ORH

NEW ZEALAND DEEPWATER FISHERIES MANAGEMENT PRACTICES

ORANGE ROUGHY

DEEPWATER GROUP LTD
PUBLICATION SERIES 2013/03

deepwater group

DEEPWATER GROUP LTD

A non-profit organization delivering the vision of New Zealand's deepwater quota owners to be recognised as having the best managed deepwater fisheries in the world, working closely with scientists and in partnership with the Ministry for Primary Industries.

ACKNOWLEDGEMENTS

DWG would like to extend their appreciation to all those who supported and contributed to the preparation of this report. In particular, we'd like to thank the Ministry for Primary Industries for their editorial contributions.

CITATION

Clement, I.T, Gargiulo, S., Irving, A. & Tilney, R. (2013). New Zealand Deepwater Fisheries Management Practices: Orange Roughy (Deepwater Group Ltd Publication Series 2013/03, dated November 2013). Wellington, New Zealand: Deepwater Group Ltd.

DESIGN & PRINT

Design: Nikki Kidd and Ros Wells. Printing: Copy Direct Ltd.

ISSN NO.

Print: 2350-3076 Online: 2350-3084

003
Introduction

004
Profile
Known Distribution and Main Fishing Grounds

007
Stock Sustainability
Stock Structure
Stock Assessment
Stock Status
Harvest Strategy
Management Reference Points & Responses

019
Managing Environmental Effects
2013 Ecological Risk Assessment
Bycatch Species
Endangered, Protected & Threatened Species
Seabirds
Marine Mammals
Fish
Corals
Habitats & Ecosystems

027
Effective Fisheries Management
Governance & Policy
- Legal & Customary Framework
- Collaborative & Participatory Processes
- Compliance & Enforcement

Fisheries Management Plans
- Fisheries Plan
- Non-Regulatory Management
- Research Plan

031
Certified Sustainable

033
References

Introduction

OUR VISION: To be recognised as the best managed deepwater fisheries in the world.

New Zealand seafood products have a strong reputation for consistent high quality and for being harvested using world's best environmentally sustainable practices. Consumers wanting a safe and sustainable food source need look no further than the New Zealand deepwater species orange roughy.

Orange roughy is one of New Zealand's most commercially important and earliest deepwater fisheries. Orange roughy are caught by trawling within four main fishing regions: off New Zealand's northern North Island (ORH1); Cape Runaway to Banks Peninsular (ORH2A, 2B & 3A); Chatham Rise (ORH3B); and Challenger Plateau (ORH7A) on the west coast.

New Zealand's seafood industry, including quota owners in the orange roughy fisheries, is committed to ensuring sustainable utilisation. This is delivered through the business ethos that sound environmental practices make good business sense.

Our role is to supply consumers with safe, nutritious, appetising and affordable seafood. The combined pressures of human population growth, increasing energy costs and the need to ensure sustainable production mean we need to find ways to produce more seafood, with more certainty, while minimising any adverse environmental effects. By 2030 the world demand for food will double, which will need to be met while still maintaining the environmental integrity that supports this production sustainably.[i]

Our commitment to sustainable utilisation includes the use of independent third party assessments to verify that our management measures reflect international best practice. Four of New Zealand's orange roughy fisheries are currently being assessed against the stringent MSC standards. These are: Mid-East Coast (ORH2A South, ORH2B and ORH3A), Northwest Chatham Rise (ORH3B), East and South Chatham Rise (ORH3B) and Challenger Plateau (ORH7A). This report focuses on these four fisheries and how they align with these standards.

Deepwater Group Ltd (DWG) is an alliance of quota owners in New Zealand's deepwater fisheries. DWG represents the interests of shareholders who collectively own approximately 90% of the New Zealand orange roughy quota.

Profile

"Orange roughy is one of New Zealand's most commercially important and earliest deepwater fisheries."

Common Name

Orange Roughy

Scientific Name

Hoplostethus atlanticus

Ministry Code

ORH

Fishing Method

Bottom trawl.

Distribution

Widely distributed throughout New Zealand and harvested from depths of around 700 m to 1,200 m (Figure 1).

Quick Facts

Orange roughy have firm pure white flesh with a delicate, almost shellfish-like flavour.

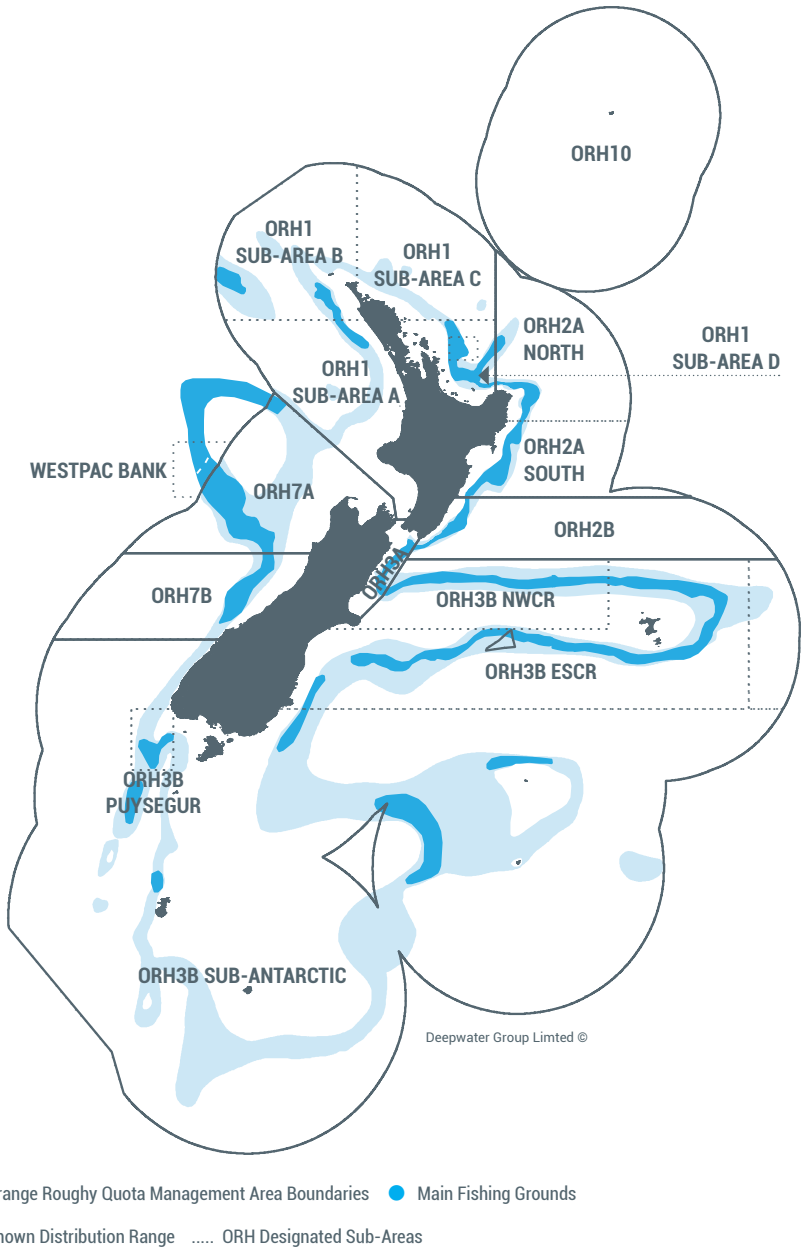
Orange roughy are slow growing and may live for more than 80 years.

New Zealand has the largest and longest standing orange roughy fishery in the world.

Four New Zealand orange roughy fisheries have been pre-assessed against the world-leading Marine Stewardship Council standards for sustainable seafood.

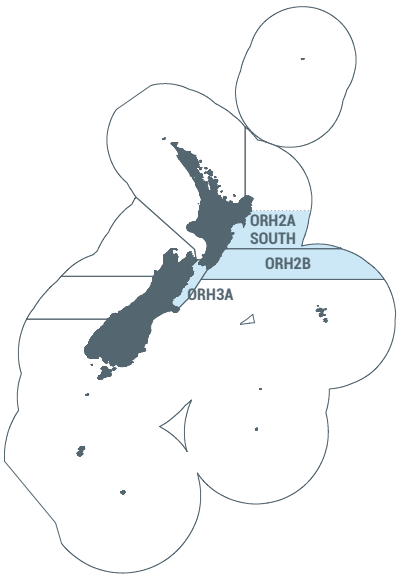
FIGURE 1

ORANGE ROUGHY KNOWN DISTRIBUTION RANGE AND MAIN FISHING GROUNDS[1]



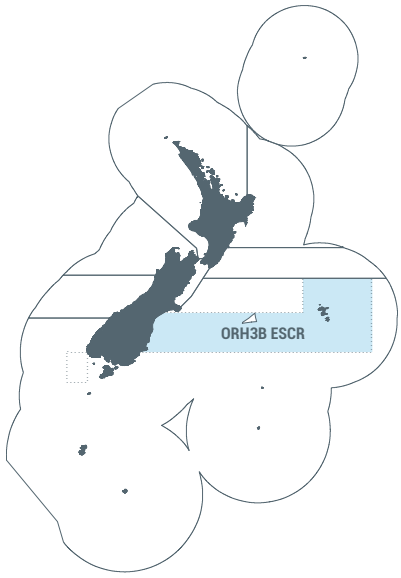
1. 'Known distribution range' provides an indication of where orange roughy are likely to be found based on all known records of orange roughy collected from research and commercial activities. They may be found elsewhere. 'Main fishing grounds' is based on the trawl footprint for the last ten years, only a fraction of this is trawled annually (see Habitats and Ecosystems).[xxviii]

FIGURE 2
ORH MID EAST COAST FISHERY



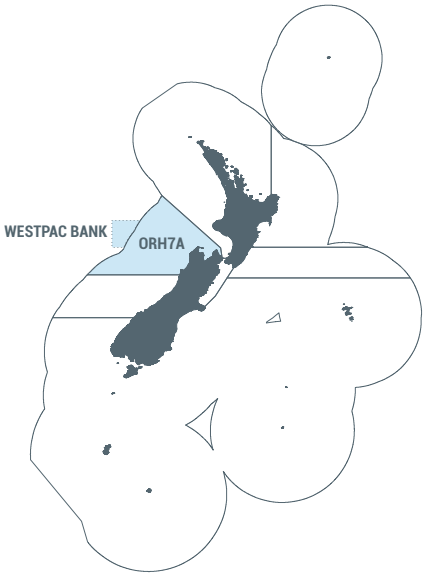
● ORH Mid East Coast Fishery ○ ORH Quota Management Areas
..... ORH Designated Sub-Areas

FIGURE 2+
ORH3B EAST AND SOUTH CHATHAM RISE FISHERY



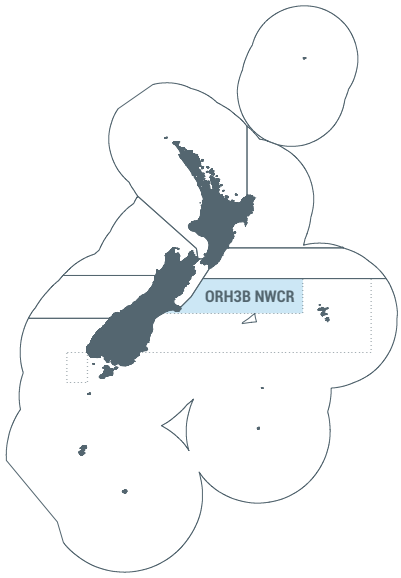
● ORH3B East & South Chatham Rise Fishery ○ ORH Quota Management Areas
..... ORH Designated Sub-Areas

FIGURE 2++
ORH7A FISHERY



● ORH7A Fishery ○ ORH Quota Management Areas
..... ORH Designated Sub-Areas

FIGURE 2+++
ORH3B NORTHWEST CHATHAM RISE FISHERY



● ORH3B Northwest Chatham Rise Fishery ○ ORH Quota Management Areas
..... ORH Designated Sub-Areas

CASTLE POINT LIGHTHOUSE. NORTH ISLAND, NEW ZEALAND xxxix

Stock Sustainability

"The DWFAWG evaluates relevant research, determines the status of fisheries and fish stocks, and estimates likely future stock size under different catch level assumptions."

Stock Structure

New Zealand orange roughy are managed as nine main fish stocks: northern North Island (ORH1), East Cape (ORH2A North), Mid-East Coast (ORH2A South, ORH2B, and ORH3A), Northwest Chatham Rise (ORH3B), East and South Chatham Rise (ORH3B), Puysegur (ORH3B), Sub-Antarctic (ORH3B), Challenger Plateau (ORH7A), and west coast South Island (ORH7B).

Scientific surveys and assessments are carried out regularly on key orange roughy stocks, which together comprise 70% of annual catch. Catches from each are managed by Total Allowable Commercial Catches (TACCs)[2] for each Quota Management Area (QMA, e.g. ORH2A or ORH3B) or, where more than one separate biological stock exists within a QMA, then by separate catch limits within the TACC. TACCs and catch limits are set by the Minister for Primary Industries based on the best available scientific information.

The focus of this report is on Mid-East Coast (ORH MEC), Northwest Chatham Rise (ORH3B NWCR), East and South Chatham Rise (ORH3B ESCR) and Challenger Plateau (ORH7A Challenger) fisheries.

Stock Assessment

"...scientists work together to ensure the orange roughy fisheries are adequately monitored."

Deepwater Group Ltd (DWG), the Ministry for Primary Industries (MPI) and scientists work together to ensure the orange roughy fisheries are adequately monitored.

Research surveys and stock assessments have been undertaken for all four fisheries.

Research results are presented to MPI's open scientific forum, the Deep Water Fisheries Assessment Working Group (DWFAWG), which provides technical guidance and peer review. All research information must meet (or exceed) MPI's Research and Science Information Standard for New Zealand Fisheries prior to being accepted as being of sufficient quality to inform management decisions.[ii]

The DWFAWG evaluates relevant research, determines the status of fisheries and fish stocks, and estimates likely future stock size under different catch level assumptions. It does not make management recommendations or decisions, as these responsibilities lie with MPI fisheries managers and the Minister for Primary Industries.

The DWFAWG is attended by MPI scientists, research providers, independent scientists, fisheries managers, and representatives from Industry and environmental NGOs. Once accepted by the DWFAWG, stock assessments are further peer reviewed through a scientific plenary process and are reported in the annual Fisheries Assessment Plenary Report[iii] (publically available on MPI's website[iv]).

Although assessment efforts for each of the stocks have varied, stocks with the most commercial focus or those that require rapid rebuilding are most closely monitored and assessed at regular intervals, given they will likely require more management attention. Some have also been closed for a period of time to maximise the rate of rebuilding.

High levels of observer coverage and the Vessel Monitoring System allow for easy monitoring of commercial activity and catch across the different fishing grounds. If fishing patterns or stock size alters significantly, management reviews are undertaken as required.

The development and application of a robust stock assessment model for orange roughy has proven to be challenging. Early attempts using both deterministic and stochastic approaches have been found to be inadequate. In 2012-13 a modified age-structured approach was developed and successfully applied to the ORH MEC fishery. MPI and quota owners plan for stock assessments to be undertaken on each of the four fisheries in ORH MEC, ORH3B NWCR, ORH3B ESCR and ORH7A Challenger during 2013-14.

ORH Mid-East Coast Stock Assessment

A modified age-structure modelling approach was used to assess the ORH MEC stock status in 2013. This updated the 2011 assessment by including additional age and maturity data from the 1993 and 2010 trawl surveys and updated age frequencies from the spawning fishery, produced using the most recent ageing protocols.

The 2013 stock assessment used datasets from three different fisheries (flat areas, hills and the spawning fishery) and included catch history, catch rates, length frequencies, a trawl survey time-series, and egg and acoustic survey series.

The availability of age frequencies from the trawl survey and the spawning fishery

2. The TACC is the amount of fish commercial fishermen are allowed to catch of a particular stock in a given year which has been set by the Minister.

made it feasible to estimate a large number of year-class strengths (YCS). The 2013 stock assessment considered a base model, using the Haist parameterisation, and a sensitivity run, using the Francis parameterisation.

ORH3B East & South Chatham Rise Stock Assessment

The main orange roughy spawning aggregation within the ORH3B ESCR stock has been surveyed acoustically using the same vessel, equipment and methodology each year since 2002.[iii]

This spawning aggregation forms during June-July each year and the location and structure of this aggregation makes it amenable to acoustic surveying – it occurs over flat grounds and extends upwards into the water column. The biomass of this main aggregation has been the key input into annual assessments.

In 2011 a second spawning aggregation was discovered and surveyed to the west of the main aggregation. There is no record of this second aggregation's existence in previous years and biological data from the survey confirm that it is discrete from the main spawning plume. This second spawning aggregation has been surveyed each year since its discovery. The results of the 2011 and 2012 surveys have been reviewed by the DWFAWG and were included in the 2013 determination of stock status.

Additional, smaller spawning events also occur in other areas within ORH3B ESCR. Some of these aggregations have been surveyed acoustically and these orange roughy are also taken into account in the assessment of stock status.

Estimates of spawning biomass from acoustic surveys are used as the basis for estimating the minimum current mature biomass of the ORH3B ESCR stock. However, not all mature orange roughy spawn each year so a method for calibrating the acoustic biomass has been developed and used to generate estimates of the total mature biomass. These estimates have been provided since 2008.

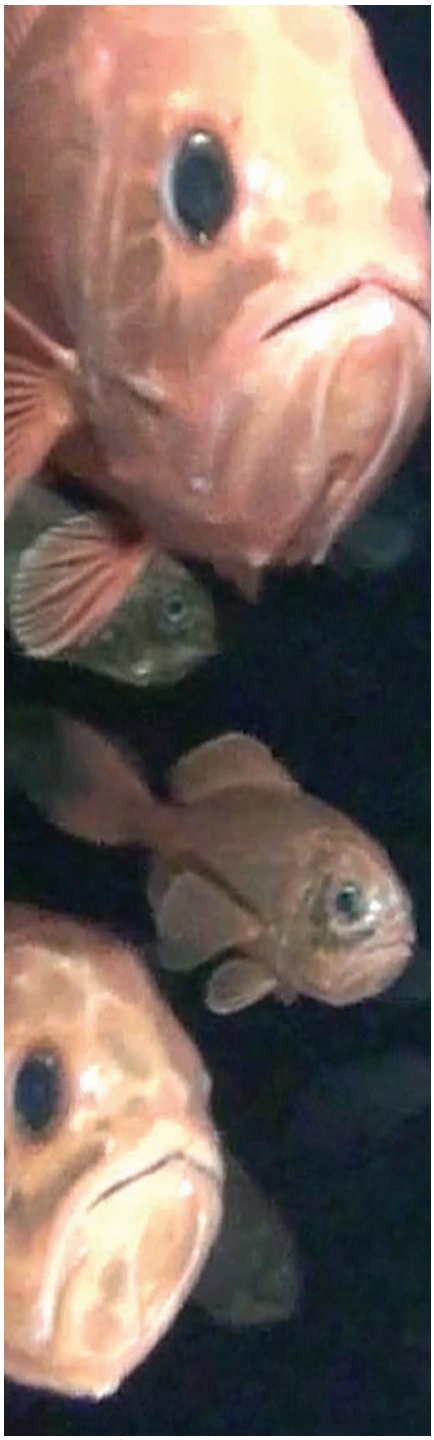
The DWFAWG considers the stock assessment models used prior to 2008 to no longer be appropriate, precluding the use of these models for determining stock status. Nevertheless, estimates of B_0 from these earlier models have been fairly consistent and are believed to be valid. An F_{MSY} Harvest Strategy applied to estimates of the total mature biomass has been successfully applied to the fishery since 2010.

ORH3B Northwest Chatham Rise Stock Assessment

The most recent assessment of the ORH3B NWCR stock to be accepted by the DWFAWG took place in 2006.[iii] The deterministic model used in these assessments has since been found to be ineffective at providing robust orange roughy population simulations.

In 2012 and 2013 surveys using a multi-frequency Acoustic Optical System (AOS) were completed for the two main Undersea Topographic Features (UTFs) within ORH3B NWCR: Graveyard Hill and Morgue Hill. These surveys provide more relevant and reliable estimates of current orange roughy spawning biomass for these two features, albeit preliminary as these have yet to go through scientific peer-review and the DWFAWG processes.

Results from the 2012 biomass survey were presented to the DWFAWG in May 2013. The DWFAWG considered the multi-frequency AOS survey method



Orange Roughy[xl]

showed improvements over previous single-frequency acoustic surveys in estimating acoustic biomass of orange roughy where the aggregations comprised a mix of species. However, as the AOS method has yet to be fully evaluated, the DWFAWG has reserved its final determination pending further consideration of the 2013 survey results.

The DWFAWG's primary concern is around the proportion of 'unseen' biomass that is estimated to be in the acoustic shadow-zone but is not directly measured. For the ORH3B NWCR surveys, this is estimated to be 29% of the total biomass estimate. Recent evidence from video footage, taken using a moored camera array on Morgue Hill and from the AOS, demonstrates that orange roughy occur within the near-seabed acoustic shadow-zone in densities that appear to be comparable to (or higher than) those observed in mid-water.[vii]

The results of the 2012 and 2013 surveys will undergo further evaluation and validation during 2013-14, with the objective of having these accepted as valid and using them within a stock assessment model to better determine current stock status.

ORH7A Challenger Stock Assessment

Annual trawl surveys of orange roughy on the Challenger Plateau took place between 1983 and 1990.[iii] These historic surveys were conducted by a variety of vessels over different survey strata, which make comparisons between survey results problematic and preclude their use in stock assessments.

From 2005, seven further surveys have taken place, each using the same trawl gear, vessel and methodology. These took place in 2005, 2006 and annually from 2009 to 2013. These surveys covered survey strata comparable to the historical 1987-90 surveys, but are considered as a separate time series.

The new survey time series incorporates a random-stratified trawl-sampling component over flat ground and an acoustic component over both flat ground and undersea hills. As orange roughy in the ORH7A Challenger stock are considered to be part of a single straddling stock, which extends beyond the 200 nm boundary of the New Zealand Exclusive Economic Zone (EEZ), these surveys occur within pre-determined strata both within the EEZ and on the Westpac Bank outside of the EEZ (Figure 2++).

In 2012, Cordue[ix] compared biomass estimates derived from simultaneously collected acoustic and trawl data from the 2009, 2010 and 2011 surveys to determine a catchability coefficient (q) for the trawl net. Applying q to the trawl biomass estimates enabled these to be combined with the acoustic estimates to produce a single, absolute biomass estimate for each survey. These were subsequently used in the determination of stock status in 2012.

Dent Island, Campbell Islands,Sub-Antarctic, New Zealand[xiii]

In addition, Doonan et al.[x] analysed and compared the age distributions of otoliths collected from research surveys in 1987 and 2009. Fish otoliths accrete layers of calcium carbonate during periods of growth – which results in the appearance of light and dark bands similar to those found within a tree trunk. By counting these rings, and assuming they are formed on an annual basis, it is possible to estimate the age of orange roughy.

The study indicated that the average age of the spawning population in 2009 was much younger than in 1987 and consisted mainly of relatively young recruits, providing evidence of incoming recruitment.

The 2013 assessment of stock status again adopts the Cordue[ix] approach and for management purposes the mean of the 2009-12 biomass estimates was used. The mean of the 2010-12 biomass estimates was also considered as an alternative. The estimation took account of potential bias in orange roughy target strength (i.e. in the acoustic surveys) and incorporated observation error.

A further combined trawl and acoustic survey was carried out in 2013 and the results of this survey are currently undergoing analysis and will be used to inform the management of the ORH7A Challenger stock in due course. In the interim, a conservative TACC of 500 t, well below the F_{MSY} Harvest Strategy estimate, has been applied to the fishery (see Management Reference Points and Responses).

Stock Status

ORH Mid-East Coast Stock Status

The base model (Haist) and sensitivity run (Francis) used in the 2013 stock assessment provide different estimates of current biomass.[iii] The base model estimates the current biomass to be between 12-33% B_0, with a mean of 21% B_0. The sensitivity run estimates current biomass to be between 21-38% B_0, with a mean of 29% B_0.

This stock is considered Unlikely (<40%) to be at or above the Management Target range and About as Likely as Not (40-60%) to be below the Soft Limit but Very Unlikely (<10%) to be below the Hard Limit. At current catch levels, overfishing is Very Unlikely (<10%) to be occurring.

Under both models the biomass is expected to increase over five years of projected catches up to 1,200 t per year.

ORH3B East & South Chatham Rise Status

In 2013 the status of the ORH3B ESCR stock was estimated to be between 19-32% B_0,[iii] with a mean of 25% B_0. The stock is considered Unlikely (<40%) to be at or above the Management Target

TABLE 1
CURRENT STOCK SIZE AND STATUS FOR ORH MEC (FROM HAIST AND FRANCIS MODELS)[III]

MODEL RUN	B_0 (000 t)	B_{2013} (000 t)	B_{2013} (%B_0)	P(B_{2013} <10%B_0)	P(B_{2013} <20%B_0)	P(B_{2013} <30%B_0)
Haist	113 (100-135)	23 (13-44)	12 (12-33)	0.00	0.45	0.06
Francis	118 (103-136)	34 (23-50)	29 (21-38)	0.00	0.01	0.40

TABLE 2
CURRENT STOCK STATUS FOR ORH3B ESCR (SHOWN AS A PERCENTAGE OF B_0 USING RANGE OF ESTIMATES FROM B_0 AND CURRENT BIOMASS)

B_0 (t)	LOW $B_{CURRENT}$ (69,400 t)	HIGH $B_{CURRENT}$ (120,500 t)	MEAN (%B_0)
300,000	-	-	31.3%
375,000	18.5%	32.1%	**25.1%**
450,000	-	-	20.9%

and Likely (>60%) to be below the Fishing Intensity Target. It is also Unlikely (<40%) to be below the Soft Limit and Very Unlikely (<10%) to be below the Hard Limit. Overfishing is Unlikely (<40%) to be occurring.

ORH3B Northwest Chatham Rise Stock Status

There is no current valid stock assessment for the ORH3B NWCR stock. A stock assessment, using the model developed in 2012-13 for ORH MEC, is planned for 2013-14.

The previous deterministic assessment model has been found to be unreliable as it does not serve to provide a robust estimate of current stock status. The new assessment is expected to show that the stock has been rebuilding following substantially reduced fishing intensity in recent years.

ORH7A Challenger Stock Status

In 2012 the best estimate of current stock status was provided by using the mean of the biomass estimates from the period 2009 to 2011. This was based on the understanding that, as orange roughy have a low level of productivity and as there has been very low levels of catch taken since the 2009 survey then, the mature biomass should have been relatively constant during this period.[ii]

In 2013 the DWFAWG was divided on whether to adopt the mean of the biomass estimates from surveys in the period 2009-12 or the mean from those during 2010-12. Both estimates are held to be equally valid and the 2013 assessment concluded the current biomass to be 20 or 24% B_0.

FIGURE 3
ESTIMATED SPAWNING STOCK BIOMASS FOR ORH MEC (FROM HAIST AND FRANCIS MODELS)

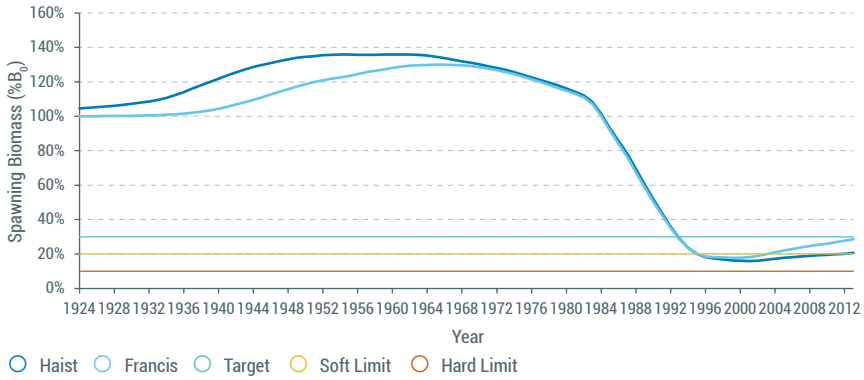


FIGURE 4
FIVE-YEAR PROJECTIONS AT CURRENT CATCH LIMIT (930 t) FOR ORH MEC (FROM HAIST & FRANCIS MODELS)

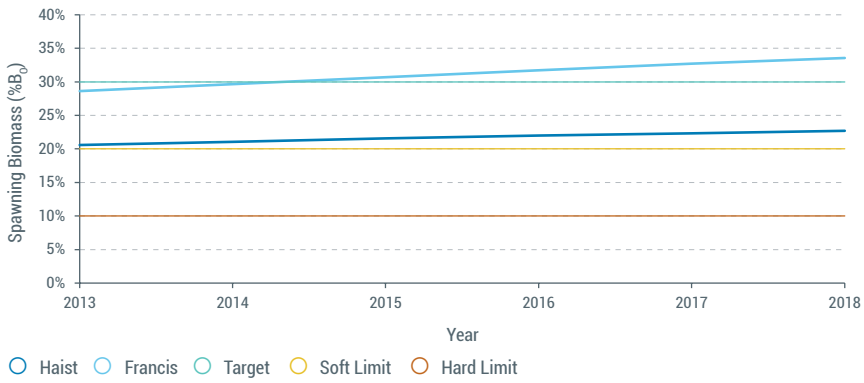
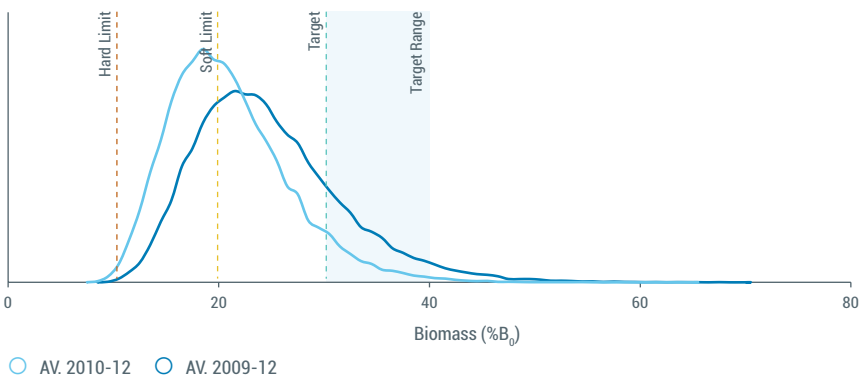


FIGURE 5
ESTIMATED STOCK SIZE AND STATUS FOR ORH7A (FROM THE AVERAGE 2010-12 AND 2009-12 DISTRIBUTIONS)



The biomass is Unlikely (<40%) to be at or above the Management Target and About as Likely as Not (40-60%) to be below the Soft Limit but Very Unlikely (<10%) to be below the Hard Limit. Overfishing is Very Unlikely (<10%) to be occurring.

Harvest Strategy

"When stock sizes decline, the management response is to reduce the TACC."

All fish populations, even those that aren't fished, naturally fluctuate in size. When stock sizes decline, the management response is to reduce the TACC. Conversely, when stock sizes increase, TACCs and catch levels are increased.

When new fisheries are established on stocks that have never been fished before higher catch levels are available for a period of time until stock size is reduced from the unfished level (B_0 [3]) to the most productive size. The most productive size can be estimated in different ways and is generally obtained from stock sizes in the range of one half to one quarter of the unfished level. This early stage of fisheries management is known as 'fishing down' a stock. When a stock has been reduced to its most productive size, longer term sustainable catches are set at lower levels than those taken in the initial years.

One of the reasons that orange roughy catches have been reduced so much is that most New Zealand orange roughy fisheries reached the end of their 'fishing down' period during the 1990s and TACCs were reduced accordingly.

In New Zealand, this management framework is underpinned by the Fisheries Act 1996 which requires stocks managed under the Quota Management System (QMS) to be

"maintained at or above the biomass that can produce the Maximum Sustainable Yield (MSY)" (i.e. B_{MSY} [4]).

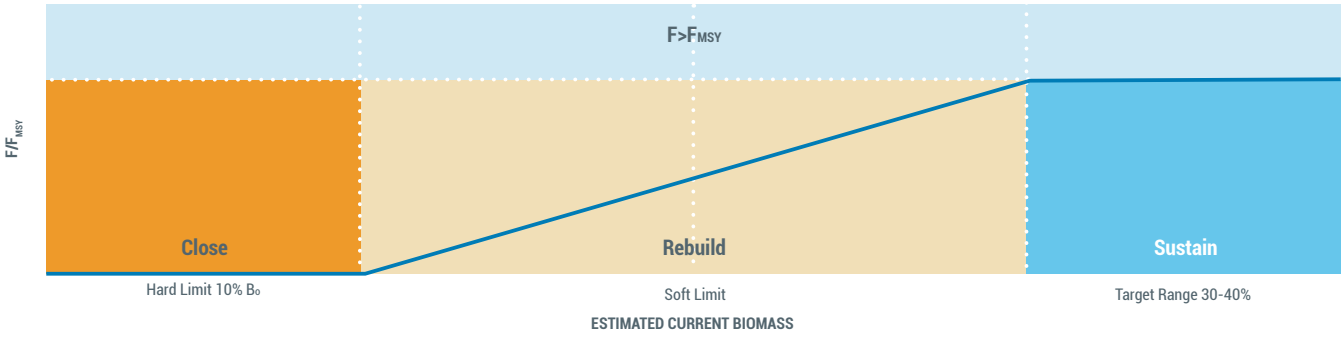
MSY is the largest average long-term annual catch that can be taken from a stock under prevailing ecological and environmental conditions.

In 2008, this management framework was further defined through the introduction of the Harvest Strategy Standard for New Zealand Fisheries (HSS).[xi] The HSS is a government policy that establishes best practice in relation to the setting of targets and limits for QMS fish stocks.

For orange roughy, a specific Harvest Strategy has been introduced which requires catch limits to be set to provide for a fishing mortality (F) of 4.5% of the current stock size (i.e. for every 1000 adult orange roughy, 45 are harvested each year, and 955 are left to ensure healthy stock sizes for the future). In this Harvest Strategy F is set at the level of natural mortality as a proxy for F_{MSY} [5]. When stocks are below the size that will support MSY, then setting catches at the F_{MSY} harvest level will over time enable the stocks to rebuild in size back to B_{MSY}.

This F_{MSY} Harvest Strategy has been implemented in the orange roughy fishery within ORH3B ESCR. As F was above 4.5% it was phased in over a three-year period from the 2008-09 fishing year and

FIGURE 6
ORANGE ROUGHY HARVEST STRATEGY



3. B_0 is the estimated biomass that would exist in the absence of fishing.
4. B_{MSY} is the estimated biomass that will support the Maximum Sustainable Yield (MSY).
5. F_{MSY} is the fishing mortality rate that, if applied constantly, would result in the MSY being harvested from the fishery.

fully implemented from 2010-11. After successful application in ORH3B ESCR, this F_{MSY} Harvest Strategy is now being progressively implemented, or considered for implementation, in other New Zealand orange roughy fisheries.

In 2013 the Harvest Strategy for orange roughy was further refined by the introduction of a more conservative management target range and by setting the fishing mortality target to be less than F_{MSY} if the stock size drops below this target range.

The previous management target was 30% B_0 which is a model-based estimate of B_{MSY}.[xii] MPI and DWG have now agreed to set a management target range of 30-40% B_0 for orange roughy stocks (Figure 6). The default soft and hard limits of 20% B_0 and 10% B_0 respectively have been retained.

If the mature biomass is below 30% B_0, the level of F is reduced below 4.5% to rebuild the stock toward the target range at a faster rate than would be achieved under a constant F harvest strategy. This provides for a more conservative management approach.

The MPI Harvest Strategy Standard specifies that when a stock falls below the soft limit (i.e. 20% B_0), the stock should be rebuilt to the management target in not less than twice the time period that would be required for the stock to rebuild in the absence of fishing. For those stocks where there is no robust stock assessment model, and it is not possible to estimate these parameters, the current Harvest Strategy is set to provide a fishing mortality below F_{MSY} that will ultimately result in the stock rebuilding to B_{MSY}.

Managing within a conservative target range above B_{MSY} provides a buffer and offers greater certainty that stocks will remain at or above B_{MSY}, and within the optimum range for both long-term sustainability and economic harvest levels.

Management Reference Points & Responses

"...conservative targets, combined with regular stock monitoring and reviews, enables fisheries managers time to respond to changes in stock size and to make timely TACC changes."

Management reference points have been established for New Zealand's orange roughy fisheries according to the HSS (Table 3). Management use these to respond to different stock statuses and ensure stocks are maintained at optimum sustainable levels.

The development and application of a robust stock assessment model for orange roughy has proven to be challenging. For those fisheries where there is no accepted stock assessment model, the DWFAWG estimates $B_{current}$ from biomass surveys, and uses this to determine stock status against a plausible range of B_0 estimates. Managers then apply the F-based Harvest Strategy to set catch limits.

Biological data (e.g. growth rates and recruitment levels), biomass estimates (from research surveys), and fisheries data (from commercial catches and observer records) are used to model and estimate stock status against these reference points. Modelling can also be used to estimate probable future stock biomass trajectories under different future harvest levels.

TABLE 3
ORANGE ROUGHY FISHERIES HARVEST STRATEGY

REFERENCE POINT	MANAGEMENT RESPONSE
Management Target of 30-40% B_0 Catch or TACC = 4.5% $B_{CURRENT}$	TACCs/agreed catch limits are used to maintain stocks within this target range.
Soft limit of 20% B_0	If the size of a stock is below this threshold, a formal time-constrained rebuilding plan will be implemented to increase the stock size to within the management target range.
Hard limit of 10% B_0	If the size of a stock is below this limit, fisheries on this stock will be considered for closure. The rebuild strategy requires a catch limit to be set to enable the stock to rebuild in size to the target range in not more than twice the time period it would take in the absence of fishing.
Rebuild Strategy	The rebuild strategy requires a catch limit to be set to enable the stock to rebuild in size to the target range in not more than twice the time period it would take in the absence of fishing.
Harvest Control Rules	Management actions are determined after consideration of the current stock assessment, along with the results of five year forecasts of stock sizes under a range of catch assumptions, if available, and guided by the management reference points.

Since 2005, the total annual harvest of orange roughy from the New Zealand Exclusive Economic Zone (EEZ) has ranged between 6,000 t and 16,000 t. Management changes have included a number of TACC and sub-area catch limit revisions in response to changes in stock size. Management responses have also included, where necessary, catch limits to be set at zero or fisheries to be closed to allow stocks to rebuild at the fastest possible rate.

QMAs and initial TACCs for orange roughy were based on knowledge of fish stock mixes and fisheries locations at the time of the QMS implementation in 1986.

Subsequent information, including genetic analyses, knowledge of spawning localities and the location of the main fishing grounds, indicates that several biologically separate orange roughy stocks exist within some QMAs. It was evident that the sustainability of these separate stocks would be enhanced if they were managed as separate fisheries and so separate Designated Sub-Areas were introduced for those QMAs within which multiple stocks are known to exist, each sub-area having a separate catch limit.

Multiple orange roughy stocks are recognised and managed in the ORH3B and ORH2A QMAs. Historically, a three-tiered management approach has been in place for these (since 1992 in ORH3B and 1994 in ORH2A) to provide for the following:

1. TACCs – set under the Fisheries Act by the Minister for each QMA. TACCs are set based on the best available information, enacted by regulation and allocated amongst quota owners on the basis of their proportional ownership of quota shares.
2. Catch Limits within Designated Sub-Areas – these are agreed to by the Minister in consultation with quota owners and MPI, but are not enacted by regulation. Catches within these catch limits are managed by quota owners and are audited by MPI.
3. Catch Limits by Geographic Location – these were previously applied within some Designated Sub-Areas to provide a 500 t limit on catches taken within a 10 nm radius of a defined UTF. The limits were agreed by the Minister in consultation with quota owners and MPI, but were not enacted by regulation. Catches within these limits were managed by quota owners and audited by MPI. These limits have been used in developing, or experimental, fisheries in ORH1 and ORH3B for several years, but no longer apply.

At the start of each fishing year, ORH2A and ORH3B Annual Catch Entitlements (ACE) are partitioned amongst Designated Sub-Areas by quota owners and these are managed, fished and traded separately for each sub-area fishery. The market has determined separate values for ACE from different sub-areas. DWG provides monthly catch reports by sub-area to MPI.

These measures work well to spread catches amongst separate fishery areas within the ORH2A and ORH3B QMAs.

ORH Mid-East Coast Management

New Zealand's orange roughy fisheries have been managed under the QMS since 1986 and TACCs for each of the ORH2A, ORH2B and ORH3A QMAs have been in place since that time. In 1994 a summary of genetic, biological and fisheries information indicated that the orange roughy within ORH2A South, ORH2B and ORH3A are most likely part of a single stock for management purposes. Since then these areas have been assessed and managed as a single stock.

In the same year a second biologically discrete stock was recognised to occur in the northern part of ORH2A. Managers introduced a new Designated Sub-Area, ORH2A North, which is now assessed and managed separately from the ORH MEC stock.

The MEC stock spans the southern portion of ORH2A, ORH2B and ORH3A (Figure 2). The MEC catch limit comprises the agreed catch limit for ORH2A South and the TACCs for each of ORH2B and ORH3A.

Since 1994 catch limits for the ORH MEC fishery have been changed based on the best available stock assessments available at the time (Figure 7).

While it is evident that stock size has probably been below B_{MSY} (i.e. <30% B_0) since at least the mid-1990s up to the 2013 stock assessment, the stock assessments and biomass surveys here have proven to be imprecise.

A new stock assessment model was trialled in 2011. This estimated the ORH MEC stock size to be lower than the management target and to be either around 24% B_0 and to be increasing slowly in size under the current catch level, or to be around 10% B_0 and to be decreasing in size. Given the contrasting results of the two models, MPI and quota owners agreed to implement precautionary catch reductions and to obtain more reliable information of stock status.

An F_{MSY} approach was proposed and from 2011-12 the Minister introduced a three-year phase down of the catch limit from 1,500 t to 600 t. The first of these

cuts was introduced that year with the TACC reduced to 1,230 t. In addition, MPI and DWG were to review the management and monitoring approach, and if a viable alternative emerged this was to be implemented accordingly.

For the 2012-13 fishing year, an additional 300 t was shelved, with an effective catch limit of 930 t. MPI and DWG had not yet developed an alternative management approach and did not have sufficient confidence in the available information (2011 assessment) to warrant a further TACC reduction. In the same year MPI contracted a stock assessment using a revised modelling approach. This new approach provided a more robust assessment of stock status and estimates the current biomass to be around 24% B_0 and to be increasing in size under current catches (Figure 3 & 4).

For 2013-14, 300 t was again shelved (catch limit again 930 t) with the understanding that a long-term arrangement would be finalised during 2013-14 that would incorporate the results from a multi-frequency acoustic survey.

ORH3B East & South Chatham Rise Management

Three management sub-areas and associated catch limits were implemented on the Chatham Rise in 1992 when the best available information suggested there were separate stocks on the Northwest Chatham Rise, on the East Chatham Rise, and along the South Chatham Rise. A subsequent review has determined that there are only two biological stocks on the Chatham Rise, one on the Northwest Chatham Rise and a second on the East and South Chatham Rise (Figure 1).[xiii]

FIGURE 7
CATCHES AND LIMITS FOR ORH MEC.[III]
(NOT INCLUSIVE OF YEARS PRIOR TO ESTABLISHMENT OF THIS MANAGEMENT AREA)

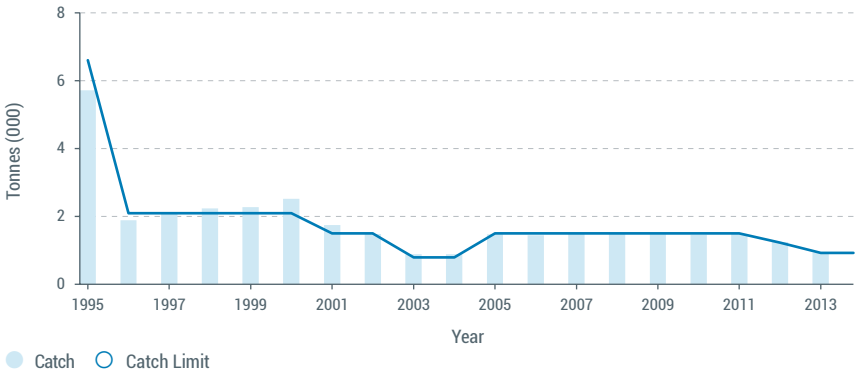
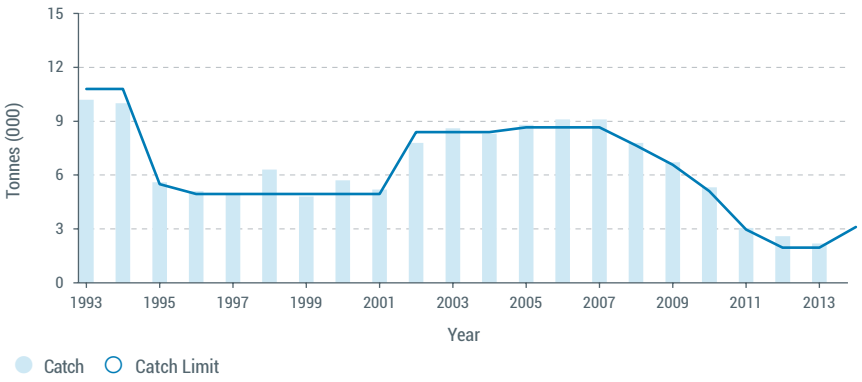


FIGURE 8
CATCHES AND LIMITS FOR ORH3B ESCR.[III]
(NOT INCLUSIVE OF YEARS PRIOR TO ESTABLISHMENT OF THIS MANAGEMENT AREA)



By 2006 biomass estimates showed an apparent decline in the spawning biomass below the management target. Consequently quota owners and MPI agreed to implement an F_{MSY}-based Harvest Strategy based on the best estimates of $B_{current}$. F_{MSY} was estimated to be 4.5% of mature $B_{current}$. As the catch limit for this stock at that time exceeded this level, a stepped reduction in the catch limit over a three-year period was implemented, to obtain the desired catch level of F_{MSY}.

In 2013 this Harvest Strategy was further refined from a target of 30% B_0 to a target range of 30-40% B_0 and introduced an abatement in the level of F when stock size is less than the target range (i.e. to increase the rate of rebuild in stock size back to the target range)(Figure 6).

In 2013-14, the catch limit for ORH3B ESCR was increased, based on the estimates of current biomass (Figure 8). As this stock is currently assessed to be 24% B_0 (i.e. below the management target range) the catch limit was based on 0.75 of F_{MSY} to promote stock size rebuilding at an increased rate compared with a catch based on F_{MSY}.

In 2014 a new stock assessment has been contracted for this stock using a model similar to that applied to the ORH MEC stock during 2013.

ORH3B Northwest Chatham Rise Management

Stock assessments for ORH3B NWCR were discontinued in 2006 on the basis that the deterministic model used was unable to adequately index the stock, estimating that this stock was rebuilding at a time when it was apparent that it was more likely to be stable or in decline. In response to these uncertainties, quota

FIGURE 9
CATCHES AND LIMITS FOR ORH3B NWCR.[III]
(NOT INCLUSIVE OF YEARS PRIOR TO ESTABLISHMENT OF THIS MANAGEMENT AREA)

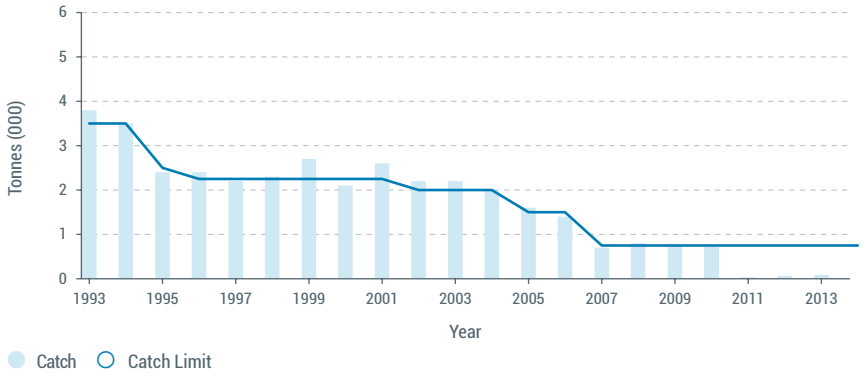
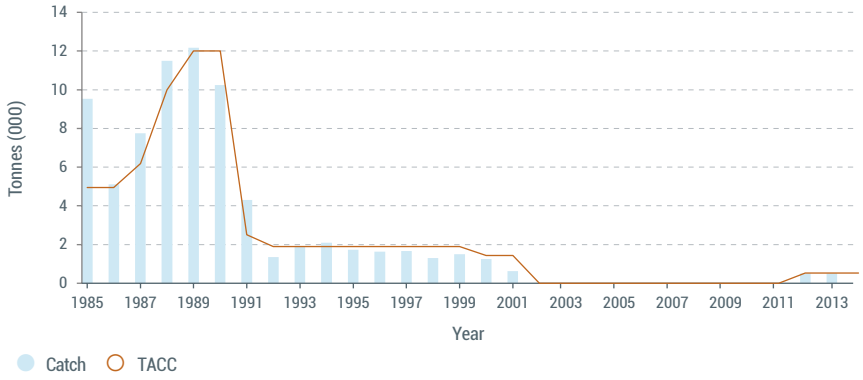


FIGURE10
CATCHES AND TACCs FOR ORH7A CHALLENGER PLATEAU [III]



owners and MPI agreed to halve the catch limit to 750 t and this was supported by the Minister.

In the absence of robust information on which to base management decisions, and in response to low catch rates, quota owners agreed to take no catch from this stock for three years from 1 October 2010 to 'rest' the fishery, to rebuild the stock size, and to undertake biomass surveys.

ORH7A Challenger Plateau Management

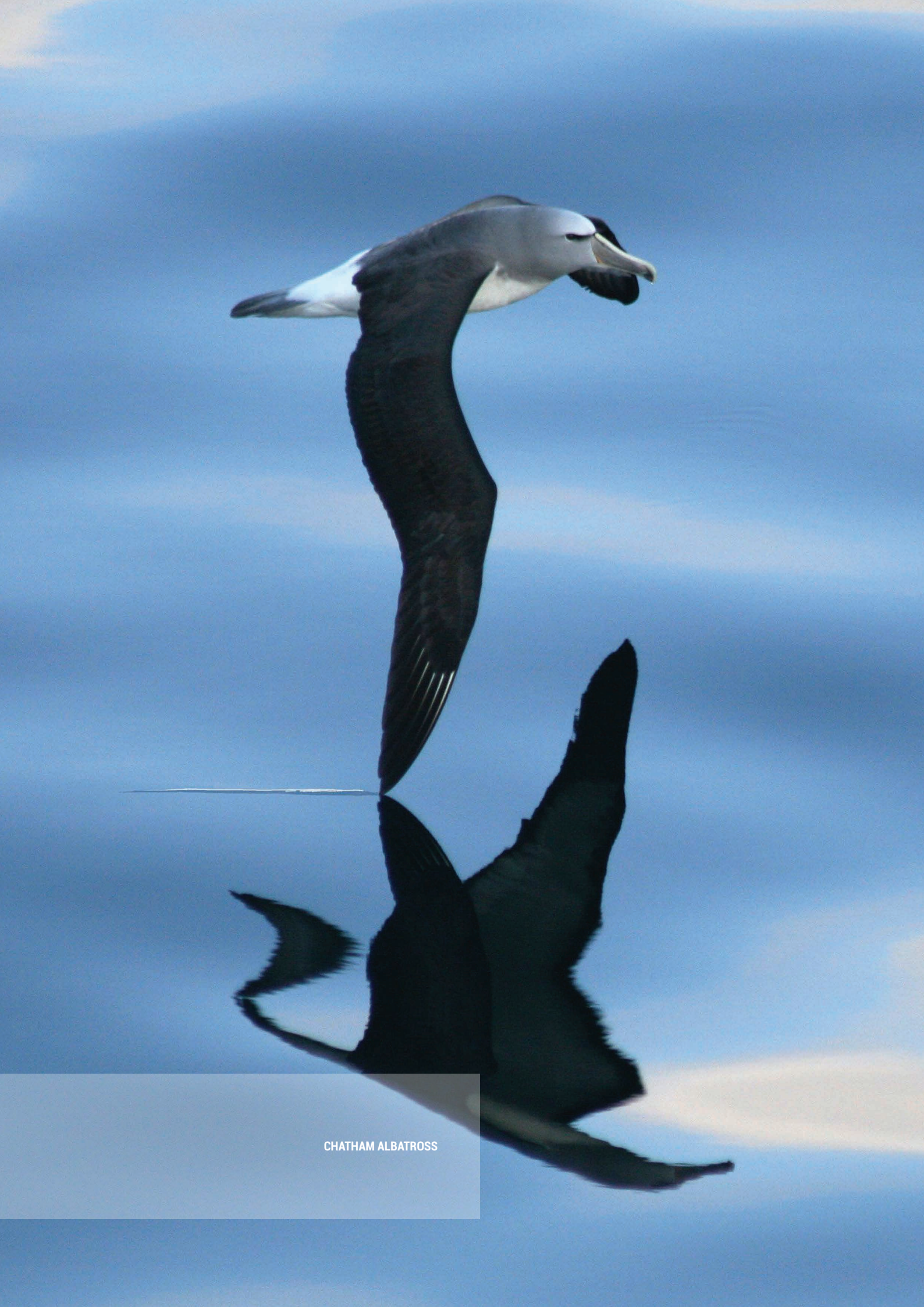
The ORH7A Challenger fishery commenced in 1982, when spawning aggregations were found, and catches were regulated by quota from 1983. Prior to 1987 most fishing occurred inside New Zealand's 200 mile EEZ but in that year fishing extended beyond the EEZ onto the Westpac Bank (about 25 nm beyond the EEZ). Since 1991 the ORH7A fishery has been managed as a straddling stock requiring ORH7A quota to be used for any orange roughy caught within the Westpac Bank designated area.

Between 1986 and 1988 the ORH7A TACC was experimentally increased in an attempt to better understand the relationship between commercial catch rates (CPUE) and orange roughy stock size.[xiv] It soon became apparent that these experimental TACCs had been set too high and that the stock had been reduced to a low size by the early 1990s. The TACC was consequently reduced to 2,400 t in 1990 and to 1,900 t in 1991. While annual catches remained above 1,000 t for most of the period through to 1999, catch rates continued to decline and quota owners and the Minister agreed to close the fishery from 2000-01, to promote stock rebuilding at the maximum rate (Figure 10).

In the absence of any fishery information as a basis for monitoring stock recovery, quota owners commissioned a series of trawl and acoustic biomass surveys starting in 2005. Following the 2009 survey, it was estimated that the stock had rebuilt to approximately 24% B_0 and the fishery was reopened from 1 October 2010 with a precautionary TACC of 500 t, based on the F_{MSY} approach and a B_0 estimate from earlier stock assessments.

In 2014 a full stock assessment for this stock will be undertaken using a model similar to that applied to the MEC stock during 2013.

Orange Roughy[xli]



CHATHAM ALBATROSS

Managing Environmental Effects

All of New Zealand's seabirds and marine mammals and many species of corals and sharks are fully protected by law.

2013 Ecological Risk Assessment

"Risk of serious or irreversible harm for each of the ecological components considered was 'negligible' to 'moderate'."

In August 2013 an Expert Panel assessed the ecological risks associated with these four orange roughy fisheries, with the objective of providing a basis for managing the effects of fishing on the environment.[xv] The Expert Panel scored the level of consequence and the likelihood of the impact for each ecological component, as well as the confidence in their assessment. The outcome of the risk assessment was that, overall, the risk of serious or irreversible harm for each of the ecological components considered was 'negligible' to 'moderate'. Information gaps were identified and programmes to address these are being implemented. The results are publically available (www.deepwatergroup.org) and are summarised below.

Bycatch Species

"More than 80% of catches by weight consist of orange roughy..."

New Zealand's orange roughy fisheries generally take very low quantities of non-commercial finfish bycatch.[xxvi] [xvii] More than 80% of catches by weight consist of orange roughy and most of the remainder of the catch is comprised of other commercial species sustainably managed under the QMS including oreo, hoki and black cardinal fish.

For these four orange roughy fisheries, over 96% of orange roughy caught in the last five years is from orange roughy target tows (i.e. not from vessels targeting other species).

Detailed reporting and catch balancing procedures are required by law for QMS species taken within New Zealand's Exclusive Economic Zone (EEZ). All catches of quota species, whether taken as bycatch or as target catch, must be landed and reported against the appropriate catch limit and against Annual Catch Entitlements (ACE).

Due to the generally low catch volumes, species outside of the QMS are considered to be at low risk of being overfished. However, if a sustainability problem is identified for any non-QMS species, these may be introduced to the QMS under the provisions of the New Zealand Fisheries Act 1996 which requires such stocks, or species, be added to the QMS if the existing management is not ensuring sustainability or is not providing for utilisation.

The Fisheries Act, defines 'ensuring sustainability' as

"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' is defined as

"conserving, using, enhancing and developing a fisheries resources to enable people to provide for their social, economic, and cultural wellbeing."

Orange Roughy[xl]

Endangered, Protected & Threatened Species

"All of New Zealand's seabirds and many species of corals and sharks are protected under the Wildlife Act 1953."

Seabirds and marine mammals are at times attracted to fishing vessels as an opportunistic source of food. In doing so they may unwittingly put themselves at risk of harm. In seeking easy access to food, they have demonstrated that they can modify their behaviours to overcome obstacles. Patterns of 'at risk' behaviour are observed to vary both seasonally and between species, and to be dependent on their eagerness to feed in close proximity to vessels and nets. As such, incidental interactions with fishing vessels are inherent and will continue to occasionally occur. In the same way that other industrial workplaces have hazard management plans in place to reduce accidents, MPI and DWG have active programmes in place to reduce incidental interactions, including developing and implementing mitigation methods.

All of New Zealand's seabirds and many species of corals and sharks are protected under the Wildlife Act 1953. All of New Zealand's marine mammals are protected under the Marine Mammal Protection Act 1978. It is an offence to harass, hunt, or kill any of these protected species without lawful authority. While the accidental or incidental capture of these species by commercial fishing activities is not unlawful, all incidents must be reported.

Observer coverage of New Zealand's orange roughy fisheries is delivered through the government's Scientific Observer Programme, which provides independent monitoring of any interactions that occur between protected species and vessels in the orange roughy fisheries. On average, around 37% of all tows targeting southern blue whiting have been observed in recent years (see Compliance and Enforcement).[xviii] This information provides reliable evidence that the level of interactions with seabird and marine mammal species during target orange roughy fishing in New Zealand is very low.[xv]

Seabirds

"Orange roughy fisheries...found to pose very little risk to seabirds (i.e. seabird population growth can sustain the few fishing-related captures)."

MPI uses a risk-based approach to assess and to prioritise seabird species that might require management intervention. This approach is informed by the New Zealand Seabird Risk

TABLE 4
MARINE SPECIES FULLY PROTECTED UNDER THE WILDLIFE ACT 1953

PHYLUM	CLASS		
Cnidaria	Anthozoa *(corals and sea anemones)*	Black corals	All species in the order Antipartharia
	Hydrozoa *(hydra-like animals)*	Gorgonian corals	All species in the order Gorgonacea
		Stony corals	All species in the order Scleractinia
		Lamniformes *(mackerel sharks)*	All species in the order Stylasteridae
Chordata	Chondrichthyes *(cartilaginous fishes)*	Lamniformes *(mackerel sharks)*	Basking shark *(Cetorhinus maximus)*
			Deepwater nurse shark *(Odontapsis ferox)*
			White pointer shark *(Carcharodon carcharias)*
		Orectolobiformes *(carpet sharks)*	Whale shark *(Rhincodon typus)*
		Rajiformes *(skates and rays)*	Manta ray *(Manta birostris)*
			Spinetail devil ray *(Mobula japanica)*
	Osteichthyes *(bony fishes)*	Perciformes *(perch-like fishes)*	Giant grouper *(Epinephelus lanceolatus)*
			Spotted black grouper *(Epinephelus daemelii)*

Assessment[xix], which has quantitatively estimated the potential levels of risk to seabird populations arising from incidental mortalities associated with New Zealand's commercial fisheries. Using this information, further research, education, and seabird mitigation measures can be determined and applied where these are most needed and where they will be most effective.

The orange roughy fisheries have been found to pose very little risk to seabirds (i.e. seabird population growth is able to sustain the few fishing-related captures).[xv xix] With effective mitigation measures in place the risk scores for deepwater fisheries, including those for orange roughy, have reduced over time.[xx]

Trawlers targeting orange roughy all employ international best practices to mitigate the risk of interacting with seabirds. Management measures to mitigate interactions with seabirds and New Zealand's deepwater trawl fisheries currently include:

- Mandatory use of seabird mitigation devices during fishing;
- Mitigation research;
- Education, training and outreach;
- Vessel-specific offal management procedures; and
- Real-time incident reporting.

The current high level of observer coverage in New Zealand's orange roughy fisheries enables independent monitoring and reporting of seabird interactions and of vessel adherence with both Government and industry risk mitigation requirements.

Information on interactions with seabirds is reviewed annually. Captures of all bird

FIGURE 11
ESTIMATED SEABIRD CAPTURES IN ALL ORANGE ROUGHY TRAWL FISHERIES WITH 95% CONFIDENCE INTERVALS[XVIII]

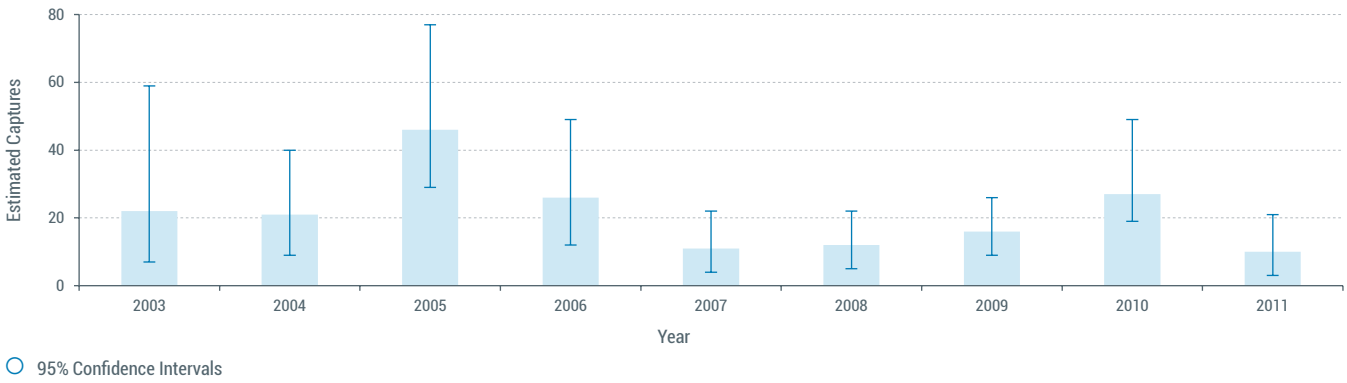
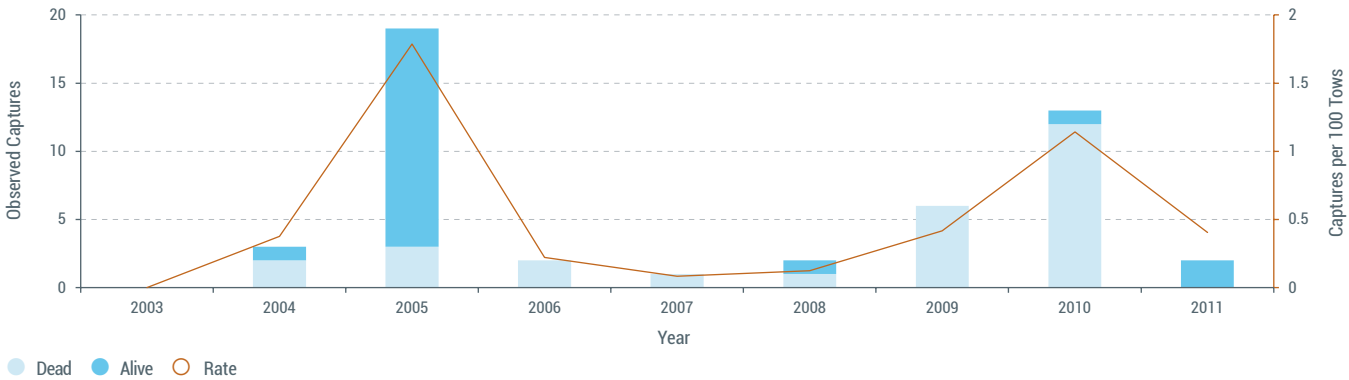


FIGURE 12
OBSERVED SEABIRD CAPTURES IN ALL ORANGE ROUGHY TRAWL FISHERIES[XVIII]



types combined show a decreasing trend between 2002-03 and 2011-12 across all New Zealand deepwater fisheries.[xx] For the last nine years the average observed capture rate in orange roughy trawl fisheries has been 0.5 birds per 100 tows, which is considered to be a very low rate (Figure 12).[xviii] For the four orange roughy fisheries considered here, observed seabird captures have averaged five birds per year.[xxi] In 2011-12 there were no observed seabird captures reported.

An important part of minimising the risk to seabirds from orange roughy fishing is the Vessel-specific Management Plans (VMPs), which have been developed and implemented by the industry and proven effective at mitigating interactions. In particular, VMPs require all vessels to designate how they will reduce the presence of offal in the water when trawling. One method that has proven to be most effective is to release factory waste in intermittent batches (as opposed to continuous discharge) which reduces the time seabirds are attracted to the 'risk zone' at the stern of vessels and ahead of the warps. This approach has been accepted as world's best practice by the Agreement on the Conservation of Albatrosses and Petrels, and underpins the VMPs.[xxii] Other best practice measures include mitigation methods such as streamer lines, bird bafflers, and warp deflectors, which have been mandatory since April 2006.

Marine Mammals

There have been very few marine mammals captures (including New Zealand fur seals, New Zealand sea lions, dolphins, and whales) observed in New Zealand's orange roughy fisheries.[xxi] In the ten-year period (2002-03 to 2011-12) only six fur seal captures have been observed. The only other marine mammal captures recorded were two sea lions in 1997 and 1998, both of which were released alive. None of these captures were in the four orange roughy fisheries discussed here. Experts have determined that there is no risk to marine mammals from the four fisheries and that there is very good information to support this.[xv]

Fish

Five species of sharks (basking, deepwater nurse, white pointer, oceanic whitetip, and whale sharks) are protected by law in New Zealand waters. Of the protected fish species, including these five shark species, there have been no reported captures in orange roughy fisheries. Experts have determined that there is none to negligible risk to these protected fish species, particularly given there is very little spatial overlap between these species and the fisheries.[xv]

Corals

Protected coral species have been a focus for government observers in orange roughy fisheries and 22% of observed tows recorded coral bycatch between 2007-08 to 2009-10.[xxiii xxiv] Experts have determined that risk to protected coral species is low to moderate.[xv]
New Zealand cold-water corals are generally widespread and New Zealand's deepwater fisheries are spatially managed with defined areas that have been closed to bottom trawling (see Habitats & Ecosystems). There are also highly active and developed monitoring programmes together with ongoing research in place.

However, at present, limited taxonomic information makes the level of risk difficult to assess, especially given that this is a field that is constantly evolving.[xv] For example, assessing risk based on whether a species is considered endemic is complicated by the fact that just because it has not yet been discovered elsewhere does not necessarily mean that it is not found elsewhere.


White-Capped Albatross


Blue Shark

Habitats & Ecosystems

"New Zealand's Benthic Protection Area network is over four times the area of New Zealand's landmass."

Orange roughy are widely distributed throughout New Zealand and harvested from depths of around 700 m to 1,200 m. They may exist in deeper water but to date these depths have not been sampled by trawling. They frequent areas of flat and sloping ground, are found on and around some Undersea Topographic Features (UTFs), and also occur in the water column well off the seabed where they are known to feed on mesopelagic prey species.[xxv]

Concerns have been expressed about the impacts bottom trawling may be having on benthic (or seabed) communities. Extensive research and active monitoring programmes are in place to determine these impacts and to assess whether these are adverse to the benthic environment.

As part of the 10-Year Research Programme, the trawl grounds of the orange roughy fisheries are mapped and audited annually. This allows the extent of trawl interactions with the seabed to be monitored and provides a mechanism to identify if and where further management measures might be necessary.[xxvi]

To mitigate any impacts, MPI and DWG have also developed and implemented a programme of spatial management (Table 5 and Figure 13), which includes:

- Benthic Protection Areas (BPAs) – where bottom trawling is prohibited[xxvii]
- 'Seamount' Closures – where fishing is prohibited.

BPAs are large, broadly representative areas closed to set aside and protect the full range of benthic marine biodiversity. Their selection was based on the best available scientific knowledge, the Marine Environment Classification, to encompass pristine areas that for the most part have not been impacted by trawling, to provide large and untouched refuges for benthic communities.

In total, 30% of New Zealand's EEZ is closed by law to bottom trawling. This New Zealand marine spatial management programme continues to constitute one of the largest bottom trawl closures within any EEZ in the world and when introduced comprised 24% of the total area under Marine Protection Areas (MPAs) in the world. To give an indication of their size, New Zealand's BPA network is over four times the area of New Zealand's landmass.

Bottom trawling for orange roughy occurs year-round over flat ground and on UTFs. The US Board on Geograhic Names[xxx] characterises UTFs as:

- Hills – a vertical elevation from the sea floor of less than 500 m
- Knolls – a vertical elevation from the sea floor of between 500 m and 1,000 m
- Seamounts – a vertical elevation from the sea floor of more than 1,000 m and with a limited extent across the summit.

It is important to note that New Zealand's 'seamount' closures include UTFs in all three of the above categories.

No seamounts are fished for orange roughy in any of these four fisheries as all the fished UTFs are either hills or knolls.

TABLE 5
EXISTING MARINE SPATIAL MANAGEMENT IN NEW ZEALAND'S EEZ[XXVIII XXIX]

MANAGEMENT TOOL	LEGISLATION	RESTRICTIONS	AREA (KM2)
Benthic Protection Areas (BPAs)	Fisheries Act 1996 Fisheries (Benthic Protection Areas) Regulations 2007	Prohibition on use of dredge and restrictions on use of trawl net within 100 m of the seabed.	1,124,539
'Seamount' Closures	Fisheries Act 1996 Fisheries Regulations	Prohibition on trawling	78,466
Total Area Closed (km^2)[6]			1,200,741
Total Area as a Percentage of New Zealand's EEZ			30%

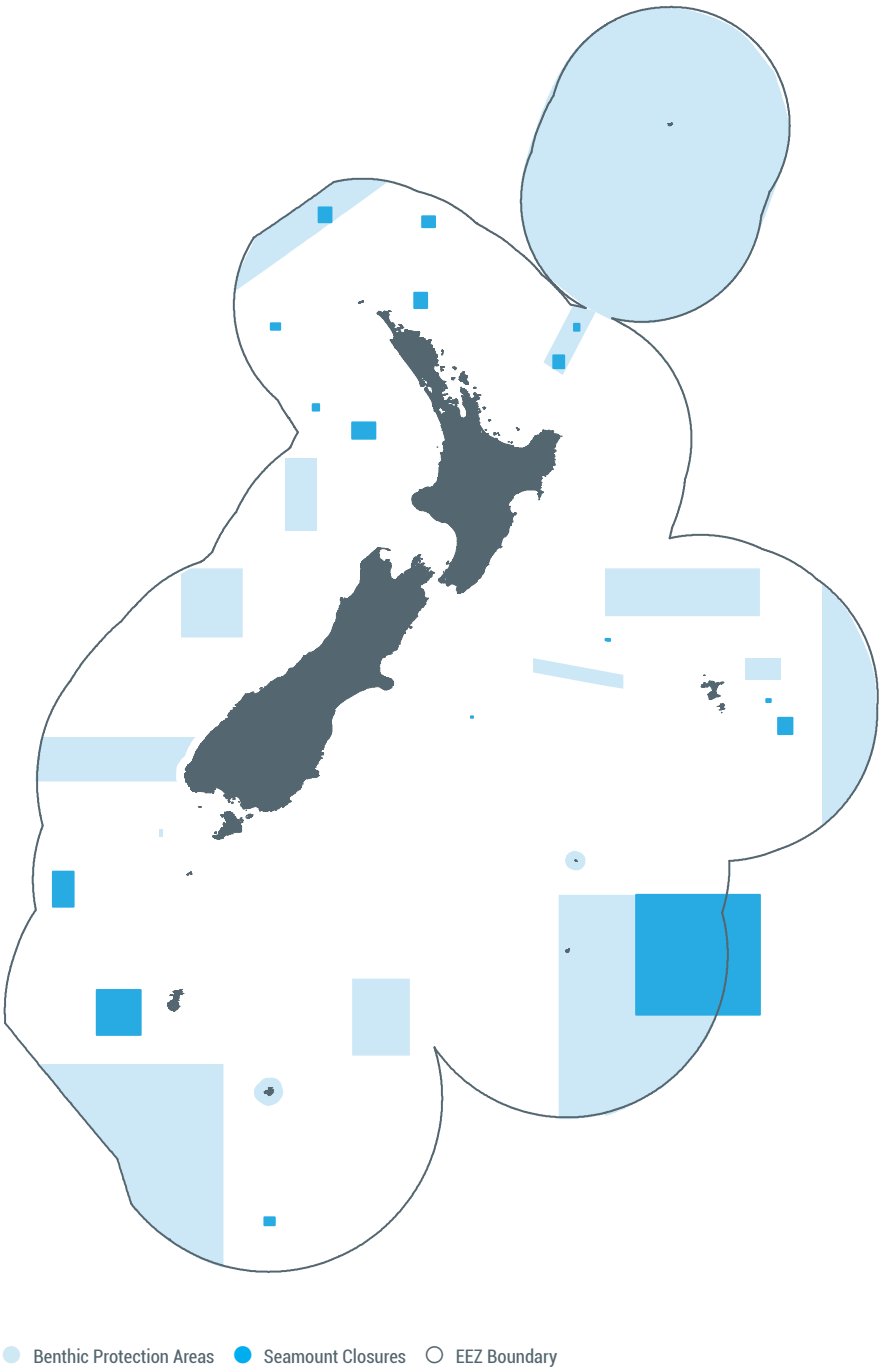
6. In some areas, BPAs and 'seamount' closures overlap. Therefore, this is based on the footprint area.

During the 21-year period from 1989-90 to 2009-10, New Zealand's target orange roughy fisheries have contacted 7% of New Zealand's seafloor within the primary depth range (800-1,200 m).[xxxi] This constitutes 1% of the area of New Zealand's EEZ and Territorial Sea (TS). For the most recent five-year period, the area of seafloor contacted amounts to less than 1% of the primary depth range for orange roughy (i.e. on an annual basis for these orange roughy fisheries more than 99% of the primary depth range remains untouched by bottom trawling). By these measures, the extent of the orange roughy bottom trawl grounds is only a very small part of the depth range.

Factors that may mitigate the impact of the fishery on the seafloor include the relatively small size of orange roughy trawl nets (generally only 18-25 m wide), the short duration and bottom contact time of most tows (when fishing on UTFs the trawl gear is typically only in contact with the seabed for five to ten minutes), restrictions on where bottom trawling can occur (the steepness and roughness of the terrain frequently limits the proportion of UTFs that can be trawled) and large areas of New Zealand's EEZ that are now closed to bottom trawling (Figure 13).

New Zealand's orange roughy fishing grounds have been progressively developed over the past three decades and there is now relatively little exploratory fishing over new grounds. These fisheries are now primarily supported by relatively small, localised areas which sustain high catch rates year on year.

FIGURE 13
BENTHIC PROTECTION AREAS AND 'SEAMOUNT' CLOSURES




CRINOID XLI

Effective Fisheries Management

"New Zealand was ranked first for managing marine resources among the 53 major fishing nations that were assessed."

New Zealand by Satellite

Governance & Policy

Legal & Customary Framework

New Zealand's fisheries management regime is centred on the Quota Management System (QMS), a system introduced in 1986 based on Individual Transferrable Quotas (ITQ, quota) and Total Allowable Commercial Catches (TACCs). The QMS ensures sustainable utilisation of fisheries resources through the direct control of harvest levels based on best available independent scientific assessments.

Within the QMS, ITQ have been allocated in perpetuity providing each quota owner with a proportional share of the TACC. At the commencement of each year, ITQ give rise to Annual Catch Entitlements (ACE), the annual harvesting right expressed in tonnes. The QMS is administered by MPI through the Fisheries Act 1996.

Quota is an asset that provides owners with incentives to increase returns from their property rights by reducing harvest costs and increasing product values. Improved economic efficiencies have also resulted in alignment between fishing capacities and the sustainable catches from QMS fish stocks, thereby avoiding over-capitalised fisheries (i.e. too many vessels competing for available fish stocks).

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".*

Maori interests are now significant participants in the New Zealand Seafood Industry.

New Zealand has implemented the most extensive quota-based fisheries management system 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. The status of the stocks of each species within the QMS is determined using the best available scientific information and each stock is managed independently.

MPI employs fisheries managers (to advise the Minister on the appropriate level at which to set catch allowances) and fisheries scientists (to oversee the collection and analysis of scientific information to inform management advice). Fisheries managers and scientists work closely to ensure the management advice provided to the Minister is consistent with the best available scientific information. TACCs are set by the Minister based on advice provided by fisheries managers, in consultation with quota owners and other external stakeholders.

At an operational level, the orange roughy fisheries are managed in accordance with the National Fisheries Plan for Deepwater and Middle-depth Fisheries.[xxxii]

New Zealand recently became one of only two fishing jurisdictions to achieve a top ranking in a review of fisheries management systems around the world.[xxxii] In a second study, New Zealand was ranked first for managing marine resources among the 53 major fishing nations that were assessed.[xxxiv]

Collaborative & Participatory Processes

"In 2006, DWG and MPI entered into a formal partnership to enable collaboration"

In 2006, DWG and MPI entered into a formal partnership to enable collaboration in the management of New Zealand's deepwater fisheries, including the orange roughy fisheries.[xxxv] This partnership has been updated in 2008 and 2010 and has directly facilitated improved management of the orange roughy fisheries in almost all respects through:

- A close working relationship under a shared and agreed vision, objectives and collaborative work plan
- Real-time open communication between DWG and MPI on information relevant to management measures, particularly from the Ministry's Scientific Observer Programme and commercial catching operations
- Agreement on a strategic plan for the management of New Zealand's EEZ fisheries
- Development and implementation of clear and agreed management objectives for all New Zealand's deepwater fisheries, including orange roughy, through fisheries plans
- Increased dialogue with the Department of Conservation (DOC).

Compliance & Enforcement

"Commercial fishermen face prosecution and risk severe penalties..."

MPI maintains a comprehensive compliance programme, which includes both encouraging compliance through support and respect for the fisheries management regime, and creating effective deterrents.

This strategy is underpinned by the VADE compliance operating model, which focusses on all elements of the compliance spectrum and takes the following form:

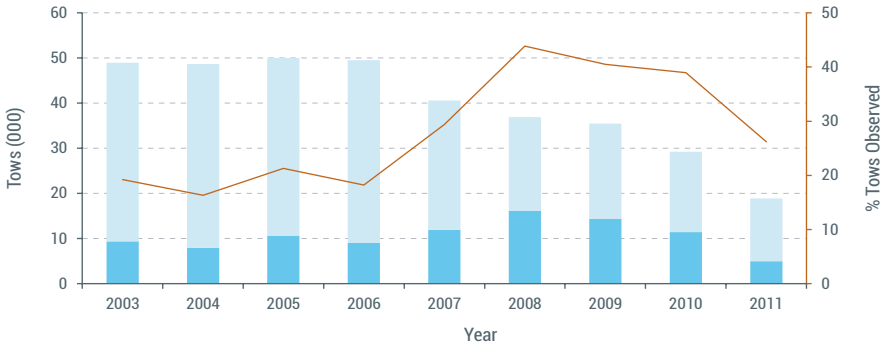
1. Voluntary Compliance – outcomes are achieved through education, engagement and communicating expectations and obligations
2. Assisted Compliance – reinforces obligations and provides confidence that these are being achieved through monitoring, inspection, responsive actions and feedback loops
3. Directed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

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 MPI to monitor all deepwater vessel locations at all times. In combination with at-sea and air surveillance, supported by the New Zealand joint military forces, the activities of deepwater vessels are fully monitored and verified to ensure compliance with both regulations and with industry-agreed operating codes.

All commercial catches from QMS stocks must be reported and balanced against ACE at the end of each month. Catches may only be landed at designated ports and sold to Licensed Fish Receivers (LFRs). Reporting requirements for deepwater trawl vessels include logging the location, depth and main species caught for each tow and the total landed catch for each trip undertaken.

MPI audits catch-effort and landing reports from deepwater vessels, reconciles these against multiple sources including VMS records, data collected by onboard MPI observers, and catch landing records from LFRs to ensure that all catches are reported and documented correctly. Around 37% of all tows targeting orange roughy have been observed in the last five years and MPI has plans in place to increase this coverage further and MPI has plans in place to increase this coverage further (Figure 14).[xviii] Quayside

FIGURE 14
EFFORT AND OBSERVED EFFORT IN ORANGE ROUGHY TRAWL FISHERIES[XVIII]



Kaikoura Coast, South Island, New Zealand

inspections are also undertaken to verify reported landings.

Commercial fishermen face prosecution and risk severe penalties, including automatic vessel or quota forfeiture, upon conviction of breaches to the fisheries regulations. Financial penalties are also imposed, in the form of deemed values, to discourage commercial fishermen from over-catching their ACE holdings. For every kilogram of catch above the available ACE held, MPI invoices the permit holders a deemed value charge.

Deemed values are set at a level to remove the commercial value from sale of any catch above the level of ACE held. This provides the incentive for permit holders to acquire or maintain sufficient ACE to cover all their catch. It is illegal to discard or to not report catches of QMS species. For some high value stocks, such as orange roughy, differential deemed values apply such that the rate charged increases depending on the proportion by which catches exceed ACE holdings.

The deepwater fishing industry in New Zealand works closely with the 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 and MPI.[xxxvi] 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 agreed non-statutory management measures.

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 agreed non-statutory management measures. In the orange roughy fisheries, these management measures include the management of catches within the designated sub-area catch limits. DWG works directly with vessel managers and skippers to administer the reporting and monitoring of catches against the sub-area catch limits, while MPI performs an auditing and verification role to ensure that reliable data are being reported by industry vessels.

Fishery Management Plans

Fisheries Plan

MPI and DWG, in consultation with other interested parties, have developed a National Fisheries Plan for Deepwater and Middle-depth fisheries, including those for orange roughy.[xxxii] This Fisheries Plan (the Plan) is a statutory document, approved by the Minister of Fisheries in 2010. The Plan provides an enabling framework, outlining agreed management objectives, timelines, performance criteria and review processes, and has a life of five years between reviews.

The Plan specifies that the orange roughy fisheries will be assessed against agreed reference points for the management of orange roughy harvest. It specifies a range of objectives and measures for bycatch management and for the mitigation of incidental interactions with protected species (e.g. seabirds, marine mammals, and certain sharks).

The actual management measures and delivery outcomes in the Plan are specified in MPI's Annual Operational Plan (AOP), which will be reviewed and updated annually. In addition, an Annual Review Report (ARR) assesses performance against the AOP, and the Plan in general, and is available to all stakeholders and interested parties.

Non-Regulatory Management

> *"...regulations are complemented by additional industry-agreed non-regulatory measures."*

Extensive regulations govern the orange roughy fisheries including a legal obligation to report all protected species captures and a ban on bottom trawling within marine protected areas. These regulations are complemented by additional industry-agreed non-regulatory measures, known as the New Zealand Deepwater Fisheries Operational Procedures (OPs).[xxxvii] The Minister relies on the effectiveness of both regulatory and non-regulatory measures to ensure the sustainable management of these fisheries.

The OPs outline the designated sub-area boundaries and catch limits agreed between MPI and quota owners, as well as industry-agreed best practice to minimise interactions with seabirds and marine mammals.

Research Plan

> *"...programme to improve both the information to underpin management decisions and the efficiencies in science service provision."*

In 2009 DWG proposed that the industry's science and research programme should be integrated with that being undertaken by MPI to form a single and integrated 10-Year Research Programme that would be:

- Management Lead – to ensure we obtain adequate science-based information to underpin sustainable management decisions
- Comprehensive – increase the annual investment by MPI in deepwater science and information by 50% including more research surveys, more stock assessments, more stock characterisations, and greater observer coverage
- Environmentally Sound – including enhanced monitoring of interactions between the deepwater fleet and protected species, regular Ecological Risk Assessments to scientifically determine where fishing activities are causing risk of harm to the marine environment, and assessments of trophic interactions
- Cost Efficient – reduce service delivery costs through public tender and multi-year contracts.

In 2010 MPI implemented this 10-Year Research Programme to improve both the information to underpin management decisions and the efficiencies in science service provision.

JACQUEMART ISLAND, CAMPBELL ISLANDS, SUB-ANTARCTIC, NEW ZEALAND[XLII]

Certified Sustainable

"We're focused on ensuring we not only have the best science and fisheries management practices but also independent recognition that orange roughy is a sustainable choice."

Sealord Group Chief Executive, Graham Stuart[xxxviii]

Four of New Zealand's orange roughy fisheries (MEC, NWCR, ESCR and Challenger) are currently being pre-assessed against the Marine Stewardship Council's (MSC) standards.

The MSC's fishery certification programme sets the highest independent standards for sustainable fishing practices. MSC is a global organisation working with fisheries, seafood companies, scientists, conservation groups and the public to promote the best environmental choices in seafood.

The MSC standards are based on three principles:

1. Are the fish stocks healthy?
2. Is the fishery damaging the marine ecosystem?
3. Is there ongoing effective management of that fishery?

Fisheries are assessed by third-party accredited auditors and their findings are peer-reviewed.

> *"There have been some misconceptions in the US market about New Zealand orange roughy and without doubt some of the fisheries — outside New Zealand — were fished to below sustainable levels,"*

explains Graham Stuart, CEO of Sealord Group.[xxxviii]

> *"All of us in the New Zealand industry realize that retailers and consumers need to have assurance that the fish they buy comes from a sustainably managed fish stock. So we're focused on ensuring we not only have the best science and fisheries management practices but also independent recognition that orange roughy is a sustainable choice."*

MSC Certification will help provide independent recognition of the industry's commitment to continuous improvement and to a collaborative partnership with MPI and others. This commitment has seen DWG and MPI actively developing and applying new methods and strategies to reduce interactions with seabirds, marine animals, and the broader marine ecosystem, and to align strategic and operational objectives, resulting in a long-term science and information plan and more investment in monitoring and research.

To track a fishery's certification progress go to: *www.msc.org/track-a-fishery/fisheries-in-the-program*

AUCKLAND WEST COAST. NORTH ISLAND, NEW ZEALAND[XLII]

References

Deepwater Group Limited
Email: info@deepwatergroup.org

i. United Nations secretary-General's high-level panel on Global sustainability. (2012). Resilient People, Resilient Planet: A future worth choosing. New York: United Nations.

ii. Ministry for Fisheries. (2011). Research and Science Information Standard for New Zealand, April 2011. Wellington, New Zealand: Author.

iii. Ministry for Primary Industries. (2013). Fisheries Assessment Plenary, May 2013: Stock Assessments and Yield Estimates. Wellington, New Zealand: Author.

iv. Ministry for Primary Industries. (2012). Document Library Homepage. Retrieved from http://fs.fish.govt.nz/Page.aspx?pk=61&tk=297

v. Bull, B., Francis, R., Dunn, A., Gilbert, D, Bian, R. & Fu, D. (2012). CASAL (C++ algorithmic stock assessment laboratory): CASAL User Manual v2.30-2012/03/21. NIWA Technical Report 135. 280p.

vi. Tracey, D., Horn, P., Marriot, P., Krusic-Golub K., Gren, C., Gili, R. & Mieres, L.C. (2007). Orange Roughy Ageing Workshop: Otolith Preparation and Interpretation. Draft report to the Deepwater Working Group.

vii. Ryan, T. & Kloser, R. (2013). Biomass Estimates of Orange Roughy in June 2012 at Northwest Chatham Rise Using a Net Attached Acoustic Optical System. Report to Deepwater Group New Zealand. Copy held at CSIRO Marine and Atmospheric Research, Hobart.

viii. Field, K. (1999). Assessment of the Challenger Plateau (ORH7A) Orange Roughy for the 1998-99 Fishing Year. NZ Fisheries Assessment Report 99/9.

ix. Cordue, P. (2012). Estimation of Absolute Biomass from the Time Series of Trawl and Acoustic Surveys of Challenger Orange Roughy. ISL Client Report. For MAF. 30p.

x. Doonan, I., Horn, P. & Krusic-Golub, K. (2012). Estimated Age of Orange Roughy in Challenger (ORH7A) in 1987 Compared to that in 2009. DWWG Document 2012-04. 20p.

xi. Ministry of Fisheries. (2008). Harvest Strategy Standard for New Zealand Fisheries. Wellington, New Zealand: Author.

xii. Francis, R. (1992). Recommendations Concerning the Calculation of Maximum Constant Yield (MCY) and Current Annual Yield (CAY). New Zealand Fisheries Assessment Research Document 1992/8. 26p.

xiii. Dunn, M. & Devine, J. (2010). A Holistic Approach to Determining Stock Structure of Orange Roughy on the Chatham Rise. New Zealand Fisheries Assessment Research Document 2010/17. 65p.

xiv. Robertson, D. (1986). Orange roughy (Hoplostethus atlanticus). In Baird, G.G.; McKoy, J.L. (Comps. And Eds.). Background Papers for the Total Allowable Catch Recommendation for the 1986-87 New Zealand Fishing Year. pp. 88-108. (Preliminary discussion paper, held in the NIWA library, Wellington, NZ).

xv. Boyd, R.O. (2013). Assessment of Ecological Effects of Four New Zealand Orange Roughy Fisheries. Report for Deepwater Group Ltd, Wellington (Unpublished report held by Deepwater Group Ltd, Wellington) 39p. + Appendices.

xvi. Anderson, O. (2011). Fish and Invertebrate Bycatch in Orange Roughy and Oreo Fisheries, 1990-91 to 2008-09. New Zealand Aquatic Environment and Biodiversity Report No. 67.

xvii. Ministry for Primary Industries and Deepwater Group Ltd (2013). Orange Roughy Observer Programme Report 2007-08 to 2011-12. Report prepared for the Orange Roughy Assessment of Environmental Effects of Fishing Workshop August 2013. 77p.

xviii. Abraham, E. & Thompson, F. (2012). Captures of Birds in Orange Roughy Trawl Fisheries, in the New Zealand Exclusive Economic Zone, during the 2010–11 Fishing-Year. Retrieved from http://data.dragonfly.co.nz/psc/v20121101/birds/orange-roughy-trawl/all-vessels/eez/2011/, Apr 15, 2013.

xix. Richard, Y., Abraham, E. & Filippi, D. (2011). Assessment of the risk to seabird populations from New Zealand commercial fisheries. Final Research Report for Ministry of Fisheries projects IPA2009/19 and IPA2009/20 (Unpublished report held by the Ministry of Fisheries, Wellington).

xx. Ministry for Primary Industries. (2012). Aquatic Environment and Biodiversity Annual Review 2012. Compiled by the Fisheries Management Science Team. Wellington, New Zealand: Author.

xxi. Thompson, F. & Berkenbusch, K. (2013). Protected Species Bycatch in New Zealand Orange Roughy Trawl Fisheries, 2002-03 to 2011-12. Draft Final Research Report for Ministry for Primary Industries (Unpublished report held by the Ministry for Primary Industries, Wellington). 56p.

xxii. Pierre, J., et al. (2010) Reducing interactions between seabirds and trawl fisheries: Responses to foraging patches provided by fish waste batches. Biological Conservation 143 (11): 2779-2788.

xxiii. Tracey, D., Baird, S., Saunders, B. & Smith, M. (2011). Distribution of Protected Corals in Relation to Fishing Effort and Assessment of Accuracy of Observer Identification. Prepared for Marine Conservation Services, New Zealand Department of Conservation. June 2011. 70p.

xxiv. Baird, S., Tracey, D., Mormede S. & Clark, M. (2012). The Distribution of Protected Corals in New Zealand Waters. Prepared for New Zealand Department of Conservation. August 2012. 95p.

xxv. Tilney, R. (2013). Management of Benthic Effects by New Zealand's Orange Roughy Fisheries. Clement & Associates report prepared for Deepwater Group Ltd. 8p.

xxvi. Ministry of Fisheries. (2011). Research Specifications for the 10-year Research Programme for Deepwater Fisheries. DFR2010-02 Appendix One: July 2011.

xxvii. Helson, J., Leslie, S., Clement, G., Wells, R. & Wood, R. (2010). Private rights, public benefits: industry-driven seabed protection. Marine Policy 2011 34: 557-566.

xxviii. Black, J. & Wood, R. (2010). Analysis of New Zealand's Trawl Grounds for the Tier 1 Species, GNS Science Consultancy Report 2010/167. 31p.

xxix. Ministry for Primary Industries. (2013). National Aquatic Biodiversity Information System Homepage. Retrieved from http://www.nabis.govt.nz/

xxx. US Board on Geographic Names. (2005). Policies and Guidelines for the Characterization of Undersea Feature Names. 6p. http://earth-info.nga.mil/gns/html/underseafeatures.html

xxxi. Stewart, T. (2013). Analysis of Orange Roughy Trawl Footprint 2007/08 – 2011/12 and 1989/90 – 2011/12, and Underwater Topographic Feature Trawl Effort Analysis. GNS Report produced for Deepwater Group Ltd. 32p.

xxxii. Ministry for Primary Industries. (2010). National Deepwater and Middle-depth Fisheries Plan - Part 1B Orange Roughy Fishery. Wellington, New Zealand: Author.

xxxiii. Worm, B., Hilborn, R. et al. (2009). Rebuilding Global Fisheries. Science 325 (5940): 578-585.

xxxiv. Alder, J., Cullis-Suzuki, S., et al. (2010). Aggregate performance in managing marine ecosystems of 53 maritime countries. Marine Policy 34 (3): 468-476.

xxxv. Ministry of Fisheries and Deepwater Group Ltd. (2010). Memorandum of Understanding for the Deepwater Fisheries Management Partnership. 8p.

xxxvi. Ministry of Fisheries and Deepwater Group Ltd. (2009). Compliance Charter. In: Memorandum of Understanding for the Deepwater Fisheries Partnership. Annex 2: Compliance. 1p.

xxxvii. Deepwater Group Ltd. (2011). New Zealand Deepwater Operational Procedures: Orange Roughy and Oreo Fisheries. Version 4, 1 October 2011. Wellington, New Zealand: Author.

xxxviii. Seaman, T. (May 13, 2013). Sealord looks to MSC, own data to prove orange roughy health. Undercurrent News. Retrieved from http://www.undercurrentnews.com/2013/05/31/sealord-looks-to-msc-own-data-to-prove-orange-roughy-health/

xxxix. http://all-free-download.com/free-photos/new_zealand_landscape_lighthouse_236861.html

xl. Images by NIWA (with funding from the New Zealand government through Ministry for Primary Industries and Land Information New Zealand Ocean Survey 2020).

xli. Image NIWA. http://www.niwa.co.nz/

xlii. http://commons.wikimedia.org/wiki/Category:Images