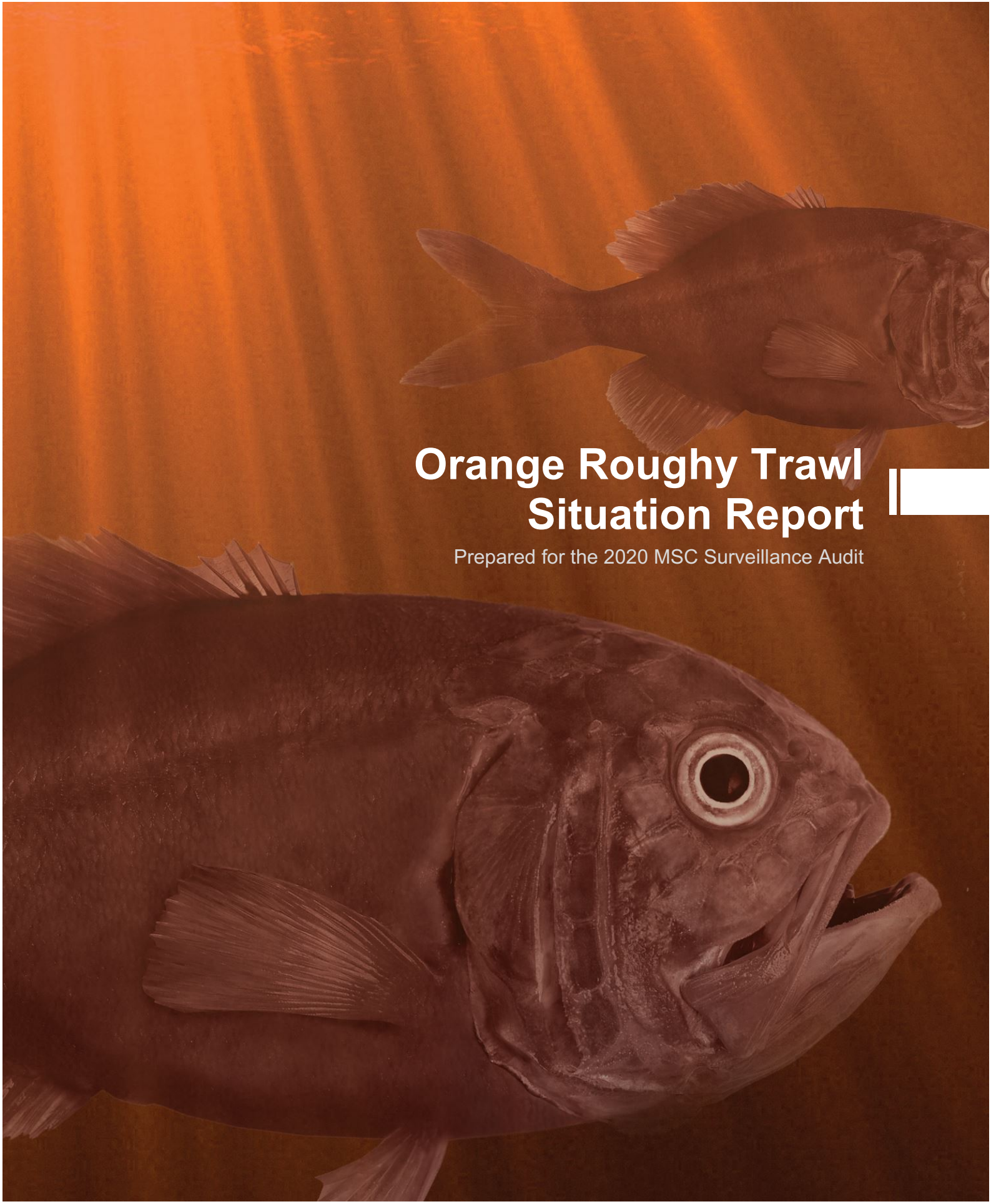

Orange Roughy Trawl Situation Report

Prepared for the 2020 MSC Surveillance Audit

deepwater group

deepwater group

Table of Contents

Purpose of this report

This report is prepared for the third annual MSC surveillance audit of three New Zealand orange roughy Units of Certification (UoC): ORH 3B Northwest Chatham Rise (NWCR), ORH 3B East & South Chatham Rise (ESCR) and ORH 7A Challenger Plateau & Westpac Bank (Challenger) trawl fisheries and builds on the information previously provided for the 2017 and 2018 audits. The third audit was initially scheduled to occur in December 2019.

It is Deepwater Group Limited's (DWG) submission that these three fisheries continue to conform with the MSC Fisheries Standard (FCR V1.3) as evidenced in the following updated information and references.

Cited references for which links are not provided are available here:
https://deepwatergroup.org/certification/orange-roughy-audit-2020/

Overview of fishery status and information

Orange roughy trawl certification details

Certification date	8 September, 2016
Stock areas	UoC 1: ORH 3B NWCR UoC 2: ORH 3B ESCR UoC 3: ORH 7A-WB
Species	*Hoplostethus atlanticus*
Method/gear	Trawl

Orange roughy fishery management

The abundance of orange roughy stocks is monitored using acoustic surveys and stock assessments every four years, as outlined by the Management Strategy Evaluation (MSE), (Cordue, 2014).

The MSE underpinned the development of a Harvest Control Rule (HCR), which involved testing the performance of a number of potential harvest control rules against simulated stock trajectories over long periods of time to allow for uncertainty in the inputs. The agreed HCR is estimated to have a greater than 97% probability of maintaining the stock above the lower bound of the management target range (30% B_0) under a range of assumptions about stock-recruit relationships and estimates of natural mortality.

The HCR is used to suggest catch limits based on the estimated stock status in relation to the management target range. Where a stock is estimated to be below the midpoint of the target range (F_{mid} = 0.045), recommended catch limits are lower than for a stock near the top of the target range (125% F_{mid}). Likewise, the HCR allows for a higher catch limit for stocks that are above the mid-point of the target range.

UoC Stock status, TACCs, Catch Limits & catches

UoC 1 – ORH 3B NWCR

Update on stock status (Dunn & Doonan, 2018)	ORH 3B NWCR: B_{2017} estimated to be 38% B_0. 'Very Likely' (>90%) to be at or above the lower end of the management target range.
ORH 3B TACC 2018-19 ORH 3B TACC 2017-18 ORH 3B TACC 2016-17	6,091 t 5,197 t 5,000 t
NWCR Catch Limit 2018-19 NWCR Catch Limit 2017-18 NWCR Catch Limit 2016-17	1,149 t 1,250 t 1,250 t
UoA share of TACC UoC share of TACC	100% 95.8%
NWCR catch 2018-19 NWCR catch 2017-18 NWCR catch 2016-17	294 t 724 t 646 t

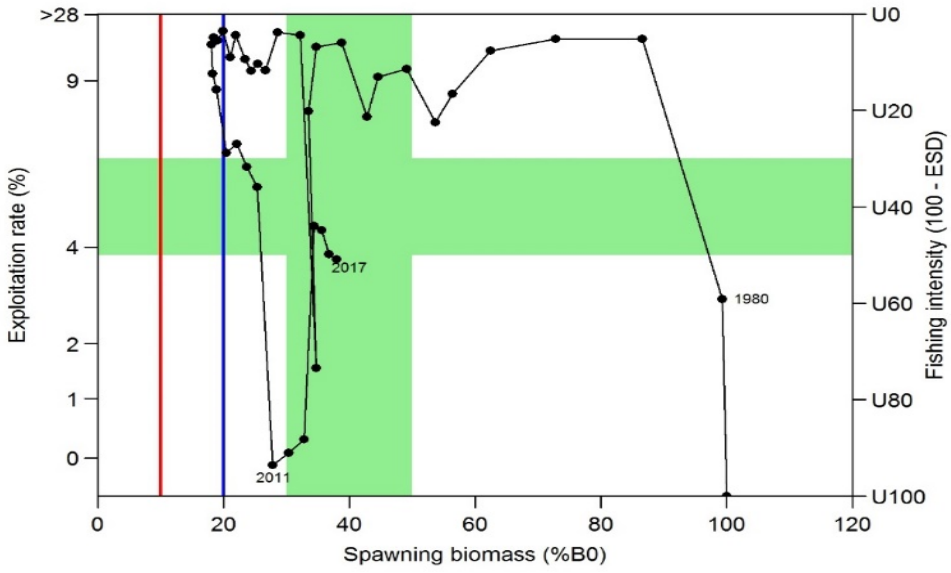

Figure 1: Historical trajectory of spawning biomass (% B_0), median exploitation rate (%) and fishing intensity (100-ESD) (base model, medians of the marginal posteriors). The biomass target range of 30–50 % B_0 and the corresponding exploitation rate range are marked in green. The soft limit (20% B_0) is marked in blue and the hard limit (10% B_0) in red. Note that the Y-axis is non-linear (FNZ, 2019).

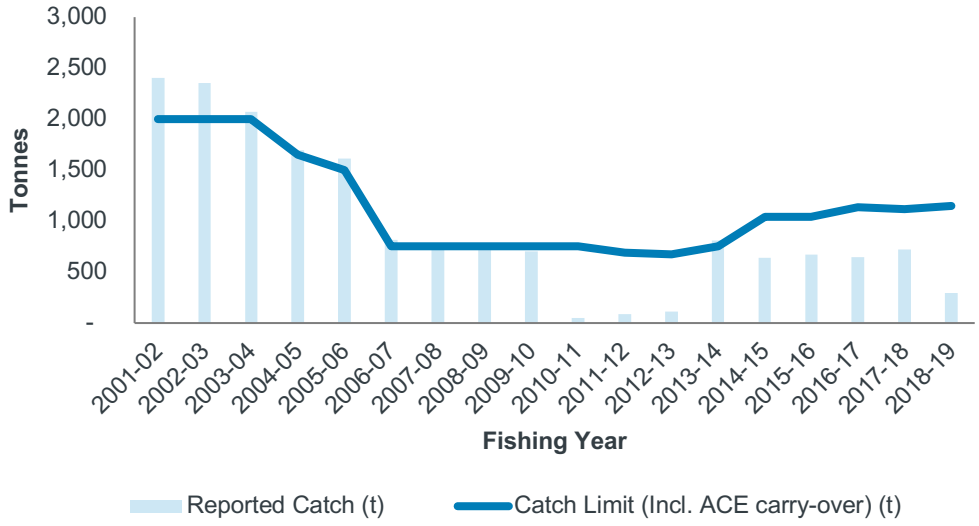

Figure 2: ORH 3B NWCR Catch Limits and Commercial Catches. Voluntary fishery closure from 2010-11 to 1012-13 to promote stock rebuilding.

Biomass projections:

Five-year biomass projections were made for the Base model run assuming future catches to be the TACC (1 250 t), or the current agreed catch limit (1,043 t; 207 t has been shelved). For each projection scenario, future recruitment variability was sampled from actual estimates between 1940 and 1979. At the TACC (1,250 t) and the current agreed catch limit (1,043 t), SSB is predicted to remain stable or slowly increase over the next five years, and the probability of the SSB going below the soft or hard limits is zero.

The NWCR fishery:

The NWCR catch limit from 2014-15, of 1,250 t, was established prior to development of the HCR. The industry chose a more conservative approach by shelving 207 t annually. Application of the HCR to the 2018 stock assessment resulted in a reduced catch limit of 1,150 t. Catches have been below the catch limit since 2014-15.

UoC 2 – ORH 3B ESCR

Update on stock status (Dunn & Doonan, 2018)	ORH 3B ESCR: B_{2017} estimated to be 33% B_0. 'Likely' (>60%) to be at or above the lower end of the management target range.
ORH 3B TACC 2018-19 ORH 3B TACC 2017-18 ORH 3B TACC 2016-17	6,091 t 5,197 t 5,000 t
ESCR Catch Limit 2018-19 ESCR Catch Limit 2017-18 ESCR Catch Limit 2016-17	4,095 t 3,100 t 3,100 t
UoA share of TACC UoC share of TACC	100% 95.8%
UoA ESCR catch 2018-19 UoA ESCR catch 2017-18 UoA ESCR catch 2016-17	4,143 t 3,328 t 3,300 t

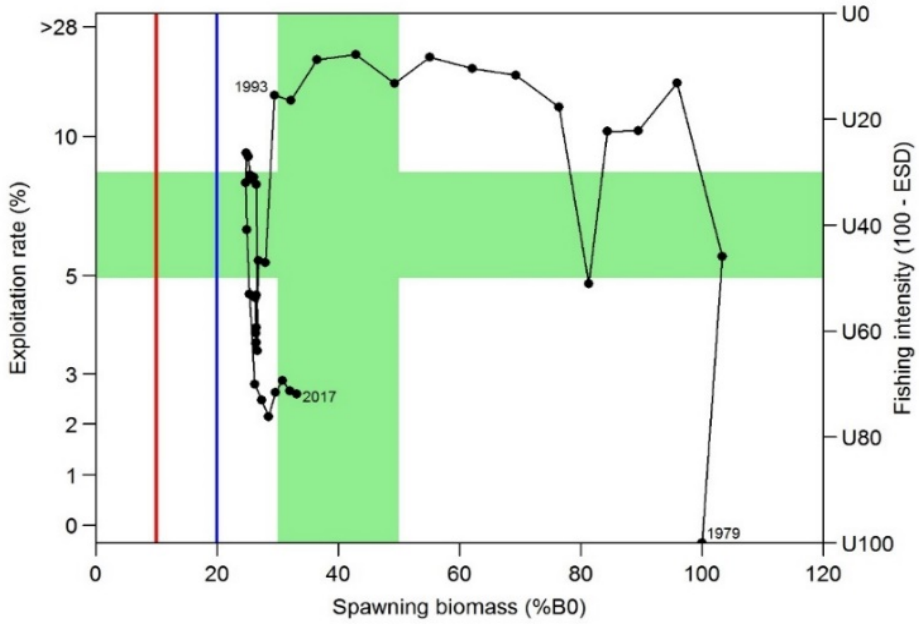

Figure 3: Historical trajectory of spawning biomass (% B_0), median exploitation rate (%) and fishing intensity (100-ESD) (base model, medians of the marginal posteriors). The biomass target range of 30–50 % B_0 and the corresponding exploitation rate range are marked in green. The soft limit (20% B_0) is marked in blue and the hard limit (10% B_0) in red. Note that the Y-axis is non-linear (FNZ, 2019).

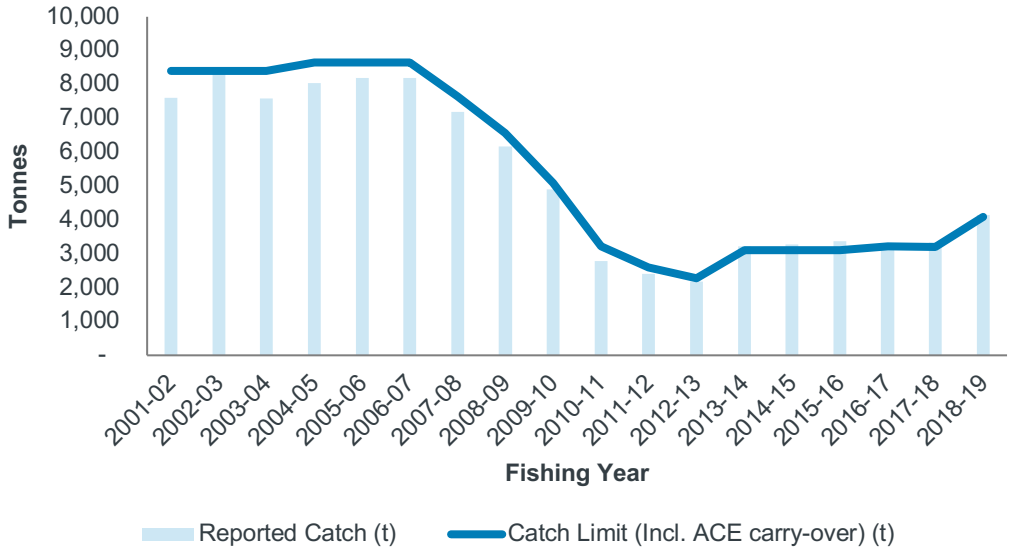

Figure 4: ORH 3B ESCR Catch Limits and Commercial Catches.

Biomass projections:

Five-year biomass projections were made for the Base model run assuming future catches to be the Catch Limit (3,100 t). For each projection scenario, future recruitment variability was sampled from actual estimates between 1940 and 1979. At the Catch Limit, the SSB is predicted to slowly increase over the next five years, and the probability of the SSB going below the soft or hard limits is zero.

The ESCR Fishery:

The catch limit from 2013-14 through to 2017-18, of 3,100 t, was set before the HCR-recommended yield estimate was calculated in 2014-15. While the HCR indicated a catch limit of 3,772 t, industry chose to adopt a more conservative approach to promote stock rebuilding and elected to retain the limit of 3,100 t. Following the 2018 stock assessment the HCR indicated a catch limit of 5,670 t (FNZ, 2018). Industry again adopted a conservative approach by agreeing to a phased increase over three years. The 2018-19 catch limit of 4,095 t marked the first of three increases, while the 2019-20 catch limit of 4,775 t marks the second increase (FNZ, 2019d).

The 2018 stock assessment estimated the stock was at 33% B_0 with an 86% probability that it was above the lower bound of the management target range of 30% of B_0 and was increasing. Projections from the stock assessment showed the median biomass increasing each year for the next five years to 37% of B_0 by 2023 under the increased catch limit (FNZ, 2019a).

UoC 3 – ORH 7A-WB

Update on stock status (Cordue, 2019)	ORH 7A-WB: B_{2019} estimated to be 47% B_0. 'Very Likely' (>90%) to be at or above the lower end of the management target range and 'About as Likely as Not' (40-60%) to be at or above the upper end of the target range of 30-50% B_0.
ORH 7A TACC 2018-19 ORH 7A TACC 2017-18 ORH 7A TACC 2016-17	1,600 t 1,600 t 1,600 t
UoA share of TACC UoC share of TACC	100% 93.9%
ORH 7A catch 2018-19 ORH 7A catch 2017-18 ORH 7A catch 2016-17	1,589 t 1,780 t 1,623 t

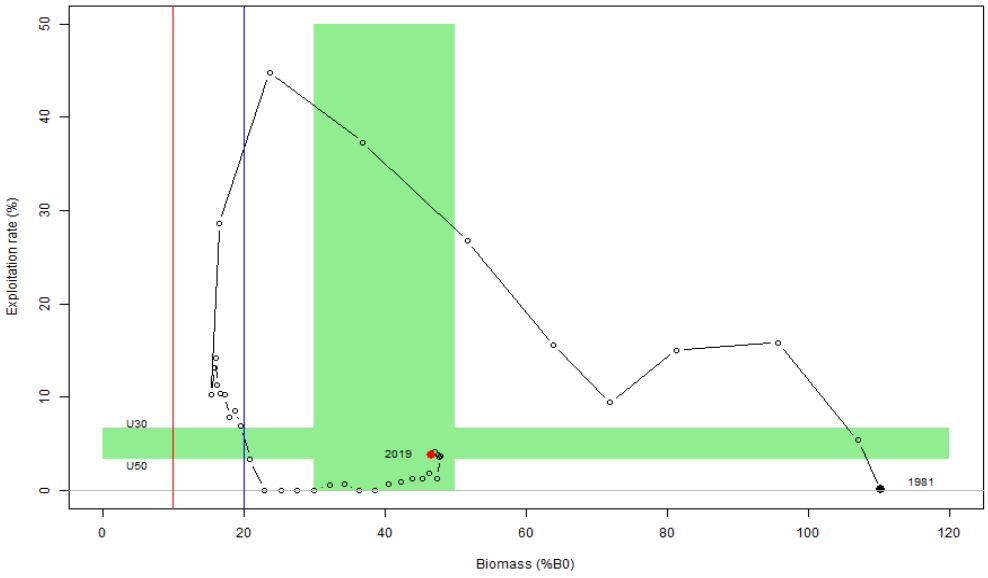

Figure 5: Historical trajectory of spawning biomass (% B_0) and fishing intensity (exploitation rate) (base model, medians of the marginal posteriors). The biomass target range of 30–50% B_0 and the corresponding exploitation rate (fishing intensity) target range are marked in green. The soft limit (20% B_0) is marked in blue and the hard limit (10% B_0) in red (FNZ, 2019).

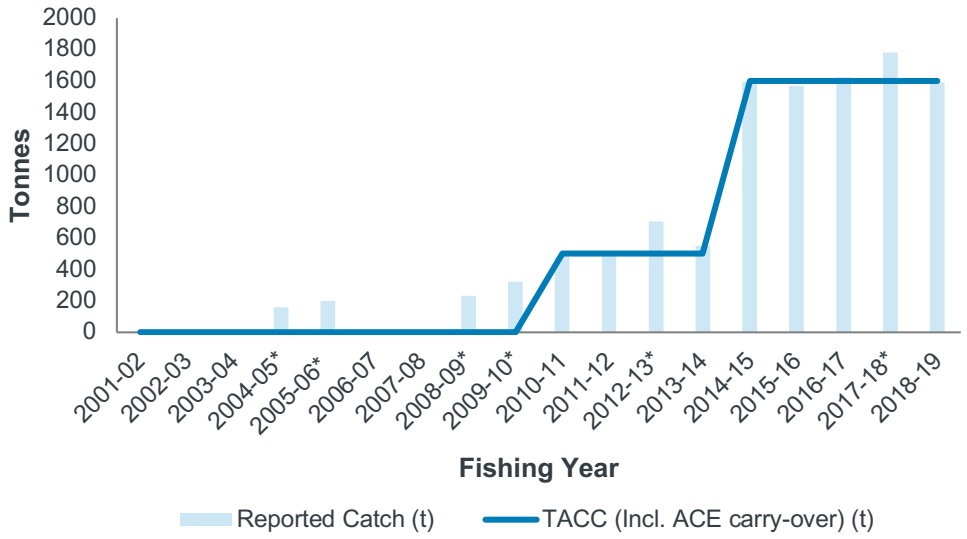

Figure 6: ORH 7A Challenger TACCs and reported catches. The fishery was closed to fishing from 2001-02 to 2009-10. Asterisks on the x-axis denote years where biomass survey catches were taken against a special permit.

Biomass projections:

Five-year projections were conducted (with resampling from the last 10 estimated YCS, 1986–1995) for a constant catch of 1,600 t (i.e. the current TACC). A 5% catch over-run was assumed. Projections were done for the base model and for the LowM-Highq sensitivity model (as a "worst case" scenario). SSB is predicted to decrease slowly over the next five years for both models, while staying within the target biomass range. For both models the estimated probability of SSB going below either the soft limit (20% B_0) or the hard limit (10% B_0) is zero. For the base model projection, exploitation rates are predicted to slowly increase but still be at the lower end of the fishing intensity target range in 2024 (95% CI 0.030–0.054 compared to the target range of 0.033– 0.067), (FNZ, 2019).

The ORH 7A fishery:

Following a 10-year closure, the fishery was re-opened to commercial fishing on 1 October 2010 with a TACC of 500 t. Following implementation of the HCR in 2014-15 the TACC was increased to 1,600 t. Application of the HCR following the 2019 assessment indicated there was an opportunity to increase the TACC for this stock by up to 833 t. Industry agreed to adopt a precautionary approach by accepting a lower increase of 460 t, which increased the TACC to 2,060 t from 1 October 2019 (FNZ, 2019e).

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Overview of environmental information

Observer Coverage

MPI's scientific observer programme (SOP) collects data from fisheries, including ETP incidental capture information. This ETP component, under New Zealand law, is administered and funded by the Department of Conservation (DOC) through levies recovered from relevant fisheries' quota owners. All observer deployment is managed by the SOP.

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.

The level of observer coverage for the different fisheries/sectors is tailored to suit the data and information requirements, including for stock assessment, compliance monitoring and ETP species captures. FNZ considers that 30% 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 observer coverage plans for deepwater fisheries in 2019-20 are provided in the Annual Operational Plan (FNZ, 2019), while performance against targeted observer coverage in previous years is reviewed in the Annual Review Report (FNZ, 2019a).

Observer coverage over the three UoA fishery areas has averaged 30% over the recent 5-year period (Table 1, Fig. 7). This level of coverage is considered by MPI to be sufficient given the low level of ETP species captures and high level of overall compliance by orange roughy fisheries.

Table 1: Observer coverage in the orange roughy trawl fisheries 2014-15 to 2018-19.

NWCR UoA	2014-15	2015-16	2016-17	2017-18	2018-19	5-year Average
Commercial tows	266	392	456	392	217	345
Observed tows	117	91	100	123	64	99
% Observed tows	44%	23%	22%	31%	29%	29%
ESCR UoA	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**5-year Average**
Commercial tows	964	1229	1179	1249	1250	1174
Observed tows	254	690	324	49	384	340
% Observed tows	26%	56%	27%	4%	31%	29%
ORH 7A UoA	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**5-year Average**
Commercial tows	696	560	533	547	475	562
Observed tows	52	242	153	402	109	192
% Observed tows	7%	43%	29%	73%	23%	34%

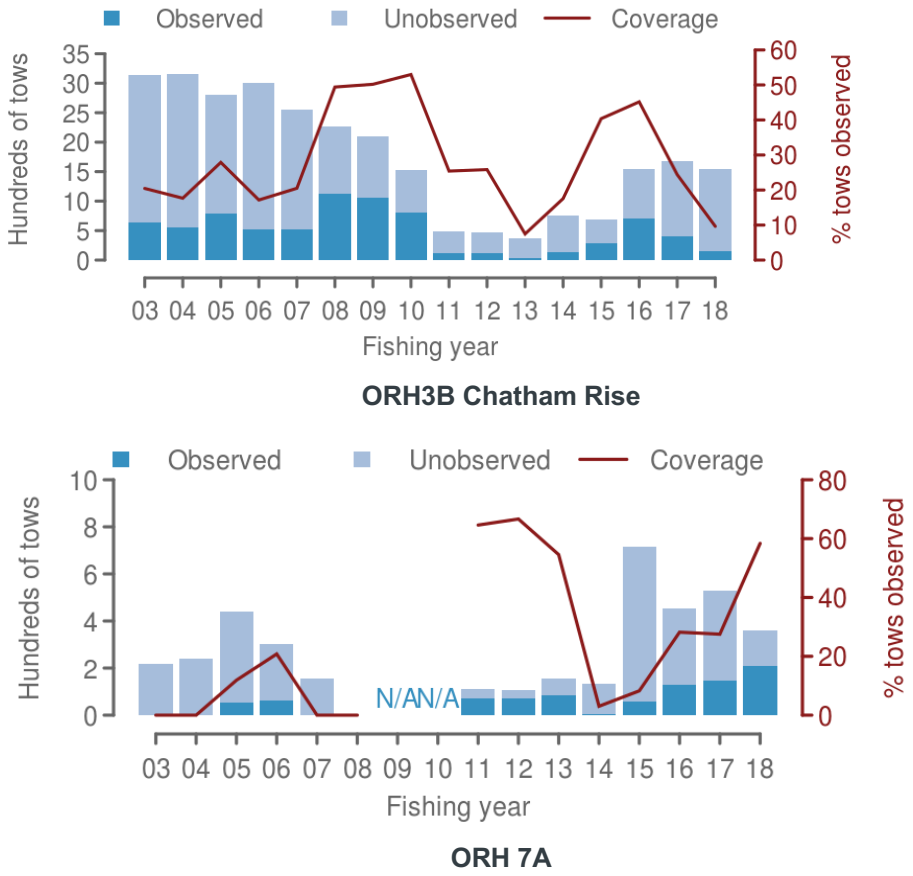

Figure 7: Observer coverage and fishing effort in orange roughy fisheries in ORH 3B Chatham Rise and in ORH 7A (Dragonfly, 2019). Note: for ORH 7A, data prior to 2011 are for fisheries other than orange roughy in Fishery Management Area 7. The most recent fishing year for which data are presented is 2017-18.

Retained & bycatch species

Orange roughy accounted for 83.6% of the total estimated catch weight recorded by observers in all New Zealand orange roughy-targeted fisheries during the 2018-19 fishing year. Two other QMS species, smooth oreo (9.7%) and black oreo (1.5%) were next-most prominent in catches. The rest of the catch comprised deep water sharks (1.4%), rattails (0.7%) and a further 14 QMS species (2.0%). Overall, 97% of the catch is made up of species managed within the QMS, for which direct controls exist to limit their overall catch (Table 2).

Catches of the two most abundant non-QMS bycatch species groups, deep water sharks and rattails, are moderate, estimated at 127 t and 64 t respectively during 2018-19 (FNZ, pers. comm.).

Table 2: Estimated total catches in all orange roughy-targeted fisheries in 2018-19 based on observer data. QMS species are shaded (FNZ, R. Tinkler, 2019, pers. comm.).

Species	Estimated Catch (t)	% Catch
Orange roughy	7,742	83.59%
Smooth oreo	897	9.69%
Black oreo	135	1.46%
Sharks & Dogfish unid.	65	0.70%
Rattails	56	0.60%
Hoki	54	0.58%
Ribaldo	54	0.58%
Slickhead	49	0.53%
Seal shark	37	0.40%
Spiky oreo	26	0.28%
Johnson's cod	25	0.27%
Cardinal fish	21	0.23%
Morids	20	0.22%
Hake	15	0.16%
Shovelnose dogfish	12	0.13%
Long-nosed chimaera	7	0.08%
Deepwater dogfish unid.	7	0.07%
Alfonsino & long-finned beryx	6	0.07%
Javelinfish	6	0.06%
Pale ghost shark	6	0.06%
Baxter's lantern dogfish	4	0.04%
White rattail	3	0.03%
Longnose velvet dogfish	2	0.02%
Ghost shark	2	0.02%
Warty oreo	1	0.01%
Warty squid	1	0.01%
Smooth skate	1	0.01%
Gemfish	1	0.01%
Basketwork eel	1	0.01%
Sea perch	1	0.01%
Black slickhead	1	0.01%
Bluenose	1	0.01%
Ling	1	0.01%
Other	4	0.04%
Totals	**9,262**	**100.00%**

Estimated average catch composition data for the ORH 3B NWCR, ESCR and ORH 7A-WB UoAs, based on scaled-up observer data, are provided below in three categories: QMS species, elasmobranchs, and non-QMS species catches (Tables 3-8). Note that the scaling up from observed to estimated catches is based on the percentage of observer coverage,

which will not provide accurate catch estimates. The percentage species composition should, however, be representative. The QMS species comprised 83% of the total catch in NWCR, 96.1% in ESCR and 91.4% in ORH 7A-WB. Elasmobranchs comprised 4.8% of the catch in NWCR, 1.4% in ESCR and 2.9% in ORH7B-WB. Non-QMS species comprised 12.2% of the catch in NWCR, 2.5% of the catch in ESCR and 5.7% in ORH 7A-WB.

Table 3: NWCR UoA estimated average annual QMS catches based on observer data

NWCR UoA QMS Species 2014-15 to 2018-19	Estimated Average Annual Catch (t)	% Catch
Orange roughy	660.3	74.4%
Smooth oreo	48.7	5.5%
Hoki	17.3	2.0%
Hake	3.8	0.4%
Pale ghost shark	2.5	0.3%
Ribaldo	0.7	0.1%
Black oreo	0.7	0.1%
Ling	0.4	0.0%
Sea perch	0.1	0.0%
Alfonsino	1.5	0.2%
Totals	**736.1**	**83.0%**

**Only average annual catches >1 tonne are provided*

Table 4: NWCR UoA estimated average annual elasmobranch catches based on observer data

NWCR UoA Elasmobranchs 2014-15 to 2018-19	Estimated Average Annual Catch (t)	% Catch
Baxters lantern dogfish	9.6	1.1%
Deepwater dogfish	5.4	0.6%
Long-nosed chimaera	4.8	0.5%
Shovelnose spiny dogfish	4.0	0.4%
Widenosed chimaera	3.4	0.4%
Smooth skin dogfish	2.4	0.3%
Longnose velvet dogfish	2.7	0.3%
Pale ghost shark	2.5	0.3%
Seal shark	2.6	0.3%
Plunket's shark	2.1	0.2%
Other sharks and dogs	2.0	0.2%
Leafscale gulper shark	1.2	0.1%
Totals	**42.6**	**4.8%**

**Only average annual catches >1 tonne are provided*

Table 5: NWCR UoA estimated average annual non-QMS catches based on observer data

NWCR UoA Non-QMS species 2014-15 to 2018-19	Estimated Average Annual Catch (t)	% Catch
Slickhead	28.3	3.2%
Slender cods	22.7	2.6%
Baxters lantern dogfish	9.6	1.1%
Warty squid	5.9	0.7%
Deepwater dogfish	5.4	0.6%
Long-nosed chimaera	4.8	0.5%
Morid cods	3.6	0.4%
Smallscaled brown slickhead	3.2	0.4%
Shovelnose spiny dogfish	4.0	0.4%
Widenosed chimaera	3.4	0.4%
Basketwork eel	2.9	0.3%
Smooth skin dogfish	2.4	0.3%
Longnose velvet dogfish	2.7	0.3%
Seal shark	2.6	0.3%
Plunket's shark	2.1	0.2%
Javelin fish	1.9	0.2%
Other sharks and dogs	2.0	0.2%
Leafscale gulper shark	1.2	0.1%
Totals	**108.5**	**12.2%**

**Only average annual catches >1 tonne are provided*

Table 6: ESCR UoA estimated average annual QMS catches based on observer data

ESCR UoA QMS species 2014-15 to 2018-19	Estimated Average Annual Catch (t)	Estimated % Catch
Orange roughy	6,892.4	69.3%
Smooth oreo	2,245.6	22.6%
Black oreo	231.0	2.3%
Ribaldo	52.5	0.5%
Hoki	74.8	0.8%
Spiky oreo	39.0	0.4%
Cardinalfish	6.2	0.1%
Alfonsino	15.3	0.2%
Hake	2.7	0.03%
Pale ghost shark	1.7	0.02%
Ling	3.5	0.04%
Totals	**9,564.7**	**96.3%**

**Only average annual catches >1 tonne are provided*

Table 7: ESCR UoA estimated average annual elasmobranch catches based on observer data

ESCR UoA Elasmobranchs 2014-15 to 2018-19	Estimated Average Annual Catch (t)	Estimated % Catch
Baxters lantern dogfish	37.7	0.38%
Other sharks and dogs	25.5	0.26%
Shovelnose spiny dogfish	24.6	0.25%
Longnose velvet dogfish	7.9	0.08%
Deepwater dogfish	14.9	0.15%
Seal shark	4.2	0.04%
Smooth skin dogfish	2.8	0.03%
Widenosed chimaera	2.1	0.02%
Leafscale gulper shark	1.5	0.01%
Plunket's shark	2.2	0.02%
Long-nosed chimaera	2.1	0.02%
Giant chimaera	1.0	0.01%
Totals	**126.3**	**1.27%**

Table 8: ESCR UoA estimated average annual non-QMS catches based on observer data

ESCR UoA Non- QMS species 2014-15 to 2018-19	Estimated Average Annual Catch (t)	Estimated % Catch
Baxters lantern dogfish	37.7	0.38%
Other sharks and dogs	25.5	0.26%
Slickhead	32.9	0.33%
Slender cods	34.6	0.35%
Shovelnose spiny dogfish	24.6	0.25%
Rattails	16.7	0.17%
Morid cods	10.8	0.11%
Longnose velvet dogfish	7.9	0.08%
Basketwork eel	7.6	0.08%
Warty squid	8.2	0.08%
Deepwater dogfish	14.9	0.15%
Seal shark	4.2	0.04%
Javelin fish	4.6	0.05%
Smooth skin dogfish	2.8	0.03%
Widenosed chimaera	2.1	0.02%
Leafscale gulper shark	1.5	0.01%
Plunket's shark	2.2	0.02%
Long-nosed chimaera	2.1	0.02%
Small-headed cod	1.5	0.02%
Smallscaled brown slickhead	2.5	0.02%
Giant chimaera	1.0	0.01%
Totals	**245.7**	**2.47%**

Table 9: ORH 7A-WB UoA estimated average annual QMS catches based on observer data

ORH 7A-WB: QMS Species 2014-15 to 2018-19	Estimated Average Annual Catch (t)	Estimated % Catch
Orange roughy	4,616	88.1%
Spiky oreo	78	1.5%
Ribaldo	44	0.8%
Hake	23	0.4%
Pale ghost shark	13	0.2%
Hoki	8	0.2%
Cardinalfish	3	0.1%
Smooth skate	1	0.0%
Sea perch	1	0.0%
Smooth oreo	1	0.0%
Totals	**4,787**	**91.4%**

**Only average annual catches >1 tonne are provided*

Table 10: ORH 7A-WB UoA estimated average annual elasmobranch catches based on observer data

ORH 7A-WB: Elasmobranchs 2014-15 to 2018-19	Estimated Average Annual Catch (t)	Estimated % Catch
Baxters lantern dogfish	43.3	0.83%
Other sharks and dogs	39.0	0.74%
Shovelnose spiny dogfish	35.0	0.67%
Longnose velvet dogfish	8.5	0.16%
Deepwater dogfish	7.6	0.15%
Seal shark	5.1	0.10%
Smooth skin dogfish	2.8	0.05%
Widenosed chimaera	2.2	0.04%
Leafscale gulper shark	1.9	0.04%
Plunket's shark	3.2	0.06%
Long-nosed chimaera	2.3	0.04%
Pale ghost shark	1.9	0.04%
Totals	**153.0**	**2.92%**

**Only average annual catches >1 tonne are provided*

Table 11: ORH 7A-WB UoA estimated average annual non-QMS catches based on observer data

ORH 7A-WB: Non-QMS species 2014-15 to 2018-19	Estimated Average Annual Catch (t)	Estimated % Catch
Baxters lantern dogfish	44.2	0.84%
Other sharks and dogs	40.6	0.77%
Slickhead	39.9	0.76%
Slender cods	40.4	0.77%
Shovelnose spiny dogfish	36.2	0.69%
Rattails	19.0	0.36%
Morid cods	11.0	0.21%
Longnose velvet dogfish	9.0	0.17%
Basketwork eel	8.6	0.16%
Warty squid	8.0	0.15%
Deepwater dogfish	8.9	0.17%
Seal shark	6.1	0.12%
Javelin fish	3.4	0.06%
Smooth skin dogfish	2.8	0.05%
Widenosed chimaera	2.3	0.04%
Leafscale gulper shark	2.2	0.04%
Plunket's shark	3.5	0.07%
Long-nosed chimaera	2.6	0.05%
Oilfish	0.6	0.01%
Small-headed cod	3.8	0.07%
Smallscaled brown slickhead	4.6	0.09%
Totals	**297.5**	**5.68%**

**Only average annual catches >1 tonne are provided*

The bycatch of smooth oreo (reporting code SSO) in NWCR (5.5% of total catch) and in ESCR (22% of total catch) means it is a 'main' retained species in both UoAs. As the OEO4 management area overlaps the key orange roughy fishery areas in ORH 3B NWCR and ORH 3B ESCR, the SSO4 stock assessment is applicable to both UoAs. There are no 'main' bycatch species in any of the UoAs.

A 2019 stock assessment of smooth oreo in OEO4 estimated B_{2018} at 40% B_0 for the base model. B_{2018} is About as Likely as Not (40-60%) to be at or above the target of 40% B_0. Stock projections indicated 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 smooth oreo in OEO4 is currently 2,600 t (DWG, 2019).

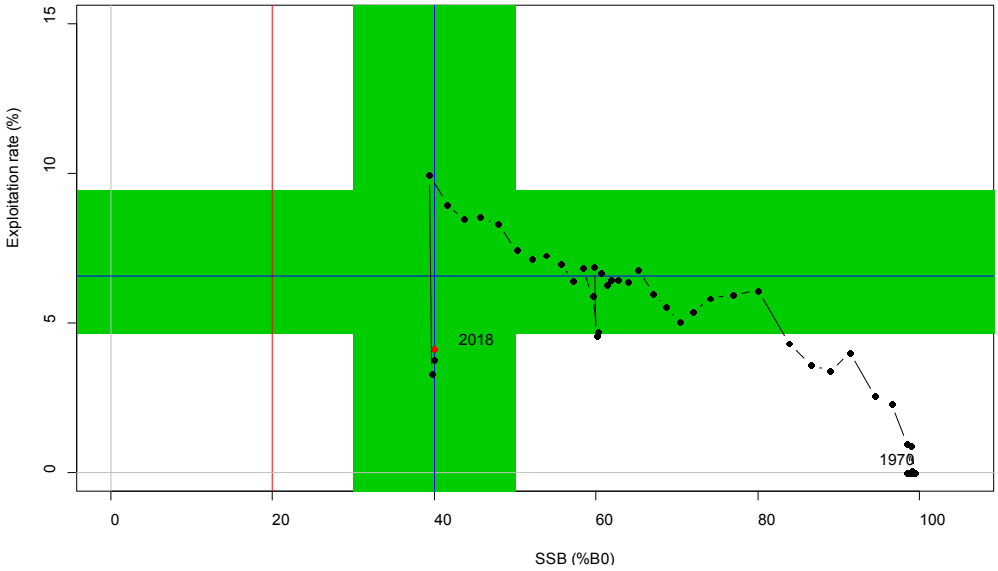

Figure 8: Historical trajectory of SSO4 spawning biomass (% B_0) and exploitation rate (%) (base model, medians of the marginal posteriors). A reference range of 30–50% B_0 and the corresponding exploitation rate range are coloured in green. The soft limit (20% B_0) is marked by a red line and the target biomass (40% B_0) and associated exploitation rate limit are marked by blue lines (Cordue, 2019).

ETP species

Information on incidental captures of ETP species, reported by vessels and by MPI observers, is summarised in the Aquatic Environment and Biodiversity Annual Review reports (e.g. FNZ 2019d), and for ETP species other than corals on the MPI website which is maintained under contract by Dragonfly Ltd (Dragonfly, 2019). 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. Measures relating to the monitoring of ETP species are described in DWG's Operational Procedures (DWG, 2019, 2019a, 2019b, 2019c) and Vessel Management Plans (DWG, 2019d).

Seabirds

The numbers of observed incidental seabird captures are used to model the estimated number of annual captures based on the total number of trawl tows undertaken. Note that 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 annually 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) assumes 50% of released alive birds will not survive. Many of the net captures involve birds foraging on top of the net when it's on the surface on hauling and getting their 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 four observed captures in the Chatham Rise UoAs and three observed captures in the ORH 7A UoA over the recent 5-year period (Fig. 9). This translates to 27 estimated seabird captures in UoAs NWCR and ESCR, and 9 estimated captures in the ORH 7A UoA (Fig. 10).

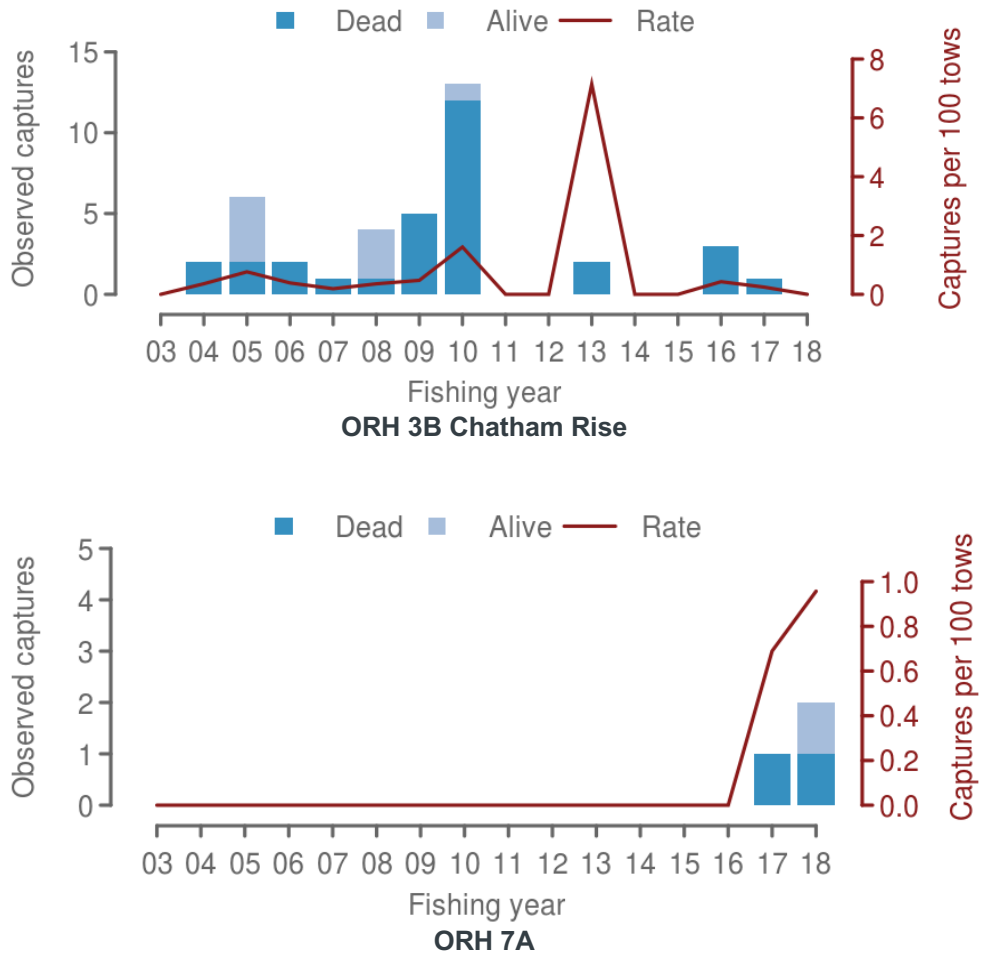

Figure 9: Observed seabird captures in the ORH 3B UoAs on the Chatham Rise (top) and the ORH 7A UoA (bottom), (Dragonfly, 2019).

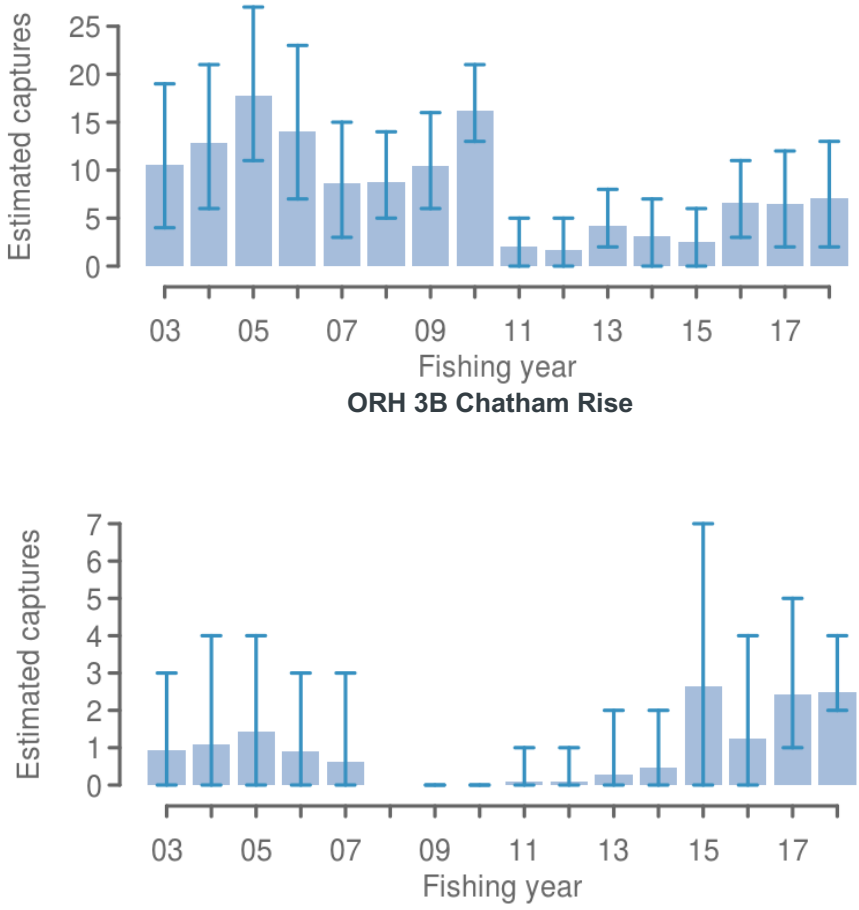

Figure 10: Estimated total incidental seabird captures (dead and live-released) in UoAs NWCR & ESCR on the Chatham Rise (top) and in UoA ORH 7A (bottom) by orange roughy trawl fisheries, 2002-03 to 2017-18 (Dragonfly, 2019).

DWG Liaison Programme for ETP Species Risk Management

DWG's Environmental Liaison Officer (ELO) visits factory vessels and fresh fish trawlers involved in the orange roughy 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 in order 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 (DWG, 2019e).

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.

In summary, the existing seabird mitigation strategy applied by the orange roughy trawl fisheries has a high probability of ensuring the UoAs do not hinder nor threaten the recovery of any seabird populations.

New Zealand fur seal

There has been only one observed fur seal capture by an orange roughy vessel in recent years (Fig. 11).

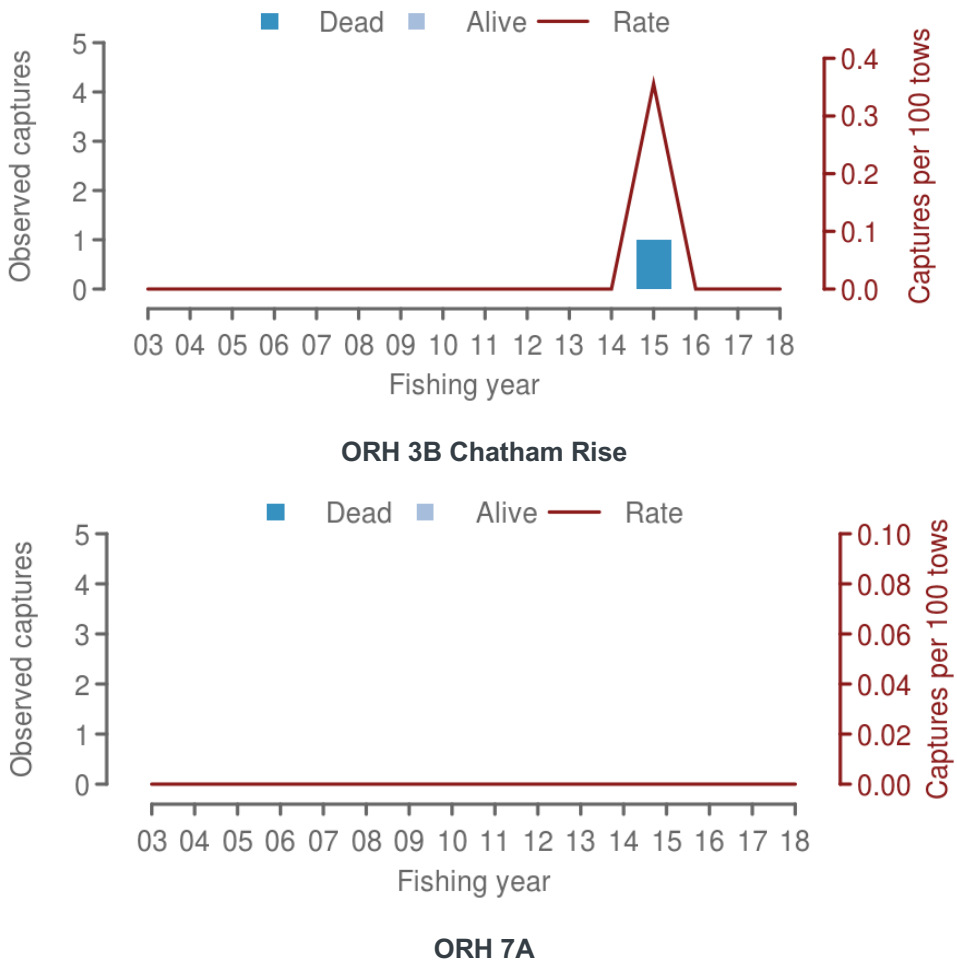

Figure 11: New Zealand fur seal captures by orange roughy trawl fisheries on the Chatham Rise (top) and in ORH 7A (bottom), 2002-03 to 2017-18 (Dragonfly, 2019).

New Zealand sea lion

There have been no reported captures of a New Zealand (NZ) sea lion by orange roughy trawl fisheries during the period 2003-03 to 2017-18), (Dragonfly, 2019).

Whales & dolphins

There have been no reported captures of whales or dolphins by orange roughy trawl fisheries during the period 2003-03 to 2017-18), (Dragonfly, 2019).

Benthic interactions

New Zealand's strategy to guard against adverse impacts on the benthic environment includes multiple area closures in the EEZ. A total of 17 Benthic Protection Areas (BPAs), representatively distributed around the EEZ, and 17 'seamount' closures, collectively close 30% of the EEZ to bottom fishing (Helson et al., 2010). The area closures protect:

- 28 percent of underwater topographic features (including seamounts)
- 52 percent of seamounts over 1,000 metres in height
- 88 percent of known active hydrothermal vents.

Aquatic environment and biodiversity research initiatives related to the benthic effects of fishing are detailed in the Annual Operational Plan for Deepwater Fisheries (FNZ, 2018, pp. 29-31), and include undertaking a spatially explicit benthic impact assessment for deepwater fisheries.

Approximately 34% of the New Zealand EEZ is considered 'fishable', meaning it is shallower than 1,600 metres and open to fishing (i.e. not within a Benthic Protection Area or other closure to bottom trawling).

The trawl footprint of orange roughy and oreo fisheries is monitored annually to assess the extent of their interactions with the benthic habitat (Baird & Wood, 2018, Baird & Mules, 2019, Black & Tilney, 2017, Black et al., 2013). Baird & Mules (op. cit.) estimated that in 2016-17, all New Zealand OEO and ORH fisheries traversed 0.2% and 1.15% respectively of the EEZ fishable area between 800-1,600 m.

ORH/OEO trawl footprints indicate that the fisheries have traversed between 1.1% and 3.6% of UoA fishable grounds (i.e. 800-1,600 m depths) over the most recent two years, which is around one-tenth the area fished during the period of peak orange roughy fishing in the late 1980s and early 1990s (Table 12). New area trawled in 2018-19 amounted to between 0.3% and 0.8% of the fishable area, much of which has involved 'in-filling' of previously untouched areas within the traditional fishing grounds. In NWCR there has been a trend towards longer tows on slope habitat to the west of the 180 hills in recent years, while in ESCR the fishing effort has remained spread between UTF and slope habitat, as before. In ORH 7A there has been a marked expansion of the fishery eastwards as of 2015-16, which is reflective of the fishery operating outside of the spawn period (the spawning area is in the extreme western part of ORH 7A).

Table 12: UoA trawl footprint in relation to the fishable area 800-1,600 m (Baird & Mules, 2019; Black, 2020).

UoA	All Years 1989-90 to 2018-19[1]	2016-17[2]	2017-18[1]	2018-19[1]	New Area 2018-19[1]	Closed Area
NWCR	37.6%	2.9%	3.6%	2.4%	0.3%	0.3%
ESCR	28.7%	1.5%	2.1%	2.0%	0.4%	4.6%
ORH 7A-WB	12.3%	1.2%	1.1%	1.7%	0.8%	15.6%

[1]Black, 2020 [2] Baird & Mules, 2019.

A detailed analysis of the UoA trawl footprints for all years for which data are available (i.e. 1989-90 to 2018-19) and for the two most recent fishing years (i.e. 2017-18 and 2018-19) is provided in Table 13.

Table 13: Analysis of UoA trawl footprint over all years 1989-90 to 2018-19 and for 2018-19 (Black, 2020).

Category	UoA ORH 7A & WB		UoA ORH 3B NWCR		UoA ORH 3B ESCR	
	All Years 1989-90 to 2018-19	2018-19	All Years 1989-90 to 2018-19	2018-19	All Years 1989-90 to 2018-19	2018-19
UoA Area (km^2)	233,607	233,607	137,583	137,583	196,856	196,856
Fishable Area (FA) (km^2)	78,869	78,869	17,398	17,398	38,198	38,198
Deeper than FA (km^2)	24,793	24,793	28,168	28,168	107,558	107,558
Closures within FA (km^2)	12,301	12,301	45	45	1,755	1,755
Closures within FA (%)	15.6%	15.6%	0.3%	0.3%	4.6%	4.6%
Swept area (km^2 in UoA)	9,910	1,319	6,948	419	11,756	764
Swept area (% of UoA)	4.2%	0.6%	5.0%	0.3%	6.0%	0.4%
Swept area (km^2 in FA)	9,740	1,319	6,539	419	10,969	764
Swept area (% FA)	12.3%	1.7%	37.6%	2.4%	28.7%	2.0%
New swept area (km^2 in UoA)		641		55		140
New swept area (% of FA)		0.8%		0.3%		0.4%
Number of tows	9,517	477	11,333	224	46,778	1,351

Analysis of trawl tows illustrated that most fishing occurs at just over 1,000 m in NWCR and at just over 800 m depth in ESCR. The proportions of tows prosecuted on UTFs was around 30% in NWCR and around 65% in ESCR. Catches of orange roughy and oreo species in NWCR were higher on slope habitat while in ESCR they were roughly equal on slope and on UTF habitat (Table 14).

Table 14: Trawl fishing depths, numbers of tows on slope and on UTF habitat and ORH/OEO catches in 2017-18 and 2018-19 in the NWCR and ESCR UoAs (Black, 2020).

Metric	UoA ORH 3B NWCR		UoA ORH 3B ESCR	
	2017-18	2018-19	2017-18	2018-19
Tow depth - minimum	650	623	450	460
Tow depth - median	1031	1042	830	845
Tow depth - maximum	1323	1315	1498	1400
Total Number of tows	399	224	1261	1351
Number of tows on UTF	119	72	804	875
% of tows on UTF	30%	32%	64%	65%
Number of tows on slope	280	152	457	476
% of tows on slope	70%	68%	36%	35%
ORH/OEO catch on UTFs (t)	145	101	2,199	2,324
ORH/OEO catch on slope (t)	664	229	2,445	3,486

Maps illustrating the historic (i.e. 1989-90 to 2018-19) and recent (i.e. 2017-18 & 2018-19) trawl footprints for each of the UoAs are provided in Appendix 1. Note that areas of 'hard benthic habitat', as determined by swath mapping surveys undertaken by industry in 1994 (Patchell, 2019), have been added to the maps (in red) to illustrate probable coral habitat at orange roughy fishery depths in the NWCR and ESCR UoAs.

Corals

Swath mapping surveys undertaken in 1994 (Patchell, op. cit.), were used to estimate the extent of hard benthic habitat (HBH) potentially suited to coral growth at fishable depths on the Chatham Rise. The trawl footprint maps provided in Appendix 1 illustrate that much of the HBH on the slope habitat is not traversed by trawls, most likely because it is too rough for the gear. It is postulated that many of these HBH areas serve as coral refugia, as less than ~7% of these areas have been traversed. Unsurprisingly, a high percentage of UTF area falls within the hard benthic habitat (Table 15).

Table 15: The estimated extent of hard benthic habitat and swept areas within the fishable areas in the NWCR and ESCR UoAs (Black, 2020).

Metric	UoA ORH 3B NWCR		UoA ORH 3B ESCR	
	2017-18	2018-19	2017-18	2018-19
Hard Benthic Habitat (HBH) (km^2)	772	772	3,517	3,517
Swept area OHR/OEO (km^2 in HBH area)	44	25	239	220
% swept area in HBH area	5.7%	3.2%	6.8%	6.3%
UTF area within HBH areas	20	20	230	230
% UTF area within HBH areas	94%	94%	87%	87%

Observed coral bycatch in the Chatham Rise UoAs averaged 173 kg/year over the 5-year period 2013-14 to 2017-18 (FNZ, D. Kerrigan 2018 pers. comm.). In 2018-19 the observed coral catch was 222 kg (FNZ, R. Tinkler 2019, pers. comm.), which translates to around 1.5 kg per observed tow in NWCR and 0.2 kg per observed tow in ESCR. The estimated scaled-up coral catch amounted to 470 kg in NWCR and 277 kg in ESCR (Table 16).

Table 16: Observed and estimated total ETP coral capture during the 2018-19 fishing year – all species combined (FNZ, R. Tinkler, 2019 pers. comm.).

UoA	Observed Coral Capture (kg)	No. Coral Tows	No. Observed Tows	Coral per Observed Tow (kg)	Scaled Coral Catch (kg)
NWCR	136.3	22	90	1.5	470
ESCR	85.8	24	405	0.2	277
ORH 7A	0.1	1	170	0.0006	0.30
Totals	**222.2**	**47**	**665**	**1.72**	**747**

Vessels are obliged by law to report all ETP coral captures and the effectiveness of this reporting is borne out by the fact that the vessel-reported coral captures are in the same ball-park as the estimated scaled-up coral catch estimates from observer sampling. For example, in 2017-18, when very low observer coverage in the ESCR fishery yielded a zero coral catch estimate, the vessels reported 749 kg of coral captured (Table 17).

It is apparent from both the observer- and vessel-reported data that coral capture by these two Chatham Rise UoA fisheries is very minor, around 0.6 kg per tow averaged over all tows during 2017-18 (Table 17).

Table 17: Vessel-reported coral capture during the 2017-18 fishing year (FNZ, R. Tinkler, 2019, pers. comm.)

UoA	Vessel-Reported Coral Catch (kg)	No. Coral Tows	% Tows with Coral	Coral catch/coral tow (kg)	Total No. Tows	Avg. coral catch/tow All tows (kg)
NWCR	324	52	13.0%	6.2	399	0.8
ESCR	749	77	6.1%	9.7	1,261	0.6
Totals	**1,073**	**129**	**7.8%**	**8.3**	**1,660**	**0.6**

The coral species most abundant in NWCR catches are Scleractinian stony corals, particularly *Solenosmilia variabilis*. In ESCR, the main species encountered are the Alcyonacean bubblegum coral *Paragorgia arborea* and the Scleractinian bushy hard coral *Goniocorella dumosa* (Table 18).

Table 18: ETP corals, by group/species, observed captured during the 2018-19 fishing year (FNZ, R. Tinkler, 2019 pers. comm.).

Coral Group	UoA	Catch (kg)	Scientific name	Common name
Gorgonian corals - Alcyonacea	NWCR	1	*Chrysogorgia* spp	Golden coral
Gorgonian corals - Alcyonacea		0.1	No species id.	Gorgonian coral
Stony corals - Scleractinia		3	*Goniocorella dumosa*	Bushy hard coral
Stony corals - Scleractinia		106.9	No species id.	Scleractinia
Stony corals - Scleractinia		25.3	*Solenosmilia variabilis*	Deepwater branched
	Total	**136.3**		
Black corals Antipatharia	ESCR	1.6	No species id.	Black coral
Black corals Antipatharia		1	*Leiopathes* spp.	Black coral
Black corals Antipatharia		1	*Leiopathes secunda*	Black coral
Black corals Antipatharia		1	*Triadopathes* spp.	Black coral
Gorgonian corals - Alcyonacea		1.4	Keratosis spp.	Bamboo coral
Gorgonian corals - Alcyonacea		1.8	No species id.	Gorgonian coral
Gorgonian corals - Alcyonacea		0.1	No species id.	Bamboo corals
Gorgonian corals - Alcyonacea		54.3	*Paragorgia arborea*	Bubblegum coral
Stony corals - Scleractinia		8.2	No species id.	Stony branched
Stony corals - Scleractinia		17	*Goniocorella dumosa*	Bushy hard coral
Stony corals - Scleractinia		3	*Madrepora oculata*	Madrepora coral
	Total	**85.8**		
Gorgonian corals - Alcyonacea	ORH7A	0.1	No species id.	Gorgonian coral
	Total	**0.1**		

Progress against coral Conditions 2 & 3 is separately provided.

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Overview of management information

Changes to management system & regulations

The TAC/TACC for ORH 3B was increased following the October 2019 sustainability round, which increased the catch limit for the East & South Chatham Rise area. Another increase is likely in 2020-21. In addition, the TAC/TACC for ORH 7A was increased from 1 October 2019 based on the 2019 stock assessment that estimated current stock status at 47% B_0.

Electronic reporting and geo-positional reporting (VMS) for all trawlers was phased in during 2019.

The South Pacific Regional Fisheries Management Organisation (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. The measures include a catch limit of 200 t for Westpac Bank, of which 190 t were allocated to New Zealand. A further update to the catch limit for the Westpac Bank area will be considered by the Commission in February 2020 on the basis of the 2019 ORH 7A stock assessment. The measures came into force in May 2019 and are being fully implemented.

Changes to personnel involved in science or management

A new lead scientist for deepwater fisheries, Gretchen Skea, has been appointed at MPI following the departure of Alistair Dunn.

Legal & customary framework

New Zealand's fisheries management is centred on the Quota Management System (QMS), a system introduced in 1986 based on Individual Transferrable Quota (quota), Total Allowable Catch (TAC) limits and Total Allowable Commercial Catch (TACC) limits.

Quota provides a property right to access commercial fisheries and has been allocated to Maori as part of the Treaty of Waitangi Settlements that acknowledge the Treaty guaranteed Maori *"full exclusive and undisturbed possession of their…fisheries."*

Quota is a tradable property right that entitles the owner to a share of the TACC. At the commencement of each fishing year, quota gives rise to Annual Catch Entitlements (ACE) which are tradable, expressed in weight, and entitle the holder to land catch against them. The QMS enables sustainable utilisation of fisheries resources through the direct control of harvest levels based on the best available science. The QMS is administered by MPI through the Fisheries Act 1996.

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 QMS.

At an operational level, these fisheries are managed in accordance with the National Fisheries Plans.

The National Fisheries Plan for Deepwater Fisheries has been revised and implemented as of May 2019 (MPI, 2019). It is a statutory document, approved by the Minister, which provides

an enabling framework outlining agreed management objectives, timelines, performance criteria and review processes. There is a species-specific chapter for orange roughy within this plan (MPI, 2010).

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 – reporting on progress towards meeting the five-year plan and on the annual performance of the deep water fisheries against the AOP (FNZ, 2019a).

Collaboration

In 2006, DWG and FNZ (then MPI), entered into a formal partnership to enable collaboration in the management of New Zealand's deep water fisheries. This partnership (MPI, 2010a) was updated in 2008 and 2010 and has directly facilitated improved management of the orange roughy trawl fisheries through:

- A close working relationship under a shared and agreed vision, objectives and collaborative work plans
- Real-time, open communication between DWG and FNZ on information relevant to management measures, particularly from the FNZ Observer Programme and commercial catching operations.

FNZ and DOC actively consult with interested parties to inform management decisions through their open scientific working groups and public consultation processes.

Compliance & enforcement

FNZ maintains a comprehensive compliance programme, which includes both encouraging compliance through support and creating effective deterrents. This strategy is underpinned by the VADE model, which focuses on all elements of the compliance spectrum as follows:

1. Voluntary compliance – outcomes are achieved through education, engagement and communicating expectations and obligations
2. Assisted compliance – reinforces obligations and provides confidence that these are being achieved through monitoring, inspection, responsive actions and feedback loops
3. Directed compliance – directs behavioural change and may include official sanctions and warnings
4. Enforced compliance – uses the full extent of the law and recognises that some individuals may deliberately choose to break the law and require formal investigation and prosecution.

Since 1994, all vessels over 28 m have been required by law to be part of the Vessel Monitoring System (VMS) which, through satellite telemetry, enables FNZ to monitor all hake/hoki/ling vessel locations at all times. This system is now being replaced by Geospatial Position 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.

All commercial catches from QMS stocks must be reported and balanced against ACE at the end of the month. It is illegal to discard or not to report catches of QMS species. Catches may only be landed at designated ports and sold to Licensed Fish Receivers (LFRs). Reporting requirements for hake/hoki/ling trawl vessels include logging the location, depth, main species caught for each tow, and total landed catch for each trip.

Introduced in January 2019, all New Zealand vessels are transitioning in a staged implementation programme to new Electronic Reporting and Geospatial Position Reporting (replaces VMS) regulations. All New Zealand vessels now report catch daily on an event-by-event basis. These reports are validated against positional data allowing for timely interventions and compliance oversight in near real time.

FNZ audits commercial vessel catch-effort and landing reports, reconciles these against multiple sources including VMS records, data collected by onboard FNZ observers, and catch landing records from LFRs to ensure that all catches are reported correctly.

Observer coverage in the orange roughy UoAs has ranged between 4% and 73% over the recent period 2014-15 to 2018-19.

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 (DWG, 2019e).

DWG personnel and vessel operators meet with FNZ's Management and Compliance teams annually to discuss and evaluate any issues that may have arisen (MPI, 2019a). Any identified risks are communicated to the fleet along with proposed remedial action to be undertaken (DWG, 2019f).

Research plans

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). 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 and a biomass survey of ORH 3B NWCR and ESCR will be undertaken during June-July 2020, followed by a revised stock assessment of ORH 3B ESCR.

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).

Tables 8-11 (pp. 29-31) and 16 (p. 41) of FNZ's Annual Operational Plan 2019/20 provide research projects to be undertaking that relate to deep water fisheries during 2019-20 (FNZ, 2019).

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Appendix 1 – UoA trawl footprint maps

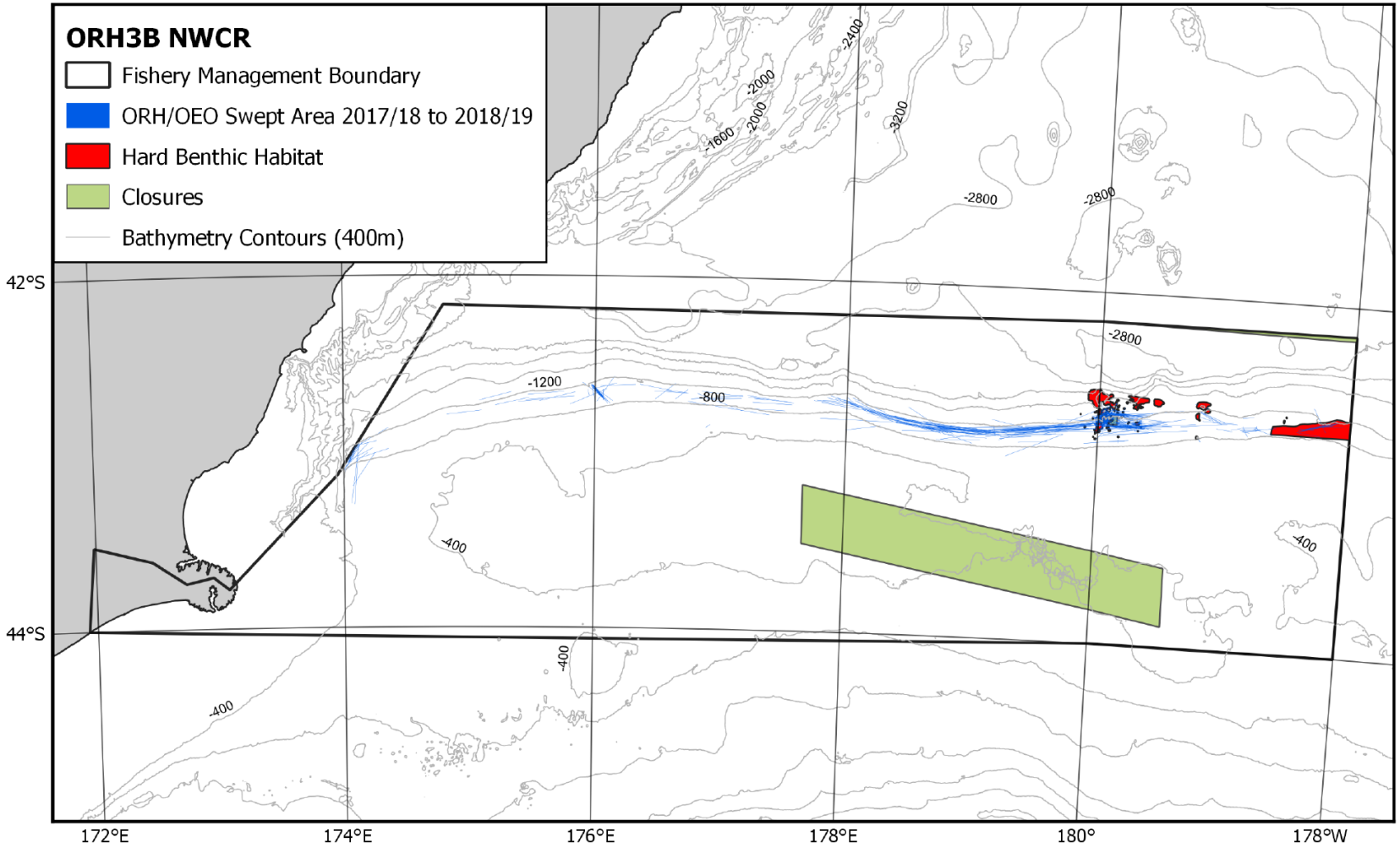

Figure A1: NWCR UoA trawl footprint, 2017-18 & 2018-19.

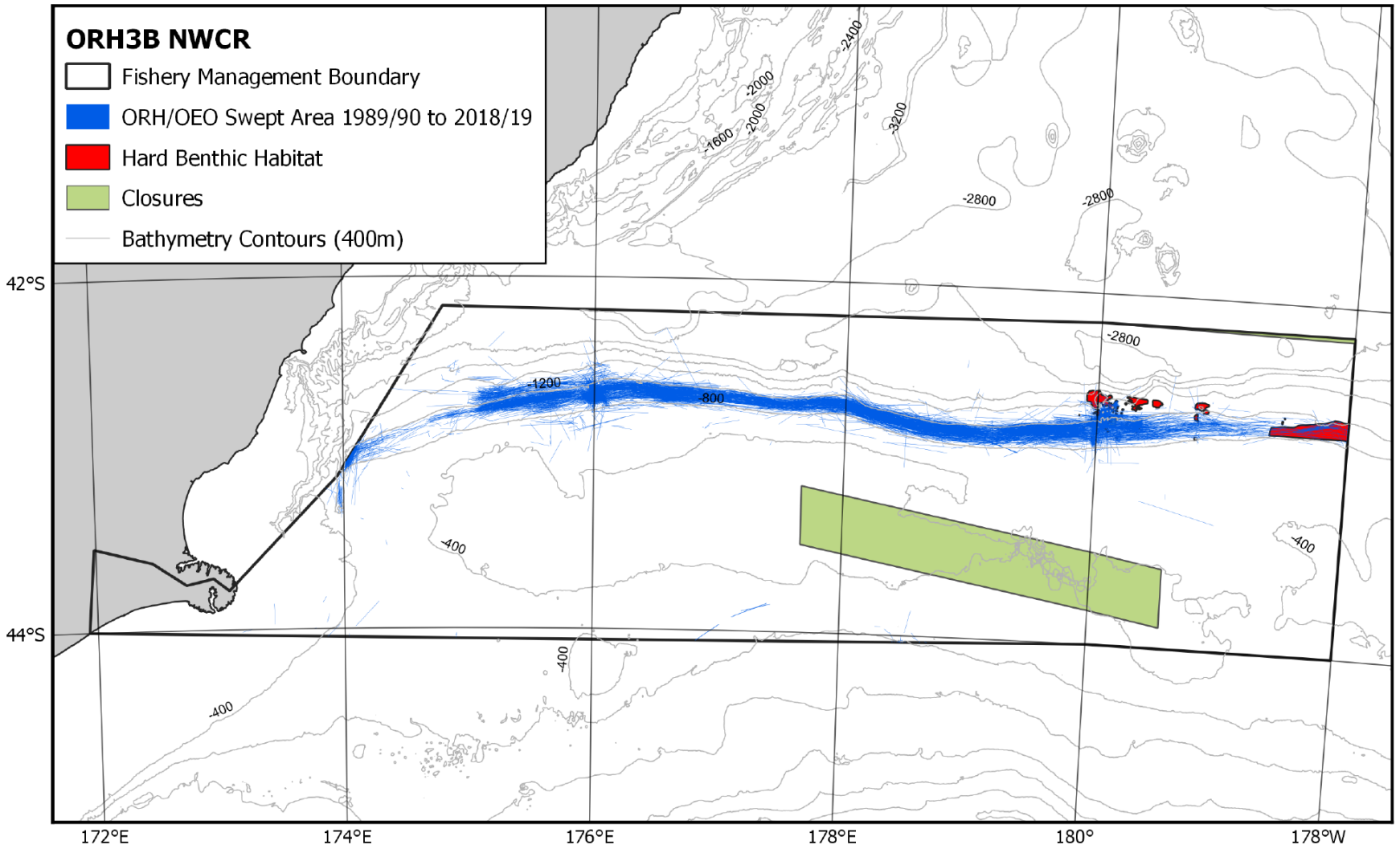

Figure A2: NWCR UoA trawl footprint 1989-90 to 2018-19.

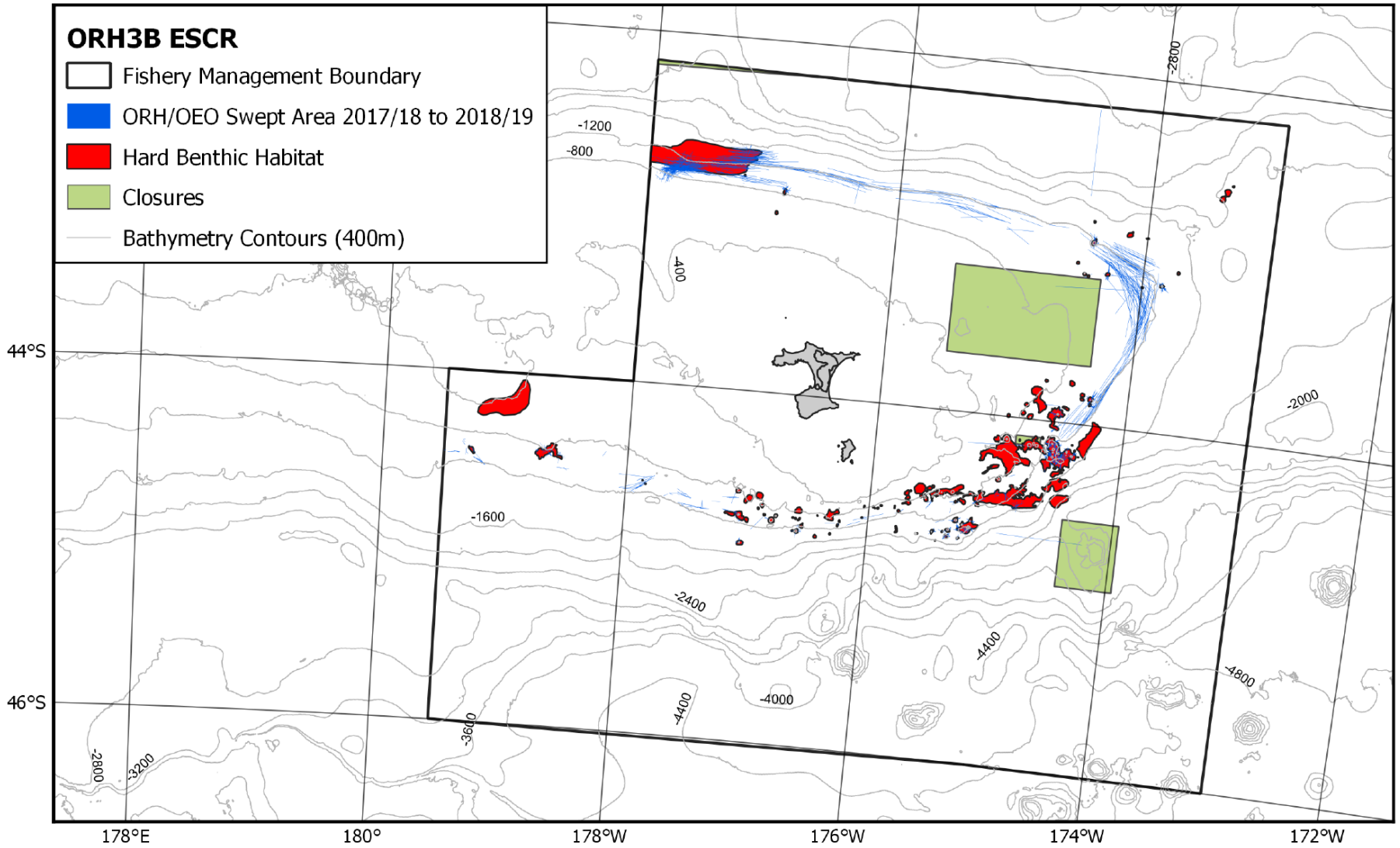

Figure A3: ESCR UoA trawl footprint, 2017-18 & 2018-19.

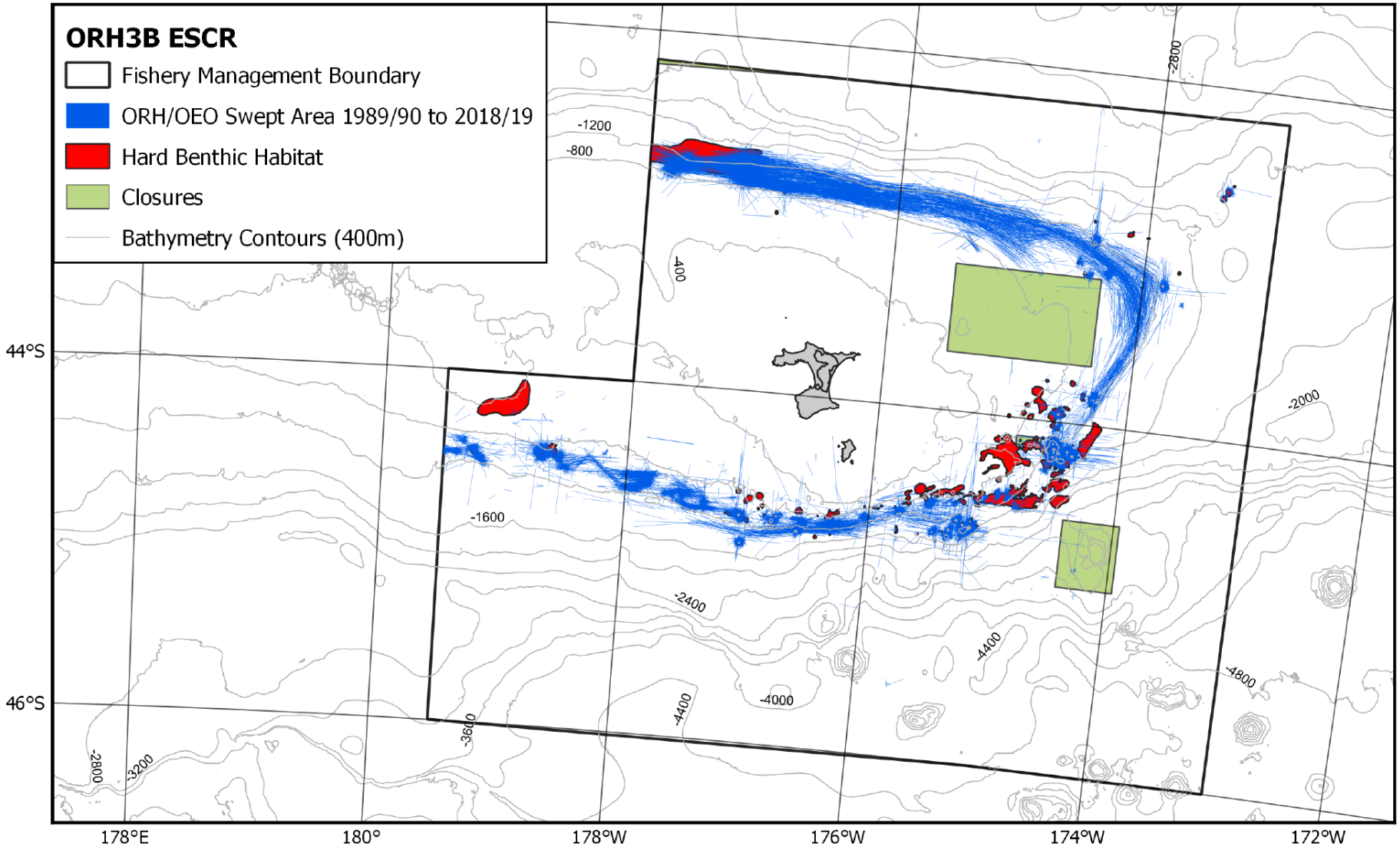

Figure A4: ESCR UoA trawl footprint 1989-90 to 2018-19.

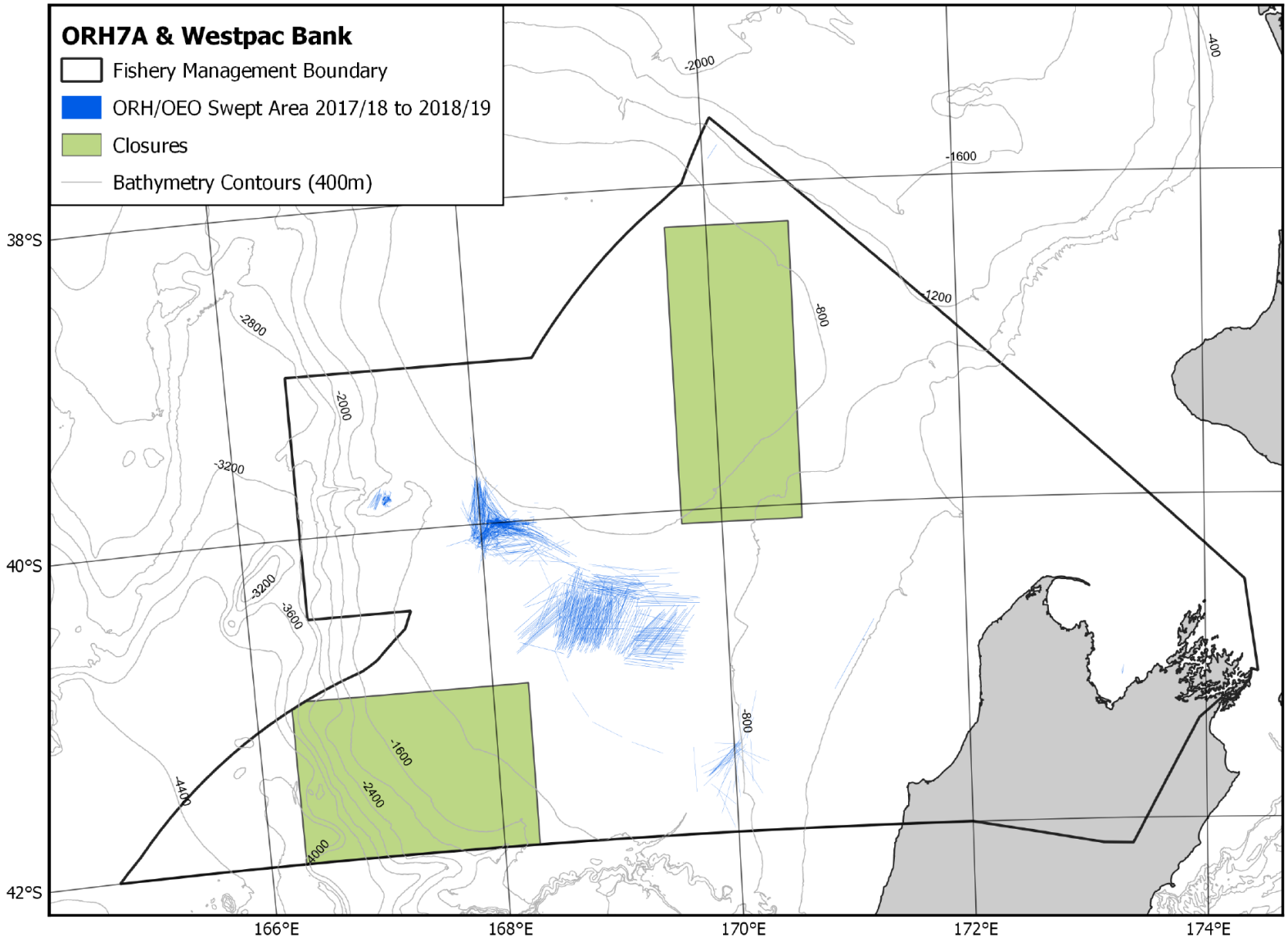

Figure A5: ORH 7A-WB UoA trawl footprint, 2017-18 & 2018-19.

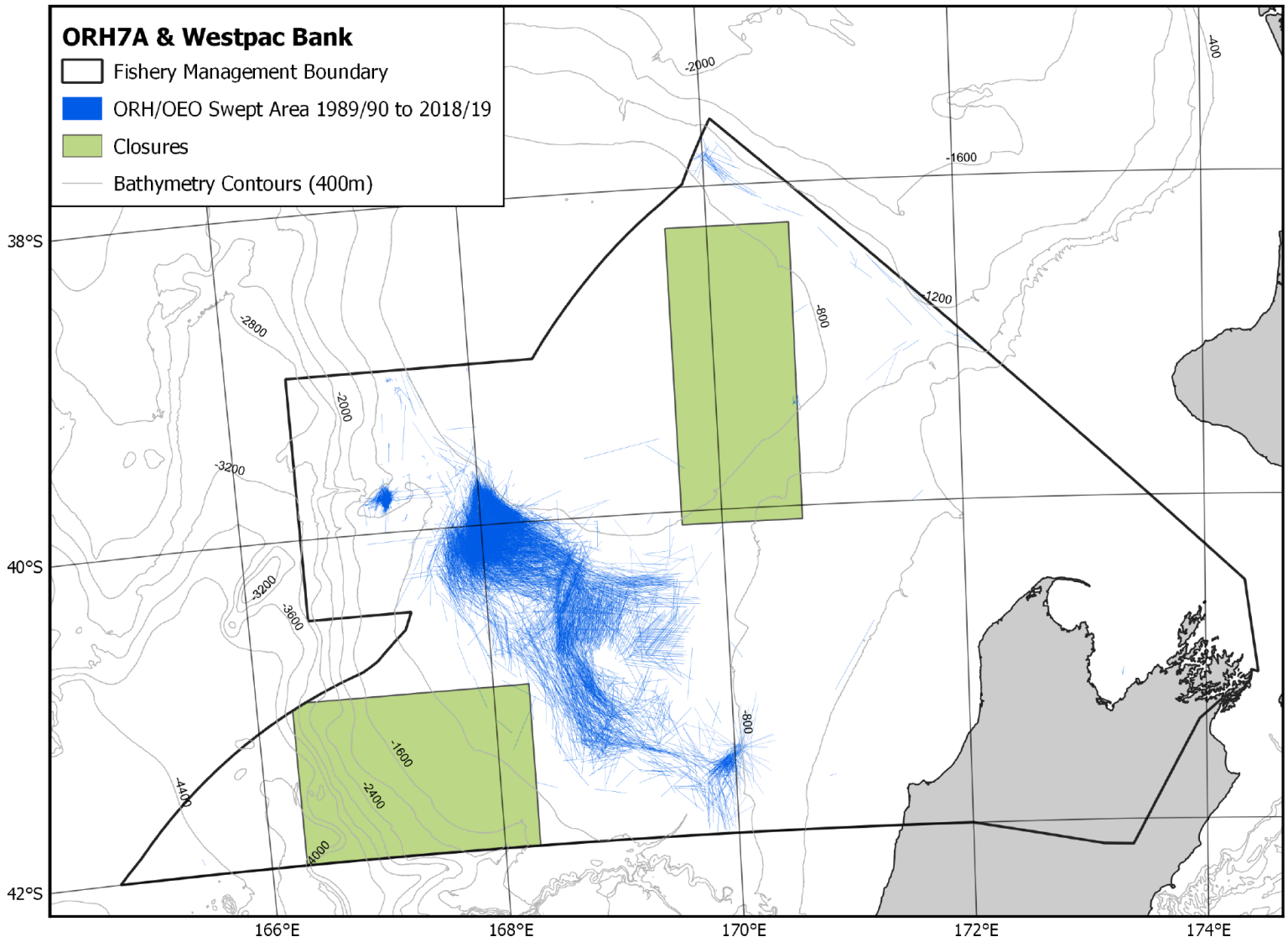

Figure A6: ORH 7A-WB UoA trawl footprint 1989-90 to 2018-19.