

2. Description of Proposed Fishing Activities

This section provides the detailed description of fishing activities (the *Fishery Plan* or *Harvesting Plan*) for deepwater fishing by New Zealand vessels in the SPRFMO Area during 2008 and 2009, as required by the SPRFMO Benthic Assessment framework (SPRFMO 2007c).

2.1 Fishing Methods

The New Zealand high seas bottom fisheries are well-developed fisheries that have been in operation for about the past two decades. While fishing areas have expanded over time, and fishing methods and gear have been steadily refined and improved, the current fisheries operate in much the same way as they have for the past decade or so. Descriptions and analyses presented in this assessment have been based on data for the period from 1990 onwards, when fishery development started to increase significantly, to 2006/07, with emphasis on the years 2002 - 2006, this being the reference period in the interim measures upon which to base catch and effort management measures.

2.1.1 Bottom Trawling Methods

New Zealand flagged bottom trawling vessels fishing in the SPRFMO Area during 2008 and 2009 will be targeting orange roughy, alfonsino, cardinalfish and oreo species using specific deepwater bottom trawl nets and fishing methods developed over the past decade, and which are currently used both within and beyond the New Zealand Exclusive Economic Zone (EEZ), to specifically target these species.

- **Deepwater Trawl Net Designs**

Modern deepwater trawling is an aimed method of trawling, usually targeting relatively dense aggregations of fish which are often located and targeted acoustically. This differs from the herding type trawl fishing of, for example, flatfish, hake or cod which are fished using long, non-aimed tows on flat, muddy seabed. To reduce damage to fishing gear on the hard ground typical of areas inhabited by species such as orange roughy, and to enable nets to be rapidly and accurately aimed at fish aggregations, deepwater trawling methods have evolved in various ways towards agile net systems that minimise groundrope length, net size and unnecessary ground contact, particularly by non-fishing gear components such as trawl doors.

Some typical deepwater trawl net designs currently used in these fisheries are shown in Figure 1. Nets are manufactured from braided nylon twines, typically ranging in thickness from 4mm for the wings, to 5mm for the end sections, doubled for areas of the net belly subject to abrasion. Codends attached to these nets are made of heavier rope meshes. Net headropes are equipped with hard floats to provide the buoyancy needed to maintain the net opening during trawling (see Plate 2), while the footrope may be equipped with a variety of ground-gear, depending on the seabed type to be trawled. The nets used are designed to provide net mouth openings (groundrope lengths) between wing-tips of 15 - 20 m under optimal towing conditions, with headline heights of 5 m - 6 m above the footrope. Nowadays, nets are also equipped with netsounders and headline sensors to monitor the net opening, to determine position of the net relative to the seabed, and to facilitate accurate targeting of nets at acoustic fish targets.

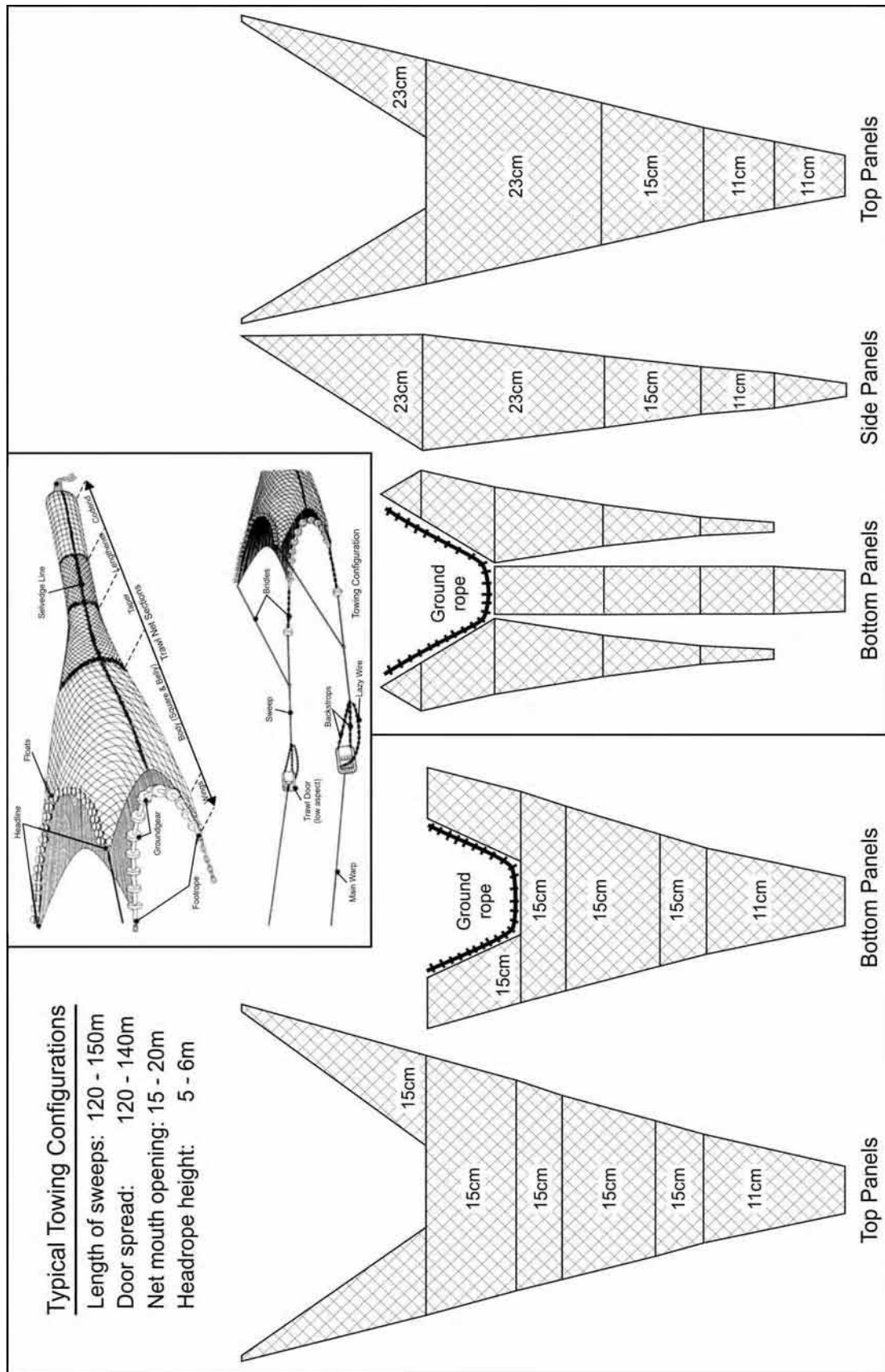


Figure 1. Stylised net construction diagrams for typical bottom trawl nets used in the New Zealand deepwater orange roughly targeted bottom trawl fishery. Two alternate simplified net designs are shown, using different mesh sizes and net wing configurations. Inset shows an illustration of the configuration of a typical bottom trawl net during trawling.

- **Trawl Doors and Towing Configurations**

Trawl doors used in New Zealand deepwater bottom trawl fisheries were initially of the older style 'vee-door', to maximise the stability of doors during towing. Vee doors have a low aspect ratio, with their length being greater than their height (Figure 2 a), which results in greater stability. However, these doors are dependent on bottom contact (ground shear forces) to create their net spreading force. With the move to better winch systems and increased use of electronics to accurately target fish aggregations, there has been a move to high aspect ratio doors, in which the height is 1.5 to 1.8 times length (See Figure 2 b). These doors do not require bottom contact and depend solely on hydrodynamic forces to generate spread. Efforts to reduce drag and increase control of trawl doors has also resulted in a move to smaller, more efficient doors from producers of high-technology doors, such as Nichimo, Hampidjan and Morgere.

The trawl doors currently used by New Zealand deepwater bottom trawlers typically range from ~1,200kg - 2,000kg in weight, and from ~4m² - 8m² in size, depending on the vessel engine power and net design. Modern doors (such as the Morgere WV and WX doors shown in Plate 2 b) and c) are generally designed and rigged to operate off the bottom, being set to minimise the risk of digging in should there be any contact with the seabed. Deepwater trawl nets rigged in this way are ideally 'flown' such that the net contacts the seabed only in the area of the aggregated fish shoals, with the doors themselves preferably not touching the seabed.

Lengths of sweeps and bridles (the towing and herding wires connecting the trawl doors and the net opening) have also been significantly reduced in comparison to hoki trawl nets, to provide better control over the gear and reduced seabed contact (Table 1).

Table 1. Comparative lengths of sweeps and bridles used on New Zealand hoki-targeted and orange roughy-targeted bottom trawl net systems.

Net Type	Sweep Length	Bridle Length
Hoki trawl	140 - 210m	30m
Orange roughy trawl	100 m	12m

The combination of sweeps and bridles connecting the doors to the nets on current orange roughy targeted trawls typically range in length from 120m - 140m, the combination of doors and sweep lengths being set to achieve net openings of 15m - 20m between wingtips. Under these configurations, distance achieved between trawl doors during towing (door spread) is maximally 120m - 150m under optimal towing conditions. In areas where operators wish to accurately target fish aggregations and require maximal control of the net, they may even operate with very short bridles and no sweeps.

The extent to which these gear modifications, together with other operational measures, are intended to minimise unnecessary contact with the seabed is further described in *Section 7: Management and Mitigation Measures*.

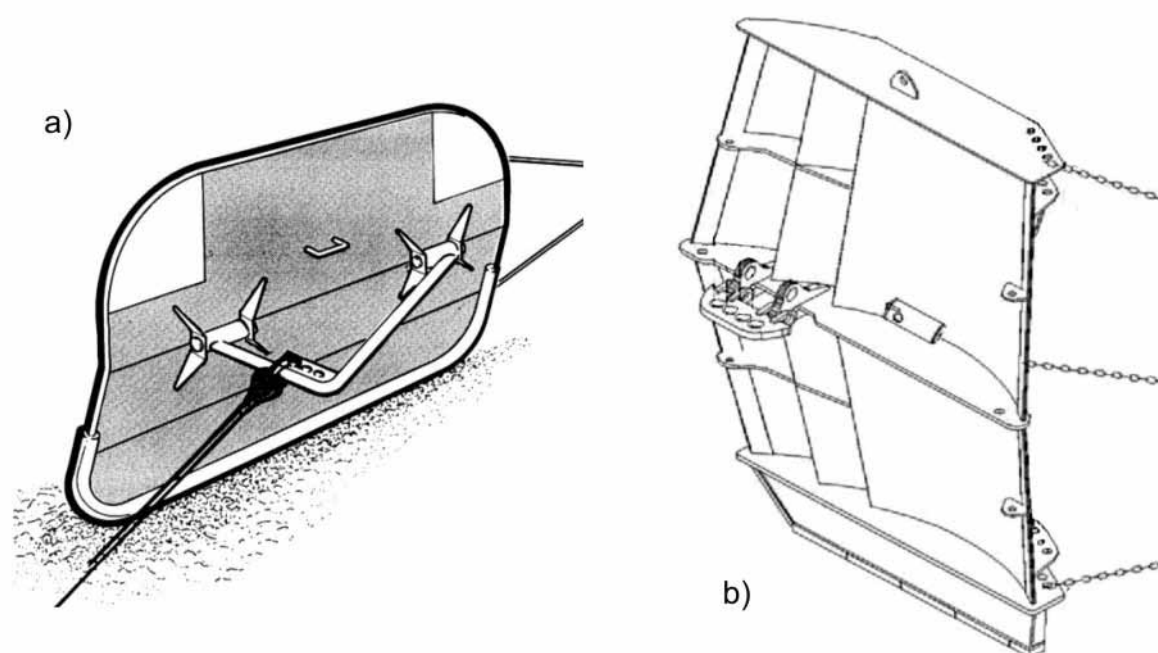


Figure 2. Illustrations of trawl doors used in New Zealand bottom trawl fisheries showing a) Older style low aspect-ratio 'vee' door, and b) More recent high aspect-ratio hydrodynamic door.



Plate 1. Examples of trawl doors in use on New Zealand deepwater bottom trawlers showing a) Nichimo Super-Vee doors rigged on a trawler stern, b) a Morgere WX door and c) a Morgere WV door.



Plate 2. Alternate ground-gear configurations used when deepwater bottom trawling for species such as orange roughy and oreos showing ground-ropes equipped with a) 50-60cm rubber bobbins separated by rubber spacers, and b) with more closely spaced 60-80cm 'rockhopper' rubber discs plus leading end steel bobbins.

- **Ground Gear Configuration**

For bottom trawling on hard ground, net footropes are equipped with some form of ground-gear to protect the footrope, and to enable the net to manoeuvre over rough terrain or minor obstacles. Initially, deepwater trawlers used steel bobbins on the groundrope when fishing hard ground, these being standard at the time on Northern Hemisphere cod trawlers. It has been found that these are not necessary and that gear efficiency is improved and bottom contact reduced by incorporating

rubber components in the ground rope. Initially, steel bobbins were replaced by smaller 40 cm - 60 cm diameter rubber bobbins (Plate 2a). More recently, there has been a shift to the use of 50cm - 80cm rubber discs separated by spacers along the footrope to create 'rockhopper' gear (Plate 2b). Whereas bobbins are designed to allow the footrope to roll over rough ground, the groundrope in a rockhopper system is rigged under tension, causing the net to 'hop' over encountered obstacles, rather than attempting to drag through or roll over them.

2.1.2 Bottom Line Fishing Methods

New Zealand vessels fishing the high seas have used a variety of bottom line fishing methods over the history of these fisheries, the most important of which have been bottom longlines, dahn lines and trot lines. The proportion of fishing effort using each of these methods over the 2002 - 2006 reference period is shown in Table 2.

Table 2. Summary of total bottom line fishing (hooks) by New Zealand vessels using various methods in the SPRFMO Area over the period 2002 - 2006.

Year	Bottom Longline Hooks	Dahn Line Hooks	Trot Line Hooks	Total Hooks
2002	0	0	0	0
2003	50,538	2,900	0	53,438
2004	229,425	36,984	2,400	268,809
2005	362,438	18,895	2,690	384,031
2006	483,194	18,610	0	501,810
Total	1,125,595	77,389	5,090	1,208,088

In recent years, the predominant line fishing method has been bottom longlines, accounting for 93% of the hooks fished over 2002 - 2006. Most of the remaining effort consisted of dahn line sets (a form of vertical drop line), with very little trot line effort (a form of suspended longline).

Typical configurations of these three types of bottom line fishing gear are illustrated in Figure 3. Bottom longline configurations on smaller vessels may use weights (~5kg), or a combination of weights and floats, to keep lines on or near the bottom, depending on target species. Larger autoline vessels may use lead-core weighted bottom lines (~50g / m) to keep the lines on the bottom. New Zealand high seas bottom longline operations, particularly when targeting bluenose and hapuku / bass, use short lines with relatively few hooks to target specific seabed features. The number of hooks used per set averaged 980 over 2002 - 2006, although with a wide range (standard deviation 1,194 hooks). Longer sets may be used when exploring new areas, or fishing flatter seabed, and a maximum of 9,000 hooks was reported over the period. New Zealand bottom longline fishermen usually use circle hooks to minimise seabird bycatches.

Dahn lines are a form of drop-line, vertically deployed between surface buoys and a seabed weight, with a bottom section rigged with hooked snoods to fish a specific depth range above the seabed (Figure 3). A vessel will usually deploy a number of Dahn lines in a specific area during a day's fishing, and the number of hooks reported per day over 2002 - 2006 averaged 864 (s.d. 469), with a maximum reported daily effort of 1,920 hooks. These drop line systems were initially implemented to target for hapuku / bass on flanks and summits of steeper seabed features, with the length (fished depth range) of the hooked section being adjusted to target bluenose swimming higher off the seabed. Trot lines can be considered to be a combination of the bottom longline and drop line fishing methods, using a buoyed longline suspended above the seabed, equipped with short dropper lines of 20 - 25 hooked short snoods. Effort reported for trot lines during 2002 - 2006 averaged 138 hooks per set, with a maximum of 600 hooks.

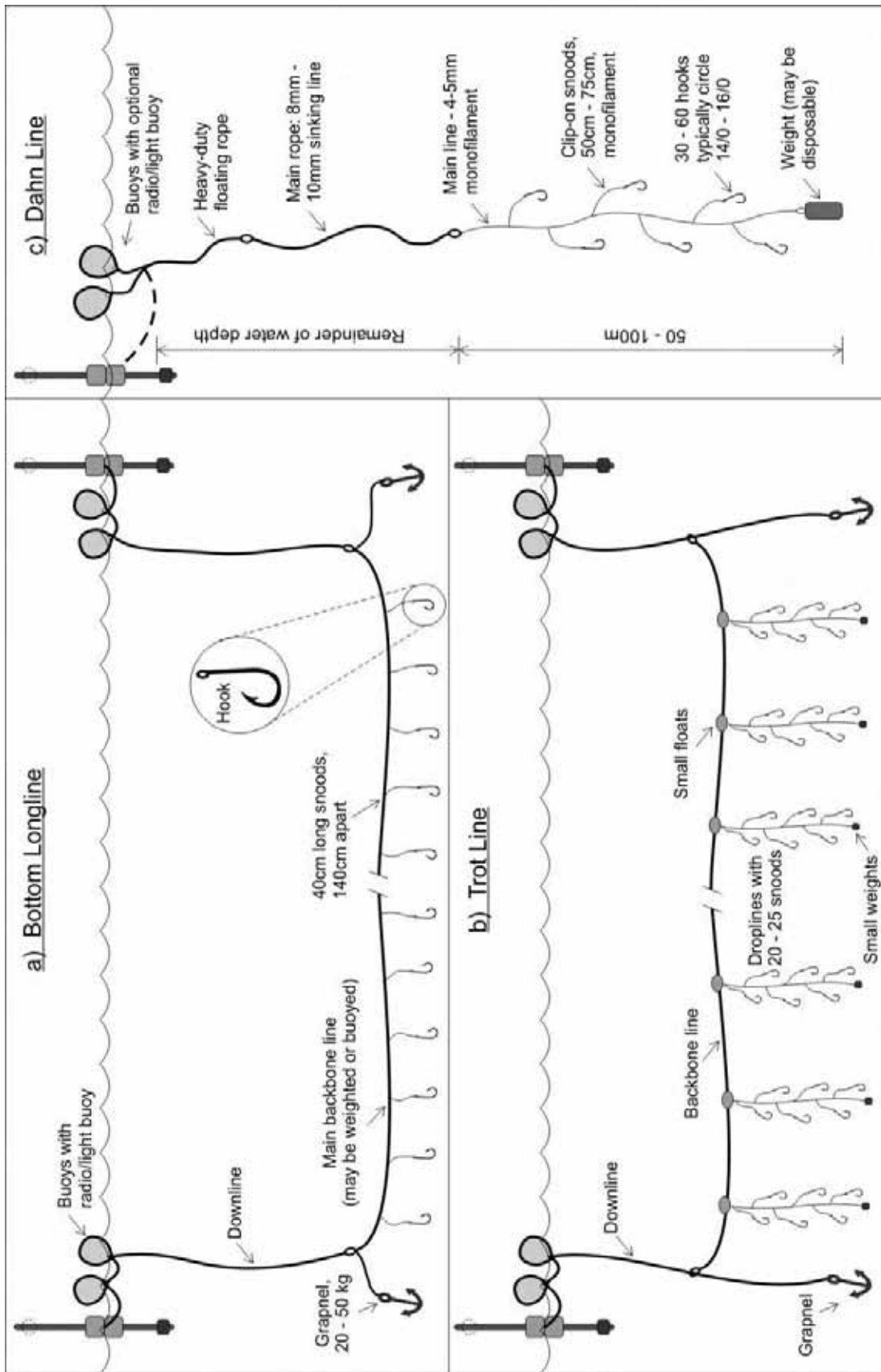


Figure 3. Diagrammatic illustration of bottom line fishing gear used by New Zealand vessels, showing example configurations for a) Bottom Longlines, b) Trot Lines and c) Dahn Lines.

2.2 Depth Ranges to be Fished

2.2.1 Bottom Trawling Fishing Depths

New Zealand vessels are required to report seabed depth on catch return forms for each fishing trip, enabling the frequency of trawl tows in different depth ranges over the period 2002-2006 to be analysed (Figure 4).

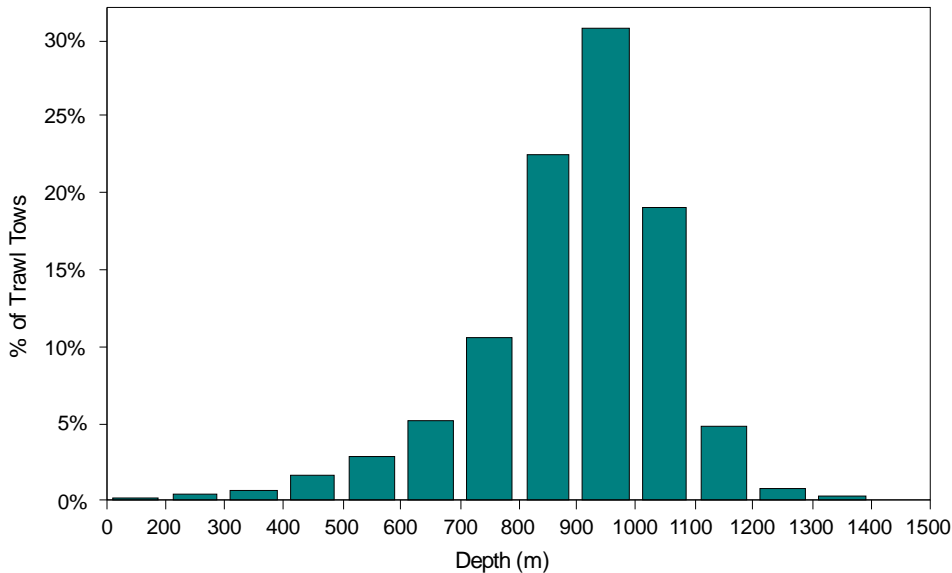


Figure 4. Fishing depth frequency distribution of high seas bottom trawl tows by New Zealand vessels fishing in the SPRFMO Area over the period 2002 - 2006. (Total tows for which depth information was available for this analysis was 13,662)

Over this period, 13,662 of the total reported 13,713 tows reported bottom depth. 11% of these tows were conducted in depths less than 700 m, 6% in depths greater than 1,100 m, with 83% of tows being conducted in the depth range 700 m - 1,100 m. Just over half the tows were conducted over the depth range 800 m - 1,000 m, with a strong mode in the 900 m - 1,000 m depth range.

The participants, fishing methods and fishing areas to be fished during 2008 and 2009 have not changed since the 2002 - 2006 reference period, and bottom trawling to be conducted during this interim period, and covered by this impact assessment, will be conducted over the same depth ranges, and in similar proportions of tows by depth range as shown in Figure 4.

2.2.2 Bottom Line Fishing Depths

Over 2002 - 2006, sets representing 962,873 of the total 1,208,088 hooks deployed reported bottom depth (Figure 5). Most bottom line fishing is conducted shallower than bottom trawling, particularly when targeting hapuku / bass, and 90% of the reported hooks were set in depths <800 m, mostly from 400 m - 600 m. However, the remaining 10% of bottom line effort was widely spread across the depth range from 1,000 m - 1,700 m. This effort generally consisted of very few, most likely exploratory, bottom longline sets at each of these deeper depth ranges.

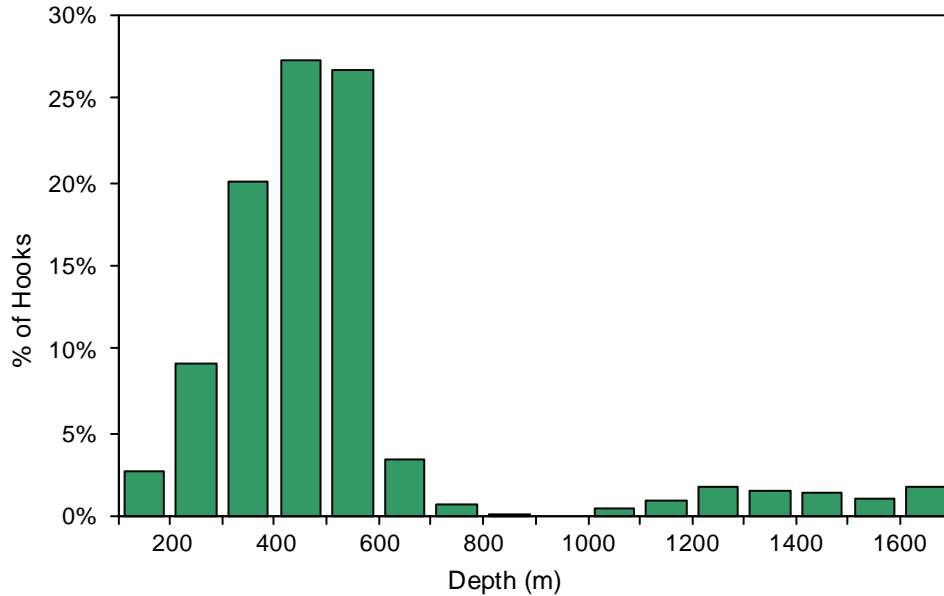


Figure 5. Fishing depth frequency distribution of high seas bottom line hooks by New Zealand vessels fishing in the SPRFMO Area over the period 2002 - 2006. (Total hooks for which depth information was available for this analysis was 962,873)

The participants, fishing methods and fishing areas to be fished during 2008 and 2009 have not changed since the 2002 - 2006 reference period, and bottom line fishing to be conducted during this period, and covered by this impact assessment, will be conducted over the same depth ranges, and in similar proportions of tows by depth range as shown in Figure 5.

2.3 Target and Likely Bycatch Species

2.3.1 Bottom Trawling Target Species

Twenty two different species were declared as bottom trawl target species over 2002 - 2006, with the top 4 species groups constituting 98% of targeted species (Table 3), and the others contributing the remaining 2%. Target species in 2008 and 2009 will remain the same.

Table 3. Top four species contribution to the total New Zealand bottom trawl catch in the SPRFMO Area over the period 2002 - 2006.

Species	% Targeting
Orange roughy	91%
Alfonsino	4%
Cardinalfish	2%
Oreos	1%
Others (<1% each)	2%

Catches of a total of 137 species or species groups were reported for 2002 - 2006. Of these, the top ten species contributed 96% of the total New Zealand high seas catch (Table 4). Reported by foreign flagged vessels landing into New Zealand, and therefore required to report the catches that contributed to those landings, have been included in Table 4 to explain the differences in reported New Zealand catch to those reported by Penney et al (2007), who included this foreign flagged catch in that paper.

Table 4. Top ten species contribution to the total New Zealand bottom trawl catch in the SPRFMO Area over the period 2002 - 2006.

Species Code	Scientific Name	Common Name	NZ Flag Catch (t)	Other Flag Catch (t)
ORH	<i>Hoplostethus atlanticus</i>	Orange roughy	9,259	2,767
BOE	<i>Allocyttus niger</i>	Black oreo	598	298
EPT	<i>Epigonus telescopus</i>	Deep sea cardinal	638	46
BYX	<i>Beryx splendens</i> and <i>B decadactylus</i>	Slender beryx, Longfinned beryx	250	181
SSO	<i>Pseudocyttus maculatus</i>	Smooth oreo	248	58
RIB	<i>Mora moro</i>	Ribaldo	276	15
RAT	<i>Macrouridae</i> .Family	Rattails	274	1
BSH	<i>Dalatias licha</i>	Seal shark	120	
BOA	<i>Paristiopterus labiosus</i>	Boarfish	85	
SOR	<i>Neocyttus rhomboidalis</i>	Spiky oreo	78	2
Total (top 10 species)			11,827	3,368

It is expected that bottom trawl targeting over 2008-09 will closely reflect the historic targeting patterns that occurred over 2002-2006.

2.3.2 Bottom Line Fishing Target Species

The bottom line fisheries have primarily targeted bluenose and hapuku / bass over the history of these fisheries, with bluenose being targeted by 77% of effort (hooks fished), and hapuku / bass by 19% of effort, over 1990 - 2007 (Table 5). Over this period there has been a trend towards increased bluenose targeting, and decreased hapuku / bass targeting. Bluenose targeted effort increased from 58% in 1990-95 to 90% in 2007, while hapuku / bass targeting decreased from 34% to 7% in response to declining catches of hapuku and increased market demand for bluenose.

Table 5. Changes in proportion of New Zealand bottom line effort (hooks fished) targeted at the two main species groups, bluenose and hapuku / bass, in the SPRFMO Area over the period 1990 - 2007.

Period	Bluenose	Hapuku / Bass	Others
1990-1995	58%	34%	8%
1996 - 2001	70%	16%	14%
2002-2006	80%	16%	4%
2007	90%	7%	3%
Overall	77%	19%	4%

A number of other species are caught in addition to these primary targets, with a total of 59 species or species groups reported on bottom line catch return forms for 2002 - 2006. Of these, the top ten species contributed 97% of the total bottom line catch from all high seas areas over the period (Table 6).

Table 6. Top ten species contribution to the total New Zealand bottom longline, trot line and dahn line catch in the SPRFMO Area over the period 2002 - 2006.

Species Code	Scientific Name	Common Name	Catch (t)
BNS	<i>Hyperoglyphe antarctica</i>	Bluenose	495
HPB	<i>Polyprion oxygeneios / P. americanus</i>	Hapuku / Bass	158
KTA	<i>Nemadactylus</i> spp.	King tarakihi	24
SPD	<i>Squalus acanthias</i>	Spiny dogfish	20
SKI	<i>Rexea</i> spp.	Gemfish	6
KIN	<i>Seriola lalandi</i>	Kingfish	5
PTO	<i>Dissostichus eleginoides, D. mawsoni</i>	Toothfish	4
SPE	<i>Helicolenus</i> spp.	Sea perch	3
SCH	<i>Galeorhinus galeus</i>	School shark	3
RSN	<i>Centroberyx affinis</i>	Red snapper	2
Total (top 10 species)			720

It is expected that bottom line targeting over 2008-09 will closely reflect the historic targeting patterns that occurred over 2002-2006.

2.4 Intended Period and Duration of Fishing

Vessels involved in New Zealand bottom fisheries on the high seas are also involved in domestic fisheries within the New Zealand EEZ, fishing the high seas once quotas for the year have been fished, or when lulls in domestic fishery seasons permit time for fishing the high seas. Both the trawl and line fisheries on the high seas therefore show strong seasonal patterns.

2.4.1 Bottom Trawling Fishing Season

The New Zealand high seas bottom trawl fishery is a southern hemisphere winter fishery, primarily occurring over the months April to August. Over 2002 - 2006, there was some evidence of differences in the peak fishing times for orange roughly between the different fishing areas, with the Challenger and West Norfolk areas peaking in June, the West Norfolk area in July and the Louisville Ridge area in August (Figure 6).

2.4.2 Bottom Line Fishing Season

In contrast to the bottom trawl fishery, the New Zealand flagged bottom line fishery is a southern hemisphere summer fishery, occurring primarily over the months October to January with a strong peak in catches in December, and with effort extending out to April (Figure 7).

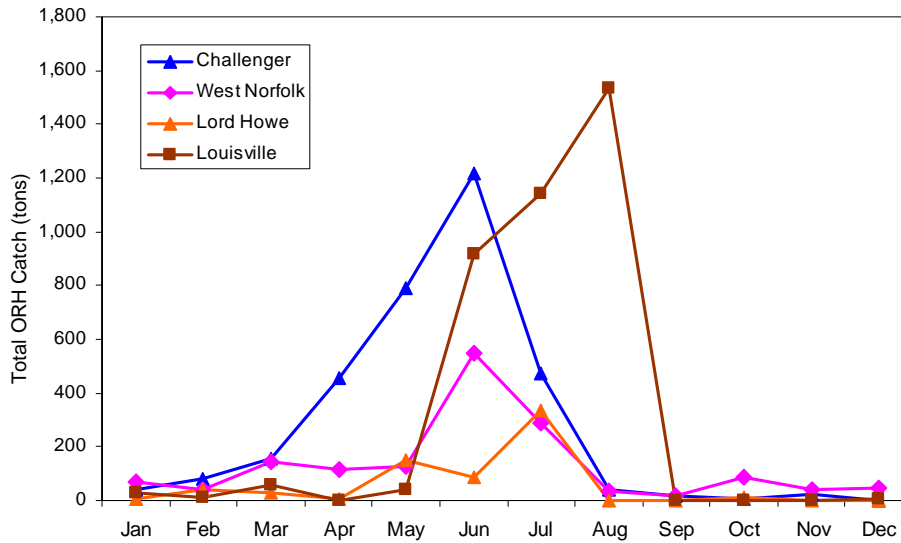


Figure 6. Total New Zealand bottom trawl catch of orange roughy per month in the various fishing areas in the SPRFMO Area over the period 2002 - 2006.

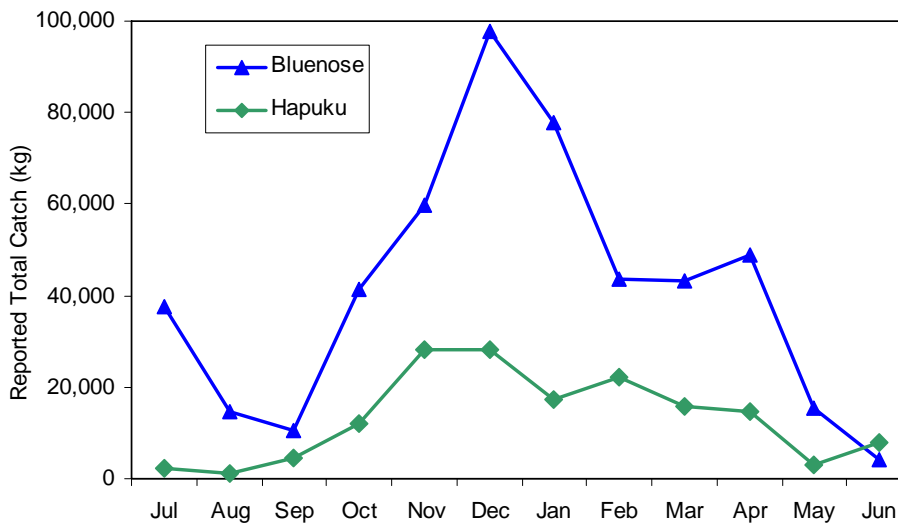


Figure 7. Total New Zealand bottom line catch of bluenose and hapuku / bass per month in the SPRFMO Area over the period 2002 - 2006.

2.5 Effort Indices

2.5.1 Bottom Trawl Fishing Effort

There has been a steady declining trend in the number of New Zealand vessels participating in high seas bottom trawl fisheries (see *Section 5. Status of the Deepwater Stocks to be Fished*), from a peak of 55 vessels in 1996 to 9 vessels in 2007. Over the period 2002 - 2006, the number of vessels declined from 23 to 12, with an average of 18 per year.

The SPRFMO interim measures require Participants to limit their effort or catch to the annual average over the period 2002 - 2006. Given the decline in effort and the management measures now in place, (see *Section 7. Management and Mitigation Measures*), the number of New Zealand bottom trawl vessels is not expected exceed the 2002 - 2006 average of 18 vessels. Between May, when the 2008 New Zealand high seas permits incorporating the SPRFMO interim measure

provisions were issued, to end November 2008, only four of the vessels issued with high seas permits (listed in Appendix A) had conducted bottom trawl fishing operations in the SPRFMO Area.

The number of bottom trawl tows has also declined over the reference period from 2,944 tows in 2002 to 1,135 tows in 2006 (see Section 5. Status of Deepwater Stocks). In terms of evaluating seabed impact of these tows, most orange roughy targeted bottom trawls are of short duration and distance. Over 2002 - 2006, tow duration averaged 2.19 hours (s.d. 2.63 hours), and an average 5.84 nm (s.d. 6.98 nm) in length. However, almost one third of these tows were shorter than 15 minutes, and 60% were shorter than 30 minutes. Over half the tows extended for less than 2 nm (3.7 km) (Figure 8). These short tows are typical of the highly targeted fishing on dense fish aggregations, or specific seabed features known to support fish. The wide range in tow durations / distances results from fewer long tows, usually on flatter ground adjacent to high profile features.

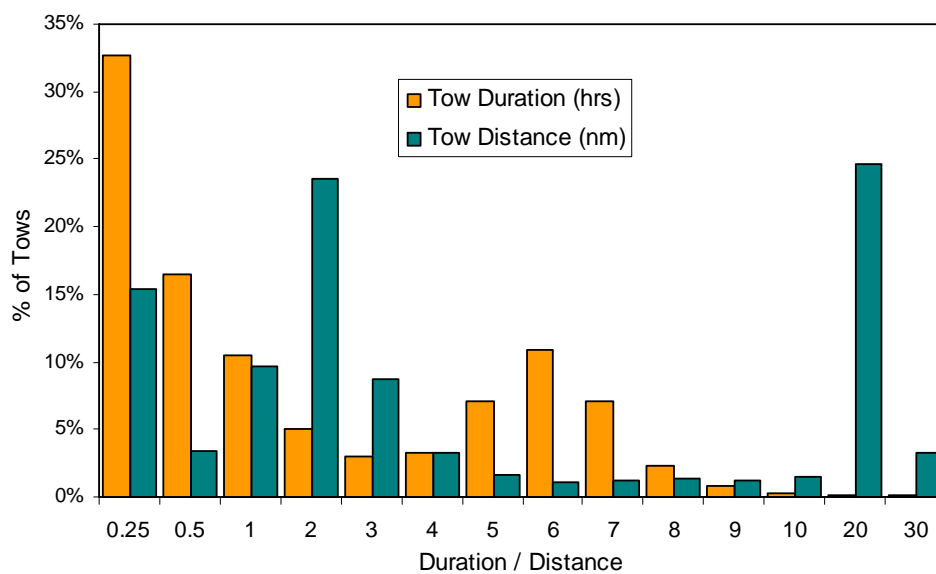


Figure 8. Frequency distribution of tow duration and tow distance by New Zealand high seas bottom trawlers fishing in the SPRFMO Area over the period 2002 - 2006.

As a result of the continuing trend towards highly targeted trawling in the high seas orange roughy fishery, tow durations and lengths continue to decrease. Of the four vessels which have conducted fishing on the high seas in 2008, observer data are so far available for four trips by three of these vessels. Two hundred and thirty five bows were observed on these four trips, with an average duration of 14 minutes per tow, and a maximum reported duration of 3.3 hours. Lengths of these tows averaged 1.3 km (s.d. 1.7 km), with a maximum reported length of 14.9 km.

2.5.2 Bottom Line Fishing Effort

In contrast to the bottom trawl fishery, effort in the New Zealand high seas bottom line fisheries increased over the period 2002 - 2006, from zero effort in 2002, 3 vessels (53,438 hooks) in 2003, to 10 vessels (501,810 hooks) in 2006, averaging 6 vessels over the period. This effort increase reflects a resurgence in interest and targeting for bluenose, following recent increased market demand for the species. New Zealand operators historically operated 10 bottom line vessels on the high seas from 1995 to 1998 (see Section 5. Status of Deepwater Stocks).



Plate 3. Typical compact bottom trawling vessels used by New Zealand operators to target deepwater species such as orange roughy in the SPRFMO Area.

2.6 Information on Vessels to be Used

Between May and December 2008, 30 vessels were issued with New Zealand high seas fishing permits (Appendix A). These include bottom trawl, midwater trawl, purse-seine and bottom line vessels, many of which intend to primarily fish within the EEZ, but which take out high seas permits to allow for high seas fishing, if required, for highly migratory, pelagic and demersal species. Of these vessels, only four had conducted any bottom trawl fishing in the SPRFMO Area by December 2008. The vessels which have conducted high seas bottom trawling during 2008 range in length from 32.7 m to 43.7 m, in gross tonnage from 317 t to 671 t, and are equipped with engines ranging in power from 690 to 1,620 kilowatts (see Appendix A). Photographs of typical New Zealand bottom trawlers used to target species such as orange roughy are shown in Plate 3.