New Zealand's Sustainable Fisheries: Orange Roughy

1. Conservative management of orange roughy

- In New Zealand orange roughy is recognised to be a vulnerable deep sea species because of its relatively low productivity. This commercial species is therefore managed conservatively under the New Zealand Quota Management System (QMS). The QMS delivers the following outcomes:
    - Quota owners have accepted the rights and responsibilities that come with Individual Transferrable Quota (ITQ). These include taking a long term custodial approach to management and harvesting, meeting the costs for all Government research, and undertaking additional research and management measures to ensure the sustainability of all fisheries.
    - A Total Allowable Commercial Catch (TACC) is set by the Minister of Fisheries for each orange roughy fishery, based on the best scientific advice.
    - TACCs are set without political considerations and without the need to consider the policies and practices of neighbouring states, enabling management to be based on independent scientific advice, and that is effective, responsive, proactive, and sustainable.
- Management targets and reference points for orange roughy are in accordance with world's best practice. The target is to maintain stocks at or above the level that will produce the maximum sustainable yield. For orange roughy this has been set at 30% of the unfished stock size.
- In order to reduce the stock size down to this level, TACCs are initially set at higher levels than are sustainable in the long term. When the target level is reached, catches are reduced to levels that will provide sustainable yields over the long term. Over time this has lead to reductions in TACCs.
- What this harvest strategy means in practice is that, with perfect knowledge, an orange roughy fishery with an unfished biomass of, say, 100,000 t would be 'fished down' to a stock size of not less than 30,000 t, where productivity is assessed to be optimised. To do this catches during the 'fishing down' phase are necessarily higher than those set for the second phase, which is to maintain the stock size at or above a size that will provided maximum sustainable yields over the long term. In essence, the 'fishing down' phase provides a 'one off' availability of 70,000 t, which is taken over the early years of an orange roughy fishery. Once completed, the annual sustainable yields from a 30,000 t stock of orange roughy are estimated to be 1,350 t. Inevitably, under long term

sustainable management, catch reductions will follow at the end of the 'fishing down' phase.

- Unfortunately, perfect knowledge is not available for orange roughy fisheries. During the development and management of these fisheries over the past 30 years our understandings of their biology and stock dynamics has had to be developed from a near zero-base. Orange roughy stocks do not follow the 'northern hemisphere' scientific assessment models applied in the early years. They are now understood to be long lived, to grow slowly, to not mature until 25-30 years and to have very low fisheries productivity. These understandings, along with empirical information of fisheries performance, have established that the early estimates of productivity were too high. As a result, the current stock size is below the target level for several of New Zealand's orange roughy fisheries. TACCs have now been revised downwards using lower productivity estimates.
- For orange roughy, long term yields are now set at 4.5% of the stock size. This equates to an annual harvest of 1 out of every 22 orange roughy, leaving 21 in the water.
- If stocks fall below management target levels, the management response is to reduce catches to provide for rebuilding. The rate of rebuilding may be maximised by closing the fishery. To date, four orange roughy fisheries in New Zealand have had this management response, one of which has since been rebuilt and reopened
- Catches of orange roughy are within the TACCs.

2. Will orange roughy be fished to extinction?

- Concerns have been expressed by lobby groups that orange roughy will be fished to extinction. These concerns have no basis in reality, for several reasons:
    - Orange roughy are widespread in low abundances throughout the New Zealand Exclusive Economic Zone (EEZ). Furthermore, orange roughy are not constrained to New Zealand's waters; they are found globally within the preferred depth and temperature ranges and are fished in only very small proportions of their total distribution.
    - Orange roughy are known to exist throughout their habitat range outside of these fished areas from research trawl surveys. Because of the very large areas of habitat, even at very low levels of abundance, there are large numbers of orange roughy additional to those in these assessments.
    - In the New Zealand EEZ, trawling for orange roughy has covered less than 5% of their habitat range; 95% of this habitat remains unfished for orange roughy and 9.3% is closed to bottom trawling (see map on page 7). While the main areas of high abundances that have been discovered have been fished, even if only low abundances

of orange roughy occur elsewhere, the large size of the unfished areas mean significant numbers of orange roughy will always exist, even in the absence of effective fisheries management controls.

- In the fished areas, assessments by scientists estimate there are 128,000 tonnes of adult orange roughy, or approximately 100 million individual adults, the females of which lay approximately a trillion eggs each spawning cycle. If orange roughy living outside these areas are considered the numbers will be much higher than these.
- Without effective management controls, commercial fishing may reduce stock sizes to very low levels, but this has never lead to the extinction of any commercial species, as the costs of catching will always lead to cessation of viable fishing well before the 'last fish' is caught.
- This is not the case in New Zealand where active and effective management measures, including the use of low or zero catches to promote maximum rates of stock rebuild, have proven to be effective.
- Orange roughy stocks have proven to be resilient – fisheries in New Zealand, Australia and Namibia whose stocks were formerly assessed to have been below management targets, in some cases to be below 10% of the unfished size, have all responded to reduced catches or to closures by rebuilding in size.

3. Specific requirements for harvesting of orange roughy against quota

- The New Zealand Government regulates the harvesting of orange roughy against quota with stringent legal obligation on permit holders that require:
  - Details of all trawl tows to be logged and reported (including location of tows, time on bottom, depth, headline height, wing spread, target species, and catches of main species).
  - All vessel locations to be continuously monitored by Government through satellite telemetry.
  - All catches must be landed to a Licensed Fish Receiver (LFR) in New Zealand and these landings are recorded and balanced against quota to the kilogram. All LFRs are audited by Government to ensure catch records align with landing records. Vessels are not permitted to travel to other states to unload catches taken from within New Zealand waters.
  - All catches, including key by-catch species and any captures of protected species, to be recorded and reported to the Ministry of Fisheries.
  - All trawlers to comply with regulated and non-regulated measures to mitigate interactions with seabirds and marine mammals.

- A high level of Government observer coverage aboard vessels fishing for orange roughy - in recent years between 41-47% of all orange roughy tows have been observed.
- Rigorous documentation and auditing procedures to monitor catches against quota; a very effective prosecution and judicial system; and a punitive penalty regime, which includes automatic forfeiture of vessel and quota upon conviction.

4. Management of orange roughy informed by independent science

- Management of New Zealand's orange roughy fisheries is consistent with the best available scientific advice, based on world's best practice. The fisheries science used to inform management decisions is provided by independent, third party contractors and by Government scientists. The science working group process that considers and discusses results from this work is open to the public.
- Scientists monitor the state of orange roughy fisheries using all relevant information including results from research surveys, biological research, commercial catch information, Government observer data and stock assessments.
- In 2010, the Ministry of Fisheries, with full support from orange roughy quota owners, implemented a 10-Year Research Programme to ensure the necessary science-based information is available to inform sustainable management determinations. This programme specifies the scientific services required for monitoring stock size (including biomass surveys, collection of biological data, stock assessments), for determining sustainable yields and for monitoring and assessing the effects of fishing on the aquatic environment (including Ecological Risk Assessments and population evaluations to determine whether adverse effects are occurring).
- In 2011, the Ministry of Fisheries implemented a Research and Science Information Standard for New Zealand Fisheries to ensure all research continues to consistently meet world's best practice.

5. More conservative management introduced – stocks rebuilding

- The fisheries on orange roughy stocks are constantly monitored and stock status is regularly assessed.
- In New Zealand the total orange roughy harvest was relatively stable at around 15,000 tonnes/year during the period 2000-01 to 2005-06. The combined size of these seven main orange roughy stocks is estimated to be around 128,000 tonnes.

- In 2006 the Ministry of Fisheries quota owners formed a partnership to combine resources and to enhance fisheries management of New Zealand's deepwater fisheries. This has included a comprehensive programme to develop and to implement more conservative and effective management of target stocks, of by-catch stocks and of the impacts of fishing on the marine environment.
- For orange roughy these initiatives have resulted in the collection of more science-based information and the implementation of more conservative harvest strategies. Over the past five years, a reference fishing mortality of 4.5% of the current stock size has been progressively implemented. This equates to an annual harvest of 1 out of every 22 orange roughy, leaving 21 in the water.
- The implementation of these revised management targets, combined with improved information on stock status, has resulted in a managed scale-down in the TACCs for some orange roughy fisheries and to reduced catch levels, which are presently around 8,000 tonnes/year.
- Better information on stock status though more regular research surveys has also provided evidence of stock rebuilding. This has provided a basis to inform the reopening of fisheries where stocks have rebuilt and provided confidence to fisheries managers and quota owners to adopt more conservative harvest strategies including significant catch reductions to promote rebuilding in other orange roughy fisheries.
- Of the nine fisheries stocks, three are presently not fished to provide for stock rebuild, one has rebuilt and was reopened in 2010-11, and six have their management under review, which includes the progressively implementation of more conservative harvest strategies and lower catches. A result of this 'restructuring' of New Zealand's orange roughy fisheries will be further catch reductions during the next few years.

6. Effective management in place

- In 2009 the Ministry of Fisheries implemented Harvest Strategy Standards, which set out acceptable target and limit reference points and prescribe the management options when these trigger points are reached, to ensure harvests are maintained within sustainable limits.
- In 2010 the Minister of Fisheries approved the National Fisheries Plan for Deepwater and Middle-depth Fisheries.
- Management of orange roughy fisheries is undertaken according to the goals and objectives of this Fisheries Plan, which incorporates the Harvest Strategy Standards.
- This Fisheries Plan sets 5-year objectives aimed at management ensuring the sustainability of fish stocks and the management of impacts on associated and dependent species.

Deep water fish stocks are managed to an agreed harvest strategy, informed by robust fishery-dependent and fishery-independent information.

- The Fisheries Plan provides for Annual Operating Plans, which prescribe a work plan and management measures necessary to ensure deep water fish stocks are sustainably managed.
- The Fisheries Plan also provides for Annual Review Reports which will provide a public and transparent assessment of management actions delivered against objectives through the previous year's Annual Operating Plan.

7. Orange roughy – precise target fisheries

- There have been suggestions that orange roughy trawl fisheries have a large by-catch of other species. This proposition is without foundation and is not supported by data collected by Government fisheries observers.
- Orange roughy target trawling is a precision operation - 81% of the observed catches are orange roughy. Of the non-target catch, 94% is comprised of species which are sustainably managed under the QMS and are retained as valuable commercial catch. Given that less than 5% of these deepwater habitats in New Zealand waters are fished for orange roughy, and the very low by-catch levels of non-QMS species, any impacts on other deepwater species (such as sharks) is negligible. By world standards this is a clean trawl fishery.

8. Managing the impacts of orange roughy fishing on the marine environment

- The Government and quota owners have implemented measures to minimise the impacts on the marine environment by orange roughy fisheries.
- Fishing permit holders are required by law to record non-target catches and to monitor, record and report captures of non-target species, including incidental captures of seabirds and marine mammals.
- Government observers are deployed aboard deepwater vessels fishing orange roughy to monitor the catches and interactions with non-target species and to collect biological data for use in the management of the fishery. In recent years, observers have monitored between 41-47% of all orange roughy tows.

9. **Orange roughy fishing grounds impact only a small proportion of their habitat**

Figure 1: Orange roughy habitat and orange roughy trawl grounds 1989-90 to 2008-09

10. Minimal interactions with seabirds and marine mammals

- It has been alleged that orange roughy fisheries capture high numbers of seabirds and marine mammals. This allegation is not supported by data collected by Government fisheries observers.
- Incidental interactions between seabirds and trawlers harvesting orange roughy occur very occasionally. Most of these result from seabirds foraging opportunistically near fishing gear, either through striking trawl warps or becoming caught while feeding on or around the trawl net when it is on the surface during shooting and hauling.
- Government and quota owners have implemented a range of legislated and non-legislated controls to mitigate harm to seabirds. Monitoring by observers demonstrates that these are working and that numbers of interactions between seabirds and orange roughy fishing are at very low levels.
- In 2010, Government and stakeholders completed a risk assessment of fisheries interactions with seabirds in New Zealand waters. For all deepwater trawling (including trawls targeting orange roughy) the results of this risk assessment are that seabird mortalities occur at very at low rates, and that "*All birds considered at risk of exposure to this fishery scored either 1 (interactions are remote) or 2 (interactions are unlikely) with the exception of the two Buller's albatrosses, Salvin's albatross and white-capped albatross which all scored 3 (interactions are uncommon)*".
- Total seabird captures have been estimated from all deepwater tows (including tows targeting orange roughy), monitored by Government observers. Observer coverage of these fisheries has been increased and plans are in place to extend this to coverage further. Mitigation measures were implemented during 2006 after which time the numbers and rates of observed seabird captures have declined.

Table 2: Observed and estimated seabird capture rates and numbers from all deepwater tows (from Ministry of Fisheries)

Year	Number of deepwater tows	Proportion of tows observed	Number of observed captures	Captures per 100 tows	Estimated number of captures
2004-05	8,409	19%	19	1.17	79
2005-06	8,291	16%	5	0.39	29
2006-07	7,477	31%	1	0.04	10
2007-08	6,730	42%	6	0.21	14
2008-09	6,130	39%	6	0.25	23

- The information in the above table shows the low rates and low numbers of interactions between seabirds and deepwater trawlers.
- New Zealand fur seals are also attracted to trawlers fishing for deepwater species through their opportunistic feeding on or near nets when these are near the surface during shooting and hauling resulting in occasional interactions. These events may occasionally result in accidental capture, injury or drowning.
- Government and quota owners have implemented fleet-wide 'best practice' operational procedures to avoid accidental captures and, in the event of any capture, to minimise harm to fur seals, and to fishing crew when assisting their release.

Table 3: Observed and estimated New Zealand fur seal capture rates and numbers from all deepwater tows (from Ministry of Fisheries)

Year	Number of deepwater tows	Proportion of tows observed	Number of observed captures	Captures per 100 tows	Estimated number of captures
2004-05	8,409	19%	4	0.25	13
2005-06	8,291	16%	2	0.15	10
2006-07	7,477	31%	2	0.09	3
2007-08	6,730	42%	4	0.14	8
2008-09	6,130	39%	0	0	4

- The information in the above table shows low rates and numbers of interactions between New Zealand fur seals and deepwater trawlers, increasing observer coverage, and reducing capture rates across deepwater fisheries.
- The infrequent numbers of interactions with fur seals is notable given the increasing abundance of fur seals around New Zealand and their learned behaviour of feeding on offal and on fish from trawl nets when near the surface.

11. Minimal impacts on benthic habitats from bottom trawling for orange roughy

- Recent concerns have been expressed around the use of bottom trawls, suggesting that trawling causes widespread damage to benthic habitats and, in particular, to those encrusted with corals and sponges. These sessile invertebrates mostly inhabit hard substrates where they can attach and they are seldom found on soft substrates such as mud or sand.

- The trawl grounds for orange roughy are confined to very small and very specific areas within their overall habitat range (as shown in the map on page 7). Only limited areas of the habitat range of orange roughy have ever been contacted by bottom trawls.
- Most orange roughy are caught on relatively flat grounds comprised of soft substrates, although some fishing does occur on underwater drop-offs, hills and knolls. Orange roughy fishing has very low spatial impacts as trawling is very targeted with relatively small nets (i.e. 25 metres wide, 2-3 meters headline height, 100 meters door spread), short tow durations, and fishing consistently over the same grounds. When fishing on hills and down slopes, the trawl doors rarely contact the seabed.
- An independent analysis estimates that, during the past 20 years (i.e. 1989-90 to 2008-09) less than 5% of the orange roughy habitat range has been contacted once or more by bottom trawls targeting orange roughy. In the most recent year assessed (i.e. 2008-09), only 0.31% of the orange roughy habitat range was contacted by bottom trawls. These analyses assume the swept area of trawls to be the width between the trawl doors and not just the net itself (i.e. a width of 100 metres not 25 metres).
- The results of this analysis of orange roughy trawl grounds found that 95% of the orange roughy habitat range has never been bottom trawled for orange roughy. This is indicative of the precise and focussed nature of target fishing for orange roughy generally, and for orange roughy in particular, and of the minimal impacts from bottom trawling for orange roughy on benthic habitats.
- In many cases the areas where corals are known to live hold no commercial quantities of orange roughy or are too deep or too steep for access by bottom trawling. While some coral is taken by trawls at times in small localised areas, this is not seen to be cause significant adverse effects because of the large and extensive areas of habitats encrusted with coral within New Zealand waters.
- The area trawled for orange roughy has decreased significantly in size in recent years as catches have been decreased to sustainable levels and as fishing has become more directly targeted to the productive grounds, which are fished consistently each year. This optimises both fisheries economics and conservation and minimises the scale and extent of any impacts on benthic communities.

12. Management of bottom trawling impacts on benthic communities

- To ensure the biodiversity of benthic communities is conserved within the habitat range of orange roughy, large representative areas of the seabed (equivalent to 1.2 million square km) have been closed to bottom trawling. These closures, along with closures of selected 'seamounts' and of Marine Reserves together exclude bottom trawling from 32% of New Zealand's Exclusive Economic Zone (EEZ).

- These large representative marine protected areas are known as Benthic Protection Areas (BPAs) and form one of the largest networks of protected marine habitats in the world for the express purpose of protecting the biodiversity of benthic communities.
- Within the BPA closures, 9.3% of orange roughy habitat is closed by law to bottom trawling.
- The objective of closing these large areas is to protect a broadly representative range of the benthic biodiversity within diverse seabed habitats, most of which have not been modified by human activities. However, the BPA closures do encompass some areas that were previously trawled including areas that were fished for orange roughy.
- In total, these closures comprise an area of seabed close to four times that which has been contacted by bottom trawl within the New Zealand EEZ (i.e. only 7.1% of the waters within the EEZ have been contacted by bottom trawl one or more times).
- The selection of BPA locations was based on the government's Marine Environment Classification (MEC) scheme, completed in 2005. This MEC scheme is the result of a multi-disciplinary assessment of the available information on marine habitats by Government departments and scientists. MEC categories were the best available information at the time and, although the categories in the EEZ are based predominantly on physical variables (i.e. depth, sea surface temp, seabed slope, solar radiation) and are not expressly predictive of benthic fauna, they do include factors likely to influence benthic fauna (such as depth, substrate type, oceanographic conditions, geographic location). DWG and the Government accepted that while the MEC requires further refinement, it could be used to provide a basis for delineating and implementing BPAs as a first major step in marine conservation in the EEZ.
- Selection of the BPA areas was based on the following key criteria:
    - Large areas – to ensure widespread protection at the broad ecosystem level
    - Broadly representative of benthic habitats in the EEZ – based on the MEC and WWF-NZ's report *"Shining a spotlight on the biodiversity of New Zealand's marine ecoregion"*
    - Simple boundaries - to facilitate ease of compliance
    - Unmodified - areas that are largely pristine (i.e. untouched by fishing)
- In addition, selection of areas were made on consideration of:
    - Knowledge of habitats rich in corals and sponges
    - Closure of not less than 10% of each MEC class within the EEZ
    - For each class, closures were spread among two or more BPAs
    - The closures were evenly spread east and west of the tectonic boundary, which runs through the centre of the NZ EEZ

- Closures were evenly spread north and south within the EEZ, which runs from sub-tropical waters to sub-Antarctic waters

- The Government has recently updated this MEC scheme to include information on benthic biota (i.e. the Benthic Optimised Marine Environment Classification system, BOMEC). Quota owners are committed to assist the Government in ensuring adequate protection is afforded to benthic ecosystems and communities within the EEZ.

13. Summary

- New Zealand's orange roughy fisheries are sustainably managed, characterised by the application of world's best practice management standards, conservative harvest levels, objectives based management practices, independent scientific surveys, stock assessments and research to inform robust stock management decisions.
- Effective measures are in place to ensure that incidental interactions with protected species are avoided or minimised and to protect the biodiversity of benthic communities within the habitat range of orange roughy.
- New Zealand's QMS enables management of orange roughy fisheries to be effective, responsive, proactive, and sustainable.

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