# Assessment of ecological effects of four New Zealand orange roughy fisheries

**R O BOYD**

**Report for Deepwater Group Limited**

**August 2013**

BOYD FISHERIES CONSULTANTS LTD
1 Baker Grove Wanaka, New Zealand 9305
e/ rboyd@ihug.co.nz m/ +64 21 748 828
t/ +64 3 443 6399 f/ +64 3 443 6381

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# EXECUTIVE SUMMARY

An Expert Panel assessed the ecological risks of four New Zealand target bottom trawl fisheries at a workshop held in Wellington in August 2013. The assessed fisheries were ORH MEC, ORH7A, ORH3B NWCR and ORH3B ESCR.

The assessment of ecological effects of fishing (AEEF) was based on a framework that was designed to be appropriate for assessing the potential risks of fishing on all ecological categories. The ecosystem was divided into five broad ecological categories as follows:

i. Retained species
ii. Bycatch species
iii. Endangered, threatened and protected species
iv. Habitat
v. Ecosystem

A wide range of scientific information was available to support the assessments. In addition to published reports, presentations were made to the Expert Panel by contracted science providers and by stakeholders to provide additional detailed information for the assessment.

The assessments were based on achieving fishery management objectives appropriate to each ecological category. Using the scientific information and their collective knowledge and expertise, the Expert Panel members assessed and scored the level of consequence and likelihood of impact to each ecological component based on the management objectives and sub-objectives. Confidences in the assessments were also scored.

The AEEF assessed risks of serious or irreversible harm to retained species as being negligible or very low. All of the retained species are managed under the QMS framework with active research programmes and regular stock assessments.

Risks of serious or irreversible harm to bycatch species or species groups were assessed as being low to moderate. The primary risk issues were related to limited information for particular species groups, namely the slickheads (Alepocephalidae), ghost sharks (Chimaeridae and Rhinochimaeridae), and some species of deepwater shark species. Potentially useful information exists on these species but it has not been formally analysed and was thus unavailable to the Panel. The Panel did not complete assessments of some species due to insufficient information and time.

Risks of serious or irreversible harm to ETP species were assessed as being none or negligible except for protected corals where they were assessed as being low to moderate. Risks to protected corals are related mainly to limited taxonomic information.

Risks of serious or irreversible harm to structure and function of habitat on a regional basis were assessed as being low. The Expert Panel had some differing views on what habitat elements should be considered to fully incorporate structure and function.

Risks of serious or irreversible harm to the ecosystem were assessed as being low. Information to support the assessment was generally good but more information would assist in reducing areas of uncertainty.

# 1. Introduction

## Background and Purpose of the AEEF

The orange roughy assessment of environmental effects (ORH AEEF or AEEF) is a joint project of Deepwater Group Limited (DWG) and Ministry for Primary Industries (MPI). The AEEF is a project to inform fishery managers (DWG and MPI) of the risks associated with selected orange roughy fisheries on ecological systems using a process that follows generally accepted standards used for conducting ecological risk assessments of fisheries. Boyd Fisheries Consultants Ltd was contracted by DWG to facilitate and manage the ORH AEEF Workshop and to ensure that the risk assessment was completed and a report finalised.

## Scope

Four orange roughy fisheries are assessed in the AEEF:

- ORH MEC which incorporates the orange roughy ORH2A South, ORH2B and ORH3A quota management areas (QMA),
- ORH7A, including Westpac Bank which is adjacent to and outside the EEZ. The Westpac Bank and ORH7A management areas are believed to include the same biological stock of orange roughy
- ORH3B NWCR which is that part of the ORH3B QMA on the northwest Chatham Rise
- ORH3B ESCR which is that part of the ORH3B QMA on the east and south Chatham Rise

Figure 1 shows the location and boundaries of the four orange roughy fisheries.

## Objective and AEEF Approach

The overall objective of the ORH AEEF is to inform managers of the ecological risks associated with the target orange roughy fisheries in order that managers can implement programmes that will address the risks.

Within the overall objective, the AEEF has three main sub-objectives:

i. to identify the ecological risks posed by each of the target orange roughy fisheries and the level of those risks;
ii. to identify the degree of confidence associated with each assessment; and,
iii. to identify any information gaps associated with each assessment.

In order to identify risks, an Expert Panel approach was chosen to identify risks (consequences), the likelihood of those risks, including the confidence of the Panel in its assessments. The Expert Panel approach is efficient and brings together expertise covering the different areas of knowledge required to undertake the assessments. For the ORH AEEF, additional information and knowledge was contracted from science providers to inform the Expert Panel.

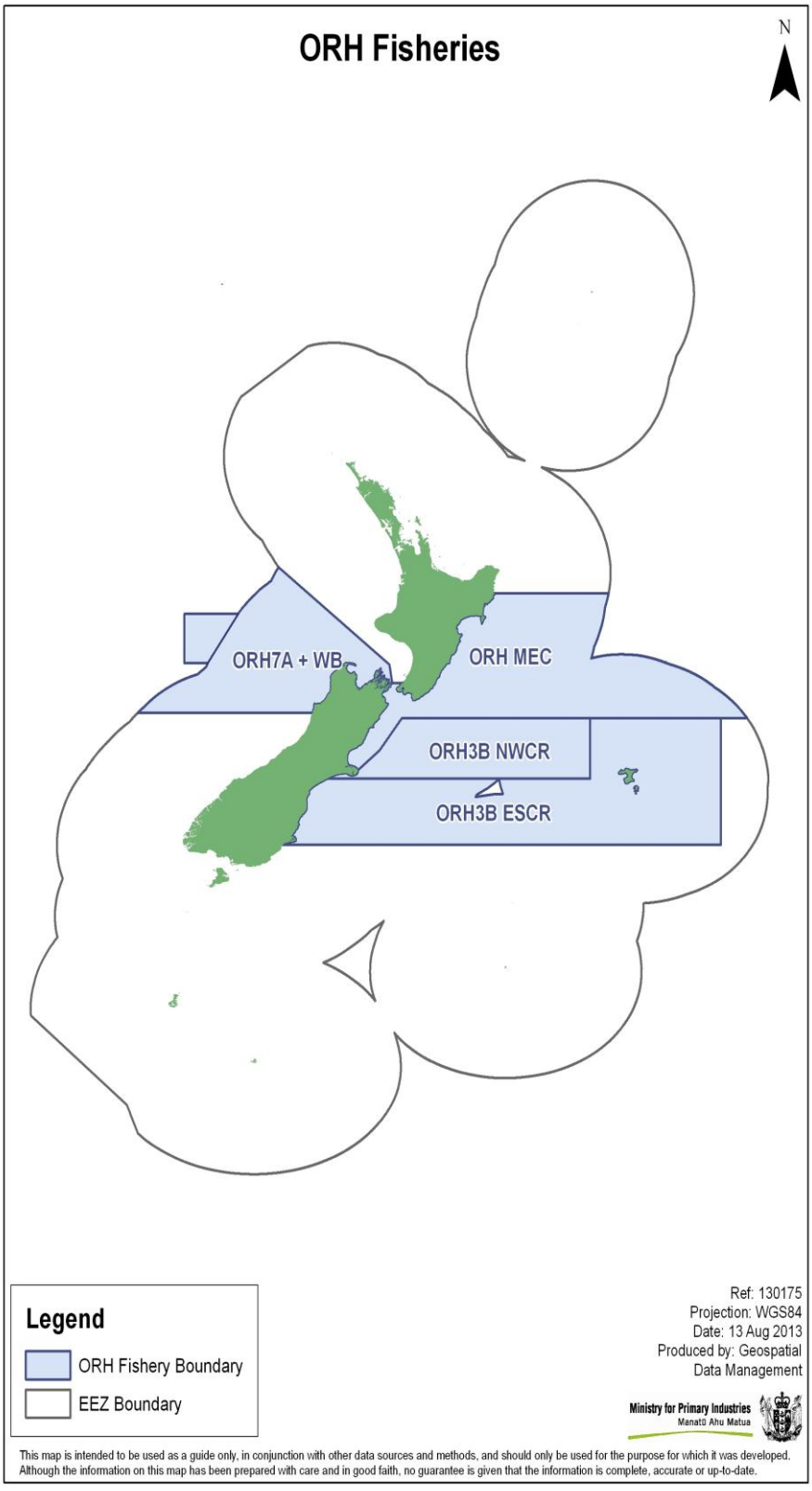


**Figure 1: The four orange roughy fisheries.**

# 2. The AEEF

## Process

All organizations known to have an interest in fisheries and environmental and ecological issues associated with the fisheries and marine environment were invited to participate in the AEEF (Appendix 1). This included invitations to attend the AEEF workshop and advising them of the terms reference and protocols. A comprehensive library of background information and relevant research was compiled and made available on the DWG website to inform the AEEF.

The Expert Panel members (Table 1) were invited to be Panel members and came from a variety of backgrounds in order to provide the requisite range of expert knowledge, skills and independence that would be required for the AEEF. The Panel included an independent overseas expert.

**Table 1: Expert Panel members for the orange roughy AEEF**

| | |
|---|---|
| Dr Jeremy Helson | Manager Deepwater Fisheries, Ministry for Primary Industries |
| Dr Geoff Tingley | Principal Scientist Stock Assessment, Ministry for Primary Industries |
| Richard Wells | Manager, Deepwater Group Limited |
| Dr Paul Crozier | Marine Advocate, WWF New Zealand |
| Duncan Leadbitter | Independent Fisheries Expert, Fish Matter Pty Ltd (Australia) |

## The AEEF Workshop

The AEEF for the four orange roughy fisheries was undertaken over a two day period at a workshop held in Wellington on 5 and 6 August 2013. The AEEF method (as revised by the Expert Panel) is set out in Appendix 2, together with the terms of reference and protocols for the Expert Panel. The methodology and supporting scientific literature and reports had been pre-circulated to the Panel members.

Appendix 3 gives the workshop programme. A list of observers and participants who attended the workshop is set out below.

**Observers and participants**

- Alistair MacFarlane, International Policy and Market Access Manager, Seafood New Zealand
- Dr Kevin Stokes, Stokes.Net.NZ Ltd (Contracted to attend as a Participant)
- Andy Smith, Operations Manager, Talley's Group Ltd
- Graham Patchell, Resource Manager, Sealord Group Ltd
- Igor Debski, Science Advisor, Marine Species and Threats, Department of Conservation
- Tiffany Bock, Fisheries Analyst Deepwater, Ministry for Primary Industries
- Dr Malcolm Clark, Fisheries Scientist, NIWA
- George Clement, Chief Executive Officer, Deepwater Group Ltd

- Aaron Irving, Senior Policy Advisor, Deepwater Group Ltd
- Sharleen Gargiulo, Policy Advisor, Deepwater Group Ltd

The workshop commenced with a brief general discussion amongst the Expert Panel members. The purpose of this discussion was to clarify the objectives of the risk assessment workshop, the risk assessment method and related procedural matters to reach a common understanding of the method and process. The Panel agreed to make minor amendments to the AEEF method to improve it and clarify the meaning of the descriptions of the levels of consequence and these were incorporated into the method in Appendix 2 which was used for the Workshop.

Following the initial discussions, the Expert Panel proceeded to undertake the assessments using the AEEF Method in Appendix 2 by progressively considering each ecological component and scoring them using the descriptions of levels of risk, likelihood and confidence in the respective tables for each ecological component in the AEEF Method.

# 3. RESULTS

## 3.1 Retained Species

### 3.1.1 Introduction

At the invitation of the Facilitator, the Panel commenced with a discussion aimed at clarifying which species it should consider within this component, including any differences between 'retained' and 'by-catch'.

Therefore, the Panel first considered

a) what data were available on non-target catch, and
b) appropriate thresholds.

It was agreed that commercial catch data does not provide a sufficient level of detail or accuracy on the catch of many individual species to determine the total catch of non-target species. Commercial fishers find it difficult to identify some less frequently caught deepwater fishes and their catch returns may contain errors. Commercial fishers report a number of the more difficult to identify species using generic categories, e.g., some shark species are reported under the code 'OSD' – other sharks and dogfish. The MPI scientific fishery Observer Programme is specifically designed to address the need for accurate species identification as well as obtaining independent estimates of catch weights. Overall, the Observer Programme provides catch data that is much more detailed and accurate. There are a number of published reports (e.g., Anderson 2011, 2013) that summarise observer data for the orange roughy fisheries, including scaled up estimates that take into account observer coverage.

The Panel discussed the published and unpublished literature on non-target catch based on observer data. The Panel first considered Table 5 of Anderson (2013) and Appendix 1 of Anderson (2011) which give estimates of annual non-target catch from target orange roughy fisheries (including non-target retained and discarded species). The estimates in Anderson (2013) do not use stratification. It was noted that the Anderson (2011, 2013) reports did not separate the four orange roughy fisheries and therefore do not provide sufficient detail to determine differences in non-target catch between the four individual orange roughy fisheries being assessed.

Each of the four fisheries, based on the Panel's expert knowledge, have slightly different catch composition. The only source of information that provides separate data on non-target catch for the four individual fisheries is contained in Deepwater Group Ltd & Ministry for Primary Industries (2013) [subsequently referred to in this report as DWG & MPI (2013)]. This provides observer data for all retained and discarded species for the past five years for each of ORH MEC, ORH 7A (including Westpac Bank), ORH3B NWCR, and ORH3B ESCR. Observer coverage for the past five years has varied from very low to very high (Table 2). Observer coverage has been moderate to high in most years, with the exception of the ORH MEC fishery where it has been low in all years. 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. The small number of tows in ORH3B NWCR in the past two years is the result of a voluntary agreement by industry to cease ORH target fishing in the area.

**Table 2: Annual trawl effort (total tows) and observer coverage (% of total tows observed) for each of the four orange roughy fisheries.**

| | 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 |

The Panel discussed its expert knowledge of the four orange roughy fisheries, the level of observer coverage, and the degree of consistency between the observer data in DWG & MPI (2013) and estimates in Anderson (2011, 2013). The Panel decided that the high level of observer coverage meant that observed catch rates in DWG & MPI (2013) were sufficiently reliable and reflected the rates of non-target catch in each of the four orange roughy fisheries. The Panel noted a lesser degree of reliance could be placed on the observer data for the ORH MEC fishery due to the low level of observer coverage in this fishery and that this would need to be taken into account in its assessments. While considering all of the scientific information and observer data, the Panel would use its expert judgment as appropriate to each circumstance.

The Panel then discussed which species should be specifically assessed in the AEEF, noting that there were up to several hundred observed non-target fish species identified in the catch (MPI & DWG 2013). Protected species and benthic invertebrates would be considered elsewhere in the AEEF. Without excluding any single fish species that could be considered to be exposed to risk, the Panel agreed that the following general criteria would be used to determine which fish species or species groups should be explicitly assessed as retained and bycatch species in the AEEF:

a) As a general rule, a catch that is ≥5% of the total catch of all species in the fishery, or depending on the Panel's knowledge very near that level of the total catch of the fishery (to take into account uncertainty in the observer data).
b) 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.
c) 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 Panel determined that it would use Appendix 1 of Anderson (2011) to distinguish between 'retained species' and 'bycatch species'.

The Panel determined that risks to the following retained species should be assessed in one or more of the four orange roughy fisheries:

- alfonsino (BYX), ≥5% of the total catch in one or more orange roughy fisheries
- smooth oreo (SSO), ≥5% of the total catch in one or more orange roughy fisheries
- black oreo (BOE), large tonnage in one or more fisheries
- black cardinalfish (CDL), low productivity
- pale ghost shark (GSP), low productivity
- dark ghost shark (GSH), low productivity
- smooth skate (SSK), low productivity

It was agreed that although the catch of hoki was large in one or more of the orange roughy fisheries, the Panel did not need to explicitly consider hoki as it is MSC Certified.

The Panel proceeded to assess the above species for each orange roughy fishery using the AEEF method. The results by species and fishery follow. Scores are derived from the descriptions in the AEEF Method.

### 3.1.2 Alfonsino (BYS, BYX)

#### 3.1.2.1 Alfonsino, ORH MEC

***Scores***

| **Consequence** | | **Likelihood** | | **Confidence** | |
|---|---|---|---|---|---|
| a) Status of biomass | 1 | a) Ability to control impact | 1 | a) Information availability & quality | 1 |
| b) Biomass trend | 2 or 3 | b) Performance | 2 | c) Monitoring/review | 1 |
| c) Population structure | 2 | | | d) Consensus amongst experts | 2 |
| d) Scale of fishery | 1 | | | | |

***Rationale***

**Consequence**

a) Estimates of current biomass are not available. A target reference point has not been set, therefore the proxy is determined under the Fisheries Act 1996 as 40% $B_0$ (the default for QMS species). Alfonsino have a maximum age of 17 years. The fishery has operated through at least two generations (refer p. 49 of 2013 Fisheries Assessment Plenary (Ministry for Primary Industries 2013). Catches have been consistent at or above the level of the TACC since the inception of the fishery. A schooling species. CPUE analysis indicates this is not useful as an index of abundance.
b) Biomass trend steady, no indication of a need to rebuild, however there was limited information as CPUE is not useful. However, a constant catch over a long time series indicates there is not a declining trend. Fishery performance strongly suggests sustainable at current levels.
c) No evidence of significant change in length (age) structure over time. Evidence of ongoing recruitment of young fish. No juveniles evident in New Zealand fishery, it is thought they recruit from elsewhere in the Pacific.
d) The catch of alfonsino by the ORH MEC fishery is <10% of the total alfonsino catch in the ORH MEC area.

**Likelihood**

a) The Panel discussed whether the ORH MEC fishery poses a risk to alfonsino and whether there was a capability to address any management issues if required. Alfonsino is a QMS species and there is multi-layered system of controls and information gathering (Fisheries Act, QMS monitoring, deemed values, observer programme, regular reviews etc.) to respond to triggers using a combination of mechanisms. The Panel concluded that there was a high degree of certainty that management needs could be met under the current system. Duncan Leadbitter interpreted this sub-objective in a different manner, suggesting that the sub-objective should be interpreted as relating to specific management measures to control the catch of alfonsino in the orange roughy fishery, and scored it as a 3.

b) There is evidence to indicate that performance targets will be achieved. There is no current need to take any specific actions but the ability to do so exists. Duncan Leadbitter would score it as a 1

**Confidence**

a) While there is a lack of information to do a quantitative assessment of alfonsino there is a substantial body of good scientific information, i.e., length frequency, age structure, catch and effort over time. All information available from ORH fishery catches of alfonsino goes into the evaluation of the alfonsino fishery to set TACCs and other management measures etc.
b) Data are reviewed regularly (every three years), for example, the recent characterisation study (MacGibbon 2013).
c) There were a few minor unresolved issues around the table - i.e. information quality, interpretation of objectives but overall there is consensus on all of the scores.

#### 3.1.2.2 Alfonsino, (BYS, BYX) ORH7A, ORH3B NWCR, ORH3B ESCR

The scale of the alfonsino catch in these fisheries Table A1, Consequence (d) is 1 (<10% of total catch). The catches from these fisheries are very low or negligible whether considered proportionately or quantitatively and are below the minimum level set by the Panel for determining risk. There is no risk to alfonsino in any of the four fisheries, the species is managed under the QMS and information is very good.

### 3.1.3 Smooth oreo (SSO)

The scale of the smooth oreo catch is negligible to <10% of total SSO catch in ORH MEC, ORH7A and ORH3B NWCR fisheries. It is 10-20% of total SSO catch in ORH3B ESCR. SSO is managed under the QMS with all of the associated management controls, monitoring and review. Quantitative stock assessments are available for all SSO stocks. OEO3A's last assessment was in 2009 = 36% $B_0$ and OEO4's last assessment was in 2012 = 33-41% $B_0$. Most of the SSO catch taken in the ORH3B ESCR fishery is taken from the OEO4 stock. The smooth oreo catches from these ORH fisheries are very low or negligible whether considered proportionately or quantitatively and are below the minimum level set by the Panel for determining risk. The Panel concluded that there were no risks to any of the SSO stocks from the four ORH fisheries, information was good and determined that it did not need to consider SSO further.

### 3.1.4 Black cardinalfish (CDL)

The catch is below the minimum level for considering risk to retained species in the AEEF. The catch of CDL from the ORH target fisheries is small in all of the ORH fisheries, being negligible (<500 kg) in ORH7A and ORH3B NWCR and <10% of total CDL catch in ORH MEC, and ORH3B ESCR. CDL is

managed and monitored under the QMS. The TACC for CDL2 was recently reduced to allow the stock to rebuild. The Panel concluded that there were no risks to any of the CDL stocks from the four ORH fisheries, information was good and determined that it did not need to consider CDL further.

### 3.1.5 Pale ghost shark (GSP)

The catch is below the minimum level for considering risk to retained species in the AEEF. The catches of GSP from the ORH MEC, ORH7A, and ORH3B ESCR target fisheries are negligible both proportionally and quantitatively. It is marginally above 1% in ORH3B NWCR and constitutes about 1% of GSP catch in the QMA. GSP is managed and monitored under the QMS. The Panel concluded that there were no risks to GSP from the four ORH fisheries, information was adequate and that it did not need to consider GSP further.

### 3.1.6 Dark ghost shark (GSH)

The catch is below the minimum level for considering risk to retained species in the AEEF. The catch of GSH from each of the ORH target fisheries is very small (<500 kg per fishery) and insignificant in relation to total catches of GSH. GSH is managed and monitored under the QMS. The Panel concluded that there were no risks to GSH from the four ORH fisheries and determined that it did not need to consider GSH further.

### 3.1.7 Smooth skate (SSK)

The catch of SSK is below the minimum level for considering risk to retained species in the AEEF. However it is an endemic species and due to its biology is vulnerable to fishing. It is also recorded by IUCN as 'near threatened'. The catch of SSK from each of the ORH target fisheries is negligible (<10 to <300 kg annually per fishery) and insignificant in relation to total catches of SSK (3000 t nationally). SSK is managed and monitored under the QMS. The Panel concluded that there were no risks to SSK from the four ORH fisheries and determined that it did not need to consider SSK further.

## 3.2 Bycatch

The AEEF method provides that where appropriate, bycatch species can be considered as a species group. Depending on the species, information and catch levels, the Panel considered the following species or groups as potentially qualifying using the 5% threshold, 1% threshold and/or ≥ 10% of total catch threshold for vulnerable species as appropriate in each case. Categorisation on the status of each species as bycatch (discarded) is based on Appendix 1 of Anderson (2011).

- Slickheads (Alepocephalidae as a group)
- Morid cods (Moridae as a group)
- Rattails (Macrouridae as a group)
- Deepwater skates and rays as a group
- Chimaeras (Chimaeridae and Rhinochimaeridae as a group)
- Shovelnose dogfish
- Seal shark
- Baxter's dogfish
- Deepwater dogfish (all other deepwater dogfish as a group)

### 3.2.1 Slickheads (Alepocephalidae) ORH MEC, ORH7A, ORH3B NWCR, ORH3B ESCR

#### *Scores*

| **Consequence** | | **Likelihood** | | **Confidence** | |
|---|---|---|---|---|---|
| a) Status of biomass | ns | a) Ability to control impact | 3 | a) Information availability & quality | 3 |
| b) Biomass trend | ns | b) Performance | 3 | c) Monitoring/review | 2 |
| c) Population structure | ns | | | d) Consensus amongst experts | 1 |
| d) Scale of fishery | ns | | | | |
| Consequence not scored, more detailed analysis of commercial catch and trawl survey data and biological information over time is needed. | | | | | |

#### *Rationale*

**Consequence**

Not scored, the Panel determined that insufficient information was available. There is use of generic species codes (e.g. SLK), the main species appear to be black slickhead (BSL), big scale slickhead (SBI), small scale slickhead (SSM) and big headed slickhead (BAT). Most of the observer data catch weights of slickheads are identified to family name only. There is very little in the way of biomass estimates – the depth range of slickheads (FishBase, Froese & Pauly (Eds). 2013) is down to 3000 m, well below the depth of deepwater trawl surveys. Information is patchy. O'Driscoll et al. (2011) provides no information of biomass status from Chatham Rise surveys (too shallow). Doonan & Dunn (2011) Table 7.3 contains abundance estimates from ORH MEC deepwater trawl surveys. There is also biological information but it is not known the degree to which it may have been compiled or analysed. The Panel considered it needed more information to determine the scale of slickhead catches. Estimates of current biomass and population status do not appear to be available.

**Likelihood**

a) There is catch reporting, monitoring of commercial catch.
b) There is implied information for the species' long term viability, i.e., continuity and consistency of catch. While no active management is occurring, the ability to do so exists.

**Confidence**

a) Some information is available but it has not been examined and the amount of information varies between the four orange roughy fisheries.

c) There has been regular collection of data, monitoring, research surveys.

d) There was consensus on the assessments

### 3.2.2 Morid cods (largely HJO but considered as a group)

The catch of morids (primarily Johnson's cod, HJO) is below the minimum level – well below 1% of total catch in all fisheries except ORH3B ESCR where morids (HJO plus the generic MOD code) make up only slightly >1% of total catch. HJO is only moderately vulnerable (FishBase, Froese & Pauly (Eds). 2013). Therefore HJO does not meet the Panel's criteria for considering risk to bycatch species as a vulnerable species. The Panel concluded that as it was not a vulnerable species and catches were well under <5% of total catch so it did not need to consider it further.

### 3.2.3 Rattails (Macrouridae considered as a group)

The catches of Macrouridae make up <1% of total catch in all four orange roughy fisheries. The Panel's assessment was that rattails do not meet the AEEF criteria for considering risk to bycatch species as a vulnerable species. The Panel concluded that Macrouridae are not vulnerable species and catches were well under <5% of total catch so it did not need to consider it further.

### 3.2.4 Deepwater skates and rays (considered as a group)

In relation to deepwater skates and rays, it was agreed to consider the following species/species codes: DSK (deepwater spiny skate), skate, other (OSK), Richardson's skate (RIS), *Notoraja spinifera* (BTS), long-tailed skate (LSK), deepsea skates (BTH), and longnosed deepsea skate (PSK).

The catch of deepwater skates (excluding the QMS species smooth skate, SSK) in all four orange roughy fisheries is extremely small, in the order of 100kg per year except ORH3B ESCR where the catch is in the order of 2 t/year. Given the very small catches, the Panel concluded that there were no risks to non-QMS deepwater skates from the four ORH fisheries.

### 3.2.5 Chimaeras, ORH MEC, ORH7A, ORH3B NWCR, ORH3B ESCR

**Chimaeridae and Rhinochimaeridae considered as a group: excludes QMS species GSP and GSH considered above as Retained species**

***Scores***

| Consequence | | Likelihood | | Confidence | |
|---|---|---|---|---|---|
| a) Status of biomass | 4 | a) Ability to control impact | 3 | a) Information availability & quality | 3 |
| b) Biomass trend | 2 | b) Performance | 3 | c) Monitoring/review | 2 |
| c) Population structure | 1 | | | d) Consensus amongst experts | 1 |
| d) Scale of fishery | 2 | | | | |
| a) Status of biomass not known | | | | | |

***Rationale***

**Consequence**

a) Status of biomass was not known and was scored as 4. The quantities caught in the four fisheries are well under 1% of total catch. Mostly longnosed chimaera (LCH). Using scaled up observer data, catches by fishery are in the order of ORH MEC = 2.5t, ORH3B NWCR = 3.3t and ORH3B ESCR = 18t annually. Catches of all other non-QMS chimaeras are negligible. There is no information on biomass. Catch information needs to be broken out in more detail and checked to confirm the estimated commercial catch from each ORH fishery.
b) Doonan and Dunn (2011) give an increasing LCH biomass trend in the ORH MEC. For Chatham Rise trawl fisheries, O'Driscoll et al. (2011) at p. 321 found no clear trend in biomass which was well estimated for LCH even though LCH occurs deeper than the survey range of 400-800m. O'Driscoll et al. (2011) gives length frequency information and there is no obvious change over any period of time. In these surveys LCH has a CV of 20% indicating a wide distribution. The biomass of RCH has increased (p. 467, O'Driscoll et al. 2011) but biomass is not well estimated by these surveys.
c) O'Driscoll et al. (2011) gives length frequency information. There is no obvious change over any period of time. There is a need for clarification of this information by undertaking a more detailed assessment of the data.
d) The scale of the catch of the chimaeras from the ORH fisheries was estimated at 10-20% of total catch in each QMA. The level of catch needs to be checked.

**Likelihood**

a) Catch reporting, monitoring of commercial catch is in place
b) There is a reasonable amount of implied information for the species' long term viability, i.e., continuity and consistency of catch, some information from trawl survey trends.

**Confidence**

a) There is good trawl survey and biological data and some information on abundance and trends. Deepwater trawl survey data for the Chatham Rise is available but not analysed.
c) Trawl surveys monitor these species although the Chatham Rise survey series (O'Driscoll et al. 2011) is for depths above those where orange roughy are caught.
d) There was full consensus.

### 3.2.6 Shovelnose dogfish (SND), ORH MEC, ORH7A, ORH3B NWCR, ORH3B ESCR

#### *Scores*

| **Consequence** | | **Likelihood** | | **Confidence** | |
|---|---|---|---|---|---|
| a) Status of biomass | 4 | a) Ability to control impact | 3 | a) Information availability & quality | 3 |
| b) Biomass trend | 2 | b) Performance | 3 | c) Monitoring/review | 2 |
| c) Population structure | 1 | | | d) Consensus amongst experts | 2 |
| d) Scale of fishery | 3 | | | | |
| a) Status of biomass not known | | | | | |

#### *Rationale*

**Consequence**

The four orange roughy fisheries were considered jointly by the Panel. SND is not endemic and is widespread. Dr Clark advised that there is no indication that the New Zealand landmass affects SND distribution and it would be appropriate to consider SND as a single population across all four fisheries.

a) Status of biomass not available and scored as 4.
b) O'Driscoll et al. (2011) p. 570 gives trawl survey estimates over 19 years of 3000-5000 t with a flat trajectory and a CV of up to 20% from the Chatham Rise trawl survey series. Doonan & Dunn (2011) Table 7.3 gives abundance estimates of up to 14,000 t in ORH MEC surveys. The Panel determined that there was data about biomass and trend which appeared steady but we could not determine biomass status with available data. Inferences could be made about (a) from (b and (c) but there was uncertainty. Dr Crozier indicated that he held concerns that the O'Driscoll et al. (2011) results were for a too narrow and shallow depth range outside the main SND distribution and so would not be considered reliable information for evaluating SND. Dr Clark advised that information from the 600-900 m trawl surveys indicated SND was common.
c) There was no trend in the length data in O'Driscoll et al. (2011). Together with (b) it indicated that there were no significant changes in population structure although information was limited.

d) Estimated catch from the orange roughy fisheries is in the order of 20-40% of total SND catch.

**Likelihood**

a) There is catch reporting, monitoring of commercial catch.
b) There is implied information for the species' long term viability, i.e., continuity and consistency of catch. Trawl survey data indicates no trend. While no active management is occurring, the ability to do so is there.

**Confidence**

a) Some information is available but it has not been examined and the amount of data varies between the fisheries.
c) There is regular collection of data, monitoring, research surveys.
d) There was consensus on most issues but with unresolved matters requiring further consideration.

### 3.2.7 Seal shark (BSH) and Baxter's dogfish (ETB) (considered at the same time), ORH MEC, ORH7A, ORH3B NWCR, ORH3B ESCR

The catch is below the minimum level for considering risk to retained species in the AEEF. The catches of each species were <10% of total catch of these species in each ORH fishery based on observer data. The Panel also looked at the Chatham Rise survey data (including gonad and length data) in O'Driscoll et al. (2011). It was noted that the ETB habitat distribution extends beyond the survey depth and distribution. However, there were no trends in biomass and there was a solid database. The Panel concluded that there were no risks to BSH or ETB from the four ORH fisheries and determined that it did not need to consider these species further.

### 3.2.8 Deepwater dogfish (all other deepwater dogfish considered as a group)

The Panel considered the other deepwater dogfish species. Unlike SND, BSH and ETB which are easily determined, identification of these other shark species is difficult even for MPI scientific observers. Most of the commercial catch of these other deepwater shark species is recorded by scientific observers using the generic categories of OSD (other sharks and dogfish) and DWD (deepwater dogfish). While there would be some information available, a more detailed breakdown of what is known about catch and biological data would be required in order to assess risks to these species from the orange roughy fisheries. The Panel considered there was insufficient information available to it at this time and there was insufficient time to undertake an assessment of these species at the workshop. Information is available and this would need to be brought together in order to complete an assessment of risks to these deepwater shark species. However it was noted that the draft NPOA Sharks (due for public submission in September 2013) will address the principal information issues with shark species. The risks to the deepwater sharks are also recognised in the draft NPOA Sharks.

## 3.3 ETP Species

### 3.3.1 Introduction

The following marine species or species groups are protected under the provisions of the Wildlife Act 1953 which is administered by the Department of Conservation.

- Protected fishes
  - Oceanic whitetip shark (*Carcharhinus longimanus*)
  - Basking shark (*Cetorhinus maximus*)
  - Deepwater nurse shark (*Odontaspis ferox*)
  - White pointer shark (*Carcharodon carcharias*)
  - Whale shark (*Rhincodon typus*)
  - Manta ray (*Manta birostris*)
  - Spinetail devil ray (*Mobula japanica*)
  - Giant grouper (*Epinephelus lanceolatus*)
  - Spotted black grouper (*Epinephelus daemelii*)
- Reptiles
- All seabirds except black backed gull
- All marine mammals
- Corals:
  - Black corals - all species in the order Antipatharia
  - Gorgonian corals—all species in the order Gorgonacea
  - Stony corals— all species in the order Scleractinia
  - Hydrocorals

No additional species in the ETP category were identified by the Panel as requiring assessment (e.g., because they are listed in CITES Appendix 1).

Igor Debski, Department of Conservation, was present throughout the ETP assessments and provided additional information, insight, and expertise.

### 3.3.2 Protected fishes

The Panel commenced discussion on protected fishes by considering the data available from a range of sources. These sources were the MPI observer data report (MPI & DWG 2013); Conservation Services Programme reports (Rowe2009, 2010; Ramm 2010, 2012a, 2012b), and other relevant literature (Anderson 2011, 2013; Francis & Smith 2010; Francis & Lyon 2012; Francis & Sutton 2012). Igor Debski (Department of Conservation) provided additional information to the Panel on individual fish species, knowledge of catches, potential risks and other technical matters and answered questions put to him by the Panel.

All of the data sources indicated that there have been no captures of oceanic whitetip shark, white pointer shark, whale shark, deepwater nurse shark, manta ray, spinetail devil ray, giant grouper or

spotted black grouper in orange roughy fisheries. Whale shark, manta ray and giant grouper are tropical species and do not occur in the range of the four orange roughy fisheries. Igor Debski advised the Panel that there were significant misidentification and reporting issues for the deepwater nurse shark with most reported New Zealand records 'almost certainly wrong'. The MPI species code for the protected deepwater nurse shark is similar to that for 'other spiny dogfish' Other taxa are also referred to as 'nurse sharks' and the deepwater nurse shark has other common names. Sharpnose sevengill, sixgill and broadnose sevengill are similar species. Therefore the deepwater nurse shark is easily confused with other (non-protected) shark species.

The Panel agreed that there was either no risk or a negligible risk to most of the protected fish species from any of the four orange roughy fisheries. The one exception was the basking shark. This conclusion was supported by a high level of observer coverage, reporting requirements, and little or no overlap between the distributions of a number of these species with the four orange roughy fisheries. Igor Debski of the Department of Conservation agreed with this assessment.

The Panel agreed that basking shark required a formal assessment because of its vulnerability, concerns within New Zealand and overseas regarding a decline in abundance, and uncertainty about the status of the population.

#### 3.3.2.1 Basking shark (BSK), ORH MEC, ORH7A, ORH3B NWCR, ORH3B ESCR

***Score***

| **Consequence** | | **Likelihood** | | **Confidence** | |
|---|---|---|---|---|---|
| a) Mortality/cryptic impacts | 1 | a) Ability to control impact | 2 | a) Information availability & quality | 2 |
| b) Effects on population status | 2 | b) Performance | 2 | c) Monitoring/review | 1 |
| | | | | d) Consensus amongst experts | 2 |

***Rationale***

**Consequence**

a) The Panel agreed that the catch of basking shark from all orange roughy fisheries is either none or very little. Therefore, the risk of mortality from the orange roughy fisheries is of minimal consequence.
b) The Panel's consensus was that that a capture of none or one cannot lead to an adverse effect on the basking shark population. Dr Crozier stated that even if one fish was taken in five years we cannot conclusively state "the effects of the fishery on the ETP population [of basking sharks] are 'known'.

**Likelihood**

a) BSK is a fully protected species with monitoring and reporting in place. Any catch is to be released alive if possible.
b) Observer coverage in most of the orange rough fisheries is high. There have been no observed catches of BSK in the four orange roughy fisheries.

**Confidence**

a) There is a substantial information base, including annual Conservation Services Programme (CSP) reports, MPI observer data, and additional detailed reviews including two recent reports that review basking shark bycatch. These indicate very low interactions of BSK with the orange roughy fisheries as evidenced by no reported captures. There is insufficient information on the status of the population.
c) There is mandatory reporting, extensive monitoring through the CSP and MPI observer programmes and annual review.
d) There was general consensus amongst the Panel. Dr Crozier indicated doubt that the effects of the fishery are known.

During the Panel's discussions and assessment of BSK, Igor Debski suggested that there was room for improvement in the future management of BSK interactions with fisheries and that a Department of Conservation research project is underway investigating possible mechanisms to improve in this area, e.g. vessels could seek to avoid BSK and formal release methods/procedures could be developed to improve survival. Members of the Panel discussed the NPOA Sharks which is in a draft form and contains a range of measures aimed at improving the ability to prevent and reduce potential impacts of fisheries on shark species.

### 3.3.3 Reptiles

Within the sub-tropical northern areas of the New Zealand EEZ there are very infrequent catches of marine turtles. There are no records of the capture of marine reptiles south of the northern regions of the EEZ. The orange roughy fisheries operate well south of the distribution of these reptiles. The Panel determined that there was no risk to protected reptiles from the four orange roughy fisheries and that there was very good information to support this assessment.

### 3.3.4 Seabirds

The Panel commenced with an extensive consideration of protected seabirds by discussing the available information. The primary information available was Thompson & Berkenbusch (2013) that provided estimates of seabird captures by orange roughy fishery for the past ten years and Richard & Abraham (2013) which estimates the risk to New Zealand seabird species from all commercial fisheries. This is a 'Level 2' (semi-quantitative) risk assessment.

The Panel discussed whether it should only assess the 'at risk' birds from the Level 2 Seabird Risk Assessment. Detailed work had gone into it and it had been fully reviewed using a formal and public

process. Table 85 at p. 39 of Richard & Abraham (2013), were proxies of the overlap between the risk assessment and observer data. Cryptic mortality was incorporated. For example,Chatham Island albatross was considered to be 'high risk' as it has a low population and there were high levels of inshore trawl effort that has relatively low observer coverage which leads to the high risk score in Richard & Abraham (2013). In contrast, ORH tows are of short duration, with correspondingly less gear time in the water, have very low warp to depth ratio (i.e. steep angle of warp into the water and hence reduced exposed warp) because of the depth of water and also do fewer trawls. These features mean orange roughy trawls should present a lower level of risk and lower level of captures and cryptic mortality than trawl fisheries targeting other species

There was discussion about potential biological removals[1] (PBRs) and it was noted that where NZ captures exceeded PBR there might be significant impacts if this was a transient international species as it would not account for impacts that may be occurring elsewhere around the world.

The Panel discussed the relationship between different methods of fishing in relation to cryptic mortality and ability for it to weight and scale based on this. The Panel noted that the risk assessment in Richard & Abraham (2013) included cryptic mortality and related issues, incorporated formal MPI and public submission processes, was based on international studies, was widely accepted as current best information, and is linked to the NPOA-Seabirds. The Panel agreed that the best way forward was to base its assessments around the Richard & Abraham (2013) risk assessment. Thompson & Berkenbusch (2013) provided the estimated captures of seabirds (using data on observed captures) by species or category and fishery. These estimates are of captures and do not consider cryptic mortality (whilst Richard & Abraham's (2013) risk assessment does) and the Panel agreed that it would need to account for this in its assessments.

The Panel agreed that it would assess risks to Salvin's albatross, Chatham Island albatross, and northern giant petrel using their risk status in Richard & Abraham (2013). Based on the seabird risk assessments in Richard & Abraham (2013) the Panel determined that it did not need to consider any other species. Table A-5 at p. 39 of Richard & Abraham (2013) provides the estimated number of potential fatalities to the three at risk species from all deepwater trawl fisheries which includes the four orange roughy fisheries. This information would be considered together with the capture data in Thompson & Berkenbusch (2013). It was noted that the orange roughy fisheries contributed only a portion of total effort of all deepwater fisheries (comprising effort in CDL, BXY, OEO and ORH fisheries) and therefore well under 100% of any contribution to the deepwater trawl component of potential estimated mortality used in the PBR associated with deepwater trawling in Richard & Abraham (2013).

[1] The Potential Biological Removal (PBR) level is the maximum number of animals, not including natural mortalities, that may be removed from a population while allowing that population to reach or maintain its optimum sustainable population.

### 3.3.4.1 Salvin's albatross

#### *Scores*

| **Consequence** | | **Likelihood** | | **Confidence** | |
|---|---|---|---|---|---|
| a) Mortality/cryptic impacts | 2 | a) Ability to control impact | 1 | a) Information availability & quality | 2 |
| b) Effects on population status | 2 | b) Performance | 2 | c) Monitoring/review | 1 |
| | | | | d) Consensus amongst experts | 1 |

#### *Rationale*

**Consequence**

a) Estimated captures for all four ORH fisheries are negligible to very low (Thompson & Berkenbusch 2013). There is an acceptable degree of certainty of knowledge given the level of observer coverage.
b) Appendix A-5 of Richard & Abraham (2013) estimates that all deepwater fisheries (including the four ORH fisheries) contribute 48 (range 25-79) potential fatalities to the PBR out of estimated total potential fatalities from all fisheries of about 2,500. Richard & Abraham (2013) has been accepted by the AEWG and reported in an AEBR and management plans have been based on that information.

**Likelihood**

a) A fully protected species, vessel management plans, training programmes, mandatory reporting and observer coverage.
b) There is an ability to inform the management system, annual CSP reports, observer data and monitoring is ongoing. Observer coverage is good except for ORH MEC where it is relatively low.

**Confidence**

a) There is very good quality information in all areas apart from cryptic mortality which is uncertain. Observer coverage in ORH MEC needs to be improved.

c) There is a highly developed and active monitoring programme together with ongoing research to reduce risks to seabirds.

d) Full consensus.

### 3.3.4.2 Chatham Island albatross

The Panel's assessment was that there are very few (one or none) captures of Chatham Island albatross by the orange roughy fisheries given the very low 'large bird' (albatross) numbers in all

areas in Thompson and Berkenbusch (2013). Chatham Island albatross were included in the 'other albatross' category. Therefore the Panel identified that 'other albatross' captures in Thompson & Berkenbusch (2013) needed to be broken down by species to confirm whether any Chatham Island albatross had indeed been observed.

The Panel determined that on the basis of the available information the risk to Chatham Island albatross from the four orange roughy fisheries was negligible and that there was no need to proceed through the formal AEEF scoring process. Information quality was high with the proviso that 'other albatross' captures needed to be broken down by species.

#### 3.3.4.3 Northern giant petrel

The Panel's assessment was that there are very few if any captures by the four orange roughy fisheries given the very low other bird numbers in all areas in Thompson and Berkenbusch (2013). Northern giant petrel was included in the 'other bird category. Therefore the Panel identified that the 'other bird' category of captures in Thompson & Berkenbusch (2013) needed to be broken down by species to confirm whether any northern giant petrel had been captured.

### 3.3.5 Corals, ORH MEC, ORH7A, ORH3B NWCR, ORH3B ESCR

#### 3.3.5.1 Introduction

Dr Malcolm Clark (NIWA) made an oral and Power Point presentation to the Panel on behalf of Di Tracey (NIWA) who had prepared the Power Point presentation. A copy of the Power Point presentation is available on the Deepwater Group Ltd website at the webpage http://deepwater.hosting.outwide.net/our-species/orange-roughy/assessment-of-environmental-effects-of-fishing-2/ and is referenced in this report as Tracey (2013). Discussion points and Dr Clark's answers to questions from the Panel are set out below.

The cold water corals are diverse and the various coral types had different vulnerabilities to fishing. Critical to this was their growth rate and recovery for which there is limited information. It was important to understand the difference between the living and dead part of the coral for those species that grew in reef-like forms.

Overall, there was a good information base from NIWA research, including dredge samples and video.

Most deepwater coral spp. need hard surface to attach to and survive. They are temperature tolerant but can be influenced by oceanographic conditions, e.g. acidification, and are not necessarily light-driven (e.g. not symbiotic like tropical corals).

***Questions and answers:***

- Are any species are endemic? Yes. Explained that there were a lot of genera within families and that endemism was difficult to assess as the field is always evolving (some spp. may not have been discovered elsewhere, but this does not necessarily mean they don't live there).
- Distribution beyond EEZ? Yes most are quite widespread but to what extent depends on the species. Some species are endemic
- Is absence in the data for corals >1600m depth because they don't live there or because of sampling selection. No, statistically confident they are absent at these depths.
- Has there been full grid sampling? No, but have looked at variables of where likely to exist and sampled accordingly.
- Are some corals groups unlikely to exist in NWR, MEC and 7A but likely to be found in ESR but will be localised? Yes.
- Are there functional relationships between the other benthic organisms found with corals species? There is uncertainty but there appear to be functional relationships with other fauna.
- Identification problems? There are identification problems particularly at the species-level but noted that this was improving.
- Dispersal? They can widely disperse but need the right conditions, esp. dependent on foundations/substrate they can attach to.
- Habitat for fish? Little is understood about the linkages that might exist between corals and some fish species, although it is generally understood that they provide some benefits for some species, e.g., for hiding and for nursery grounds.
- Recolonisation? Because they're difficult to age there are also data gaps in terms of understanding how they recolonise.

The Panel commenced by noting that there was cross-over between habitats and ETP corals. A high proportion of the information on the presence of deepwater corals came from the incidental captures in trawl fisheries. There was less information for areas that had not been trawled. Observer data provided catch quantities but was considered unreliable as a comprehensive measure of risk and coral distribution due to trawl selectivity and the fact that the distribution of the orange roughy fishery was based on the distribution of the target species rather than coral habitats. There were differences in the retention of different morphological forms of coral in trawl gear.

The Panel determined that it should undertake its assessment of risk to protected corals based on differences based on variations in vulnerability to trawl gear (not taxa), i.e., using the main morphological types. These are:

- Tree like
- Reef forming
- Erect (whip like)
- Solitary

The Panel discussed the most appropriate approach to take in considering risks to each of these coral forms and determined that the most robust approach to assessing risks would be to use the

distribution of the corals and the proportion of the total habitat area of each coral type that is potentially impacted. The Panel relied on the following main sources of information for the assessment – information on distribution of corals summarised in Tracey (2013), Baird et al. (2012), and Tracey et al. (2011), and information on the proportion of seabed habitat that had been trawled (in particular seamounts, knolls and hills) provided in Clark (2013) and Stewart (2013).

#### 3.3.5.2 Corals, ORH MEC, ORH7A, ORH3B NWCR, ORH3B ESCR

##### *Scores*

**Tree like**

| **Consequence** | | **Likelihood** | | **Confidence** | |
|---|---|---|---|---|---|
| a) Mortality/cryptic impacts | 2 | a) Ability to control impact | 2 | a) Information availability & quality | 3 |
| b) Effects on population status | 2 | b) Performance | 1 | c) Monitoring/review | 2 |
| | | | | d. Consensus amongst experts | 2 |

**Reef forming**

| **Consequence** | | **Likelihood** | | **Confidence** | |
|---|---|---|---|---|---|
| a) Mortality/cryptic impacts | 2 | a) Ability to control impact | 2 | a) Information availability & quality | 3 |
| b) Effects on population status | 2 | b) Performance | 1 | c) Monitoring/review | 2 |
| | | | | d. Consensus amongst experts | 2 |

**Whip like**

| **Consequence** | | **Likelihood** | | **Confidence** | |
|---|---|---|---|---|---|
| a) Mortality/cryptic impacts | 3 | a) Ability to control impact | 2 | a) Information availability & quality | 3 |
| b) Effects on population status | 3 | b) Performance | 1 | c) Monitoring/review | 3 |
| | | | | d. Consensus amongst experts | 2 |

**Solitary**

| Consequence | | Likelihood | | Confidence | |
|---|---|---|---|---|---|
| a) Mortality/cryptic impacts | 3 | a) Ability to control impact | 2 | a) Information availability & quality | 3 |
| b) Effects on population status | 3 | b) Performance | 1 | c) Monitoring/review | 3 |
| | | | | d. Consensus amongst experts | 2 |

### *Rationale*

**Consequence**

a) The Panel considered the two distributions concerned here, corals and fisheries, and how these overlap and interact. If they are not overlapping then it is reasonable to assume there is no risk of mortality. Species identification is an issue. However, as entire coral orders are protected this is conservative and potentially protects species not yet identified. Retention (catchability) by trawl gear affects knowledge of mortality and cryptic impacts. The Panel considered that looking at these factors together was a reliable basis for assessing risk/consequence.

   For tree like and reef forming types, the interaction of distribution, mortality and impacts were better known due to their likely better retention by trawl gear. For whip like and solitary corals, our understanding of distribution and cryptic mortality were likely to be bigger issues due to much lower retention in trawl gear, thus there is less knowledge about their distribution. Therefore, the Panel has a higher degree of certainty in its assessment of distribution and mortality for tree like and reef forming corals and lower certainty for the erect whip-like and solitary corals.

b) The overlap between the known distribution of corals and the four orange roughy fisheries is documented in detail and this provides a foundation for assessing the risks to the overall coral populations of each coral type. However, sampling issues (e.g., retention in trawl nets), and limited taxonomic information creates uncertainty which increases risk. These two issues affect the different morphological types of corals in different ways and reflect the scores assigned to each type.

**Likelihood**

a) The fishery is spatially managed with defined areas where bottom trawling or all trawling is prohibited (e.g., benthic protected areas (BPAs), 'seamount' closures). As yet there is no overall management plan, but the corals are fully protected species.
b) VMS is mandatory on ORH vessels, there is an active scientific observer programme and there is ongoing research to better understand impacts, taxonomy, and distribution to inform management. There are penalties for incursion into closed areas and monitoring is in place to measure performance.

**Confidence**

a) Much of the distributional information of the corals is based on trawl net captures which has limitations in describing distribution because trawling locations are focused on catching orange roughy rather than ascertaining coral distribution and because of the uncertainty about the retention of corals in trawl nets. Taxonomic information is good at family level but there is less information at the species level. Cryptic impacts are less well known.

c) There is a highly developed and active monitoring programme together with ongoing research aimed at better understanding corals in order to fully understand and manage risks from fisheries impacts.

d) There was consensus on most issues but confidence in some of the assessments varied between the Panel members.

### 3.3.6 Marine mammals

There are no records of marine mammal captures (New Zealand fur seals, New Zealand sea lions, dolphin species, and whales) in the four orange roughy fisheries (Thompson & Berkenbusch 2013). The fisheries operate in areas where no sea lions are present. The Panel determined that there was no risk to marine mammals from the four orange roughy fisheries and that there was very good information to support this assessment.

## 3.4 Habitat

### 3.4.1 Introduction

Four presentations were made to the Panel. Aaron Irving, DWG presented a summary of trawl footprint analysis contained in Stewart (2013). Andy Smith (Talley's Group Ltd) showed bathymetry and SeaPlot information on underwater topographic features (UTFs) that demonstrated how they were fished, what areas of UTFs could be fished and could not be fished, and answered questions about the factors that limited the direction and duration of trawl tracks on UTFs. Graham Patchell (Sealord Group Ltd) showed a video of the seafloor from the headline of a trawl net and provided information on seabed types and trawling. Dr Malcolm Clark (NIWA) gave an oral Power Point presentation covering three topics; metrics and information on UTFs, structure and function of benthic habitats on UTFs, and information on changes in benthic fauna in the Graveyard hills complex. Dr Clark's Power Point presentation is available on the Deepwater Group Ltd website at http://deepwater.hosting.outwide.net/our-species/orange-roughy/assessment-of-environmental-effects-of-fishing-2/ and is referenced in this report as Clark (2013).

The Panel considered that there were two primary kinds of benthic habitat – underwater topographic features or UTFs (e.g., seamounts, knolls and hills) that were mostly comprised of hard substrates and flat or gently sloping areas of seafloor on the continental slope that are mostly soft sediments and are referred to as slope/flats. The Panel discussed whether each of these primary forms of habitat – UTFs and slope/flats should be considered separately in relation to structure and function on a regional or bioregional basis. Further discussion considered whether or how seabed depth should be taken into account and whether substrate type should be taken into account, including whether biogenic habitats are a habitat type that should receive separate consideration.

There was consideration of the appropriate assessment scale –the primary issue was to assess habitat on a regional or bioregional scale as required by the MSC standard. Therefore, it was necessary for the Panel to consider what constitutes a 'region' or 'bioregion'. The Panel determined that for the purpose of the habitat assessment it would consider 'region' or 'bioregion' at the quota management area (QMA) scale, not at a wider geographic scale. Whilst small, the QMA scale was precautionary and accommodated potential habitat differences that might exist between the four

orange roughy fisheries due to oceanographic conditions, latitude and longitude. Duncan Leadbitter suggested that considering habitat on the QMA scale might not constitute the whole of the habitat that should be considered. Dr Tingley suggested that a QMA scale for these fisheries was too small to be in agreement with the MSC standard as currently written.

The Panel determined that it would assess habitat (benthic) on the basis of region (QMA), considering depth and features. The information in Stewart (2013) and Clark (2013) provided good information to do this.

Based on knowledge of the characteristics of features and the factors that limited where trawls could operate together with how fishers deployed their trawls on them, the Panel agreed to assume that where a feature had been trawled one or more times that that no more than 25% of the basal area was impacted. Dr Tingley prepared a table (Table 3) based on page 27 of Clark (2013) that gave the area of UTFs impacted in each orange roughy fishery since the fishery commenced using the assumption that 25% of the area of a feature was impacted from one more trawls and recommended that its accuracy be checked after the Workshop. The Panel agreed that this table would be used as the basis for the assessment of impact on UTF habitat. Stewart (2013) provided information on the area of orange roughy habitat that had been trawled including slope/flat habitat.

**Table 3: Assumed UTF area impacted in orange roughy fisheries since the commencement of the fishery based on 25% of the basal area impacted from one or more tows.**

| | | **UTFs fished** | | **UTFs Unfished** | | |
|---|---|---|---|---|---|---|
| Depth | Fishery | Total area (km2) | Impacted area (km2) | Area (km2) | **Total area all UTFs (km2)** | **% of total UTF area impacted** |
| 500-1200 | ORH MEC | 691 | 172.75 | 972 | 1663 | 10% |
| | ORH7A | 10 | 2.5 | 1.5 | 11.5 | 22% |
| | ORH3B NWCR | 35.4 | 8.85 | 7.6 | 43 | 21% |
| | ORH3B ESCR | 263 | 65.75 | 178 | 441 | 15% |
| | | | | | | |
| 800-1000 | ORH MEC | 194 | 48.5 | 617 | 811 | 6% |
| | ORH7A | 8 | 2 | 0 | 8 | 25% |
| | ORH3B NWCR | 10 | 2.5 | 3 | 13 | 19% |
| | ORH3B ESCR | 62 | 15.5 | 103 | 165 | 9% |

### 3.4.1 Habitat Assessment by ORH fishery

***Scores***

**ORH MEC slope/flat**

| Consequence | | Likelihood | | Confidence | |
|---|---|---|---|---|---|
| a) Community composition and abundance/biodiversity | 1 | a) Ability to control impact | 2 | a) Information availability & quality | 2 |
| b) Habitat structure and function | 2 | b) Performance | 1 | c) Monitoring/review | 2 |
| | | | | d) Consensus amongst experts | 2 |

**ORH MEC UTFs**

| Consequence | | Likelihood | | Confidence | |
|---|---|---|---|---|---|
| a) Community composition and abundance/biodiversity | 1 | a) Ability to control impact | 2 | a) Information availability & quality | 2 |
| b) Habitat structure and function | 2 | b) Performance | 1 | c) Monitoring/review | 2 |
| | | | | d) Consensus amongst experts | 2 |

**ORH7A slope/flat**

| Consequence | | Likelihood | | Confidence | |
|---|---|---|---|---|---|
| a) Community composition and abundance/biodiversity | 1 | a) Ability to control impact | 2 | a) Information availability & quality | 2 |
| b) Habitat structure and function | 2 | b) Performance | 1 | c) Monitoring/review | 2 |
| | | | | d) Consensus amongst experts | 2 |

**ORH7A UTFs**

| Consequence | | Likelihood | | Confidence | |
|---|---|---|---|---|---|
| a) Community composition and abundance/biodiversity | 2 | a) Ability to control impact | 2 | a) Information availability & quality | 2 |
| b) Habitat structure and function | 2 | b) Performance | 1 | c) Monitoring/review | 2 |
| | | | | d) Consensus amongst experts | 2 |

**ORH3B NWCR slope/flat**

| Consequence | | Likelihood | | Confidence | |
|---|---|---|---|---|---|
| a) Community composition and abundance/biodiversity | 1 | a) Ability to control impact | 2 | a) Information availability & quality | 2 |
| b) Habitat structure and function | 2 | b) Performance | 1 | c) Monitoring/review | 2 |
| | | | | d) Consensus amongst experts | 2 |

**ORH3B NWCR UTFs**

| Consequence | | Likelihood | | Confidence | |
|---|---|---|---|---|---|
| a) Community composition and abundance/biodiversity | 2 | a) Ability to control impact | 2 | a) Information availability & quality | 2 |
| b) Habitat structure and function | 2 | b) Performance | 1 | c) Monitoring/review | 2 |
| | | | | d) Consensus amongst experts | 2 |

**ORH3B ESCR slope/flat**

| Consequence | | Likelihood | | Confidence | |
|---|---|---|---|---|---|
| a) Community composition and abundance/biodiversity | 1 | a) Ability to control impact | 2 | a) Information availability & quality | 2 |
| b) Habitat structure and function | 2 | b) Performance | 1 | c) Monitoring/review | 2 |
| | | | | d) Consensus amongst experts | 2 |

**ORH3B ESCR UTFs**

| Consequence | | Likelihood | | Confidence | |
|---|---|---|---|---|---|
| a) Community composition and abundance/biodiversity | 1 | a) Ability to control impact | 2 | a) Information availability & quality | 2 |
| b) Habitat structure and function | 2 | b) Performance | 1 | c) Monitoring/review | 2 |
| | | | | d) Consensus amongst experts | 2 |

### *Rationale*

**Consequence**

a) There were time scale and depth differences between Stewart (2013) and Clark (2013). It was noted that time scale may be important in terms of functionality and recovery. There was no geographical variation in the fisheries over time although the trawl footprint had progressively contracted to core areas as a result of reduced TACCs and better knowledge of where ORH can be caught. Clark (2013) used 500-1200m and 800-1000m depth bands in describing UTFs trawled and area fished with the data cumulative since the fishery commenced. Stewart (2013) only considered number of UTFs trawled not area of UTF trawled. However, detailed data on trawl tracks are available but the analyses have yet to be completed.

   The Panel noted that structure was not necessarily directly linked to function, e.g. if coral is removed by a trawl and yet fish are still there afterwards, then this is evidence that function is more complex.

   Differences in scores for Confidence in the four fisheries reflect the different proportions of habitat that has been trawled in Table 3 based on Clark (2013). It was agreed that having more information, such as basal area and area trawled by individual feature would be useful. The data to undertake such analysis was available but have not yet been analysed.

   Stewart (2013) used three strata, 400-800m, 800-1200m and 1200-1600m depth to analyse trawl footprint. Areas trawled and not trawled were for the last five years. Areas of slope and flat tended to be mostly soft sediment. All areas in all four fisheries within the >0% probability of orange roughy capture were <20% impacted in the past 5 years (Stewart 2013).

b) While it was difficult to infer habitat function from physical characteristics the Panel agreed that the assessment was about 'serious and irreversible harm'. The area impacted was small in relation to total habitat and risks were correspondingly small and limited.

**Likelihood**

a) For both UTF and Flat/Slope habitat, spatial management tools were in place
b) VMS was mandatory on all ORH targeting vessels, there is an active observer programme and there is ongoing research to better understand habitat impacts and inform management.

**Confidence**

a) The Panel considered that there was detailed information on where fishing occurred and where features located but there was a lack of information on structure and function, at least in terms of direct and intimate links. It was noted that inferring through fish species (as opposed to community composition) had limitations.

c) For both UTF and slope/flats habitats, spatial management tools were in place, VMS was on vessels, there is an active observer programme and because management is periodically reviewed to respond to new information and research.

d) The Panel was unable to come to full consensus on what constituted 'habitat' as Duncan Leadbitter believed that substrate type should be considered (i.e., hard versus soft and biogenic habitat) and that region or bioregion impacts should be addressed on a wider geographical scale rather than QMA. For both UTF and slope/flats habitats, spatial management tools were in place, VMS was on vessels, there is an active observer programme and because management is periodically reviewed to respond to new information and research.

## 3.5 Ecosystem (ORH MEC, ORH7A, ORH3B NWCR, ORH3B ESCR)

### *Scores*

| **Consequence** | | **Likelihood** | | **Confidence** | |
|---|---|---|---|---|---|
| a) Community composition and abundance/ biodiversity | 1 | a) Ability to control impact | 1 | a) Information availability & quality | 3 |
| b) Trophic structure/function | 3 | b) Performance | 2 | c) Monitoring/review | 2 |
| | | | | d) Consensus amongst experts | 2 |

### *Rationale*

The Panel commenced with a discussion on the orange roughy ecosystem before scoring confidence. It was noted that the objective and the MSC standard for ecosystem is about 'structure and function' and 'serious and irreversible harm'. Reports most pertinent to the assessment were Dunn (2013), Knight et all. (2011) and Pinkerton (2011).

Dunn (2013) provides a detailed overview of current knowledge of the ORH ecosystem as well as commentary on current information gaps. Knight et al. (2011) gives an EEZ wide assessment of sustainability of fisheries from an energetics analysis which indicates the pressure on the ecosystem from the combined harvest of all New Zealand deepwater fisheries appears to be sustainable from an energetics perspective. Pinkerton (2011) provides a balanced trophic model of the Chatham Rise ecosystem with focus of the model on the role of demersal fishes.

Dunn (2013) indicates that current ecosystem knowledge is good in a general sense. The key elements of the ecosystem such as prey, predators, competitors and the community are reasonably well known. Components and characteristics of the ecosystem are largely described and understood. The level and quality of information was good. There is ongoing research to fill in gaps.

Some changes in the orange roughy ecosystem could be inferred from the results of trawl survey time series (e.g., Chatham Rise middle depth trawl surveys and MEC trawl surveys) but the depth strata analysed in the published reports on the Chatham Rise surveys are too shallow to draw any

firm conclusions for the deeper areas inhabited by ORH. However, there are trawl survey data for deep strata on the Chatham Rise that have not yet been analysed. Changes in abundance of some species are being observed from the deepwater trawl survey results in the ORH MEC area. These may either be a 'positive' compensatory response as the ecosystem adapts to fishing removals, or a 'negative', but to say which is speculative. Change in terms of functionality needs to be addressed and should be considered. There is an implicit assumption that if managing fisheries at target level, then there is a predator/prey balance. $B_{MSY}$ was only a proxy. Managing individual species by quota (TACCs) is not managing according to a multispecies model and so care needs to be taken. . It was noted by the Panel that, in recent years, deeper strata have been included in the Chatham Rise trawl surveys and that these will contain useful and relevant information but that these data have yet to be analysed.

The detailed information available from trawl surveys time series (Chatham Rise, MEC and Challenger) shows no evidence of the loss of species or species groups. While trawl surveys indicate that there are changes in the relative abundance of some individual species, the changes are both up and down. The Panel's view was that there is no evidence of significant change in the ecosystem based on this evidence. Current orange roughy catches are much reduced from historical levels. Change over time is likely to be more associated with biomass being fished down rather than a change in functionality. Overall, there is good information available and that has identified some changes in the ecosystem. The Panel was positive about the quality and usefulness of Dunn's (2013) paper. It suggested a number of approaches were available to learn more about how the ecosystem functioned and how to monitor it.

**Consequence**

a) The Panel commenced its assessment by considering ecosystem consequence. The Panel considered that as only a small biomass is being removed from the ecosystem both in absolute terms and proportionately, it was unlikely to result in a significant change in the ecosystem. Overall, the observed changes are small and insignificant to the ecosystem as a whole. There is no evidence of a loss of species. Dr Crozier had a different view, indicating that orange roughy catches are much reduced from the past. In the past the removals of orange roughy were significant and are likely to have had an effect on ecosystem functionality.
b) The evidence as a whole indicates that at current catch levels, there is no serious or irreversible harm to individual components or the overall structure or function of the ecosystem in the four orange roughy fisheries. Duncan Leadbitter noted that some ORH were 100+ years old and therefore few were being eaten, indicating orange roughy were unlikely to play a significant role in the energy/trophic system. Dr Crozier had a different opinion and assessed the score to (b) as a (4) stating that a more precautionary approach should be adopted to determine whether the fishery was having a serious or irreversible harm to the ecosystem due to the biological characteristics of orange roughy (slow growth, late maturity).

**Likelihood**

a) Biomass removals can be controlled using TACCs. Other impacts (e.g., to protected species, habitat) can be managed using spatial controls and some are already in place. Less formal

measures also exist such as codes of practice. Under the Fisheries Act 1996, the Minister must take into account a number of sustainability, environmental and information principles.

b) All of the management tools are available and are being used to control ecosystem impacts, e.g., limits on total catch (TACCs), BPAs, 'seamount' closures, protected species controls). ETP considerations inherently have an ecosystem component and TACC reductions or other management interventions to reduce effort have been made expressly for ETP/ecosystem considerations, e.g. in the squid trawl fishery in order to reduce impacts to seabirds and sea lions rather than for fisheries/stock management considerations. There is strong evidence that management tools such as TACCs and closed areas are effective and adhered to.

**Confidence**

a) Ecosystem information for all fisheries was generally good but better for the Chatham Rise fisheries. Dr Tingley indicated the fisheries on the Chatham Rise fisheries could probably be scored as (1) but there was less information in the other fisheries and so they should be scored conservatively. Dr Crozier considered there was insufficient information to consider the ecosystem information as good.
b) There were regular trawl surveys and periodic trawl survey reviews. Non-fish components of the ecosystem, especially protected species, were closely monitored.
c) There was a general consensus but with some disagreement. Dr Crozier scored consequence at a more precautionary level.

# 4. Summary

## Retained species

The Expert Panel assessed risks of serious or irreversible harm to retained species as being negligible or very low. All of the retained species are managed under the QMS framework with a substantial information base, active monitoring via the Observer Programme, active research programmes and regular stock assessments.

## Bycatch species

Risks of serious or irreversible harm to bycatch species or species categories were assessed as being low to moderate. The primary risk issues were related to limited information for particular species groups, namely the Alepocephalidae, Chimaeridae and Rhinochimaeridae, and some deepwater shark species. Potentially useful information exists on these species but it has not yet have been formally analysed and thus was unavailable to the Panel. The Panel did not complete assessments of some species due to insufficient information and time.

### ETP species

Risks of serious or irreversible harm to ETP species were assessed as being negligible or absent except for protected corals where they were assessed as being low to moderate.

Risks to protected corals are related mainly to limited taxonomic information and a lack of detail on the extent of trawl footprint impact on the particular habitats corals occupy, i.e., what the distribution of corals is outside of the trawl footprint. There are also information issues as a result of variable retention of various coral forms in trawl nets. While there was good information generally to support the assessment on corals, improved information in these areas is likely to reduce risks and improve confidence in the assessment of risks.

### Habitat

The risks of serious or irreversible harm to structure and function of habitat on a regional basis using QMA boundaries and seabed depth as a proxy for regions were assessed as being low. Only small proportions of slope/flat and UTF habitats are being impacted by the orange roughy fisheries when considered on a regional basis.

The Expert Panel had some differing views on what specific habitat elements or proxies should be considered to fully incorporate the features of structure and function.

### Ecosystem

Risks of serious or irreversible harm to the ecosystem were assessed as being low. All but one member of the Expert Panel considered that information to support the assessment was good and the key ecosystem elements are known.

## 5. Further work and information needs

The Expert Panel identified a number of areas requiring further analysis of existing data or research and to this extent the AEEF of the four orange roughy fisheries is a work in progress. While there is a large body of information to support the AEEF, the lack of specific kinds of information or analysis of research data that has been collected but not yet analysed impeded assessments on a number of ecological components. Until existing research data are fully analysed and remaining information gaps identified, some ecological components are potentially being exposed to greater risk.

Information needs, both analysis of existing data and the collection of new data, are identified throughout this report and it is recommended that these be followed up.

### Retained species

- No specific information needs were identified.

### Bycatch species

- Information needs were identified for slickheads (Alepocephalidae), ghost sharks (Chimaeridae and Rhinochimaeridae), and some deepwater shark species. Some data are available and this should be compiled and formally analysed.

### ETP species

- Information needs were identified for Chatham Island albatross and northern giant petrel captures, cryptic mortality of seabirds, and corals (taxonomy, retention in trawl nets, cryptic mortality). Some data exists to meet these needs and should be analysed.

### Habitat

- More detailed information is required on the areas of habitat that are impacted by trawl nets, in particular the specific areas or parts of UTFs that are being impacted and not impacted. Data are available to meet some of these requirements and should be analysed.

### Ecosystem

- More information is needed on ecosystem characteristics including the role of species, relationships between species and biodiversity.

## 6. Acknowledgements

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