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Pre-assessment Report of four New Zealand Orange Roughy Fisheries

Prepared for

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1	10 Oct 2013	Client Draft Report
2	20 Dec 2013	Final Report

Table of Contents

1. Executive summary

MRAG Americas, Inc. conducted a pre-assessment of four New Zealand orange roughy (*Hoplostethus atlanticus*) fisheries, starting with a site visit to Nelson and Wellington, New Zealand in August 2013. The assessment team consisted on Dr. Robert Trumble, Dr. Andre Punt, and Dr. Ian Poiner. Dr. Trumble, Vice President of MRAG Americas, served as assessment lead; he has led or overseen all of MRAG America's pre-assessments or full assessments. He has extensive experience in fisheries management. Dr. Punt, a professor at the University of Washington, has conducted fishery stock assessments and developed improvements in stock assessment methodologies. Dr. Poiner is a marine scientist with experience in conservation and management of marine ecosystems.

The fishery exhibits a high level of cooperation between the fishing industry, represented by the Deepwater Group (DWG), and the Ministry of Primary Industries (MPI). The DWG, as client for the pre-assessment, provided an exhaustive reference list of joint DWG-MPI reports, industry and government technical reports, and peer reviewed papers in support of the assessment team. The team found, through meetings during the site visit and review of documentation, that several performance indicators of Principle 1 are likely to score less than 60, that a number of performance indicators of Principle 1 and Principle 2 would likely score $\geq$60 but <80, and all performance indicators of Principle 3 would likely score $\geq$80. The fisheries would benefit from improvements as indicated below:

Scores likely below 60
PI 1.1.2 Reference points
All four fisheries use the same reference points. However, the limit reference point (taken to be the hard limit) is below the MSC default value of 20% $B_{0\ or}$ ½ B_{msy}, unless an analytical justification is provided. In addition, a limit reference point of 10% of B_0 is lower than is common for fish species, especially given the current assumption that steepness for orange roughy is 0.75. A more careful reasoning for the limit reference point is required for the fishery to score 60 for this PI. There is also no justification for the management target range of 30-40% of B_0. The target range is less conservative than that for hoki of 35% - 50% of B_0, a more productive species. While the range of hoki is derived from economic considerations, and may not be relevant for orange roughy, a more careful reasoning for the management target range is required for the fishery to score 80 for this PI.

PI 1.2.4 Assessment of stock status (except for the MEC)
An assessment which involves fitting a population dynamics model is available for the MEC stock. However, population model-based assessments either do not exist for the other stocks (ORH3B East and South Chatham Rise; ORH7A) or are dated (ORH3B; Northwest Chatham Rise). The assessment for the Northwest Chatham Rise was conducted in 2006, uses a method now considered invalid, and does not use recent data. This assessment would not be sufficient as the basis for satisfying PI 1.2.4. Information on recent abundance is available for the other stocks. However, the estimates of B_0 are based on the outcomes of historical assessments which used methods now considered inappropriate. While the estimates of B_0 from the historical assessments may be robust, use of such estimates in providing management advice would require careful justification. New stock assessments (based for example on the approach used for the MEC) should be conducted for all stocks and reviewed through the MPI assessment process. Adequate detailed documentation of the assessment will need to be made available to the assessment team to allow a technical review of the assessment to be conducted. A particular challenge for the assessment of the East and South Chatham Rise is how to handle the abundance on the newly-discovered Rekohu plume. Assuming that the Rekohu plume only arose in 2011 would likely to be an

unacceptably optimistic assumption while even the assumption that this plume represents the same proportion of the total spawning biomass prior to 2007 would require careful justification.

No external review of the orange roughy assessment has been undertaken in recent years. However, the MPI Working Group process provides an internal review of the assessment (even though membership of the Working Groups is open, this review is considered internal as participation only primarily involves scientists from New Zealand). Access to working group documents will need to be arranged to allow an evaluation of the nature and thoroughness of this peer-review process.

Scores perhaps below 60 (but insufficient information to evaluate this)
PI 1.1.3 Stock Rebuilding
All stocks would be considered to be depleted given the estimates of biomass relative to B_0 in the 2013 Stock Assessment Plenary Report. However, no projections have been undertaken and reported in the Plenary Report to estimate the expected time to rebuild to the management target range under the harvest control rule. It is therefore currently impossible to evaluate whether the rebuilding time is 30 years or 3 times the generation time. For orange roughy, the generation time is such that 3 times the generation time will substantially exceed 30 years. It will need to be shown that rebuilding is expected within 30 years (or 20 years for SG 80). Given a stock assessment, estimation of rebuilding times could be based on projections under the harvest control rule for alternative assumptions regarding how the assessment is conducted and regarding future recruitment. It should be noted that there will be some stock size below which it is impossible to rebuild to the lower end of the management target range in the MSC timeframe even in the absence of any exploitation for low productivity stocks such as orange roughy.

Scores likely between 60 and 80
PI 1.1.1. Stock Status
The ability to score this PI is limited by the lack of agreed recent stock assessments which use conventional methods of stock assessment to estimate stock status relative to management reference points (see Section 3.3.d). The only stock with a recent stock assessment is the MEC. Nevertheless, the estimates of biomass relative to B_0 reported in the 2013 Plenary Report (MPI, 2013b,c,d) were less than the lower bound of the management target range for all four stocks. One of the estimates of $B_{current}$ / B_0 for the Northwest Rise was below the hard limit.

PI 1.2.1 There is a robust and precautionary harvest strategy in place
The harvest strategy for orange roughy is well-defined and is responsive to the state of the stock. However, no evidence exists that the harvest strategy will work in achieving its objectives. Such evidence would require either monitoring data which shows direct evidence for an increase in abundance or the results of projections using a stock assessment model. CB2.5.1.2 states that “tested” means that a structural logistic argument exists that supports the choice of strategy. Evidence that the orange roughy harvest strategy will achieve its objective is needed for the fishery to achieve a score of SG 80 on scoring issue b.

PI 1.2.2 Harvest control rules and tools
The form of the harvest control rule is consistent with the harvest strategy. However, there is no justification for the specific choices for the values for the parameters of the harvest control rule (e.g. why F_{MSY} is assumed to be M, although the results of the MEC assessment suggest that this assumption may be justified for this stock at least [MPI, 2012b]). In addition, there is no documentation of the major uncertainties and how the harvest control rule was selected to take account of those uncertainties.

Principle 2

Scores likely between 60 and 79

2.2.1 Bycatch status

The AEEF Expert Panel assessed (Boyd 2013) slickheads, shovelnose dogfish, and some deepwater dogfish to be data deficient; there is not enough analysed information to score stock status; and concluded only slickheads are considered vulnerable, noting the shovelnose and deepwater dogfish could be considered as minor components of the catch (<5%). Slickheads scored conditional pass on a preliminary productivity-susceptibility analysis (Boyd, 2013); slickheads did not exceed 2% of the orange roughy catch so would not likely constitute a main species. Rattails exceeded 2% of the orange roughy catch in 3BNWCR and ESCR, but did not exceed 5%; if rattails are considered as vulnerable they could become a main species. The orange roughy fishery caught 10-20% of the total chimaera and greater than 20% of the total shovelnose dogfish; so even though chimaera and shovelnose dogfish make while a small proportion of the orange roughy catch, they may constitute a main species. They are both data deficient for stock status. Rattails, chimaeras, and shovelnose dogfish would benefit from further evaluation whether they would constitute main species, and possibly assessment under the risk-based framework.

2.2.2 Bycatch management

Measures are in place (e.g., catch data recording, observer data collection, data from trawl surveys for some species) for non-quota management system (QMS) species, but not a partial strategy. Other measures are available under the Fisheries Act if necessary. The movement of non-QMS species to QMS status as necessary shows that the measures are likely to work.

2.3.1 ETP status

Four coral species are of particular relevance to ORH fisheries being assessed (i.e., occur in the appropriate depth range) - *Solenosmilia variabilis, Madrepora oculata, Enallopsammia rostrata* and *Goniocorella dumosa.* There is information on the distribution of cold-water corals within the fished area but the distribution of the corals in non-fished areas is less well understood. Catch of stony corals as a group is monitored by observers, but there does not seem to be detailed information on the extent of trawling by species as species are difficult to tell apart.

The fishery falls within the national requirements for protection of ETP species. In most cases (fish, seabirds, sharks, and marine mammals) direct and indirect effects of the orange roughy fishery are minimal and highly unlikely to create unacceptable impacts. However, the direct and indirect impacts on coral are less certain, as the extent to which trawling might be linked to impaired benthic ecosystem functioning has yet to be determined. It is not clear that sufficient analysis has occurred to demonstrate that the fisheries are highly unlikely to have unacceptable direct and indirect impacts for deep sea corals. The fishery continues to add new areas of trawling, although at a declining level.

If protected corals are impacted, or may be impacted to any significant extent, then there is a need to define the level of that impact, including adequate identification, quantity taken and distribution of the corals.

2.3.2 ETP management

Of the ETP species potentially vulnerable to the orange roughy fishery, only corals are impacted at a level that could require explicit management. Coral are managed through closed area (32% of the EEZ, with selected UTFs, closed to trawling), and the designation as protected requires measures to prevent adverse impacts. For both UTF and slope/flats habitats, spatial management tools were in place, VMS was on vessels, there is an active

observer programme, and management is periodically reviewed to respond to new information and research. But the fishery continues to expand to new areas (although at a declining rate). Orange roughy tows appear to follow existing tow lines, but by practice, not requirement. It is unclear that a strategy is in place to minimise coral mortality, especially with the possibility of expansion of the trawl area from the fishery, and if the measures follow the approach outlined by the Ministry for Primary Industries leading to appropriate management strategies. Evaluation of whether there is a need to reduce expansion of the fisheries to new trawling areas, and if so, how that would happen would benefit the management of corals.

2.3.3 ETP information
For areas where data are insufficient to quantitatively determine outcomes (e.g. reef-building stony corals) there is ongoing research and monitoring describing their distribution and any interactions with fishing operations. The assessment would also benefit from an assessment of the level of threat of the fishery for corals generally and reef-building stony corals.

2.4.1 Habitat status
There is information on trawl footprint and a good understanding of the impact of trawling on some habitats for UTF component of the fishery. It remains to assess whether the unfished areas with remaining habitat is sufficient to prevent serious or irreversible harm to unique features. Analysis of the distribution of benthic habitats relative to the footprint of the fisheries would increase understanding of the impacts of the four fisheries being assessed.

Principle 3

Scores likely below 80

None

2. Introduction

2.1 Aims/scope of pre-assessment

The Marine Stewardship Council (MSC) is an independent, global, non-profit organization, with a mission to use the ecolabel and fishery certification program to contribute to the health of the world's oceans by recognising and rewarding sustainable fishing practices, influencing the choices people make when buying seafood, and working with our partners to transform the seafood market to a sustainable basis. It is supported by a broad coalition of those with a stake in the future of the global seafood supply. The MSC harnesses consumer power by identifying sustainable seafood products through an eco-label. The MSC has identified the following mission statement:
To safeguard the world's seafood supply by promoting the best environmental choice.

This report sets out the results of pre-assessments of four fisheries for orange roughy (*Hoplostethus atlanticus*) in the waters of New Zealand in relation to the Marine Stewardship Councils (MSC) Principles and Criteria for Sustainable Fishing (the 'MSC standard'). It must be stressed that this report can provide guidance only, and the outcome of a main assessment will be the subject of deliberation by an assessment team and would not be influenced by this pre-assessment.

The MSC strongly recommends that fisheries that are considering certification according to the MSC standard carry out a pre-assessment. Pre-assessments are most often carried out by an ASI Accredited Certification Body (CB); only accredited CBs may undertake full

assessments. A pre-assessment provides a rapid evaluation of the readiness of a fishery to proceed with full assessment but without incurring the cost of a full assessment. In case of fisheries that are not deemed ready to proceed with a chance of success to full assessment, the pre-assessment provides a risk assessment that indicates where the current performance of a fishery is unlikely to meet the SG 60 or 80 scores and, as such, provides guidance on areas requiring remedial attention or improvements to the fishery to make it more likely to pass full certification.

The **Deepwater Group** contracted MRAG Americas, Inc. (MRAG) to conduct MSC pre-assessments of four New Zealand orange roughy fisheries. To date, almost all fisheries that have successfully concluded an MSC Main Assessment have had conditions set for continuing certification, and this pre-assessment predicts conditions for the orange roughy fisheries. These conditions may relate to operational and management functions. The client is then responsible for ensuring that these conditions are met within the required timescale. The client should therefore have authority, or have secured agreement with the relevant organizations, to enact potential conditions should certification be successful. For this fishery, this is likely to require some degree of cooperation from the Ministry of Primary Industries.

The client must provide evidence that 1) the policies, management principals, and enforcement programs of the responsible fishery management bodies and fishing fleets can be expected to meet the MSC Principles and Criteria; and 2) that the status of the entire biological stock or stocks of the species utilized by the fishery are healthy, even if the fishery just fishes a small portion of the entire stock(s). This is necessary because the MSC's Standards Council has determined that the biological stock of the species fished must be demonstrated as healthy for a fishery or fisheries to be fully certified. These pieces of information are designed to help a fishery make more informed decisions regarding its ability to move forward with full certification. However, no verification of information occurs during a pre-assessment.

A pre-assessment report that meets all the requirements of the Marine Stewardship Council provides the following information:

- A short description of the fishery;
- General historical background information on the fishery and area;
- The fishery management policy objectives, regulations, and practices;
- Identification of other fisheries in vicinity, but not subject to certification;
- List of stakeholders in the fishery;
- State of preparedness for assessment, in particular, the extent to which the fisheries systems are based upon the MSC Principles and Criteria;
- A discussion of the key issues and factors identified as potentially troublesome in completing a successful certification assessment based on the MSC principles and criteria,
- A decision as to whether it will be possible to move from the pre-assessment to final assessment stage; and
- A budget estimate for conducting a full certification assessment.

2.2 Constraints to the pre-assessment of the fishery

The pre-assessment was not constrained.

2.3 Unit(s) of certification

The MSC Guidelines to Certifiers specifies that the unit of certification is "The fishery or fish stock (=biologically distinct unit) combined with the fishing method/gear and practice (=vessel(s) pursuing the fish of that stock) and management framework."

The definition of the fisheries under pre-assessment are therefore as follows:

Species: Orange roughy (*Hoplostethus atlanticus)*
Geographical Areas: ORH3B East & South Chatham Rise, ORH3B Northwest Chatham Rise, ORH7A, and ORH Mid East Coast within the waters of the New Zealand Territorial Sea and the Exclusive Economic Zone (noting that the ORH7A fishery is based on a straddling stock, under UNCLOS, extending beyond the New Zealand EEZ).
Method of Capture: Bottom trawl
Management System: Joint management by the Ministry of Primary Industries and the Deepwater Group, under the fishery laws of New Zealand
Client Group: Deepwater Group Limited

3. Description of the fishery

3.1 Scope of the fishery in relation to the MSC programme

MRAG Americas has determined that the fishery is within scope of the MSC, and does not include enhanced or introduced species, explosives or poison, or unilateral exemptions.

3.2 Overview of the fishery

New Zealand's Deepwater and Middle-depth fisheries (deepwater fisheries) are those fisheries which occur in offshore waters out to the 200 nm limit of New Zealand's Exclusive Economic Zone (EEZ). The management of New Zealand's deepwater fisheries is a collaborative initiative between the Ministry for Primary Industries (MPI, representing the Crown and its statutory obligations to the public) and the Deepwater Group Ltd (DWG). Fisheries are managed with Fishery Management Areas (FMA) (Figure 1), although FMAs may be combined or subdivided for specific fisheries. New Zealand's orange roughy fisheries are managed as eight separate stocks. MPI and DWG contract a range of research programs to routinely monitor the orange roughy fisheries and to assess the status of orange roughy stocks. Orange roughy quota owners pay the full cost for all research and monitoring into these fisheries, either through a Government cost recovery levy or through direct payment through DWG.

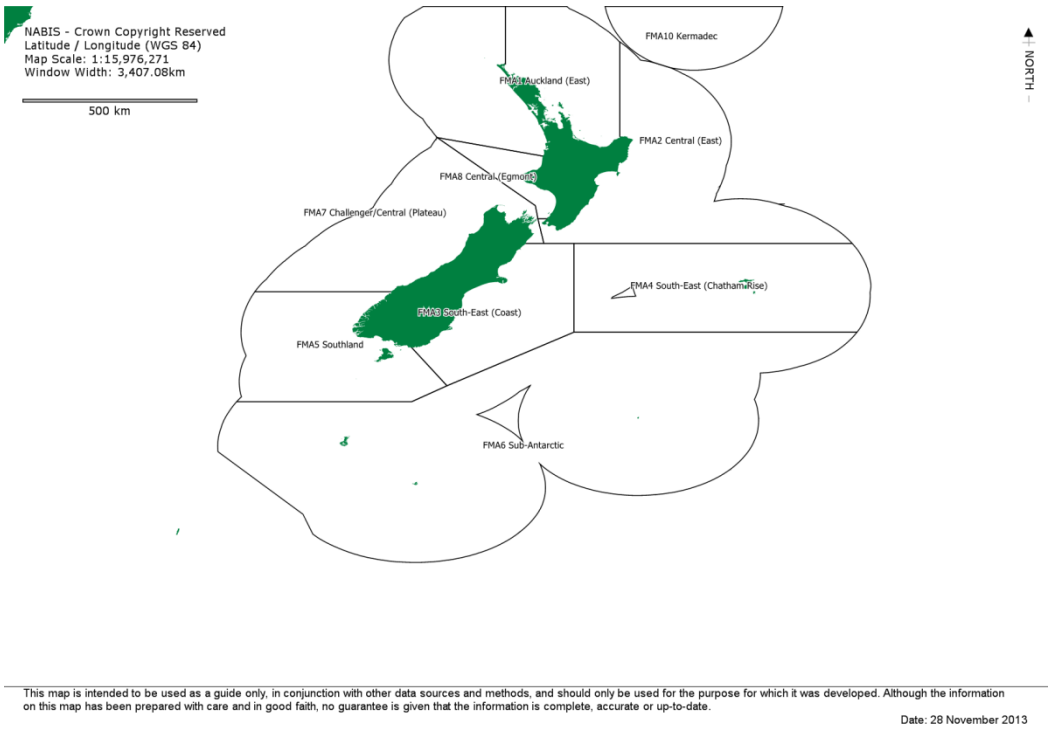

Figure 1. GenericFishery Management Areas for New Zealing (Source NABIS 2013).

The stock assessment process is open to anyone who elects to participate. These science programs are supported by orange roughy quota owners through DWG, a non-profit company established to represent quota owners' interests in fisheries science, management and sustainable utilisation. DWG represents the interests of orange roughy quota owners, who own over 95% of the orange roughy quota within the New Zealand zone.

The first orange roughy fishery began in 1978 with moderate catches. New Zealand catches of orange roughy progressively increased during the 1980s to 47,605 tonnes in 1985-86 as more fishing grounds were discovered and developed, By 1992 it became evident that orange roughy were slower growing, longer lived and less productive than previously thought and the stock assessment parameters and TACCs were adjusted downwards accordingly. As stocks were progressively 'fished down' from B_0 towards B_{MSY}, and at times to below B_{MSY}, the management response has been to reduce the TACCs. During the 1990s catches were subsequently reduced, at times to zero, to promote stock size rebuilding.

The total catch to date of orange roughy from the New Zealand zone in 2012-13 was 4,270 tonnes and the catch from each of the four fisheries was 1,124 tonnes (ORH MEC) 2,515 tonnes (ORH3B), and 512 tonnes (ORH7A).

3.3 Principle One: Target species background

3.3.1 Outline of the fishery resources

Orange roughy (*Hoplostethus atlanticus*) has an almost worldwide distribution (Branch, 2001). However, the bulk of the world catch of this species (and presumably unfished biomass) has occurred in New Zealand. In New Zealand, orange roughy are assessed and managed in several areas, each of which may contain of one or more stocks of orange roughy (Fig. 2). Orange roughy are also fished outside of the New Zealand EEZ.

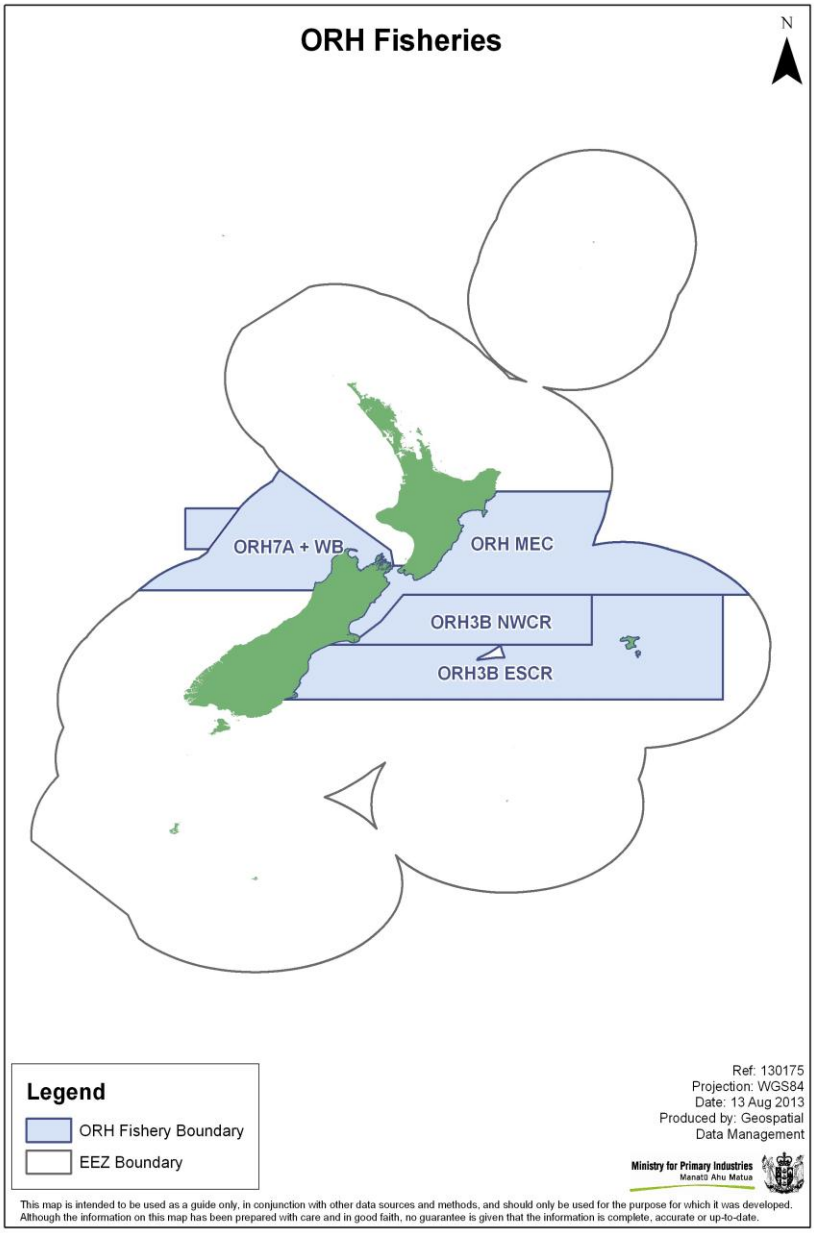

Figure 2: The four New Zealand orange roughy fisheries (Source: Boyd 2013).

The units of pre-assessment are the following populations of orange roughy (See Fig. 2):

1) the Mid East Coast (ORH2A (South), ORH2B and ORH3A).
2) the Northwest Chatham Rise (ORH3B, Northwest Chatham Rise).
3) the East and South Chatham Rise (ORH3B, East and South Chatham Rise).
4) the Challenger Plateau, including Westpac Bank (ORH7A).

Table 1 lists the catches for the Mid East Coast, the ORH3B Quota Management Area, and the Challenger Plateau.

Table 1. Catches of orange roughy for each fisheries under pre-assessment

Fishing Year	MEC	Chatham Rise	ORH7a
1979-80	-	11 800	-
1980-81	-	31 100	33
1981-82	554	28 200	4 248
1982-83	3 763	32 605	11 839
1983-84	7 401	32 535	9 527
1984-85	8 434	29 340	5 117
1985-86	7 971	30 075	7 753
1986-87	8 452	30 689	11 492
1987-88	9 695	24 214	12 181
1988-89	9 377	32 785	10 241
1989-90	10 517	31 669	4 309*
1990-91	9 988	21 521	1 357
1991-92	10 099	23 269	1 911
1992-93	9 022	20 048	2 087
1993-94	6 563	16 960	1 732
1994-95	5 721	11 891	1 636
1995-96	1 890	12 501	1 669
1996-97	2 122	9 278	1 308
1997-98	2 240	9 638	1 418
1998-99	2 273	9 372	1 245
1999-00	2 517	8 663	619
2000-01	1 752	9 274	0.2
2001-02	1480	11 325	0.2
2002-03	886	12 333	4
2003-04	886	11 254	<0.1
2004-05	1 471	12 370	161
2005-06	1 445	12 554	219
2006-07	1 506	11 271	< 0.1
2007-08	1 509	10 291	< 0.1
2008-09	1 471	8 758	248
2009-10	1 453	6 662	342
2010-11	1 484	3 486	476
2011-12	1 199	2 765	511

3.3.2 Stock structure

Allozyme studies have shown that orange roughy from within the Mid-East Coast orange roughy fisheries (i.e. Quota Management Areas, QMAs: ORH2A (South), ORH2B and ORH3A) cannot be separated, but are distinct from orange roughy on the eastern Chatham Rise (MPI, 2013b).

Five sub-stocks of orange roughy are recognised for management purposes within the ORH3B QMA, two of which (Chatham Rise and Puysegur; see Fig. 3 for the sub-areas for orange roughy in the ORH 3B QMA) have been distinguished using genetics (Smith and Benson, 1997). However, given the large size of the ORH3B QMA, as well as discontinuities in the distribution of catches, it is *a priori* likely that there are several stocks of orange roughy in this QMA. A comprehensive evaluation of the stock structure of orange roughy on the Chatham Rise was conducted during 2008 (Dunn and Devine, 2010). Dunn and Devine (2010) evaluated a variety of sources of information for the ORH3B QMA, including (a) catch distribution and catch-rate patterns, (b) locations of spawning and nursery grounds, (c) inferred migrations, (c) size, maturity and condition data, (d) genetic studies, and (e) habitat and natural boundaries.

Dunn and Devine (2010) found evidence that a separate stock of orange roughy occurs on the Northwest Chatham Rise. The evidence in support of this includes a substantive spawning ground as well as nursery grounds in the Graveyard Hills area on the Northwest Chatham Rise. Other evidence suggesting that orange roughy on the Northwest Chatham Rise and in the Spawning Box on the East Chatham Rise constitute separate stocks include: (a) a gap in the distribution of juveniles between these sub-areas, (b) evidence for a westerly post-spawning migration from the Graveyard Hills area, (c) differences in the median length among sub-areas, and (d) differences in trends in the size-of-50%-maturity among sub-

areas. The only information which suggests that the Northwest Chatham Rise may not be separate from the Spawning Box is an indication from patterns in commercial catch rates that some fish that arrive to spawn in the Spawning Box may come from the west.

In contrast to the situation for the Northwest Chatham Rise and the Spawning Box, Dunn and Devine (2010) found no evidence for separating orange roughy in the Spawning Box from those on the South Chatham Rise. A common stock in these areas was supported by a continuous nursery ground throughout the area, similar trends in the size-at-50%-maturity, inferred post-spawning migrations from the Spawning Box towards the East Rise, and a lack of differences in median lengths. Dunn and Devine (2010) found weak evidence that the area west of and including 'Hegerville' (on the South Chatham Rise) is a separate stock. This evidence included that median length analysis indicated a split in the area, and an oceanographic front at 177^0W. In contrast, the few catches of orange roughy in the area west of Hegerville and the lack of a nursery ground on the South Chatham Rise supported the hypothesis that orange roughy on the South and East Chatham Rise do not constitute separate stocks. Based on the analyses reported by Dunn and Devine (2010), the Chatham Rise is managed as two separate stocks (Northwest and East+South) for the purposes of assessment and the provision of information on which management advice is based (see Fig. 3).

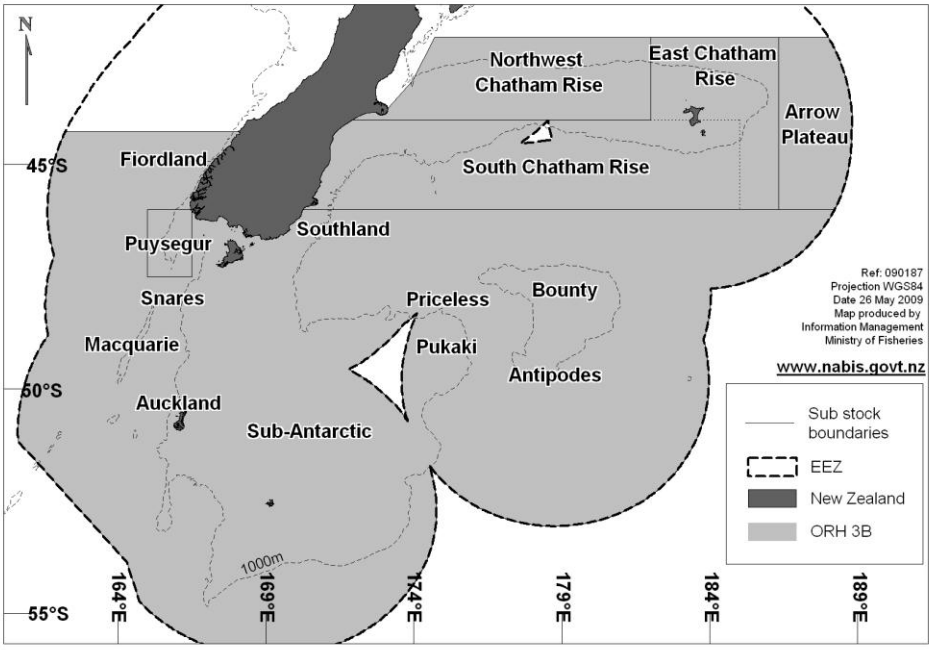

Fig. 3. Sub-area boundaries for orange roughy in the ORH3B QMA. The Spawning Box is within the western part of the East Chatham Rise (i.e. to the east of the vertical line at 175°W). The sub-Antarctic is all areas below 46°S on the east coast, and 44°16'S on the west coast, except Puysegur. (Source: MPI [2013c]).

Orange roughy in ORH7A are considered to be a straddling stock contiguous with those on the Westpac Bank immediately to the west, and to be separate from those in other areas (MPI, 2013d). Evidence to support this assumption include that studies on parasite composition, flesh mercury levels, allozyme frequency and mitochondrial DNA suggest differences among fisheries. In addition, spawning occurs at a similar time on the Challenger Plateau as on the Chatham Rise, Puysegur Bank, Richie Bank, Cook Canyon and Lord Howe Rise (MPI, 2013d).

3.3.3 Life history[1]

Orange roughy is a deepwater species, being found from 700 to at least 1,500m (MPI, 2013a). The maximum depth at which the species is found is, however, unknown (MPI, 2013a). A variety of methods have been applied to attempt to age orange roughy. Orange roughy are considered to be long-lived (otolith ring count and radiometric isotope studies suggest that orange roughy may live up to 120-130 years). Although age determination from otolith rings has been validated by length-mode analysis for juveniles up to four years of age in one study (MPI 2013a), routine aging of orange roughy has proven difficult. Specifically, biases in reading the numbers of otolith rings between laboratories have been identified (Francis, 2006), and consequently age composition data have generally not been included in stock assessments until recently.

Accurate estimation of key biological parameters (growth, natural mortality and maturation) depends on having reliable age estimates. The values for these biological parameters for all orange roughy stocks are based on age estimates from otoliths collected during the 1984 and 1990 trawl surveys of the Spawning Box and the East Chatham Rise, and aged by NIWA because these age estimates are believed not to contain serious biases (MPI, 2013a).

Natural mortality, *M*, has been estimated to be $0.045yr^{-1}$ based on otolith data from a 1984 trawl survey of the Chatham Rise. A similar estimate of *M* was obtained in 1998 from a lightly fished population in the Bay of Plenty (MPI, 2013a)

Determination of the age of maturation for orange roughy has also proved difficult although it has been inferred that most orange roughy may take more than two decades to reach maturity.

Maturation is assigned based on a marked transition zone in otolith banding, which is believed to be associated with the age of first spawning (Francis and Horn, 1997). Estimates of the age-at-50%-maturity for orange roughy off New Zealand based on transition zone observations range from 23 to 69 years (MPI, 2013a). Spawning of orange roughy generally occurs between mid-June and mid-August, and orange roughy form large spawning aggregations, which are utilized by both the fishery and when conducting acoustic surveys. It is likely, and a key part of the assessment, that individual mature orange roughy do not spawn every year.

The larval biology of orange roughy, in common with that for most deepwater marine species, is poorly known.

It was assumed that all mature fish were vulnerable to commercial fishing but no immature fish were until relatively recently. However, inclusion of age and length data in assessments in 2004 and subsequently suggest that the age of vulnerability may be 7 to 20 years greater than the age at maturity, and hence that the mature biomass may be substantially larger than the vulnerable biomass. Recently, assessments have used vulnerability data when they are available assuming that maturation was the same as becoming vulnerable to the fishery. However, the age-at-vulnerability was assumed to be the same as the age at maturity for stocks without vulnerability data.

The relationship between spawning biomass and recruitment for orange roughy is poorly known owing to a lack of data on recruitment strength and, in particular, the long lag between spawning and subsequent recruitment to the fishable stock. Assessments of orange roughy have assumed that the stock-recruitment relationship is of the Beverton-Holt

[1] The bulk of the information in this section was taken from the report of the 2013 stock assessment plenary.

form, that the steepness of the stock-recruitment relationship is 0.75, and that the extent of inter-annual variation in recruitment is very high ($\sigma_R = 1.1$) (MPI, 2013a).

3.3.4 Stock assessments

The information needed to assess stock status relative to the limit reference points and the management target range, and to apply the harvest control rule is an estimate of F_{MSY}, an estimate of current fishing mortality, an estimate of recent abundance, $B_{current}$, and an estimate of the unfished biomass B_0. F_{MSY} has been set equal to natural mortality, M ($0.045yr^{-1}$), while the estimates of $B_{current}$ are based on a stock assessment model for the MEC and Northwest Rise stocks, and are averages of estimates of recent biomass for the ESCR and the Challenger Plateau. B_0 is estimated using stock assessments for the MEC and Northwest Rise stocks, while estimates of B_0 for the ESCR and the ORH 7A are taken for historical assessments, which assumed deterministic recruitment.

The review of these assessments has been conducted primarily though meetings of the MPI[2] Deepwater Working Group which consists of scientists from NIWA, The Ministry of Primary Industries and the industry. The meetings are open to the Public. The reports of the Deepwater Working Group are available through annual summarises, with the results of detailed analyses reported in Fishery Assessment Reports (FARs). Past assessments of orange roughy on the Chatham Rise have been reviewed by scientists not normally involved in the New Zealand assessment process.

A variety of sources of data are available for assessing the current biomass and stock status of orange roughy. These data sources include catch-rates from the commercial fishery (following standardization), acoustic estimates of biomass, trawl survey estimates of biomass, and egg production estimates of biomass. Trawl surveys and the egg production method have not generally been applied to orange roughy in recent years. These methods have largely been supplanted by acoustic methods for estimating abundance. Catch-rates for orange roughy appear to exhibit hyper-depletion for some areas (Hicks, 2004), and catch-rate and survey indices have shown inconsistencies (MPI, 2013c). However, catch-rates are likely to provide information on broad qualitative trends in abundance. In principle, changes in length-composition between surveys provide some information on recruitment trends (Dunn *et al.*, 2008).

Assessments of orange roughy stocks based on fitting population dynamics models have been conducted for many years. However, it has proved challenging to conduct assessments which are not subject to considerable uncertainty for a variety of reasons:

- Given their underlying structure, models based on the assumption of deterministic recruitment predict rebuilds in biomass when catches are reduced, irrespective of data that may suggest otherwise.
- Including stochastic recruitment will allow the model to better reflect recent trends, at least in principle. However, past assessments which included stochastic recruitment led to predictions of long sequences of poor recruitment before the start of the fishery to mimic the near constancy of the mean length of the catch during periods when stock size was declining. This result is an inference and not based on direct measurements.
- Ageing of orange roughy has proved problematic in the past. In particular, there have been differences among labs in ageing methods which led to differences in age estimates, and Francis (2006) found that there was a drift in age estimates for the same otolith over time. A standard ageing technique is now available (Tracey *et al*., 2007), and otoliths for recent years have been aged using this technique (MPI,

[2] Reference is made in this document to MPI even though it was the Ministry of Fisheries during the much of period considered in the report.

2013a). However, many otoliths exist which are currently unread, but may be read for the 2013-14 assessments.

- Early assessments assumed that maturity and selectivity were the same given that the fisheries operated primarily on spawning aggregations. However, collection of data on lengths from the fisheries and the use of the transition zone as a proxy for maturation indicated that recruitment to the fishery could occur many years after maturation. Assessments have addressed this uncertainty in various ways. For example, by assuming that maturation is equivalent to joining the fishery (i.e., ignoring the transition zone) or that fishery selectivity is equivalent to maturation. The recent assessment of the MEC stock is based on explicitly modelling spawning aggregations only.
- Orange roughy has been (particularly) hard to index using standard monitoring methods. For example, trawl surveys are restricted spatially and may exhibit hyper-depletion, egg production methods lead to highly imprecise estimates, while acoustic methods (the current method of choice) are subject to uncertainty owing to the low target strength of orange roughy, mixed schools, as well as the density in the shadow zone. Substantial progress appears to have been made by the move to multibeam techniques (AOS) (e.g. Ryan and Kloser, 2013), but that method is still to be fully reviewed through the MPI stock assessment process.

Mid-East Coast (ORH 2A south, 2B, and 3A)

The fishery for orange roughy on the Mid-East Coast fishery started in 1981-82 (Table 1). The fishery initially targeted spawning aggregations, in particular the main spawning hill on Richie Bank. However, there was a shift in the fishery from the main spawning hill (in ORH2A (South)) to the hills off East Cape (in ORH2A (North)) after 1993-94. ORH2A was split into ORH2A (North) and ORH2A (South) at $38^{0}23'$ in 1994-95. ORH2A (South), ORH2B and ORH3A were subsequently considered to be single stock (denoted Mid-East Coast, MEC) for management purposes (Fig. 4). A TACC is set for the entire ORH2A QMA, with agreement between the Minister and quota owners that catches will be managed within the agreed catch limits for each of ORH2A (North) and ORH2B (South) (MPI, 2013b). The ORH MEC catch limit is set by the Minster, based on the most recent stock assessment results, and is administered as the sum of the TACCs for each of ORH2B, ORH3A and the agreed catch limit for ORH2A (South).

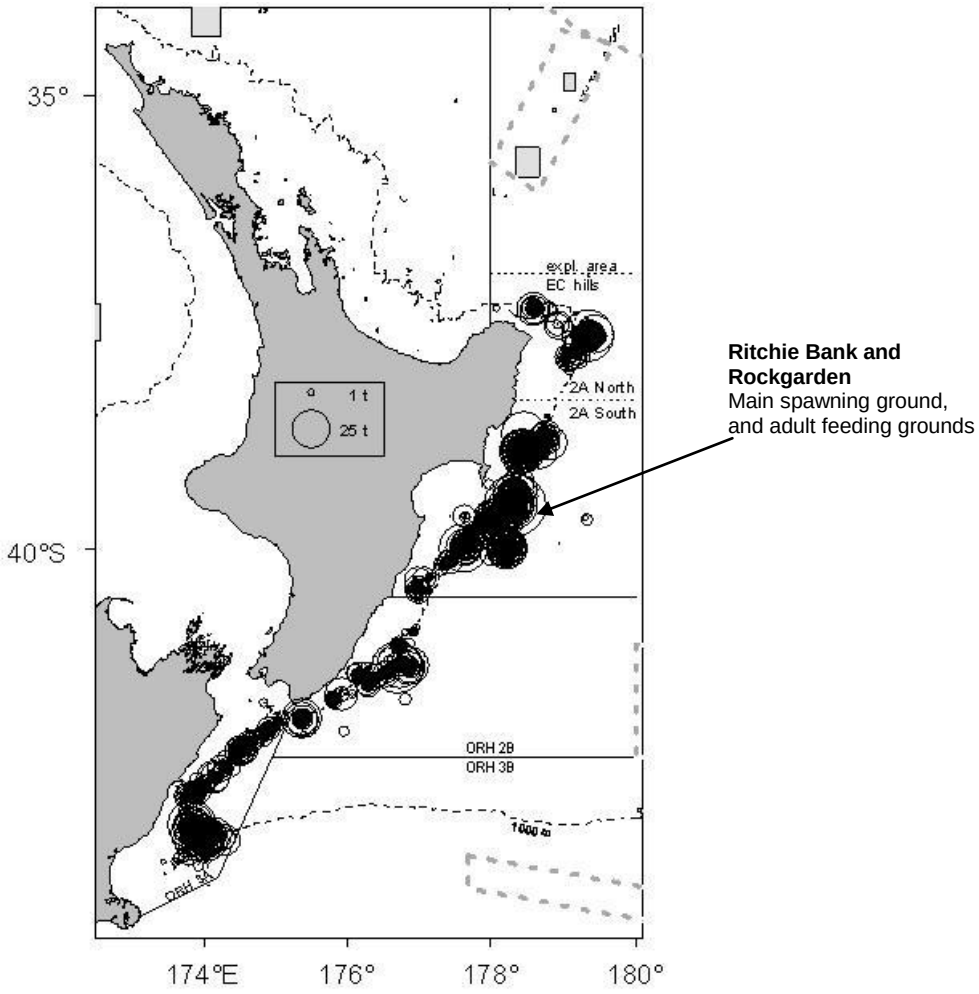

Fig. 4. Catch (t) per tow of orange roughy in ORH2A, ORH2B, and ORH3A for the five fishing years from 2006-07 to 2010-11 (circles, with area proportional to catch size), location of the fisheries assumed during stock assessment, and the location of the main spawning, feeding, and nursery grounds. Perimeters of Benthic Protection Areas (BPAs) closed to bottom trawling are marked with dashed grey lines, and seamounts closed to trawling are marked as shaded rectangles (Source: MPI [2013b])

A stock assessment for the Mid-East Coast stock was undertaken in 2011, but the results were unsatisfactory (Dunn, 2011). This assessment was updated in 2013 and the results were accepted by the Deepwater Fisheries Assessment Working Group (DWFAWG) and by the Plenary (MPI, 2013b). Following Dunn (2011), the 2013 assessment explored a variety of model structures: episodic recruitment, a regime shift, and a prime-habitat assumption. The latter assumes that there are two types of mature fish and that only older-larger fish are able to secure prime habitat. The DWFAWG recommended that the assessment be based on this last model structure. The model was fitted to CPUE data, trawl survey indices of abundance, estimates of abundance from the egg production method, and estimates of abundance from acoustic surveys (Table 2). The model was also fitted to length-frequency data for 1988-89 to 2009-10 for the northern fishery and for 1989-90 to 2008-09 for the southern fishery, catch age-frequencies for 1989-91 and trawl survey age-frequencies for 1993 and 2010, which were re-aged using the current age-reading protocol (Tracey *et al.*, 2007). Ageing error was assumed, with a CV of 10%. Data on the proportion of fish in the trawl survey in spawning condition were also included in the assessment. Prior distributions were imposed on the catchability coefficient (q) for the 2001 survey and the ratio of the q for the 2001 to that for the 2003 survey.

Table 2. Standardised CPUE indices, research trawl survey vulnerable biomass estimates, and egg survey and acoustic survey estimates of spawning biomass (with CVs). The late time series of CPUEs was not used in the assessment (Source: MPI [2013b]).

Fishing year	CPUE (early)	CV (%)	CPUE 2007 (late)	CV (%)	Trawl survey	CV (%)	Egg survey	CV (%)	Acoustic survey	CV (%)
1983–84	3.77	20	–	–	–	–	–	–	–	–
1984–85	2.34	20	–	–	–	–	–	–	–	–
1985–86	2.38	20	–	–	–	–	–	–	–	–
1986–87	2.02	20	–	–	–	–	–	–	–	–
1987–88	2.86	20	–	–	–	–	–	–	–	–
1988–89	–	20	–	–	–	–	–	–	–	–
1989–90	1.35	20	–	–	–	–	–	–	–	–
1990–91	1.89	20	–	–	–	–	–	–	–	–
1991–92	1.21	20	–	–	20838	29	–	–	–	–
1992–93	1.03	20	–	–	15102	27	11900	49	–	–
1993–94	0.78	20	–	–	12780	14	–	–	–	–
1994–95	0.52	20	–	–	–	–	–	–	–	–
1995–96	0.57	20	–	–	–	–	–	–	–	–
1996–97	0.98	20	–	–	–	–	–	–	–	–
1997–98	–	–	0.39	15	–	–	–	–	–	–
1998–99	–	–	0.40	15	–	–	–	–	–	–
1999–00	–	–	0.37	15	–	–	–	–	–	–
2000–01	–	–	0.33	15	–	–	-	-	14 900	38
2001–02	–	–	0.64	16	–	–	–	–	–	–
2002–03	–	–	0.80	15	–	–	-	-	3 800	22
2003–04	–	–	0.98	16	–	–	–	–	–	–
2004–05	–	–	0.80	15	–	–	–	–	–	–
2005-06	–	–	0.84	16	–	–	–	–	–	–
2006-07	–	–	0.96	16	–	–	–	–	–	–
2007-08	–	–	0.82	17	–	–	–	–	–	–
2008-09	–	–	0.66	16	–	–	–	–	–	–
2009-10	–	–	0.49	17	7074	19	–	–	–	–

The 2013 assessment was conducted using CASAL (Bull *et al.*, 2012). It was based on available information on the biology of orange roughy, considered two fisheries (ORH2A South and ORH2B combined with ORH3A), each with a different selectivity pattern. All of the indices, except the estimate of spawning biomass from the egg production method, were assumed to be relative indices of abundance. The selectivity pattern for the trawl survey was assumed to be dome-shaped. Two assumptions regarding the prior on the year-class strengths ('Haist' and 'Francis'; see Bull *et al*. [2012] for details) were examined. The model assumed that only spawning fish are mature and hence infers that maturity occurs at much higher age than can be inferred from the transition zone on otoliths. The fits of the model to the available data are generally adequate, although the inability to mimic the results from the 2010 trawl survey warrants further consideration.

The outputs from the 2013 assessment captured uncertainty through sensitivity tests and by computing posterior distributions for parameters and model outputs (see, for example, Fig. 5). The results from the Haist and Francis parameterizations differed quite markedly (see below). The results from the assessment were used as the basis for forecasts. The assessment and projections suggest that the stock has been increasing since 2000 and would continue to increase under the current catch limit (noting that some catch is shelved). Whether the stock will rebuild to the management target in five years depends on which of the two assumptions related to penalties on year-class strength best reflects reality and on the level of commercial catch.

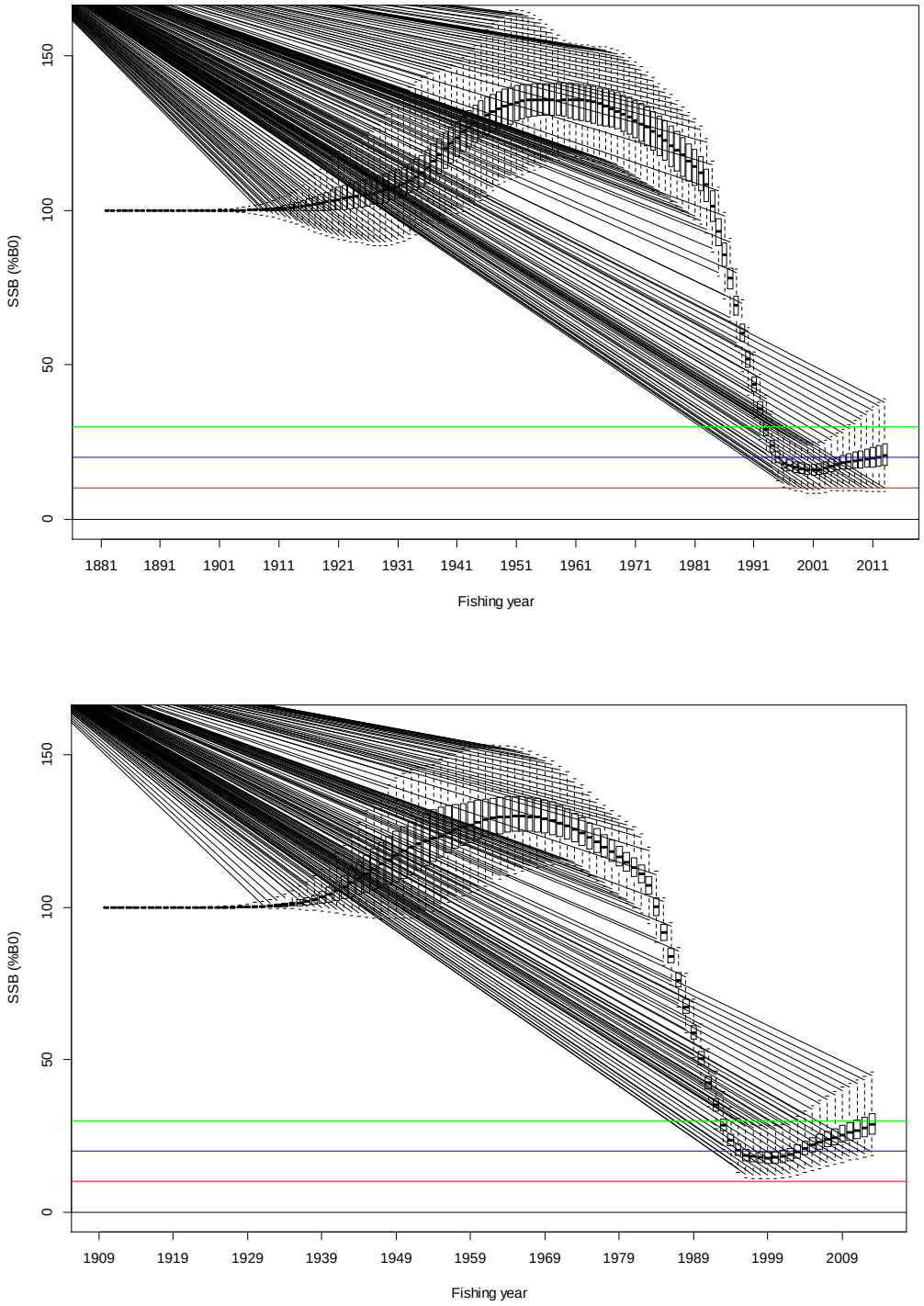

Fig. 5. MCMC estimates of spawning stock biomass trajectory (%B_0) for the Haist model (upper panel) and the Francis model (lower panel). The hard and soft limits and the lower bound of the management target range (30% B_0) are marked by the red, blue and green horizontal lines, respectively (Source: MPI [2013b])

Chatham Rise and Southern New Zealand

The fishery for orange roughy in the QRH3B QMA started on the Chatham Rise in the late 1970s. The bulk of the catches of orange roughy in the early years were taken from the Spawning Box region, although the fishery quickly expanded to Northwest and then to the South Chatham Rise areas (Table 3). Until 1982, most of the catch was taken from areas of

relatively flat bottom, between mid-June and mid-August, when fish form spawning aggregations. The Spawning Box was closed to fishing for the 1992-93 and 1994-95 fishing seasons and the fishery moved to the hills, first to Smith's City and adjacent hills (in the north-east Chatham Rise), then to the Andes and Chiefs hill complexes (in the south-east Chatham Rise). The non-spawning fishery contracted to hill complexes, particularly on the south-east Chatham Rise where new fishing locations were found (discovery of new fishing grounds, followed by apparent rapid depletion is a key feature of fisheries for orange roughy worldwide). A full description of the changes in the fishery across the entire ORH3B QMA is given in MPI (2013c) and Dunn *et al*. (2008).

A Total Allowable Commercial Catch (TACC) is set for the entire ORH3B QMA. The spatial distribution of this catch has been affected by a series of catch limit agreements between the Minister and quota owners (Table 4). MPI monitors DWG reports and operators' fishing patterns to evaluate the effectiveness of these agreed catch limits. Catches have generally been within agreed catch limits. However, the catch limit for the East Rise was exceeded in 2005-06 and 2006-07.

The ORH3B TACC has been progressively reduced over the last five years (9,420t, 7,950t, 4,610t, 3,600t, 3,600t) based on current information coming from the annual time series of acoustic biomass estimates. The agreed catch limit for the Chatham Rise for the most recent season (2012-13) of 3,600 t reflects the application of a three-year process to reduce fishing mortality on the East and South Chatham Rise to F_{MSY} (MPI, 2013c).

Table 3. ORH3B catches by area, to the nearest 10 t or 100 t, and by percentage (to the nearest percent) of the total ORH3B reported catch (Source: MPI [2013c]).

Year	Northwest Rise		South Rise		Spawning Box		Rest of East Rise		Non-Chatham	
	T	%	T	%	T	%	t	%	t	%
1978–79	0	0	0	0	11 500	98	300	2	0	0
1979–80	1 200	4	800	3	27 900	90	200	4	0	0
1980–81	8 400	30	3 700	13	16 000	57	100	0	0	0
1981–82	7 000	28	500	2	16 600	67	800	3	0	0
1982–83	5 400	35	4 800	31	4 600	30	600	4	0	0
1983–84	3 300	13	5 100	21	15 000	61	1 500	6	0	0
1984–85	1 800	6	7 900	27	18 400	63	1 100	4	0	0
1985–86	3 700	12	5 300	18	17 000	56	4 100	13	0	0
1986–87	3 200	10	4 900	16	20 200	66	2 400	8	0	0
1987–88	1 600	7	6 800	28	13 500	56	2 300	10	0	0
1988–89	3 800	12	9 200	28	16 700	51	3 100	9	0	0
1989–90	3 300	10	11 000	35	16 200	51	1 100	3	200	1
1990–91	1 500	7	6 900	32	6 100	28	6 100	29	900	4
1991–92	300	1	2 200	9	1 000	4	12 000	51	7 800	34
1992–93	3 800	19	5 400	27	100	0	4 700	23	6 100	30
1993–94	3 500	21	5 100	30	0	0	4 900	29	3 500	20
1994–95	2 400	20	1 600	13	500	5	3 500	30	3 800	32
1995–96	2 400	19	1 300	10	1 600	13	2 200	17	5 000	40
1996-97	2 200	24	1 400	15	1 700	19	1 900	21	1 900	21
1997–98	2 300	23	1 700	17	2 400	24	2 200	22	1 600	16
1998–99	2 700	28	1 200	13	1 100	11	2 500	27	1 900	21
1999–00	2 100	24	1 100	13	1 500	17	3 100	36	800	9
2000–01	2 600	27	1 700	18	1 200	13	2 300	24	1 500	17
2001–02	2 200	19	1 100	10	3 100	28	3 600	31	1 300	12
2002–03	2 200	19	1 500	13	3 200	27	3 900	33	1 500	7
2003–04	2 000	18	1 400	12	4 300	38	2 600	23	1 000	9
2004–05	1 600	13	1 700	14	4 100	33	3 000	24	2 000	16
2005–06	1 400	11	1 300	10	3 900	31	3 900	31	2 100	16
2006–07	700	7	1 200	11	4 200	37	3 700	32	1 500	16
2007–08	800	8	1 300	13	3 800	37	2 700	26	1 600	16
2008-09	750	8	1 170	14	3 400	39	2 150	25	1 290	15
2009-10	720	11	940	14	3 120	47	1 260	19	620	9
2010-11	40	1	460	13	1 860	53	740	21	380	11
2011-12	120	3	500	10	2 490	54	1 260	27	250	5

Table 4. Agreed catch limits (t) for various sub-areas within the ORH3B QMA. The East Rise includes the Spawning Box. Sub-area boundaries have varied over time. * South Rise included in the East Rise; ** Arrow Plateau included in the Sub-Antarctic (Source: MPI [2013b]).

Year	Northwest Rise	East Rise	South Rise	Puysegur	Arrow Plateau	Sub-Antarctic
1992–93	3 500	4 500	6 300	5 000	–	2 000
1993–94	3 500	4 500	6 300	5 000	–	2 000
1994–95	2 500	3 500	2 000	2 000	3 000	1 000
1995–96	2 250	4 950	*	1 000	**	4 500
1996–97	2 250	4 950	*	500	**	5 000
1997–98	2 250	4 950	*	0	1 500	4 000
1998–99	2 250	4 950	*	0	1 500	4 000
1999–00	2 250	4 950	*	0	1 500	4 000
2000–01	2 250	4 950	*	0	1 500	4 000
2001–02	2 000	7 000	1 400	0	1 000	1 300
2002–03	2 000	7 000	1 400	0	1 000	1 300
2003–04	2 000	7 000	1 400	0	1 000	1 300
2004–05†	1 500	7 250	1 400	0	1 000	1 300
2005–06†	1 500	7 250	1 400	0	1 000	1 300
2006–07†	750	8 650‡	*	0	0	1 850
2007–08†	750	7 650#	*	0	0	1 850
2008–09†	750	6 570§	*	0	0	1 850
2009–10	750	5 100§	*	0	0	1 850
2010–11	750β	2 960§	*	150	0	500
2011-12	750β	1950§	*	150	0	500

† 250 t set aside for industry research surveys.
‡ 8,650 t allocated to the East and South Chatham Rise combined, with no more than 2,000 t from the South Rise, and no more than 7,250 t from the East Rise.
# Combined East and South Rise catch not to exceed 7,650 t; East Rise (Spawning Box, NE Rise and SE Rise) not to exceed 6,500 t; South Rise catch not to exceed 1 750t. A catch limit of 1 650 t applies to each of the NE Rise and SE Rise; a catch limit of 3,200 t applies to the Spawning Box from 1 June – 31 August. Outside of June-August, this subarea component is part of the NE Rise sub-area and subject to the 1650 t catch limit.
§ East & South Rise managed as a single sub-area. In 2008-09, the catch from the spawning plume (1 June – 31 August) was not to exceed 3 285 t
β From 2010-11, quota owners have agreed to avoiding fishing on the Northwest Rise.

Northwest Chatham Rise

The last recent quantitative assessment of orange roughy on the Northwest Chatham Rise was conducted in 2006 (MPI, 2013c). This assessment was based on a model which assumed that recruitment is related deterministically to spawning biomass according to an assumed stock-recruitment relationship. As noted above, assessments based on the assumption of deterministic dynamics are no longer considered an appropriate way to conduct assessments for orange roughy. This assessment used a standardized CPUE series, an estimate of absolute mature biomass from an egg survey, three estimates of mature biomass from acoustic/trawl wide-area surveys, and a time-series of length-frequency data. The CPUE and acoustic/trawl mature biomass estimates were assumed to be relative indices of abundance, while the estimate of mature biomass from the egg survey was assumed to be a measure of absolute abundance. An informed prior was imposed on the acoustic survey estimates.

Maturity data were not used in 2006 assessment and the maturity curve was set to the selectivity ogive, which was estimated within the model. The assessment involved three 'runs': (a) use all data, (b) ignore the biomass estimates, and (c) ignore the CPUE data. The results from last of these runs were not considered credible (MPI, 2013c). The results from the assessment were used to form the basis for projections.

Acoustic surveys using the multi-frequency Acoustic Optical System (AOS) were conducted on the Graveyard and Morgue Underwater Topographic Features (UTFs) in June/July 2011, 2012 & 2013. The results from these surveys suggest that the biomass on the Northwest Chatham Rise is substantially larger than inferred from the assessment (at least 13-18,000t compared from 4-6,000t from the 2006 assessment). However, the AOS method has yet to be fully evaluated.

East and South Chatham Rise

Several stock assessments based on fitting age- and sex-structured population dynamics to the available data have been conducted for orange roughy in this area. However, these assessments no longer form the basis for management advice because: (a) the stock structure hypothesis on which previous assessments was based has been modified; and (b) all model runs in the previous assessment of the Spawning Box and Eastern Flats stock predicted that stock biomass had been rebuilding since catches were substantially reduced in the early 1990s (MPI, 2013c), but this rebuild is insensitive to recent observational data (Dunn, 2007a, b). The last stock assessment for orange roughy on the South Rise occurred in 2004 (Anon, 2004). The model on which the assessment for the South Rise was based was unable to mimic the biomass indices (standardized CPUE) well, and also predicted a biomass increase which was not seen in the biomass indices.

Since 2008, the main data reviewed when drawing conclusions about the status of the stock are: (a) research trawl surveys, (b) acoustic surveys of the spawning plumes (in the Spawning Box) and background areas, (c) catch, and (d) standardized catch-rates (MPI, 2013c). The size of spawning biomass in the absence of fishing (B_0) is inferred based on past assessments.

Research trawl surveys of the Spawning Box during July were conducted from 1984 to 1994. Although a consistent area was surveyed, three vessels conducted the surveys and it is not clear that catchability was constant among these vessels. In addition, none of the fixed stations were located in the area where the spawning plume is currently found. Irrespective of this, the trawl survey data suggest a substantial decline in abundance in the Spawning Box (21 or 26% of the 1984 biomass in 1990 depending on how the trawl data are treated; Fig. 6). The trawl surveys in the Spawning Box were abandoned in 1995 following a survey in 1994 when 66% of the biomass in the survey was caught in a single haul (Tracey *et al*., 1997). The CV for this survey was very high and the sex-ratio differed substantially from 50:50. Whether trawl surveys were indexing the full spawning biomass is also uncertain because only one tow in all of these surveys encountered the large spawning plumes (Dunn *et al*., 2008). Use of the trawl surveys as indices of spawning biomass depends on the assumption that the proportion of the spawning biomass in the survey area did not change over time. Wide-area surveys from the western edge of the Spawning Box around to the northern edge of the Andes were conducted in 2004 and 2007. These surveys did not survey the spawning plume, the Northeast Hills and the Andes, but did cover the same area of the earlier Spawning Box surveys.

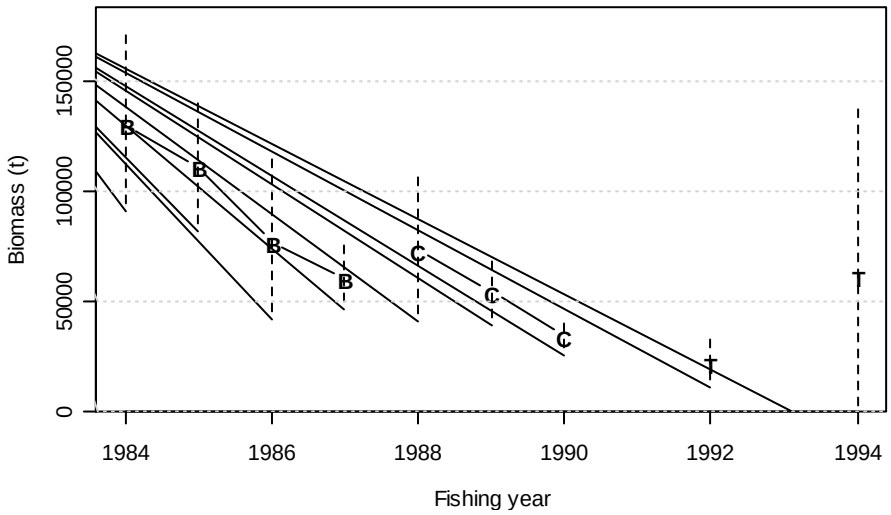

Fig. 6. The Spawning Box trawl survey biomass index (assuming a catchability of 1 for each vessel), with 95% confidence intervals shown as vertical bars. Vessels indicated as B, *FV Otago Buccaneer*; C, *FV Cordella*; T, *RV Tangaroa*. (Source: MPI [2013c]).

Acoustic estimates of biomass are available for the spawning plumes in the Spawning Box, on various hills, and of dispersed fish on the background flat areas (Fig. 7). The techniques for the spawning aggregations in the Spawning Box were reviewed and revised during 2008-2010. The major changes to past estimates reflected: (a) identification and removal of snapshots which were possibly biased because of excessive signal loss due to poor weather, where the snapshot was interrupted or where fish movement was too great, (b) removal of transects on which no orange roughy were detected, and trimming zero estimates along the remaining transects to improve CV estimates, (c) replacement of weather corrections in all years by a correction to each transect, (d) replacement of the transducer calibrations in years of poor calibration conditions with the geometric mean of the those for calibrations in good conditions, (e) application of new estimates of target strength based on observations of individual orange roughy, (f) direct correction for errors in the absorption coefficient, (g) correction of each survey estimate between 2002 and 2007 for small software errors, and (h) estimation of the sampling CV from the variation between the snapshot estimates. The pre-2000 acoustic estimates are not considered comparable with the remaining estimates because of the different methodologies employed and the relatively small number of transects on the earlier surveys (MPI, 2013c). Key sources of uncertainty related to the use of acoustic methods for estimating abundance are well known, and include estimation of target strength (several estimates have been derived for orange roughy), the impact of the shadow zone, and target identification (and mixed schools).

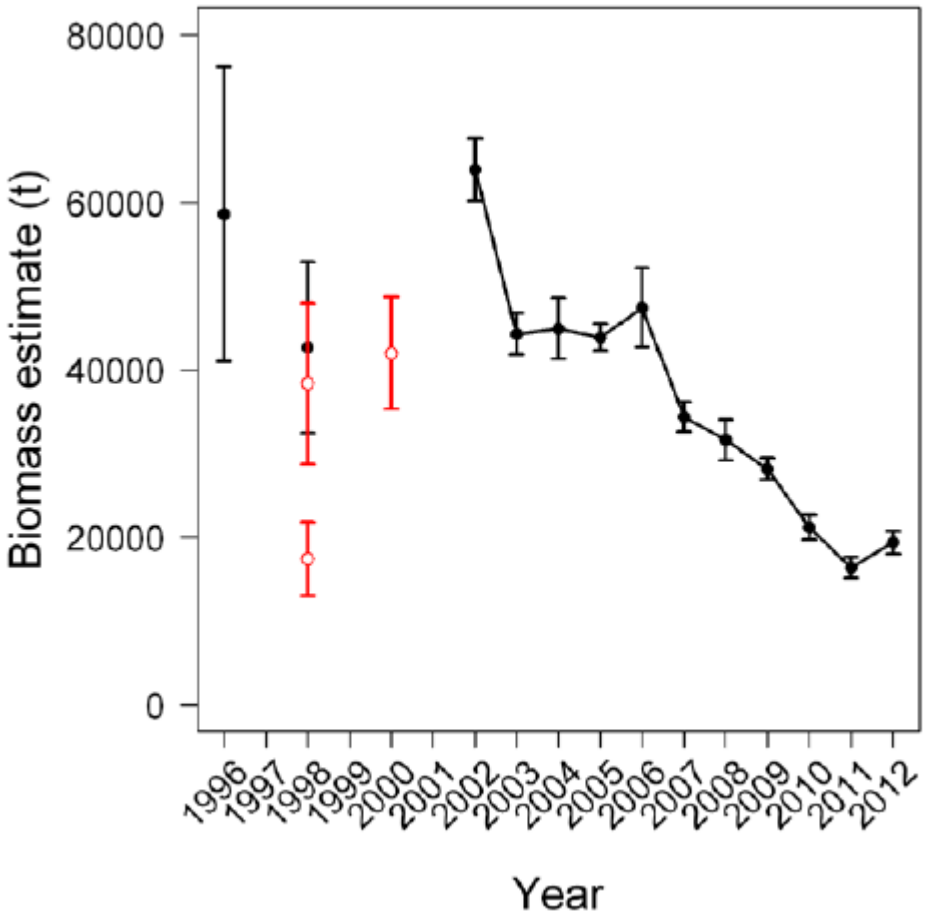

Fig. 7. Acoustic biomass estimates for the spawning plume in the Spawning Box during July, completed by MFish/NIWA using *RV Tangaroa* (1996, lower 1998, and 2000 points), by ORMC/CSIRO using *FV Amaltal Explorer* (higher 1998 point) or by the Deepwater Group/FRS using *FV San Waitaki* (time series from 2002-12). Open circles are estimated from towed body surveys, closed circles are from surveys with vessel-mounted transducers. Error bars are ±2 standard deviations.

MPI (2013c) estimated current spawning biomass for orange roughy on the East and South Chatham Rise by adding abundance estimates by area (see Table 5 for the 2013 analysis). The estimate for the spawning plume was based on the acoustic survey in 2012 of 19,392t (CV 6.9%). A new spawning plume (Rekohu) was discovered in 2011 to the west of the main plume. The Rekohu plume has been surveyed in 2011, 2012 and in 2013. The 2012 abundance estimate for this plume was 27,121t (CV 10.1%). Orange roughy on the Rekohu plume are smaller (1 cm on average; [MPI, 2013c]) than those on the main spawning plume. Moreover, age data for the two plumes in 2012 indicates that the main spawning plume has substantially more fish over 50 years than the Rekohu plume (MPI, 2013c). This 'new' plume may have been seen by fishers in 2010, but there is no record of it in any previous year. Age frequencies showed that the main spawning plume has substantially more fish over 50 years than the Rekohu plume (Doonan *et al*., 2013).

The estimate of biomass for Mt Muck (to the east of the two spawning plumes) of 10,263t was based on an acoustic survey in 2011 from the *FV San Rakaia* using a towed body equipped with an acoustic optical system (AOS, Kloser *et al.*, 2011). The AOS was developed to improve species identification of schools of mixed species. Previous acoustic estimates of abundance for this area were not accepted by the DWFAWG owing to concerns regarding species mix. It should be noted that only 5,833t of this 10,263t was actually observed, the remainder being derived from the shadow zone. The estimates for the remaining areas are based on the results of acoustic surveys on the Northeast flats, the

Northeast Hills, the Andes and the South Rise conducted between 2004 and 2007, reduced to match the proportional extent of decline in the main spawning plume (MPI, 2013c).

Table 5. Acoustic estimates of spawning biomass (t) for East and South Chatham Rise orange roughy in 2012 (source: MPI [2013c]).

Area	Mean
Spawning Plume	19 392
Rekohu Plume	27 121
Mt Muck	10 263
Other areas	6 309
Total	63 085

It is necessary to correct estimates of spawning biomass from acoustic surveys by the proportion spawning each year to estimate total mature biomass. However, although information is available on this proportion, it is very variable (1.01 – 1.91; Dunn *et al*., 2008). MPI (2013c) examined the various estimates of the proportion spawning, and selected a range of 1.1 to 1.91, and based stock status determination on the mean value of 1.49. The estimate of abundance on which 2013 management advice was based was 94,000t (a range from 69,400t to 120,500t, after accounting for the uncertainty associated with the proportion spawning). The DWFAWG noted that only 60% of the biomass was based on surveys of spawning plumes and Mt Muck, with the remainder of biomass based on early surveys and an estimate of the fraction of the mature biomass which does not spawn each year (MPI, 2013c). The time series of estimates of mature biomass for the South and East Chatham Rise decline then increase (Fig. 8). The increase is largely due to the inclusion of the Rekohu spawning plume. MPI (2013c) identified three hypotheses to explain the appearance of this plume: (a) the proportion of the total mature fish that migrated to the spawning grounds in 2011 and 2012 was higher than usual; (b) there has been a surge in recent recruitment; and (c) the Rekohu spawning plume has existed for some time but has not been discovered previously.

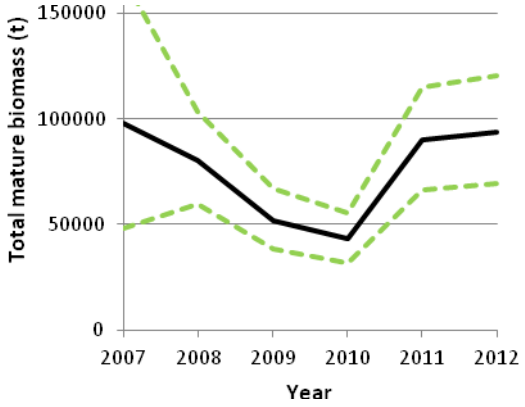

Fig. 8. Estimates of mature biomass in 2007-2012 from the 2008-2013 assessments respectively. The range in each year was generated by different assumed values of the proportion spawning (and also by different assumptions about target strength for 2007). (Source: MPI [2013c]).

Application of the harvest control rule for orange roughy requires estimates of current stock size relative to unfished stock size (B_0). Abandonment of the population model-based stock assessments makes determination of B_0 difficult. MPI (2013c) noted that the results of earlier models can provide 'ballpark' estimates of B_0 (between 300,000t and 450,000t).

Given the low productivity of orange roughy, these estimates of B_0 are essentially estimates of abundance from the 1990s plus cumulative historical catch.

Challenger Plateau

The fishery on the Challenger Plateau historically took place on the south-western region of the Plateau, both inside and outside the New Zealand EEZ. The total catch peaked during 1986-87 - 1989-89. The fishery was closed in 2000-01 and reopened in 2010-11 with a TACC of 500 t given the results of surveys which suggested increased biomass in the area.

The most recent assessment based on fitting a population dynamics model was conducted in 2005 (MPI, 2013d). This assessment was an update to a 2000 assessment which involved fitting a population model to a time-series of standardized CPUE data, along with trawl survey biomass indices and observer length-frequencies from the 1987-88 and 1998-89 fishing years. In 2010, the results of a 2009 acoustic-trawl survey of the Challenger Plateau were used to estimate biomass. In 2013, the estimate of total biomass was based on acoustic-trawl surveys for 2009-2011, while the estimate of B_0 (91,000t) was based on the 2000 assessment (MPI, 2013d). Although acoustic and trawl surveys have been conducted from 2005 through 2012, trawl survey estimates are only produced for 2005, 2009, and 2011-2012, and acoustic-trawl survey estimates for 2009-2012 using the method of Cordue (2012, 2013). This method combines estimates of biomass on spawning plumes with trawl estimates of biomass for other strata, and multiplies the resulting estimates by 1.1 to account for the difference between spawning and mature biomass. Data on age composition (Doonan *et al*., 2012) indicated that the spawning population in 2009 was much younger than in 1987.

Table 6 provides a summary statistics for 2009, 2010, 2011 and 2012 of mature-biomass distribution estimates (MPI 2013d).

Table 6: Summary statistics for 2009, 2010, 2011 and 2012 mature-biomass distribution estimates (MPI 2013d).

Year (model)	Median (t)	10^{th} percentile (t)	25^{th} percentile (t)	Mean (t)	CV (%)
2009	30 600	19 700	24 100	32 600	36
2010	18 400	12 700	15 100	19 300	31
2011	18 200	13 300	15 300	19 400	31
2012	17 300	10 700	13 500	18 500	38

3.3.e Stock status

Table 7 provides a summary of the estimates of the status of each of the four stocks, as reported by the MPI Stock Assessment Plenary (MPI, 2013b, c, d).

Table 7. Summary of stock status relative to the hard limit and the management target range (MPI, 2013a, b, c)

	MEC	Northwest Rise	ESCR	Challenger
Hard Limit	Very unlikely to be below limit	As likely as not to be below limit	Very unlikely to be below limit	Very unlikely to be below limit
Management Target	Unlikely to be above target	Very likely to be below target	Unlikely to be above target	Not reported
Overfishing	Unlikely	Unlikely	Unlikely	Very Unlikely

Very unlikely (< 10%); Unlikely (<40%), As Likely as Not (40-60%), Very likely (> 90%)

Mid-East Coast (ORH2A (South), 2B, and 3A)

The only stock with a current stock assessment is the MEC. The stock status for this stock depends on whether stock status is based on the MPD estimates or the median of the posterior and whether the Haist or Francis parameterization of recruitment is used (Table 8),

Table 8. B_{2013} as proportion of B_0 for the MEC stock (MPI, 2013b)

MPD Estimates		Posterior	
Haist	Francis	Haist	Francis
9	13	21 (12-33)	29 (21-38)

Northwest Chatham Rise

The most recent assessment for the Northwest Rise was conducted in 2006. Two runs were considered to be reliable by the MPI Stock Assessment Plenary. The estimates of the ratio of current to unfished biomass for these runs were 11% and 9%, and this stock was considered to be as likely as not to be below the hard limit.

East and South Chatham Rise

The estimate of stock status for the East and South Chatham Rise was based on comparing recent abundance from acoustic surveys with estimates of B_0 based on earlier population model-based assessments. This process lead to estimates of B_{2012}/B_0 of 0.25 (range 19-32%B_0). This range is based on the ratio of mature to spawning biomass of 1.49 (MPI, 2013c).

Challenger Plateau

The estimate of stock status for the Challenger Plateau stock involved using the results from trawl and acoustic surveys in 2005, 2006, and 2009-2012 to produce estimates of total mature biomass for 2009, 2010, 2011, and 2012. The 2009-2012 total estimates were combined to produce a single assessment for the 2013 assessment. The estimate of 2013 biomass was compared to a B_0 estimate from the 2000 assessment. The current biomass relative to B_0 ranged between 20 and 25%, depending how the abundance estimates for 2009-2012 were used.

3.3.5 Management advice

Management advice on setting TACCs for orange roughy is currently based on the New Zealand harvest strategy standard. The harvest strategy standard (MPI, 2006, 2008, 2011) aims to "provide a consistent and transparent framework for setting fishery and stock targets and limits and associated fisheries management measures, so that there is a high probability of achieving targets, a very low probability of breaching limits, and acceptable probabilities of rebuilding stocks that nevertheless become depleted, in a timely manner". The harvest strategy standard specifies probabilities for each of these outcomes. The harvest strategy standard is consistent with the 2008 Amendments to the Fisheries Act 1996. The harvest strategy (i.e. not the Fisheries Act) includes the need for a target reference point, a soft limit and hard limit. Stocks that are assessed to be depleted to below the soft limit require a formal, time-constrained rebuilding plan, while stocks that are depleted to below the hard limit should be considered for closure. Under the harvest strategy standard, stocks depleted to below soft limit should be rebuilt (with an acceptable probability) to at least the target level/range between T_{MIN} and $2XT_{MIN}$ where T_{MIN} is the theoretical minimum number of years required to rebuild a stock to the target in the absence of fishing (MPI, 2008). The harvest strategy standard was established following extensive consultation and review (including international peer-review of a draft of the standard). The harvest strategy standard is not, however, a management strategy because it does not specify, for example, the form of the harvest control rule, and the monitoring requirements, although both monitoring and some form of a harvest control rule are needed to implement the standard.

The proposed harvest strategy for orange roughy (DWG, 2013) states that the hard and soft limits will be $0.1B_0$ and $0.2B_0$ respectively while the management target will be the range 30% to 40% of B_0. The hard limit has been interpreted as the limit reference point. The proposed harvest strategy includes a fishing mortality rate reference point of F_{MSY} (assumed to equal the assumed value for natural mortality, M, 0.045yr^{-1}). Overfishing is deemed to

have occurred if fishing mortality exceeds F_{MSY}. The proposed harvest strategy is implemented using the harvest control rule given in Fig. 9. DWG (2013) notes that the biomass used when applying this harvest control is a 3-year running average of the estimates of biomass.

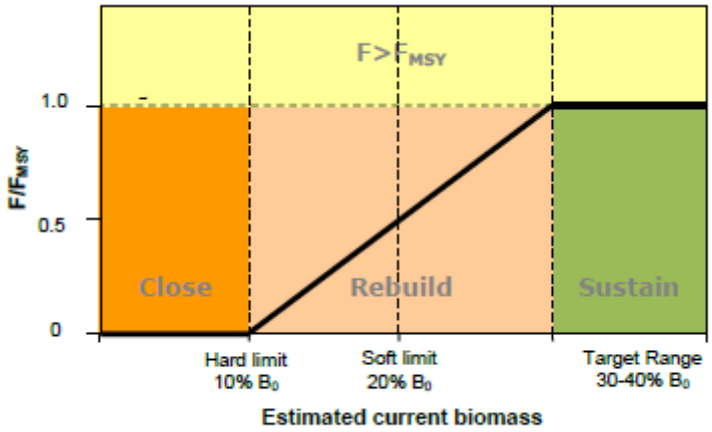

Fig. 9. The proposed harvest control rule (taken from DWG [2013]).

3.4 Principle Two: Ecosystem

3.4.1 The aquatic ecosystem, its status and any particularly sensitive areas, habitats or ecosystem features influencing or affected by the fishery

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

The NIWA “Seamounts database” holds information on 1,517 UTFs with 892 inside the New Zealand (NZ) Exclusive Economic Zone (EEZ) and 625 outside the EEZ (Clark 2013). Pitcher et al. (2007), Clark et al. (2010) and Rowden and Clarke (2010) summarized the ecological role of UTFs. The UTFs are well known as aggregation sites for pelagic fish and demersal species such as orange roughy and are important as benthic habitat for fishes (enhanced numbers and/or biomass) and invertebrates. UTF benthic biomass has been reported as 4 times that of the adjacent slope (Rowden and Clark 2010). The drivers of the differences include: the wide depth range offered by UTF elevation; variable substrate (Figure 10) that are suitable for a wide range of biodiversity including hard surfaces for attachment of sessile animals; current flow around the UTFs increasing food supply; and, regular input of food from the diurnal vertical migrations of animals from the mesopelagic to the epipelagic and back.

Reef-building stony corals (*O. Scleractinia*) are the main habitat-forming taxa on UTFs (Clark and Anderson 2013).

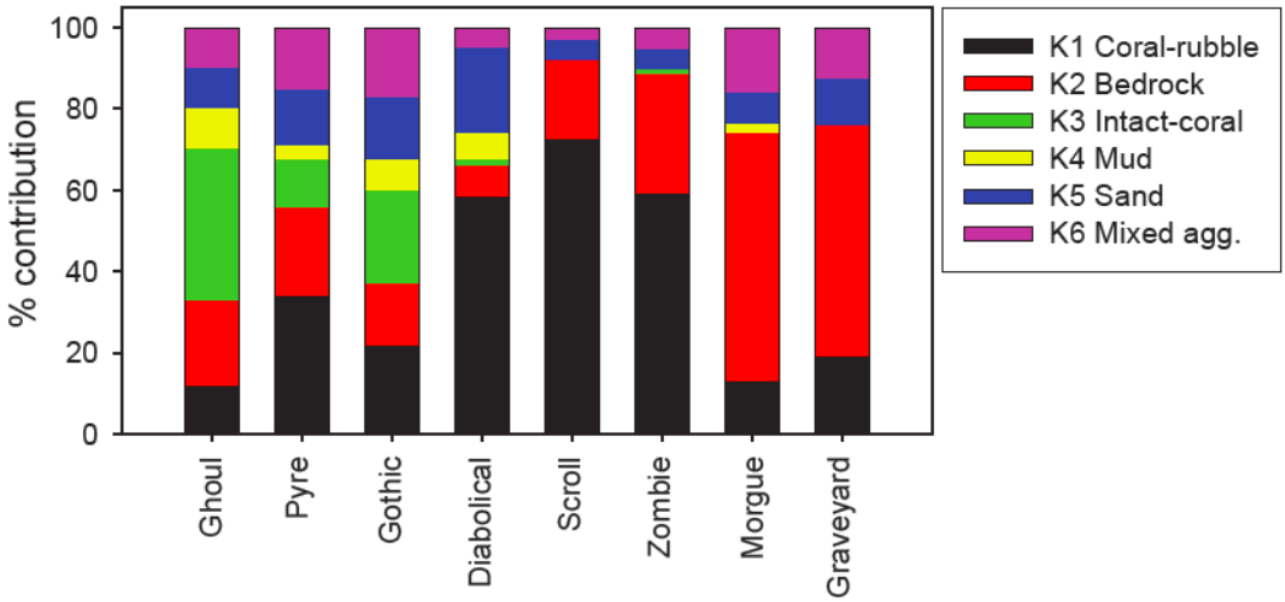

Figure 10: Proportion of substrate types for eight UTFs from Clark et al. (2010).

In the New Zealand Territorial Sea (TS) and EEZ there are substantial areas closed to bottom fishing, including marine reserves, marine protected areas (MPAs) and large Benthic Protected Areas (BPAs) and all contribute to protecting the environment generally and from the impact of trawling (Figures 11 and 12). These areas are largely based on the analysis of physical and some biological attributes and in total exclude bottom trawling from around 30% of the New Zealand EEZ to minimize benthic impact, safeguard habitats and protect representative marine benthic ecosystems and biodiversity in accordance with s 8(1) of the Fisheries Act 1996 which focuses on avoidance, mitigation or remedy of "*any adverse effects of fishing on the aquatic environment*."

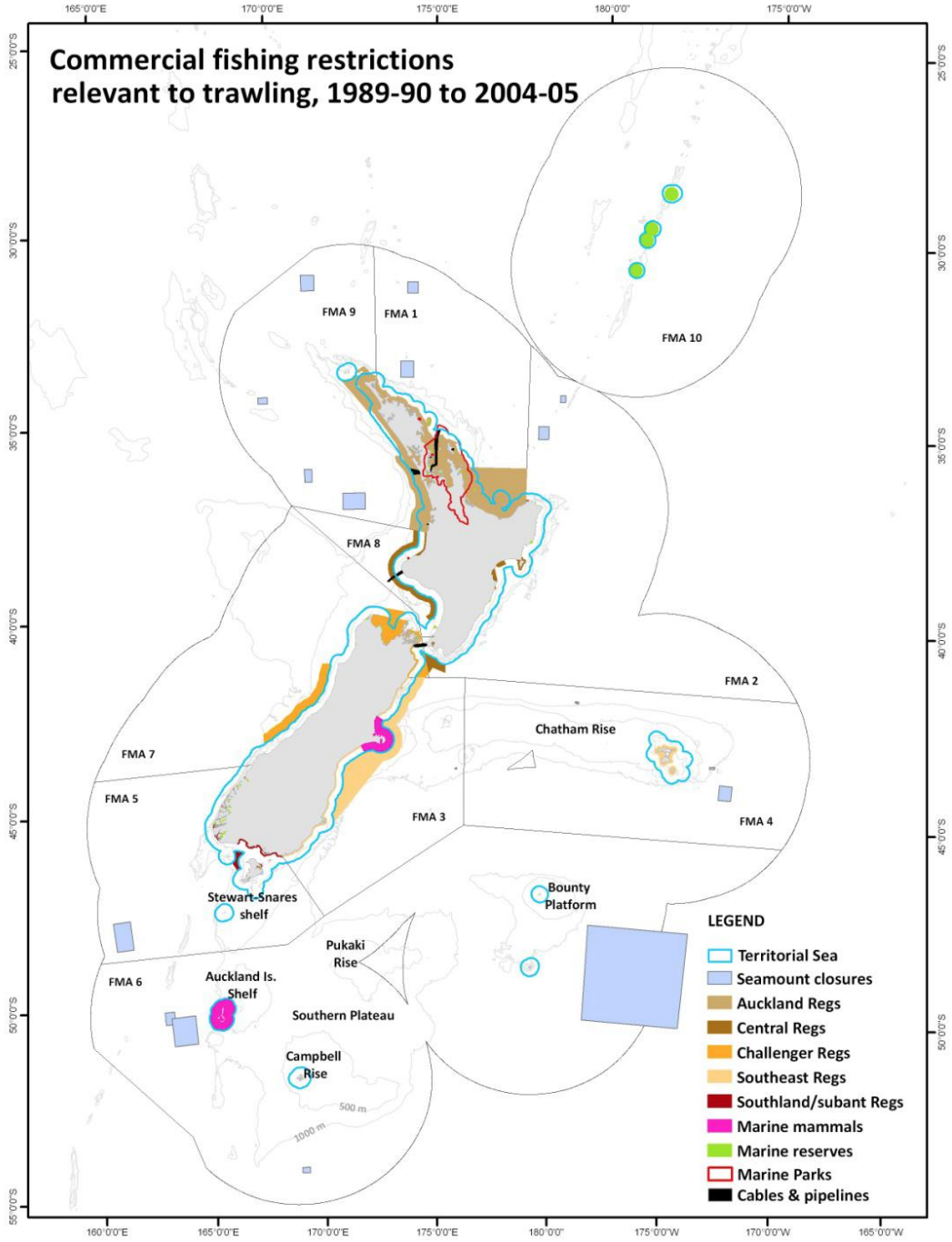

Figure 11: Map, from Baird and Wood 2010, of the major spatial restrictions to trawling present at some stage during 1989–90 to 2004–05 and the Ministry for Primary Industries Fishery Management Areas (FMAs) within the outer boundary of the New Zealand EEZ.) (From Figure 7.1; Ministry for Primary Industries 2012).

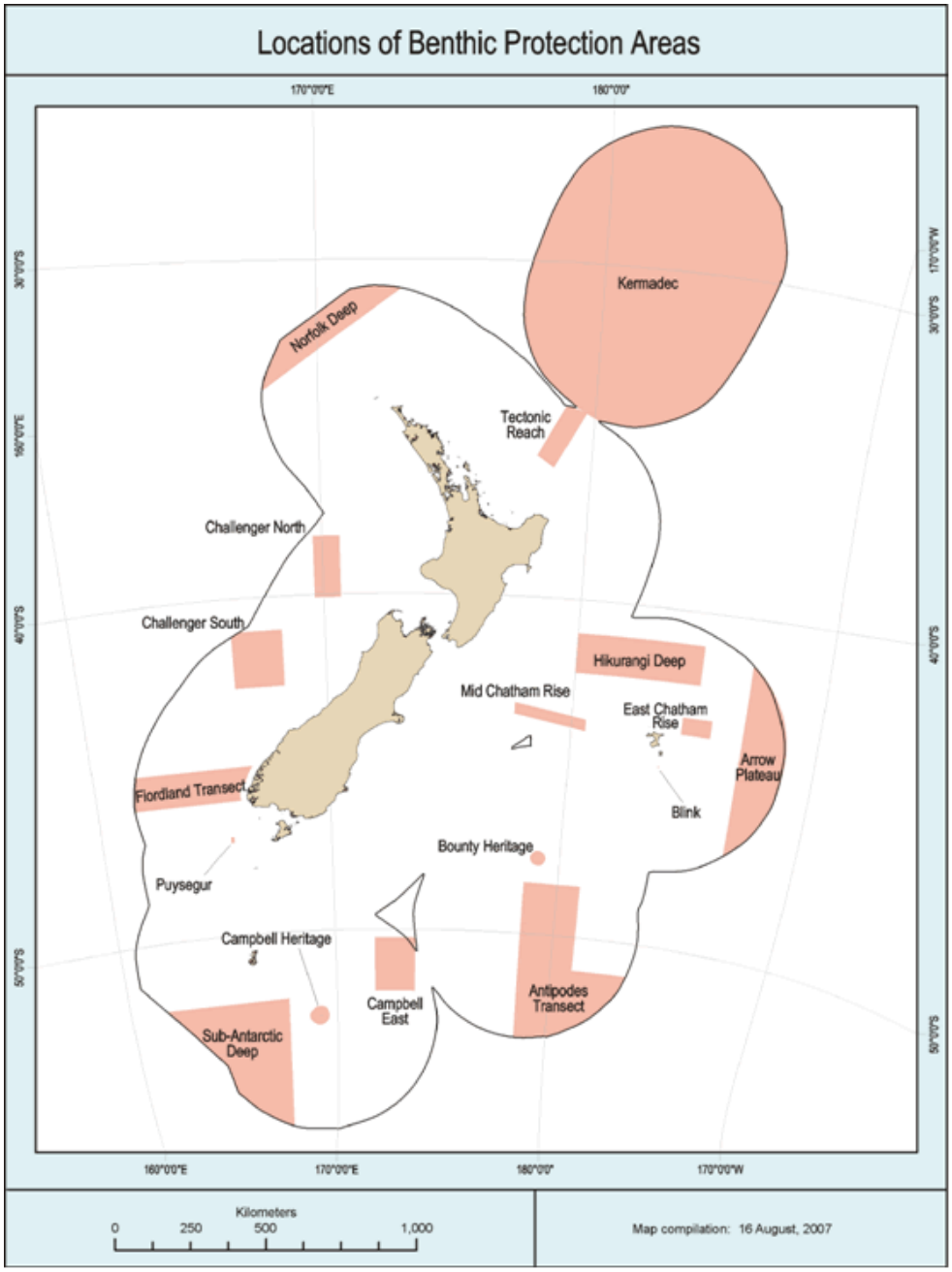

Figure 12: Map from Ministry of Fisheries website showing the general locations of Benthic Protection Areas (BPAs) (From Figure 7.3; Ministry for Primary Industries 2012).

3. 4.2 The retained and bycatch species

Estimation of annual bycatch and discard levels of non-protected species in New Zealand orange roughy fisheries have been undertaken at regular intervals since 1998 (Clark et al. 2000; Anderson et al. 2001; Anderson 2009, 2011, 2013). In a New Zealand context and in most New Zealand publications referred to above the term by-catch is of all non-target catch and includes both MSC 'retained' and 'by-catch' categories. Target fishing for orange roughy catches a relatively small amount of bycatch, with around 96 percent of the catch consisting of either orange roughy or other species managed under the Quota Management System (QMS), such as oreo (Family Oreosomatidae). All catches of species managed under the QMS are required by law to be landed by the fisher. Trawl duration is the key variable influencing bycatch rates and discard rates in the fishery. Increased non-commercial

species bycatch in orange roughy trawl catches between the mid-1990s and mid-2000s was shown to strongly correlate with an overall increase in mean trawl duration in the fishery (Ministry for Primary Industries 2012). There was a notable decrease in non-commercial by-catch in 2010-11 and 2011-12 (MPI & DWG (2013) as a result of a decrease in fishing effort and decreases in catch limits. Furthermore the bycatch rate of non-commercial species in all four ORH fisheries under assessment (UTFs and flats combined) is currently very low (DWG 2013).

In New Zealand waters there is a Government fisheries observer program and overall the level of observer coverage in the orange roughy fishery (MPI Observer Program) has been more than 10% (in terms of the total fishery catch) in all but one year, and over 50% in some years. The MPI Observer Program is specifically designed to address the need for accurate species identification (retained, bycatch and ETP species) as well as obtaining independent estimates of catch weights or numbers. Observer coverage was not evenly spread with notable under sampling of smaller vessels and the east coast fisheries. In the last 5 years (2007 to 2012) the observer coverage in the four management areas being assessed (ORH MEC, ORH7A, ORH3B NWCR and ORH3B ESCR) was relatively high except for the ORH MEC where it was relatively low in all years (Table 9).

Since 2005–06 orange roughy accounted for about 84% of the total observed catch across all orange roughy fisheries combined, including the 4 fisheries under assessment. Much of the remainder of the total catch (about 10%) comprised oreo species (Family Oreosomatidae): mainly smooth oreo (*Pseudocyttus maculatus,* 8%), and black oreo (*Allocyttus niger*, 2.1%). Rattails (various species, 0.8%) and shovelnose spiny dogfish (*Deania calcea*, 0.6%) were the species with high discard rates (90% discarded). Other fish species frequently caught and usually discarded included deepwater dogfishes (family *Squalidae*), especially *Etmopterus* species, the most common of which is likely to have been Baxter's dogfish (*E. baxteri*), slickheads, and morid cods, especially Johnson's cod (*Halargyreus johnsonii*) and ribaldo (*Mora moro*) (Ministry for Primary Industries 2012; Anderson 2011, 2013). In the last 5 years (2007 to 2012) the orange roughy catch in the four management areas being assessed (ORH MEC, ORH7A, ORH3B NWCR and ORH3B ESCR) was greater than 96% of the retained catch for all fisheries for all years except for 2011-12 in the ORH3B NWCR management area where it was over 88% of the catch. In 2011-12 in the ORH3B NWCR there was no target trawling for Orange Roughy. For these fisheries the non-orange roughy retained catch included black cardinal fish (*Epigonus telescopus*), hoki (*Macruronus novaezelandiae)*, alfonsino (*Beryx decadactylus)*, oreos, silver warehou (*Seriolella punctata)*, black oreo, smooth oreo, hake (*Merluccius australis)* and bluenose (*Hyperoglyphe antarctica)* (Irving 2013). There are significant differences in non-target catch of these species within each of the 4 fisheries under assessment.

In total, over 250 bycatch species or species groups have been observed, most being non-commercial species, including invertebrate species, caught in low numbers. Squid (mostly warty squid, *Onykia* spp.) were the largest component of invertebrate catch, followed by various groups of coral, echinoderms (mainly starfish), and crustaceans (mainly king crabs, Family *Lithodidae*). Although the catch composition varies among the four orange roughy fisheries under assessment, a general pattern of declining bycatch and discards has occurred. Total annual bycatch in all New Zealand orange roughy fisheries since 1990–91 ranged from about 2 300 t to 27 000 t, and declined over time alongside the decline in the catch and effort in the New Zealand orange roughy fisheries to be less than 4 000 t in each of the last four years (Figure 13). By-catch is mostly comprised of retained species, with non-commercial species accounting for only 5–10% by weight of the total bycatch in the recent period. Estimated total annual discards also decreased over time, from about 3,400 t in 1990–91 to about 300 t in 2007–08 (Figure 14), and since about 2000 discards were almost entirely non-commercial, non-QMS species (Ministry for Primary Industries 2012).

For the four fisheries under assessment there is specific data on non-target catch from observer data for the five fishing years 2007 to 2012 (Boyd 2013; DWG 2013). The observer coverage of the fisheries has been moderate to high in most years, with the exception of the ORH MEC fishery where it has been low in all years (Table 9). The 100% observer coverage in ORH7A is the result of this fishery being closed with the only fishing in the past five years having been conducted as part of research surveys (Boyd 2013). The small number of tows in ORH3B NWCR in the past two years is the result of an agreement by industry to cease ORH target fishing in the area to provide for the rebuild of this stock size (Boyd 2013). Several hundred non-target fish species were identified in the catch (Deepwater Group Ltd, Ministry for Primary Industries 2013).

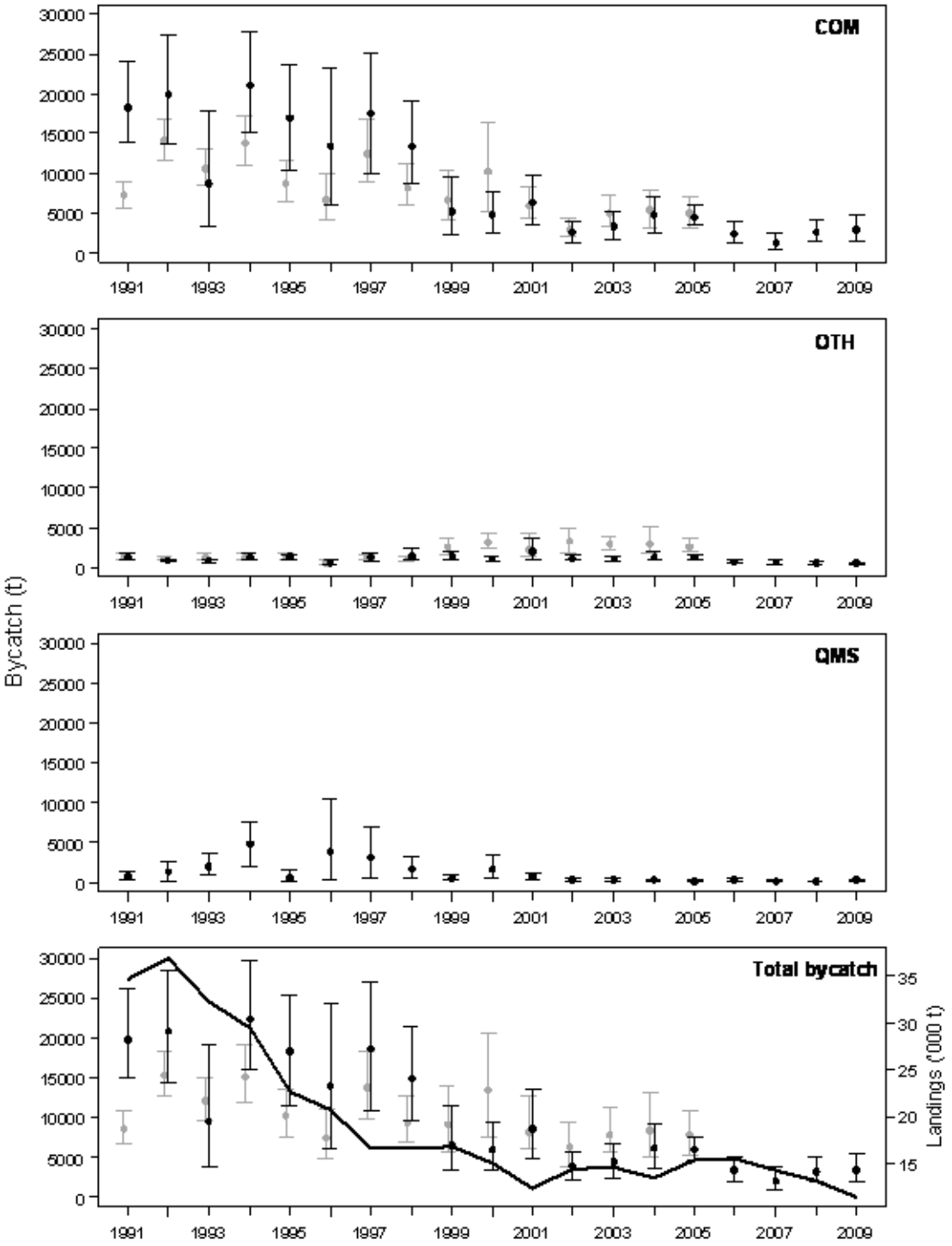

Figure 13: Annual estimates of fish bycatch in the orange roughy trawl fishery, calculated for commercial species (COM), non-commercial species (OTH), QMS species, and overall for 1990–91 to 2008–09 (black points). Also shown (grey points) are earlier estimates of bycatch in each category (excluding QMS) calculated for 1990–91 to 2004–05 (Anderson et al. 2001, Anderson 2009). Error bars show the 95% confidence intervals. The black line in the bottom panel shows the total annual estimated landings of orange roughy (O. Anderson and M. Dunn (NIWA), unpublished data). (From Figure 6.13, Ministry for Primary Industries 2012).

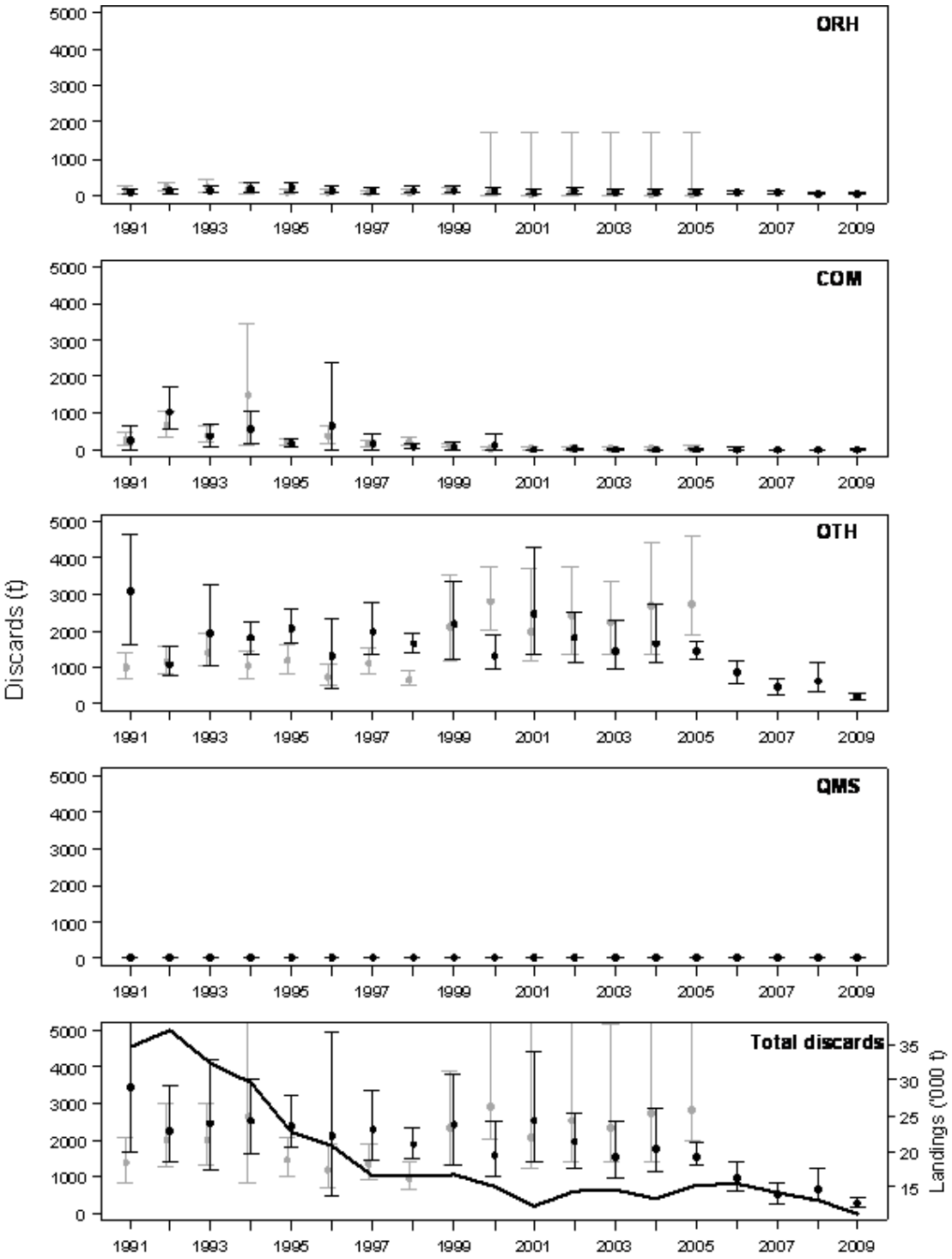

Figure 14: Annual estimates of fish discards in the orange roughy trawl fishery, calculated for the target species (ORH), commercial species (COM), non-commercial species (OTH), QMS species, and overall for 1990–91 to 2008–09 (black points). Also shown (grey points) are estimates of discards in each category (excluding QMS) calculated for 1990–91 to 2004–05 (Anderson et al. 2001, Anderson 2009a). Error bars show the 95% confidence intervals. The black line in the bottom panel shows the total annual estimated landings of orange roughy (O. Anderson and M. Dunn (NIWA), unpublished data). (From Figure 6.14, Ministry for Primary Industries 2012).

Noting the large number of retained and bycatch species caught in the four fisheries being assessed, the majority of which are caught in very small quantities; Boyd (2013) used the following three criteria to identify retained species or species groups that should be included

in an assessment of the ecosystem effects of fishing for the four management areas under assessment.

1. A catch that is ≥5% of the total catch of all species in the fishery (or base on expert knowledge very near that level of the total catch).
2. For species where the catch is between 1 and 5% of the total catch, the catch in the target orange roughy fishery is known to be or suspected to be a significant proportion (≥20%) of the total catch of the stock of that species, or the total catch of the species is large.
3. For 'vulnerable species' (e.g., low productivity species or severely depleted species) a catch that is ≥1% of the total catch of the ORH target fishery, or the catch is <1% of the total catch of the target fishery where the catch by the target orange roughy fishery is ≥10% of the total catch of that species.

The approach seems appropriate for the four fisheries being assessed. It does, however, include more 'main' species than would occur under the draft recommendation MSC for distinguishing between main and minor species (MSC 2013 http://improvements.msc.org/database/principle-2-minimising-environmental-impact/consultations/late-stage-consultation-principle-2-minimising-environmental-impact-sept-oct-2013/20130911_Late_stage_consultation_P2_merged_FINAL%20TO%20UPLOAD.pdf): main species are proposed as >5% of the catch of the unit of assessment or >20% of the total catch of the species ("5/20"), except vulnerable species for which main species are proposed as >2% of the catch of the unit of assessment or >10% of the total catch of the species ("2/10"). Using the 5/20 criteria, only alfonsino in MEC smooth oreo in 3B ESCR would be main retained species, and none would be vulnerable retained main species under the 2/10 criteria. Using the 5/20 criteria, no bycatch species exceeded 5% of the orange roughy catch in any of the areas. Chimaera catch in the orange roughy fishery exceeded 10% and 20% of the total chimaera catch and shovelnose dogfish catch in the orange roughy fishery exceeded 20% of the total shovelnose dogfish catch (Boyd 2013), so would be designated as a main bycatch species under the 5/20 or 2/10 criteria.

Table 9: Annual trawl effort (total tows) and observer coverage (% of total tows observed) for each of the four orange roughy management areas (ORH3B ESCR, ORH3B NWCR, ORH7A and ORH MEC) (From Deepwater Group Ltd, Ministry for Primary Industries (2013) as reported in Boyd 2013)

	ORH3B ESCR		ORH3B NWCR		ORH7A		ORH MEC	
Year	**No. Tows**	**% obs.**	**No. tows**	**% obs.**	**No. tows**	**% obs.**	**No. tows**	**% obs.**
2007–08	1999	47	283	64	0	-	525	8
2008–09	1952	51	183	33	65	100	581	1
2009–10	1272	57	282	30	78	100	620	8
2010–11	481	25	11	64	113	100	658	16
2011–12	466	26	9	11	105	100	468	12

Using these three criteria and Anderson (2011) to categorize 'retained species' and 'bycatch species', Boyd (2013) identified the following 7 retained species and 9 bycatch species/species groups to be assessed.

Retained Species/Species Groups

1. alfonsino (*Beryx splendens*), ≥5% of the total catch in one or more orange roughy fisheries
2. smooth oreo (*Pseudocyttus maculatus*, SSO), ≥5% of the total catch in one or more orange roughy fisheries
3. black oreo (*Allocyttus niger*), large tonnage in one or more fisheries
4. black cardinalfish (*Epigonus telescopus*), low productivity

5. pale ghost shark (*Hydrolagus bemisi*), low productivity
6. dark ghost shark (*Hydrolagus novaezealandiae*), low productivity
7. smooth skate (*Dipturus innominatus*), low productivity

Bycatch Species/Species Groups
1. Slickhead (*Alepocephalidae* Family)
2. Morid cods (*Moridae* Family)
3. Rattails (*Macrouridae* Family)
4. Deepwater skates and rays (*Rajidae, Torpedinidae, Narkidae, Dasyatidae, Myliobatidae, Mobulidae* Families)
5. Chimaeras (*Chimaeridae* and *Rhinochimaeridae* as a group)
6. Shovelnose dogfish (*Deania calcea*)
7. Seal shark (*Dalatias licha*)
8. Baxter's dogfish (*Etmopterus baxteri)*
9. Deepwater dogfish (non-specified)

All the main retained species are QMS species (Boyd 2013). Hoki (*Macruronus novaezelandiae)* was excluded from the analysis as it is already MSC certified. An Expert Panel undertook an Assessment of the Environmental Effects of Fishing (AEEF) for each of the 4 orange roughy fisheries under assessment (Boyd, 2013). Essentially this AEEF was a qualitative ecological risk assessment to assess the ecological effects of orange roughy fishing in the four management areas under assessment against the MSC P2 80 SG standards. For bycatch this assessment considered seven retained species and nine bycatch species/species groups. The assessment took into consideration biomass status, biomass trend, population structure and scale of the fishery following the approach of Fletcher (2005).

The Panel concluded the risks of serious or irreversible harm to retained species as being negligible or very low, noting that all of the main retained species are managed under the QMS with active research programs; however, not all of the main retained species had regular stock assessments. The summary of key information for main retained species follows:

Alphonsino. The catch of alphonsino in the orange roughy fishery exceeds 5% only in the MEC (DWG and MPI 2013), so is not a main species in other areas. The status is unknown, but the biomass is considered to be above a proxy of B_{40} and the fishing mortality as below F_{target} in all areas (DPI 2013 V1). The alphonsino stock is apparently within biological limits.

Black cardinal. The AEEF (Boyd 2013) considered black cardinal as vulnerable, but it exceeds 1% of the catch only in the MEC and does not exceed 2% (DWG and MPI 2013). The black cardinal stock is declining with a base estimate of biomass at $12\%B_0$, a >60% chance of falling below the soft limit, and a 40-60% chance of falling below the hard limit, according to a 2009 stock assessment (DPI 2013 V1). DPI (2013 V1) stated that the decline started with the beginning of the orange roughy fishery in FMA2 (Figure 1). The primary overlap of the orange roughy fishery with black cardinal occurs in ORH MEC. In spite of the AEEF conclusion that the orange roughy fishery has minimal risk to the black cardinal fishery (Boyd 2013), the declining abundance, out of date stock assessment, and possibility of falling below the soft and hard limits could put black cardinal in a vulnerable status; and the possible link of the declines with the orange roughy fishery points to the benefits for more evaluation of the orange roughy impacts in ORH MEC as it cannot be determined if black cardinal is within biological limits in the MEC.

Black oreo. Black oreo catches do not exceed 5% of the catch in any of the orange roughy units of assessment but exceeds 2% in the 3B ESCR (DPI and MPI 2013). No current stock assessment exists as the model was withdrawn due to likely inaccurate assumptions (DPI

2013 V1). Catches have decreased with decreasing TACC, but lack of useable assessment results provides no justification for the TACC values. If the low proportion of black oreo in the orange roughy catch moves it into a minor species designation, it would not need consideration at the 80 level. If black oreo continues as a main species it would not have sufficient information to determine if the status is within biological limits in the ORH ESCR.

Smooth oreo. Smooth oreo catches exceed 2% in MEC, 3B NWCR and 3B ESCR, and exceeds 5% in 3B ESCR. Stock assessments in EOE 1, 3A, 6 Bounty show the smooth oreo as unlikely below the limit reference point. Most of the smooth oreo catch taken in the ORH3B ESCR fishery is taken from the OEO4 stock. A 2012 stock assessment shows the OEO4 stock within biological limits (MPI 2013 V2).

Dark ghost shark. The total catch of dark ghost shark has generally been below TACCs, but lack of an assessment means that no determination of stock status has occurred, and it is unknown if the TACCs are sustainable (DPI 2013 V1). The large majority of dark ghost shark catch comes from the hoki fishery; the certified hoki fishery received a recommendation in its Public Certification Report that more information on ghost shark is desirable (IMM 2012). Given the very minor role of orange roughy in catch of dark ghost shark, one can conclude that the orange roughy fishery would not jeopardize the stock of dark ghost shark or would not hinder recovery if the stock were depleted.

Pale ghost shark. The total catch of pale ghost shark has generally been below TACCs, but lack of assessment means that no determination of stock status has occurred, and it is unknown if the TACCs are sustainable. Trawl surveys in areas GSP1 and GSP5 show no impact of the fisheries on the trawl survey index. The incidental catch of pale ghost shark in GSP1 occurs mostly from the hoki fishery, which received a recommendation for more information (IMM 2012). Given the very minor role of orange roughy in catch of pale ghost shark, one can conclude that the orange roughy fishery would not jeopardize the stock of pale ghost shark or would not hinder recovery if the stock were depleted.

Smooth skate. The catch of smooth skate in orange roughy fisheries occurs at levels less than 0.01% of total catch (DWG and MPI 2013). The lack of assessment means that no determination of stock status has occurred, and it is unknown if the TACCs are sustainable. Given the very minor role of orange roughy in catch of smooth skate, one can conclude that the orange roughy fishery would not jeopardize the stock of smooth skate or would not hinder recovery if the stock were depleted.

For the bycatch species/species groups the Panel assessed the risks of serious or irreversible harm to bycatch species or species groups as being low to moderate (Boyd, 2013). The primary risk issues identified related to limited information for particular species groups including the slickheads (Alepocephalidae), chimaeras (Chimaeridae and Rhinochimaeridae), and some species of deepwater shark species but noted there is information for these species, mostly from current observer and trawl survey data that is still to be analysed. Of the species or species groups considered in Boyd (2013), none has sufficient information to determine abundance relative to biological limits. Under the requirements of CR v1.3, these species require a PSA if determined to be main species.

Slickheads. Slickheads exceed 1% of the total catch in the MEC and 3B NWCR regions of the orange roughy fisheries, but do not exceed 2% (DWG and MPI 2013). Several of the slickhead species are considered vulnerable in Fish Base (http://www.fishbase.org/NomenClature/ScientificNameSearchList.php?crit1_fieldname=SYNONYMS.SynGenus&crit1_fieldtype=CHAR&crit1_operator=EQUAL&crit1_value=Alepocephalus&group=summary). As status determination has not occurred, a PSA is required if slickheads remain as a main species.

Morid cod. Morid cod exceed 1% but less than 2% of the total catch in the 3B NWCR and 3B SECR regions of the orange roughy fisheries (DWG and MPI 2013). Johnson's cod is not considered vulnerable in FishBase, although *Lepidion inosimae,* the only species listed as generic morid cod in Fish Base*,* is considered vulnerable and low resilience (http://www.fishbase.org/Summary/SpeciesSummary.php?ID=23146&AT=Morid cod).

Rattails. Rattails exceed 2% but less than 5% of the total catch of the orange roughy fisheries in the 3B NWCR and 3B ESCR regions of the orange roughy fisheries and exceed 2% in the NWCR fishery (DWG and MPI 2013). *Coelorinchus fasciatus,* the New Zealand rattail in FishBase, is considered low resilience and moderate to high vulnerability (http://www.fishbase.org/Summary/SpeciesSummary.php?ID=7131&AT=rattail). As status determination has not occurred, a PSA is required if rattails remain as a main species.

Deepwater skates and rays. Deepwater skates and rays as a group do not exceed 1% of the total catch in the orange roughy fisheries (DWG and MPI 2013). Given the very minor role of orange roughy in catch of deepwater skates and rays, one can conclude that the orange roughy fishery would not jeopardize the stocks of deepwater skates and rays or would not hinder recovery if the stock were depleted.

Chimaeras. Chimaeras make up less than 1% of the total catch in the orange roughy fisheries (DWG and MPI 2013). However, catch from the orange roughy fisheries may make up 10-20% of the total chimaera catch in each of the orange roughy QMAs (Boyd 2013). As status determination has not occurred, a PSA is required if chimaeras remain as a main species.

Shovelnose dogfish. Shovelnose dogfish make up less than 1% of the total catch in the orange roughy fisheries (DWG and MPI 2013). However, catch from the orange roughy fisheries may make up 20-40% of the total shovelnose dogfish catch in each of the orange roughy QMAs (Boyd 2013). Shovelnose dogfish is considered as high to very high vulnerability in Fish Base (http://www.fishbase.org/Summary/speciesSummary.php?ID=670&AT=shovelnose+dogfish). As status determination has not occurred, a PSA is required if chimaeras remain as a main species.

Seal shark. Seal shark dogfish make up less than 1% of the total catch in the orange roughy fisheries (DWG and MPI 2013); catches in the orange roughy fisheries make up less than 10% of total catch of the species, so have minimal impact on the seal shark stocks.

Baxter's dogfish. Baxters dogfish exceed 1% but less than 2% of the total catch in the 3B NWCR region of the orange roughy fisheries (DWG and MPI 2013). Baxter's dogfish is considered as low resilience and moderate to high vulnerability in Fish Base (http://www.fishbase.org/summary/Etmopterus-baxteri.html). As status determination has not occurred, a PSA is required if Baxter's dogfish remains as a main species.

Deepwater dogfish. Deepwater dogfish as a group exceed 1% but less than 2% of the total catch in the 7A region of the orange roughy fisheries (DWG and MPI 2013). The vulnerability of deepwater dogfish is assumed high in the absence of other information. The amount of catch by the orange roughy fisheries of the total deepwater dogfish is not presented. As status determination has not occurred, a PSA is required if deepwater dogfish remains as a main species.

All non-QMS species are monitored through both detailed catch reporting and observer programmes. Non QMS species are further monitored where possible in trawl surveys (biomass, population structure etc., i.e. ORH7A Trawl Survey). This allows tracking of some trends for use in determining if catch patterns change. If available information indicates

more specific management is required, then the QMS species may be introduced into the QMS.

3. 4.3 Endangered, threatened and protected (ETP) Species

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

- Legislation: the Fisheries Act, Wildlife Act, and Marine Mammals Protection Act
- The National Plan of Action – Sharks (MPI 2013)
- The Annual Operational Plan for Deepwater Fisheries (MPI 2012)
- The National Fisheries Plan for Deepwater and Middle-depth Fisheries: Part 1B, Hoki chapter (Ministry of Fisheries 2010)
- The Marine Conservation Services Programme (e.g., Annual Plan, DOC 2011)

The AEEF panel (Boyd 2013) assessed the following species or species groups that are protected under the provisions of the NZ Wildlife Act 1953; not all of these groups (e.g., black backed gull) occur in the area of assessment.

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

A review of CITES Appendix 1 for the pre-assessment workshop indicated that there are no relevant marine species not included in the current list of New Zealand protected marine species and there are no relevant listed species that are not protected under NZ legislation, although no specific documentation was presented.

Protected fishes

There have been no recorded captures of oceanic white tip shark, white pointer shark, whale shark, deepwater nurse shark, manta ray, spine tail devil ray, giant grouper or the spotted black grouper in the fisheries being assessed (Deepwater Group Ltd, Ministry for Primary Industries 2013; Rowe 2009, 2010; Ramm 2010, 2012a, 2012b; Anderson 2011, 2013; Francis and Smith 2010; Francis and Lyon 2012; Francis and Sutton 2012). Furthermore, whale shark, manta ray, giant grouper and marine reptiles are tropical/subtropical species and do not occur in the range of the four orange roughy management areas under assessment. There have been records of the capture of the deepwater nurse shark but there are significant misreporting and misidentification issues for this species and New Zealand catch records are unreliable and almost certainly wrong (Igor Debski, NZ Department of Conservation, pers com as reported in Boyd 2013).

The AEEF Expert Panel identified the basking shark (*Cetorhinus maximus*) as potentially at risk but, following a risk assessment focused on fishing mortality/cryptic impacts and population status, concluded there was no risk or a negligible risk to this species (Boyd, 2013). In coming to this assessment the Panel noted the available information indicates very low interactions of basking sharks with the orange roughy fisheries as evidenced by no reported captures. While there is a lack of information on the status of basking shark populations, any risk to the basking shark from the orange roughy fisheries is low and considered to be of minimal consequence (Boyd, 2013).

Seabirds and Marine Mammals

Orange roughy fishing vessels in the four orange roughy fisheries catch relatively few seabirds and no marine mammal captures have been recorded in the last five years. Orange roughy fishing boats catch relatively few seabirds or marine mammals (Thompson and Berkenbusch, 2013). All orange roughy fishing boats >28 m have regulations on use of net sonde cables and are required by law to deploy devices to keep birds away from the fishing gear, where they may be in danger of getting caught (MPI 2013). Industry standards, supported by MPI, require all orange roughy vessels to agree to a Vessel Management Plan that specifies the management of the disposal of fish waste to minimise it as an attractant to seabirds (MPI 2012, 2013). Thompson and Berkenbusch (2013) estimated the total number of seabirds and marine mammals that were incidentally captured in New Zealand orange roughy trawl fisheries in the period between 2002–03 and 2011–12. A total of 47 seabird captures were recorded in the four fishery management areas being assessed and no marine mammals were recorded. Most of the observed seabird captures (37 captures) occurred on the East and South Chatham Rise and Northwest Chatham Rise (9 captures). Captures included Salvin's (*Thalassarche salvini*), Buller's (*Thalassarche bulleri*), white capped (*Thalassarche steadi*), Chatham albatrosses (*Thalassarche eremita*) and unidentified large albatross. Richard and Abraham (2013) provide semi-quantitative estimates of the risk to New Zealand seabird species from all commercial fisheries including the four management areas under assessment.

The AEEF Expert Panel used data from Thompson and Berkenbusch (2013) and Richard and Abraham (2013) assessments to identify Salvin's albatross, Chatham Island albatross, and northern giant petrel as species that could potentially be at risk and therefore should be considered in an assessment of impact in the four orange roughy fisheries (Boyd, 2013). Boyd (2013) analysis focused on fishing mortality/cryptic impacts and population status. As the estimated captures for the three species in all four fishery management areas being assessed are negligible to very low they concluded the risks of serious or irreversible harm to Salvin's albatross was low and the same for the other two species of birds subject to clarifying the species composition of Thompson and Berkenbusch (2013) "other albatross" category.

Coral

The UTFs in the New Zealand region contain a rich scleractinian assemblage – higher than those recorded in other ocean basins (presentation by Clark to the pre-assessment team). Consalvey et al (2006), Baird et al. (2012), Tracey et al. (2011a) and Tracey et al. (2011b) summarised their taxonomic and distributional information. Currently 105 azooxanthellate scleractinians are recorded in the New Zealand region (representing 15% of the known azooxanthellates) with 80% occurring on the upper slope (defined as 200 – 1000m) and 39% on the lower slope (defined as 1000 m to 3000 m (Cairns 1995); the % values exceed 100 because some species occur in more than one zone). Cairns (1991) reported 32% of New Zealand scleractinians were estimated to be endemic but care must be taken with the interpretation of this number, as it is likely that these species could be found to be more

cosmopolitan with an increased sampling effort (Clarke and Anderson 2013). Tracey (2011a) pointed out that distribution data of corals from fishing vessels do not adequately reflect the true distribution for the region and are an artefact of sampling effort but that the coral collection programme from fishing vessels has provided a diverse and extensive collection of corals and an expanding valuable data source.

Baird et al. (2012) analysed 7731 records from research samples (58%) and commercial fishing vessels where observers had been present (42%) of which 46% were stony corals (56 genera from 15 families in the Order Scleractinia), 33% were gorgonians (57 general from 8 families in Order Alcyonacea), 11% were hydrocorals (16 genera from one family in Order Anthoathecata), and 10% were black corals (26 families from 7 genera in Order Antipatharia). Their analysis indicated coral records from the four orders were distributed throughout the Fishery Management Areas, though differences by area and depth were evident at the family and genus level, where lower taxonomic detail was available. Baird et al (2012) also modelled the distribution of the corals and predicted the areas likely to have the greatest probability of coral occurrence were outside the main fisheries areas, except for some deepwater fisheries that occurred on areas of steeper relief. Baird et al (2012) concluded the fisheries that pose the most risk to protected corals are the deepwater trawl fisheries for species such as orange roughy, oreo species, black cardinalfish, and alfonsino. In 2004 Tracey et al (in prep) recorded 422 records of scleractinians in New Zealand and *Goniocorella dumosa* is the most common species recorded (40%).

Four coral species are of particular relevance to the four management areas being assessed (i.e. occur in the trawling depth range) - *Solenosmilia variabilis, Madrepora oculata, Enallopsammia rostrata* and *Goniocorella dumosa* (Clark and Anderson 2013). The AEEF Expert Panel (Boyd, 2013) undertook an assessment of the risk to protected corals based on the coral morphological types (tree like, reef forming, erect/whip like and solitary) and the distribution of the corals (Baird et al. 2012; and Tracey et al. 2011a,b,c) and the proportion of the total habitat area of each coral type that is potentially impacted by trawling (Clark and Anderson 2013 and Stewart 2013). Between 2007 and 2012 the percentage of the area trawled in the four management orange roughy fisheries has ranged between 0.3% in ORH7A to 13.4% in MEC. For the past 23-years (1989 to 2012), the percentage of the swept area in each of the orange roughy fisheries areas has ranged between 11.0% in ORH7A to 50.1% in each of MEC and NWCR (Stewart 2013). Boyd (2013) reported the risks of serious or irreversible harm to corals was assessed by the Expert Panel to be low to moderate and that the risks are related mainly to limited taxonomic information, noting but did not describe differing views amongst the panel members about this assessment.

Tracey (2011a) and Consalvey (2006) concluded that the overlap of coral distribution and the fishing activities, combined with corals low productivity long recovery period, makes deep-sea corals especially vulnerable to damage by fishing gear. Eighty per cent of known seamounts in the appropriate depth range have been fished (Clark and O'Driscoll 2003). The fishery areas of highest risk to protected corals were the underwater topographic feature (UTF) focused, deepwater fisheries for orange roughy and oreo species, including the northern and southern slopes of the Chatham Rise (Tracey 2011a); the coral catch from the orange roughy fishery on the Chatham Rise included mainly black corals, stony branching and cup corals, and coral rubble, with relatively smaller catches of bubblegum coral, precious coral, other gorgonians such as primniods or plexaurids, and hydrocoral. DWG and MPI (2013) show that the catch or corals in the orange roughy fisheries differs substantially by area, ranging from a few 10s of kilograms observed in ORH MEC and ORH 7A over the period 2007-2008 to 2011-2012 to 10s of thousands of kilograms in ORH 3B SE. This suggests

Consalvey (2006) summarized the possible effects of coral damage to the ecosystem, including changes to local hydrodynamic and sedimentary conditions and a shift from a

diverse reef community to a reduced species/biomass “disturbance” community; reduced reproductive output from (1) a reduction in colony size; (2) an increase in energy resources channelled to repair rather than growth/reproduction, (3) immature colonies being delayed to reach maturity, and (4) the loss of larger individuals with a disproportionately large contribution to the reproductive output of the entire population.

According to Black at al. (2013), there have been no studies investigating whether current trawling frequencies have had adverse effects on the structure and function of benthic communities, or on the productivity of the associated fisheries. In the orange roughy fishery on the Chatham Rise, which is prosecuted primarily in the 800–1200 m depth zone, there is evidence that fishing effort has shifted geographically over time in response to changes in catch rates on individual hills (MPI 2012). The fishery expands to new areas each year, but the rate of additional ‘new area’ subjected to trawling in each successive year has continued to decline throughout the time series (Black et al. 2013). In 2009/10 new area amounted to 3208 km2, which is 4% of the 2009/10 trawl footprint of 79 512 km2 and less than 1% of the cumulative swept area for the period 1989/90 to 2009/10 of 385 032 km^2. However, the extent to which this might be linked to impaired benthic ecosystem functioning has yet to be determined.

Yet, heavily fished seamounts may still contain diverse assemblages, and no difference in species number or community structure in coral-dominated seamounts within or outside of a protected area (coral dominance indicated no or only light fishing) has been observed (Consalvey 2006). It is possible that coral diversity may be maintained on fished seamounts, as many are fished only on established tow lines, leaving some areas of the seamount, often where the seabed is particularly rough, unfished.

Boyd (2013) pointed out that corals are fully protected species, but there is no overall management plan. The orange roughy fishery is spatially managed with defined areas where bottom trawling or all trawling is prohibited (e.g., benthic protected areas (BPAs), ‘seamount’ closures), which provide some protection for corals. Managed areas have closed approximately 30% of UTFs to trawling; the remaining open areas allow for potential expansion of trawling beyond the current footprint of the fishery. If the protection of corals from trawling in the orange roughy also relies on fishing only on established tow lines, a mechanism for how the restriction to these tow lines occurs is not clear from the available information.

Cold water corals are fully protected under the Wildlife Act 1953. Interactions with fisheries are monitored through the NZ Observer Programme and vessel reporting. When impacts of fishing are such that they are causing an adverse effect on the Marine Environment (Fisheries Act s 2, s8), measures are to be taken pursuant to the Conservation Act 1987 and the Director-General of where the Department of Conservation will implement measures, including:

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

3. 4.4 Details of any critical environments or sources of concern and actions required to address them

The reef-building stony corals are particularly vulnerable to trawling as their structure is very fragile and fragments on contact (Consalvey 2006, Clark et al. 2010, Tracey et al. 20111a).

Clark and Koslow (2007) and Clark and Rowden (2009) in a study of the Graveyard hill complex compared fished, unfished UTFs and fished UTFs that were subsequently closed to trawling. Both studies found substrate diversity and the amount of intact coral matrix were lower on fished seamounts. Conversely, the proportions of bedrock and coral rubble were higher. There were also differences in benthic community composition between fished and unfished UTFs. Both studies concluded that the physical impact of trawling is an important contributing factor to the differences between the fished and unfished UTFs. From these studies and similar studies in Australia by Williams et al. (2011) there is no evidence of recovery of impacted stony coral habitat on the UTFs that have been trawled. Differences continued after the cessation of trawling with little change in the mega-faunal assemblage consistent with recovery on seamounts where trawling had ceased for 5 to 10 years. Recovery of stony coral habitat is forecast to be very slow (decadal time scales or more) (Clark et al. 2010; Williams et al. 2010).

The substrates of UTFs can be highly variable e.g. rock, mud, sand, gravel and there may be other indirect impacts of trawling including sedimentation clouds, sediment/substrate reworking, chemical changes and water quality. These potential indirect impacts of trawling are difficult to measure and not well understood.

There are 236 UTFs (197 hills, 24 knolls and 15 seamounts) within the four fisheries management areas under assessment with twelve closed by law to fishing (Stewart 2013)[3]. The main fishing range for ORH is on hills and knolls with summit depths 600-1,200 m (Stewart 2013). The knoll and hill characteristics vary between the fisheries but most of the fished UTFs are relatively small in both elevation and size (<10km^2 basal area), and moderate slope. Between 2002 and 2012 the percentage of UTFs within each fishery trawled has ranged from 15% for ORHMEC to 80% for ORH7A (Table 10). However, the number of trawls on any specific UTF ranges between 0 and 159 in the past five years (2007 to 2012) and between 1 and 540 for the past 10 years (2002 to 2012) (Stewart 2013).

The coral reef habitats that occur on the UTFs can be considered critical habitats that will need careful consideration in a MSC assessment. As outlined in Ministry for Primary Industries (2012) an assessment of the effects of trawling requires information on:

- distribution - the distribution of such habitats;
- overlap - the extent to which mobile bottom fishing methods are used in each habitat;
- impact - the consequences of any such disturbance (potentially in conjunction with other disturbances or stressors); and,
- recovery - the nature and speed of recovery from the disturbance.

Table 10. UTF Trawl activity for the period 2002 to 2012 (from Stewart 2013)

ORH Fishery	UTFs total	UTFs closed to fishing	UTFs trawled	% UTFs trawled (including closed areas)	UTFs untrawled	% UTFs untrawled (including closed areas)
ORH3B E &SCR	149	5	54	36%	95	64%
ORH3B NWCR	29	3	19	66%	10	34%
ORHMEC	53	4	8	15%	45	85%
ORH7A	5	0	4	80%	1	20%
Total	236	12	85		151	

There is information on the orange roughy trawl footprint for the four fisheries under pre-assessment (Stewart 2013; Black et al. 2013), the impact of trawling, and rates of recovery for corals on UTFs that have been trawled and are now closed to fishing (Clarke and

[3] Clarke and Anderson (2013) report 13 UTFs closed to fishing.

Anderson 2013). The distribution of benthic habitats at spatial scales required for fisheries management is not available for the NZ EEZ or the four fishery management areas being assessed. The New Zealand government commissioned the Marine Environment Classification (MEC) in 2005, an environmental classification that provides a spatial framework that subdivided the Territorial Sea and EEZ into areas having similar environmental and biological character using available physical and chemical predictors as a surrogate for biological pattern (Snelder et al. 2004, 2005, 2006). However, the MEC was not effective for benthic habitat classes to be of use in understanding the effects of trawling (Ministry for Primary Industries 2012). There have been several attempts to improve the MEC including a classification optimised for demersal fish (Leathwick et al. 2006) and a Benthic-Optimised Marine Environment Classification (BOMEC) that included more physical, chemical, and some biological data layers including sediment grain size (Ferrier et al. 2002, 2007, Leathwick et al. 2011). Recent testing (Bowden et al. 2011) has indicated that the BOMEC out-performs the original MEC at predicting benthic habitat classes but that none of the available classifications is very good at predicting the abundance and composition of benthic invertebrates at spatial scales required to improve understanding of the effects of trawling on benthic habitats (10s of metres to kilometres). Without distributional data is it is difficult to undertake a detailed assessment of the impact of trawling on the coral reef habitat of the UTFs following the approach outlined by the Ministry for Primary Industries (2012).

An alternative approach could be to undertake a more detailed analysis of the trawling footprint for the two primary kinds of benthic habitat in the fisheries i.e. underwater topographic features (UTFs) and the slope area (gently sloping areas of seafloor on the continental slope); the AEEF considered this approach (Boyd 2013). Of particular interest would be data to inform the following issues:

1. Consolidate information on the trawl footprint and trawl history of the UTF and slope areas of the fisheries to document how the trawl footprint has changed through time; while the overall footprint has decreased over time, in some areas the orange roughy fisheries appear to have moved to new areas.
2. Consolidate the proportion of UTFs that has not been trawled (including the trawl history for trawl fisheries operations) in the four areas, and for the untrawled UTFs not closed to trawling provide the likelihood they would be trawled in the future.
3. From a management and industry perspective provide the response/strategy if the trawl footprint in the UTF and slope areas increased or moved to new areas. Describe how the data on trawl footprint is used in management.

The assessment of ecosystem impacts from the four orange roughy fisheries under assessment would also benefit from more information on the relevant national policies, strategies, management and recovery plans for the ETP species (especially corals), habitat and ecosystems and where there are policies, strategies and/or plans, how are these incorporated into the management of the ORH MEC, ORH7A, ORH3B NWCR and ORH3B ESCR fishery management areas.

3.5 Principle Three: Management system background

The management system consists of a highly structured public-private partnership consisting of agreements between MPI and DWG, with a high level of stakeholder involvement (Figure 15). This overall structure forms the basis for operation of the fishery in terms of goals and objectives, fishing rights, planning, consultations, decision making, monitoring and enforcement, and regulation.

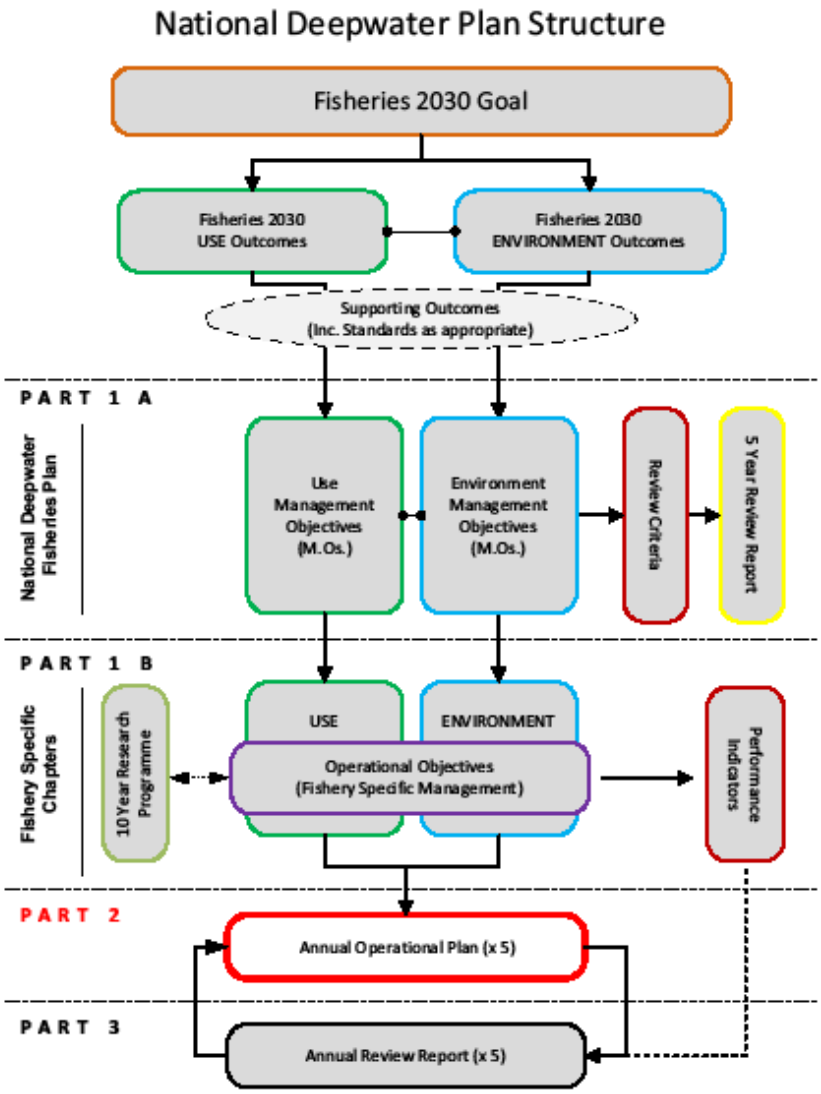

Figure 15. Structure of the management system for New Zealand deepwater fisheries.

3.5.1 Area of operation of the fishery and under which jurisdiction it falls

The four fisheries operate in the Exclusive Economic Zone (EEZ) of New Zealand beyond 12 nautical miles (nm) limit of the territorial sea out to the 200 nm limit of New Zealand's EEZ (MPI 2012); a small area on the New Zealand west coast in Area ORH7A extends beyond the EEZ (Fig 2) but fishing does not currently occur there. No foreign fishing has occurred

adjacent to New Zealand in the recent past, and none is expected in the foreseeable future. The fisheries, including the region of ORH7A beyond the EEZ, fall under the authority of the New Zealand government. The management of New Zealand's deepwater fisheries is a collaborative initiative between the Ministry for Primary Industries (MPI, representing the Crown and its statutory obligations to the public) and the owners of orange roughy quota (represented by the Deepwater Group Ltd, DWG). This arrangement allows for Management Objectives to be achieved by drawing on the combined knowledge, experience, capabilities and perspectives of both MPI and the seafood industry. MPI is responsible for the administration of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992, which implements the 1992 Fisheries Deed of Settlement under which historical Treaty of Waitangi claims relating to commercial fisheries have been fully and finally settled. MPI is also responsible for the Maori Fisheries Act 2004, which provides that the Crown allocates 20% of quota for any new quota management stocks brought into the QMS to the Treaty of Waitangi Fisheries Commission.

3.5.2 Particulars of the recognised groups with interests in the fishery and individuals or groups granted rights of access

The primary groups with direct interest in the fishery are MPI and DWG. Both are involved in the fishery through a partnership for management and research activities. MPI has the responsibility for sustainable harvest under the requirements of the Fisheries Law. Through policy, MPI and DWG work closely together through a Memorandum of Understanding (DWG 2010) with a goal to ensure New Zealand's deepwater fisheries are sustainably managed. MPI and DWG monitor fisheries performance under the terms of the MOU. Through purchase of Sealord, one of the major fishing companies of New Zealand, Maori have gained access to orange roughy and other deepwater quota; Maori participation occurs through several mechanisms, including through membership of the DWG. The Department of Conservation has responsibility for management of protected species and marine mammals. However, managing the effects of fishing on these species remains the responsibility of MPI.

Numerous non-governmental organizations representing various aspects of the public interest participate in consultations on the orange roughy fisheries. WWF-NZ, WWF-US, WWF-AU, Royal Forest and Bird Protection Society of NZ, Greenpeace, and Environment and Conservation Organisations of NZ (ECO) are participants. Other organisations may also participate selectively such as the NZ Marine Sciences Society, and TRAFFIC.

3.5.3 Details of consultations leading to the formulation of the management plan

The 1996 Fisheries Act requires consultation with stakeholders. To effect this, the Minister has established consultation guidelines. These guidelines recognize that consultation leading to decisions must occur in accordance with law; in a reasonable manner; and fairly, in accordance with the principles of natural justice. The Minister is the decision maker in fisheries management matters and his decisions are open to legal review. The law requires identification of stakeholders "with an interest" in each fishery, and the identification of those who represent stakeholders with an interest. In general, the policy recommends setting a wide range of stakeholders with an interest. The Minister must notify stakeholders in advance of the consultation, and to subsequently inform them of his decisions.

3.5.4 Arrangements for on-going consultations and decision-making processes

The process standard for stakeholder consultation has been developed (MPI 2009) to set out how MPI will meet its obligations to consult with stakeholders before providing their

advice to the Minister. The standard sets out best practice consultation processes to be followed by fisheries managers; minimum performance measures where appropriate; and a nationally consistent approach, with reference to relevant legislation and guidelines. Within this process, it is necessary to identify who has an interest; and who are representative of those having an interest. MPI must provide an initial consultation plan and the manner of consultation, including the timeframe for the consultation and the decision. MPI must distribute the decision, and subsequently review the process to assure that the consultation met all requirements.

A decision to consult or not to consult, and any decision made after consultation, must be made in accordance with the principles of administrative law, and in accordance with Fisheries Act obligations. These principles require decision-makers to act:

- in accordance with law;
- reasonably; and
- fairly, in accordance with the principles of natural justice.

Decisions that do not follow requirements are open to legal challenge.

3.5.5 Details of non-fishery users or activities and arrangements for liaison and co-ordination

Other deepwater fisheries, primarily those for the three species of oreo (smooth oreo, black oreo and spiky oreo), occur in the management areas fished by the orange roughy fleet. The MPI-DWG joint management MOU covers these fisheries and provides liaison and coordination. The remoteness of the orange roughy fishery precludes non-fishery users. However, those stakeholders with potential interest in the fishery have an opportunity to participate through the consultation procedures set by the government.

3.5.6 Objectives for the fishery

Fisheries 2030, MPI's overarching vision for New Zealand fisheries, states that by 2030, New Zealand's fisheries will be:

- world-leading and recognised for achieving a track record of environmental and commercial leadership and success, both domestically and internationally;
- a sector that New Zealanders are proud of, in that they understand that a precious but limited national resource is being responsibly managed, in the interests of all, for both the present and the future;
- based on healthy and abundant aquatic environments that are ecologically sustainable, about which we have reliable and dynamic information;
- a sector in which there are positive Crown-Maori partnerships, balancing and optimising cultural and
- commercial value;
- profitable and efficient, with a strong focus on long-term economic value;
- characterised by high trust and high accountability relationships amongst both use and non-extractive use interests and between stake/rights holder entities and Government; and
- a dynamic system in which transparent and robust decisions about allocation and trading-off are being made by stake/rights holders themselves, within a more enabling legislative and regulatory framework.

The Deepwater Fisheries Operational Plan (MPI 2012) lays out specific objectives (Table 11) for orange roughy and other fisheries:

Use Outcome: Fisheries resources are used in a manner that provides greatest overall economic social and cultural benefit.

Environment Outcome: The capacity and integrity of the aquatic environment, habitats and species are sustained at levels that provide for current and future use.

Table 11. Management objectives for deepwater fisheries

		Management Objectives
Use Outcome	MO1.1	Enable economically viable deepwater and middle-depth fisheries in New Zealand over the long- term
	MO1.2	Ensure there is consistency and certainty of management measures and processes in the deepwater and middle depths fisheries
	MO1.3	Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the reasonably foreseeable needs of future generations
	MO1.4	Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust information
	MO1.5	Ensure the management of New Zealand's deepwater and middle-depth fisheries are recognised as being consistent with or exceeding national and international best practice
	MO1.6	Ensure New Zealand's deepwater and middle-depth fisheries are transparently managed
	MO1.7	Ensure the management of New Zealand's deepwater and middle-depth fisheries meets the Crown's obligations to Maori
Environment Outcome	MO2.1	Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy
	MO2.2	Maintain the genetic diversity of deepwater and middle-depth target and bycatch species
	MO2.3	Protect habitats of particular significance for fisheries management
	MO2.4	Identify and avoid or minimise adverse effects of deepwater and middle-depth fisheries on incidental bycatch species
	MO2.5	Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on the long-term viability of endangered, threatened and protected species
	MO2.6	Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on biological diversity
	MO2.7	Identify and avoid or minimise adverse effects of deepwater and middle-depths fishing activity on the benthic habitat

3.5.7 Measures agreed upon for the regulation of fishing

MPI and the DWG to work in partnership outlining the prime areas and work plan to better manage deepwater fisheries. The two parties have developed a single joint-management framework with agreed strategic and operational priorities and work plans and timeframes. The partnership was formed to:

- advise the Minister of Fisheries on clear and agreed objectives for the deepwater fisheries;
- advise the Minister of Fisheries on management measures to support these objectives;
- define service requirements to support these objectives;
- ensure efficient delivery and value from these services; and
- provide consistent and agreed advice to the Minister wherever possible.

The partnership is focused on determining the maximum economic yield of the deepwater fisheries by setting catch limits that maximise returns over the long term within the constraints of ecological sustainability. This collaborative approach to fisheries management has an industry-wide impact on the behaviour of seafood companies by way of creating a "self-management" responsibility amongst industry participants.

This co-operation between seafood companies replaces historical competitive behaviours, improves industry wide management initiatives and subsequent compliance with standards and outcomes set, monitored and audited by government.

3.5.8 Monitoring, control and surveillance and enforcement

The orange roughy management system has documented a comprehensive and effective monitoring, control and surveillance system through 1) a compulsory satellite Vessel Monitoring System (VMS) with an on board an automatic location communicator (ALC); 2) government observers who may be placed on board to observe fishing, any transhipment and transportation, and collect any information on orange roughy fisheries resources (including catch and effort information) and the effects of orange roughy fishing on the aquatic environment; and 3) accurate recordkeeping and recording requirements to establish auditable and traceable records to ensure all catches are counted and do not exceed the ACE held by each operator. New Zealand introduced VMS in 1994 for all vessels over 28 metres, and vessels of any size that target certain species, including orange roughy requires vessels to carry and operate a registered automatic location communicator (ALC) at all times.

In combination with at-sea and air surveillance supported by the New Zealand joint forces, vessel activity can be monitored and verified to ensure compliance with regulations and with industry-agreed codes of practice.

A comprehensive reporting regime requires catch reports submitted by commercial fishers, including the estimated catch per tow, the location and depth of every tow and the total landed catch for each trip undertaken; landings only to Licensed Fish Receivers (LFRs), who must also report all catch received. MPI verification through auditing and reconciliation analysis across multiple sources ensures all catches are reported and documented correctly. Data collected by on board MPI Observers greatly assists the catch verification and auditing process. Coverage of orange roughy target fishing effort across the Chatham Rise has averaged 38% over the five years to 2009-10. Additional quayside inspections may also be undertaken to verify reported landings. Commercial fishers face prosecution and risk severe penalties, including automatic vessel and quota forfeiture, upon conviction of breaches in fisheries regulations. Financial penalties also exist to discourage commercial fishers from over-catching their ACE holdings, in the form of a deemed value regime.

The deepwater fishing industry in New Zealand works closely with 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 (represented by DWG) and MPI. This collaborative approach to management has enabled the development of shared reporting and monitoring processes that allow both parties to utilise their own operational expertise to ensure ongoing adherence to the non-statutory management measures that are in place. Relevant measures to the orange roughy fisheries include the management of sub-QMA catch limits within the overall ORH TACC. DWG works directly with vessel managers and skippers to administer the reporting and monitoring of catches against the sub-QMA catch limits, while MPI performs an auditing and verification role to ensure that reliable data is being reported by industry vessels.

4. Evaluation Procedure

4.1 Assessment methodologies used

This pre-assessment used MSC CR v1.3 and pre-assessment reporting template v1.

4.2 Summary of site visits and meetings held during pre-assessment

The pre-assessment site visit consisted of the following meetings and activities

Date	Location	Topic	Participants
20/8/2013	Nelson	Introductory meeting with DWG and MRAG	Bob Trumble, Jodie Campbell, MRAG; George Clement, DWG; Graham Patchell (Sealord), Andy Smith (Talleys)
21/8/ 2013	Nelson	Acoustic-Optical-System assessment results	Bob Trumble, Jodie Campbell, MRAG; George Clement, Richard Wells, DWG; Graham Patchell, Ross Tocker (Sealord), Tony Hazlett (Talley's)
21/8/2013	Nelson	Visit fishing vessel Amaltal Columbia; traceability overview	Bob Trumble, Jodie Campbell, MRAG; George Clement, DWG; Graham Patchell, Ross Tocker (Sealord), Tony Hazlett, Andy Smith (Talleys), Diane Frost (Endurance)
22/8/2013	Wellington	Stakeholder meeting, P1 and P3	Bob Trumble, Andre Punt, Ian Poiner, Jodie Campbell, MRAG; George Clement, Sharleen Gargiulo, Aaron Irving, DWG; Geoff Tingley, Vicky Reeve, Jeremy Helson, MPI; David Middleton, Seafood NZ; Rob Tilney, C & A Ltd., Patrick Cordue, ISL; Kevin Stokes, stokes.net.nz Ltd; David Ross, DoC; Peter Trott, Paul Crozier WWF-NZ
23/8/2013	Wellington	Stakeholder meeting, P2	Bob Trumble, Andre Punt, Ian Joiner, Jodie Campbell, MRAG; George Clement, Sharleen Gargiulo, Aaron Irving, Richard Wells, DWG; David Middleton, Seafood NZ; Rob Tilney, C & A Ltd., Patrick Cordue, ISL; Kevin Stokes, stokes.net.nz Ltd; David Ross,

Date	Location	Topic	Participants
			DoC; Peter Trott, Paul Crozier, WWF-NZ, Malcolm Clark, NIWA; Rick Boyd, Boyd Fishery Consultants
23/8/2013	Wellington	Assessment team review meeting	Bob Trumble, Andre Punt, Ian Poiner

Invitations to the site visit meetings went to a number of E-NGOs on 13 August 2013, but only WWF accepted the invitation. One E-NGO representative stated that the short notice (about 1 week) did not allow for participation. DWG posted all of the information provided to the MRAG assessors on its website and advised all invitees that this was available for them to access.

4.3 Stakeholders to be consulted during a full assessment

The following potential stakeholders have been identified:

Ministry for Primary Industries
Ministry of Conservation
NIWA
DWG
WWF NZ
WWF US
Forest and Bird
Greenpeace
ECO

If the fishery moves to full certification, outreach will occur to identify other stakeholders and offer them an opportunity to participate.

4.4 Harmonisation with any overlapping MSC certified fisheries

The fishery does not overlap with any MSC certified fisheries, so requires no harmonisation.

5. Traceability (issues relevant to chain of custody certification)

5.1 Eligibility of fishery products to enter further chains of custody

Traceability of product from the sea to the consumer is vital to ensure that the MSC standard is maintained. The MSC fishery standard encompasses traceability from the point of harvest through to the point of landing. Additional requirements can be placed on the fishery to ensure the MSC Chain of Custody principles are also maintained during at sea processing or transhipment activities.

Section 27.12 of the Certification Requirements currently requires the CAB to make a judgment about whether the systems of tracking and tracing in the fishery are sufficient to make sure all fish and fish products identified and sold as certified by the fishery originate from the certified fishery. In doing so, the CAB has to consider the following points and their associated risk to the integrity of MSC product:

- The systems in use.
- The possibility of vessels fishing outside the unit of certification.
- The opportunity of substitution of certified with non-certified fish prior to or at landing fraudulent claims from within and outside the certified fishery.

- At-sea processing activities.
- Any transhipment activities taking place.
- The number and/or location of points of landing.
- The robustness of the management systems.

The MSC is currently reviewing the traceability and Chain of Custody requirements for fisheries certificates. Changes are likely to align fishery traceability considerations more closely with the MSC Chain of Custody Standard. This would likely require review of at sea identification and segregation systems as well. The assessment below considers these additional elements to traceability.

5.2 TRACEABILITY WITHIN THE FISHERY

Traceability of fishing activity within New Zealand is largely provided by the statutory requirements to record all fishing in logbooks and through federal monitoring and compliance programs. All vessels are equipped with VMS equipment as well as being subject to observers and MPI fisheries enforcement officers. Extensive record keeping is required for reporting landings and processing activity, and this information is reported electronically to MPI. Fishing beyond the New Zealand EEZ requires special permitting prior to the activity of fishing. All EEZ and high seas fishing activity must be reported to MPI. No transhipment or motherships are used and no change of ownership of any orange roughy (raw or finished product) occurs prior to landing.

Catch information is recorded on logbooks after each haul and is tracked by VMS at all times. The information specifically contains reference to species caught (estimated catch (kg), time and date of haul, and location). Target and bycatch species are retained (unless prohibited by law) and reported with the same level of detail. Since MPI collects all catch and landing information from all orange roughy harvests, fishery-wide data collection for traceability or reconciliation purposes could be obtained from MPI, if required.

Further traceability is provided by the client's own internal systems that record the date and time of fishing activities against the date and time of packaging (if processed). All of the fish landed from this fishery can be traced back to particular fishing activities. The identification and quantity of catch can be cross-checked by observers at sea and upon landing. Vessels and companies are investigated and prosecuted for misrepresentation of landing and processing data.

The majority of orange roughly landed in New Zealand has been processed at sea by catcher/processor vessels. At-sea processing operations are similar to onshore primary processing operations with an emphasis on IQF products. Product is processed immediately upon catch, frozen, packaged and held in cold storage for the duration of the voyage. Some vessels also produce fish meal. Product labelling information includes pertinent product form and species information and can be traced back to harvest date, fishing period, vessel name and processing characteristics via bar code or lot codes.

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

If a vessel only fishes from within the certified fishery area during a single trip, there would be minimal risks to traceability of the product. This is most likely to occur within the smaller fresh fleet due to limitations on holding capacity and reduced trip length (in order to provide fresh product to markets).

All orange roughy harvested in New Zealand must be landed to a licensed fish receiver. Catches can be inspected by enforcement bodies upon landing. The main ports used by the orange roughy fleet are Nelson and Timaru in the South Island, and to a lesser extent Auckland and Gisborne in the North Island. The scope of the fishery certification would end at the port of landing for any LFR within New Zealand.

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

5.3 Eligibility to Enter Further Chains of Custody

Because of the detailed traceability within the fishery and onboard vessels, all fish and fish products from the UOC would be eligible to enter into further certified chains of custody and carry the MSC logo.

There are no MSC specific adaptations to traceability within the fleet, by the vessel companies or in the VMPs with DWG. Any fishermen that are not shareholders of DWG would follow the same procedures as DWG members, including all record keeping and product identification requirements. All orange roughy ACE holders with statutory fishing rights fishing within New Zealand's EEZ (whether or not they are shareholders of DWG) would therefore have the same risk profile as described above. Under these requirements, no additional risk accrues from non-members participating in the certification. This means all product harvested within the UOCs would be eligible to be covered by the MSC fisheries certificate and be eligible to sell product into the supply chain as certified (there would be no limitations based on vessel, ownership, membership, etc).

DWG could elect to charge non-members a fee for maintenance of the certificate, but this would be based on market-incentives and could not be controlled through the MSC fishery certification process.

Owners of the fishing vessels generally retain ownership of product until first point of sale and delivery to a customer. In nearly all cases, the change of ownership occurs well past the initial landings. Consequently, the vessel owning companies are likely to require MSC Chain of Custody certification for land based activities (including storage). Many of the companies involved in the orange roughy fishery also participate in the certified hoki fishery and hold MSC COC certification for that purpose. Adjustments to current traceability systems may be as simple as existing CoC certificate holders expanding their current scope to include orange roughy fisheries. Alternatively, cold storage facilities may in future be allowed to operate as subcontractors to the fishery certificate.

From a practical perspective, the fishery assessment must ultimately determine whether the scope of CoC for vessel operating companies should extend to at sea harvesting and processing activities as well. The pre-assessment suggests this would not be required.

6. Preliminary evaluation of the fishery

6.1 Applicability of the default assessment tree

The pre-assessment team found no reason to modify the default assessment tree, and recommends assessing against it.

6.1.1 Expectations regarding use of the Risk-Based Framework (RBF)

Boyd (2013), in a review of environmental impacts of the orange roughy fishery, concluded that the risks to bycatch (discarded) species fall in the low to moderate range. Boyd (2013), however, noted limited information to establish the stock status of slickheads *Alepocephalus australis* caught and discarded by the fishery. Slickheads were identified as vulnerable and thereby qualified as a main species. CR 27.8.8 requires a productivity-susceptibility analysis for species likely to have insufficient information for determining stock status. A preliminary PSA conducted for slickhead demonstrated a medium risk, with conditional pass as likely (Annex 2). Lack of information on average maximum age, average age at maturity, and average length at maturity caused these attributes to receive scores of three. More information on these attributes would produce a more reliable score. The assessment team does not foresee a need for RBF on other bycatch species or environmental components.

6.2 Evaluation of the fishery

Performance Indicators with likely conditions or failing score

Principle 1

Scores likely below 60
PI 1.1.2 Reference points
All four fisheries use the same reference points. However, the limit reference point (taken to be the hard limit) is below the MSC default value of 20% $B_{0\ or}$ ½ B_{msy}, unless an analytical justification is provided. In addition, a limit reference point of 10% of B_0 is lower than is common for fish species, especially given the current assumption that steepness for orange roughy is 0.75. A more careful reasoning for the limit reference point is required for the fishery to score 60 for this PI. There is also no justification for the management target range of 30-40% of B_0. The target range is less conservative than that for hoki of 35% - 50% of B_0, a more productive species. While the range of hoki is derived from economic considerations, and may not be relevant for orange roughy, a more careful reasoning for the management target range is required for the fishery to score 80 for this PI.

PI 1.2.4 Assessment of stock status (except for the MEC)
An assessment which involves fitting a population dynamics model is available for the MEC stock. However, population model-based assessments either do not exist for the other stocks (ORH3B East and South Chatham Rise; ORH7A) or are dated (ORH3B; Northwest Chatham Rise). The assessment for the Northwest Chatham Rise was conducted in 2006, uses a method now considered invalid, and does not use recent data. This assessment would not be sufficient as the basis for satisfying PI 1.2.4. Information on recent abundance is available for the other stocks. However, the estimates of B_0 are based on the outcomes of historical assessments which used methods now considered inappropriate. While the estimates of B_0 from the historical assessments may be robust, use of such estimates in providing management advice would require careful justification. New stock assessments (based for example on the approach used for the MEC) should be conducted for all stocks and reviewed through the MPI assessment process. Adequate detailed documentation of the

assessment will need to be made available to the assessment team to allow a technical review of the assessment to be conducted. A particular challenge for the assessment of the East and South Chatham Rise is how to handle the abundance on the newly-discovered Rekohu plume. Assuming that the Rekohu plume only arose in 2011 would likely to be an unacceptably optimistic assumption while even the assumption that this plume represents the same proportion of the total spawning biomass prior to 2007 would require careful justification.

No external review of the orange roughy assessment has been undertaken in recent years. However, the MPI Working Group process provides an internal review of the assessment (even though membership of the Working Groups is open, this review is considered internal as participation only primarily involves scientists from New Zealand). Access to working group documents will need to be arranged to allow an evaluation of the nature and thoroughness of this peer-review process.

Scores perhaps below 60 (but insufficient information to evaluate this)
PI 1.1.3 Stock Rebuilding
All stocks would be considered to be depleted given the estimates of biomass relative to B_0 in the 2013 Stock Assessment Plenary Report. However, no projections have been undertaken and reported in the Plenary Report to estimate the expected time to rebuild to the management target range under the harvest control rule. It is therefore currently impossible to evaluate whether the rebuilding time is 30 years or 3 times the generation time. For orange roughy, the generation time is such that 3 times the generation time will substantially exceed 30 years. It will need to be shown that rebuilding is expected within 30 years (or 20 years for SG 80). Given a stock assessment, estimation of rebuilding times could be based on projections under the harvest control rule for alternative assumptions regarding how the assessment is conducted and regarding future recruitment. It should be noted that there will be some stock size below which it is impossible to rebuild to the lower end of the management target range in the MSC timeframe even in the absence of any exploitation for low productivity stocks such as orange roughy.

Scores likely between 60 and 80
PI 1.1.1. Stock Status
The ability to score this PI is limited by the lack of agreed recent stock assessments which use conventional methods of stock assessment to estimate stock status relative to management reference points (see Section 3.3.d). The only stock with a recent stock assessment is the MEC. Nevertheless, the estimates of biomass relative to B_0 reported in the 2013 Plenary Report (MPI, 2013b,c,d) were less than the lower bound of the management target range for all four stocks. One of the estimates of $B_{current}$ / B_0 for the Northwest Rise was below the hard limit.

PI 1.2.1 There is a robust and precautionary harvest strategy in place
The harvest strategy for orange roughy is well-defined and is responsive to the state of the stock. However, no evidence exists that the harvest strategy will work in achieving its objectives. Such evidence would require either monitoring data which shows direct evidence for an increase in abundance or the results of projections using a stock assessment model. CB2.5.1.2 states that “tested” means that a structural logistic argument exists that supports the choice of strategy. Evidence that the orange roughy harvest strategy will achieve its objective is needed for the fishery to achieve a score of SG 80 on scoring issue b.

PI 1.2.2 Harvest control rules and tools
The form of the harvest control rule is consistent with the harvest strategy. However, there is no justification for the specific choices for the values for the parameters of the harvest control rule (e.g. why F_{MSY} is assumed to be M, although the results of the MEC assessment suggest that this assumption may be justified for this stock at least [MPI, 2012b]). In addition,

there is no documentation of the major uncertainties and how the harvest control rule was selected to take account of those uncertainties.

Principle 2

Scores likely between 60 and 79

2.2.1 Bycatch status
The AEEF Expert Panel assessed (Boyd 2013) slickheads, shovelnose dogfish, and some deepwater dogfish to be data deficient; there is not enough analysed information to score stock status; and concluded only slickheads are considered vulnerable, noting the shovelnose and deepwater dogfish could be considered as minor components of the catch (<5%). Slickheads scored conditional pass on a preliminary productivity-susceptibility analysis (Boyd, 2013); slickheads did not exceed 2% of the orange roughy catch so would not likely constitute a main species. Rattails exceeded 2% of the orange roughy catch in 3BNWCR and ESCR, but did not exceed 5%; if rattails are considered as vulnerable they could become a main species. The orange roughy fishery caught 10-20% of the total chimaera and greater than 20% of the total shovelnose dogfish; so even though chimaera and shovelnose dogfish make while a small proportion of the orange roughy catch, they may constitute a main species. They are both data deficient for stock status. Rattails, chimaeras, and shovelnose dogfish would benefit from further evaluation whether they would constitute main species, and possibly assessment under the risk-based framework.

2.2.2 Bycatch management
Measures are in place (e.g., catch data recording, observer data collection, data from trawl surveys for some species) for non-quota management system (QMS) species, but not a partial strategy. Other measures are available under the Fisheries Act if necessary. The movement of non-QMS species to QMS status as necessary shows that the measures are likely to work.

2.3.1 ETP status
Four coral species are of particular relevance to ORH fisheries being assessed (i.e., occur in the appropriate depth range) - *Solenosmilia variabilis, Madrepora oculata, Enallopsammia rostrata* and *Goniocorella dumosa.* There is information on the distribution of cold-water corals within the fished area but the distribution of the corals in non-fished areas is less well understood. Catch of stony corals as a group is monitored by observers, but there does not seem to be detailed information on the extent of trawling by species as species are difficult to tell apart.

The fishery falls within the national requirements for protection of ETP species. In most cases (fish, seabirds, sharks, and marine mammals) direct and indirect effects of the orange roughy fishery are minimal and highly unlikely to create unacceptable impacts. However, the direct and indirect impacts on coral are less certain, as the extent to which trawling might be linked to impaired benthic ecosystem functioning has yet to be determined. It is not clear that sufficient analysis has occurred to demonstrate that the fisheries are highly unlikely to have unacceptable direct and indirect impacts for deep sea corals. The fishery continues to add new areas of trawling, although at a declining level.

If protected corals are impacted, or may be impacted to any significant extent, then there is a need to define the level of that impact, including adequate identification, quantity taken and distribution of the corals.

2.3.2 ETP management
Of the ETP species potentially vulnerable to the orange roughy fishery, only corals are impacted at a level that could require explicit management. Coral are managed through

closed area (32% of the EEZ, with selected UTFs, closed to trawling), and the designation as protected requires measures to prevent adverse impacts. For both UTF and slope/flats habitats, spatial management tools were in place, VMS was on vessels, there is an active observer programme, and management is periodically reviewed to respond to new information and research. But the fishery continues to expand to new areas (although at a declining rate). Orange roughy tows appear to follow existing tow lines, but by practice, not requirement. It is unclear that a strategy is in place to minimise coral mortality, especially with the possibility of expansion of the trawl area from the fishery, and if the measures follow the approach outlined by the Ministry for Primary Industries leading to appropriate management strategies. Evaluation of whether there is a need to reduce expansion of the fisheries to new trawling areas, and if so, how that would happen would benefit the management of corals.

2.3.3 ETP information

For areas where data are insufficient to quantitatively determine outcomes (e.g. reef-building stony corals) there is ongoing research and monitoring describing their distribution and any interactions with fishing operations. The assessment would also benefit from an assessment of the level of threat of the fishery for corals generally and reef-building stony corals.

2.4.1 Habitat status

There is information on trawl footprint and a good understanding of the impact of trawling on some habitats for UTF component of the fishery. It remains to assess whether the unfished areas with remaining habitat is sufficient to prevent serious or irreversible harm to unique features. Analysis of the distribution of benthic habitats relative to the footprint of the fisheries would increase understanding of the impacts of the four fisheries being assessed.

Principle 3

Scores likely below 80

None

6.2.2 Other issues specific to this fishery

PI 1.2.3 Information and monitoring

The score for this PI is likely to exceed 80 given the nature of the data available for orange roughy. However, the available documentation on what is known about orange roughy is not available in a single source. The following aspects of knowledge could be assembled in documents to be presented to a full assessment:

- Stock Structure. The review by Dunn and Devine (2010) on stock structure for the East and South Chatham Rise is complete, but there needs to be a national synthesis of stock structure studies for orange roughy to more fully justify the boundaries of the management stocks. In this respect, the issue of the international component of the Challenger Plateau stock needs to be clarified.
- The harvest strategy is informed by the stock assessment, which relies heavily on the acoustic estimates of abundance as well as likely age-composition information. The 10-year research program (MPI 2010) outlines the strategy for collecting future acoustic data, but the situation with respect to age data should be clarified.
- The role of observer data for assessment purposes should be clarified.

The use of the AOS system is likely to improve the quality of the data available for assessment purposes. However, the assessment team would expect to see evidence for appropriate peer-review of the method.

6.3 Summary of likely PI scoring levels

Key to Likely scoring level in Table 11

Information suggests fishery is not likely to reach SG60 and therefore would fail on this PI	**<60**
Information suggests fishery will reach SG60 but may need a condition for this PI	**60-79**
Information suggests fishery is likely to exceed SG80 resulting in an unconditional pass for this PI	**≥80**

Table 11. Summary of pre-assessment scoring

Principle	Component	PI number	Performance Indicator	Likely scoring level			
				MEC	NWR	ESCR	Challenger
1	Outcome	1.1.1	Stock status	60-79	60-79	60-79	60-79
		1.1.2	Reference points	<60	<60	<60	<60
		1.1.3	Stock rebuilding	<60	<60	<60	<60
	Management	1.2.1	Harvest Strategy	≥80	≥80	≥80	≥80
		1.2.2	Harvest control rules and tools	60-79	60-79	60-79	60-79
		1.2.3	Information and monitoring	≥80	≥80	≥80	≥80
		1.2.4	Assessment of stock status	≥80	<60	<60	<60
2	Retained species	2.1.1	Outcome	≥80	≥80	≥80	≥80
		2.1.2	Management	≥80	≥80	≥80	≥80
		2.1.3	Information	≥80	≥80	≥80	≥80
	Bycatch species	2.2.1	Outcome	60-79	60-79	60-79	60-79
		2.2.2	Management	60-79	60-79	60-79	60-79
		2.2.3	Information	≥80	≥80	≥80	≥80
	ETP species	2.3.1	Outcome	60-79	60-79	60-79	60-79
		2.3.2	Management	60-79	60-79	60-79	60-79
		2.3.3	Information	60-79	60-79	60-79	60-79
	Habitats	2.4.1	Outcome	60-79	60-79	60-79	60-79
		2.4.2	Management	≥80	≥80	≥80	≥80
		2.4.3	Information	≥80	≥80	≥80	≥80
	Ecosystem	2.5.1	Outcome	≥80	≥80	≥80	≥80
		2.5.2	Management	≥80	≥80	≥80	≥80
		2.5.3	Information	≥80	≥80	≥80	≥80
3	Governance and Policy	3.1.1	Legal and customary framework	≥80	≥80	≥80	≥80
		3.1.2	Consultation, roles and responsibilities	≥80	≥80	≥80	≥80
		3.1.3	Long term objectives	≥80	≥80	≥80	≥80
		3.1.4	Incentives for sustainable fishing	≥80	≥80	≥80	≥80
	Fishery specific management system	3.2.1	Fishery specific objectives	≥80	≥80	≥80	≥80
		3.2.2	Decision making processes	≥80	≥80	≥80	≥80
		3.2.3	Compliance and enforcement	≥80	≥80	≥80	≥80
		3.2.4	Research plan	≥80	≥80	≥80	≥80
		3.2.5	Management performance evaluation	≥80	≥80	≥80	≥80

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Annex 1. Provisional evaluation of the fishery against the Performance Indicators

Table A1

Definition of scoring ranges for PI outcome estimates	Shading to be used	Instructions for filling 'Likely Scoring Level' cell
Information suggests fishery is not likely to meet the SG60 scoring issues.	Fail (<60)	Add either text (pass/pass with condition/fail) or the numerical range (<60/60-79/≥80) appropriate to the estimated outcome to the cell. Shade the cell of each PI evaluation table with the colour which represents the estimated PI score.
Information suggests fishery will reach SG60 but may not meet all of the scoring issues at SG80. A condition may therefore be needed.	Pass with Condition (60-79)	
Information suggests fishery is likely to exceed SG80 resulting in an unconditional pass for this PI. Fishery may meet one or more scoring issues at SG100 level.	Pass (≥80)	

Pre-assessment evaluation tables

Principle 1

Component	Outcome		
PI 1.1.1- Stock status	**The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Stock status	It is **likely** that the stock is above the point where recruitment would be impaired.	It is **highly likely** that the stock is above the point where recruitment would be impaired.	There is a **high degree of certainty** that the stock is above the point where recruitment would be impaired.
b. Stock status in relation to target reference point		The stock is at or fluctuating around its target reference point.	There is a **high degree of certainty** that the stock has been fluctuating around its target reference point, or has been above its target reference point, **over recent years**.
Justification/Rationale			
Recent assessments which involve fitting population dynamics models to monitoring data are only available for one of the four stocks under consideration (MEC). The status of this stock depends on whether stock status is based on the MPD estimates (stock close to the soft limit) or the median of the MCMC distribution (stock close to the soft limit or lower end of the management target range). In relation the latter, the difference between the Haist and Francis parameterizations is substantial (21 vs. 29% of B_0). How this uncertainty is characterized and brought forward to assess stock status will be a focus for a full assessment. Although quantitative assessments based on fitting population dynamics models are not available for three of the four stocks, the information in the Plenary Report suggests that all four stocks are			

currently below 30%B_0. As such, these stocks are not fluctuating around their target reference points.			
RBF Required? (✓/×/)		**Likely Scoring Level (pass/pass with condition/fail)**	**MEC: 60-79 NWR: No recent assessment ESCR: No recent assessment 7A: No recent assessment**

Component	**Outcome**		
PI 1.1.2 Reference points	**Limit and target reference points are appropriate for the stock**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Appropriate-ness of reference points	**Generic** limit and target reference points are based on justifiable and reasonable practice appropriate for the species category.	Reference points are appropriate for the stock and can be estimated.	
b. Level of limit reference point		The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity.	The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity following consideration of relevant **precautionary issues.**
c. Level of target reference point		The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome.	The target reference point is such that the stock is maintained at a level consistent with B_{MSY} or some measure or surrogate with similar intent or outcome, **or a higher level**, and takes into account relevant precautionary issues such as the ecological role of the stock **with a high degree of certainty**.
d. Low trophic level species target reference point		For key low trophic level species, the target reference point takes into account the ecological role of the stock.	
Justification/Rationale			
Orange roughy is not a key low trophic level species so scoring issue d does not apply. Reference points exist for all four orange roughy stocks. These reference points arise from, and are consistent with, the New Zealand Harvest Strategy Standard. Three (biomass) reference points are defined for orange roughy stocks: a hard limit (10% of B_0), a soft limit (20% of B_0) and a management target range (30-40% of B_0). For the purposes of this pre-assessment review, the limit reference point is taken to be hard limit while the target reference point is taken to be the range 30-40% of B_0. The reference points depend on being able to estimate B_0. While model-based assessments are not available for three of the four stocks, once such assessments are available, the fishery will satisfy			

scoring issue a at SG80. However, additional justification of the reference points is needed to satisfy scoring issues b and c at SG0 and SG80. Specifically:

- The hard limit is below the default in CB2.3.3.4. This is a case where the analytically-determined value for B_{MSY} (~24% B_0) is less than 40% of B_0 and there is no analytical determination of the limit reference point. Under CB2.3.3.4, the default limit reference point should be 20% of B_0, unless B_{MSY} is less than 27% B_0 (which is the case here given the assumed Beverton-Holt stock-recruitment relationship and an assumed steepness of 0.75). In that case the default limit reference point should be 75% of B_{MSY} (~18% of B_0). The hard limit of 10% of B_0 also appears low given the assumed steepness of 0.75 which implies that recruitment at the limit reference point is ~57% of the unfished level, which seems very low and likely "severely impaired".
- The management target range is larger than the analytically-derived B_{MSY} (although that B_{MSY} depends on the assumed stock-recruitment relationship - the available data are unlikely to be able to select amongst alternative stock-recruitment relationships). However, the range is less than for hoki of 35% - 50% of B_0, a more productive species, and no rationale has been presented for why this is an appropriate management target range for orange roughy.

RBF Required? (✓/×/)		**Likely Scoring Level (pass/pass with condition/fail)**	**< 60**

Component	**Outcome**		
PI 1.1.3 Stock Rebuilding	**Where the stock is depleted, there is evidence of stock rebuilding within a specified timeframe.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Rebuilding strategy design	Where stocks are depleted rebuilding strategies, which have a **reasonable expectation of success** are in place.	Where stocks are depleted rebuilding strategies are in place.	Where stocks are depleted, strategies are demonstrated to be rebuilding stocks continuously and there is strong evidence that rebuilding will be complete **within the specified timeframe**.
b. Rebuilding timeframes	A rebuilding timeframe is specified for the depleted stock that is the shorter of 30 years or **3 times its generation time**. For cases where 3 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	A rebuilding timeframe is specified for the depleted stock that is the shorter of 20 years or **2 times its generation time**. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.	The shortest practicable rebuilding timeframe is specified which does not exceed **one generation time** for the depleted stock.

c. Rebuilding evaluation	Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within the specified timeframe.	There is evidence that the rebuilding strategies are rebuilding stocks**, or it is highly likely** based on simulation modelling or previous performance that they will be able to rebuild the stock within the **specified timeframe**.	
Justification/Rationale			
All four stocks would be considered to be depleted given the estimates of biomass relative to B_0 are less than the lower limit of the management target range of 30-40% B_0. Thus, rebuilding plans need to be developed for all four stocks. The proposed harvest control rule is consistent with the Harvest Strategy Standard and would be expected to rebuild the stocks towards the management target range. However, it is not clear that the proposed harvest control rule is consistent with the requirements of the MSC standard. In particular, there is no analysis which shows that the expected rebuilding time is 30 years (SG 60) or 20 years (SG 80). Consequently, it is not possible to evaluate the fishery against scoring issues b and c.			
RBF Required? (✓/×/)		**Likely Scoring Level (pass/pass with condition/fail)**	**Cannot be evaluated (< 60 without additional analysis)**

Component	**Harvest strategy (management)**		
PI 1.2.1 Harvest strategy	**There is a robust and precautionary harvest strategy in place**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Harvest strategy design	The harvest strategy is **expected** to achieve stock management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy **work together** towards achieving management objectives reflected in the target and limit reference points.	The harvest strategy is responsive to the state of the stock and is **designed** to achieve stock management objectives reflected in the target and limit reference points.
b. Harvest strategy evaluation	The harvest strategy is **likely** to work based on prior experience or plausible argument.	The harvest strategy may not have been fully tested but **evidence** exists that it is achieving its objectives.	The performance of the harvest strategy has been **fully evaluated** and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.
c. Harvest strategy monitoring	Monitoring is in place that is expected to determine whether the harvest strategy is working.		

d. Harvest strategy review			The harvest strategy is periodically reviewed and improved as necessary.
Justification/Rationale			
The harvest strategy for orange roughy is well-defined and is responsive to the state of the stock. However, no evidence was presented that it will work in achieving its objectives. Such evidence would require either monitoring data which shows direct evidence for an increase in abundance or the results of projections using a stock assessment model. CB2.5.1.2 states that "tested" means that a structural logistic argument exists that supports the choice of strategy. Further justification for the orange roughy harvest strategy is needed to achieve a higher score.			
Likely Scoring Level (pass/pass with condition/fail)			**60 - 79**

Component	**Harvest strategy**		
PI 1.2.2 Harvest control rules and tools	**There are well defined and effective harvest control rules in place**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Harvest control rules design and application	**Generally understood** harvest control rules are in place that are consistent with the harvest strategy and which act to reduce the exploitation rate as limit reference points are approached.	**Well defined** harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.	**Well defined** harvest control rules are in place that are consistent with the harvest strategy and ensure that the exploitation rate is reduced as limit reference points are approached.
b. Harvest control rules account for uncertainty		The **selection** of the harvest control rules takes into account the **main** uncertainties.	The **design** of the harvest control rules take into account a **wide** range of uncertainties.
c. Harvest control rules evaluation	There is **some evidence** that tools used to implement harvest control rules are appropriate and effective in controlling exploitation.	**Available evidence indicates** that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules.	**Evidence clearly shows** that the tools in use are effective in achieving the exploitation levels required under the harvest control rules.
Justification/Rationale			
The New Zealand system is well structured to ensure that catches remain below the catch limits (see also PI 3.2),. However, it is unclear how the harvest control rule was selected to take account of the main uncertainties (scoring issue b). For example, the assumed value for F_{MSY} equals the estimate of the value for natural mortality. Many studies now show that $F_{MSY} < M$. Evidence was provided that $F_{MSY}=M$ may correspond to the lower limit of the management target range for the MEC stock, but additional justification for all aspects of the harvest control rule is required.			
Likely Scoring Level (pass/pass with condition/fail)			**60-79**

Component	Harvest strategy		
PI 1.2.3 Information / monitoring	**Relevant information is collected to support the harvest strategy**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Range of information	**Some** relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	**Sufficient** relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy.	A **comprehensive range** of information (on stock structure, stock productivity, fleet composition, stock abundance, fishery removals and other information such as environmental information), including some that may not be directly relevant to the current harvest strategy, is available.
b. Monitoring	Stock abundance and fishery removals are monitored and at least one indicator is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and fishery removals are **regularly monitored at a level of accuracy and coverage consistent with the harvest control rule**, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.	**All information** required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of the inherent **uncertainties** in the information [data] and the robustness of assessment and management to this uncertainty.
c.Comprehe-nsiveness of information		There is good information on all other fishery removals from the stock.	
Justification/Rationale			
The data required to support the harvest strategy includes information on stock structure, basic population dynamics and removals from the stocks, and information on abundance and age-structure. There is in general a substantial amount of information on the biology of orange roughy (notwithstanding the difficulties associated with conducting biological studies for a species which occurs at considerable depth). Survey estimates of abundance are regularly collected for the spawning plumes in the ORH 3B QMA and there are some recent estimates of abundance for the Northwest Rise and the Challenger Plateau based on acoustic/trawl surveys.		
Likely Scoring Level (pass/pass with condition/fail)			**80-100**

Component	Harvest Strategy		
PI 1.2.4 Assessment of stock status	**There is an adequate assessment of the stock status.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Appropriateness of assessment to stock under consideration		The assessment is appropriate for the stock and for the harvest control rule.	The assessment takes into account the major features relevant to the biology of the species and the nature of the fishery.
b. Assessment approach	The assessment estimates stock status relative to reference points.		
c. Uncertainty in the assessment	The assessment **identifies major sources** of uncertainty.	The assessment **takes uncertainty into account**.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a **probabilistic** way.
d. Evaluation of assessment			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
e. Peer review of assessment		The assessment of stock status is subject to peer review.	The assessment has been **internally and externally** peer reviewed.
Justification/Rationale			
An assessment which involves fitting a population dynamics model is available for the MEC stock. This assessment likely satisfies scoring issues a,b,c,d at the 80 level and scoring issues a and c at SG 100. However, population model-based assessments either do not exist for the other stocks (East+South Chatham Rise; Challenger Plateau) or are dated (Northwest Rise). The assessment for the Northwest Rise was conducted in 2006, using a method now considered invalid, and does not use recent data. This assessment would not be sufficient as the basis for satisfying PI 1.2.4. Information on recent abundance is available for the other stocks.			
Likely Scoring Level (pass/pass with condition/fail)			MEC: 80-100 ESCR: < 60 NWR: < 60 7A: < 60

Principle 2

Component	Retained Species		
PI 2.1.1 Outcome Status	**The fishery does not pose a risk of serious or irreversible harm to the retained species and does not hinder recovery of depleted retained species.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Retained species stock status	Main retained species are **likely** to be within biologically based limits. If not, go to scoring issue c below.	Main retained species are **highly likely** to be within biologically based limits. If not, go to scoring issue c below.	There is a **high degree of certainty** that retained species are within biologically based limits a**nd** fluctuating around their target reference points.
b. Target reference points			Target reference points are defined for retained species.
c. Recovery and rebuilding	If main retained species are outside the limits there are **measures** in place that are **expected** to ensure that the fishery does not hinder recovery and rebuilding of the depleted species.	If main retained species are outside the limits there is a **partial strategy** of **demonstrably effective** management measures in place such that the fishery does not hinder recovery and rebuilding.	
d. Measures if poorly understood	If the status is poorly known there are measures or practices in place that are expected to result in the fishery not causing the retained species to be outside biologically based limits or hindering recovery.		

Justification/Rationale

The main retained species are highly likely to be within biologically based limits. The key species are: alfonsino (*Beryx splendens*), ≥5% of the total catch in one or more orange roughy fisheries; smooth oreo (*Pseudocyttus maculatus*), ≥5% of the total catch in one or more of the four orange roughy fisheries management areas under assessment; black oreo (*Allocyttus niger*), large tonnage in one or more of the four orange roughy fisheries management areas under assessment; black cardinalfish (*Epigonus telescopus*), low productivity; pale ghost shark (*Hydrolagus bemisi*), low productivity ; dark ghost shark (*Hydrolagus novaezealandiae*), low productivity; and, smooth skate (*Dipturus innominatus,* SSK), low productivity. All of these species are managed within the QMS and are subject to periodic stock assessment and management intervention such as adjustment of their own TACCs.

A higher score could be achieved if more information was provided including a summary of stock assessment information and status for each retained species including – distribution, peak catch rates, biomass estimates, biomass trends, length distribution and mean length trend i.e. similar to the information provided in Table 7 of O'Driscoll, R.L. et al. (2011).

RBF required? (✓/✗)		Likely Scoring Level (pass/pass with condition/fail)	80-100

Component	Retained Species		
PI 2.1.2 Management strategy	**There is a strategy in place for managing retained species that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to retained species.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Management strategy in place	There are **measures** in place, if necessary, that are expected to maintain the main retained species at levels which are highly likely to be within biologically based limits, or to ensure the fishery does not hinder their recovery and rebuilding.	There is a **partial strategy** in place, if necessary, that is expected to maintain the main retained species at levels which are highly likely to be within biologically based limits, or to ensure the fishery does not hinder their recovery and rebuilding.	There is a **strategy** in place for managing retained species.
b. Management strategy evaluation	The measures are considered **likely** to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/species).	There is some **objective basis for confidence** that the partial strategy will work, based on some information directly about the fishery and/or species involved.	**Testing** supports **high confidence** that the strategy will work, based on information directly about the fishery and/or species involved.
c. Management strategy implementation		There is **some evidence** that the partial strategy is being **implemented successfully**.	There is **clear evidence** that the strategy is being **implemented successfully**.
d. Management strategy evidence of success			There is some evidence that the strategy is **achieving its overall objective**.
Justification/Rationale			

All of the main retained species are managed within the QMS framework. The strategy for the QMS species is based on information directly about the fishery and/or species involved, and testing based on stock status assessment supports. There is evidence that the strategy is being implemented successfully, and intended changes are occurring as evidenced in changes in TACCs. The main by-catch species have their own TACC limits set under the QMS that are adjusted based on stock status information from a variety of sources including surveys, close monitoring of catch levels of QMS species, and periodic stock assessments of QMS species. Retained QMS shark species, as well as being dealt with under the QMS, are also subject to the New Zealand National Plan of Action for the Conservation and Management of Sharks. A higher score could be achieved if more information was provided including a summary of stock assessment information and status for each retained species including – distribution, peak catch rates, biomass estimates, biomass trends, length distribution and mean length trend i.e. similar to the information provided in Table 7 of O'Driscoll, R.L. et al. (2011).

Likely Scoring Level (pass/pass with condition/fail)	**80-100**

Component	**Retained Species**		
PI 2.1.3 Information/Monitoring	**Information on the nature and extent of retained species is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage retained species.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Information quality	**Qualitative information** is available on the amount of main retained species taken by the fishery.	**Qualitative information and some quantitative information** are available on the amount of main retained species taken by the fishery.	**Accurate and verifiable information** is available on the catch of all retained species and the **consequences for the status** of affected populations.
b. Information adequacy for assessment of stocks	Information is **adequate** to **qualitatively** assess outcome status with respect to biologically based limits.	Information is **sufficient** to estimate outcome status with respect to biologically based limits.	Information is **sufficient** to **quantitatively** estimate outcome status with a **high degree of certainty**.
c. Information adequacy for management strategy	Information is adequate to support **measures** to manage **main** retained species.	Information is adequate to support a **partial strategy** to manage **main** retained species.	Information is adequate to support a **comprehensive strategy** to manage retained species, and evaluate with a **high degree of certainty** whether the strategy is achieving its objective.
d. Monitoring		Sufficient data continue to be collected to detect any **increase in risk level** (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the strategy)	Monitoring of retained species is conducted in sufficient detail to assess **ongoing mortalities to all retained species**.

Justification/Rationale		
Considerable quantities of data collected and available to inform about retained catch demonstrate that accurate and verifiable information is available on the catch of all retained species. These include data collected under large, well-organised programs including the TCEPR scheme for recording catch and effort data and the MPI scientific fishery Observer Program. These data collection efforts feed into the stock assessment process that enables periodic stock assessment to be conducted to define stock status, sufficient to estimate outcome status with respect to biologically based limits. New Zealand National Plan of Action for the Conservation and Management of Sharks will improve the quality of data relating to retained shark by-catch. Monitoring of retained species is conducted in sufficient detail to assess ongoing mortalities to all retained species.		
NOTE: When RBF is used to score PI 2.1.1, scoring issue b. (text in brackets above) should not be scored.	**Likely Scoring Level (pass/pass with condition/fail)**	**80-100**

Component	Bycatch Species		
PI 2.2.1 Outcome Status	**The fishery does not pose a risk of serious or irreversible harm to the bycatch species or species groups and does not hinder recovery of depleted bycatch species or species groups.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Bycatch species stock status	Main bycatch species are **likely** to be within biologically based limits. If not, go to scoring issue b below	Main bycatch species are **highly likely** to be within biologically based limits If not, go to scoring issue b below	There is a **high degree of certainty** that bycatch species are within biologically based limits.
b. Recovery and rebuilding	If main bycatch species are outside biologically based limits there are mitigation **measures** in place that are **expected** to ensure that the fishery does not hinder recovery and rebuilding.	If main bycatch species are outside biologically based limits there is a **partial strategy** of **demonstrably effective** mitigation measures in place such that the fishery does not hinder recovery and rebuilding.	
c. Measures if poorly understood	If the status is poorly known there are measures or practices in place that are expected to result in the fishery not causing the bycatch species to be outside biologically based limits or hindering recovery.		
Justification/Rationale			

An AEEF (Boyd 2013) identified potential main bycatch species/species groups as: Slickhead (Alepocephalidae Family); Morid cods (Moridae Family); Rattails (Macrouridae Family); Deepwater skates and rays (Rajidae, Torpedinidae, Narkidae, Dasyatidae, Myliobatidae, Mobulidae Families); Chimaeras (Chimaeridae and Rhinochimaeridae as a group); Shovelnose dogfish (Deania calcea, SND); Seal shark Dalatias licha, BSH); Baxter's dogfish *Etmopterus baxteri, ETB); and,* Deepwater dogfish (non-specified).

The bycatch species occur at very low levels in the catch of all four orange roughy fisheries as reported from the observer program (all less than 5%). The low amounts of discarded by-catch suggest the fishery is unlikely to be having a significant effect on any species other than those that may be particularly vulnerable. Observer data indicate that rattails exceed 2% of the total catch in ORH3B NWCR and ORH3B ESCR, which could lead to a 'main' designation if rattails are determined as vulnerable. The four orange roughy fisheries each contribute more than 10-20% of the total catch of chimaera and shovelnose dogfish, even though the proportion of chimaera and shovelnose dogfish in the orange roughy catch is very small; these species/groups may qualify as main species.

Boyd (2013) indicated that slickheads, shovelnose dogfish, chimaera, and deepwater dogfish are data deficient and there is not enough analysed information to score stock status. If any of these species/groups were considered as main species during a full assessment, analysis of existing data or the MSC RBF would be necessary to assess stock status.

None of the bycatch species is actively managed, and are non-QMS. However, as indications of problems with any species occur, MPI can move those species into QMS for active management.

RBF required? (✓/×)	**possible**	**Likely Scoring Level (pass/pass with condition/fail)**	**60-79**

Component	**Bycatch Species**		
PI 2.2.2 Management Strategy	**There is a strategy in place for managing bycatch that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to bycatch populations.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Management strategy in place	There are **measures** in place, if necessary, which are expected to maintain main bycatch species at levels which are highly likely to be within biologically based limits or to ensure that the fishery does not hinder their recovery.	There is a **partial strategy** in place, if necessary, that is expected to maintain main bycatch species at levels which are highly likely to be within biologically based limits or to ensure that the fishery does not hinder their recovery.	There is a **strategy** in place for managing and minimising bycatch.
b. Management strategy evaluation	The measures are considered **likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar fisheries/species).	There is **some objective basis for confidence** that the partial strategy will work, based on some information directly about the fishery and/or the species involved.	**Testing** supports **high confidence** that the strategy will work, based on information directly about the fishery and/or species involved.

c. Management strategy implementation		There is **some evidence** that the partial strategy is being **implemented successfully**.	There is **clear evidence** that the strategy is being **implemented successfully.**
d. Management strategy evidence of success			There is some **evidence** that the strategy is **achieving its objective.**
Justification/Rationale			
There are measures in place, including catch reporting and collection of discard data by observers. Under the Fisheries Act, measures can relate to catch limits, restrictions on size/sex/biological state of any species taken, and area, method and seasonal fishing restrictions. Over time, substantial catches of by-catch species tend to lead to establishment of QMS status. Evidence for this is the number of species in the QMS has grown over time. The amount of fishery information for QMS species tends to be higher than for non-QMS species. The New Zealand National Plan of Action for the Conservation and Management of Sharks provides some additional measures.			
Likely Scoring Level (pass/pass with condition/fail)			**60-79**

Component	**Bycatch Species**		
PI 2.2.3 Information/monitoring	**Information on the nature and amount of bycatch is adequate to determine the risk posed by the fishery and the effectiveness of the strategy to manage bycatch.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Information quality	**Qualitative information** is available on the amount of main bycatch species affected by the fishery.	**Qualitative information and some quantitative information** are available on the amount of main bycatch species affected by the fishery.	**Accurate and verifiable information** is available on the amount of all bycatch and the consequences for the status of affected populations.
b. Information adequacy for assessment of stocks	Information is **adequate** to **broadly understand** outcome status with respect to biologically based limits.	Information is **sufficient** to **estimate** outcome status with respect to biologically based limits.	Information is **sufficient** to **quantitatively estimate** outcome status with respect to biologically based limits with a **high degree of certainty**.
c. Information adequacy for management strategy	Information is adequate to support **measures** to manage bycatch.	Information is adequate to support a **partial strategy** to manage main bycatch species.	Information is adequate to support a **comprehensive strategy** to manage bycatch, and **evaluate** with **a high degree of certainty** whether a strategy is **achieving its objective**.

d. Monitoring		Sufficient data continue to be collected to detect any increase in risk to main bycatch species (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the strategy).	Monitoring of bycatch data is conducted in sufficient detail to assess ongoing mortalities to all bycatch species.
Justification/Rationale			
Accurate and verifiable information from observer data is available on the amount of all bycatch and the consequences for the status of affected populations. Monitoring of by-catch data is conducted in sufficient detail to assess fishing mortality of by-catch species. Information is likely available to estimate outcome status of main and some minor species, but analysis of the data has not regularly occurred. Annual reports of species composition of the orange roughy fisheries provide trends in catch of bycatch species. Surveys provide biological data for many of the species. Together the catch and survey data allow managers to watch for changes for bycatch species that may warrant more active management. Information is adequate to support a partial strategy to manage main bycatch species Information relating to the stock status of some by-catch species is inadequate to support a complete strategy. Improved data for sharks should be generated as a result of the New Zealand National Plan of Action for the Conservation and Management of Sharks.			
NOTE: When RBF is used to score PI 2.2.1, scoring issue b. (text in brackets above) need not be scored.		**Likely Scoring Level (pass/pass with condition/fail)**	**80-100**

Component	**ETP Species**		
PI 2.3.1 Outcome Status	**The fishery meets national and international requirements for protection of ETP species.** **The fishery does not pose a risk of serious or irreversible harm to ETP species and does not hinder recovery of ETP species.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Fishery effects within limits	Known effects of the fishery are **likely** to be within limits of national and international requirements for protection of ETP species.	The effects of the fishery are known and are **highly likely** to be within limits of national and international requirements for protection of ETP species.	There is a **high degree of certainty** that the effects of the fishery are within limits of national and international requirements for protection of ETP species.
b. Direct effects	Known direct effects are **unlikely** to create **unacceptable impacts** to ETP species.	Direct effects are **highly unlikely** to create **unacceptable impacts** to ETP species.	There is a **high degree of confidence** that there are **no significant detrimental direct effects** of the fishery on ETP species.

c. Indirect effects		Indirect effects have been considered and are thought to be **unlikely** to create unacceptable impacts.	There is a **high degree of confidence** that there are **no significant detrimental indirect effects** of the fishery on ETP species.

Justification/Rationale

No ETP species have been identified where orange roughy is a significant element of its diet, and the levels of by-catch are low, thus competition between the fishery and ETP species for food is extremely unlikely.

Mammals: there are no indications of fishery-induced mortalities.

Seabirds: despite large numbers of seabirds seen around deepwater vessels, interactions are infrequent in these fisheries. In the period between 2002–03 and 2011–12 a total of 47 seabird captures were recorded in the four fisheries being assessed. Most of the observed seabird captures (37 captures) occurred on the East and South Chatham Rise and Northwest Chatham Rise (9 captures). Captures included Salvin's, Buller's, whitecapped, Chatham albatrosses and unidentified large albatross none of which are classed as endangered within the New Zealand seabird threat classification.

There are no quantitative limits or defined levels of impact of fishing on sea bird populations in New Zealand; the key management objective is to minimize impacts and mortalities. There is a process to undertake semi-quantitative estimates of the risk to New Zealand seabird species from all commercial fisheries.

Sharks: Some shark species (e.g., basking shark and great white shark) are prohibited species under the Fisheries Act. None of the protected species interact with the orange roughy fisheries.

Benthic organisms: a variety of cold water corals are caught and brought up on deck, etc. Black corals (all species in the order Antipatharia); Gorgonian corals (all species in the order Gorgonacea); and, Stony corals (all species in the order Scleractinia) are protected under the provisions of the NZ Wildlife Act 1953. Four coral species are of particular relevance to ORH fisheries being assessed (i.e. occur in the appropriate depth range) - *Solenosmilia variabilis, Madrepora oculata, Enallopsammia rostrata* and *Goniocorella dumosa.*

New Zealand does not set quantitative limits on the interactions of the orange roughy fisheries, but has strong policies and strategies for minimizing interactions with marine mammals and seabirds. The policies apply to corals, but only measures (closed areas, limited trawl lines) apply to the fisheries. Therefore, the fisheries are highly likely to be within limits of national and international requirements and highly unlikely have unacceptable impacts for seabirds and marine mammals. However, it is not clear that sufficient analysis has occurred to demonstrate that the fisheries are highly unlikely to have unacceptable impacts for deep sea corals. The fishery continues to add new areas of trawling, although at a declining level.

If protected corals are impacted, or may be impacted to any significant extent, then there is a need to define the level of that impact, including adequate identification, quantity taken and distribution of the corals, as well as measures (e.g. Operational Procedures) to avoid or reduce the level of interaction. Without an understanding of the impact on corals it isn't known whether the direct effects of trawling are unlikely to create unacceptable impacts to ETP species.

Likely Scoring Level (pass/pass with condition/fail)	**60-79**

Component	ETP Species		
PI 2.3.2 Management strategy	**The fishery has in place precautionary management strategies designed to: - meet national and international requirements; - ensure the fishery does not pose a risk of serious or irreversible harm to ETP species; - ensure the fishery does not hinder recovery of ETP species; and - minimise mortality of ETP species.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Management strategy in place	There are **measures** in place that minimise mortality of ETP species, and are expected to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **strategy** in place for **managing the fishery's impac**t on ETP species, including measures to minimise mortality, which is designed to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **comprehensive strategy** in place for managing the fishery's impact on ETP species, including measures to minimise mortality, which is designed to **achieve above** national and international requirements for the protection of ETP species.
b. Management strategy evaluation	The measures are **considered likely** to work, based on **plausible argument** (e.g. general experience, theory or comparison with similar fisheries/species).	There is an **objective basis for confidence** that the strategy will work, based on **information** directly about the fishery and/or the species involved.	The strategy is mainly based on information directly about the fishery and/or species involved, and a **quantitative analysis** supports **high confidence** that the strategy will work. There is **clear evidence** that the strategy is being implemented successfully.
c. Management strategy implementation		There is **evidence** that the strategy is being implemented successfully.	There is **clear evidence** that the strategy is being implemented successfully.
d. Management strategy evidence of success			There is evidence that the strategy is achieving its objective.
Justification/Rationale			
Evidence for a strategic approach is given by the New Zealand key legislation that substantially defines the strategy for dealing with ETP species, including the Fisheries Act (1996), the Wildlife Act (1953) and Marine Mammals Protection Act (1978). A number of National Action Plans have been developed including plans for both sea birds and sharks. There is a strategy for protection of marine mammals, sharks, and seabirds that is highly likely to achieve requirement, with an objective basis that the strategy will work and with evidence of successful implementation. However, for corals, measures are in place that are likely to achieve requirements for coral, and that are considered likely to succeed. Considerable monitoring of ETP species has been conducted and is on-going. Much of the monitoring and analysis is quantitative, including data on captures/kills noted by the Observer Program through different approaches to estimate ETP population numbers to modelling attempts to assess impacts of observed interactions with the fisheries on ETP populations.		

Component	ETP Species
PI 2.3.2 Management strategy	**The fishery has in place precautionary management strategies designed to: - meet national and international requirements; - ensure the fishery does not pose a risk of serious or irreversible harm to ETP species; - ensure the fishery does not hinder recovery of ETP species; and - minimise mortality of ETP species.**

The fishery also has a variety of approaches to managing interactions between the fishery and ETP species. These range from high level approaches to highly operationally-based procedures. For example there are plans aimed at reducing interactions with seabirds through actions such as the deployment of bird protection devices (e.g. tori lines) and through the management of the disposal of fish waste (offal).

There has been the establishment of substantial areas closed to bottom fishing, including marine reserves, MPAs and large areas of BPAs, largely based on analysis of physical and some biological attributes. These all contribute to protecting both the environment generally and some EPT species.

There are clearly elements of strategy in place that address many issues but it is not yet comprehensive.

The main strategy of the fishing industry and management has been to reduce the levels of interaction and mortality. This has been very successful in a number of areas, especially for seabirds. For example the was an observed 90% reduction in warp strike mortality for birds from observer program following the implementation of mitigation measures provide an objective basis for confidence and clear evidence of successful implementation. There may be a need to have some biological basis for assessing 'adverse impact' according to the Wildlife Act based on population estimates.

Sharks are addressed at the strategic level e.g. New Zealand National Plan of Action for the Conservation and Management of Sharks. Management actions are under review and improvement through an update to the NPOA for sharks, currently in draft.

For corals (and benthic habitat management generally) a New Zealand government-commissioned MEC and BOMEC environmental classification aims to provide a spatial framework to subdivide the Territorial Sea and EEZ into areas having similar environmental and biological characteristics using available physical and chemical predictors. There are extensive areas closed to trawling (32% of the NZ EEZ) but it isn't clear how these relate to the environmental classification systems (MEC, BOMEC) and hence the effectiveness of the measure with respect to bottom trawling. But neither the MEC nor BOMEC are very good at predicting the abundance and composition of benthic invertebrates at spatial scales required to improve understanding of the effects of trawling on benthic habitats.

There is monitoring of the trawl footprint on an annual basis through mandatory reporting and VMS and this information is used to analyse the nature and extent of trawl footprint against habitat area and some regional assessments. In addition benthic interactions are measured and recorded by on board fisheries observers. Together these measures provide some understanding of the nature and extent of impacts. But the fishery continues to expand to new areas (although at a declining rate). Orange roughy tows appear to follow existing tow lines, but by practice, not requirement. It is unclear that a strategy is in place to minimise coral mortality, especially with the possibility of expansion of the trawl area from the fishery, and if the measures follow the approach outlined by the Ministry for Primary Industries leading to appropriate management strategies. Evaluation of whether there is a need to reduce expansion of the fisheries to new trawling areas, and if so, how that would happen would benefit the management of corals.

Likely Scoring Level (pass/pass with condition/fail)	**60-79**

Component	ETP Species		
PI 2.3.3 Information/monitoring	**Relevant information is collected to support the management of fishery impacts on ETP species, including: - information for the development of the management strategy; - information to assess the effectiveness of the management strategy; and - information to determine the outcome status of ETP species.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Information quality	**Information** is sufficient to **qualitatively** estimate the fishery related mortality of ETP species.	**Sufficient information is** available to allow fishery related mortality and the impact of fishing to be **quantitatively** estimated for ETP species.	Information is **sufficient to quantitatively** estimate outcome status of ETP species with a high degree of certainty.
b. Information adequacy for assessment of impacts	Information is **adequate** to **broadly understand** the impact of the fishery on ETP species.	Information is **sufficient** to **determine whether the fishery may be a threat** to protection and recovery of the ETP species.	**Accurate and verifiable information** is available on the **magnitude of all impacts, mortalities and injuries** and the **consequences for the status** of ETP species.
c. Information adequacy for management strategy	Information is adequate to support **measures** to manage the impacts on ETP species	Information is sufficient to measure trends and support a full **strategy** to manage impacts on ETP species	Information is adequate to support a **comprehensive strategy** to manage impacts, minimize mortality and injury of ETP species, and evaluate with a **high degree of certainty** whether a strategy is achieving its objectives.
Justification/Rationale			
Substantial information is available for fishing interactions with most ETP species groups and the information is sufficient to support the management of fishing impacts on ETP species. The information is mostly quantitative and collected principally though government and industry managed observer programs. There is also relevant historical and current conservation focused monitoring and research programs. The level of information available from the fishery and other sources (e.g. research) is sufficient to indicate whether the fishery may be a threat to most of the identified ETP species. Those areas where data are insufficient to quantitatively determine outcomes (e.g. reef-building stony corals) there is ongoing research and monitoring describing their distribution and any interactions with fishing operations. For corals (and benthic habitat management generally) there is a New Zealand government commissioned MEC and BOMEC environmental classification that aims to provide a spatial framework that subdivide the Territorial Sea and EEZ into areas having similar environmental and biological characteristics using available physical and chemical predictors as a surrogate for biological pattern and some biological data layers including sediment grain size. The assessment would also benefit from an assessment of the level of threat of the fishery for corals generally and reef-building stony corals.		
Likely Scoring Level (pass/pass with condition/fail)			**60-79**

Component	Habitats		
PI 2.4.1 Outcome Status	**The fishery does not cause serious or irreversible harm to habitat structure, considered on a regional or bioregional basis, and function.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Habitat status	The fishery is **unlikely** to reduce habitat structure and function to a point where there would be serious or irreversible harm.	The fishery is **highly unlikely** to reduce habitat structure and function to a point where there would be serious or irreversible harm.	There is **evidence** that the fishery is highly unlikely to reduce habitat structure and function to a point where there would be serious or irreversible harm.
Justification/Rationale			
There are two primary kinds of benthic habitat in the fisheries i.e. underwater topographic features (UTFs) and the slope area (gently sloping areas of seafloor on the continental slope). The footprint of the ORH3B fishery covers a small proportion of the known distribution of the orange roughy in this area (<10%). Operational procedures and physical environmental attributes tend to localise trawl footprints. Trawling tends to be restricted to specific areas, e.g. following specific trawl paths on UTFs, leaving many UTFs un-impacted. There are areas including UTFs protected from damage under the BPA and fisheries legislation. It is recognised that when demersal trawl gear touches the bottom, damage is done to the benthic environment and the communities that dwell there. Depending on the type of habitat, type of interaction, its duration and frequency; some areas may receive permanent damage while other areas will be able to recover in relatively short time periods. Damage to some habitats in this fishery occurs with minimal trawling and will be long lasting due to the nature of the key benthic organisms and the depth (e.g. biogenic habitat with vertical relief). Damage will, however, be restricted to areas trawled so that, the extent of any damage will be in proportion to the trawl footprint of the fishery. Although there is information on trawl footprint and a good understanding of the impact of trawling on some habitats for UTF component of the fishery, analysis of the distribution of benthic habitats relative to the footprint of the fisheries would increase understanding of the impacts of the four fisheries being assessed.			
RBF required? (✓/×)		**Likely Scoring Level (pass/pass with condition/fail)**	**60-79**

Component	Habitats		
PI 2.4.2 Management strategy	**There is a strategy in place that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to habitat types.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Management strategy in place	There are **measures** in place, if necessary, that are expected to achieve the Habitat Outcome 80 level of performance.	There is a **partial strategy** in place, if necessary, that is expected to achieve the Habitat Outcome 80 level of performance or above.	There is a **strategy** in place for managing the impact of the fishery on habitat types.

b. Management strategy evaluation	The measures are **considered likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar fisheries/habitats).	There is some **objective basis for confidence** that the partial strategy will work, based on **information directly about the fishery and/or habitats** involved.	**Testing** supports **high confidence** that the strategy will work, based on **information directly about the fishery and/or habitats** involved.
c. Management strategy implementation		There is **some evidence** that the partial strategy is being implemented successfully.	There is **clear evidence** that the strategy is being implemented successfully.
d. Management strategy evidence of success			There is some evidence that the strategy is achieving its objective.
Justification/Rationale			
There are a number of key elements of the approach to managing fisheries impacts on habitat under a range of different legislative tools. These include: (i) the closing of about one third of the New Zealand EEZ to bottom fishing though the designation of Benthic Protection areas (BPAs). (ii) the designation or Marine Protected Areas (MPAs). (iii) the designation of Marine Reserves. (iv) monitoring vessel position. There is some information on trawl footprint that can help define the overlap between the fishery and environmental parameters, including, for example, the distribution of the target or by-catch fish, environmental type, benthic habitat type, distribution of specific benthic organisms where known. The MPI observer program also has a benthic monitoring component but the identification of difficult taxonomic groups is an issue e.g. corals. Operational procedures and physical environmental attributes tend to localise trawl footprints. More definition of the management required to prevent expansion of the fisheries to sensitive new grounds would strengthen the management: even though the footprint of the fisheries has declined over time, the fisheries have added new areas of trawling.			
Likely Scoring Level (pass/pass with condition/fail)			**80-100**

Component	**Habitats**		
PI 2.4.3 Information / monitoring	**Information is adequate to determine the risk posed to habitat types by the fishery and the effectiveness of the strategy to manage impacts on habitat types.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Information quality	There is a **basic understanding** of the types and distribution of main habitats in the area of the fishery.	The nature, distribution and **vulnerability** of all main habitat types in the fishery area are known at a level of detail relevant to the scale and intensity of the fishery.	The distribution of habitat types is known over their range, with particular attention to the occurrence of vulnerable habitat types.

Component	Habitats		
PI 2.4.3 Information / monitoring	**Information is adequate to determine the risk posed to habitat types by the fishery and the effectiveness of the strategy to manage impacts on habitat types.**		
b. Information adequacy for assessment of impacts	Information is adequate to broadly understand the nature of the main impacts of gear use on the main habitats, including spatial overlap of habitat with fishing gear	Sufficient data are available to allow the nature of the impacts of the fishery on habitat types to be identified and there is reliable information on the spatial extent of interaction, and the timing and location of use of the fishing gear.	The physical impacts of the gear on the habitat types have been quantified fully.
c. Monitoring		Sufficient data continue to be collected to detect any increase in risk to habitat (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the measures).	Changes in habitat distributions over time are measured.
Justification/Rationale			
Benthic surveys have been performed of seabed types around the New Zealand continental shelf and seamounts. There have been several attempts to use this information to develop a Territorial Sea and EEZ marine environment classification (e.g. MEC, BOMEC) but these have not been effective for benthic habitats. The distribution of benthic habitats at spatial scales required for fisheries management is not available for the NZ TS or EEZ or the four management areas being assessed There are two primary kinds of benthic habitat in the fisheries i.e. underwater topographic features (UTFs) and the slope area (gently sloping areas of seafloor on the continental slope). There is on-going collection of relevant data from observer, vessel monitoring and research programs providing robust information on trawl footprint and for the UTF component of the fishery the impact of trawling and recovery for the fisheries. Various research programs and projects are current and planned to address gaps in benthic and habitat knowledge.			
Likely Scoring Level (pass/pass with condition/fail)			**80-100**

Component	Ecosystem		
PI 2.5.1 Outcome Status	**The fishery does not cause serious or irreversible harm to the key elements of ecosystem structure and function.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Ecosystem status	The fishery is **unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	The fishery is **highly unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	There is **evidence** that the fishery is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.
Justification/Rationale			

Component	Ecosystem		
PI 2.5.1 Outcome Status	**The fishery does not cause serious or irreversible harm to the key elements of ecosystem structure and function.**		
There is a body of research on trophic interactions for orange roughy fisheries generally and trophic models have been developed that include orange roughy. The low level of by-catch in the fisheries indicates direct ecosystem effects form removals are likely to be small. The footprint of the four fisheries is relatively small. Benthic impact that may damage ecosystem structure and function are restricted to <20% of the fishery management areas, and there are also areas that are currently fully protected from trawl impacts through the BPA approach. There is considerable scope to improve the quality and quantity of relevant information and how that information is used to ensure ecosystem integrity in maintained that would lead to an improved score.			
RBF required? (✓/×)		**Likely Scoring Level (pass/pass with condition/fail)**	**80-100**

Component	Ecosystem		
PI 2.5.2 Management strategy	**There are measures in place to ensure the fishery does not pose a risk of serious or irreversible harm to ecosystem structure and function.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Management strategy in place	There are **measures** in place, if necessary.	There is a **partial strategy** in place, if necessary,	There is a **strategy** that consists of a **plan**, in place.
b. Management strategy design	The **measures** take into account the **potential impacts** of the fishery on key elements of the ecosystem.	The **partial strategy** takes into account **available information and is expected to restrain impacts** of the fishery on the ecosystem so as to **achieve** the Ecosystem Outcome 80 level of performance.	The **strategy**, which consists of a **plan**, contains measures to **address all main impacts of the fishery** on the ecosystem, and at least some of these measures are in place. The plan and measures are **based on well-understood** functional relationships between the fishery and the Components and elements of the ecosystem. This plan provides for **development of a full strategy that restrains impacts** on the ecosystem to ensure the fishery does not cause serious or irreversible harm.
c. Management	The **measures** are considered likely to	The **partial strategy** is considered likely to work,	The measures are considered likely to work

strategy evaluation	work, based on **plausible argument** (e.g., general experience, theory or comparison with similar fisheries/ ecosystems).	based on **plausible argument** (e.g., general experience, theory or comparison with similar fisheries/ ecosystems).	based on **prior experience**, plausible argument or **information directly** from the fishery/ecosystems involved.
d. Management strategy implementation		There is **some evidence** that the measures comprising the partial strategy are being **implemented successfully.**	There is **evidence** that the measures are being **implemented successfully.**
Justification/Rationale			
The New Zealand Fisheries Act 1996 s 8 provides for "the utilisation of fisheries resources while ensuring sustainability." Ecosystem-based management is achieved through a multi-layered approach that considers fishery management (e.g., QMS), vulnerable species needs (e.g., NPOA sharks), ETP management (a host of protected species and related initiatives such as NPOA seabirds, NPOA sharks, the protection of marine mammals, and habitat considerations (e.g. BPAs). Vessel management plans deal specifically with achieving how avoidance and mitigation, and MMOPs control interactions with marine mammals. Legislated protection of areas of sea bottom to fishing activities, coupled with good quality monitoring of all fisheries removals that might impact on trophic structure and function and management of fishery removals (e.g. through TACCs) represent a partial strategy. Data from the fishery, including observer data together with fishery independent surveys and other research projects are taken into account in the management of the fishery. There has been the establishment of substantial areas closed to bottom fishing, including marine reserves, MPAs and large areas of BPAs (about 32% of the EEZ), largely based on analysis of physical and some biological attributes. These all contribute to protecting both the environment generally and the impacts of trawling.			
Likely Scoring Level (pass/pass with condition/fail)			**≥80**

Component	**Ecosystem**		
PI 2.5.3 Information / monitoring	**There is adequate knowledge of the impacts of the fishery on the ecosystem.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Information quality	Information is adequate to **identify** the key elements of the ecosystem (e.g. trophic structure and function, community composition, productivity pattern and biodiversity).	Information is adequate to **broadly understand** the key elements of the ecosystem.	
b. Investigation of fishery impacts	Main impacts of the fishery on these key ecosystem elements can be inferred from existing information, but **have not been investigated**	Main impacts of the fishery on these key ecosystem elements can be inferred from existing information, and **some have been investigated in detail**.	Main **interactions** between the fishery and these ecosystem elements can be inferred from existing information, and **have been investigated in detail**.

	in detail.		
c. Understand-ing of component functions		The main functions of the Components (i.e. target, Bycatch, Retained and ETP species and Habitats) in the ecosystem are **known**	The impacts of the fishery on target, Bycatch, Retained and ETP species and Habitats are identified and the main functions of these Components in the ecosystem are **understood**.
d. Information relevance		Sufficient information is available on the impacts of the fishery on these Components to allow some of the main consequences for the ecosystem to be inferred.	Sufficient information is available on the impacts of the fishery on the Components **and elements** to allow the main consequences for the ecosystem to be inferred.
e. Monitoring		Sufficient data continue to be collected to detect any increase in risk level (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the measures).	Information is sufficient to support the development of strategies to manage ecosystem impacts.
Justification/Rationale			
Dietary analyses provided information to adequately understand the functions of the key elements of the ecosystem. The main impacts of the fishery on the ecosystem elements can be inferred from the stock assessments (for key species), QMS catch trends, and surveys that cover the target species, related species, and most levels of the ecosystem. The lack of significant levels of retained and discarded by-catch, limited ETP interactions and potentially limited benthic impacts (based on the trawl foot-prints) indicate a limited ecosystem impact. There is information on trawl footprint, and the impact of trawling and the slow recovery for some UTF habitats (e.g. reef-building stony coral habitat). Information continues to be collected and analysed that would allow detect increased risk to the ecosystem.			
Likely Scoring Level (pass/pass with condition/fail)			**≥80**

Principle 3

Component	Governance and Policy		
PI 3.1.1 Legal and/or customary framework	**The management system exists within an appropriate and effective legal and/or customary framework which ensures that it: - Is capable of delivering sustainable fisheries in accordance with MSC Principles 1 and 2; - Observes the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; and - Incorporates an appropriate dispute resolution framework.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Compatibility of laws or standards with effective management	**There is an effective national legal system and a framework for cooperation with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2.**	**There is an effective national legal system and organised and effective cooperation with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2**.	**There is an effective national legal system and binding procedures governing cooperation with other parties which delivers management outcomes consistent with MSC Principles 1 and 2.**
b. Resolution of disputes	The management system incorporates or is subject by law to a **mechanism** for the resolution of legal disputes arising within the system.	The management system incorporates or is subject by law to a **transparent mechanism** for the resolution of legal disputes which is **considered to be effective** in dealing with most issues and that is appropriate to the context of the fishery.	The management system incorporates or is subject by law to a **transparent mechanism** for the resolution of legal disputes that is appropriate to the context of the fishery and has been **tested and proven to be effective**.
c. Respect for rights	The management system has a mechanism to **generally respect** the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to **observe** the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	The management system has a mechanism to **formally commit** to the legal rights created explicitly or established by custom on people dependent on fishing for food and livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.
Justification/Rationale			
The 1996 Fisheries Law and subsequent amendments provide a binding legislative and legal framework for delivering the objectives of MSC Principles 1 and 2. The law identifies and sets requirements for cooperation among the parties involved in fishing activities. The legal system transparently deals with resolution of legal disputes, as demonstrated by the protracted negotiations and court cases that settled the Maori claims. The resolution demonstrated that the system is effective and has been tested. The Maori claims settlement has led to an effective co-management of resources with a formal commitment by the government to the rights of the Maori.		

Likely Scoring Level (pass/pass with condition/fail)	80-100

Component	Governance and Policy		
PI 3.1.2 Consultation, roles and responsibili-ties	**The management system has effective consultation processes that are open to interested and affected parties.** **The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Roles and responsibility-es	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **generally understood**.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **explicitly defined and well understood for key areas** of responsibility and interaction.	Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are **explicitly defined and well understood for all areas** of responsibility and interaction.
b. Consultation processes	The management system includes consultation processes that **obtain relevant information** from the main affected parties, including local knowledge, to inform the management system.	The management system includes consultation processes that **regularly seek and accept** relevant information, including local knowledge. The management system demonstrates consideration of the information obtained.	The management system includes consultation processes that **regularly seek and accept** relevant information, including local knowledge. The management system demonstrates consideration of the information and **explains how it is used or not used**.
c. Participation		The consultation process **provides opportunity** for all interested and affected parties to be involved.	The consultation process provides **opportunity and encouragement** for all interested and affected parties to be involved, and **facilitates** their effective engagement.
Justification/Rationale			
The Ministry of Primary Industries (responsible for effective fishery management), the Department of Conservation (responsible for conservation issues such as ETP species and MPAs), and DWG (management within the quota management system) are identified as those involved in the management process. Each has clearly and explicitly defined roles. The MOU between DWG and MPI provide in detail the responsibilities for managing the deepwater fisheries. The Fishery Act requires consultations among stakeholders with an 'interest' in the decision to be made, and the Stakeholder Consultation Process Standard provides guidelines for implementing the consultations. The consultation regularly seeks and accepts information, explains the use and results, and provides opportunity and encouragement for engagement.		
Likely Scoring Level (pass/pass with condition/fail)			**80-100**

Component	Governance and Policy

PI 3.1.3 Long term objectives	The management policy has clear long-term objectives to guide decision-making that are consistent with MSC Principles and Criteria, and incorporates the precautionary approach.		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Objectives	Long term objectives to guide decision-making, consistent with MSC Principles and Criteria and the precautionary approach, are **implicit** within management policy.	**Clear** long term objectives that guide decision-making, consistent with MSC Principles and Criteria and the precautionary approach, are **explicit** within management policy.	**Clear** long term objectives that guide decision-making, consistent with MSC Principles and Criteria and the precautionary approach, are **explicit** within **and required by** management policy
Justification/Rationale			
Long-term objectives to guide decision making are set out in the Fisheries Act, in Fisheries 2030, in the National Fisheries Plan for Deepwater and Middle-depth Fisheries. These are explicit in requirements and management policy. The Annual Operational Plan outlines the management policy, and the actions required for the currently fishing year. These documents provide clear long-term objectives to guide decision-making, consistent with MSC Principles and Criteria and the precautionary approach, and are explicit within and required by management policy. **Precautionary Approach** – in regarding information principles, Section10 of Fisheries Act states: "*All persons exercising or performing functions, duties, or powers under this Act, in relation to the utilisation of fisheries resources or ensuring sustainability, shall take into account the following information principles:* *(a) Decisions should be based on the best available information:* *(b) Decision makers should consider any uncertainty in the information available in any case:* *(c) Decision makers should be cautious when information is uncertain, unreliable, or inadequate:* (d) *The absence of, or any uncertainty in, any information should not be used as a reason for postponing or failing to take any measure to achieve the purpose of this Act*." Thus, there are clear long-term objectives that guide decision-making, consistent with MSC Principles and Criteria and the precautionary approach is explicit within management policy.			
Likely Scoring Level (pass/pass with condition/fail)			**80-100**

Component	Governance and Policy		
PI 3.1.4 Incentives for sustainable fishing	**The management system provides economic and social incentives for sustainable fishing and does not operate with subsidies that contribute to unsustainable fishing.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Incentives	The management system provides for incentives that are consistent with achieving the outcomes expressed by MSC Principles 1 and 2.	The management system provides for incentives that are consistent with achieving the outcomes expressed by MSC Principles 1 and 2, and seeks to ensure that **perverse incentives** do not arise.	The management system provides for incentives that are consistent with achieving the outcomes expressed by MSC Principles 1 and 2, and **explicitly considers** incentives in a **regular review** of management policy or procedures to ensure that they do not

Component	Governance and Policy		
PI 3.1.4 Incentives for sustainable fishing	**The management system provides economic and social incentives for sustainable fishing and does not operate with subsidies that contribute to unsustainable fishing.**		
			contribute to unsustainable fishing practices.
Justification/Rationale			
The QMS and use of ITQs provide a positive incentive for the fishing industry. The Maori Fisheries Act 2004 and Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 provide for customary access to resources. These management mechanisms give long term security to the fishery. The management system does not have perverse incentives that could lead to over capacity or overfishing. Conversely, the QMS and ITQs remove perverse incentives. The Fishery Act and MPI policy require regular review of the QMS and ITQ programs to assure continued sustainable fishing practices.			
Likely Scoring Level (pass/pass with condition/fail)			**80-100**

Component	Fishery- specific management system		
PI 3.2.1 Fishery-specific objectives	**The fishery has clear, specific objectives designed to achieve the outcomes expressed by MSC's Principles 1 and 2.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Objectives	**Objectives**, which are broadly consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **implicit** within the fishery's management system.	**Short and long term objectives**, which are consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **explicit** within the fishery's management system.	**Well defined and measurable short and long term objectives**, which are demonstrably consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are **explicit** within the fishery's management system.
Justification/Rationale			
Fisheries 2030, the National Fisheries Plan, and the Annual Operational plan provide well defined and explicit long and short term objectives. However, the objectives are not measurable.			
Likely Scoring Level (pass/pass with condition/fail)			**80-100**

Component	Fishery- specific management system
PI 3.2.2 Decision-making processes	**The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives.**

Component	Fishery- specific management system		
PI 3.2.2 Decision-making processes	**The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Decision-making processes	There are **some** decision-making processes in place that result in measures and strategies to achieve the fishery-specific objectives.	There are **established** decision-making processes that result in measures and strategies to achieve the fishery-specific objectives.	
b. Responsive-ness of decision-making processes	Decision-making processes respond to **serious issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take some account of the wider implications of decisions.	Decision-making processes respond to **serious and other important issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.	Decision-making processes respond to **all issues** identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.
c. Use of precautionary approach		Decision-making processes use the precautionary approach and are based on best available information.	
d. Transparency of decision-making		**Explanations** are provided for any actions or lack of action associated with findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.	**Formal reporting** to all interested stakeholders describes how the management system responded to findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.
Justification/Rationale			
Sections 10, 11, and12 of the Fisheries Act establish the requirements for the decision-making process), and Section 10 further requires the use of best available information for all decisions. This results in measures and strategies to achieve the fishery-specific objectives. The Fisheries Act requirement for best available information leads to scientific evaluation in advance of decisions. The Fisheries Act further requires consultation with *such persons or organisations as the Minister considers are representative of those classes of persons having an interest in the stock or the effects of fishing on the aquatic environment in the area concerned including Maori, environmental, commercial, and recreational interests.* Information provided by MPI and the consultations provides a feedback involving planning, consultation, project development, and scientific enquiry, thus responding to important issues in a transparent manner.		
Likely Scoring Level (pass/pass with condition/fail)			**80-100**

Component	Fishery- specific management system		
PI 3.2.3 Compliance and enforcement	**Monitoring, control and surveillance mechanisms ensure the fishery's management measures are enforced and complied with.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. MCS implementa-tion	Monitoring, control and surveillance **mechanisms** exist, are implemented in the fishery under assessment and there is a reasonable expectation that they are effective.	A monitoring, control and surveillance **system** has been implemented in the fishery under assessment and has demonstrated an ability to enforce relevant management measures, strategies and/or rules.	A **comprehensive** monitoring, control and surveillance system has been implemented in the fishery under assessment and has demonstrated a consistent ability to enforce relevant management measures, strategies and/or rules.
b. Sanctions	Sanctions to deal with non-compliance exist and there is some evidence that they are applied.	Sanctions to deal with non-compliance exist, **are consistently applied** and thought to provide effective deterrence.	Sanctions to deal with non-compliance exist, are consistently applied and **demonstrably** provide effective deterrence.
c. Compliance	Fishers are **generally thought** to comply with the management system for the fishery under assessment, including, when required, providing information of importance to the effective management of the fishery.	**Some evidence exists** to demonstrate fishers comply with the management system under assessment, including, when required, providing information of importance to the effective management of the fishery.	There is a **high degree of confidence** that fishers comply with the management system under assessment, including, providing information of importance to the effective management of the fishery.
d. Systematic non-compliance		There is no evidence of systematic non-compliance.	

Justification/Rationale

The orange roughy management system has documented a comprehensive and effective monitoring, control and surveillance system through 1) a compulsory satellite Vessel Monitoring System (VMS) with an on board an automatic location communicator (ALC); 2) government observers who may be placed on board to observe fishing, any transhipment and transportation, and collect any information on orange roughy fisheries resources (including catch and effort information) and the effect of orange roughy fishing on the aquatic environment; and 3) accurate recordkeeping and recording requirements to establish auditable and traceable records to ensure all catches are counted and do not exceed the ACE held by each operator. Other measures include:

- fishing permit requirements;
- requirement to hold ACE to cover all target and bycatch species caught, or alternatively, to pay deemed values;
- fishing permit and fishing vessel registers;
- vessel and gear marking requirements;
- fishing gear and method restrictions;
- vessel inspections;
- control of landings (e.g. requirement to land only to licensed fish receivers);
- auditing of licensed fish receivers;

Component	Fishery- specific management system
PI 3.2.3 Compliance and enforcement	**Monitoring, control and surveillance mechanisms ensure the fishery's management measures are enforced and complied with.**

- control of transhipment;
- monitored unloads of fish;
- information management and intelligence analysis;
- analysis of catch and effort reporting and comparison with VMS, observer, landing and trade data to confirm accuracy;
- boarding and inspection by fishery officers at sea; and
- aerial and surface surveillance.

For offences against the Fisheries Act 1996 or any of the Fisheries Regulations, the offender has to satisfy a reverse onus and establish that the offence was outside their control, that they took reasonable precautions and exercised due diligence to avoid the contravention, and, where applicable, they returned fish that was unlawfully taken and complied with all recording and reporting requirements. A wide range of sanctions from fines ($250 to 500,000) and imprisonment, forfeiture of catch and potential forfeiture of vessel, to prohibition from participating in fishing in the future constitute an effective deterrent to offenses and lead to industry compliance.

The industry, with its investment in the fishery through co-management, has a strong incentive to maintain its cooperative role through compliance with legal requirements. The industry provides information as part of its memo of understanding with MPI. Kazmierow et al. 2010 provide documentation on the level of MCS in the system and the compliance of the industry.

Likely Scoring Level (pass/pass with condition/fail)	**80-100**

Component	Fishery- specific management system		
PI 3.2.4 Research plan	**The fishery has a research plan that addresses the information needs of management.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Research plan	**Research** is undertaken, as required, to achieve the objectives consistent with MSC's Principles 1 and 2.	A **research plan** provides the management system with a strategic approach to research and **reliable and timely information** sufficient to achieve the objectives consistent with MSC's Principles 1 and 2.	A **comprehensive research plan** provides the management system with a coherent and strategic approach to research across P1, P2 and P3, and **reliable and timely information** sufficient to achieve the objectives consistent with MSC's Principles 1 and 2.
b. Research results	Research results are **available** to interested parties.	Research results are **disseminated** to all interested parties in a **timely** fashion.	Research **plan** and results are **disseminated** to all interested parties in a **timely** fashion and are **widely and publicly available**.
Justification/Rationale			

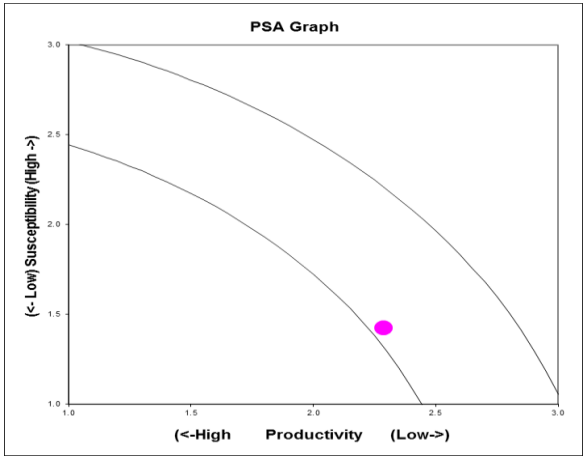
Component	Fishery- specific management system
PI 3.2.4 Research plan	**The fishery has a research plan that addresses the information needs of management.**
Fisheries 2030, the 10 Year Research Programme for Deepwater Fisheries, the National Fishing Plan Deepwater and Middle depth Fisheries Part 1A and 1B, the Conservation Services Programme Annual Plan 2013-14, and the fishery assessment plenaries provide documentation of a comprehensive research plan that provides reliable and timely information. Working groups containing stakeholders contribute to the research plans. The plenaries and annual operations plans demonstrate the wide and timely distribution of information research results. Stakeholders participating in the research planning and review receive results of the research.	
Likely Scoring Level (pass/pass with condition/fail)	**80-100**

Component	Fishery- specific management system		
PI 3.2.5 Monitoring and management performance evaluation	**There is a system for monitoring and evaluating the performance of the fishery-specific management system against its objectives.** **There is effective and timely review of the fishery-specific management system.**		
Scoring issues	**SG60**	**SG80**	**SG100**
a. Evaluation coverage	The fishery has in place mechanisms to evaluate **some** parts of the management system.	The fishery has in place mechanisms to evaluate **key** parts of the management system.	The fishery has in place mechanisms to evaluate **all** parts of the management system.
b. Internal and/or external review	The fishery-specific management system is subject to **occasional internal** review.	The fishery-specific management system is subject to **regular internal** and **occasional external** review.	The fishery-specific management system is subject to **regular internal** and **external** review.
Justification/Rationale			
The development and implementation of the Fisheries Plan framework – National Deepwater Plan, fishery specific chapters, Annual Operational Plan and Annual Review Report – ensures there is a structured process to ensure the performance of the fishery specific management system against its objectives. There is full stakeholder engagement on the development of all components of the Fisheries Plan framework and all documents are publicly available. The Ministry implements a comprehensive peer-review process for all science research that is used to inform fisheries management decisions. The fishery management system has internal and external review through the Fisheries 2030, Statements of Intention, the National Deepwater Plan, the Annual Operational Plan and Annual Review Report.			
Likely Scoring Level (pass/pass with condition/fail)			**80-100**

Annex 2. Productivity-Susceptibility Analysis

Slickhead

						Productivity Scores [1-3]								Susceptibility Scores [1-3]					1.1.1 only					PSA scores (automatic)			
PI	TAXA_NAME	FAMILY_NAME	SCIENTIFIC_NAME	COMMON_NAME	GEAR_TYPE (1.1.1)	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level (fishbase)	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	Catch (tons) (1.1.1)	Weighting (1.1.1)	Weighted Total	Weigted average	Color on PSA plot	PSA Score	MSC Score	Risk Category Name	MSC scoring guidepost
2.2.1	Osmeriformes	Alepocephalidae	Alepocephalus australis	slickhead	trawl	3	3	1	1	3	2	3	2.29	1	2	3	3	1.43	200	1.00	1.43	1.43		2.69	78.4	Med	60-80



From Boyd 2013.