Best Fish Guide 2016-2017

How it works?

Criteria for Ecological Rankings of New Zealand
Marine and Freshwater Commercial
Fisheries

Produced and published by

Royal Forest and Bird Protection Society of New Zealand, Inc.
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Contents

1.0 Introduction

Our coasts, lakes and rivers are central to our national identity: most New Zealanders live near the ocean and have a close relationship with the marine and freshwater environment. We collect kaimoana or seafood, swim, surf, dive, snorkel, sail, and appreciate the variety of marine and freshwater life.

New Zealand has one of the largest marine areas in the world, covering more than 1% of the Earth's surface and 23 times our land area. The marine areas of New Zealand's Territorial Sea (TS), Exclusive Economic Zone (EEZ), and Extended Continental Shelf (ECS) are incredibly diverse. They range from the sub-tropical oceans in the north, to our temperate waters around the mainland and cool sub-Antarctic waters in the south.

Many of our marine and freshwater species are found nowhere else in the world. Scientists estimate that more than 80% of New Zealand's biodiversity is found in our oceans (Department of Conservation, 2000), and much more is yet to be discovered. About 17,966 marine species are known from New Zealand including over 4000 undescribed species in collections (Gordon, 2013). The total number of species in the New Zealand marine environment could be well over 100,000 species (Gordon, Beaumont, MacDiarmid, Robertson, & Ahyong, 2010). New species are being discovered all the time, for example around 20 new fish species found each year (Gordon, 2013).

Our marine and freshwater environments are a vital part of our economy, supporting our $1.58 billion commercial fishing industry (Ministry for Primary Industries (MPI), 2016a; Seafood New Zealand, 2016) and much of our $34.7 billion tourism industry (Statistics New Zealand, 2016).

New Zealand has 43 no-take marine reserves representing less than 0.48% of New Zealand's marine environment. The only fully protected reserves are within our territorial sea. New Zealand has some closures within the EEZ, these include Benthic Protection Areas (Helson et al., 2010) and Seamount Closure Areas (Brodie & Clark, 2003), but there are currently no full (no-take, including areas closed to mining) protection within the EEZ[1], and there is no mechanism other than special legislation to create such protections beyond the 12 nautical mile territorial sea.

The Royal Forest & Bird Protection Society of New Zealand Inc. (Forest & Bird) has a vision for New Zealand's fisheries:

By 2040

- New Zealand has an ecologically resilient and sustainable economy with healthy functioning marine and freshwater ecosystems
- New Zealand continues to develop a sustainable fishing industry

By 2025:

- Adverse impacts on the marine environment from fishing, like bycatch of protected species and habitat damage have been significantly reduced, mitigated or repaired and are negligible, and
- Ocean protection is secured by establishing a comprehensive marine protected areas network including no take marine reserves throughout New Zealand, and

[1] At the time of writing the proposed Kermadec Ocean Sanctuary legislation is before the New Zealand Parliament.

- New Zealand meets or exceeds world's best practice in fisheries management and environmental practice, so it can market truly sustainable products worldwide.

Forest & Bird's Best Fish Guide - a guide to inform seafood consumers and encourage environmentally sound consumer choices when purchasing seafood[2].

This report presents the background and methodology behind the assessment criteria used in the 2016 Best Fish Guide for commercial marine and freshwater fisheries. The Best Fish Guide uses separate assessment criteria for aquaculture species, which were developed to be as consistent as possible with this wild commercial fisheries assessment (see Forest & Bird Best Fish Guide 2016).

The Best Fish Guide methodology was first developed in 2002 and published in 2004 following extensive international research of similar fisheries certification and assessment methodologies and wide consultation with the New Zealand fisheries science community.

This report supports the 2016 Best Fish Guide, representing the sixth edition of the guide. The methodology has been refined since the original version and is updated with each review to reflect changes in available information. A new feature of this edition is that, where possible, regional (stock) differences by species and fishing method differences are assessed. This edition also assesses all commercially caught freshwater species such as eels and whitebait species.

This guide was originally developed in response to concerns about fisheries management in New Zealand and globally. This included the decline of inshore and deepwater fisheries and the closure of several orange roughy fisheries. These concerns continue today, a new report has identified that overfishing and dumping is still occurring and that the level of fish caught in New Zealand waters could be several times higher than what has been reported over 60 years (Simmons, et al., 2016). Of the 638 stocks managed by the MPI, in 2014, as few as 104 stocks have adequate information to inform management decisions (Cryer, Mace, & Sullivan, 2016).

2.0 Why an Ecological Assessment?

The main objective of the Best Fish Guide is to stimulate informed consumer choice for fish and other seafood products sourced from ecologically sustainable fisheries and well-managed stocks by providing consumers with independent information on the ecological impacts of New Zealand fisheries.

The Best Fish Guide ecological assessment is used to categorise and rank New Zealand commercial marine and freshwater fisheries on the basis of their ecological sustainability. It evaluates the impact that fishing has on target species, non-target species, the wider marine environment, and how fisheries are managed.

In putting together these assessment criteria we reviewed a number of approaches that have been used internationally to assess the ecological sustainability of seafood. This includes the Marine Conservation Society UK's *Good Fish Guide* (Clarke, 2003) Marine Conservation Society 2012 & 2016), Monterey Bay Aquarium's *Seafood Watch* program (2015), Blue Ocean Institute's G*uide to Ocean Friendly Seafood*, Greenpeace's *Red Fish* List, the Australian Marine Conservation Society's *Sustainable Seafood Guide* (2013), and

[2] Seafood refers to any fish or other marine or freshwater species, like cray fish or oysters caught commercially in marine fisheries or freshwater fisheries

Bathgate (1999) ecological assessment.

The Marine Stewardship Council (MSC) was established in 1996 to globally certify sustainable fisheries. There have been ongoing concerns over the approach taken by the MSC in certifying New Zealand and other fisheries without adequate regard for a range of environmental impacts such as habitat destruction of bottom trawling and the impact of bycatch on fur seals and globally threatened seabirds (Christian, et al., 2013; Jacquet, Pauly, Ainley, Holt, Dayton, & Jackson, 2010).

Despite all these international guides and assessments there was a lack of information for New Zealand consumers. The Best Fish Guide is the only independent assessment of all New Zealand fisheries and aquaculture. Forest & Bird hopes that the Best Fish Guide will help inform consumers and encourage them to make the best choice for our oceans.

We acknowledge that there are socio-economic benefits of fishing, however this is an ecological assessment and not a socio-economic assessment of New Zealand commercial fisheries. For this reason the economic benefits to local communities and New Zealand are not considered. In addition, a range of other issues have not been assessed in the criteria, for more information (see section 4.5).

2.1 Assessment Issues

Species assessments are based on the best available and the most up to date information. The assessment will cover the last 5 years of fishing activity so as to acknowledge any improvements in operations.

The assessment has not directly compared the spatial impact of a wild fishery and an aquaculture operation. But the criteria were developed to be relatively consistent so a comparison can be made between assessed wild fisheries and aquaculture.

At this stage the assessment is not applied to fish or seafood imported from other countries including tinned and frozen fish. A separate set of criteria has been developed to assess New Zealand farmed seafood (see Forest and Bird Aquaculture Best Fish Guide, 2016).

3.0 Key principles underpinning the commercial fishing Best Fish Guide

3.1 Ecosystem approach

Ecosystem-based management is more comprehensive and holistic than a single-species approach (Mangel *et al.*, 2000) and includes considerations of trophic interactions, habitat impacts of fishing gear, precautionary management, marine protected areas and marine reserves (Ecosystem Principles Advisory Panel, 1999; Kock, Reid, Croxall, & Nicol, 2007; Mace, 2001; Pauly, et al., 2002; Ward, Heinemann, & Evans, 2001; Soto, Aguilar-Manjarrez & Hishamunda, 2008; White & San Diego-McGlone, 2008)

The approach used by the Best Fish Guide is consistent with an ecosystem-based management regime (Ecosystem Principles Advisory Panel, 1999; Dayton, Thrush, & Coleman, 2002). Such an approach requires:

1. *"Knowledge of the total fishing mortality on targeted and incidentally caught species, including mortality resulting from regular discards and bycatch;*
2. *Investigations of links between species (e.g. predator and prey, competitors) and the habitat within which they reside; and*
3. *Recognition of the trade-offs to biodiversity and population structure within*

ecosystems that result from high levels of extraction." (Dayton, Thrush, & Coleman, 2002).

As is the case in many countries, New Zealand focuses fisheries management on single-species, rather than apply an ecosystem-based management approach, incorporating the precautionary principle.

3.2 Precautionary approach

In assessing fisheries in New Zealand Forest & Bird has applied a precautionary approach[3] to the available information and uncertainty associated. The precautionary approach has been very widely recognised in fisheries management internationally (e.g. Gabriel & Mace, 1999; Restrepo, Mace, & Serchuk, 1999; Food and Agriculture Organisation, 1995a; Food and Agriculture Organisation, 1995b United Nations Implementing Agreement on High Seas Fisheries and Straddling Stocks, 1996). It is currently not included explicitly in the 1996 Fisheries Act.

Restrepo *et al.*, (1999) recommended that as part of the precautionary approach there should be a move away from using maximum sustainable yield (MSY) as a target to be achieved, but rather a limit to be avoided. Roughgarden & Smith, (1996) have argued for maintaining stocks at higher biomass levels as a means of "buying natural insurance". They recommended establishing a target stock at three-quarters of the average unharvested abundance. Lauck, Clark, Mangel, & Munro (1998) have also argued for protecting a substantial proportion (up to 50%) of the spawning stock from fishing as an insurance measure against errors when setting catch limits. Further discussion on stock size targets used in New Zealand under the New Zealand Harvest Strategy (Ministry of Fisheries, 2008a; Ministry of Fisheries, 2008b) and alternative approaches, and how they compare is set out in section 5.1.

International agreements and measures have further articulated the precautionary approach. Section 5 of the Fisheries Act 1996 requires decision makers to act in a manner consistent with *"international obligations relating to fishing"*. Amongst these obligations are the United Nations Food and Agriculture Organisation (FAO) Code of Conduct on Responsible Fisheries (1995b) which includes taking the "precautionary approach widely to conservation and management" (article 6.5)[4]. Article 7.5 of the Code of Conduct further set out what constitutes precautionary management in fisheries[5]. The United Nations

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[3] See also Precautionary Principles definition in the glossary.

[4] *"6.5 States and subregional and regional fisheries management organizations should apply a precautionary approach widely to conservation, management and exploitation of li ving aquatic resources in order to protect them and preserve the aquatic environment, taking account of the best scientific evidence available. The absence of adequate scientific information should not be used as a reason for postponing or failing to take measures to conserve target species, associated or dependent species and non-target species and their environment."*

[5] 7.5 Precautionary approach

7.5.1 States should apply the precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment. The absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures.

7.5.2 In implementing the precautionary approach, States should take into account, inter alia, uncertainties relating to the size and productivity of the stocks, reference points, stock condition in relation to such reference points, levels and distribution of fishing mortality and the impact of fishing activities, including discards, on non-target and associated or dependent species, as well as environmental and socio-economic conditions.

7.5.3 States and subregional or regional fisheries management organizations and arrangements should, on the basis of the best scientific evidence available, inter alia, determine:
stock specific target reference points, and, at the same time, the action to be taken if they are exceeded; and
stock-specific limit reference points, and, at the same time, the action to be taken if they are exceeded; when a limit reference point is approached, measures should be taken to ensure that it will not be exceeded.

7.5.4 In the case of new or exploratory fisheries, States should adopt as soon as possible cautious conservation and management measures, including, inter alia, catch limits and effort limits. Such measures should remain in force until there are sufficient data to allow assessment of the impact of the fisheries on the long-term sustainability of the stocks, whereupon conservation and management measures based on that assessment should be implemented. The latter measures should, if appropriate, allow for the gradual development of the fisheries.

7.5.5 If a natural phenomenon has a significant adverse impact on the status of living aquatic resources, States should adopt conservation and management measures on an emergency basis to ensure that fishing activity does not exacerbate such adverse impact. States should also adopt such measures on an emergency basis where fishing activity presents a serious threat to the sustainability of such resources. Measures taken on an emergency basis should be temporary and should be based on the best scientific evidence available.

Implementing Agreement on High Seas Fisheries and Straddling Stocks[6], which is schedule 1A of the Fisheries Act 1996, includes a requirement on *"coastal States and States fishing on the high seas to apply the precautionary approach in accordance with article 6.[7]"*

This precautionary approach is consistent with the recommendation that the burden of proof should be reversed in fisheries management (Dayton, 1998). Dayton recommended that those hoping to exploit marine ecosystems *"must demonstrate no ecologically significant long-term changes"*. The reversal of the burden of proof was also recommended by Restrepo *et al.*, (1999) as a mechanism for applying the precautionary approach.

In line with the precautionary principle, where information is uncertain or unknown about the state of a fishery for any criterion, the score for the associated species will be reduced.

4.0 How does the Ecological Assessment work?

The Best Fish Guide assessment uses six ecological criteria, then weighs each criterion, assesses the extent to which a fishery meets all of the criteria and then calculates an overall ecological ranking for sustainability for each fishery. The following section further explains the assessment process applied to each species or species group.

4.1 Assessment criteria

The six assessment criteria for assessing the status of New Zealand's commercial marine and freshwater fisheries are:

1. **Status of seafood stock** - Sustainability of catches (criterion 5.1);
2. **Biological characteristics** - to assess the risk of over-fishing or recovery (criterion 5.2);
3. **Fishing method impacts** - including level of impact on non-protected by-catch and habitat (criterion 5.3);
4. **Bycatch of protected or threatened species** - such as seabirds, marine mammals and other species listed by Department of Conservation[8] and IUCN (criterion 5.4);
5. **Unit of fish stock arrangement** - for marine species - including whether more than one species or stock are managed together; for freshwater species - habitat status including scale of loss and trend (criterion 5.5);
6. **Effectiveness of management, monitoring, and research** - including management plans, stock assessment information, and monitoring (criterion 5.6).

The Best Fish Guide criteria have changed since the last edition to better assess our wild fisheries by assessing, where possible, regional (stock) differences and assessing differences in fishing method impacts on habitat and bycatch. The updated criteria also include the assessment of all commercially caught New Zealand freshwater species.

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[6] The United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (in force as from 11 December 2001)

[7] Article 6 includes requirements for:

"1. States shall apply the precautionary approach widely to conservation, management and exploitation of straddling fishstocks and highly migratory fishstocks in order to protect the living marine resources and preserve the marine environment.

2. States shall be more cautious when information is uncertain, unreliable or inadequate. The absence of adequate scientific information shall not be used as a reason for postponing or failing to take conservation and management measures."

[8] Seabirds, turtles, sea snakes and marine mammals are protected under the Wildlife Act 1953 and the Marine Mammals Protection Act 1978.

Also protected under the Wildlife Act (Schedule 7A) are a number of marine species a full list is in Appendix VIII.

The most recent global guides and methodologies have been reviewed to identify generic issues and differences. These include assessing the general approaches used by the Monterey Bay and Marine Conservation Society, and the criteria used by the Marine Stewardship Council to assess ecological sustainability. Each involves an assessment of target stock sustainability, bycatch issues including protected and threatened species, and the appropriateness of management. Unlike some other sustainability assessment systems, in the Forest & Bird guide if the fish or seafood is ranked red in any criterion it is not automatically ranked red overall, rather its overall ranking is still the sum of the scores of all criteria. In the species commentary critical issues raised by a poor ranking in any assessment criteria is described and alternatives noted.

4.2 Weighting of criteria

This involves an assessment of whether each criterion is considered equal in its contribution to the overall ecological sustainability of a fishery.

4.2.1 Marine Fisheries

For marine fisheries weighting of the individual criteria was reviewed as part of each iteration of the guide. This involved experts and reviewers as part of this process[9].

Status of seafood stock was recommended to have the highest weighting, therefore it has been assigned the largest weighting constant of '3' (see table 1). Biological characteristics, fishing method impacts and bycatch of protected or threatened species were rated higher than the unit of seafood stock arrangement and effectiveness of management monitoring and research**.** This gave a higher weighting to the impacts of a fisheries as well as the resilience of the species fished, from management arrangements.

Table 1: Weighting of criteria for marine wild fisheries

Weighting constant	Criteria
3	Status of seafood stock
2	Biological characteristics
2	Fishing methods impacts
2	Protected or threatened species bycatch
1	Unit of seafood stock arrangement
1	Effectiveness of management, research and monitoring

4.2.2 Freshwater Fisheries

For freshwater fisheries the weighting of the individual criteria was reviewed. This involved experts and reviewers with workshops as part of this process[10]. Status of seafood stock was recommended to have the highest weighting, therefore it has been assigned the largest weighting constant of 3 (see table 1). Biological characteristics and unit of seafood stock arrangement (in this case the habitat status) were rated higher than the other three criteria (see table 2). This was in part due to the similar methods used and the low level of impact on protected and other threatened species.

Table 2: Weighting of criteria for freshwater wild fisheries

Weighting constant	Criteria
3	Status of seafood stock
2	Biological characteristics
1	Fishing methods impacts

[9] Workshops were carried out with independent experts who need to remain anonymous to determine appropriate weighting constants for both marine and freshwater fisheries.

1	Protected or threatened species bycatch
2	Unit of Seafood Stock Arrangement (Habitat status)
1	Effectiveness of management, research and monitoring

4.3 Scoring

Each criterion has been scored either on a national basis (one score for the whole species throughout New Zealand), or where enough information is available, as regional/separate stocks (where there are regional difference in a species stock status) or fishing method basis (where there are differences in the impacts of difference fishing methods). The scoring for each criterion used a rating from 1 to 5 with:

5 = Excellent (A)
4 = Good, but with some inadequate features (B)
3 = Weak, but with several mitigating features (C)
2 = Inadequate, with at least one mitigating feature (D)
1 = Wholly inadequate (E)

4.4 Overall scores

The overall sustainability of the seafood for national, regional (stock) or method is determined by adding the totals for all six criteria together to give an overall sustainability score.

Scoring for: Status and sustainable yield x weighting + biology and risk of over-fishing x weighting + fishing method impacts x weighting + Protected species or threatened species bycatch x weighting + fish stock arrangement (marine) or Habitat status (Freshwater) x weighting + Plans, research and monitoring x weighting = Overall Sustainability Score

Example:
The maximum score was 55 and the minimum potential score was 11. For example: Squid trawl was allocated 2 for status and sustainable yield, 5 for biology and risk, 1 each for fishing method impact and protected or threatened species bycatch plus 4 for fish stock arrangement, and 2 for management, research and monitoring. These results for each category were then applied against the weighting, which results in a score of 26 giving an E or red ranking.

The overall sustainability score for each commercial marine and freshwater fishery is turned into a percentage of the maximum possible score which allows the fishery to be ranked[10] as:

Green (A) – above 80 per cent – good to eat (Best choice);

Light Green (B) – between 65 and 80 per cent – good to eat (Good choice)

Amber (C) – between 50 and 64 per cent - Ok to Eat/some concerns (OK choice)

Dark Orange (D) – between 40 and 49 per cent - seafood of concern (Bad choice)

Red (E) – below 40 per cent - seafood to avoid (Worst choice).

[Note: These bands are based on standard university grades - see http://www.victoria.ac.nz/students/study/progress/grades]

[10] This approach is different from other assessments for example Monterrey Bay Aquaculture criteria – which splits the results in thirds.

4.5 Limitations and Assumptions

This assessment system is based on the best information available. Further, the health and status of each species may vary over time. Forest and Bird intends to regularly update the Best Fish Guide to record and be able to use long-term trends.

Several issues which are not included in these criteria are:

- Organic certification of seafood species (Pelletier & Tyedmers, 2007);
- Animal welfare issues e.g. fish handling;
- Energy and greenhouse gas emissions (the carbon footprint of fisheries) from fishing (Ayers & Tyedmers, 2008 and Hilborn & Tellier, 2012);
- Impact of climate change and ocean acidification;
- Effect on other fishing interests e.g. recreational or customary fishers;
- Employment practices and working conditions (Ministerial Inquiry into Foreign Charter Vesssels, 2012);
- Socio-economic impacts and benefits;
- Adverse impacts from noise and sound.

These issues were not included as either they do not involve ecological issues or the information was not available to allow an assessment of the issue. The issue of energy use and carbon emissions in fisheries are issues that could be looked at in future assessment if more information was available.

In freshwater, only eel fisheries (e.g. longfin, shortfin and the Australian spotted eel) and white bait (e.g. galaxids) commercial fisheries are considered. This assessment does not include recreational trout or other introduced fisheries. It also does not include customary fisheries such as lamprey.

5.0 Assessment criteria – what do they mean?

The following section further explains the criteria used to assess the status of each fishery or seafood stock.

5.1 Status of seafood stock

The stock status and sustainable yield of a fishery is a fundamental indicator of ecological sustainability or health of a fishery.

MSY: The sustainable yield and the amount of fishing pressure a fish population or stock can sustain over time has been historically compared to the maximum sustainable yield (MSY). Section 13 of the Fisheries Act relates MSY to the stock size and requires the Minister for Primary Industries to maintain a *"stock at or above the level that can produce the maximum sustainable yield"*. There is no similar requirement for freshwater fish managed by the Department of Conservation (DOC).

However, it has been widely acknowledged that MSY can be a risky strategy because it assumes perfect knowledge of catch, stock biological information and other stock assessment information. It assumes there are no changes in environmental factors affecting recruitment or other biological parameters, and that management responds immediately to changes in sustainability information. This is crucial at low stock size estimates of the stock level that supports the MSY (e.g. B_{MSY} of under 30% of the unfished stock size - Bo) (MPI, 2015 and MPI, 2016a)

Fisheries stock assessments in New Zealand refer to maximum constant yield (MCY) (for pre-harvest strategy assessments) or current annual yield (CAY) (MPI, 2015 and MPI 2016b). In addition, the current biomass of a stock is usually compared to the unfished,

unexploited or virgin biomass (Bo) (Cordue, 2004; Ministry of Fisheries, 2008a and Ministry of Fisheries, 2008b). These are usually referred to as reference points (Caddy & Mahon, 1995).

Reference point catch limits (e.g. CAY) are usually defined in NZ stock assessments in relation to the risk of falling below 20% of Bo more than 10% of the time – the limit reference point. This is known as the safety condition (Francis R. , 1992 & 1999).

Harvest Strategy: Further development of reference points from MCY and CAY led the Ministry of Fisheries (now MPI) to adopt the Harvest Strategy Standard (Ministry of Fisheries, 2008a & 2008b) Since then less than 20 percent of stocks (about 104 stocks) have been assessed under the standard (MPI, 2016b).

The harvest strategy sets out three core elements:

- A specified target level about which a fishery or stock should fluctuate (usually between 30% and 50% Bo);
- A soft limit (default *"½ B_{MSY} or 20% B_0, whichever is higher"*) that triggers a requirement for a formal, time-constrained rebuilding plan; and
- A hard limit (default *"1/4 B_{MSY} or 10% B_0 whichever is higher"*) below which fisheries should be considered for closure. The strategy determines that any fishery below the "hard limit" will be designated as collapsed.

New Zealand's harvest strategy also includes a limit reference point on fishing mortality (e.g. F_{MSY}**).**
The strategy notes that *"it is becoming increasingly difficult to justify stock targets less than 30-40% Bo (or, equivalently, removing more than 60-70% of the unfished biomass)"* (Ministry of Fisheries, 2008a).

In contrast the Australian harvest strategy is more conservative and sets a proxy for B_{MSY} at 40% Bo and a hard limit of 20% Bo when all targeting of a fishery shall cease (DAFF, 2007 & 2013). The recent review of the Australian Harvest strategy includes several technical reports which have in general endorsed a more conservative approach (Haddon, Klaer, Smith, Dichmont, & Smith, 2012 and Penney, Ward, & Vieira, 2013).

Penney et al (2013) in their review of the Australian harvest strategy suggested a range of best practice approaches would involve higher stock levels:

- Target for important forage fish at 75%Bo "to ensure stocks remain large enough to fulfil their ecotrophic functions";
- The proxy for BMSY for shark species may need to be closer to 50%Bo than the current proxy of 40%Bo;
- BMEY proxy is more likely to lie in the range of 50-60%Bo.

Concerns about the single species nature of MSY or many reference points have lead to consideration of predator and prey relationships. These ecological relationships have been an important consideration in the Convention for the Conservation of Antarctic Marine Living Resources' (CCAMLR) approach to fisheries management. In CCAMLR, target levels have been set at 50%Bo for predator species (e.g. toothfish) and 75%Bo for prey species (e.g. krill or icefish) (Constable, de la Mare, Agnew, Everson, & Miller, 2000).

In a review of biological reference points for a number of shark species, Bracinni, Brooks, Wide & McAuley (2015) showed that the biomass target for shark species can exceed 40%Bo and ranged from 46% to 65%Bo depending on the shark species.

Smith et al., (2011) noted that retaining stocks at higher levels (e.g. 75%Bo) for low trophic

level species had lower ecological impacts. They noted that *"halving exploitation rates would result in* much *lower impacts on marine ecosystems while still achieving 80% of MSY"*. And further: *"Considerable reduction in impacts can be achieved by moving from exploitation at MSY levels (achieved at 60% depletion levels) to a target of 75% of unexploited biomass (25% depletion)."*

Maintaining larger fish stocks also ensures the retention of more, larger older fish in the population. Larger older female fish produce many more eggs that younger smaller females. The big old fat fecund female fish (BOFFF) hypothesis is that these fish are essential to the sustainability of long-lived fish populations (Berkeley, Hixon, Larson, & Love, 2004). For example, larvae produced by older fish can grow faster than those produced by younger fish (Birkeland & Dayton, 2005). Fishing can lead to the loss of larger and older fish for example the average age of the western hoki stock declined by 2 years due to the effects of fishing.

New Zealand is also less conservative than the UN Fish Stocks Agreement in setting fishing mortality at MSY (F_{MSY}**)** as maximum target of fishing mortality rather than a limit to avoid and a point where *"fishery management strategies shall ensure that the risk of exceeding limit reference points is very low".*

Over-fishing can be either recruitment over-fishing or growth over-fishing, or both. Recruitment over- fishing means the current catches are causing a decline in the number of young fish entering the exploited component of a stock, whereas growth over-fishing is reflected in the reduction in the size of the fish being harvested.

Overfishing and fishing down [11] a stock to a level significantly below 20% Bo can lead to the loss of genetic diversity in the target fish population (Hauser, Adcock, Smith, Bernal Ramirez, & Carvalho, 2002; Smith, Francis, & McVeagh, 1991; Smith & Benson, 1997). The BFG criteria does not assess the potential loss of genetic diversity.

Marine fisheries have been rated in accordance with the current information available and compared to the requirements of the principles of the Fisheries Act 1996[12] or other internationally accepted standards. For marine species some minor QMS species have not been assessed to date under the guide (refer to Appendix IIA of those not assessed). Marine commercial fishstocks can be assessed annually by the MPI[13] stock assessment working groups, but few marine fisheries have detailed quantitative stock assessments (less than 20% of quota stocks). Cryer et al (2016) looks at aspects of the ecosystem approach in New Zealand fisheries that for 104 stocks information is available to assess MSY reference

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[11] Fishing down of fish stocks is based on a management approach whereby fish populations are capable of sustaining long-term harvest as a result of compensatory biological responses. Compensation occurs through a reduction in food or space competition from other individuals (density dependent factors) and a biological response through faster growth rates and producing more young than is necessary to maintain the population. The usual result is that the large more fecund fish are removed from the population. This approach leads to fishing down of marine food webs (Pauly & Maclean, 2003)

[12] **Purpose and Principles** of the Fisheries Act 1996 includes:
8. Purpose— (1) The purpose of this Act is to provide for the utilisation of fisheries resources while ensuring sustainability. (2) In this Act—**``Ensuring sustainability''** means—
(a) Maintaining the potential of fisheries resources to meet the reasonably foreseeable needs of future generations; and
(b) Avoiding, remedying, or mitigating any adverse effects of fishing on the aquatic environment:
``Utilisation'' means conserving, using, enhancing, and developing fisheries resources to enable people to provide for their social, economic, and cultural wellbeing.
9. Environmental principles— All persons exercising or performing functions, duties, or powers under this Act, in relation to the utilisation of fisheries resources or ensuring sustainability, shall take into account the following environmental principles:
(a) Associated or dependent species should be maintained above a level that ensures their long-term viability: (b) Biological diversity of the aquatic environment should be maintained:
(c) Habitat of particular significance for fisheries management should be protected.
10. Information principles— All persons exercising or performing functions, duties, or powers under this Act, in relation to the utilisation of fisheries resources or ensuring sustainability, shall take into account the following information principles:
(a) Decisions should be based on the best available information:
(b) Decision makers should consider any uncertainty in the information available in any case:
(c) Decision makers should be cautious when information is uncertain, unreliable, or inadequate:
(d) The absence of, or any uncertainty in, any information should not be used as a reason for postponing or failing to take any measure to achieve the purpose of this Act.

[13] The Ministry of Fisheries, and the Ministry of Agriculture and Forestry (MAF) which includes fisheries, is now part of the Ministry for Primary Industries (MPI).

points for biomass (Bmsy) and fishing mortality (Fmsy). These represent about 74% of current New Zealand landings.

For freshwater fisheries only eel fisheries (longfin, shortfin and the Australian spotted eel (*Anguilla reinhardtii*) are managed by the MPI under the Fisheries Act. Eels are in the quota management system. Other native freshwater fisheries (e.g. whitebait) are managed by the Department of Conservation under the Conservation Act.

Whitebait fisheries[14] have never been assessed for sustainability or long-term yield by the Department of Conservation. The only management action is input control on size of net, season and hours of fishing, etc. (See Whitebait fishing regulations 1994 and the Whitebait Fishing (West Coast) Regulations 1994).

For those fish stocks not assessed under the Harvest Strategy an approach applied by NIWA is used (NIWA, 1997) to assess whether catch limits set are risky. NIWA define risky as the absence of a maximum constant yield (MCY) estimate or when the current total allowable commercial catch (TACC) is at least twice the MCY (excluding fishstocks for which there are current annual yield [CAY] estimates).

Scores are applied in the following way:

- Based on the best available information on the state of the stock in relation to management target, Bmsy, harvest strategy limits including 20% of the unfished biomass (Bo) for a stock.
- Using the CCAMLR standards as the best international practice for minimum stock size.
- Where the status of the stock was not reported or highly uncertain the status was recorded as uncertain or unknown and given the next to lowest score (i.e. a score of "D")
- Where different stocks of the same species have a different status and separate regional assessments are not possible the worst known state was used.
- Assessing stocks in relation to reference points, Bmsy or an alternative target level set for the fishery.
- Consideration was also given to stocks which were potentially subject to serial depletion (e.g. paua) or where the impacts of disease events on fish sustainability (e.g. Foveaux Strait dredge oysters affected by *Bonamia*).

Table 3: Score for status and sustainable yield of marine and freshwater species

Score	Status	Stock status
A	**Catches well below MSY and stock well above B_{MSY} and above target level (>50% Bo)**	A fish or seafood stock has the potential in the short term to sustain catches higher than those currently taken and there is an agreed pathway to reduce catches to the MSY, CAY or equivalent target biomass level.
A	**Stock above 50%Bo**	The fish or seafood stock is above 50% Bo and no projected declined below this level in the next 5 years.

[14] Under the regulations: **whitebait** means those fish commonly called whitebait, being—
(a) the young or fry of the following *Galaxias* species:
(i) *Galaxias maculatus* (inanga):
(ii) *Galaxias brevipinnis* (koaro):
(iii) *Galaxias argenteus* (giant kokopu):
(iv) *Galaxias postvectis* (short jawed kokopu):
(v) *Galaxias fasciatus* (banded kokopu):
(b) the young or fry of the fish (commonly known as smelt) of which the scientific name is *Retropinna retropinna*

B	**Catch limit <MCY**	Where the harvest strategy has not been applied - Catches or catch limit less than the estimated MCY based on average catches over a set period (cYav).
B	**Catches at or below the MSY level Stock between 40-50%Bo**	The fish or seafood stock is between 40-50% Bo and not projected to go below this level in the next 5 years.
C	**Catch limit or catches >MCY but <2xMCY**	Where the harvest strategy has not been applied - Catches or catch limit exceeds the estimated MCY based on average catches over a set period (cYav) but less than twice the estimated MCY and stable or increasing catch rates.
C	**Catch exceeds MSY, CAY or MCY but stock above B_{MSY}**	Catch limit or catches exceed MSY but the stock is still above the B_{MSY} level or equivalent target level, e.g. above B_{MAY} or B_{MCY}, whichever is higher and there is no concern about serial depletion or serious disease events.
C	**Stock between 30 and 40%Bo**	The fish or seafood stock is between 30-40% Bo and projected to go below this level in the next 5 years.
D	**Catch limit or catches greater than twice MCY**	Where the harvest strategy has not been applied - Catches or catch limit exceeds twice the estimated MCY based on average catches over a set period (cYav).
D	**Stock below Bmsy but above 20% Bo**	The stock has been over-fished and reduced below the size that would support the MSY based on B_{MAY} or B_{MCY} and there is no concern over serial depletion or serious disease events.
D	**Stock between 20 and 30%Bo**	The fish or seafood stock is between 20-30% Bo and projected to go below this level in the next 5 years.
D	**Uncertain/ unknown yield or stock size**	Status and sustainability are unknown due to lack of adequate monitoring data or research. There are no estimates of yield i.e. CAY or risk based yields or forward projections. Fisheries operating under such uncertainty are not adopting a precautionary approach and cannot be shown to be sustainable.
E	**Stock below 20% Bo**	Fishery is over-fished and catches need to be substantially reduced to allow the stock to recover e.g. orange roughy. Below the harvest strategy soft limit.
E	**Stock below B_{MSY} and subject to other factors**	Fishery is over-fished and likely below the size that would support the MSY and is subject to either recent low recruitment which would prevent recovery to Bmsy within 10 year, serial depletion (e.g. paua) or recent serious disease events (e.g. dredge oysters).

Note: MSY in this context includes CAY, or to achieve the agreed stock target level.

5.2 Biological characteristics – to assess the risk of over-fishing or recovery

This criterion considers the biological characteristics that give a species resilience or susceptibility to over-fishing including how it might respond. Considerations here include life span, age at sexual maturity, fecundity (number of eggs or young produced), productivity and level of natural mortality. In addition, the geographic distribution, degree of regional endemism (whether it is restricted to one area or widely distributed), behaviour and social structure of a species (whether it is solitary, schooling, territorial, highly

migratory or site specific) also contribute to how a species responds to commercial exploitation. This is relevant to both freshwater and marine species.

In general, species are characterised as intrinsically vulnerable when they have a long life span (50 years or more), are late maturing (15 years or more), have low fecundity, and low natural mortality. Such species are most at risk from the impacts of fishing. Examples species include orange roughy, oreos, bluenose and various sharks (e.g. Cheung, Pitcher, & Pauly, 2005; Cheung, Watch, Morato, Pitcher, & Pauly, 2007; Dulvy, Sadovy, & Reynolds, 2003). These characteristics make them more susceptible to the impacts of fishing than a short-lived species such as squid that produces a large number of eggs. Sharks are vulnerable in particular those that produce a small number of live pups (Dulvy & Reynolds, 2002; Garcia, Lucifora, & Myers, 2008; Myers & Worm, 2003). For example, mature female school sharks produce 17-41 pups, while mature female spiny dogfish produce only 2-17 pups (Cortes, 2002).

In species that are slow to mature, the effects of overfishing may not be seen until it is too late to reverse them. Fish which exhibit aggregating or schooling behaviour (for feeding or spawning) are also easily targeted by commercial fishing vessels that can take large catches in a short time, for example orange roughy (Francis & Clark, 2005). Likewise, fish such as blue cod change sex, with the largest individuals being male and therefore current management restrictions like minimum size limits may not protect the total population[15].

In general short-lived highly productive species such as squid or anchovy which live for one or a few years can sustain a larger proportion of their population being caught each year. Their populations will naturally fluctuate much more than slow growing long lived multi-year class species, such as orange roughy or school shark. In general, long lived, low productivity, low fecundity species may only sustain having a small proportion of the population caught each year.

A number of researchers have looked at the extinction risk facing fish species (Dulvy, Sadovy, & Reynolds, 2003; Musick, 1999; Musick, et al., 2000a; Musick, Burgess, Cailliet, Camhi, & Fordham, 2000b). Musick et al (1999) proposed criteria designed to identify fishstocks that could be at risk so that action can be taken in the early stage of decline to avoid listing species as threatened with extinction. This is similar to the approach of intrinsic vulnerability in ranking species risk to fishing.

Resilience has been compared between deepwater, inshore, pelagic, and other fisheries (Norse, et al., 2012). They considered: *"Most deep-sea fishes have life histories giving them far less population resilience/productivity than shallow-water fishes, and could be fished sustainably only at very low catch rates if population resilience were the sole consideration."*

Garcia et al., (2008) looked at life history traits and extinction risk in sharks, skates, rays and chimaeras and recommended conservation priority to deepwater species. Clark (2009) looked at resilience and intrinsic extinction vulnerability for deepwater species around seamounts. Clark (2009) noted that "their biology is not evolved to cope with high levels of natural predation and so they are more vulnerable to overfishing than shallow water shelf species."

In addition to the categories developed by Musick and others for the American Fisheries Society (Musick, et al., 2000a and Musick, et al., 2000c) a new category for species with very high resilience (e.g. squid) has been added so as to give a five point risk rating for

[15] Size limits are usually designed to protect immature fish but they can also ensuring that the species spawns at least once prior to reaching the size limit or to enhance the value of the catch (Hancock (ed) (1992)Hancock (ed) 1992).

each species and make these criteria consistent with other criteria (table 4). This table is applicable to marine and freshwater.

As in Musick et al., (2000a), fishstocks may be classified according to any of the criteria with intrinsic rate of increase being the key factor. The stock should be assessed according to the lowest productivity parameter for which data are available in table 3. For example, a stock with high fecundity (>10^4), but late maturity (5-10 years) and long life span (>30 years), would be classified under the very low productivity category.

Table 4: Population resilience and productivity parameters

	Productivity Parameter						
Population resilience	**Intrinsic rate of increase (r) /yr**	**von Bertalanffy k**	**Fecundity per year**	**Age at maturity (Tmat)**	**Max age (Tmax)**	**Natural Mortality (M)[16]**	**Risk Rating**
Very High	>1	>0.60	>105	<1	<1	>0.4	A
High	1-0.51	0.31-0.60	104-105	1-2	2-3	0.2-0.4	B
Medium	0.16-0.50	0.16-0.30	102-103	2-4	4-10	0.1-0.2	C
Low	0.05-0.15	0.05-0.15	10-102	5-10	11-30	0.05-0.1	D
Very low	<0.05	<0.05	<10	>10	>30	<0.05	E

(See Appendix IIa for comparison between NZ fish species.)

In addition to the productivity risk to a stock there are a number of other factors that may be relevant, including:

- Rarity;
- Small range and whether the stock is endemic to New Zealand e.g. longfin eels or blue cod;
- Specialised habitat requirements such as coral reef beds or seagrass beds;
- Specialised requirements for settlement of larvae and limited larval movement e.g. oysters, scallops or paua;
- Loss of habitat, especially on species with a small range and specialised habitat requirements e.g. whitebait species;
- Depth, as deepwater species are more at risk.

These categories have been used to assess a fishery's potential risk based on the parameters used in table 4. The biology of each species is scored from A to E – from most resilient to fishing, to least resilient based on life-span, time to maturity, reproductive output, and schooling or biological behaviour (table 5).

Table 5: Score for biology and risk of over-fishing

Score	**Notes**
A - very resilient to Fishing	Abundant, fast to mature, produce large number of eggs/young, short life span, capable of sustaining large catches over extended periods, e.g. arrow squid, anchovies.
B	Reasonably abundant and fast growing with high reproductive capacity, mostly pelagic, e.g. red cod and red gurnard.

[16] Natural mortality has been added for comparison with von Bertalanffy r and k.

C - moderately resistant to fishing	Vulnerable to over-fishing because of one or more of the following factors: relatively late onset of sexual maturity, low fecundity, slow growing, aggregate (e.g. when spawning) or form schools, long-lived, limited habitat of distribution, or limited settlement requirements e.g. elephant fish.
D	Key biological information is unknown (including age, age at recruitment and mortality, natural mortality, biological parameters (von Bertalanffy, 1957).
D	Very vulnerable to over-fishing because of a number of the following factors: late onset of sexual maturity, low fecundity, slow growing, aggregate (e.g. when spawning), or form schools, long-lived, limited habitat of distribution, highly variable recruitment, or very specialised settlement requirements e.g. school shark or rig.
E - least resilient to fishing	Unlikely to sustain exploitation beyond a very low level. Late onset of sexual maturity, few young, and/or rare, deepwater species, limited habitat/range, e.g. orange roughy or oreos.

Note: Appendix IIa sets out key biological information on commercial fish and other seafood species and includes an estimate of a species resilience or risk rating which is used in the assessment of each species

5.3 Fishing method impacts including non-threatened species bycatch and habitat damage

This criterion assesses the impact of different fishing methods on the wider environment including non-threatened species bycatch[17] and habitat damage. This criterion is used to assess methods used in marine and freshwater fisheries. The level of protected species and threatened species bycatch is assessed under criteria 5.4

Different fishing methods have different environmental impacts, for example dredging and bottom trawling generally have a greater impact on the seafloor and benthic species than passive techniques such as longlining and gillnetting. The degree of impact caused by various techniques varies with depth, type of seafloor, and weight or type of gear used (Collie, Hall, Kaiser, & Pioner, 2000). The scale of impact can be substantial.

The criterion looks at both direct and in-direct impacts on the marine environment. Some of this information can be found in MPI's *Fisheries Assessment Plenaries, May 2016: stock assessments and stock status* (2016b).

A. The direct impacts of fishing methods:

- On non-target species, including bycatch of fish and invertebrates (Abraham & Thompson, 2009; Abraham, Thompson, & Oliver, 2010; Cryer, Hartill, & O'Shea, 2002).
- Habitat destruction where fishing gear damage and remove seabed (benthic) plants and animals such as sensitive sponges, corals, bryozoans (lace corals), and shellfish, which are important settlement surfaces, cover and habitat for other organisms (Cranfield,

[17] "Bycatch: those species taken in a fishery targeted on other species, or a different size range of the same species and includes that part of the catch that has no commercial value and is discarded alive, injured or dead. Three classes:
Economic bycatch – species discarded because they are of little or no economic value (e.g. in poor condition or non-marketable);
Regulatory bycatch – marketable species discarded because of management regulations (e.g. size limits, allocations or seasons);
Collateral mortality – species killed in encounters with fishing gears that are not brought on board the vessel." (Morgan & Chuenpagdee, 2003)

Rowden, Smith, Gordon, & Michael, 2004; Norse & Watling, 1999; Thrush, et al., 1998; Thrush, et al., 2001; Thrush & Dayton, 2002; Clark, et al., 2016).

- Sediment disturbance - Trawling and dredging can disturb sediment which can smother organisms and block light for algae and seaweeds in shallow water (Kaiser, Ramsay, Richardson, Spence, & Brand, 2000; Kaiser, Collie, Hall, Jennings, & Pointer, 2001; National Research Council, 2002; Kaiser, et al., 2006).

B. The indirect effects of fishing are more difficult to assess and measure. These potential changes include alterations to food chains and predator-prey relationships (Jennings & Kaiser, 1998; Symes, 1998; Robertson & Chilvers, 2011). Examples of indirect effects include:

- Reduction in key stone species (ecologically important species) e.g. reduction in snapper and rock lobster causing kina barrens (Shears & Babcock, 2003; Ling, et al., 2014);
- The reduction in key prey species affecting natural predators e.g. krill on whales, seals or penguins (Trivelpiece, et al., 2011) or impacts on squid availability affecting sea lions (Robertson & Chilvers, 2011);
- Discarding of unwanted catch (e.g. under-sized or non-target) changing food availability and changing food webs and impact on community structure, increasing the abundance of scavengers (Voiter, et al., 2004; Bicknell, Oro, Camphuysen, & Votier, 2013);
- Fishing gear (e.g. trawling) reducing prey availability (Hiddink, Johnson, Kingham, & Hinz, 2011);
- Reduction in biogenic habitats (three dimensional living structure e.g. horse mussels) reducing settlement surfaces or habitat for other species (Carbines, Jiang, & Beentjes, 2004);
- Fishing debris and lost commercial gear can continue to harm marine wildlife for an indefinite period (e.g. entanglement) (NOAA Marine Debris Program, 2015).

One estimate of the amount of sediment stirred up globally by bottom trawling "is about the same amount of all sediment deposited on the world's continental shelves by rivers each year — almost 22 gigatons" (Kelly, 2016).

Examples of the impact of bottom trawling and dredging on deepwater habitat and on seamounts, has been highlighted in numerous studies (Clark & Rowden, 2009; Dayton P. K., Thrush, Agardy, & Hofman, 1995; Gray, Dayton, Thrush, & Kaiser, 2006; Jones, 1992; Kaiser, et al., 2006; Thrush & Dayton, 2002; Rice, 2006). The resilience of these features, particularly those "dominated by cold water corals is low compared to most other marine systems" (Clark, 2009) (also see Clark & Rowden, 2009; Williams, et al., 2010).

The impact of trawling on "flat" or non-reef communities has also been highlighted by a 2002 review of the impact of bottom trawling for scampi, tarakihi and gemfish in 200-600m of water in the Bay of Plenty (Cryer, Hartill, & O'Shea, 2002). Cryer et al., found a significant impact on a range of benthic biodiversity based on research trawls undertaken over three years. They considered the impact to be indicative of the effects of trawling occurring throughout the fisheries management area.

A recent review by O'Neill and Ivanovic (2016) looked at the physical impacts of bottom trawling on soft sediments. The aim was to better assess and quantify the environmental and ecological impact of towed fishing gear.

A report by the Marine Conservation Biology Institute (Chuenpagdee, Morgan, Maxwell, Norse, & Pauly, 2003; Morgan & Chuenpagdee, 2003) examined the collateral impacts of different fishing methods in the United States. The report, Shifting Gear, was based on

responses by marine biologists who ranked the effect of different fishing gear by habitat damage[18] and the severity of marine damage[19] including bycatch.

Forest & Bird has reviewed the results of Morgan and Chuepagdee's study (2003) to determine whether there are effects which are different in the New Zealand fisheries. Forest & Bird also looked at additional methods which were not assessed in the US study such as collecting and diving, jigging, trolling, hook and line, fyke nets and beach seining. On review an additional criteria to that applied in Shifting Gear was added, based on the bycatch of sponges, coral, bryozoans, and other invertebrates. This was to better reflect the full range of species caught as bycatch in New Zealand by commercial fishers.

In most cases the rankings are similar to those in the US study (table 6). A noticeable change is the ranking for mid-water trawls which has been revised to reflect the high proportion (about 50 percent in the hoki fishery) of mid-water trawls scrape the seabed. Bottom longlining has been amended to take into account the impact on sponges, corals and other benthic invertebrates. A similar increase in the impact rating for bottom longlining in South Pacific waters was reported by Williams et al (2011).

To avoid duplication with the threatened and protected species criteria (5.4) the assessment of seabird and marine mammal bycatch has been removed from the approach applied by Morgan and Chuepagdee (2003). This criterion is important when comparing the impacts of fisheries where different methods are used e.g. trawling versus jigging for squid.

Table 6: Ecosystem Impacts of different fishing methods

Main Fishing Methods	Habitat impacts						Overall Rating	Management Rating
	Physical	Biological	Sponges, corals etc.	Shell-fish & crabs	Fin-fish	Sharks & rays		
Collecting and diving	1	1	1	1	1	1	6	**A**
Jigging	1	1	1	2	1	1	7	**A**
Trolling	1	1	1	1	2	1	7	**A**
Purse seining	1	1	1	1	3	3	10	**A**
Hook and line	1	1	1	1	3	3	10	**A**
Set net (freshwater)	2	2	1	1	3	1	10	**A**
Fyke nets	3	2	1	1	2	1	10	**A**
Trawls-middle depth - no bottom contact	1	3	1	1	3	2	11	**B**
Gill-nets – mid-water	1	1	1	1	4	4	12	**B**
Pots	3	2	1	3	2	1	12	**B**
Longlining – pelagic	1	1	1	1	4	5	13	**B**

[18] "Habitat damage" – damage to living seafloor structures (e.g. corals, sponges, bryozoans) as well as alteration to the geologic structures (e.g. boulders, cobbles, gravel, sand, mud) that serve as nursery areas, refuges, and homes for fishes and organisms living on or near the seafloor.

[19] "Collateral damage" – unintentional or incidental damage to sealife or seafloor habitat caused by fishing activities directed toward other types of sea life. Collateral impact includes bycatch and habitat damage.

Gill net – bottom	2	2	2	1	4	4	15	**C**
Beach seining	3	2	2	3	3	2	15	**C**
Longlining – bottom	2	2	2	1	4	5	16	**C**
Hydraulic dredge	4	3	3	5	2	2	19	**D**
Trawls – middle-depth - with bottom contact	4	4	2	2	5	2	19	**D**
Pair trawling	5	4	4	3	4	2	22	**E**
Dredging	5	5	5	5	3	2	25	**E**
Trawls – bottom	5	5	5	4	5	3	27	**E**

Individual characteristic: 1 = No or very low impact; 5= very high impact;
Overall: A= best; E = worst.

Each species reviewed in our assessment may be caught by a number of fishing methods, but there is usually a dominant technique. For instance, hoki is caught mainly by trawling. The fishing techniques scored for each species in this assessment are the most common fishing methods used to commercially catch the species in New Zealand. If there is a range of methods used, the fishery is assessed on the basis of the method with the most significant impact unless it was possible to separate fishing methods used; e.g. trawl versus longline snapper.

Scores vary according to the overall impact, the amount of bycatch (non-target catch which is either utilised or discarded) and effect on habitat (minimal impact to substantial damage) (table 7).

Table 7: Score for fishing method

Score	Technique	Environmental Effects of technique
A (D if not selective)	**Collecting and Free Diving** e.g. paua, pipi	**Bycatch and wastage:** Collecting (usually from the intertidal zone) and diving can be highly selective but can cause sequential depletion. **Habitat damage:** Low habitat impact. Collection and trampling in the intertidal zone may impact on intertidal communities but this is likely to be low compared to recreational catches which can strip areas of fish and shellfish. Free divers are likely to have minimal impact on sub-tidal habitats.
A	**Jigging** e.g. squid	**Bycatch and wastage:** Jigging is highly selective and takes minimal bycatch. Discarded lines and lost jigs may have an impact on other sea life. **Habitat damage:** No habitat impact.
A	**Trolling (marine)** e.g. albacore tuna	**Bycatch and wastage:** Trolling is a relatively selective method of catching tuna with few other species being caught. Other species are occasionally hooked on trolls. **Habitat damage:** No habitat impact.
A	**Purse seining (marine)** e.g. kahawai and blue mackerel	**Bycatch and wastage:** Purse seining usually targets single species schools, and tends to be relatively selective but does catch bycatch of other fish species. **Habitat damage:** Negligible impact on the seafloor.

A	**Handlining (rod and line and handheld spools) (marine)** e.g. snapper	**Bycatch and wastage:** Non-target and undersized fish can be taken as bycatch. Heavy fishing pressure can cause localised depletion of some species. **Habitat damage:** Minimal habitat impact.
A	**Set nets Freshwater** e.g. Inanga	**Bycatch and wastage:** White bait nets result in little discards. **Habitat damage:** Low habitat impact.
A	**Fyke nets (freshwater/estuary)** e.g. freshwater eel	**Bycatch and wastage:** Fyke nets are selective, with some bycatch of other fish species. **Habitat damage:** Minimal habitat impact.
B	**Lampara nets (marine)** e.g. anchovies, pilchards, and garfish	**Bycatch and wastage:** Lampara nets usually targets single species schools, and tends to be relatively selective but can catch small fish depending on size of mesh used and target species. **Habitat damage:** Minimal habitat impact.
B	**"Mid-water" trawling** (with no-bottom contact)	**Bycatch and wastage:** Can take substantial tonnage of bycatch. **Habitat damage:** If the seabed is not touched then impact is minimal.
B	**Trapping and Potting (Marine)** Potting – lobster Trapping – blue cod	**Bycatch and wastage:** Fish traps and lobster pots are selective, with some bycatch of other fish species and octopus. Other large animals can get entangled in pot lines. **Habitat damage:** Minimal habitat damage unless placed on fragile corals or other reef species.
B	**Longlining** **Pelagic** – tuna	**Bycatch and wastage:** Longlining for tuna results in significant mortality of billfish and sharks. Discarded lines and may have an impact on other sea life. **Habitat damage:** minimal habitat impact
B	**Longlinning** (inshore) e.g. snapper	**Bycatch and wastage:** Longlining can be species selective depending on how long line is set. The bycatch of sharks species **Habitat damage:** minimal habitat impact
B	**Gillnetting (drift net**) e.g. mullet	**Bycatch and wastage:** Gillnetting has the potential to take large amounts of bycatch including sharks. Longer soaking periods lower the chance of unwanted fish being released alive. **Habitat damage:** Minimal impact on the seafloor.
C	**Beach seining (marine)** e.g. yellow-eyed mullet	**Bycatch and wastage:** Beach seining has low selectivity, which varies with mesh size. **Habitat damage:** Minimal habitat damage unless placed on reefs or sensitive habitat
C-D	**Danish seining** e.g. snapper	**Bycatch and wastage:** Similar to beach seining but carried out in deeper water with the catch hauled on deck. The catch is more likely to be crushed and survival of discarded catch is lower than beach seining. **Habitat damage:** Danish seine nets contact seafloor. While mostly carried out on sandy and low profile seafloor, it can impact on sensitive and vulnerable seabed habitat.
C - D	**Gillnetting (**including set netting) e.g. rig shark, elephant fish	**Bycatch and wastage:** Gillnetting(including set netting) has the potential to take large amounts of bycatch including sharks, and reef fish. Longer soaking periods lower the chance of unwanted fish being released alive. If placed in ecologically important habitats of threatened species susceptible to nets, then ranked as D due to bycatch. E.g. mauis dolphin habitat Penguins and shearwaters are very susceptible to gill nets. **Habitat damage:** Minimal impact on the seafloor unless placed on reef or sensitive habitat.
C	**Longlining Demersal/ Bottom-set** – ling & bluenose **Droplines** – bluenose	**Bycatch and wastage:** Longlining for ling and other species can include bycatch of seabirds. Discarded lines and may have an impact on other sea life **Habitat damage:** minimal habitat impact

C	**Drag net** e.g. flat fish	**Bycatch and wastage:** Drag net has low selectivity, which varies with mesh size. **Habitat damage:** Minimal habitat damage unless placed on reef or sensitive habitat.
D	**Dredging (Hydraulic)** **Dredging:** e.g. surf clams	**Bycatch and wastage:** Dredging can take large quantities of bycatch including fish and invertebrate species, e.g. sponges, corals and other benthic species **Habitat damage:** significant habitat damage including loss of biogenic habitats, increase turbidity and alters substrate topography.
D	**"Middle-depth" trawling** (with bottom contact) e.g. hoki, squid, and southern blue whiting	**Bycatch and wastage:** Can take substantial tonnage of bycatch including fish. Also invertebrate species when the trawl touches the bottom. **Habitat damage:** If the seabed is not touched then impact is minimal, however pelagic trawls may often touch the bottom and therefore can in some situations have similar impacts to bottom trawling.
E	**Dredging** **Dredging:** e.g. oysters, scallops	**Bycatch and wastage:** Dredging can take large quantities of bycatch including fish and invertebrate species, e.g. sponges, corals etc. **Habitat damage:** Gear dragged along the seafloor may cause major habitat damage and loss of biogenic habitats, increase turbidity and alters substrate topography. Dredging is particularly damaging to benthic species
E	**Bottom trawling and dredging, including pair trawling** **Trawling:** e.g. orange roughy. **Dredging:** e.g. oysters, scallops	**Bycatch and wastage:** Trawling and dredging can take large quantities of bycatch including fish and invertebrate species, e.g. sponges, corals etc. **Habitat damage** Gear dragged along the seafloor may cause major habitat damage, loss of biogenic habitats, increases turbidity and alters substrate topography. Dredging is particularly damaging to benthic species

Note: The bycatch of protected or threatened species is dealt with under criteria 5.4 and not under this criteria.

5.4 Protected species or threatened species bycatch

This criterion assesses the effect on protected species or threatened species of a fishery and related fishing activity and any mitigation measures applied. All marine mammals and seabirds, and the marine species listed in Appendix III are protected under the Wildlife Act or the Marine Mammals Protection Act.

The IUCN (International Union for the Conservation of Nature and Natural Resources) Redlist (2001a & 2016) and the Department of Conservation (DOC) list (Molloy, et al., 2002 and Townsend et al., 2007) list a range of threatened species (see Appendix IV). These include some marine invertebrates and marine fish, alongside all marine mammals and seabirds, and marine reptiles.

IUCN Redlist (2001a) and the DOC list list species on the basis of threat of extinction, including decline in population (see table 8). The two criteria are slightly different but have been compared on equivalent level of risk. Table 6.1 of the AEBAR (2015) (MPI 2015b) lists for all NZ seabirds the DOC (Robertson, et al., 2013) and the IUCN threat category.

Appendix IV and V sets out some of the available information on reported seabird and marine mammal captures in observed fisheries[20]. Appendix VI lists the turtle species

[20] Observed fisheries are those which have had some effort covered by MPI at sea fisheries observers. Observer coverages varies depending on the fishery, size of vessels, bycatch issues and a priority on formerly chartered foreign vessels. Over the last five years coverage has ranged from: zero in pot fisheries; under 2% in inshore

reported caught in observed fisheries. For freshwater fish species the DOC listings (Goodman, et al., 2014) and IUCN Redlist was used (see www.redlist.org).

Under the Code of Conduct on Responsible Fisheries (Food and Agriculture Organisation, 1995b) the FAO approved International Plans of Action (IPOAs) which set out requirements for national plans of action (NPOAs) on :

- Reducing Incidental Catch of Seabirds in Longline Fisheries;
- Conservation and Management of Sharks (Food and Agriculture Organisation, 1999)

Table 8: IUCN and Department of Conservation Threatened species categories

		Threat Category	
Chance of extinction	**Decline in population**	**IUCN (International)**	**DOC Equivalent (National)**
>50% in 10 years or 3 Generations	80% decline in 10 years or 3 generations	Critically Endangered	Nationally Critical
>20% in 20 years or 5 Generations	50% decline in 10 years or 3 generations	Endangered	Nationally Endangered; Nationally Vulnerable, Serious decline
>10% in 100 years	20% decline in 10 years or 3 generations	Vulnerable	Gradual decline; At Risk: range restricted or sparse
=<10% in 100 years	<20% decline in 10 years or 3 generations	Near-Threatened	No category
Insufficient data	Insufficient data	Data Deficient	Data Deficient
Much less than 10% in 100 years	Much less than 20% decline in 10 years or 3 generations	Least Concern	Not Threatened

References: IUCN, (2001a & 2001b); Molloy, et al., (2002) and Townsend, et al., (2007)

The current National Plan of Action on Seabird captures in fisheries was approved in 2013 (MPI, 2013) and includes *"capture rates are reducing towards negligible levels in all New Zealand fisheries, where practicable"*. It also set 5 year objectives to reduce capture rates including:

- *"capture rates are reducing in all New Zealand fisheries in accordance with reduction targets in the relevant planning documents for those fisheries." And*
- *"Five year biological risk objective: The level of mortality of New Zealand seabirds in New Zealand commercial fisheries are reduced so that species currently categorised as at very high or high risk from fishing move to a lower category of risk."*

A MPI stakeholder working group has been undertaking a process to estimate current seabird capture rates and develop targets with 5 year objectives to reduce seabird captures in all fisheries.

The most recent NPOA on Sharks was adopted in 2014 (MPI, 2014a). This included a general objective to eliminate shark finning at sea and: *"To maintain the biodiversity and the long-term viability of all New Zealand shark populations".* Some sharks are protected under schedule 7A of the Wildlife Act 1953 including basking sharks, white pointer, and

trawl, set net and longline fisheries; over 10% in middle-depth and deepwater trawl fisheries; over 50% in southern blue whiting, southern squid, and to 100% in large boat tuna longline fisheries.

whale sharks. (See Appendix VIII).

Risk assessments

MPI has been developing risk assessments and threshold limits on a species fatalities based on an estimate of potential biological removals (PBR)[21] a bycatch species (e.g. Maui dolphin) can withstand and allow it to recover (Wade, 1998). A major exercise has involved assessing the risk to individual seabird species from trawl, longline and set net fisheries (Richard & Abraham, 2015a & 2015b)

A quantitative risk assessment was also carried out on Maui dolphins using estimates of PBR for the dolphin (Currey, Boren, Sharp, & Peterson, 2012). This looked at fishing and non-fishing threats to Maui dolphins and plausible mortalities over the next five years. *"The panel attributed 95.5% of these mortalities to commercial, recreational, customary or illegal fishing-related activities combined, and the remaining 4.5% to non-fishing-related threats"* (Currey et. al., 2012). Depending on the assumptions, the estimates of mortalities that the population could withstand was one dolphin death in 6.4 years to one death in 23 years.

A qualitative risk assessment has also been applied to shark species (both QMS and non-QMS) captures in fisheries (Ford, et al., 2015). The general approach has been identify risk and apply a risk ranking to the species covered – the seabird risk assessment is the most advanced.

Table 9: Current Risk assessments applied

Group	Type of Risk	Risk includes	Not included in risk
Seabirds	Semi-quantitative	Trawl, longline, set nets	Pots, purse seine, hand line, trolling and jigging
Sharks	Qualitative	Trawl, longline	Un-observed fisheries?
Marine mammals Maui dolphin NZ Sea lions	Quantitative Quantitative	Trawl, longline and Non-fishing Squid 6T Trawl	Other trawl fisheries

Note: A risk assessment for all New Zealand marine mammals is being developed for MPI, but it is not yet completed, reviewed or publicly available.

One element in risk assessments based on Wade (1998) is the application of a recovery factor in the estimation of risk. For the seabird risk assessments there has been no determination of the recovery factors to use in the risk assessment. For Maui dolphin a recovery factor of 0.1 was applied as it is a critically endangered species.

In developing this criterion Forest and Bird have applied the recommendations of Dillingham and Fletcher (2008). Following on from Taylor et al (2003), Dillingham and Fletcher consider: *"Without further information, it may be reasonable to set f= 0.5 for 'least concern' species, f= 0.3 for 'near threatened', and f= 0.1 for all threatened species. A value of f= 1.0 may be appropriate for 'least concern' species known to be increasing or*

[21] The glossary has further information on PBR.

stable."

So where available the risk rankings (which is the estimated total annual potential fatalities/PBR) used in Richard and Abraham (2015a) (see table 9) have been adjusted using recovery factors based on the threat status of the seabird species affected by fisheries. For Maui Dolphin the risk result of different fisheries assessed by Currey, et al., (2012) was used.

Where there was no published risk ranking then the most recent estimate of bycatch in a fishery was used. In the assessment an average of the most recent 5 years of estimated bycatch of protected species were used (Abraham, Richard, Berkenbusch, & Thompson, 2016).

The scores A to E were set to indicate the risk posed by fishing (including commercial bycatch species) to species globally threatened with extinction (table 10). For example, for an endangered or critically endangered species the threshold has been set at zero.

Table 10: Scores for protected species or threatened species bycatch

Score	Note
A	Final risk ratio less than 0.1
A	Fishery catches no protected species or threatened species bycatch.
B	Final risk ratio for fishery between 0.1 and 0.3
B	Fishery catches less than 10 per annum of non-threatened protected species.
C	Final risk ratio for fishery between 0.3 and 0.5
C	Fishery catches less than 20 per annum of non-threatened protected species or catches non-threatened species.
D	Final risk ratio for fishery between 0.5 and 1
D	Fishery catches vulnerable or near-threatened species or catches large numbers of protected species over 20 per annum but less than 100 annually.
E	Final risk ratio for fishery greater than 1.
E	Fishery catches endangered or critically endangered species.
E	Fishery catches more than 100 threatened or protected species annually.

5.5 Stock Arrangement (Marine) and Habitat Status (Freshwater)

This criterion is designed to assess two issues: the arrangement for individual fish-stock for each marine species is managed; and consider for freshwater species the loss of habitat and any associated trends.

5.5.1 Marine Species

The criteria assesses the stock unit used to manage fish or seafood species in New Zealand and the effectiveness of the management for straddling stocks and highly migratory species caught in New Zealand waters.

Under both quota management and non-quota management several species can be

administered as one quota group. For example, three oreo species are managed as one unit despite different biological characteristics and depth ranges, etc. (Appendix II), and eight flatfish species are managed as one unit. While most flatfish are fast growing and short-lived (3-6 years) recent studies have shown that brill and turbot (currently managed within the same quota management unit) live longer, reaching a maximum age of 21 years and 16 years respectively (Stevens, et al., 2001).

An additional risk can be the management of several stocks as one quota or fisheries management area. Separate stocks are considered to be separate breeding populations. Managing several stocks together can lead to one stock, particularly the smaller stock, being over-exploited. For example, the two hoki stocks in New Zealand are managed as one quota unit.

For some species there is an added risk of serial depletion if the stock unit is a small geographical unit as in the case of cockles and paua (McShane & Naylor, 1995). The quota management species have usually had catch limits established for large areas which do not take into account the potential for serial depletion of discrete sub-units (such as spawning populations). In many cases the species stock structure and boundaries are unknown (e.g. anchovy and alfonsino).

The scores A to E were set to indicate the risk posed by managing multiple species as one unit or not dividing stocks into different management areas, or the management of highly migratory species or straddling stocks (table 11).

Table 11: Marine Species: Scores for management unit

Score	Note
A	Fishery is managed by individual species, stocks are divided into different management units (quota or fisheries management areas) and there is no risk of serial depletion.
B	Fishery is managed by individual species, stocks are divided into different management units but there is a low risk of serial depletion of discrete sub-units (e.g. spawning populations).
C	Fishery is managed by individual species but two stocks are managed as one management unit and any other stocks are managed separately or management boundaries do not match stock boundaries.
C	Fishery is managed by individual species but stock structure is unknown or highly uncertain but there is a low risk of serial depletion.
D	Fishery is managed by individual species but more than two stocks are managed as one management unit.
D	Fishery is managed by individual species but stock structure is unknown but it is managed by fisheries management areas and there is a high risk of serial depletion of discrete sub-units (e.g. spawning populations).
E	More than one species are managed as one fishery (e.g. oreos, groper).
E	More than one species are managed as one fishery and stock structure is unknown.

All schemes: A= Best; E = Worst

5.5.2 Freshwater Fisheries Habitat

The key risk to freshwater species is the loss or modification of habitat. This is the primary focus of the Department of Conservation advocacy and management approach to freshwater fisheries. This criteria looks at the freshwater habitat related decline and not the effect of whitebaiters fishing effort.

Over the last 40 years freshwater fisheries have declined due to a range of factors including loss and degradation of habitats (Elston, Anderson-Lederer, Death, & Joy, 2015). Reduction in habitat, invasive species and deteriorating water quality remain the top threats to native freshwater fish species (Elston et. al., 2015).

Freshwater fisheries for eels are managed by MPI under the Fisheries Act while whitebait fisheries are managed by the Department of Conservation under the Conservation Act.

Commercial whitebait fisheries are made up of the juvenile fish of five galaxid species and smelt which migrate upstream after spending time at sea. The species are – inanga (*Galaxias maculatus*), koaro (*Galaxias brevipinnis*), banded kokopu (*Galaxias fasciatus*), giant kokopu (*Galaxias argenteus*) and shortjaw kokopu (*Galaxias postvectis*).

Of the whitebait and eels species assessed several have been assessed by the Department of Conservation or IUCN as threatened species. Table II of Appendix II lists the "white bait" species in commercial fisheries, their biological characteristics (if known), and their current threat status.

Land use changes and continued urban and industrial development have caused declines in native freshwater fish species in numbers and distribution (McDowall, 1996; Goodman, et al., 2014). To maintain fish populations it is necessary to protect spawning habitat and maintain migratory pathways (Wilding, Young, & Pitkethley, 2000; MPI, 2015; NIWA, 2014).

Lowland streams and wetlands are more important for whitebait species than upland or high country streams.

Nationally the decline in freshwater wetlands has been very significant over the last 100 years. In their review of New Zealand's remaining natural habitat for biodiversity, Ausseil et al (2011) stated that:
"The greatest losses occurred in the North Island where only 5% of historic wetlands remain compared with 16% in the South Island. The South and Stewart Islands contain 75% of all remaining wetland area, with the highest proportions persisting on the West Coast of the South Island and on Stewart Island. The remaining wetland sites are highly fragmented. Most sites (74%) are less than 10 ha in size, accounting for only 6% of national wetland area. Only 77 wetland sites are over 500 ha, accounting for over half of the national wetland area."

The Waikato Regional Council notes *"Although a habitat-related decline in the abundance of whitebait can result in fishery decline, an increase in whitebaiters can potentially cause a decline through overfishing. The fishery may also decline because of factors not related to a change in the fish stocks. For example, river works related to flood protection may reduce the number of locations on riverbanks where whitebaiters can fish, and access to fishing locations may become restricted." (Waikato Regional Council, 1999).*

Jowett and Richardson (2003) found that native forests are important for some white bait glaxids (koaro, banded kokopu), and the area of wetlands in a catchment was positively

related to the abundance of giant kokopu.

Table 12 is an example of the level of wetland loss in the Waikato River catchment. Banded kokopu and koaro are affected by the loss of forest cover and subsequently their numbers have decline faster than inanga so they make up a smaller proportion of the whitebait catch in the Waikato River (Waikato Regional Council 1999).

Table 12: Extent of Wetland loss in Waikato River Catchment (after Cheyne 1981)

	Area of Wetland Present (km2)		**% Reduction**
Year	**C1840**	**1976**	
Waikato	**64.8**	**10.9**	**83.1**
Waipa	**37.6**	**0.1**	**99.6**
Total	**102.4**	**11.0**	**89.0**

Source: Waikato Regional Council, 1999

The riparian spawning habitat can be very limited which increases the risk from habitat species. On the West Coast of the South Island, the impacts due to intensive agricultural land use downstream in catchments affecting migratory passage were predicted to reduce the accessible habitats for koaro and banded kokopu by 55% and 70%, respectively. In addition, local land use reduced koaro and banded kokopu habitats to 70% and 90%, respectively, of total accessible habitat (West Coast Regional Council, 2002)

Disturbance rankings can also be used as a measure of effect of habitat changes on whitebait species. The West Coast Regional Council (2002) has used a disturbance categories system to assess the impact of farming on freshwater habitat (refer to Table 13).

Table 13: Criteria for four disturbance classes

Classification criteria	Class 1: Highly modified	Class 2: moderately modified	Class 3: slightly modified	Class 4: little or no modification
Stream canalisation and straightening	>70%	25-70%	10-25%	<10%
Amount of riparian vegetation that has been disturbed or removed	>70%	25-70%	10-25%	<10%
Restriction of stock access (pastoral areas)	<10%	10-70%	70-90%	>90%

From: Table 2.2, West Coast Regional Council (2002)

Disturbance ranking indicates the modification of habitat. This does not represent all the changes that may affect freshwater species due to changes and loss of habitat.

The information available across New Zealand is limited. To simplify this approach an assessment was made to divide the areas into five equal units between 100% un modified to less than 20% of habitat left. This sets a limit reference consistent with 80% habitat loss and acknowledging that in some regions (e.g. part of the West Coast of the South Island) habitat loss and remaining wetland is much less than 80%.

The scores A to E (table 14) were set to indicate the level of habitat left for freshwater

species, habitat disturbance and trend in habitat quality and size. These scores were developed from the criteria used in Table 13.

Table 14: Freshwater Species: Habitat impacts

Score	Note
A	80-100% habitat left and there is no decline below this level and high quality habitat remains. Low habitat disturbance.
B	60-80% of Habitat left and there is no decline below this level and high quality habitat remains. Slightly modified habitat disturbance.
C	40-60% of Habitat left and there is no decline below this level and nearly half the high quality habitat remains. Moderately modified habitat disturbance.
D	20-40% of habitat left and there is no decline below this level. Highly modified habitat disturbance.
E	20% or less of habitat left. Very highly modified habitat disturbance.

All schemes: A= Best; E = Worst

5.6 Plans, Research, and Monitoring

This criterion is designed to assess how fisheries managers are undertaking management, research and monitoring of a fishery. This includes the level of enforcement of rules.

New Zealand marine fisheries are split into two groups inshore and highly migratory (including shellfish), and deepwater. There are no approved management plans for inshore fisheries. However, deepwater (including middle-depth fisheries) and highly migratory fisheries currently have approved management plans under the Fisheries Act.

Fisheries managers rely on accurate research-based stock assessments to develop management regulations, including catch limits, to manage fishstocks well. Other controls include input measures such as seasonal closures, size limits and gear restrictions (trawl mesh size, length of gill nets) and output measures such as total allowable catches.

MPI runs an annual fisheries stock assessment process. There is no equivalent process or assessment of freshwater species apart from eels, as white bait species are managed by the Department of Conservation.

Determination of stock status and sustainable yield relies principally on obtaining accurate catch, effort and other information over many years. This requires assumptions about the accuracy of the reporting of catches, extent of the fishing effort, and the location of fisheries. Poaching, illegal catches, inaccurate and misreporting, and discarding complicate any assessment[22]. The wrong species may be reported or the wrongful application of the reporting code may result in several species being reported together e.g. flatfish.

Fisheries scientists therefore look for fisheries independent sources of information. These include random trawl surveys, acoustic surveys and tagging surveys. In addition, the presence of independent scientific observers on board vessels ensures additional biological information is collected and provides a baseline check against the accuracy of commercial fishers' reporting, including information on bycatch (both fish and non-fish). In some

[22] Examples of past mis-reporting include hake 7 as hake 4, under-reporting of hake (700-1000t/yr) and ling (250-400t/yr), silver warehou bycatch in the west coast hoki fishery, and estimated annual illegal catches of paua (400 tonnes) and rock lobster (230 tonnes) (Annala, Sullivan, & O'Brien, 2003; Dunn, 2003; Sullivan, et al., 2005 and Bremner, Johnstone, Bateson, & Clarke, 2009) Greater levels of discarding and dumping than previously recognised have been reported by (Simmons, et al., 2016)

fisheries additional information is collected by monitoring catches in fish processing factories. Fewer trawl surveys and other research surveys are being undertaken than was 20 years ago due to funding constraints.

In New Zealand independent scientific observer coverage is almost non-existent in many inshore fisheries (less than one percent of effort covered (Abraham, Thompson, & Oliver, 2010)) and can be low, with observer bias problems, in middle depth and deepwater fisheries (for example, oreos, orange roughy or hoki), and in inshore fisheries. Efforts are being made to improve observer coverage in all fisheries or applying electronic monitoring systems. Scientific observer coverage is under 10% in inshore trawl, purse seine, set net and many bottom line fisheries. MPI has made the requirements for electronic monitoring in northern inshore fisheries but the efficacy of these methods when compared to human observers has yet to be tested.

Most fisheries catch limits are set based on commercial fishing returns (e.g. catch effort returns, such as catch per trawl, longline set or pot-lift) as independent fisheries research is non-existent. The reporting in some commercial fisheries only provides effort information within large statistical areas and the actual position of the fishing effort (trawl or pot-lift) is not reported, for example, on catch landing returns still used in some inshore fisheries[23].

Fisheries information and planning for research is essential for the management of fisheries.

Essential fishery information to manage a stock includes:

- fish life-history and habitat requirements, for example, maximum age, natural mortality, age at reproductive maturity (Paul, 1992);
- the status and trends of fish populations, fishing effort and catch levels;
- fishery effects on fish age structure and other marine living resources;
- environmental effects on larval and juvenile survival and growth.

Some of this essential fisheries information is set out in Appendix II which is used to assess resilience to overfishing and recovery.

Forest & Bird found that information on commercially exploited fish populations is patchy at best. In low commercial value stocks basic biological information such as maximum age, growth rates and age at maturity is often missing. The use of inaccurate or poor information in fisheries models and the setting of catch limits can lead to erroneous decisions being made.

Effective management is more than just collecting catch and biological information on each fishery by species. The impact of non-commercial fisheries must also be considered. The tendency for short-term economic objectives to over-ride environmental considerations means that New Zealand has some way to go to achieve ecologically sustainable fisheries.

5.6.1 High seas and straddling stock fisheries

For highly migratory species (e.g. tunas) or straddling stocks (e.g. Challenger orange roughy) the New Zealand EEZ only includes part of the fish stock and fishery so the status and measures applied by any international management regime needs to be considered (see Appendix V). For straddling stocks not covered by the Western and Central Pacific Tuna Commission (WCPFC) or the Commission on the Conservation of Southern Bluefin Tuna

[23] Catch landing returns (CLR) only reports within large statistical areas and individual effort (e.g. trawls) are not reported separately. The alternative total catch effort processor return (TCEPR) is filled out by the larger trawlers. Over the last 10 years CLR has been mainly replaced by a range of new forms which provide more detailed information on fishing activity.

(CCSBT) there are no international catch limits. Measures exist for some species not covered by the tuna agreements (e.g. bottom fishing controls and protection of vulnerable marine ecosystems for orange roughy and catch limits for jack mackerel) under the South Pacific Regional Fisheries Management Organisation (SPRFMO). Even where there is international management there is often not the commitment to take action required to reduce catch limits to sustainable levels (e.g. CCSBT for southern bluefin tuna) or there may be a high level of illegal, unauthorised or unregulated fishing (IUU) (e.g. some toothfish stocks under the Commission on the Conservation of Antarctic Marine Living Resources - CCAMLR).

The criteria used since 2005 has taken into account the management of straddling stocks and highly migratory species. These include whether there are conventions or agreements for the species and whether these are delivering effective actions, and whether there is significant IUU activity. For consistent consideration of management these issues have been moved into this criterion.

5.6.2 General

Monitoring of fisheries includes the level of enforcement activity to prevent illegal and unreported catch. New Zealand adopted a national plan of action on IUU fishing in June 2004. (See http://www.fish.govt.nz/current/iuu-fishing/iuu-fishing.pdf.)

The following management and research factors are considered as important elements of an ecologically sustainable management and research system and against which the management of a species should be compared:

- Fisheries Act (or Conservation Act for whitebait fisheries) agreed management plans and strategies based on the knowledge of species and stocks including biological reference points or standards identified (i.e., indicators against which the status of a stock can be judged) and agreed as in harvest strategy or equivalent;
- Annual quantitative stock assessments and setting catch limits on the basis of best assessments, application of harvest strategy or alternative, and use of precautionary principle, including any stock rebuilding strategy;
- Regular scientific research providing basic biological characteristics of species including natural mortality, age at recruitment, age at maturity and maximum age;
- Adequacy of recent and ongoing research, research plans including independent at sea observation and monitoring, bycatch monitoring, and the use of fishery independent methods, e.g. random trawl surveys, tagging or acoustic methods;
- Enforcement system – with clear rules and catch reporting and compliance – with low level of illegal activity.

For highly migratory species and straddling stocks - the adequacy of international fisheries management regime in place – including management plans, regular stock assessments, catch limits, observation, monitoring and enforcement systems.

For freshwater fisheries the research component includes monitoring habitat component quality and changes, as well as the fishery itself.

The following scores (A to E) have been developed for the overall assessment of plans, research and monitoring of New Zealand’s commercial marine or freshwater fisheries (table 15). Stocks were rated on the basis of the five management and research factors set out above.

Table 15: Scores for Plans, research and monitoring

Score	Notes
A	All five of the above elements present.
A	There is an international agreement which manages highly migratory species or straddling stocks well, sets precautionary catch limits and there is a low level of IUU catches.
B	3 or 4 elements present including basic biological information, biological reference points, and regular stock assessments, and a management plan.
B	There is an international agreement which well manages highly migratory species or straddling stocks, sets precautionary catch limits but despite comprehensive measures to eliminate IUU catches they continue at a moderate level.
C	2 or 3 elements present including basic biological information and biological reference points.
C	There is strong interim arrangement which sets precautionary catch limits and there is substantial progress towards an international agreement which will manage highly migratory species or straddling stocks.
C	There is an international agreement which sets precautionary catch limits for highly migratory species or straddling stocks, but there are only limited measures to eliminate IUU catches and they continue at a moderate level.
D	1 or 2 elements present, including an enforcement system and catch monitoring.
D	There is a weak interim arrangement but there is a commitment to develop an international agreement to manage highly migratory species or straddling stocks.
D	There is an international management regime to set conservation measures for the species but it has yet to apply any sustainable catch limits or catch limits are not sustainable or the agreement represents only a small part of the catch and there is a high level of IUU fishing.
E	None of the elements present.
E	There is no international management regime or interim measures in place to manage a fisheries high seas component.

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Appendix I: Major Commercial Marine Fish Species

Trawl Fisheries	**Dredge fisheries**
Northern Inshore trawl	Dredge oyster (*Tiostrea chilensis*)
Snapper (*Pagrus auratus*)	Scallop *(Pecten novaezelandiae)*
John dory (*Zeus faber*)	Surf clams
Tarakihi (*Nemadactylus giganteum*)	**Demersal Longline fisheries**
Trevally (*Pesudocaranx dentex*)	Snapper (*Pagrus auratus*)
Jack mackerel (*Trachurus novaezelandiae, T declivis*)	**Other Longline fisheries**
Barracouta (*Thyristes atun*)	Ling (*Genypterus blacodes*)
Red gurnard (*Chelidonichthys kumu*)	Bluenose (*Hyperglyphe antarctica*)
Southern inshore trawl	Hapuku (*Polyprion oxygeneios*)
Red cod (*Pseudophycis bachus*)	Bass (*Polyprion americanus*)
Red gurnard (*Chelidonichthys kumu*)	School shark (*Galeorhinus australis*)
Flatfish (*Rhombosolea leporina*)	
Blue cod (*Parapercis colias*)	**Pelagic longline – tuna**
	Southern blue fin (*Thunnus maccoyii*)
Northern middle depth trawl	Bigeye tuna (*Thunnus obesus*)
Gemfish (*Rexea solandri*)	Albacore (*Thunnus alalunga*)
Hoki (*Macruronus novaezelandiae*)	Yellowfin tuna (*Thunnus albacares*)
West Coast and Chatham Rise Middle depth trawl	Swordfish (*Xiphias gladius*)
Hoki (*Macruronus novaezelandiae*)	
Hake (*Merluccius australis*)	**Trolling**
Ling (*Genypterus blacodes*)	Albacore (*Thunnus alalunga*)
Silver warehou (*Seriolella punctata*)	
Southern Mid depth trawl	**Purse seine**
Arrow Squid (*Nototodarus sloanii*)	Kahawai (*Arripis trutta*)
Barracouta (*Thyristes atun*)	Skipjack tuna (*Katsuwonus pelamis*)
Hoki (*Macruronus novaezelandiae*)	Trevally (*Pseudocaranx dentex*)
Hake (*Merluccius australis*)	Blue mackerel (*Scomber australasicus*)
Ling (*Genypterus blacodes*)	
Silver warehou (*Seriolella punctata*)	**Set Net fisheries**
Sub-Antarctic mid depth trawl	Rig (*Mustelus lenticulatus*)
Arrow Squid (*Nototodarus sloanii*)	School shark (*Galeorhinus galeus*)
Southern blue whiting (*Micromesistius australis*)	Butterfish (*Odax pullus*)

Hake (*Merluccius australis*)	Grey mullet (*Mugu cephalus*)
Ling (*Genypterus blacodes*)	
	Potting fisheries
Deepwater trawl (over 750m)	Red rock lobster (*Jasus edwardsii*)
Orange roughy (*Hoplostethus atlanticus*)	Blue cod (*Parapercis colias*)
Smooth oreo (*Pseudocyttus maculates*)	
Black oreo (*Allocyttus niger*)	**Diving - Paua**
Black cardinal fish (*Epigonus telescopus*)	Paua (*Haliotis iris* and *H. australis*)
Scampi trawl	**Freshwater**
Scampi (*Metanephrops challengeri*)	Eels (Anguilla sp)
	Whitebait (Gallaxias sp)

Appendix II: Key Biological Indicators of Fish Species

Table I: Marine Species

Common name	Scientific name	Age when mature	Maxi-mum age	Age first fished	M -natural mortality	Von B growth *k*	Risk rating
Albacore tuna	*Thunnus alalunga*	6-8	14+?	1-2	0.34 (0.2-0.5)	0.40-0.61	C?
Alfonsino	*Beryx splenden* *B. decadactylus*	4-5 ?	17 ?	4-5 ?	0.23 ?	0.08F-0.11M ?	C? D?
Anchovy	*Engraulis australis*	1	6	2	?	?	A?
Antarctic toothfish	*Dissostichus mawsoni*	13-17	48+	5-7	0.13	0.090	E
Arrow squid	*Nototodarus sloanii* *N. gouldi*	22-30 cm ML	1? 1?	? ?	? ?	2.1-3.6 2-2.8	Ae A
Barracouta	*Thyrsites atun*	2-3	10+	3?	0.3	0.259F 0.336M	C
Bigeye tuna	*Thunnus albacares*	3	11+	2	0.5	0.106-0.608	C
Black cardinalfish	*Epigonus telescopus*	35	100+	35	0.034?	0.034	E
Blue cod	*Parapercis colias*	2-6	32	2	0.14	0.129F 0.222M	Ce
Blue mackerel	*Scomber australasicus*	2	24	3	0.2?	0.15	C
Blue moki	*Latridopsis ciliaris*	5-6	43	5	0.1	0.208	D?
Blue shark	*Prionace glauca*	7-9F 8M	22	2	0.19-0.21	0.165M 0.2297F	Ds
Blue warehou	*Seriolella brama*	4-5	22	4	0.24	0.169-0.314	C
Bluenose	*Hyperoglyphe antarctica*	15-17	76	15?	0.09	0.071F-0.125M	D
Butterfish	*Odax pullus*	2-4	19	2-3	0.3-0.45	0.23-0.517	B
Cockles	*Austrovenus stutchburyi*	1	8+	2-5	0.3	0.26-0.311	B
Dark ghost shark	*Hydrolagus novaezealandiae*	5-9?	?	?	?	0.052-0.090F	D?s
Elephantfish	*Callorhinchus milii*	3-5	9-15	3+	0.23	0.026F 0.34M	C
Flatfish:							
Yellow- belly flounder	*Rhombosolea leporina* *R. plebeia*	?	?	?	?	?	?e
Sand flounder/Dab	*R. retiaria*	2-3	6?	2	1.1-1.3	0.23F 0.781M	Ae
Black flounder	*R tairina*	?	?	?	?	?	?e
Greenback flounder	*Pelotretis flavilatus*	2?	5-10	2?	0.42F 0.85M	0.25M 0.26F	?e
Lemon sole	*Peltorhamphus novaezealandiae*	?	?	?	0.62-0.96	1.29F 1.85M	Ae
New Zealand sole	*Colistium guntheri*	?	?	?	?	?	?e
Brill	*C. nudipinnis*	?	21	?	0.20	0.1F 0.37M	Be
Turbot		?	16	?	0.26	0.34M 0.39F	B
Frostfish	*Lepidopus caudatus*	?	8?	?	0.58?	?	B?
Garfish	*Hyporhampus ihi*	2-3?	10?	2-3?	0.5?	?	Be

Gemfish	*Rexea solandri*	3-6	17	3-5	0.25	0.114-0.231F	D
Grey mullet	*Mugil cephalus*	3	15	4?	<0.33	0.587F 0.619M	B
Green-lipped mussel	*Perna canaliculus*	1	?	1?	?	?	?
Groper – hapuku bass	*Polyprion oxygeneios* *P. americanus*	10-13 10?	60+ 40+	5 5?	<0.1 <0.1?	? ?	D D
Hake	*Merluccius australis*	4-7	25+	2	0.19	0.131-0.214	C
Hoki	*Macruronus novaezelandiae*	4+	20-25	2	0.25F-0.3M	0.161-0.261	C
Jack mackerel - Peruvian	*Trachurus declivis,* *T. novaezelandiae,* *T. symmetricus murphyi*	2-4 3-4 4?	25+ 25+ 32+	2-3 ? 2?	0.18 0.18 0.3?	0.28 0.30 0.155	C C C?
John dory	*Zeus faber*	2-3	12	2-3	0.38	0.425F 0.480M	B
Kahawai	*Arripis trutta*	3-5	26	3-4?	0.20	0.23-0.35	C
Kina	*Evechinus chloroticus*	4-5	20+	8-9?	0.2??	?	C?
Kingfish	*Seriola lalandi*	4-7?	16+?	2-4?	0.20-0.25	0.119F-0.137M	C?
Leather jacket	*Parika scaber*	2	7+?	2?	0.6??	?	B?
Ling	*Genypterus blacodes*	5-9	46	5	0.18	0.067-0.188	C
Lookdown dory	*Cyttus traversi*	?	38?	?	0.15??	0.058	C?
Mako shark (shortfin)	*Isurus oxyrinchus*	7-9M 19-21F	29+	7?	0.10-0.15	0.0524M 0.0154F	Ds
Moonfish	*Lampus gutatus*	4-5	14+	2-4	0.20-0.25	?	B
Orange roughy	*Hoplostethus atlanticus*	23-29	120-130	23-29	0.045	0.059-0.070	E
Oreos: black, smooth, Spiky	*Allocyttus niger,* *Pseudocyttus maculatus* *Neocyttus rhomboidalis*	27 31 ?	153 86 100+	27? 21 ?	0.044 0.063 ?	0.043F 0.056M 0.047F 0.067M ?	E E E?
Oysters (dredge)	*Tiostrea chilensis*	3-4	36+	4-8	0.042-0.92	0.48	D?
Packhorse lobster	*Jasus verreauxi*	?	?	?	?	?	D?
Pacific bluefin tuna	*Thunnus orientalis*	3-5	15+	3+	0.1-0.4	0.1035-0.211	D
Paddle crabs	*Ovalipes catharus*	3-4?	?	3-4?	?	???	B?
Pale ghost shark	*Hydrolagus bemisi*	?	?	?	??	?	D?s
Parore	*Girella tricuspidata*	4-5	10+	4?	?	?	C
Patagonian toothfish	*Dissostichus eleginoides*	8-10	50+	8	0.13	0.08-0.085?	D
Paua	*Haliotis iris,* *H. australis*	3-5? ?	? ?	5-8+ ?	0.02-0.25 ?	0.164-0.34 ?	E E?
Pilchards	*Sardinops sagax (neopilchardus)*	2	9	2	0.46-0.66	?	A

Porae	*Nemadactylus douglasii*	?	30+	8	0.15??	?	D
Porbeagle shark	*Lamna nasus*	8-11M 15-18F	65?	1+	0.05-0.10	0.112-0.060	Es
Queen scallops	*Zygochlamys delicatula*	4 M, 5F	10+	3-5	?	0.187	C
Rays bream	*Brama brama*	3-5	25+?	?	0.2??	?	D?
Red cod	*Pseudophycis bachus*	2-3	7?	2	0.76	0.47-0.53M 0.41-0.49F	B
Red gurnard	*Chelidonichthys kumu*	2-3	16	2	0.29M 0.35F	0.37-0.569M 0.25-0.641F	B
Red snapper	*Centroberyx affinis*	?	40 ?	?	0.1??	?	D?
Ribaldo	*Mora moro*	?	39 +?	?	0.106F 0.112M	0.072-0.14	D?
Rig	*Mustelus lenticulatus*	4-8	20+	2	0.2-0.3	0.119	Ds
Rock lobster	*Jasus edwardsii*	3-12	40+?	5-11	0.12	?	D?
Rubyfish	*Plagiogeneion rubiginosum*	7?	100?	7	0.03-0.1	0.045	E
Scallops	*Pecten novaezelandiae*	2	6-7	2-3	0.21-0.5	0.378-1.7?	B
Scampi	*Metanephrops challengeri*	3-4	15?	3-4	0.2-0.25	0.11-0.14	D
School shark	Galeorhinus galeus	12-17M 13-15F	50+	10 ?	0.1	?	Ds
Sea perch	*Helicolenus percoides*	5-7	43	5	0.07-0.13	0.128-0.117	D?
Silver warehou	*Seriolella punctata*	3-4	23	3-4	0.2-0.3	0.33F 0.41M	B
Skates: rough Smooth	*Zearaja nasutus* *Dipturus innominatus*	4-6 8-13	9+ 28 +	? ?	0.25-0.35 0.12-0.15	0.096-0.16 0.095	Ds Ds
Skipjack tuna	*Katsuwonus pelamis*	1	12 ?	1	0.3-2.0	1.85-1.30	C?
Snapper	*Pagrus auratus*	3-4	60	3-5	0.051-0.075	0.061-0.16	D
Southern blue whiting	*Micromesistius australis*	2-4	25	3-4	0.2	0.032-0.035	D
Southern bluefin tuna	*Thunnus maccoyii*	8-12	22 +	4	0.2	0.14-0.18	D
Spiny dogfish	*Squalus acanthias*	6-10	26F 21M	4?	0.2	0.069F 0.116M	Ds
Sprats – Slender Stout	*Sprattus antipodum* *S muelleri*	? ?	? ?	? ?	? ?	? ?	A? A?
Stargazer	*Kathetostoma giganteum*	5-7	26	2-3	0.18-0.23	0.13-0.18F 0.15-0.2M	C
Stripped marlin	*Tetrapturus audax*	1-2?	12+?	2?	0.389-0.818	0.22?	C

Surf clams: Deepwater tuatua Fine (silky) dosinia Frilled venus shell Large trough shell Ringed dosinia Triangle shell Trough shell	 *Paphies donacina,* *Dosinia subrosea,* *Bassinia yatei,* *Mactra muchisoni,* *Dosinia anus,* *Spisula aequilatera,* *Mactra discors*	 ? ? ? ? ? ? ?	 17 11 22 7 14	 ? ? ? ? ? ? ?	 0.26-0.32 ? ? 0.4-0.46 0.2-0.26 0.68-0.89 0.28-0.38	 ? ? ? ? ? ? ?	 B ? ? A B A B
Swordfish	*Xiphias gladius*	1M-10F	20?	1	0.22?	?	C
Tarakihi	*Nemadactylus macropterus*	4-6	40+	3-4	008-0.15	0.1666-0.252M 0.2009-0.234F	C
Trevally	*Pseudocaranx dentex*	3-5	40+	3-4	0.083-0.1	0.28-0.29	D
Trumpeter	*Latris lineatae*	?	43+?	?	?	?	C?
White warehou	*Seriolella caerulea*	3-4	23?	3-4	0.24-0.27?	?	C
Yellow-eyed mullet	*Aldrichetta forsteri*	2	7	2	0.66	?	A?
Yellow fin tuna	*Thunnus albacares*	1-2	8+	2	0.1-0.2 0.6-0.8?	0.250-0.660	C

Shark QMS Species

Species	**No of pups**	**Gestation**	**Fecundity/ year**	**Risk rating**	**IUCN Threat status**
Blue shark	4-135	9-12 mths	? low	7	Near threatened
Elephant fish	Egg cases	?	? low	9	Least concern
Ghost shark – dark	?	?	? low	9	Least concern
Ghost shark – pale	?	?	?low	8	Least concern
Mako shark	4-18 (12)	About 18 mths	4	8	Vulnerable
Porbeagle shark	About 4	8-9 mths	3.75	8	Vulnerable
Rig	2-37 (11)	10-11	11?	9	Least concern
School shark	5-10-40+	2-3 yr cycle	2-13?	9	Vulnerable
Skate – rough	Egg cases (2)	?	?	9.5	Least concern?
Skate - smooth	Egg cases (2)	?	?	9	Near threatened?
Spiny dogfish	1-19	2 year cycle	0.5-10	9	Vulnerable

Table II: Freshwater species in fisheries and threat status

Name	Species	Max length (cm)	Age at maturity (year)	Max age (year)	Age first fished (year)	M -natural mortality	Von B Growth K	DoC Threat Status	IUCN Threat status	Risk Rating
Inanga	*Galaxias maculatus*	19	?	3+?		?	?	At risk - declining	LC	D
Koaro	*Galaxias brevipinnis*	28	?	^40		?	?	At risk - declining	LC	D
Banded kokopu	*Galaxias fasciatus*	25	?	9		?	0.24-0.4795	Not threatened	LC	C
Giant kokopu	*Galaxias argenteus*	40+	?	27+		?	?	At risk - declining	Vu	D
Shortjaw kokopu	*Galaxias postvectis*	26	2-3	?		?	?	Nationally vulnerable	EN	D
Smelt	*Retropinna retropinna*	16	2	?		?	?	Not threatened	LC	D
Eel – longfin	*Anguilla dieffenbachia*		11-56	106	8-17	0.036?	?	At risk - declining	NA	Ee
Eel – shortfin	*Anguilla australis, A. reinhardtii*		5-41 ?	60 ?	6-13 ?	0.038? ?	? ?	Not threatened	NA	E

Note to tables:

Risk rating see table 5.

Von B K is for both sexes combined uless indicated.

Table Abbreviations:

e = endemic; s= sharks, rays and relatives; ? = unknown; number? = uncertain; number??= very uncertain

F= Female; and M = Male ML = mantle length for squid

IUCN Threat categories:

EN – Endangered; Vu – vulnerable; LC – least concern; NA – not assessed

DOC Threat Categories -

Dec = Declining
NC = Nationally Critical
NE = Nationally Endangered
NT = Not Threatened
NU = Naturally Uncommon
NV = Nationally Vulnerable
Rec = Recovering
Rel = Relict
RR = Range Restricted

Table References: Paul (1992); Neil, Paul, & Horn (2004); MPI (2014b, 2015 & 2016b); Fishbase.org; McDowall (1990).

Aquaculture species	
King/ quinnat salmon (*Oncorhynchus tshawytscha*)	Pacific oysters (*Crassostrea gigas*)
Mussels *(Perna canaliculus)*	Paua *(Haliotis iris)*

Appendix II A: Wild Commercial Fish Species Not Assessed

Name	
Bladder kelp	(KBB)
Deepwater (king) clam	(PZL)
Giant spider crab	(GSC)
Greenlipped mussel	(GLM)
Horse mussel	(HDR)
King Crab	(KIC)
Knobbled whelk	(KWH)
Pipi	(PPI)
Redbait	(RBT)
Red Crab	(CHC)
Sea Cucumber	(SCC)
Tuatua	(TUA)
Smooth hammerhead sharks	(HHS)

Reference: MPI (2015 & 2016b).

Appendix III: Marine Species Listed by the Bonn Convention, ACAP and CITES

1. Agreement on the Conservation of Albatross and Petrels (ACAP)

Table 1: Albatross, petrel and shearwater species listed in Annex 1 of ACAP

Albatrosses	
Diomedea exulans	Wandering
Diomedea dabbenena	Tristan
Diomedea antipodensis	**Antipodean**
Diomedea amsterdamensis	Amsterdams
Diomedea epomophora	**Southern Royal**
Diomedea sanfordi	**Northern Royal**
Phoebastria irrorata	Waved
Thalassarche cauta	Shy
Thalassarche steadi	**White-capped**
Thalassarche salvini	**Salvin's**
Thalassarche eremite	**Chathams**
Thalassarche bulleri	**Buller's**
Thalassarche chrysostoma	**Grey-headed**
Thalassarche melanophris	**Black-browed**
Thalassarche impavida	**Campbell**
Thalassarche carteri	Indian Yellow-nosed
Thalassarche chlororhynchos	Atlantic yellow-nosed
Phoebetria fusca	Sooty
Phoebetria palpebrata	**Light-mantled sooty**
Phoebastria nigripes	Black-footed Albatross
Phoebastria immutabilis	Laysan albatross
Phoebastria albatrus	Short-tailed albatross
Petrels	
Macronectes giganteus	Sthn giant
Macronectes halli	**Nthn giant**
Procellaria aequinoctialis	**White-chinned**
Procellaria conspicillata	Spectacled
Procellaria parkinsoni	**Parkinson or Black**
Procellaria westlandica	**Westland**
Procellaria cinereal	**Grey**

Notes:
1. Species in **bold** breed in New Zealand
2. See www.acap.org

2. Other Relevant Marine Species covered by Bonn Convention (CMS):

Appendix I (endangered migratory species)

Species	**Common name**
Physeter macrocephalus	Sperm whale
Balaenoptera borealis	Sei whale
Balaenoptera physalus	Fin whale
Balaenoptera musculus	Blue whale
Megaptera novaeangliae	Humpback whale
Eubalaena australis	Southern right whale
Chelonia mydas	**Green sea turtle**
Caretta caretta	**Loggerhead sea turtle**
Eretmochelys imbricate	**Hawksbill turtle**
Lepidochelys olivacea	**Olive Ridley turtle**
Dermochelys coriacea	**Leatherback, leathery turtle or Luth**
Carcharodon carcharias	**Great white shark**
Cetorhinus maximus	**Basking shark**

Appendix II (migratory species covered through agreements)

Species	**Common name**
Balaenoptera bonaerensis	Antarctic minke whale
Balaenoptera edni	Bryde's whale
Capera marginata	Pygmy right whale
Orcinus orca	Orca
Physeter macrocephalus	Sperm whale
Phocoena dioptrica	Spectacled porpoise
Lagenorhynchus obscurus	Dusky dolphin
Delphinus delphis	***Common Dolphin***
Chelonia mydas	***Green sea turtle***
Caretta caretta	***Loggerhead sea turtle***
Dermochelys coriacea	***Leatherback, leathery turtle or Luth***
Isus oxyrinchus	**Shortfin mako shark**
Isus paucus	**Longfin mako shark**
Lamna nasus	**Porbeagle shark**
Rhincodon typus	**Whale shark**
Squalus acanthias*	**Spiny dogfish***
Alopias pelagicus	**Pelagic Thresher Shark**
Alopias superciliosus	**Bigeye Thresher Shark**
Alopias vulpinus	**Common Thresher Shark**
Carcharhinus falciformis	**Silky Shark**
Manta birostris	Manta Ray
Mobula japanica	**Spinetail Mobula, Spinetail Devil Ray, Japanese Devil Ray**
Sphyrna lewini	Scalloped hammerhead shark
Sphyrna mokarran	Great hammerhead shark

Note: CMS – Convention on Migratory Species (see www.cms.org) Species in bold are reported caught in New Zealand fisheries. * Dogfish listed in northern hemisphere only. Other manta and mobula species and sawfishes have not been included.

3. Marine species listed by CITES

Interpretation

1. Species included in these Appendices are referred to:
   a. by the name of the species; or
   b. as being all of the species included in a higher taxon or designated part thereof.
2. The abbreviation "spp." is used to denote all species of a higher taxon.
3. Other references to taxa higher than species are for the purposes of information or classification only. The common names included after the scientific names of families are for reference only. They are intended to indicate the species within the family concerned that are included in the Appendices. In most cases this is not all of the species within the family.
4. The names of the countries in parentheses placed against the names of species in Appendix III are those of the Parties submitting these species for inclusion in this Appendix.

Note: Listed tropical shells and cucumber species are not included in this Appendix. See www.cites.org

Appendices (as at 21 November 2016)

I	**II**	**III**
F A U N A (ANIMALS) **P H Y L U M C H O R D A T A** **CLASS MAMMALIA** **(MAMMALS)**		

Otariidae Fur seals, sealions		
	***Arctocephalus* spp.** (incl NZ fur seal & NZ Sea lion)	
Phocidae Seals		
	Mirounga leonine (Sth Elephant seal)	
CETACEA Dolphins, porpoises, whales		
Most whales (including beaked whales) and some dolphins	**CETACEA spp.** (Except the species included in Appendix I.)	

Balaenidae Bowhead whale, right whales		
Balaenopteridae Humpback whale, rorquals		
CLASS ELASMOBRANCHII **(SHARKS)**		
CARCHARHINIFORMES		
Carcharhinidae Requiem sharks		
	Carcharhinus longimanus	
Sphyrnidae Hammerhead sharks		
	Sphyrna lewini	
	Sphyrna mokarran	
	Sphyrna zygaena	
LAMNIFORMES		
Cetorhinidae Basking shark		

	Cetorhinus maximus	
Lamnidae Mackerel sharks		
	Carcharodon carcharias	
	Lamna nasus	
ORECTOLOBIFORMES		
Rhincodontidae Whale shark		
	Rhincodon typus	
RAJIFORMES		
Mobulidae Mobulid rays		
	***Manta* spp.**	
CLASS ACTINOPTERYGII (FISHES)		
SYNGNATHIFORMES		
Syngnathidae Pipefishes, seahorses		
	***Hippocampus* spp**	
P H Y L U M C N I D A R I A CLASS ANTHOZOA (CORALS AND SEA ANEMONES)		
ANTIPATHARIA Black corals		
	ANTIPATHARIA spp.	
SCLERACTINIA Stony corals		
	SCLERACTINIA spp.	
CLASS HYDROZOA (SEA FERNS, FIRE CORALS AND STINGING MEDUSAE)		
STYLASTERINA		
	Stylasteridae Lace corals	

Appendix IV: Bird Species Reported Caught in Quota Areas

Taxa **Albatross**	**Tuna Longline**	**Ling and bluenose Longline**	**Trawl (incl squid, hoki, scampi, jack mackerel, ling, barracouta, oreo, orange roughy, warehou)**	**Other (Inshore incl snapper longline, inshore trawl, and set nets)**
FMA 1	Campbell (v), Buller's (v), Gibson's (v), Salvin's (v), white- capped Antipodean	Campbell Wandering	White-capped Salvin's	Campbell Southern Royal
FMA 2	Antipodean (v), black-browed (e), Buller's (v), Campbell (v), Chatham (cr), Gibson's (v), northern royal (e), Salvin's (v), white-capped (nt), wanderer, White-capped	Wandering (e)	Pacific (v), Salvin's (v), white-capped (nt)	White-capped
FMA 3	Antipodean (v), Buller's (v), Campbell, Gibson's (v), light- mantled sooty (nt), northern royal (e), southern royal, white-capped (nt), Wanderer	Salvin's (v)	Antipodean (v), Buller's (v), Salvin's (v), southern royal (v), white-capped (nt)	Salvin's
FMA 4		Buller's (vu), Chatham (cr), Pacific (vu), Salvin's (v), white capped, Sthn Royal	Black-browed (e), Buller's (v), Campbell (v), Salvin's (v), white-capped (nt), Gibson's (v), Chatham's (e) Salvin's (v), southern royal	White capped, Salvin's

FMA 5	Antipodean, Buller's (v), Campbell (v), Gibson's (v), light-mantled (nt), southern royal (v), white-capped (nt)	White capped, Salvin's	Buller's (v), Campbell (v), Salvin's (v), southern royal (v), white-capped (nt), Gibson's Chatham's Salvin's	White-capped
FMA 6	Salvin's	Salvin's (v)	Buller's (v), Campbell (v), white-capped (nt), Salvin's, black-browed	
FMA 7	Black-browed (e), Buller's (v), Campbell (v), Gibson's (v), light- mantled (nt), white-capped (nt)	White capped, Buller's	Black-browed (e), Buller's (v), Campbell (v), white- capped (nt)	White-capped
FMA 8	White-capped			White-capped
FMA 9	White-capped			White-capped
FMA 10	Black-browed, Wandering			

Cont. Appendix IV: Bird Species Reported Caught in Quota Areas

Taxa (cont) **Petrel, shags, penguins**	**Tuna Longline**	**Ling and bluenose Longline**	**Trawl (incl squid, hoki, hake, scampi, jack mackerel, barracouta, oreo, orange roughy, warehou)**	**Other (incl snapper longline, inshore trawl, and set nets)**
Petrel and others			**Petrels and others**	

FMA 1	Black (v), flesh-footed shearwater (lc), grey-faced, white-chinned, sooty shearwater, grey	Fleshfooted shearwater (lc), black (v), grey- faced, white-chinned	Flesh-footed shearwater (lc), sooty shearwater (nt), black petrel, white-chinned	Black (v), Flesh-footed shearwater (lc), grey- faced, buller's shearwater (v), fluttering shearwater (lc), sooty shearwater, grey Pied shag Gannet
FMA 2	Northern giant (nt), westland, black (v), grey (nt), white- chinned (v), flesh-footed shearwater, sooty shearwater	Sooty shearwater, grey	Flesh-footed shearwater (lc), sooty shearwater (nt), white-chinned	Grey (nt), shearwater, sooty shearwater (nt), cape (lc), Sthn giant
FMA 3	Grey (nt), white-chinned (v)	White-chinned (v), sooty shearwater, grey	Grey (nt), sooty shearwater (nt), white-chinned (v), Northern giant (nt), spotted shag	Sooty shearwater (nt), Yellow eyed penguin (e) Little shags Stewart Island shag
FMA 4	Grey	Southern cape, grey (nt), white-chinned (v), sooty shearwater	Northern giant (nt), grey-faced, grey (nt), white chinned (v), sooty shearwater (nt), Antarctic prion, southern cape	Cape petrel, grey
FMA 5	Grey (nt), white-chinned (v), sooty shearwater, Westland	Common diving, sooty shearwater, white-chinned, grey	White-chinned, black bellied storm, sooty shearwater, cape petrel, grey-backed storm, black bellied storm	Cape petrel, Nthn giant petrel, cape petrel, Yellow-eyed Penguin, Fiordland crested penguin, Pied shag
FMA 6	White-chinned (v), grey	Northern giant (nt), southern giant (v), grey (nt), white-chinned (v), cape petrel (lc), Snares cape and sthn cape sooty shearwater	Grey (nt), white-chinned (nt), black bellied storm (lc), sooty shearwater (nt), cape petrel (lc), diving, white- headed, Northern giant petrel	

FMA 7	Westland		Cape petrel, fairy prion, white-chinned, sooty shearwater, Nthn, diving petrel, Sthn petrel, westland, giant	Cape petrel
FMA 8			Sooty shearwater White-chinned	Spotted shag
FMA 9	White-chinned Sooty shearwater	White-chinned Sooty shearwater		Spotted shag, fluttering shearwater
FMA 10				

Notes:

1. This is based on target fisheries with captures of seabirds observed by MPI observers. This doesn't include captures of bird species that were not identified or cryptic mortality (birds killed but not retained in fishing gear)
2. Information from Abraham, Richard, Berkenbusch, & Thompson (2016); Abraham, Thompson, & Oliver (2010); Abraham & Thompson (2009); Baird (2001); Baird (2004a, 2004b, 2004c & 2005a); Baird and Gilbert 2010; Bartle (2000); Berkenbusch, Abraham, & Torres (2013); Ramm (2011 & 2012); Rowe (2009 & 2010); Thompson, Berkenbusch, & Abraham (2013); and CSL Autopsy Reports including Bell (2015); Robertson (2000); Robertson & Bell (2002a & 2002b); Robertson, Bell, & Scofield (2003a & 2003b)
3. Threatened status of albatross according to IUCN criteria (2001a) – cr – critically endangered, e – endangered, v –vulnerable, nt – near threatened, lc – least concern.
4. FMA is the fisheries management area.
5. Bird bycatch may occur in other areas but there has been no or very low Ministry of Fisheries observer coverage.
6. There are also penguins and shags reported caught in other inshore set net fisheries.

Appendix V: Marine Mammals Reported Caught in Quota Areas

	Sea lions (v)	**Fur seals**	**Hector's (e) /Maui dolphin (cr)**	**Other cetaceans (incl short-beaked common dolphin, dusky dolphin & bottle-nosed dolphin)**
FMA 1		Tuna (incl SBT) longline		Southern bluefin tuna longline Trevally trawl Tarakihi trawl
FMA 2		Hoki/hake/ling trawl, tuna (incld SBT) longline, bluenose longline and scampi trawl		Southern bluefin tuna longline
FMA 3		Hoki/hake/ling trawl, scampi trawl Squid trawl southern bluefin tuna longline Set Net	Shark set net, Red cod/flatfish Trawl	Shark set net
FMA 4		Hoki trawl, Orange roughy trawl Hake trawl		Ling longline
FMA 5	Squid trawl Hoki trawl Jack mackerel trawl Baracouta trawl SBT Tuna longline	Hoki trawl Jack mackerel trawl Barracouta trawl Tuna longline		Inshore trawl and Southern bluefin tuna longline Set Net
FMA 6	Squid Trawl Scampi trawl Southern blue whiting trawl Jack mackerel trawl Oreos trawl Orange roughy trawl Hoki trawl	Squid trawl Southern blue whiting trawl Hoki trawl Barracouta trawl Jack mackerel trawl Smooth oreo/orange roughy trawl Tuna longline Scampi trawl Ling longline Shark Set net		Ling longline

FMA 7		Hoki trawl Jack mackerel trawl Tuna longline hake trawl barracouta trawl Silver warehou trawl Frostfish trawl Ling trawl Southern bluefin tuna longline School shark set net		Jack mackerel trawl Baracouta trawl Set net Southern bluefin tuna longline Hoki trawl
FMA 8		Scampi trawl Hoki trawl Jack Mackerel Trawl	Rig set net	Jack mackerel trawl Snapper trawl
FMA 9		Set Nets Tuna longline	Rig set net	Jack mackerel trawl baracouta trawl tuna longline
FMA 10				

Notes:

1. This is based on target fisheries with captures of marine mammals observed by MPI observers. This doesn't include captures of bird species that were not identified or cryptic mortality (birds killed but not retained in fishing gear).
2. Other cetaceans caught include common, dusky dolphins and pilot whales.
3. Leopard seals and elephant seals are occasionally caught in sub-Antarctic (QMA6) including in the scampi trawl fishery.
4. For background information see Abraham, et al., (2016); Abraham & Thompson (2009); Abraham, Thompson, & Oliver (2010) Thompson *et al.*, 2010, Thompson and Abraham 2010 and 2011; Baird (2001); Baird (2004a); Baird (2005b, 2005c, 2005d & 2005e) 2007, and 2008; Manly, Seyb, & Fletcher (2002a, 2002b & 2002c); Ramm (2011 & 2012); Rowe (2009 & 2010) and the CSL Autopsy Reports including Bell (2015); Robertson C. J., (2000); Robertson & Bell (2002a & 2002b) and Bartle (2000)
5. Threatened status of marine mammals according to IUCN 2016 – cr – critically endangered, e – endangered, v – vulnerable, nt – near threatened, lc – least concern.

Appendix VI: Turtle species reported caught in New Zealand fisheries

Turtle Species	Species	Fishery	Quota Areas	IUCN Threat status
Leatherback Turtle	*Dermochelys Coriacea*	Swordfish, southern bluefin, Pacific bluefine and bigeye tuna surface longline Flatfish & grey mullet set net Tarakihi - bottom trawl	1, 2, 7, 8 ,9	Critically endangered (Pacific Ocean)
Green turtle	*Chelonia mydas*	Snapper bottom longline; Big eye, Southern Bluefin and swordfish surface longline; Grey mullet set net Trevally trawling	9, 1, 2, 7	Endangered
Hawkesbill turtle	*Eretmochelys imbricate*	Bigeye tuna & Swordfish surface longline	9, 1	Critically Endangered
Loggerhead	*Caretta caretta*	Bigeye tuna surface longline Trevally bottom trawl	9, 1	Vulnerable
Unidentified Turtles	?	Bigeye tuna and southern Bluefin tuna surface longline. Scampi bottom trawl.	1, 7, 9	?

Reference: Abraham, Thompson, & Oliver (2010); Abraham, Richard, Berkenbusch, & Thompson (2016); Baird (2005); Godoy (2016) & Ramm (2012).

Appendix VII: Highly Migratory Species and Straddling stocks

Name	Species	UNCLOS Appendix I	Convention	Highly Migratory or straddling stock	Threat status (IUCN)
Albacore tuna	*Thunnus alalunga*.	Yes	WCPFC	HM	Near threatened
Antarctic toothfish	*Dissostichus mawsoni*	No	CCAMLR/ SPRFMO		
Pacific Bluefin tuna	*Thunnus orientalis*	Yes	WCPFC /IATTC	HM	Vulnerable
Bigeye tuna:	*Thunnus obesus*	Yes	WCPFC	HM	Vulnerable
Skipjack tuna:	*Katsuwonus pelamis*	Yes	WCPFC	HM	Least concern
Yellowfin tuna:	*Thunnus albacares*	Yes	WCPFC	HM	Near threatened
Southern bluefin tuna	*Thunnus maccoyii*	Yes	CCSBT	HM	Critically endangered
Marlins: shortbilled Mediterranean Longbill White Striped Roundscale Black Blue	*Tetrapturus angustirostris*; *Tetrapturus belone*; *Tetrapturus pfluegeri*; *Tetrapturus albida*; *Tetrapturus audax*; *Tetrapturus georgei*; *Makaira mazara*; *Makaira indica*; *Makaira nigricans*.	Yes	WCPFC	HM	DD DD ? Vulnerable NT DD ? DD Vulnerable
Swordfish	*Xiphias gladius*	Yes	WCPFC	HM	LC
Oceanic sharks: Basking Whale shark	*Hexanchus griseus*; *Cetorhinus maximus*; Family - *Alopiidae*; *Rhincodon typus*; Family - *Carcharhinidae*; Family - *Sphyrnidae*; Family - *Isurida*	Yes	WCPFC	HM	 Vulnerable Endangered
Orange roughy	*Hoplostethus atlanticus*	No	SPRFMO	SS	
Patagonian toothfish	*Dissostichus eleginoides*	No	CCAMLR/ SPRFMO?	SS	

Notes: UNCLOS – United Nations Convention on the Law of the Sea
WCPFC – Western and Central Pacific Fisheries Commission
CCSBT – Commission on the Conservation of Southern Bluefin Tuna
CCAMLR – Commission on the Conservation of Antarctic Marine Living Resources
HM – High migratory species
IATTC - Inter-American Tropical Tuna Commission
SS – Straddling stock
SPRFMO - South Pacific Regional Fisheries Management Organisation

Appendix VIII Marine Animals Protected under Wildlife Act 1953

Schedule 7A -Marine species declared to be animals

CNIDARIA

Anthozoa (corals and sea anemones)—
- Black corals—
  - all species in the order Antipatharia
- Gorgonian corals—
  - all species in the order Gorgonacea
- Stony corals—
  - all species in the order Scleractinia

Hydrozoa (hydra-like animals)—
- Hydrocorals—
  - all species in the family Stylasteridae

CHORDATA

Chondrichthyes (cartilaginous fishes)—
- Carcharhiniformes (ground sharks)—
  - Oceanic whitetip shark (*Carcharhinus longimanus*)
- Lamniformes (mackerel sharks)—
  - Basking shark (*Cetorhinus maximus*)
  - Deepwater nurse shark (*Odontaspis ferox*)
  - White pointer shark (*Carcharodon carcharias*)
- Orectolobiformes (carpet sharks)—
  - Whale shark (*Rhincodon typus*)
- Rajiformes (skates and rays)—
  - Manta ray (*Manta birostris*)
  - Spinetail devil ray (spinetail mobula) (*Mobula japanica*)

Osteichthyes (bony fishes)—
- Perciformes (perch-like fishes)—
  - Giant grouper (Queensland grouper) (*Epinephelus lanceolatus*)
  - Spotted black grouper (*Epinephelus daemelii*)

- Schedule 7A: amended, on 3 January 2013, by clause 3 of the Wildlife (Oceanic Whitetip Shark) Order 2012 (SR 2012/356).
- Schedule 7A: amended, on 16 December 2010, by clause 3 of the Wildlife (Basking Shark) Order 2010 (SR 2010/411).

Appendix IX: Acronyms and Glossary

A. Acronyms and Abbreviations

ACAP – Agreement on the Conservation of Albatrosses and Petrels.

Bo – The unfished, initial, or virgin recruited biomass for a stock.

B_{MSY} – The recruited biomass that supports the maximum sustainable yield.

B_{MAY} – The recruited biomass that will support the maximum average yield.

B_{MCY} – The recruited biomass that supports the maximum constant yield.

B_{MEY} – the recruited biomass that supports the maximum economic yield.

CAY - current annual yield - this is the estimate of the maximum sustainable catch for the current year in reference to a level of fishing mortality which has an "acceptable level of risk".

CITES – Convention on Trade in Endangered Species.

CCAMLR – Convention on the Conservation of Antarctic Marine Living Resources

CCCSBT – Convention on the Conservation of Southern Bluefin Tuna

CELR - Catch Effort Landing Return (called CEL within the database)

CLR - Catch Landing Return (called CLR within the database)

CMS – Convention on Migratory Species.

DOC – Department of Conservation.

ECER - Freshwater Eel Catch Effort Return (called ECE within the database)

ECLR – Freshwater Eel Catch Landing Return (called ECL within the database)

ESY – Ecologically sustainable yield – the yield an ecosystem can sustain without shifting to an undesirable state.

F – fishing mortality rate is that part of the total mortality rate applying to the fish population that is caused by fishing.

FMSY – the fishing mortality rate that, if applied constantly, would result in an average catch corresponding to the MSY and average biomass corresponding to BMSY.

HS CELR – High Seas Catch Effort & Landing Return (called HCE within the database)

HS TCER – High Seas Trawl Catch Effort Return (called HTC within the database)

HS TLCER – High Seas Tuna Longlining Catch Effort Return (called HTU within the database)

HS SJCER – High Seas Squid Jigging Catch, Effort Return

HS LCER – High Seas Lining Catch, Effort Return (called HLC within the database)

IATTC – Inter-America Tropical Tuna Commission

ITQ - Individual Transferable Quota - quota share of the TACC. ITQs are property rights to a fishery granted in perpetuity which can be traded.

LCER – Lining Catch, Effort Return (called LCE within the database)

LTCER – Lining Trip Catch, Effort Return (called LTC within the database)

M - natural mortality on a fishstock.

MAY – Maximum Average Yield - which is the long-term current annual yield and equivalent to MSY.

MCY - maximum constant yield - the maximum constant catch that is sustainable with "acceptable levels of risk" at probable levels of future biomass for a fishstock.

MFish – Ministry of Fisheries, now Ministry for Primary Industries.

MEY - Maximum Economic Yield - the greatest difference between the costs of inputs and the values of outputs (catch). This is the sustained catch that produces the maximum economic value this is usually at a catch below MSY. In the Australian harvest strategy a default BMEY has been set at 1.2 times BMSY.

MPI – Ministry for Primary Industries.

MSY - Maximum sustainable yield, in relation to any stock, means the greatest yield that can be achieved over time while maintaining the stock's productive capacity, having regard to the population dynamics of the stock and any environmental factors that influence the stock: (section 2, Fisheries Act 1996).

NCELR – Netting Catch, Effort and Landing Return (called NCE within the MPI database)

NFPSCR – Non-fish / Protected Species Catch Return (called NPC within the MPI database)

OSY – Optimum sustainable yield is the yield which considers factors in addition to maximum sustainable yield, for instance, effects on other species in the ecosystem and of other human uses of the ecosystem.

PBR – Potential Biological Removals – estimate of the level of mortality ('bycatch') in commercial fisheries (Wade & Angliss, 1997) which would not prevent a species recovering to or staying above their Maximum Net Productivity Level (generally taken to be between 50% and 80% of carrying capacity). PBR is calculated using an estimate of abundance for the population subject to the mortality, an estimate of the intrinsic (or biological) maximum rate of population increase (Rmax), and a standard 'recovery factor'.

QMA – quota management area – which is an area to which quota (tonneage) has been allocated.

SJCER - Squid Jigging Catch Effort Return (called SJC within the MPI database)

SPRFMO – South Pacific Regional Fisheries Management Organisation

TACC - Total Allowable Commercial Catch - this is the TAC minus an allowance for customary Maori fisheries, recreational fisheries and other mortality on a stock caused by fishing. The TACC is established under section 20 of the Fisheries Act 1996.

TAC - Total Allowable Catch of any fishstock this includes the TACC plus an allowance for non-commercial catches including customary Maori catch and other mortality caused by fishing. The TAC is established under section 13 or 14 of the Fisheries Act 1996.

TCEPR - Trawl Catch Effort Processing Return (called TCP within the MPI database)

TCER – Trawl Catch Effort Return (called TCE within the MPI database)

TLCER - Tuna Long-lining Catch Effort Return (called TUN within the MPI database)

Von B k – this is the Brody growth co-efficient (k) and defines the growth rate toward the maximum. This is from the standard Von Bertalanffy model (1938) which describes the growth in fish length. $L_t = l_\infty [1 - e^{-k(t-t_o)}]$ where l_∞ is the theorectical maximum body length and t_0 non-zero body length at age zero.

WCPFC – Western and Central Pacific Fisheries Commission.

A1 – Quota and Fisheries Areas Acronyms and areas

Acronym	Fish Area	Description of Area
AKE	FMA 1	East North Island from North Cape to Bay of Plenty
CEE	FMA 2	East North Island from Cape Runaway to Wellington
SEC	FMA 3	East coast South Island from Clarence River to Catlins
SOE	FMA 4	Central and East Chatham Rise
SOU	FMA 5	Southland -Foveaux Strait to Fiordland incl Stewart Isld & Snares Shelf
SUB	FMA 6	Subantarctic including Bounty, Antipodes Islands and Pukaki Rise
SOI	FMA6A	Boxes around Auckland and Campbell Islands
CHA	FMA 7	West Coast South Island, Tasman, Marlborough Sounds and south Cook Strait
CEW	FMA 8	West North Island fromSouth Taranaki Bight to Wellington
AKW	FMA 9	West North Island from North Cape to North Taranaki Bight
KER	FMA 10	Kermadec Islands EEZ
ET	High Seas	Outside New Zealand EEZ

Note: FMA and QMAs may not always cover the same area.

B. Glossary

Aquaculture - aquatic species, such as fish and shellfish, in salt, brackish, or freshwater. Farming implies private ownership and enhancement of production by stocking, feeding, providing protection from predators and other management measures.

Beach-seine - A large enclosing net, brought out by boats and dragged to the (sandy) shore. Also a net used to encircle fish in shallow water; usually operated by two people wading out from shore, the net has lead weights to keep the bottom on the sea floor and floats to keep the top of the net at or near the surface. The seine may be set from a boat but hauled in from the land.

Benthic species or benthos - animals or plants living on the bottom of the ocean, river or lake.

Biological diversity - means the variability among living organisms, including diversity within species, between species, and of ecosystems: [Section 2 of the Fisheries Act 1996] The Biodiversity Convention also defines this as:

`"Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.'

Biomass - an aggregate weight, at a particular time, of fish (or other organisms) in a stock or in a fishery.

Bottom trawl net - a net designed to trawl along the seabed and catch fish found close to the bottom such as orange roughy and oreos.

Bottom pair-trawl - a net designed to trawl along the seabed and catch fish found close to the bottom but towed between two similar trawlers.

Bycatch or bykill - those species killed in a fishery targeted on other species or a different size range of the same species and includes that part of the catch that has no commercial value and is discarded.

Catch - the total number or weight of fish and other marine life, including bycatch, taken by fishers from an area over some period of time, as opposed to landings, which do not

reflect the amount of discards.

CCAMLR: Commission for the Conservation of Antarctic Living Marine Resources - established by treaty in 1980, the CCAMLR is unique among fisheries agreements in that the conservation measures adopted by the Commission must include a fishery's impact on the entire ecosystem, rather than on just the targeted species. This ecosystem approach aims to prevent a decrease in the size of harvested populations to levels that threaten their stable recruitment, and to minimize the risk of changes in the marine ecosystem that are not potentially reversible over two or three decades. The meetings of the Commission are held annually in Hobart, Australia, with representatives of the 23 CCAMLR member states and the EU.

Cetaceans - an order of marine mammals that comprises the whales, dolphins, and porpoises.

Continental shelf - The continental shelf is a gradually sloping undersea shelf of land that extends beyond shore of the continent. The nature of this geologic "shelf" is home to a great diversity of fish and shellfish species.

Copepods - a large group (approximately 6,000 species) of tiny shrimp-like crustaceans. They are an important food source for many larger animals, including fish, seabirds, and baleen whales.

Coral reefs - Coral reefs are built up over hundreds of years by colonies of small animals, called coral polyps, and their skeletons of calcium carbonate. Coral reefs cover less than 1% of the ocean area but are home to one-third of all marine fish species.

Crustacean - the aquatic equivalent of insects, also from the phylum Arthropoda. Found in both fresh and salt water, crustaceans are invertebrates and characteristically have a segmented body and exoskeleton, with limbs that are paired and jointed. Lobsters, crabs, shrimp and barnacles are examples of crustaceans.

Danish seine - A method of seining with a large net but the catch is landed on the vessel. Can be a single or two boat net where an area of water of about 2 square kilometres is swept as two encircling ropes leading to a trawl-like net are retrieved by the vessel(s). Fish within the ropes are herded into the net during hauling.

Demersal species - fish found on or near the bottom of the ocean, for example orange roughy.

Depleted fishery - a fishery where the population has been reduced to less than that which would support the maximum sustainable yield.

Developed fishery - a fishery operating at or near the level of the maximum sustainable yield, subject to other environmental constraints.

Developing fishery - a fishery in which experimental or feasibility fishing is being undertaken to determine whether the resource can support a viable fishery.

Dip-net - A net used for transferring the catch of a deep-sea seine after it has been brought alongside. It is operated either entirely by hand or partly by hand and partly by mechanical power. Other names are scoop, brailer, spoon net, brail net, and hand brailer.

Driftnet - a gillnet weighted at the bottom and supported by floats at the top which drifts with the tide or current. Large driftnets used to be in excess of 50 km on the high seas and in New Zealand EEZ can be no longer than 1km.

Dragnet - a small net pulled by two or more people which is dragged along the bottom.

EEZ - Exclusive Economic Zone - the zone from 12 nautical miles out to 200 nautical miles offshore established pursuant to international agreement under the United Nations Convention on the Law of the Sea.

Fishing effort - the amount of fishing activity undertaken. It is usually measured by the total time spent fishing combined with the quantity of gear used, for example the catch per thousand hooks or the catch per trawl. This provides the level of effort in CPUE. Nominal fishing effort provides an indirect measure of fishing mortality.

Fecundity - the level or rate of egg or offspring production. Fecundity may change with the size and age of a species.

Finning - the practice of cutting off the fins of sharks and discarding the carcasses

overboard. Asia is the primary market for shark fins, which are used to make shark fin soup. Congress banned shark- finning in all U.S. waters in 2000.

Fishery - can be defined in many ways though, in general terms, it is the take or removal of a species from the aquatic environment using some type of fishing technology. The emphasis is on the human aspects of fishing and all the activities it involves.

Food chain - the sequence of organisms through which energy and materials are transferred (in the form of food), or the linear progression of feeding levels in which one organism is the food source for the next.

Food web - the complex, interlocking series of individual food chains in an ecosystem, i.e., all the predator- prey relationships.

Fyke net - A long bag net distended by hoops, into which fish can pass easily, without being able to return.

Globally threatened species - a species that is globally threatened with biological extinction under the World Conservation Union criteria, which are Critically Endangered, Endangered and Vulnerable.

Growth over-fishing - this is when the losses due to natural and fishing mortality exceeds the gains due to recruitment and growth during the same period. This is usually reflected by a reduction in the size of the fish being harvested.

High-grading - the practice of discarding at sea all or a portion of a vessel's legal catch in order to obtain a higher or larger grade of fish that brings higher prices. It may occur in both quota and non-quota fisheries.

Hinaki - traditional Maori woven eel net traps made from supplejack and flax.

Invertebrate - jellyfish, octopus and sponge are examples of marine invertebrates, or animals without a backbone. In fishery management terms, invertebrate usually refers to shellfish, such as lobsters, shrimp, oysters and scallops.

Jig - a multi-barbed hook used mainly to catch squid.

Lampara net - Similar to, but much smaller than, a purse seine with no pursing action. This net is generally used for catching artificial light attracted schools of small fish such as anchovy and pilchard. There is a central spoon-shaped section and two lateral wings and the net is usually operated from a small boat. The rapid retrieval of the lead line does close the bottom of the net but it is not a true purse.

Landings - commercial landings are defined as the quantity of fish and shellfish brought ashore for sale. The term also applies to the amount caught for personal use by recreational fishermen. This measurement does not include the amount of bycatch incidentally caught and discarded dead at sea.

Maximum sustainable yield - the maximum amount of a species that can be taken without diminishing the future take.

Metric tonne - often the unit of measurement for commercial and recreational landings, a metric tonne is equal to 1000 kilograms, 0.984 long tons, 1.1023 short tons, or 2204.6 pounds.

Mid-water trawl - a trawl designed catch species in mid-water e.g. hoki and southern blue whiting. These trawl nets can have 60 metre headline heights (top to bottom on net) and opening over 150m wide.

Nautical mile - one nautical mile is the equivalent of 1.15 statute miles.

Overcapitalization - this occurs when there is more fishing capacity (ie, more boats, gear or investment in equipment) than is needed to catch the available amount of fish in an economically efficient and sustainable manner. Overcapitalization poses a threat to fish populations because it can easily lead to over-fishing.

Over-fishing - over-fishing exists when the rate of fishing is greater than the level required to meet the management goal or maximum sustainable yield. In other words, over-fishing occurs when a population of fish is caught faster than it can replenish itself through reproduction.

Pelagic - an ancient Greek word for the open ocean or high seas, the area comprising most of the Earth's surface.

Pelagic species - species found near the surface of the sea and not on or near the seabed, for

example tuna and kahawai.

Pinipeds - carnivorous aquatic mammals of the order *Pinnipedia*, seals, including eared seals (*Otariidae*) and True seals (*Phocidae*)

Plankton - small plant and animal species that spend at least part of their time on the sea surface. They rely in large part on ocean currents for distribution and transportation. As eggs and larvae, many marine species, such as cod and Dungeness crabs, are planktonic for part of their life cycle. The plankton provide food for many commercially important fish and form the basis of ocean food webs. Some of the largest marine creatures, such as whale sharks and blue whales, eat plankton. Zooplankton are animals and phytoplankton are plants.

Population - a group of interbreeding organisms that represents the level of organization at which speciation begins. In other words, a population is a group within a species that shares common ecological and genetic features compared to other individuals of that species.

Precautionary principle - a proactive method of dealing with the environment that places the burden of proof on those whose activities could harm the environment rather than on the public. It is the opposite of the wait-and-see principle; acting before scientific proof of deleterious effects is applying a precautionary approach. (Norse)

Purse seine - a floating net designed to surround fish and can be closed at the bottom, or "pursed" by means of a free-running line attached to the bottom of the net. The net may be of up to 1 km length and 300 m depth and is used to encircle surface schooling fish such as kahawai, trevally and skipjack tuna. During retrieval the bottom of the net is closed or pursed by drawing a purse line through a series of rings to prevent the fish escaping.

Recruit - a fish entering the period in its life history when it is exposed to fishing. Related phrases include pre-recruits, age or length at recruitment, recruitment failure.

Recruitment - recruitment is the general replacement of fish to a stock or population. In fisheries it is the time when a fish grow to a size they become liable to be caught in fishing gear.

Recruitment failure - the failure of the fishstock to be replaced by recruits.

Recruitment over-fishing - occurs when the spawning stock has been reduced to a level at which recruitment of young fish entering the exploited component of the fishery is significantly reduced.

Ring net - A modified lampara net with purse rings operated by two vessels.

Seamount - underwater volcanic mountain, ridges and plateaus that rise up several kilometres from the sea floor, but do not reach the surface of the sea.

Seine - a type of fishing net that encircles a school of fish.

Set - to prepare and cast a net; one "set" is typically defined as the interval from the time the net is cast to the time the net is hauled in.

Set net - a type of gill net that has been intentionally set, staked or anchored or otherwise fixed in stationary position, as opposed to drift nets.

Stock - the technical definition of a stock is an interbreeding sub-population of a species, reproductively isolated to some extent from other populations. Used as a unit for fishery management, however, "stock" refers to a specific population or group of populations of one or more species.

Straddling stock - a stock which straddles two management jurisdictions e.g. Challenger orange roughy stock which covers the New Zealand EEZ and the adjacent high seas area.

Territorial Sea - defined by the 1982 United Nations Convention on the Law of the Sea, is the belt of coastal waters extending at most 12 nautical miles (22.2 km; 13.8 mi) from the baseline (usually the mean low-water mark) of a coastal state (e.g. New Zealand).

Trammel net - type of gill net with three panels suspended from a common surface line and attached to a single bottom line. The two outside panels are of a larger mesh

than the inside panel.

Trawl - net with a wide mouth tapering to a small, pointed end, usually called the cod end. Trawls are towed behind a vessel at any depth in the water column.

Trolls - lines with lures or baited hooks that are drawn through the water from a vessel while in motion.

Appendix X: References for overall New Zealand fishing effort

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Fish Name	**BFG name**	***Scientific Name***
Abalone	Paua	*Haliotis iris*
Ahi	Bigeye Tuna	*Thunnus obesus*
Ahi	Yellow fin tuna	*Thunnus albacares*
Akiwa	Black cardinal fish	*Epigonus telescopus*
Albacore Tuna	Albacore Tuna	*Thunnus alalunga*
Alfonsino	Alfonsino	*Beryx splendens, D. decadactylus*
Anchovy	Anchovy	*Engraulis australis*
Anguile australe	Eels	*Anguilla australis , A. dieffenbachii, A.reinhardtii*
Araara	Trevally	*Pseudocaranx dentex*
Arāra	Trevally	*Pseudocaranx dentex*
Arrow Squid	Arrow Squid	*Nototodarus sloanii, Nototodarus gouldi*
Ashiro	Ling	*Genypterus blacodes*
Aua	Yellow-eyed mullet	*Aldrichetta forsteri*
Australian long-finned eel	Eels	*Anguilla australis, A. dieffenbachii, A.reinhardtii*
Australian salmon	Kahawai	*Arripis trutta*
Barndoor skate	Skates	*Zearaja nasutus, Dipturus innominatus*
Barracouta	Barracouta	*Thyrsites atun*
Bass	Groper	*Polyprion oxygeneios, Polyprion americanus*
Beryx	Alfonsino	*Beryx splendens, D. decadactylus*
Beryx de nouvelle-zelande	Orange roughy	*Hoplostethus atlanticus*
Big-eye cardinalfish	Black cardinal fish	*Epigonus telescopus*
Bigeye Tuna	Bigeye Tuna	*Thunnus obesus*
Black cardinal fish	Black cardinal fish	*Epigonus telescopus*
Black dory	Oreos	*Allocyttus niger*
Black Flounder	Flatfish	*Rhombosolea retiaria*
Black Oreo	Oreos	*Allocyttus niger*
Black-footed paua	Paua	*Haliotis iris*
Blauer wittling	Southern blue whiting	*Micromesistius australis*
Blue bream	Bluenose	*Hyperoglyphe antarctica*
Blue cod	Blue cod	*Parapercis colias*
Blue grenadier	Hoki	*Macruronus novaezelandiae*
Blue hake	Hoki	*Macruronus novaezelandiae*
Blue mackerel	Blue mackerel	*Scomber australasicus*
Blue moki	Blue moki	*Latridopsis ciliaris*
Blue Pointer	Blue shark	*Prionace glauca*
Blue shark	Blue shark	*Prionace glauca*
Blue warehou	Blue warehou	*Seriolella brama*
Blue whaler	Blue shark	*Prionace glauca*
Bluefin	Pacific bluefin tuna	*Thunnus orientalis*

Bluefin	Southern bluefin tuna	*Thunnus maccoyii*
Bluenose	Bluenose	*Hyperoglyphe antarctica*
Bluff oyster	Oyster	*Ostrea chilensis*
Bonita	Bluenose	*Hyperoglyphe antarctica*
Bream	Snapper	*Pagrus auratus*
Brill	Flatfish	*Colistium guntheri*
Brim	Snapper	*Pagrus auratus*
Broadbill	Swordfish	*Xiphias gladius*
Broadbill swordfish	Swordfish	*Xiphias gladius*
Brown oreo	Oreos	*Allocyttus niger, Neocyttus rhomboidalis, Pseudocyttus maculatus*
Bulldog	Stargazer	*Kathetostoma giganteum*
Butterfish	Butterfish	*Odax pullus*
Calamari	Arrow Squid	*Nototodarus sloanii, Nototodarus gouldi*
Chimera	Dark ghost shark	*Hydrolagus novaezealandiae*
Chimera	Pale ghost shark	*Hydrolagus bemisi*
Chinchard neozelandias	Jack mackerel	*Trachurus declivis, T. novaezelandiae, T. symmetricus murphyi*
Clam	Cockles	*Austrovenus stutchburyi*
Cockles	Cockles	*Austrovenus stutchburyi*
Common warehou	Blue warehou	*Seriolella brama*
Coque	Cockles	*Austrovenus stutchburyi*
Coquille saint-jacques de Nouvelle-Zealande	Scallops	*Pecten novaezealandiae*
Couta	Barracouta	*Thyrsites atun*
Crayfish	Packhorse lobster	*Sagmariasus verreauxi*
Crayfish	Rock lobster	*Jasus edwardsii*
Creamfish	Leather jacket	*Parika scaber*
Cutlassfish	Frostfish	*Lepidopus caudatus*
Dab	Flatfish	*Rhombosolea plebeia*
Dark ghost shark	Dark ghost shark	*Hydrolagus novaezealandiae*
Deepsea cod	Ribaldo	*Mora moro*
Deepsea dory	Oreos	*Allocyttus niger, Neocyttus rhomboidalis, Pseudocyttus maculatus*
Deepsea perch	Orange roughy	*Hoplostethus atlanticus*
Deepsea perch	Sea perch	*Helicolenus percoides*
Deepsea trevalla	Bluenose	*Hyperoglyphe antarctica*
Deepsea warehou	White warehou	*Seriolella caerulea*
Demi-bec neozelandias	Garfish	*Hyporhamphus ihi*
Dore austral	Oreos	*Allocyttus niger, Neocyttus rhomboidalis, Pseudocyttus maculatus*
Eels	Eels	*Anguilla australis , A. dieffenbachii, A.reinhardtii*
Elephant shark	Elephantfish	*Callorhinchus milli*

Elephantfish	Elephantfish	*Callorhinchus milli*
Flake	School shark	*Galeorhinus galeus*
Flat oyster	Oyster	*Ostrea chilensis*
Flatfish	Flatfish	
Foveaux Strait Oyster	Oyster	*Ostrea chilensis*
Frostfish	Frostfish	*Lepidopus caudatus*
Gangiei	Skates	*Zearaja nasutus, Dipturus innominatus*
Gaori	Skates	*Zearaja nasutus, Dipturus innominatus*
Garfish	Garfish	*Hyporhamphus ihi*
Gemfish	Gemfish	*Rexea solandri*
Giant stargazer	Stargazer	*Kathetostoma giganteum*
Golden snapper	Red snapper	*Centroberyx affinis*
Googly-eyed cod,	Ribaldo	*Mora moro*
Goushyuumadai	Snapper	*Pagrus auratus*
Granatbarsch	Orange roughy	*Hoplostethus atlanticus*
Green rock lobster	Packhorse lobster	*Sagmariasus verreauxi*
Greenback flounder	Flatfish	*Rhombosolea tapirina*
Greenbone	Butterfish	*Odax pullus*
Grey boy	School shark	*Galeorhinus galeus*
Grey mullet	Grey mullet	*Mugil cephalus*
Grey shark	School shark	*Galeorhinus galeus*
Grondin rouget	Red Gurnard	*Chelidonichthys kumu*
Groper	Groper	*Polyprion oxygeneios, Polyprion americanus*
Gummy shark	Rig/lemonfish	*Mustelus lenticulatus*
Haature	Jack mackerel	*Trachurus declivis, T. novaezelandiae, T. symmetricus murphyi*
Haiku	Hake	*Merluccius australis*
Hake	Hake	*Merluccius australis*
Haku	Kingfish	*Seriola lalandi*
Hakuraa	Groper	*Polyprion oxygeneios, Polyprion americanus*
Half-beak	Garfish	*Hyporhamphus ihi*
Hangenge	Garfish	*Hyporhamphus ihi*
Hapuka	Groper	*Polyprion oxygeneios, Polyprion americanus*
Hauture	Jack mackerel	*Trachurus declivis, T. novaezelandiae, T. symmetricus murphyi*
Hauwai	Paua	*Haliotis iris, H. australis*
Herring	Yellow-eyed mullet	*Aldrichetta forsteri*
Hihiwa	Paua	*Haliotis iris, H. australis*
Hikau	Frostfish	*Lepidopus caudatus*
Hinangi	Cockles	*Austrovenus stutchburyi*
Hohopu	Grey mullet	*Mugil cephalus*
Hoka	Ling	*Genypterus blacodes*

Hoka	Red Cod	*Pseudophycis bachus*
Hokarari	Ling	*Genypterus blacodes*
Hoki	Hoki	*Macruronus novaezelandiae*
Hoplostete orange	Orange roughy	*Hoplostethus atlanticus*
Hopu	Grey mullet	*Mugil cephalus*
Horse mackerel	Jack mackerel	*Trachurus declivis, T. novaezelandiae, T. symmetricus murphyi*
Huangi	Cockles	*Austrovenus stutchburyi*
Huangiangi	Cockles	*Austrovenus stutchburyi*
Huuai	Cockles	*Austrovenus stutchburyi*
Ihe	Garfish	*Hyporhamphus ihi*
Inaka	Paua	*Haliotis iris, H. australis*
Jack fish	Trevally	*Pseudocaranx dentex*
Jack mackerel	Jack mackerel	*Trachurus declivis, T. novaezelandiae, T. symmetricus murphyi*
Jock Stewart	Sea perch	*Helicolenus percoides*
John dory	John dory	*Zeus faber*
Julienette	Red Cod	*Pseudophycis bachus*
Kaaraerae	Spiny dogfish	*Squalus acanthias*
Kaataha	Yellow-eyed mullet	*Aldrichetta forsteri*
Kahawai	Kahawai	*Arripis trutta*
Kahu	Kingfish	*Seriola lalandi*
Kaisersgranat	Scampi	*Metanephrops challengeri*
Kalamari	Arrow Squid	*Nototodarus sloanii, Nototodarus gouldi*
Kalmar	Arrow Squid	*Nototodarus sloanii, Nototodarus gouldi*
Kanae	Grey mullet	*Mugil cephalus*
Kaorea	Red snapper	*Centroberyx affinis*
Kapua	Groper	*Polyprion oxygeneios, Polyprion americanus*
Karahiwa	Paua	*Haliotis iris, H. australis*
Karahiwa	Paua	*Haliotis iris, H. australis*
Kararuri	Paua	*Haliotis iris, H. australis*
Kataka	Yellow-eyed mullet	*Aldrichetta forsteri*
Kauaeroa	Groper	*Polyprion oxygeneios, Polyprion americanus*
Kawerai	Groper	*Polyprion oxygeneios, Polyprion americanus*
Kehe	Hake	*Merluccius australis*
Kin koorako	Kina	*Evechinus chloroticus*
Kina	Kina	*Evechinus chloroticus*
Kina ariki	Kina	*Evechinus chloroticus*
King dory	Lookdown dory	*Cyttus traversi*
Kingfish	Kingfish	*Seriola lalandi*
Kingklip	Ling	*Genypterus blacodes*
Kingu	Ling	*Genypterus blacodes*

Koekohe	Trumpeter	*Latris lineata*
Koeo	Paua	*Haliotis iris, H. australis*
Kohikohi	Trumpeter	*Latris lineata*
Koinga	Spiny dogfish	*Squalus acanthias*
Kokowhaawhaa	Anchovy	*Engraulis australis*
Komutumutu	Trevally	*Pseudocaranx dentex*
Kooeaea	Butterfish	*Odax pullus*
Koopuuhuri	Kahawai	*Arripis trutta*
Kooukauka	Kahawai	*Arripis trutta*
Kopapa	Trevally	*Pseudocaranx dentex*
Kopukopu	Blue cod	*Parapercis colias*
Kopuwai	Grey mullet	*Mugil cephalus*
Korohiwa	Paua	*Haliotis iris, H. australis*
Kororiwha	Paua	*Haliotis iris, H. australis*
Korowhaawhaa	Anchovy	*Engraulis australis*
Koura	Packhorse lobster	*Sagmariasus verreauxi*
Koura	Rock lobster	*Jasus edwardsii*
Kourea	Snapper	*Pagrus auratus*
Kourepoua	Stargazer	*Kathetostoma giganteum*
Kuakua	Scallops	*Pecten novaezealandiae*
Kumukumu	Red Gurnard	*Chelidonichthys kumu*
Kupae	Sprats	*Sprattus antipodum, Sprattus muelleri*
Kuparu	Groper	*Polyprion oxygeneios, Polyprion americanus*
Kuparu	John dory	*Zeus faber*
Kutuhori	Flatfish	*Peltorhamphus novaezeelandiae*
Kuuwharuwharu	Eels	*Anguilla australis, A. dieffenbachii, A.reinhardtii*
Langoustine-de-NZ	Scampi	*Metanephrops challengeri*
Langschwanz-Seehecht	Hoki	*Macruronus novaezelandiae*
Latchet	Red Gurnard	*Chelidonichthys kumu*
Leather jacket	Leather jacket	*Parika scaber*
Lemonfish	Rig/lemonfish	*Mustelus lenticulatus*
Ling	Ling	*Genypterus blacodes*
Longfinned albacore	Albacore Tuna	*Thunnus alalunga*
Long-finned eel	Eels	*Anguilla australis, A. dieffenbachii, A.reinhardtii*
Lookdown dory	Lookdown dory	*Cyttus traversi*
Mackerel shark	Mako shark	*Isurus oxyrinchus*
Madai	Snapper	*Pagrus auratus*
Maha-taharaki	Gemfish	*Rexea solandri*
Maka	Barracouta	*Thyrsites atun*
Makaa	Barracouta	*Thyrsites atun*
Maka-tikati	Gemfish	*Rexea solandri*
Makawhiti	Yellow-eyed mullet	*Aldrichetta forsteri*

Mako	Mako shark	*Isurus oxyrinchus*
Mako shark	Mako shark	*Isurus oxyrinchus*
Makohuarau	School shark	*Galeorhinus galeus*
Mako-huarau	Spiny dogfish	*Squalus acanthias*
Makorepe	Elephantfish	*Callorhinchus milli*
Makumaku	Kingfish	*Seriola lalandi*
Mangaa	Barracouta	*Thyrsites atun*
Mangoo-hapuu	Spiny dogfish	*Squalus acanthias*
Mango-pekepeke	Spiny dogfish	*Squalus acanthias*
Mango-pounamu	Blue shark	*Prionace glauca*
Manumanu	Skates	*Zearaja nasutus, Dipturus innominatus*
Marakuha	Sprats	*Sprattus antipodum, Sprattus muelleri*
Marare	Butterfish	*Odax pullus*
Marari	Paua	*Haliotis iris, H. australis*
Mararī	Butterfish	*Odax pullus*
Marariwha	Paua	*Haliotis iris, H. australis*
Marlin	Striped marlin	*Tetrapturus audax*
Matapara	Rock lobster	*Jasus edwardsii*
Matapuku	Rock lobster	*Jasus edwardsii*
Matiri	Bluenose	*Hyperoglyphe antarctica*
Matohe	Butterfish	*Odax pullus*
Matuawhapuku	Sea perch	*Helicolenus percoides*
Merlan bleu austral	Southern blue whiting	*Micromesistius australis*
Merluse	Hoki	*Macruronus novaezelandiae*
Merluza	Hake	*Merluccius australis*
Merluza azul	Hoki	*Macruronus novaezelandiae*
Minamimaguro	Pacific bluefin tuna	*Thunnus orientalis*
Minamimaguro	Southern bluefin tuna	*Thunnus maccoyii*
Moamoa	Stargazer	*Kathetostoma giganteum*
Moeone	Groper	*Polyprion oxygeneios, Polyprion americanus*
Mohimohi	Pilchards	*Sardinops sagax*
Moki	Blue moki	*Latridopsis ciliaris*
Moki trumpeter	Blue moki	*Latridopsis ciliaris*
Monkfish	Stargazer	*Kathetostoma giganteum*
Moonfish	Moonfish	*Lampris guttatus*
Mora	Ribaldo	*Mora moro*
Morwong	Tarakihi	*Nemadactylus macropterus*
Nasello azzurro	Hoki	*Macruronus novaezelandiae*
Nelson oyster	Oyster	*Ostrea chilensis*
New Zealand cod	Blue cod	*Parapercis colias*
Ngu	Stargazer	*Kathetostoma giganteum*
Northern Kingfish	Kingfish	*Seriola lalandi*
New Zealand cod	Red Cod	*Pseudophycis bachus*
New Zealand dory	Oreos	*Allocyttus niger, Neocyttus rhomboidalis,*

		Pseudocyttus maculatus
NZ gem scallop	Queen scallops	*Chlamys delicatula*
NZ gem shellfish	Queen scallops	*Chlamys delicatula*
NZ golden snapper	Snapper	*Pagrus auratus*
NZ Herring	Sprats	*Sprattus antipodum, Sprattus muelleri*
NZ Jack Mackerel	Jack mackerel	*Trachurus declivis, T. novaezelandiae, T. symmetricus murphyi*
NZ littleneck clam	Cockles	*Austrovenus stutchburyi*
NZ sea crab	Paddle crabs	*Ovalipes catharus*
NZ smooth dory	Oyster	*Ostrea chilensis*
NZ sole	Flatfish	*Peltorhamphus novaezeelandiae*
Ocean bream	Tarakihi	*Nemadactylus macropterus*
Ocean perch	Sea perch	*Helicolenus percoides*
Opah	Moonfish	*Lampris guttatus*
Orange roughy	Orange roughy	*Hoplostethus atlanticus*
Oreos	Oreos	*Allocyttus niger, Neocyttus rhomboidalis, Pseudocyttus maculatus*
Oursin de Nouvelle-Zelande	Kina	*Evechinus chloroticus*
Oyster	Oyster	*Ostrea chilensis*
Paakirikiri	Blue cod	*Parapercis colias*
Paara	Frostfish	*Lepidopus caudatus*
Paatiki	Flatfish	
Paatiki nui	Flatfish	*Colistium nudipinnis*
Paatiki rori	Flatfish	*Peltorhamphus novaezeelandiae*
Paatikimohoao	Flatfish	*Rhombosolea retiaria*
Paatikitotara	Flatfish	*Rhombosolea leporina*
Paatutuki	Blue cod	*Parapercis colias*
Pacific bluefin tuna	Pacific bluefin tuna	*Thunnus orientalis*
Pacific mackerel	Blue mackerel	*Scomber australasicus*
Packhorse lobster	Packhorse lobster	*Sagmariasus verreauxi*
Paddle crabs	Paddle crabs	*Ovalipes catharus*
Paea	Swordfish	*Xiphias gladius*
Pakaurua	Skates	*Zearaja nasutus, Dipturus innominatus*
Pakeke	Flatfish	*Peltorhamphus novaezeelandiae*
Pale ghost shark	Pale ghost shark	*Hydrolagus bemisi*
Päpaka	Paddle crabs	*Ovalipes catharus*
Papakura	Eels	*Anguilla australis, A. dieffenbachii, A.reinhardtii*
Papatia	Packhorse lobster	*Sagmariasus verreauxi*
Para-taharangi	Frostfish	*Lepidopus caudatus*
Patete	Sprats	*Sprattus antipodum, Sprattus muelleri*
Patikinui	Flatfish	*Colistium guntheri*
Paua	Paua	*Haliotis iris, H. australis*

Pawharu	Packhorse lobster	*Sagmariasus verreauxi*
Pearl	Dark ghost shark	*Hydrolagus novaezealandiae*
Pearl	Pale ghost shark	*Hydrolagus bemisi*
Peruvian Jack Mackerel	Jack mackerel	*Trachurus declivis, T. novaezelandiae, T. symmetricus murphyi*
Pesce arancio	Orange roughy	*Hoplostethus atlanticus*
Peterfisch	Oreos	*Allocyttus niger, Neocyttus rhomboidalis, Pseudocyttus maculatus*
Pilchards	Pilchards	*Sardinops sagax*
Pillie	Pilchards	*Sardinops sagax*
Piper	Garfish	*Hyporhamphus ihi*
Pohuikaroa	Sea perch	*Helicolenus percoides*
Porae	Trumpeter	*Latris lineata*
Porbeagle	Porbeagle shark	*Lamna nasus*
Porbeagle shark	Porbeagle shark	*Lamna nasus*
Porpoise shark	Porbeagle shark	*Lamna nasus*
Pota	Arrow Squid	*Nototodarus sloanii, Nototodarus gouldi*
Poutini	Blue shark	*Prionace glauca*
Puaihakua	Sea perch	*Helicolenus percoides*
Pukeru	John dory	*Zeus faber*
Pure	Scallops	*Pecten novaezealandiae*
Puurau	Kina	*Evechinus chloroticus*
Puuwhaiau	Red Gurnard	*Chelidonichthys kumu*
Queen paua	Paua	*Haliotis australis*
Queen scallops	Queen scallops	*Chlamys delicatula*
Raawaru	Blue cod	*Parapercis colias*
Rari	Ling	*Genypterus blacodes*
Rattail	Pale ghost shark	*Hydrolagus bemisi*
Raumarie	Trevally	*Pseudocaranx dentex*
Red Cod	Red Cod	*Pseudophycis bachus*
Red Gurnard	Red Gurnard	*Chelidonichthys kumu*
Red rock lobster	Rock lobster	*Jasus edwardsii*
Red roughy	Orange roughy	*Hoplostethus atlanticus*
Red snapper	Red snapper	*Centroberyx affinis*
Reherehe	Eels	*Anguilla australis , A. dieffenbachii, A.reinhardtii*
Repe	Elephantfish	*Callorhinchus milli*
Reperepe	Elephantfish	*Callorhinchus milli*
Ribaldo	Ribaldo	*Mora moro*
Rig	Rig/lemonfish	*Mustelus lenticulatus*
Rock lobster	Rock lobster	*Jasus edwardsii*
Rock salmon	Rubyfish	*Plagiogeneion rubiginosum*
Rock salmon	Spiny dogfish	*Squalus acanthias*
Roodbars	Alfonsino	*Beryx splendens, D. decadactylus*
Rosy soldierfish	Orange roughy	*Hoplostethus atlanticus*
Rough skate	Skates	*Zearaja nasutus*
Rubyfish	Rubyfish	*Plagiogeneion rubiginosum*

Saint-pierre	John dory	*Zeus faber*
Sand Flounder	Flatfish	*Rhombosolea plebeia*
Sand perch	Blue cod	*Parapercis colias*
Sardine	Pilchards	*Sardinops sagax*
Sardine	Sprats	*Sprattus antipodum, Sprattus muelleri*
Scallops	Scallops	*Pecten novaezealandiae*
Scampi	Scampi	*Metanephrops challengeri*
Scaree	Sea perch	*Helicolenus percoides*
Schnapper	Snapper	*Pagrus auratus*
School shark	School shark	*Galeorhinus galeus*
Sea bass	Groper	*Polyprion oxygeneios, Polyprion americanus*
Sea bream	Snapper	*Pagrus auratus*
Sea egg	Kina	*Evechinus chloroticus*
Sea mullet	Grey mullet	*Mugil cephalus*
Sea perch	Orange roughy	*Hoplostethus atlanticus*
Sea perch	Sea perch	*Helicolenus percoides*
Sea Urchin	Kina	*Evechinus chloroticus*
Seehecht	Hake	*Merluccius australis*
Shibi	Yellow fin tuna	*Thunnus albacares*
Shortfin mako	Mako shark	*Isurus oxyrinchus*
Short-finned eel	Eels	*Anguilla australis, A. dieffenbachii, A.reinhardtii*
Short-finned squid	Arrow Squid	*Nototodarus sloanii, Nototodarus gouldi*
Silver bream	Tarakihi	*Nemadactylus macropterus*
Silver eel	Eels	*Anguilla australis , A. dieffenbachii, A.reinhardtii*
Silver kingfish	Gemfish	*Rexea solandri*
Silver trumpeter	Elephantfish	*Callorhinchus milli*
Silver warehou	Silver warehou	*Seriolella punctata*
Skates	Skates	*Zearaja nasutus, Dipturus innominatus*
Skipjack tuna	Skipjack tuna	*Katsuwonus pelamis*
Slimehead	Orange roughy	*Hoplostethus atlanticus*
Smooth dory	Oyster	*Ostrea chilensis*
Smooth Oreo	Oreos	*Pseudocyttus maculatus*
Smooth skate	Skates	*Dipturus innominatus*
Snapper	Snapper	*Pagrus auratus*
Snoek	Barracouta	*Thyrsites atun*
South pacific crab	Paddle crabs	*Ovalipes catharus*
Southern anchovy	Anchovy	*Engraulis australis*
Southern blue whiting	Southern blue whiting	*Micromesistius australis*
Southern bluefin tuna	Southern bluefin tuna	*Thunnus maccoyii*
Southern kingfish	Gemfish	*Rexea solandri*
Southern mackerel	Blue mackerel	*Scomber australasicus*

Southern poutassou	Southern blue whiting	*Micromesistius australis*
Southern queen	Queen scallops	*Chlamys delicatula*
Southern spiny dogfish	Spiny dogfish	*Squalus acanthias*
Spikey dogfish	Spiny dogfish	*Squalus acanthias*
Spikey Oreo	Oreos	*Neocyttus rhomboidalis*
Spineback	Spiny dogfish	*Squalus acanthias*
Spiny dogfish	Spiny dogfish	*Squalus acanthias*
Spiny rock lobster	Rock lobster	*Jasus edwardsii*
Splendid alfonsino	Alfonsino	*Beryx splendens, D. decadactylus*
Spotted estuary smooth- hound	Rig/lemonfish	*Mustelus lenticulatus*
Spotted oreo	Oreos	*Allocyttus niger, Neocyttusrhomboidalis, Pseudocyttus maculatus*
Spotted spiny dogfish	Spiny dogfish	*Squalus acanthias*
Spotted warehou	Silver warehou	*Seriolella punctata*
Spotten dogfish	Rig/lemonfish	*Mustelus lenticulatus*
Sprats	Sprats	*Sprattus antipodum, Sprattus muelleri*
Spurdog	Spiny dogfish	*Squalus acanthias*
Stargazer	Stargazer	*Kathetostoma giganteum*
Stone eye	Bluenose	*Hyperoglyphe antarctica*
Striped marlin	Striped marlin	*Tetrapturus audax*
Striped mullet	Grey mullet	*Mugil cephalus*
Striped trumpeter	Trumpeter	*Latris lineata*
Sudlicher kaiserbarsch	Alfonsino	*Beryx splendens, D. decadactylus*
Suei	Skates	*Zearaja nasutus, Dipturus innominatus*
Surf clams	Surf clams	*Paphies donacina, Dosinia subrosea, Bassinia yatei, Mactra muchisoni, Dosinia anus, Spisula aequilatera, Mactra discors*
Swimming crab	Paddle crabs	*Ovalipes catharus*
Swordfish	Swordfish	*Xiphias gladius*
Takaketonga	Striped marlin	*Tetrapturus audax*
Takeke	Garfish	*Hyporhamphus ihi*
Tamure	Snapper	*Pagrus auratus*
Tarakihi	Tarakihi	*Nemadactylus macropterus*
Tarao	Butterfish	*Odax pullus*
Tawatawa	Blue mackerel	*Scomber australasicus*
Teifsee-petersfisch	Oreos	*Allocyttus niger, Neocyttus rhomboidalis, Pseudocyttus maculatus*
Tewetewe	Blue mackerel	*Scomber australasicus*
Tftis	Arrow Squid	*Nototodarus sloanii, Nototodarus gouldi*
Thon rouge de sud	Pacific bluefin tuna	*Thunnus orientalis*
Thon rouge de sud	Southern bluefin	*Thunnus maccoyii*

	tuna	
Tiikati	Frostfish	*Lepidopus caudatus*
Tiikati	Gemfish	*Rexea solandri*
Tiikati	Hake	*Merluccius australis*
Tio	Oyster	*Ostrea chilensis*
Tio para	Oyster	*Ostrea chilensis*
Tio repe	Oyster	*Ostrea chilensis*
Tipa	Queen scallops	*Chlamys delicatula*
Tipai	Scallops	*Pecten novaezealandiae*
Tope	School shark	*Galeorhinus galeus*
Toti	Groper	*Polyprion oxygeneios, Polyprion americanus*
Trevally	Trevally	*Pseudocaranx dentex*
Trigger fish	Leather jacket	*Parika scaber*
Trumpeter	Trumpeter	*Latris lineata*
Tuangi	Cockles	*Austrovenus stutchburyi*
Tuna hao	Eels	*Anguilla australis, A. dieffenbachii, A.reinhardtii*
Tuna heke	Eels	*Anguilla australis, A. dieffenbachii, A.reinhardtii*
Tupa	Scallops	*Pecten novaezealandiae*
Turbot	Flatfish	*Colistium nudipinnis*
Uku	Skates	*Zearaja nasutus, Dipturus innominatus*
Venus shells	Cockles	*Austrovenus stutchburyi*
Waewae	Skates	*Zearaja nasutus, Dipturus innominatus*
Warehenga	Kingfish	*Seriola lalandi*
Warehou	Blue warehou	*Seriolella brama*
Wariwari	Garfish	*Hyporhamphus ihi*
Whaapuku	Groper	*Polyprion oxygeneios, Polyprion americanus*
Whai	Skates	*Zearaja nasutus, Dipturus innominatus*
Wharangi	Paua	*Haliotis iris, H. australis*
Wheketere	Arrow Squid	*Nototodarus sloanii, Nototodarus gouldi*
Whiptail,	Hoki	*Macruronus novaezelandiae*
White bait	Inanga, Koaro, Banded Kokopu, Giant Kokopu, Shortjawed kokopu, smelt	*Galaxias maculatus, Galaxias brevipinnis, Galaxias fasciatus, Galaxias argenteus, Galaxias postvectis, Retropinna retropinna*
White cod	Ribaldo	*Mora moro*
White fillets	Elephantfish	*Callorhinchus milli*
White tuna	Albacore Tuna	*Thunnus alalunga*
White warehou	White warehou	*Seriolella caerulea*
Whiting	Hake	*Merluccius australis*
Wrackbarsch	Groper	*Polyprion oxygeneios, Polyprion americanus*

Wreckfish	Groper	*Polyprion oxygeneios, Polyprion amerircanus*
Yellow eel	Eels	*Anguilla australis, A. dieffenbachii, A.reinhardtii*
Yellow fin tuna	Yellow fin tuna	*Thunnus albacares*
Yellow-belly flounder	Flatfish	*Rhombosolea leporina*
Yelloweye mullet	Yellow-eyed mullet	*Aldrichetta forsteri*
Yellow-eyed mullet	Yellow-eyed mullet	*Aldrichetta forsteri*
Yellow-footed paua	Paua	*Haliotis australis*
Yellowtail Kingfish	Kingfish	*Seriola lalandi*