SG 100
a	Objectives			
	Guide post	Long-term objectives to guide decision-making, consistent with the MSC Fisheries Standard and the precautionary approach, are **implicit** within management policy.	**Clear** long-term objectives that guide decision-making, consistent with MSC Fisheries Standard and the precautionary approach are **explicit** within management policy.	**Clear** long-term objectives that guide decision-making, consistent with MSC Fisheries Standard and the precautionary approach, are **explicit** within **and required by** management policy.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The Fisheries Act 1996 requires a precautionary approach. The MSC vocabulary defines the precautionary as: "The precautionary approach shall be interpreted to mean being cautious when information is uncertain, unreliable or inadequate and that the absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures." Section 10 of the Fisheries Act 1996 specifies four information principles, which encompass the precautionary principle, that must be taken into account in relation to the utilisation of fisheries resources or ensuring sustainability:

All persons exercising or performing functions, duties, or powers under the Fisheries Act, in relation to the utilisation of fisheries resources or ensuring sustainability, shall take into account the following information principles:

- decisions should be based on the best available information:
- decision makers should consider any uncertainty in the information available in any case:
- decision makers should be cautious when information is uncertain, unreliable, or inadequate:
- the absence of, or any uncertainty in, any information should not be used as a reason for postponing or failing to take any measure to achieve the purpose of this Act.

Fisheries 2030, MPI's overarching vision for New Zealand fisheries established in 2009, specifies an overarching goal for New Zealand's fisheries and two outcomes:

> **Goal**: New Zealanders maximising benefits from the use of fisheries within environmental limits.
>
> **Use Outcome:** Fisheries resources are used in a manner that provides greatest overall economic social and cultural benefit.
>
> **Environment Outcome:** The capacity and integrity of the aquatic environment, habitats and species are sustained at levels that provide for current and future use.

The National Deepwater Plan provides an integrated, transparent way of defining management objectives, actions, and services required to meet relevant legislative obligations and strategic directions for managing New Zealand's deepwater fisheries. The plan also provides a reporting mechanism to measure progress towards meeting objectives. The purpose of national fisheries plans is to provide clear management objectives to support the purpose and principles of the Fisheries Act 1996 and to identify key deliverables for MPI over the medium term (5 years). Work on the revision began in 2016. In May 2019, MPI approved the plan (https://www.mpi.govt.nz/dmsdocument/18779/direct).

See Section 7.4.1.4 and 7.4.1.6 for more details.

Clear long-term objectives, consistent with the precautionary approach, are explicit and required, meeting SG60, 80, and 100.

References

Fisheries 2030; https://www.mpi.govt.nz/dmsdocument/18779/direct

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 3.2.1 – Fishery-specific objectives

PI 3.2.1		The fishery-specific management system has clear, specific objectives designed to achieve the outcomes expressed by MSC's Principles 1 and 2		
Scoring Issue		SG 60	SG 80	SG 100
a	Objectives			
	Guide post	**Objectives**, which are broadly consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **implicit** within the fishery-specific management system.	**Short and long-term objectives**, which are consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **explicit** within the fishery-specific management system.	**Well defined and measurable short and long-term objectives**, which are demonstrably consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **explicit** within the fishery-specific management system.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

The National Deepwater Plan provides an integrated, transparent way of defining management objectives, actions, and services required to meet relevant legislative obligations and strategic directions for managing New Zealand's deepwater fisheries (https://www.mpi.govt.nz/dmsdocument/18779/direct). The plan also provides a reporting mechanism to measure progress towards meeting objectives. The purpose of national fisheries plans is to provide clear management objectives to support the purpose and principles of the Fisheries Act 1996 and to identify key deliverables for MPI over the medium term (5 years). Section 4 of the plan provides for each objective:

- **Description**: What does the objective mean?
- **Current Status**: What is the current status of deepwater fisheries in relation to the objective?
- **Management Initiatives**: What actions or initiatives are proposed to progress towards achievement of the objective?
- **Key Performance Indicators**: What would deepwater fisheries look like when the objectives were achieved?

The Section 4 information provides well defined objectives. The performance indicators in Section 4 provide mechanisms for measuring success for some, but not all, of the objectives. Therefore, the management system contains well-defined and measureable objectives, although not all objectives meet the 'measurable' requirement.

The DWG-MPI MOU (DWG-MFish, 2010) further lays out specific objectives for implementing the National Deepwater Plan.

This meets the SG60, 80, and 100.

References

https://www.mpi.govt.nz/dmsdocument/18779/direct, DWG-MFish, 2010

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 3.2.2 – Decision-making processes

PI 3.2.2		The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives, and has an appropriate approach to actual disputes in the fishery		
Scoring Issue		SG 60	SG 80	SG 100
a	Decision-making processes			
	Guide post	There are **some** decision-making processes in place that result in measures and strategies to achieve the fishery-specific objectives.	There are **established** decision-making processes that result in measures and strategies to achieve the fishery-specific objectives.	
	Met?	**Yes**	**Yes**	
Rationale				

When management changes are proposed to meet sustainability requirements (such as a change to a TAC/TACC), MPI prepares a discussion document that provides the Ministry's initial proposals for issues needing decision and a range of management options. In orange roughy fisheries such proposals primarily relate to changes in TACCs/catch limits. The proposals outlined in MPI's discussion document are preliminary and are provided as the basis for consultation with stakeholders. Subsequently, MPI prepares a decision document, which summarises stakeholders' views on their proposals and makes recommendations to the Minister. The decision document and the Minister's letter setting out his final decisions are posted on MPI's website as soon as they become available.

A decision to consult or not to consult, and any decision made after consultation, must be made in accordance with the principles of administrative law, and in accordance with Fisheries Act 1996 obligations. These principles require decision-makers to act:

- in accordance with law;
- reasonably; and
- fairly, in accordance with the principles of natural justice.

Decisions that do not follow requirements are open to legal challenge.

These requirements meet SG60 and 80.

b	Responsiveness of decision-making processes			
	Guide post	Decision-making processes respond to **serious issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take some account of the wider implications of decisions.	Decision-making processes respond to **serious and other important issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.	Decision-making processes respond to **all issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Consultation is a central component of the management decision-making process (Fisheries Act Section 12, Stakeholder Consultation Process Standard). The Minister makes the final decision based on advice received from other parties (Section 12 – "the Minister shall consult with such persons or organisations as the Minister considers are representative of those classes of persons having an interest in the stock or the effects of fishing on the

aquatic environment in the area concerned including Maori, environmental, commercial, and recreational interests").

MPI prepares a discussion document that provides the Ministry's initial proposals for issues needing decision and a range of management options. In orange roughy fisheries such proposals primarily relate to changes in TACCs/catch limits. The proposals outlined in MPI's discussion document are preliminary and are provided as the basis for consultation with stakeholders. Subsequently, MPI prepares a decision document, which summarises stakeholders' views on their proposals and makes recommendations to the Minister. The decision document and the Minister's letter setting out his final decisions are posted on MPI's website as soon as they become available. This demonstrates the management system responding to serious and important issues in an open and transparent way, taking into account the wider implications and alternatives for decision making. This meets the SG60 and 80. While the management system considers a wide range of issues, it is not clear that the system takes into account all issues, thus not meeting the SG100.

	Use of precautionary approach			
c	Guide post		Decision-making processes use the precautionary approach and are based on best available information.	
	Met?		**Yes**	
Rationale				

The Fisheries Act 1996 requires a precautionary approach. The MSC vocabulary defines the precautionary as: "The precautionary approach shall be interpreted to mean being cautious when information is uncertain, unreliable or inadequate and that the absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures." Section 10 of the Fisheries Act 1996 specifies four information principles, which encompass the precautionary principle, that must be taken into account in relation to the utilisation of fisheries resources or ensuring sustainability:

SPRFMO CMM 03-2021 and 03a-2021 specifically deal with international requirements for bottom fishing in the SPRFMO area, with an objective "through the application of the precautionary approach and an ecosystem approach to fisheries management, to ensure the long-term conservation and sustainable use of deep sea fishery resources.

As an example of implementation of the precautionary approach, the orange roughy fishery was closed in Area 7A (Challenger) from 2000 to 2009 to allow rebuilding, and the industry voluntarily refrained from harvesting orange roughy in the NWCR from 2010-11 to 2012-13, even though they had available quota, as part of a plan to increase the rate of abundance growth. This was described in the Review of Sustainability Measures and Other Management Controls for Selected Deepwater Fishstocks 2014. All deepwater fisheries are subject to no fishing in benthic-protected areas. In another deepwater fishery, the TACC for hoki has been revised several times in recent years to address uncertainties.

The management system meets the SG80.

	Accountability and transparency of management system and decision-making process			
d	Guide post	Some information on the fishery's performance and management action is generally available on request to stakeholders.	**Information on the fishery's performance and management action is available on request**, and explanations are provided for any actions or lack of action associated with findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.	Formal reporting to all interested stakeholders **provides comprehensive information on the fishery's performance and management actions** and describes how the management system responded to findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

Formal reporting on management actions or inactions is part of the formal consultation process. When management changes are proposed to meet sustainability requirements (such as a change to a TAC/TACC), MPI prepares a discussion document that provides the Ministry's initial proposals for issues needing decision and a range of management options. In orange roughy fisheries such proposals primarily relate to changes in TACCs/catch limits. The proposals outlined in MPI's discussion document are preliminary and are provided as the basis for consultation with stakeholders. Subsequently, MPI prepares a decision document, which summarises stakeholders' views on their proposals and makes recommendations to the Minister. The decision document and the Minister's letter setting out his final decisions are posted on MPI's website as soon as they become available. These measures together meet the SG60, 80, qne 100.

	Approach to disputes			
e	Guide post	Although the management authority or fishery may be subject to continuing court challenges, it is not indicating a disrespect or defiance of the law by repeatedly violating the same law or regulation necessary for the sustainability for the fishery.	The management system or fishery is attempting to comply in a timely fashion with judicial decisions arising from any legal challenges.	The management system or fishery acts proactively to avoid legal disputes or rapidly implements judicial decisions arising from legal challenges.
	Met?	**Yes**	**Yes**	**Yes**

Rationale

The Minister is the decision maker in fisheries management matters and his decisions are bound by the law, and are therefore open to legal review. The law requires identification of stakeholders "with an interest" in each fishery, and the identification of those who represent stakeholders with an interest.

Section VII Disputes Resolution of the Fisheries Act states that the section "(a) applies to disputes about the effects of fishing (excluding fish farming) on the fishing activities of any person who has a current fishing interest provided for or authorized by or under this Act; but
(b) does not apply to disputes about ensuring sustainability or about the effects of any fishing authorised under Part 9." Section VII further requires that the Minister publicly set out an approved statement of procedure for the resolution of such disputes. The Minister of Fisheries published in 1998 the dispute resolution procedures. The Minister's approved statement of procedure for the resolution of disputes consists of four steps, with each step in turn involving specific actions to be undertaken by the parties to the dispute to give effect to the requirements of Section VII of the Act:

- Dispute summary report by the party identifying the report
- Production and Distribution of Initial Assessment Report demonstrating the dispute is about the effects of fishing, and does not involve issues associated with ensuring sustainability
- Negotiation and attempts at resolution
- Prepare an Outcome Report with conclusion of the process including resolution or not of the dispute.

The parties to the dispute may make recommendations that involve sustainability or customary fishing that would require action beyond the authority of the Minister.
The collaboration between the DWG and MPI works to avoid disputes, as the agreement of common goals and negotiations to achieve them occurs during the normal working relationship between the two parties.
The principles in the Fisheries Act require decision-makers to act:

- in accordance with law;
- reasonably; and
- fairly, in accordance with the principles of natural justice.

Decisions that do not follow requirements are open to legal challenge.
Legal challenges are uncommon in the fisheries, in part because of the collaborative decision making.
Therefore, the management system proactively acts to avoid disputes. Lack of judicial decisions does not provide direct evidence of rapid implementation, but the requirements of the Fisheries Act and policies of DWG and MPI strongly suggest this would be the case. The fishery reaches the SG60, SG80, and SG100.

References

Fisheries Act 1996
MFish 1998
DWG-MPI 2010

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 3.2.3 – Compliance and enforcement

PI 3.2.3		Monitoring, control and surveillance mechanisms ensure the management measures in the fishery are enforced and complied with		
Scoring Issue		SG 60	SG 80	SG 100
a	MCS implementation			
	Guide post	Monitoring, control and surveillance **mechanisms** exist, and are implemented in the fishery and there is a reasonable expectation that they are effective.	A monitoring, control and surveillance **system** has been implemented in the fishery and has demonstrated an ability to enforce relevant management measures, strategies and/or rules.	A **comprehensive** monitoring, control and surveillance system has been implemented in the fishery and has demonstrated a consistent ability to enforce relevant management measures, strategies and/or rules.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The orange roughy management system has documented a comprehensive and effective monitoring, control and surveillance system through:

4. compulsory use of satellite-based Vessel Monitoring System (VMS) with an onboard automatic location communicator (ALC);
5. government observers who may be placed on board to observe fishing, transhipment and transportation to collect any information on orange roughy fisheries resources. This includes information to monitor the effects of orange roughy fishing on the aquatic environment; and,
6. accurate recordkeeping and recording requirements to establish auditable and traceable records to ensure all catches are counted and do not exceed the ACE held by each operator.

New Zealand introduced the VMS in 1994 which requires by law all vessels over 28 metres and all vessels that target orange roughy to carry and operate a registered ALC at all times. Paper-based catch reporting was also required by all fishing vessels operating in NZ's EEZ. These systems have now been replaced by near real time Geospatial Position Reporting and daily Electronic Catch Reporting. FNZ still combines this functionality with at-sea and aerial surveillance, supported by the New Zealand Defence Force. This independently provides surveillance of activities of deep-water vessels through inspection and visual capability to ensure these vessels are fully monitored and verified to ensure compliance with both regulations and with industry-agreed Operational Procedures.

In combination with at-sea and air surveillance supported by the New Zealand joint forces, vessel activities in the three UoAs are monitored and verified to ensure compliance with regulations and with industry-agreed operational procedures. Commercial fishermen face prosecution and risk severe penalties, which include automatic forfeiture of vessel and quota upon conviction of breaches of the fisheries regulations (unless the court rules otherwise). Financial penalties are also imposed in the form of deemed values to discourage fishermen from over-catching their ACE holdings.

The extensive regulations governing these fisheries are complemented by additional industry-agreed non-regulatory measures, known as the New Zealand Deepwater Fisheries Operational Procedures. The Minister for Fisheries relies on the effectiveness of both regulatory and non-regulatory measures to ensure the sustainable management of these fisheries. As part of DWG's Operational Procedures, DWG has an Environmental Liaison Officer whose role is to liaise with vessel operators, skippers and FNZ to assist with the effective implementation of these Operational Procedures (Cleal, 2019, Cleal, 2020). DWG personnel and vessel operators meet with MPI's Management and Compliance teams annually to discuss and evaluate any issues that may have arisen (DWG, 2020, 2020a, MPI, 2019a). Any identified risks are communicated to the fleet along with proposed remedial action to be undertaken (DWG, 2019).

The comprehensive MCS system has demonstrated a consistent ability for effective enforcement meeting SG60,80, and 100.

b	Sanctions			
	Guide post	Sanctions to deal with non-compliance exist and there is some evidence that they are applied.	Sanctions to deal with non-compliance exist, **are consistently applied** and thought to provide effective deterrence.	Sanctions to deal with non-compliance exist, are consistently applied and **demonstrably** provide effective deterrence.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

Under the Fisheries Act, in proceedings for an offence against this Act it is not necessary for the prosecution to prove that the defendant intended to commit the offence; rather, the defendant must show the contravention was due to the act or default of another person, or to an accident or to some other cause beyond the defendant's control; and the defendant took reasonable precautions and exercised due diligence to avoid the contravention. Upon conviction, the Fisheries Act allows for sanctions that may include prison time, fines from $250 to $500,000, forfeiture of quota, vessels, and other property. As only several major companies own quota, severe sanctions could put them out of business. Financial penalties are also imposed in the form of deemed values to discourage fishermen from over-catching their ACE holdings. The industry, with its investment in the fishery through co-management, has a strong incentive to maintain its cooperative role through compliance with legal requirements.

In combination with at-sea and air surveillance supported by the New Zealand joint forces, vessel activities in the three UoAs are monitored and verified to ensure compliance with regulations and with industry-agreed operational procedures. MPI uses 'informed and assisted compliance' help minimize infractions. Most fishermen follow the regulations; some engage in opportunistic non-compliance that is usually easily detected by enforcement agents, and a few will actively seek advantage with illegal fishing. Checking and feedback of minor infractions hold the second group in line; but only severe sanctions, up to loss of fishing permits and vessels, will deter the last group. Enforcement personnel report that compliance is high in the orange roughy fishery.

Therefore, sanctions are consistently applied, and provide effective compliance, meeting SG60, 80, and 100.

c	Compliance			
	Guide post	Fishers are **generally thought** to comply with the management system for the fishery under assessment, including, when required, providing information of importance to the effective management of the fishery.	**Some evidence exists** to demonstrate fishers comply with the management system under assessment, including, when required, providing information of importance to the effective management of the fishery.	There is a **high degree of confidence** that fishers comply with the management system under assessment, including, providing information of importance to the effective management of the fishery.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The industry complies with reporting requirements, traceable documentation, effective surveillance, landing and reconciliation of catch against ACE, catch documentation audits, and checks against past catch. Kazmierow et al. (2010) surveyed fishermen on compliance decision making, and found generally good compliance. The MPI has devolved responsibility for obtaining scientific information to the orange roughy fishing industry, as demonstrated in the research plan, operations plans, and the industry-ministry MOU. The DWG provides information necessary for the management of the fishery on the premise that better information can reduce uncertainty and lead to more flexibility in management. Together, these actions demonstrate with a high degree of confidence that the fishermen comply with the requirements and provide substantial amounts of information for the management of the fisheries. This meets SG60, 80, and100.

d	Systematic non-compliance		
	Guide post		There is no evidence of systematic non-compliance.

	Met?		**Yes**	

Rationale

The high level of meeting reporting requirements, the relatively high level of observer coverage, and ongoing monitoring by enforcement agents demonstrates no evidence of systematic non-compliance. This meets the SG80.

References

The CAB shall list any references here, including hyperlinks to publicly-available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

PI 3.2.4 – Monitoring and management performance evaluation

PI 3.2.4		**There is a system of monitoring and evaluating the performance of the fishery-specific management system against its objectives There is effective and timely review of the fishery-specific management system**		
Scoring Issue		SG 60	SG 80	SG 100
a	Evaluation coverage			
	Guide post	There are mechanisms in place to evaluate **some** parts of the fishery-specific management system.	There are mechanisms in place to evaluate **key** parts of the fishery-specific management system.	There are mechanisms in place to evaluate **all** parts of the fishery-specific management system.
	Met?	**Yes**	**Yes**	**Yes**
Rationale				

The Annual Review Report for Deepwater Fisheries 2018-2019 (MPI 2021) provides a record of the annual reviews of the fisheries, including orange roughy. **Part 1** describes the progress that has been made during the 2018-2019 financial year towards meeting the five year management priorities set out in the 2019/20 Annual Operational Plan. Achievement of these annual management priorities aims to contribute towards meeting the five year high level Management Objectives and Operational Objectives set out in Part 1 of the National Deepwater Plan.

Part 2 provides detail on MPI work that is relevant to deepwater fisheries management and is planned by financial year (1 July – 30 June). These processes include the planning and contracting of fisheries and conservation research projects, planning observer coverage on the deepwater fleet and the cost recovery regime. Progress made during the 2012/13 financial year is detailed.
Part 3 *reports on the combined environmental impacts of deepwater fishing, and on the deepwater fleet's adherence to the non-regulatory management measures that were in place for the 2018-2019 fishing year (1 October 2018 – 30 September 2019).*

The annual review report evaluates the development and implementation of the Fisheries Plan framework – National Deepwater Plan with fishery specific chapters and Annual Operational Plan for the fisheries. This review encompasses all parts of the management system, therefore reaching the SG60, SG80, and SG100.

b	Internal and/or external review			
	Guide post	The fishery-specific management system is subject to **occasional internal** review.	The fishery-specific management system is subject to **regular internal** and **occasional external** review.	The fishery-specific management system is subject to **regular internal and external** review.
	Met?	**Yes**	**Yes**	**No**
Rationale				

Progress against the objectives in the National Fisheries Plan for Deepwater and the Annual Operational Plan is reviewed annually and reported in the Annual Review Report. MPI conducts an extensive review of performance of the deepwater fisheries that incorporates consultations with industry and other stakeholders. Parts of the management system, specifically science and enforcement, undergo external review.

In 2018, MPI completed an external review of the Deepwater Fisheries Management conducted by Independent Quality Assurance New Zealand (IQANZ 2018). The review covered the relevant parts of fishery management described in CR v1.3 GCB4.11 and CR v2.0 GSA4.10. Therefore, this scoring issue meets the SG80. Evidence of regular external review has not been provided, thereby precluding the SG100.

References

The CAB shall list any references here, including hyperlinks to publicly-available documents.

Draft scoring range and information gap indicator added at Announcement Comment Draft Report stage

Draft scoring range	**≥80**
Information gap indicator	**Information sufficient to score PI**

Overall Performance Indicator scores added from Client and Peer Review Draft Report stage

Overall Performance Indicator score	
Condition number (if relevant)	

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Principle 1

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9 Appendices

9.1 Assessment information

9.1.1 Previous assessments

The NZ orange roughy fishery was first certified in 2016, using the MSC Fishery Certification Requirements and Default Assessment Tree version 1.3, with four conditions. Two conditions were closed in 2019, at the second surveillance audit, and two were closed in 2020, at the third surveillance audit. All previous reports, including the full assessment with objections process, and previous three surveillances, are available on the MSC track-a-fishery website.

Table 50 – Summary of previous assessment conditions

Condition	PI(s)	Year closed	Justification
Insert condition number and summary	Insert PI	State year of closure, if applicable.	
1- Provide evidence that the ORH3B ESCR stock is at or fluctuating around its target reference point.	1.1.1.	2019	See MRAG Americas 2020
2- For the ORH3B NWCR and ORH3B ESCR, by the end of the certification period, the direct effects of ORH fishing must be highly unlikely to create unacceptable impacts to ETP coral species.	2.3.1.	2020	See MRAG Americas 2020
3- By the end of the certification period information must be sufficient to determine whether the fishery may be a threat to protection and recovery of ETP coral species.	2.3.3.	2020	See MRAG Americas 2020
4- By the third annual surveillance the fishery-specific management system must undergo occasional external review.	3.2.5.	2019	See MRAG Americas 2020

9.1.1 Small-scale fisheries

Table 51– Small-scale fisheries

Unit of Assessment (UoA)	Percentage of vessels with length <15m	Percentage of fishing activity completed within 12 nautical miles of shore
ORH 7A-WB	0%	0%
ORH 3B ESCR	0%	0%
ORH 3B NWCR	0%	0%

9.2 Evaluation processes and techniques

9.2.1 Site visits

The CAB shall include in the report:

- An itinerary of site visit activities with dates.
- A description of site visit activities, including any locations that were inspected.
- Names of individuals contacted.

Reference(s): FCP v2.2 Section 7.16

A remote site visit will be held via teleconference during the week of November 2nd, 2021. The purpose of these meetings is for a fishery assessment and stakeholder consultation to receive information from fishery representatives, government management agencies, non-governmental organizations, and other interested stakeholders.

A key purpose of the site visit is to collect information and to speak to stakeholders with an interest in the fishery. For those parts of the assessment involving the MSC's RBF (Principle 2, secondary species in this case) see http://www.msc.org/about-us/standards/methodologies/fam/msc-risk-based-framework, Please note we will be using a stakeholder-driven, qualitative analysis during the site visit. To achieve a robust outcome from this consultative approach, we rely heavily on participation of a broad range of stakeholders with a balance of knowledge of the fishery. We encourage any stakeholders with experience or knowledge of the fishery to participate in these meetings. (FCP v2.2 7.12.3 and Annex PF2.3.2)

9.2.2 Stakeholder participation

The CAB shall include in the report:

- Details of people interviewed: local residents, representatives of stakeholder organisations including contacts with any regional MSC representatives.
- A description of stakeholder engagement strategy and opportunities available.

Reference(s): FCP v2.2 Section 7.16

MRAG invites stakeholders to provide input on the Announcement Comment Draft Report or any other information considered relevant, including knowledge and concerns about the fishery and to the assessments of the fishery. Stakeholders must provide objective evidence and references in support of any claims or claimed errors of fact. Unless covered by FCP 4.3.3 any information that cannot be shared with other stakeholders even under a confidentiality agreement shall not be: referenced in the assessment, used to determine the assessment outcome or used as the basis for an objection to a certification. MRAG will schedule meetings with stakeholders if requested.

9.2.3 Evaluation techniques

At Announcement Comment Draft report stage, if the use of the RBF is triggered for this assessment, the CAB shall include in the report:

- The plan for RBF activities that the team will undertake at the site visit.
- The justification for using the RBF, which can be copied from previous RBF announcements, and stakeholder comments on its use.
- The RBF stakeholder consultation strategy to ensure effective participation from a range of stakeholders including any participatory tools used.
- The full list of activities and components to be discussed or evaluated in the assessment.

At Client Draft Report stage, if the RBF was used for this assessment, the CAB shall include in the report:

- A summary of the information obtained from the stakeholder meetings including the range of opinions.
- The full list of activities and components that have been discussed or evaluated in the assessment, regardless of the final risk-based outcome.

The stakeholder input should be reported in the stakeholder input appendix and incorporated in the rationales directly in the scoring tables.

Reference(s): FCP v2.2 Section 7.16, FCP v2.2 Annex PF Section PF2.1

An announcement of the MSC reassessment of the New Zealand orange roughy is being published 30 September 2021. Stakeholders are being informed of the assessment by email and through announcements posted on the MSC website. Relevant materials for the assessment were submitted to the assessment team by the Client. The audit will be conducted remotely beginning 02 November 2021. Remote meetings with stakeholders will be scheduled during that time frame.

The assessment is being carried out in accordance with the MSC Fisheries Standard v2.01, and includes the use of the Risk Based Framework to address PI 2.2.1 due to main and minor secondary species being data-deficient according to FCP 2.2:7.7.3. Using the RBF for this component requires a Productivity Susceptibility Analysis to be carried out for each species or species group deemed data-deficient in the secondary species category. A PSA requires some expert judgement to determine the correct risk scores for the susceptibility attributes. As such the assessment team will ensure opportunity to gain appropriate expert opinion during the site visit on these species and their interactions with the UoAs. There is some information from catch composition and trawl surveys already, and this will be supplemented by the results of the PSA analysis.

Following the MSC guidelines for implementation timeframes, the assessment will be conducted in accordance with the process requirements in FCP v2.2.

9.3 Peer Review reports

To be drafted at Public Comment Draft Report stage

The CAB shall include in the report unattributed reports of the Peer Reviewers in full using the relevant templates. The CAB shall include in the report explicit responses of the team that include:

- Identification of specifically what (if any) changes to scoring, rationales, or conditions have been made; and,
- A substantiated justification for not making changes where Peer Reviewers suggest changes, but the team disagrees.

Reference(s): FCP v2.2 Section 7.14

9.4 Stakeholder input

To be drafted at Client and Peer Review Draft Report stage

The CAB shall use the 'MSC Template for Stakeholder Input into Fishery Assessments' to include all written stakeholder input during the stakeholder input opportunities (Announcement Comment Draft Report, site visit and Public Comment Draft Report). Using the 'MSC Template for Stakeholder Input into Fishery Assessments', the team shall respond to all written stakeholder input identifying what changes to scoring, rationales and conditions have been made in response, where the changes have been made, and assigning a 'CAB response code'.

The 'MSC Template for Stakeholder Input into Fishery Assessments' shall also be used to provide a summary of verbal submissions received during the site visit likely to cause a material difference to the outcome of the assessment. Using the 'MSC Template for Stakeholder Input into Fishery Assessments' the team shall respond to the summary of verbal submissions identifying what changes to scoring, rationales and conditions have been made in response, where the changes have been made, and assigning a 'CAB response code'.

Reference(s): FCP v2.2 Sections 7.15, 7.20.5 and 7.22.3

9.5 Conditions

9.5.1 Conditions

To be drafted at Client and Peer Review Draft Report stage

The CAB shall document in the report all conditions in separate tables.

Reference(s): FCP v2.2 Section 7.18, 7.30.5 and 7.30.6

Table X – Condition 1

Performance Indicator	
Score	*State score for Performance Indicator*
Justification	*Cross reference to page number containing scoring template table or copy justification text here.*
Condition	*State condition.*
Condition deadline	*State deadline for the condition.*
Exceptional circumstances ☐	*Check the box if exceptional circumstances apply and condition deadline is longer than the period of certification (FCP v2.2, 7.18.1.6). Provide a justification.*
Milestones	*State milestones and resulting scores where applicable* ***Spell out the measurable improvements and outcomes (using quantitative metrics) expected each year and/or the outcome and score that shall be achieved at any interim milestone (FCP 7.18.1.5)*
Verification with other entities	*Include details of any verification required to meet requirements in FCP v2.2 7.19.8.*
Complete the following rows for reassessments.	
Carried over condition ☐	*Check the box if the condition is being carried over from a previous certificate and include a justification for carrying over the condition (FCP v2.2 7.30.5.1.a)* *Include a justification that progress against the condition and milestones is adequate (FCP v2.2 7.30.5.2). The CAB shall base its justification on information from the reassessment site visit.*
Related condition ☐	*Check the box if the condition relates to a previous condition that was closed during a previous certification period but where a new condition on the same Performance Indicator or Scoring Issue is set.* *Include a justification – why is a related condition being raised? (FCP v2.2 7.30.6 & G7.30.6).*
Condition rewritten ☐	*Check the box if the condition has been rewritten. Include a justification (FCP v2.2 7.30.5.3)*

9.6 Client Action Plan

To be drafted at Public Comment Draft Report stage

The CAB shall include in the report the Client Action Plan from the fishery client to address conditions.

Reference(s): FCP v2.2 Section 7.19

9.7 Surveillance

To be drafted from Client and Peer Review Draft Report

The CAB shall include in the report the program for surveillance, timing of surveillance audits and a supporting rationale.

Reference(s): FCP v2.2 Section 7.28

Table X– Fishery surveillance program				
Surveillance level	Year 1	Year 2	Year 3	Year 4
e.g. Level 5	e.g. On-site surveillance audit	e.g. On-site surveillance audit	e.g. On-site surveillance audit	e.g. On-site surveillance audit & re-certification site visit

Table X – Timing of surveillance audit			
Year	Anniversary date of certificate	Proposed date of surveillance audit	Rationale
e.g. 1	e.g. May 2018	e.g. July 2018	e.g. Scientific advice to be released in June 2018, proposal to postpone audit to include findings of scientific advice

Table X – Surveillance level justification			
Year	Surveillance activity	Number of auditors	Rationale
e.g.3	e.g. On-site audit	e.g. 1 auditor on-site with remote support from 1 auditor	e.g. From client action plan it can be deduced that information needed to verify progress towards conditions 1.2.1, 2.2.3 and 3.2.3 can be provided remotely in year 3. Considering that milestones indicate that most conditions will be closed out in year 3, the CAB proposes to have an on-site audit with 1 auditor on-site with remote support – this is to ensure that all information is collected and because the information can be provided remotely.

9.8 Risk-Based Framework outputs

To be drafted at Client and Peer Review Draft Report stage

9.8.1 Productivity Susceptibility Analysis (PSA)

The CAB shall include in the report an MSC Productivity Susceptibility Analysis (PSA) worksheet for each Performance Indicator where the PSA is used and one PSA rationale table for each data-deficient species identified, subject to FCP v2.2 Section PF4. If species are grouped together, the CAB shall list all species and group them indicating which are most at-risk.

Reference(s): FCP v2.2 Annex PF Section PF4

Table X – PSA productivity and susceptibility attributes and scores		
Performance Indicator		
Productivity		
Scoring element (species)		
Attribute	Rationale	Score
Average age at maturity		**1 / 2 / 3**
Average maximum age		**1 / 2 / 3**
Fecundity		**1 / 2 / 3**
Average maximum size Not scored for invertebrates		**1 / 2 / 3**
Average size at maturity Not scored for invertebrates		**1 / 2 / 3**
Reproductive strategy		**1 / 2 / 3**
Trophic level		**1 / 2 / 3**
Density dependence Invertebrates only		**1 / 2 / 3**
Susceptibility		
Fishery Only where the scoring element is scored cumulatively	*Insert list of fisheries impacting the given scoring element (FCP v2.2 Annex PF 7.4.10)*	
Attribute	Rationale	Score
Areal Overlap	*Insert attribute rationale. Note specific requirements in FCP v2.2 Annex PF4.4.6.b, where the impacts of fisheries other than the UoA are taken into account*	**1 / 2 / 3**
Encounterability	*Insert attribute rationale. Note specific requirements in FCP v2.2 Annex PF4.4.6.b, where the impacts of fisheries other than the UoA are taken into account*	**1 / 2 / 3**

Selectivity of gear type		**1 / 2 / 3**
Post capture mortality		**1 / 2 / 3**
Catch (weight) Only where the scoring element is scored cumulatively	*Insert weights or proportions of fisheries impacting the given scoring element (FCP v2.2 Annex PF4.4.4)*	**1 / 2 / 3**

Table X – Species grouped by similar taxonomies (if FCP v2.2 Annex PF4.1.5 is used)

Species scientific name	Species common name (if known)	Taxonomic grouping	Most at-risk in group?
e.g. Genus species subspecies		Indicate the group that this species belongs to, e.g. *Scombridae, Soleidae, Serranidae, Merluccius spp.*	Yes / No

9.9 Harmonised fishery assessments – delete if not applicable

Harmonisation is required in cases where assessments overlap, or new assessments overlap with pre-existing fisheries.

If relevant, in accordance with FCP v2.2 Annex PB requirements, CAB shall describe in the report the processes, activities and specific outcomes of efforts to harmonise fishery assessments. The report shall identify the fisheries and Performance Indicators subject to harmonisation.

Reference(s): FCP v2.2 Annex PB

Table X – Overlapping fisheries

Fishery name	Certification status and date	Performance Indicators to harmonise
New Zealand Hoki, Hake and Ling Trawl Fishery	Certified since September 2018 under FCR v 1.3	Principle 2 where 2.1, 2.2 or 2.3 populations are in common; Principle 3

Table X – Overlapping fisheries

Supporting information	
- Describe any background or supporting information relevant to the harmonisation activities, processes and outcomes.	
TBD in further stages of the assessment	
Was either FCP v2.2 Annex PB1.3.3.4 or PB1.3.4.5 applied when harmonising?	**Yes / No**
Date of harmonisation meeting	**DD / MM / YY**
If applicable, describe the meeting outcome	
- e.g. Agreement found among teams or lowest score adopted.	

Table X – Scoring differences

Performance Indicators (PIs)	Fishery name	Fishery name	Fishery name	Fishery name
PI	**Score**	**Score**	**Score**	**Score**
PI	**Score**	**Score**	**Score**	**Score**
PI	**Score**	**Score**	**Score**	**Score**

Table X – Rationale for scoring differences
If applicable, explain and justify any difference in scoring and rationale for the relevant Performance Indicators (FCP v2.2 Annex PB1.3.6)
If exceptional circumstances apply, outline the situation and whether there is agreement between or among teams on this determination

9.10 Objection Procedure – delete if not applicable

To be added at Public Certification Report stage

The CAB shall include in the report all written decisions arising from the Objection Procedure.

Reference(s): MSC Disputes Process v1.0, FCP v2.2 Annex PD Objection Procedure