Transitioning to alternative fishing methods off New Zealand's West Coast North Island

A response to the threat to Māui dolphin

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MAKING SENSE OF
THE NUMBERS

Authors: Fiona Stokes, Hugh Dixon and Dr Ganesh Nana

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Making sense of the numbers

Māui dolphin are a critically endangered species that is only found on the West Coast of the North Island of New Zealand. The Māui dolphin population is estimated at 63 individuals over one year of age. In addition to natural mortality, this population faces threats caused by human beings.

The risk of human-induced threats to Māui dolphin is high because they are found inshore and their habitat overlaps with human coastal activities. The scientific advice is that 95 percent of Māui dolphin mortality caused by humans can be attributed to set-netting (also known as gill-netting) and trawling. In an attempt to reduce the level of threat, some fishing areas have been closed and/or restricted through a range of specific fishing regulations. To date, these regulations have not been accompanied by measures to assist affected fishers with a transition to alternative fishing methods.

WWF-New Zealand advocate an extension to fishing restrictions to ensure that no set-netting or conventional trawling takes place between Maunganui Bluff and the Whanganui River mouth, including harbours, and out to the 100 metre depth contour. This is based on scientific advice regarding the range of Māui dolphin. WWF-New Zealand asked BERL to investigate the costs of transitioning away from commercial set-netting and trawling within this range, to inform discussion on how to ensure the survival of Māui dolphin.

Factors impacting on transition costs

Estimating the cost of transitioning existing fishing operations away from commercial set-netting and trawling within this range is not straight forward. There are many uncertain factors at play including data limitations and the paucity of data as to the nature of existing operations. For example, fishing data is collated by management areas, which do not perfectly align with the north-south Māui dolphin range BERL was asked to consider. Fishing data is also not collated according to depth contours so a proxy, 12 nautical miles, was used. This proxy is by no means perfect. In some areas it goes beyond the 100 metre depth contour and in other areas the 100 metre depth contour goes beyond 12 nautical miles.

The analysis is based on assessing a transition from set-netting and trawling to longlining (with best practice sea-bird by-catch mitigation) – an existing fishing method known to pose no threat to these dolphins. It does not examine the potential for technological changes to enable set-netting or trawling to continue while posing no threat to Māui dolphin. If such changes take place they would affect the nature of the transition costs. The potential to fish in deeper water was also considered, but advice received indicated there is either little or no potential to catch most of the species targeted in this region at greater depth. Accordingly, it was not included as an option within this analysis.

Potentially changes to annual catch entitlement could facilitate a transition, but this is not something that can be addressed in this study. Rather, it would need the involvement of the Ministry for Primary Industries and relevant fishing stakeholders.

The analysis that BERL was able to undertake must therefore be viewed in light of these constraints and should be seen as a contribution to the discussion. It is not the final word and WWF-New Zealand have made it clear that the organisation would welcome further work being done on how a transition could be achieved.

Developing scenarios

Bearing in mind these limitations, BERL has collated data and information that is publicly available, and in conjunction with industry advice, has estimated the potential transition costs under a principal and alternative scenario. Our principal scenario assumes that boats unable to transition will leave the industry, while our alternative scenario assumes that boats unable to transition will be replaced with ones that can.

The pessimistic scenario assumes revenue losses and boat refit costs at the high end of the range, along with spending on a retraining package, also at the high end of the range. The optimistic scenario assumes these revenue losses, boat refits and retraining costs at the low end of the range.

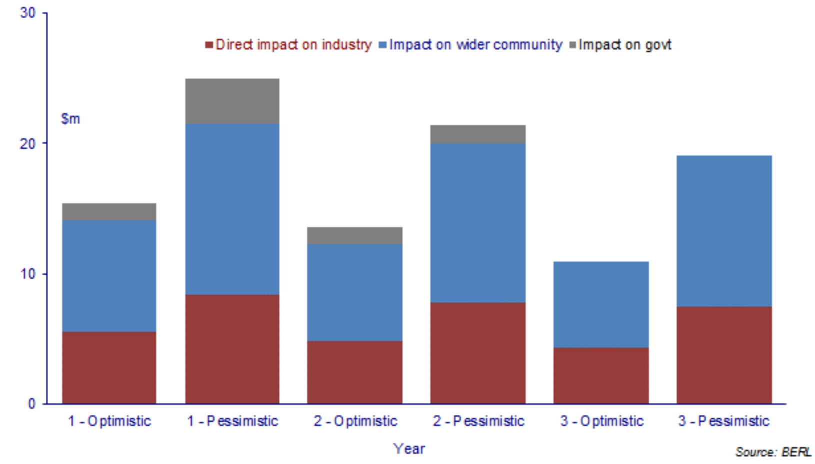
While these scenarios and the consequent estimates are dependent on the assumptions adopted, this approach does provide a framework to assess the magnitude of the costs involved. Should more comprehensive data or better information become available, as to where on the spectrum the outcome is more likely to lie, BERL would look to calculate a more precise estimate.

In 2014, 87 commercial fishing boats operated on the West Coast of the North Island using set nets and trawling, catching an estimated 2.7 million kilograms (kgs) of fish. Of this number, 75 of the 87 boats used set nets to fish and 12 boats used trawling. Withdrawing set-netting and trawling from Māui Dolphin habitat is likely to result in 78 of the boats exiting the fishing industry in the principal scenario. This is based on industry advice that indicates these boats are unsuitable to change to operate longlines.

In the alternative scenarios BERL assumed that 56 of the 78 boats that left the industry in the principal scenarios, were provided with financing to fund upgraded boats. Under the alternative scenarios a high proportion of commercial boats and employment was maintained in the fishing industry.

Principal scenario cost estimates

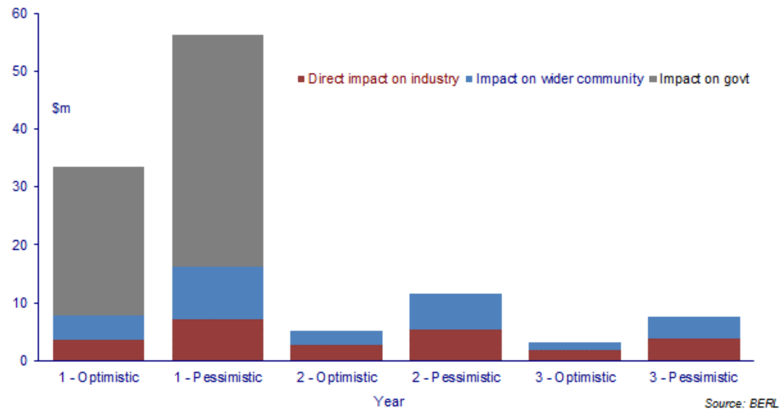
Given the data available and our assumptions, the total net costs of the transition to longlining could range from $40.1 million to $65.6 million, over a three year period.



The pessimistic principal scenario estimates a total transition cost of just over $25 million in the first year of an assumed three year transition period. This cost would fall to just over $19.1 million in the third year, as shown in the figure. The pessimistic scenario represents the worst case scenario. It illustrates the impact on the fishing industry on a per-boat basis and the impact on the Government of the cost of transition. These impacts estimate that the direct impact on industry will be $8.4 million in the first year, falling to $7.5 million by the third year.

The estimated cost in the optimistic principal scenario totals just under $15.5 million in the first year, dropping to just under $11 million in the third year. In this scenario the revenue losses and costs are assumed at the lowest end of the relevant range. Here, the direct impact on industry is an estimated $5.5 million in the first year, with a fall to $4.3 million by the third year. In the third year the impact on the Government has fallen to zero as the proposed retraining of displaced workers has taken place.

Alternative scenario cost estimates



Given the data available and our assumptions, the total net costs of the transition to longlining could range from $41.8 million to $75.3 million, over a three year period.

The pessimistic alternative scenario estimates a total transition cost of just under $56.2 million in the first year of an assumed three year transition period. This cost would fall to just under $7.6 million in the third year, as shown in the figure. The pessimistic scenario represents our worst case scenario. It illustrates the impact on the fishing industry on a per-boat basis and the impact on the Government of the cost of transition. **These impacts estimate that the direct impact on Government will be $39.9 million in the first year**, while the direct impact on industry will be $7.2 million in the first year, falling to $3.8 million by the third year.

The estimated cost in the optimistic alternative scenario totals just under $33.5 million in the first year, dropping to just over $3.1 million in the third year. In this scenario the revenue losses and costs are assumed at the lowest end of the relevant range. **Here, the direct impact on Government is an estimated $25.6 million in the first year**, while the direct impact on industry is an estimated $3.6 million in the first year, with a fall to $1.8 million by the third year.

Mitigating these impacts

These total cost estimates include the 'multiplier' (or 'ripple') effects on sectors associated with, reliant on, and/or supplying the fishing industry. Consequently, mitigating the overall costs of transition could be addressed by focussing on the direct impact of the transition. Mitigating these direct impacts would in turn avoid the majority of the indirect 'multiplier' effects being experienced.

Estimates of the direct transition costs include costs associated with boat refitting, adoption of new fishing techniques, loss of revenue arising from new techniques and catching different species, and re-training those displaced from the fishing industry.

The argument for transition assistance is relatively straightforward. The costs of measures to limit the threats to Māui dolphin should not be borne by one industry, sector, or community. The role of Government to act on behalf of the wider community in this regard is clear. BERL estimates, dependent on transparent assumptions, provide a much needed starting point from which the level of transition assistance required can be robustly assessed.

This mitigating effect can be seen in our principal and alternative scenarios. In the principal scenario the direct impact of the transition falls heavily on the industry and the wider community across the three year period. **In the alternative scenario a substantial portion of the three year impact on industry and the wider community has been replaced by a one year impact on the Government of between $25.6 million and $39.9 million.**

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1 Introduction

Māui dolphin is a critically endangered species that is only found on the West Coast of the North Island of New Zealand. The population is estimated at 63 individuals over one year of age. In addition to natural mortality, this population faces threats caused by human beings.

The risk of human-induced threats to Māui dolphin is high because they are found inshore and their habitat overlaps with human coastal activities. The scientific advice is that 95 percent of Māui dolphin mortality caused by humans can be attributed to set-netting (also known as gill-netting) and trawling. In an attempt to reduce the level of threat, fishing areas have been closed and/or restricted through a range of specific fishing regulations. To date, these regulations have not been accompanied by measures to assist affected fishers with a transition.

WWF-New Zealand advocate an extension to fishing restrictions so that no trawling or set-netting takes place between Maunganui Bluff and the Whanganui River mouth, including harbours, and out to the 100 metre depth contour based on scientific advice regarding the range of Māui dolphin.

WWF-New Zealand approached BERL to undertake an analysis of the fishing industry within the range of Māui dolphin moving to alternative fishing methods, and the transition costs involved in moving to these alternatives.

Specifically, WWF-New Zealand asked BERL to answer the following questions:

1. What is the capacity of the commercial fishing industry to transition from set-netting and conventional trawling to alternative fishing methods?
2. What are these methods?
3. What would be the potential cost (or level of capital investment) required to make this transition? Here, capital investment includes machinery and equipment as well as human capital.

As part of the cost calculation, WWF-New Zealand asked BERL to identify, if possible, who bears the costs associated with using alternative fishing methods.

To do this, BERL first assessed the available data to determine a reasonable way to reflect the Māui dolphin range in the analysis. Six statistical areas within the fisheries regime – Egmont, Taranaki, Waikato, Manukau Harbour, Kaipara Harbour, and Helensville – are a close approximation to the north-south range, although they exclude approximately 40 kilometres towards the north end of this range. Fishing data is also not collated according to depth contours, so a proxy, 12 nautical miles, was used. This proxy is by no means perfect. In some areas it goes beyond the 100 metre depth contour and in other areas the 100 metre depth contour goes beyond 12 nautical miles.

BERL then identified what fishing methods are currently used in these six statistical areas and out to 12 nautical miles; and what the alternative, viable options could be.

We used data and information gathered from industry sources and the Ministry for Primary Industries (MPI) to determine the current set net and trawling fishing effort and the direct costs associated with these fishing methods.

Following this Introduction, we present a statistical account of the fishing industry on the West Coast of the North Island. Section 3 reviews the data and other information that governed the specification of our cost scenarios, while Section 4 presents the Scenarios themselves. Section 5 details our conclusions from this study.

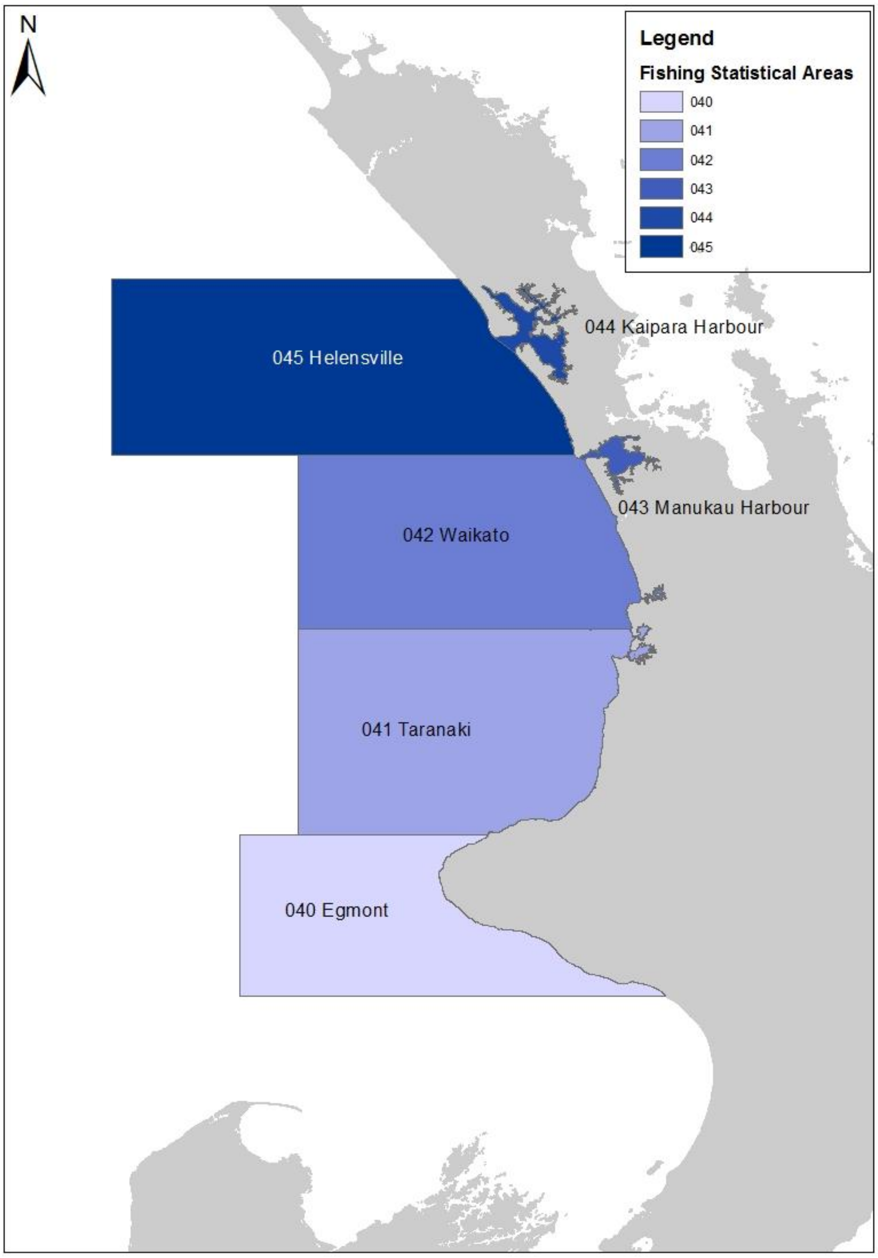
The main body of the report is supported by a number of appendices. Appendix A outlines the measures currently in place to protect Māui dolphin. Appendix B describes the main instruments used to regulate the fishing industry as a whole. Appendix C includes data to supplement the statistical account, in Section 2, of fishing on the West Coast if the North Island. Appendix D explains the multiplier methodology we used to estimate the costs of transitioning to alternative fishing methods in the Māui dolphin range. Appendix E is a bibliography of the other studies and sources we referred to as part of this study.

2 Fishing on the West Coast of the North Island

This section of our report provides an overview of the current situation in regards to set-netting and trawling on the West Cost of the North Island. This data is for 2014, the latest year that information was available.

BERL requested fisheries data from the Ministry for Primary Industries (MPI) on the six fisheries statistical areas that relate to the Māui dolphin range on the West Coast of the North Island. These areas are: Egmont (040), Taranaki (041), Waikato (042), Manukau Harbour (043), Kaipara Harbour (044), and Helensville (045). This request for fisheries data was to build a profile of the current fishing effort.

Figure 2-1 Commercial fishing statistical catch areas



The 2014 data is recent enough to reflect the set-netting and trawling restrictions that are already in place over part of this area.

2.1 Current fishing effort using set nets and trawling

We have focused our analysis on the current fishing effort using set nets and trawling between zero and 12 nautical miles offshore to determine whether there are opportunities to use alternative fishing methods in these areas based on the fish stock, the total allowable catch, the market value of the fish stock, and where the fish are located.[1]

The data provided by MPI included:

- the name of the fish species
- the amount of fish caught within zero to four nautical miles offshore, four to eight nautical miles, and eight to 12 nautical miles;
- the fishing method used;
- the number of times a vessel fished, and
- the size of the vessel.

Further requests to MPI for data provided the total number of trawling and set-netting vessels operating, broken down by statistical area.

Our analysis considered the total catch by fish stock and the estimated value of this catch. This allowed us to consider:

- the potential loss of revenue if these methods of fishing were prohibited;
- if the Total Allowable Commercial Catch (TACC) of these fish stocks was reached (and therefore is there the potential to change target species); and
- how much of the fishing effort currently occurs within this area, using this method.

The MPI data did not indicate how many people were on each fishing vessel. To obtain an indication of crew, we gathered data from Maritime New Zealand on how many crew are required on a vessel operating in a coastal area and offshore. The data indicated that:

- to operate in a coastal area, two crew are required on a vessel under 20 metres, while three crew are required on a vessel under 35 metres.
- to operate in an offshore area beyond 12 nautical miles, two crew are required on a vessel under 20 metres. If the vessel is operating at more than 100 nautical miles, three crew members are required.
- If the vessel is under 25 metres, three crew are required. However, if the vessel is operating more than 100 nautical miles from shore, four crew are required.

2.2 The catch within the statistical areas

The commercial catch overall

The fish species caught in the six fishing statistical areas, that are included as part of the Marine Mammal Sanctuary and Threat Management Plan, that had the highest value in 2014 were Snapper, Grey Mullet, Trevally, Rig, Gurnard, and John Dory.

[1] MPI records the following common fishing methods related to trawling: bottom pair trawl, bottom trawl, and mid water trawl. In the areas of interest only bottom trawl has been recorded as a trawling fishing method. Therefore our focus has been on this type of trawling.

Statistics on the catch, broken down by fisheries area and fish species, are presented in Appendix C, but the catch for the six areas combined is summarised in Table 2-1. The table also shows the percentage of each fish species caught by set net, bottom trawl, and other methods, and the estimated value of the total catch.[2]

Table 2-1 Summary of top 10 fish species caught in 2014, by catch volume

Species	2014 Catch greenweight (kgs)	Percentage caught by Set Net	Percentage caught by Bottom Trawl	Percentage caught by other methods	Estimated value (2014)
GREY MULLET	464,923	46.1%	0.0%	53.9%	$1,673,722
TREVALLY	411,621	13.3%	83.8%	2.9%	$783,496
SNAPPER	366,216	4.3%	94.2%	1.5%	$2,180,635
SKIPJACK TUNA	315,567	0.0%	0.0%	100.0%	$157,784
GURNARD	281,505	4.0%	92.5%	3.5%	$740,359
RIG	177,982	91.0%	7.9%	1.0%	$683,481
KAHAWAI	133,182	18.4%	71.6%	10.0%	$101,884
BARRACOUTA	99,242	0.0%	99.7%	0.3%	$32,750
JACK MACKEREL	70,873	1.4%	13.9%	84.7%	$21,970
SCHOOL SHARK	68,666	68.8%	28.4%	2.7%	$179,762

Source: Ministry for Primary Industries and BERL

Snapper is the most valuable fish species overall, with an approximate total value, using MPI port prices, of around $2.18 million. Statistics New Zealand retail fish prices indicate that, of the fresh fish on the market, Snapper is the most valuable and fetches the highest price per kilogram. However, Snapper are, by weight, only the third most caught fish in this inshore fishery, after Grey mullet and Trevally.

As will be seen in appendix C, the proportion of Snapper caught by trawling in the six statistical areas varies between 72 and 100 percent. This proportion varies because statistical areas such as the Waikato and Helensville report no Snapper being caught by set-netting, while areas such as Egmont, Taranaki, Manukau Harbour and Kaipara Harbour have some Snapper caught in set nets.

In addition, between 60 and 100 percent of the Snapper landed by trawler were caught within eight nautical miles of shore in 2014. In areas where set-netting of Snapper occurs, between 64 and 74 percent of Snapper were caught within this distance from shore. In terms of TACC, Snapper was almost at the limit in 2014, with 98 percent of the TACC caught in that year.

Commercial catch by trawl

Table 2-2 describes the catch, by trawl, of the top 10 fish species in the six statistical areas. The table shows the total catch for 2014 for the 10 fish species, as well as the estimated value of the fish caught and the percentage of TACC that this fish represents.[3]

[2] Prices for each fish species are based on 2014/15 port prices provided by the Ministry for Primary Industries.

[3] For this report TACC refers to only the 2014/15 TACC for the Fishing Management Areas (FMA) 8 and 9. The commercial catch detailed in this report are caught exclusively in these two FMAs.

Table 2-2 Summary of top 10 species caught by trawl in 2014, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC	Estimated value (2014)
TREVALLY	345,021	16.0%	$656,727
SNAPPER	344,903	26.5%	$2,053,727
GURNARD	260,458	11.4%	$685,005
BARRACOUTA	98,952	0.9%	$32,654
KAHAWAI	95,307	18.3%	$72,910
JOHN DORY	47,794	17.8%	$336,049
TARAKIHI	26,883	1.9%	$81,103
SCHOOL SHARK	19,532	2.8%	$51,133
RIG	14,118	2.0%	$54,215
LEATHERJACKET	9,990	0.9%	$5,694

Source: Ministry for Primary Industries and BERL

As will be seen in Appendix C, approximately 75 percent of the Trevally and Snapper caught by trawlers are caught in the Helensville statistical area. These two fish species, along with Gurnard, are the three that are caught in the largest numbers across all six statistical areas.

Almost 85 percent of Barracouta are caught within the southern Egmont and Taranaki statistical areas, while almost 90 percent of the Kahawai are caught in the two northern Waikato and Helensville statistical areas.

This indicates that, while a large portion of the catch within each area is accounted for by three species (Snapper, Trevally and Gurnard), there are still differences in the fish species that make-up the remainder of the catch.

The table also shows that the percentage of the annual TACC for each of the species that is caught within the six statistical areas varies considerably. However, it is clear that the six areas account for large proportions of the TACC for Snapper, Kahawai, John Dory, Trevally and Gurnard.

John Dory, Gurnard and Tarakihi do not feature in the other tables in this section, which implies that almost all of the catch of these species within the six areas is by trawl. The MPI data also show that two-thirds of this catch is within eight nautical miles. Only a small number of these fish species are caught by set net.

John Dory ranks alongside Snapper in terms of value per kilogram. John Dory and Gurnard are sold predominantly as whole fish or as fillets. John Dory is also exported as a whole, chilled fish.

Commercial catch by set net

Table 2-3 describes the catch of the top 10 fish species caught by set net in the six statistical areas. Again, for each species, it shows the weight of the catch, the proportion of the TACC within the six areas, and the estimated value of the catch.

Table 2-3 Summary of top 10 species caught by set net in 2014, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC	Estimated value (2014)
GREY MULLET	214,410	23.2%	$771,875
RIG	161,998	23.4%	$622,100
FLATFISH	60,898	5.1%	$274,039
YELLOWBELLY FLOUNDER	57,093	0.0%	$255,129
TREVALLY	54,728	2.5%	$104,171
SCHOOL SHARK	47,253	6.9%	$123,705
COMMON WAREHOU	31,875	0.0%	$68,233
KAHAWAI	24,527	4.7%	$18,763
SNAPPER	15,904	1.2%	$94,700
PARORE	12,576	0.0%	$24,775

Source: Ministry for Primary Industries and BERL

Grey Mullet is the top species, by weight, caught by set net in 2014; and these fish are primarily caught in the Manukau and Kaipara harbours. Grey Mullet also account for the highest total value of any of the top 10 species caught using this method, although the data in the table suggest that Rig have a higher value per kg. Rig and School Shark (the sixth most caught fish) are the fish predominantly served at the fish and chip shop.

In the Egmont fisheries statistical area 96 percent of Rig are caught by set net, while 92 percent are caught using this method in the Taranaki fisheries area. This contrasts with the Waikato area, where trawling is used to catch Rig. Across all of the areas, the majority of Rig is caught within eight nautical miles.

School Shark is caught in the Taranaki and Egmont fisheries statistical areas only; and around 60 percent of the fish are caught by set net within eight nautical miles of shore. Accordingly, this catch will be significantly impacted by the restrictions designed to protect Māui dolphin.

Flatfish and Yellowbelly Flounder are two other species that are caught primarily by set net in the Manukau and Kaipara harbours. Like Grey Mullet, these two species are not caught by bottom trawling. Flatfish has the highest port price per kg of all the fish caught by set net, slightly ahead of the port price for Snapper and John Dory.

Trevally are caught by both set net and trawling. Although a larger proportion of the total Trevally catch is by trawling, the majority of the catch within eight nautical miles of the shore is by set-netting. Trevally are most abundant further offshore at depths of about 80 metres, which explains why trawling is more effective overall.

With set-netting, the pattern of the catch is different between the in-harbour areas (Manukau and Kaipara) and the areas outside the harbours (Egmont, Taranaki, Waikato and Helensville). Table 2-4 and Table 2-5 present the top five species caught by set net within these two broader areas; and as can be seen, only Rig and Trevally are caught in large numbers both inside and outside the harbours.

Table 2-4 Summary of top five species caught by set net outside the harbours in 2014, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC	Estimated value (2014)
RIG	79,773	11.5%	$306,341
SCHOOL SHARK	46,885	6.8%	$122,741
COMMON WAREHOU	31,873	0.0%	$68,229
TREVALLY	15,700	0.7%	$29,884
SNAPPER	14,830	1.1%	$88,305

Source: Ministry for Primary Industries and BERL

Rig and School Shark dominate the catch from set-netting outside the harbours, while Grey Mullet dominate the catch by set netting within the harbours. Flatfish and Yellowbelly Flounder are also important species within the harbours.

Table 2-5 Summary of top five species caught by set net inside the harbours in 2014, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC	Estimated value (2014)
GREY MULLET	214,409	23.2%	$771,872
RIG	82,225	11.9%	$315,759
FLATFISH	60,403	5.1%	$271,811
YELLOWBELLY FLOUNDER	57,092	0.0%	$255,124
TREVALLY	39,028	1.8%	$74,287

Source: Ministry for Primary Industries and BERL

The two tables also indicate that, both by weight and by value, set netting is more productive within the harbours than outside the harbours.

3 Developing the economic impact of transition scenarios

In this section, we present the data and other information that governed how we specified the scenarios of economic impact that are presented in Section4.

Exactly what will happen if there is a switch to longlining cannot be predicted; and many different outcomes could be envisaged. However, for the purposes of this study, we developed two plausible scenarios based on differing assumptions about:

- whether and to what extent it would be technically possible for the current fishing fleet to make the change from trawling and set netting to longlining
- how the fish catch and, consequently, the revenue from each boat would change, and
- the extent to which the fishers would need training and support in order to adapt to their new circumstances.

Many different assumptions could be made about each of these factors, but we restricted the assumptions to enable us to develop optimistic and pessimistic versions of a principal scenario, and optimistic and pessimistic versions of an alternative scenario. In what follows, the assumptions that underpin the scenarios and their respective versions are spelled out, but the key difference between the principal and alternative scenarios is that the latter assumes that boats that are not suitable for conversion to longlining will be replaced, using a financing package, rather than simply being retired and not replaced.

Based on studies completed elsewhere in the world, BERL assumes that the transition process will take approximately three years.[4] Beyond year 3 we envisage there will be additional factors impacting on the fishing industry. The response to restrictions and transition to alternative methods are likely to be accompanied by additional responses to customer and market changes. These additional changes would include demand behaviour and customer taste changes, changes in stock and Annual Catch Entitlement (ACE), and vessel costs, pricing, and the impact of new research and development applications to new fishing methods, new product and market development. In this context, there will likely be decisions and responses regarding maintenance and renewal of equipment, not to mention investment in workforce skills training.

Consequently, estimating transition costs beyond year 3 would require a more sophisticated modelling of the long-term development of the industry. However, we expect transition costs beyond year 3 to be noticeably less than those in the first 3 years.

3.1 The factors affecting the impact of transition

Before setting out the scenarios and their likely economic impact, it is important to discuss the factors about which it was necessary to make assumptions.

3.1.1 Feasibility of switching to longlining

Fishers use set nets and trawling on the West Coast of the North Island because these are currently the most efficient means of catching the fish species they are targeting. They catch these target species to meet market needs, as part of the Quota Management System and the Total Allowable Commercial Catch (TACC).

[4] Vivid Economics. (2014). Towards Investment in Sustainable Fisheries: The Role of Finance. Discussion Paper Prepared for ISU-EDF; California Fisheries Fund. (2013). Investing in sustainable fishing. (www.californiafisheriesfund.org); Rangeley, R. W., & Davies, R. W. D. (2012). Rising the "Sunken Billions": Financing the transition to sustainable fisheries. Marine Policy 36, 1044-1046.

The inshore fishing fleet in this area consists of independent fishers who are contracted to companies that have large quota, and small-scale owner-operators. The fish species these fishers target are within shallower, inshore waters.

The independent fishers that are contracted to harvest fish lease the right to catch a quota for a particular time in a particular area. They then land this fish to licensed fish receivers (LFRs) or processing facilities, and this fish goes to domestic and international markets.

The reason why fishers lease the right to catch is because a quota owner cannot move between management areas, they have quota to fish a particular fish stock within a particular area. However, Annual Catch Entitlements (ACE) may be transferred to other people. If ACE is transferred, the new owner is entitled to take the amount of ACE that was transferred and the previous owner's catch rights are reduced by the amount that was transferred. For this transfer to occur, ACE needs to be available. In addition, this ACE needs to have a commercial value.

Smaller owner-operators, who are less able to change their boats, their fishing methods, or their ACE due to fishing restrictions, are most vulnerable to a change from commercial set-netting and conventional trawl to another fishing method. If further restrictions are implemented, a major benefit to fishers of changing the method of fishing from commercial set-netting and trawling to another method is the ability to continue to fish in this area and potentially catch their target species. Certainty regarding access to a fishing area is important – if fishers know they can fish in an area, there is an incentive to continue to invest in vessels, crew and sustainable fishing practises.

At a basic level, if further restrictions to fishing areas and fishing methods go ahead, the greatest impact will be on trawling. The catch data that we have analysed indicates that almost all of the John Dory, Gurnard and Tarakihi caught within this area was caught using this method, and that between 60 and 100 percent of Snapper was caught by trawling. In 2014, the majority of this catch was within eight nautical miles of shore.

Some Snapper and Gurnard are already caught using longline fishing methods in this area, but the volumes are comparatively small. The industry advice we have received indicates that it is also possible to catch Rig and School Shark by longline fishing. Trevally can also be caught using this method but greater effort is required. Consequently, if this method was considered the method that fishers should convert to, there could also be some associated reduction in catch volumes.[5]

It should also be noted that longline fishing can lead to bycatch. Bycatch is when a fish or other marine species is caught unintentionally when catching a certain target species. This study assumes that conversion to long lining will entail use of best practice sea bird by-catch mitigation techniques. In New Zealand, bycatch of non-target fish species can lead to penalties such as Deemed Values (DVs).

These penalties could be particularly problematic when the bycatch is Snapper, because of the species' high value per kilogram and the associated DVs. This unintentional catch could also lead to an increase in fish mortality, particularly among juvenile fish.

It has not been possible for this analysis to examine the non-target fish by-catch issue in detail, but it is clear that if a transition is to take place, it will be important for the Government and the relevant quota holders to consider potential modifications to the ACE on the West Coast of the North Island to better enable fishers to make longlining commercially viable.

[5] We note that the quality of the fish caught may change with a change in fishing method. However, for this research we have assumed that this does not happen. There is ongoing international research into the quality of fish caught using longlining versus trawl. See for example, Clarke, Borges & Officer (2005); Hareide (1995); Rotabakk, Skipnes, Akse & Birkeland (2011), and Nofima (2010).

The potential to fish in deeper water was considered but advice received indicates there is either little or no potential to catch most of the species targeted in this region at greater depth, so it was not included as an option within this analysis.

There is also the potential for new trawling technology to be developed that does not pose a threat to dolphins and that can replace traditional trawling methods with minimal impact on the type and quantity of fish caught. Installing such technology might have significant up-front costs that warrant transitional assistance. However, this study has focused on existing fishing methods.

This study focusses on commercial fishers changing from bottom trawling and set-netting to longline fishing. With longline fishing unsuitable for the Kaipara and Manukau Fisheries we have split commercial set-netters in our analysis into those who catch fish inside the harbours and those that catch fish outside the harbours. This is because commercial set-netters fishing inside the harbour cannot change to longline fishing, unless they also change to fishing outside the harbour area.

Industry advice received by BERL indicates that:

- Commercial fishing boats that trawl or set net cannot fish further out using these methods.
- To continue fishing these commercial fishing boats would need to change to longline fishing methods.
- Commercial set net boats under 20 metres are unable to change to longlining but trawl boats under 20 metres may be able to change to longlining.
- Not all commercial trawling boats will be able to change gear to longlining due to the individual setup of the boat.
- Longlining is impracticable for commercial fishing within the Manukau and Kaipara Harbours.

This means not all of the current fleet of set-netters and trawlers will be able to continue to operate on the West Coast of the North Island if these methods of fishing are restricted. Some of these commercial fishing boats will exit the industry.

Against this background, **we estimate that between 78 and 84 of the 87 commercial fishing boats operating on the West Coast of the North Island will exit the fishing industry.**

- Commercial fishing boats that currently set net in the Kaipara and Manukau Harbours will no longer be able to operate in this area. This is because these harbours are unsuitable for longlining. Further, all **54** commercial boats in these harbours are less than 20 metres in length, and are unsuitable to change to operating longlines in areas outside the Harbours.
- Commercial fishing boats that currently set net outside the Harbours on the West Coast of the North Island will no longer be able to operate in this area. This is because all **21** of these boats are less than 20 metres in length, and it is unsuitable to change these boats to operate longlines.
- Between **3** and **9** of the 12 commercial inshore trawl boats will be unable to change their gear from trawling to longlining. These boats will be unable to continue operating.

Our estimate of between 3 and 9 commercial inshore trawl boats exiting the industry is based on industry advice that not all commercial trawlers operating in inshore fisheries may be able to change their gear, but this assumption is not made on detailed knowledge of each trawl boat's ability to have its gear changed from trawling to longlining. This is why we have included a range of potential boat losses.

In addition to the industry advice, BERL has assumed that no commercial fishing boat that is unable to change to longline fishing methods will purchase a new boat. This assumption is based on previous studies of the West

Coast of the North Island fishers by Aranovus Limited (2007).[6] This study found that the finances of inshore commercial fishers were such that they were unlikely to make large capital investments, such as the purchase of a new boat.

Each fishing boat will have a different design, setup, length, and age, so the cost of refitting will vary substantially. This cost is considered a one-off cost that would occur in the first year of the transition. **Industry advice indicated that the cost per boat could vary from $20,000 to $100,000 per boat**. The range depends on, as mentioned, each boat's **design, setup, and the level of investment** each boat owner wants to make in the fishing gear.

It is assumed that a sufficient number of businesses are available to undertake this work. It is also assumed that changing fishing gear will not cause any additional loss in revenue for the commercial fishing boats that undertake this transition, beyond those already accounted for.

3.1.2 How the catch and revenues will change

To estimate the loss of revenue from these commercial fishing boats exiting the fishing industry, we have estimated the revenue that these exiting boats would have generated.

This impact does not include any commercial fishing boats that may leave the industry for any other reasons. It is assumed that all boats that are able to transfer to using longline fishing methods will do so, and that they will continue to fish in this area.

The data that follows relate to commercial fishing boats engaged in set-netting or trawling. We note that, in particular, we do not estimate the number engaged in other methods of fishing in these fishing areas, although they are reflected in Table 2-1 in terms of catch volumes. We assume that those engaged in other methods of fishing continue their operations and are unaffected by any restrictions or consequent transition arrangements.

According to the MPI, 87 commercial set net and bottom trawl fishing boats operated on the West Coast of the North Island, catching an estimated 2.7 million kgs of fish in 2014.

Catch data was provided by MPI, and our detailed analysis of this data was provided in the previous section. The catch data contains monthly catch volume, split by fish species, fishing method, statistical area of catch, number of fishing events that occurred in the month and the number of boat involved in the fishing events.

From the 2011-2013 data we calculate that:

- 54 of the 87 commercial fishing boats used set nets to fish in the Manukau and Kaipara Harbours and caught an estimated 435,000 kgs of fish a year.
- 21 of the 87 commercial fishing boats used set nets to fish outside the Manukau and Kaipara Harbours and caught an estimated 264,000 kgs of fish a year.
- 12 of the 87 commercial fishing boats used trawling to fish and caught an estimated 2.0 million kgs of fish a year.

Loss of revenue from fishing boats exiting the industry

The annual revenue lost is estimated at between $3,871,000 and $6,915,000. This includes $1,572,000 in lost revenue from the exit from the industry of the 54 set-netters operating in the harbours, and $778,000 in lost revenue from the exit from the industry of the 21 set-netters operating outside the harbours. The annual revenue lost estimate is presented as a range because it is estimated that between $1,522,000 and $4,566,000 revenue will be lost following the exit of commercial trawlers from the industry.

[6] Aranovus Limited (2007) A socio-economic impact assessment of fishers: proposed options to mitigate fishing threats to Hector's and Māui Dolphins.

This estimate of lost revenue was based on MPI commercial catch data for 2011, 2012 and 2013. This catch data allowed us to estimate the average revenue per boat for set-netters and trawlers as it specifies the fishing method, fish species, and the weight of the catch. These estimates were based on the following assumptions:

- That the average catch across the three years of 2011, 2012 and 2013 reflects the normal standard annual catch for these commercial fishing boats.
- That data on the 2014/15 port price per kilogram of fish was provided by the Ministry of Primary Industries (MPI). Port prices are the agreed prices received by commercial fishers for their landed catch.
- For any fish species not included in the port price list provided by the Ministry of Primary Industries, a $0.50 per kilogram price was assigned to provide a nominal value for these fish. This nominal price covers around 12,000 kg of fish.
- For the purposes of this study, each boat catches the same weight of the same species of fish.

Across the 2011, 2012 and 2013 years, the 54 commercial set net fishing boats operating in the harbours caught an average of 8,100 kgs of fish per boat, or 435,000 kgs in total. The main fish species caught was Grey Mullet, Rig, Flatfish and Yellowbelly flounder. Using the 2014 port price data ($ per kilogram) provided by MPI, we estimate that each commercial set netter would receive an average of approximately $29,100 from their 8,100 kgs of fish[7].

The 21 commercial set net fishing boats operating outside the harbours caught an average of 12,600 kgs of fish per boat, or 264,000 kgs in total. The main fish species caught were Rig, School Shark, Trevally and Snapper, with each boat catching on average more than 1,000 kgs of these fish species. Using the 2014 port price data provided by MPI, we estimate that each commercial set netter would receive an average of approximately $37,000 from their 12,600 kgs of fish.

Across the 2011, 2012 and 2013 years, the 12 commercial trawl fishing boats caught an average 166,000 kgs of fish per boat. The main fish species caught were Trevally, Snapper, Gurnard and John Dory, with each boat catching on average more than 1,000 kgs of these fish species. Again using the 2014 port price data, we estimate that each commercial trawler would receive an average of approximately $507,000 for their annual 166,000 kgs of fish.

Reduced revenue from remaining boats

The remaining commercial fishers that are able to change from trawling to longline fishing face a drop in their annual revenue stemming from two sources:

1. **Each type of fishing method requires the crew to be trained**. It is assumed that the remaining fishing boats and their crew would take around two years to become trained in the use of longline fishing, and to be able to use the longline gear efficiently, and maximise their fish catch using this method.
2. From industry advice we know that fishers using the longlining fishing method **would catch lower volumes** of Gurnard, John Dory and Trevally, three of the four main types of fish targeted by inshore fishers in this area. Therefore the total annual fish catch using longline fishing would be lower than the current annual fish catch using trawling.

While the training of crew to use longline fishing would cause a temporary drop in revenue, the lower annual catch volumes would cause an ongoing loss of revenue until the fishery adjusts to new conditions.

[7] The estimated revenue here is extremely small. This might imply that the operations in question are not truly commercial, even though they have commercial licences. Alternatively, it might be that they are commercial, but only part-time. A third possibility is that the fishers do not rely solely on the landed price of the fish they catch, but also generate additional revenues by retailing the fish themselves.

We have assumed that:

- The price per kilogram of fish will remain constant across the three year transition period.
- The main fish species targeted by longlining will be similar to that currently targeted by trawlers and set-netters, which are Snapper, John Dory, Gurnard, Trevally and Rig.
- **Fish catch revenue in the first year will be between 32 and 79 percent lower** than the current $507,000 revenue per trawl boat due to lower catch volumes from using the longline fishing method and the retraining of crew in the use of longline.
- Fish catch revenue **in the second year will be between 20 and 58 percent lower** than the current $507,000 revenue per trawl boat due to lower catch volumes and the retraining of crew.
- Fish catch revenue **in the third year will be between 9 and 36 percent lower** than the current $507,000 revenue per trawl boat due to lower catch volumes using longlining.

3.1.3 Retraining the fishers

Fishers who are no longer able to work in the fishing industry will need to retrain to find work in other industries within the local economy. This retraining package could include:

- Course fees to attend a local tertiary education provider and complete an appropriate qualification to work in another industry
- Student allowance while undertake the training
- Central government funding of the course and qualification
- Up to one year of Job Seeker benefit, as the ex-fisher seeks work on completion of their qualification.

With between 78 and 84 commercial fishing boats no longer able to operate, their workers will no longer have a job in the fishing industry. Without talking directly to each boat's captain or owner, BERL have assumed that:

- Each commercial set-net boat is carrying two crew including the captain, as this is the minimum number of crew required by Maritime New Zealand rules for boats under 24 metres operating in coastal waters.
- Each commercial trawler boat is carrying three crew including the captain, as this is the minimum number of crew required by Maritime New Zealand rules for boats under 35 metres operating in coastal waters.
- Under this assumption it would mean that an estimated **159 to 177 crew/workers operating these boats could be the subject of the retraining package**.

However, earlier studies of the West Coast of the North Island fishers indicate that the average age of set net fishers was early-50s, while trawl fishers were slightly younger, with an average age in the late-40s. Given the average age of the fishers, it is expected that a small proportion would retire rather than retrain and look for other work.

BERL have therefore assumed that:

- **25 percent of the estimated 159 to 177 affected workers will retire, leaving 119 to 133 crew/workers requiring retraining to help them find work in the area**.

For the retraining package the following assumptions have been made:

- The courses undertaken will range from 17 weeks to one year of full-time study
- The affected workers will study full-time

- The cost of course fees is between $3,200 and $6,700 per individual
- The cost of student allowance is between $4,760 and $11,200 per individual
- The cost of central government funding for the courses is between $3,480 and $8,190 per individual
- The cost of Job Seeker benefits is an annual $11,190 per individual.

4 Estimated economic impact of the transition scenarios

In this section, we present our estimates of the economic impact of transitioning, away from trawling and set netting in the six fisheries statistical areas where Māui dolphin are present, to the use of longlining as the method of fishing.

To ensure we cover a range of possible options, we present in this section the estimated economic impacts of four transition scenarios. These four scenarios are arranged as optimistic and pessimistic versions of a principal scenario and an alternative scenario. The main difference between these two overarching scenarios is our assumption made about what occurs with commercial fishing boats unable to make the transition as is. In our principal scenario it is assumed that these commercial fishing boats exit the industry, while in our alternative scenario it is assumed that these commercial fishing boats are exchanged for commercial fishing boats capable of fishing using the alternative fishing methods.

4.1 Principal scenario

4.1.1 Optimistic version

The assumptions underpinning this scenario and version are summarised in Table 4-1

Table 4-1 Assumptions used for optimistic version of the principal scenario

Assumptions about transitioning to new fishing method • Commercial fishing boats under 20m cannot change to longlining • Longline fishing cannot occur within Manukau and Kaipara Harbours • All commercial boats able to change to longlining will do so • No new commercial fishing boats will be purchased • 25 percent of commercial boats over 20m cannot change to longlining • It will cost $20,000 per boat to change fishing method to longlining
Assumptions about the catch and revenues • The price of fish will remain constant over the three years • Fish catch revenue for boats longlining, will be 32 percent lower than 2014, in year one • Fish catch revenue for boats longlining, will be 20 percent lower than 2014, in year two • Fish catch revenue for boats longlining, will be 9 percent lower than 2014, in year three
Assumptions about retraining the fishers • Commercial set net boats carry two crew including the captain • Commercial trawl boats carry three crew including the captain • 25 percent of crew unable to operate will retire • Course length is 17 weeks • Study is full-time • Course fees are $3,207 per individual • Student Allowance is $4,763 per individual • Cost of Government funding per course is $3,480 per individual • Cost of Jobseeker benefit to Government is $11,190 per year per individual

The total impact under the optimistic scenario is $15.45 million in year one, reducing to $10.97 million in year three. The optimistic scenario represents our best case scenario. Table 4-2 shows the impact on the fishing industry on a per-boat basis, and the impact on the Government of the cost of transition.

Table 4-2 Summary of net impact of principal optimistic scenario across three years of transition

	Optimistic scenario						
	#	Year ($) Total			Year ($) per boat		
		1	2	3	1	2	3
Direct impact on industry							
Direct impact on set netting							
loss of revenue from boat exits (Habours)	*54*	1,571,547	1,571,547	1,571,547	29,103	29,103	29,103
loss of revenue from boat exits (excl. Harbours)	*21*	777,758	777,758	777,758	37,036	37,036	37,036
Direct impact on trawling							
loss of revenue from boat exits	*3*	1,521,960	1,521,960	1,521,960	507,320	507,320	507,320
reduced revenue from remaining boats	*9*	1,452,079	933,112	414,146	161,342	103,679	46,016
increased costs of boat refits	*9*	180,000	0	0	20,000	0	0
Subtotal of direct impacts		5,503,343	4,804,376	4,285,410			
Impact on wider community							
Indirect effects		5,833,544	5,092,639	4,542,534			
Induced effects		2,751,672	2,402,188	2,142,705			
Total		14,088,558	12,299,204	10,970,649			
Impact on govt							
retraining of displaced workers	*119*						
student allowances		566,774					
course study fees		381,633					
EFTS SAC funding		414,159					
job seeker support			1,331,719				
Total		1,362,565	1,331,719	0			
Total impact		**15,451,124**	**13,630,923**	**10,970,649**			

Source: BERL

In year one direct impacts on the fishing industry from the reduction in revenue and an increase in costs will total around $5.50 million. The direct impacts will decline in year two to $4.80 million and further decline in year three to $4.29 million.

In addition to the direct impact in the fishing industry, there will be a flow-on impact on wider community, this comprises $5.83 million in indirect and $2.75 million in induced effects that impact on both the fishing industry and the wider community. The overall impact on the fishing industry and wider community in year one will be a total impact of $14.09 million.

The indirect and induced effects are felt throughout the industry and include the impact on the suppliers to fishing boats, such as those supplying fuel and gear. In addition, businesses that purchase fish from these commercial fishing boats will be affected by the lower volumes of fish available. Businesses that provided goods and services to the workers on these fishing boats will also be affected.

In year two the total impact on the fishing industry and wider community will reduce to $12.30 million and then to $10.97 million in year three, as the direct impacts reduce across the three years.

The impact on the Government from the proposed retraining package is $1.36 million in year one, $1.33 million in year two and $0 in year three. This is based on the assumption that the displaced workers will undertake study in the first year and by the end of year two will have secured a new job.

Cost of changing fishing gear

The cost of changing from trawling to longline equipment is variable depending on the length of the boat and its design. BERL assumes that in this optimistic scenario the cost would be **$20,000 per boat**.

Change in revenue from fishing

Under this scenario it is estimated that the **9 commercial trawl boats transferring to longline will catch less fish and that this will reduce revenue** by:

- $161,300 per boat in year one;
- $103,700 per boat in year two.

Once the fishers are proficient with the longline equipment and are able to efficiently catch fish, it is estimated their revenue will decline by 9 percent. This reduction of $46,000 per boat (from the current revenue earned from trawling) assumes there is no change in the price of fish across the period, or due to the change in catch amounts.

Retraining crew

Under this scenario, BERL estimates that the following tertiary qualification costs, student allowance payments and SAC funding costs will be incurred:

- $4,763 per individual for student allowance payments;
- $3,207 per individual in course fees;
- $3,480 per individual in SAC funding.

4.1.2 Pessimistic version

The assumptions underpinning this scenario and version are summarised in Table 4-3

Table 4-3 Assumptions used for pessimistic version of the principal scenario

Assumptions for this scenario match those already noted for the Principal Optimistic Scenario, except for the following:
Assumptions about transitioning to new fishing method • 75 percent of commercial boats over 20m cannot change to longlining • It will cost $100,000 per boat to change fishing method to longlining
Assumptions about the catch and revenues • Fish catch revenue for boats longlining, will be 79 percent lower than 2014, in year one • Fish catch revenue for boats longlining, will be 58 percent lower than 2014, in year two • Fish catch revenue for boats longlining, will be 36 percent lower than 2014, in year three
Assumptions about retraining the fishers • Course length is 1 year • Study is full-time • Course fees are $6,700 per individual • Student Allowance is $11,206 per individual • Cost of Government funding per course is $8,189 per individual • Cost of Jobseeker benefit to Government is $11,190 per year per individual

The total impact under the pessimistic scenario is $25.02 million in year one, reducing to $19.12 million in year three. The pessimistic scenario represents our worst case scenario. Table 4-4 shows the impact on the fishing industry on a per-boat basis, and the impact on the Government of the cost of transition.

Table 4-4 Summary of net impact of principal pessimistic scenario across first three years of transition

	Pessimistic scenario						
	#	Year ($) Total			Year ($) per boat		
		1	2	3	1	2	3
Direct impact on industry							
Direct impact on set netting							
loss of revenue from boat exits (Habours)	*54*	1,571,547	1,571,547	1,571,547	29,103	29,103	29,103
loss of revenue from boat exits (excl. Harbours)	*21*	777,758	777,758	777,758	37,036	37,036	37,036
Direct impact on trawling							
loss of revenue from boat exits	*9*	4,565,879	4,565,879	4,565,879	507,320	507,320	507,320
reduced revenue from remaining boats	*3*	1,201,937	877,066	552,194	400,646	292,355	184,065
increased costs of boat refits	*3*	300,000	0	0	100,000	0	0
Subtotal of direct impacts		8,417,121	7,792,249	7,467,378			
Impact on wider community							
Indirect effects		8,922,148	8,259,784	7,915,420			
Induced effects		4,208,560	3,896,125	3,733,689			
Total		21,547,829	19,948,158	19,116,487			
Impact on govt							
retraining of displaced workers	*133*						
student allowances		1,490,478					
course study fees		891,100					
EFTS SAC funding		1,089,137					
job seeker support			1,488,392				
Total		3,470,715	1,488,392	0			
Total impact		**25,018,544**	**21,436,550**	**19,116,487**			

Source: BERL

In year one direct impacts on the fishing industry from the reduction in revenue and an increase in costs will total around $8.42 million. The direct impacts will decline in year two to $7.79 million and further decline in year three to $7.47 million.

In addition to the direct impact in the fishing industry, there will be a flow-on impact on wider community, this comprises $8.92 million in indirect and $4.21 million in induced effects that impact on both the fishing industry and the wider community. The overall impact on the fishing industry and wider community in year one will be a total impact of $21.55 million.

In year two the total impact on the fishing industry and wider community will reduce to $19.95 million, and then to $19.12 million in year three, as the direct impacts on the industry reduce across the three year period. By year three the impact on the fishing industry and wider community in this scenario is $8.15 million larger than the optimistic scenario.

The impact on the Government from the proposed retraining package is $3.47 million in year one, $1.49 million in year two and $0 in year three.

Cost of changing fishing gear

The cost of changing from trawling to longline equipment is variable depending on the length of the boat and its design. BERL assumes that in this pessimistic scenario the cost would be $100,000 per boat.

Change in revenue from fishing

Under this scenario it is estimated that the **3 commercial trawl boats transferring to longline will catch less fish and that this will reduce revenue** by:

- $400,600 per boat in year one
- $292,400 per boat in year two.

Once the fishers are proficient with the longline equipment and are able to efficiently catch fish, it is estimated that their revenue will decline by 36 percent. This reduction of $184,100 per boat (from the current revenue earned from trawling) assumes no change in the price of fish across the period or due to the change in catch amounts.

Retraining crew

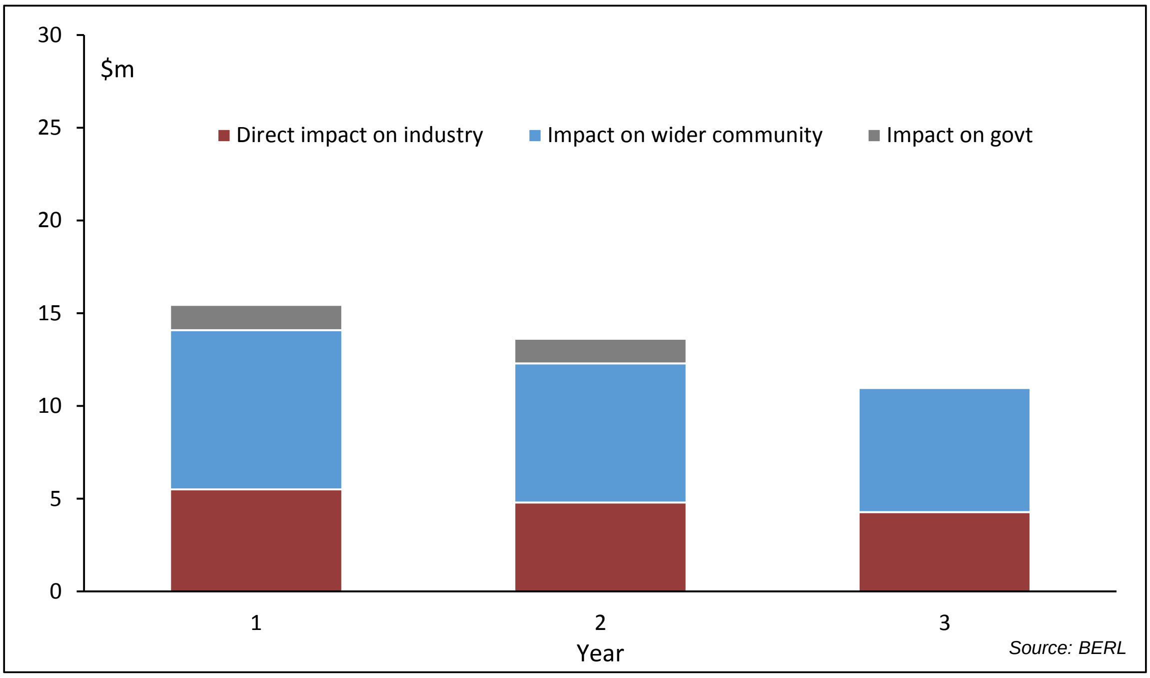
Under this scenario, BERL estimates that the following tertiary qualification costs, student allowance payments and SAC funding costs will be incurred:

- $11,206 per individual for student allowance payments,
- $6,700 per individual in course fees
- $8,189 per individual in SAC funding

4.1.3 Summary

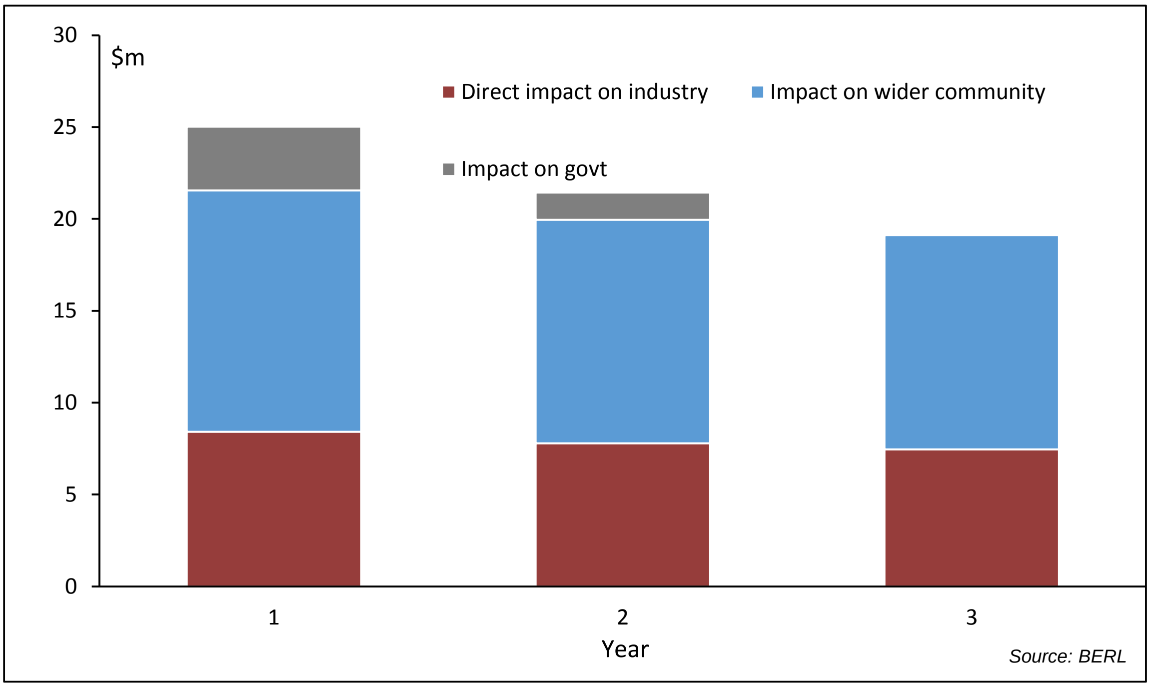
In summary, both the optimistic and the pessimistic scenarios show that the largest impact of the transition occurs in year one. As illustrated in Figure 4-1 and Figure 4-2 the net year one impact ranges from $15.45 million to just over $25 million.

Figure 4-1 Overall net impact of principal optimistic scenario across three years



As discussed earlier, the first year sees the biggest upheaval with between 78 and 84 fishing boats potentially leaving the industry, and between 3 and 9 boats changing their fishing methods from trawling to longline. In addition, the greatest decline in revenue is in year one as the remaining boats retrain to use longline fishing methods and people who are unable to work in the industry retrain and gain new qualifications and skills.

Figure 4-2 Overall net impact of principal pessimistic scenario across three years



It is also clear from these figures that the largest impact of this transition is in the form of direct costs on the fishing industry, and indirect costs on the industry and wider community, with the impact on the Government of its retraining packages being only a small percentage of the overall impact in both scenarios. This means extending protection for Māui dolphin will disadvantage the fishing industry. **Here we would note that mitigating the overall costs of transition could be addressed by focussing on the direct impact of the transition. Mitigating these direct impacts would in turn avoid the majority of the indirect 'multiplier' effects being experienced.**

4.2 Alternative scenario

4.2.1 Optimistic version

For these alternative scenarios, we are looking at further optimistic and pessimistic scenarios. However, compared to the principal scenario, instead of fishing boats exiting the industry, they are exchanged for second-hand fishing boats suitable for longlining, using financing assumed to have been provided by the Central Government. For modelling purposes we have assumed the financing has been provided in this scenario is via a Central Government grant or similar financing deal. Moreover the financing of the boat exchange would more realistically need to be the result of a joint venture between the fishing industry and the Central Government.

This means that the boats which are not suitable to be changed over to longlining exiting out of the fishing industry, which under our previous scenarios ranged from 78 to 84 boats, will under this scenario be sold off and second hand boats suitable for longlining will be purchased in the first year of the transition period.

The assumptions underpinning this scenario and version are summarised in Table 4-5

Table 4-5 Assumptions used for optimistic version of the alternative scenario

Assumptions for this scenario match those already noted for the Principal Optimistic Scenario, except for the following:

Assumptions about transitioning to new fishing method

- Commercial fishing boats will be purchased to replace boats unable to longline
- Set net boats replaced at a net cost of $410,000 per boat
- Trawlers replaced at a net cost of $310,000 per boat

Assumptions about retraining the fishers

- No retraining of crews is undertaken

Table 4-6 Summary of net impact of alternative optimistic scenario across three years of transition

	Optimistic scenario						
	#	Year ($)			Year ($)		
		1	2	3	1	2	3
		Total			per boat		
Direct impact on industry							
Direct impact on set netting							
loss of revenue from boat exits (Habours)	*14*	407,438	407,438	407,438	29,103	29,103	29,103
Reduced revenue from boats (Habours)	*40*	378,129	247,132	116,135	9,453	6,178	2,903
loss of revenue from boat exits (excl. Harbours)	*5*	185,180	185,180	185,180	37,036	37,036	37,036
Reduced revenue from boats (excl. Habours)	*16*	186,077	118,327	50,577	11,630	7,395	3,161
Direct impact on trawling							
loss of revenue from boat exits	*1*	507,320	507,320	507,320	507,320	507,320	507,320
reduced revenue from boats	*11*	1,774,763	1,140,471	506,178	161,342	103,679	46,016
increased costs of boat refits	*9*	180,000	0	0	20,000	0	0
Subtotal of direct impacts		3,618,908	2,605,868	1,772,829			
Impact on wider community							
Indirect effects		2,866,399	1,792,577	909,555			
Induced effects		1,352,075	845,555	429,035			
Total		7,837,381	5,244,000	3,111,420			
Impact on govt							
Net value of replacement boats for set netters	*61*	25,010,000			410,000		
Net value of replacement boats for trawlers	*2*	620,000			310,000		
Total		25,630,000	0	0			
Total impact		**33,467,381**	**5,244,000**	**3,111,420**			

Source: BERL

In year one direct impacts on the fishing industry from the reduction in revenue and an increase in costs will total around $3.62 million. The direct impacts will decline in year two to $2.61 million and further decline in year three to $1.77 million.

In addition to the direct impact in the fishing industry, there will be a flow-on impact on wider community, this comprises $2.87 million in indirect and $1.35 million in induced effects that impact on both the fishing industry and the wider community. The overall impact on the fishing industry and wider community in year one will be a total impact of $7.84 million.

In year two the total impact on the fishing industry and wider community will reduce to $5.24 million and then to $3.11 million in year three, as the direct impacts reduce across the three years.

The impact on the Government from finance provided to the fishing industry is $25.63 million in year one, as this is a one-off impact, in year two and year three there will be zero impact on the government.

In the previous optimistic scenario, 75 set net boats and 3 trawl boats were assumed to be unable to transition from their current fishing method to the longline fishing method. From expert advice, the set net boats were not long enough, as they needed to be at least 20 metres in length. All the set net boats were under 20 metres in length, and therefore unable to be longline boats. For the 3 trawl boats, it was assumed that 25 percent of the 12 trawl boats currently fishing in the area would be unable to change to longline based on the configuration of the boat.

Of the 159 owners and crew of these 78 boats, it was assumed that 25 percent would retire, with the remainder then undergoing retraining to enable to find work in other industries. This assumption was based on the high average age of the set net and trawl fishermen on the West Coast of the North Island from studies undertaken in 2007.

Under this alternative optimistic scenario, we still assume that 25 percent of the owners and crew would choose to retire rather than continue to operate in the fishing industry through the transition to longline fishing. This would mean that:

- Of the 54 set net boats operating inside the harbours, the crew and owners of 14 boats would retire.
- Of the 21 set net boats operating outside the harbours, the crew and owners of 5 boats would retire.
- Of the 3 trawl boats operating, the crew and owners of 1 boat would retire.

The retirements would leave **58 boats** to be swapped for second hand boats suitable for longlining.

To determine the cost of swapping the boats, we used information on current commercial boats available for purchase on the following websites:

- www.maritime.co.nz
- www.nzboatsales.com
- www.gulfgroup.co.nz

From the information collected from these sites, an analysis of the price of available commercial boats suitable for longline fishing, along with the price of set net and trawl boats was conducted. This analysis showed that on average:

- A suitable commercial longline boat could be purchased for $590,000,
- A commercial set net boat could be sold for $180,000, a net difference of $410,000
- And a commercial trawl boat could be sold for $280,000, a net difference of $310,000.

This analysis revealed that to swap each set net boat, financing of $410,000 would be needed to cover the difference between the purchase and sale prices. For a trawl boat, financing of $310,000 would be needed. Given the number of boats involved this would total:

- $25.01 million for set net boats, with 61 swapped at a coat of $410,000 per boat,
- And $620,000 for trawl boats, with 2 swapped at a cost of $310,000 per boat.

So a total of **$25.63 million** would be needed to swap all 63 commercial boats to commercial boats suitable for longlining.

For modelling purposes we have assumed the financing has been provided in this scenario is via a Central Government grant or similar financing deal. For these alternative scenarios we considered a number of options for how the investment in the replacement boats could be funded, from conventional financing from commercial banks, and a variety of financing options from a joint venture between the fishing industry and the Central Government.

We have discounted conventional financing from commercial banks, as from the fish catch data from the target area, the annual revenue for these commercial boats from the target area is too low for the boats to be able to undertake the required investment using financing from a commercial bank. Therefore using this option to fund the replacement boats, would see us in the same situation as our principal scenarios, with the majority of the boats and crew leaving the industry.

From the remaining options considered, financing from a joint venture between the fishing industry and the Central Government was considered a strong option to be explored. The joint venture between the fishing industry and the Central Government would be in the best position to provide the financing to these fishing boats. The financing would need to be interest-free in the short-term because this would allow for the largest number of commercial boats to be included, otherwise boat owners facing already tight profit margins would be unable to service the financing and interest payments while going through the three year transition period, and continue in the industry. In reality with the transition period taking around three years, and with boats during this period operating on reduced revenue as they learn to be efficient longline fishers, the financing from Central Government may need to be suspensory as well, with repayment starting no sooner than year four to allow the commercial fishers to have sufficient time to adjust to the transition from set netting and trawling to longlining.

4.2.2 Pessimistic version

The assumptions underpinning this scenario and version are summarised in Table 4-7.

Table 4-7 Assumptions used for pessimistic version of the alternative scenario

Assumptions for this scenario match those already noted for the Principal Optimistic Scenario, except for the following:
Assumptions about transitioning to new fishing method • Commercial fishing boats will be purchased to replace boats unable to longline • Set net boats replaced at a net cost of $600,000 per boat • Trawlers replaced at a net cost of $475,000 per boat
Assumptions about the catch and revenues • Fish catch revenue for boats longlining, will be 79 percent lower than 2014, in year one • Fish catch revenue for boats longlining, will be 58 percent lower than 2014, in year two • Fish catch revenue for boats longlining, will be 36 percent lower than 2014, in year three
Assumptions about retraining the fishers • No retraining of crews is undertaken

Table 4-8 Summary of net impact of alternative pessimistic scenario across first three years of transition

	Pessimistic scenario						
	#	Year ($) Total			Year ($) per boat		
		1	2	3	1	2	3
Direct impact on industry							
Direct impact on set netting							
loss of revenue from boat exits (Habours)	*14*	407,438	407,438	407,438	29,103	29,103	29,103
Reduced revenue from boats (Habours)	*40*	864,044	559,433	254,822	21,601	13,986	6,371
loss of revenue from boat exits (excl. Harbours)	*5*	185,180	185,180	185,180	37,036	37,036	37,036
Reduced revenue from boats (excl. Habours)	*16*	439,713	284,532	129,351	27,482	17,783	8,084
Direct impact on trawling							
loss of revenue from boat exits	*2*	1,014,640	1,014,640	1,014,640	507,320	507,320	507,320
reduced revenue from boats	*10*	4,006,457	2,923,552	1,840,647	400,646	292,355	184,065
increased costs of boat refits	*3*	300,000	0	0	100,000	0	0
Subtotal of direct impacts		7,217,472	5,374,775	3,832,078			
Impact on wider community							
Indirect effects		6,143,118	4,189,859	2,554,601			
Induced effects		2,897,697	1,976,349	1,205,000			
Total		16,258,287	11,540,983	7,591,679			
Impact on govt							
Net value of replacement boats for set netters	*61*	36,600,000			600,000		
Net value of replacement boats for trawlers	*7*	3,325,000			475,000		
Total		39,925,000	0	0			
Total impact		**56,183,287**	**11,540,983**	**7,591,679**			

Source: BERL

In year one direct impacts on the fishing industry from the reduction in revenue and an increase in costs will total around $7.22 million. The direct impacts will decline in year two to $5.37 million and further decline in year three to $3.83 million.

In addition to the direct impact in the fishing industry, there will be a flow-on impact on wider community, this comprises $6.14 million in indirect and $2.90 million in induced effects that impact on both the fishing industry and the wider community. The overall impact on the fishing industry and wider community in year one will be a total impact of $16.26 million.

In year two the total impact on the fishing industry and wider community will reduce to $11.54 million and then to $7.59 million in year three, as the direct impacts reduce across the three years.

The impact on the Government from finance provided to the fishing industry is $39.93 million in year one, and because this is a one-off impact, in year two and year three there will be zero impact on the government.

In the previous pessimistic scenario, 75 set net boats and 9 trawl boats were assumed to be unsuitable to transition from their current fishing method to the longline fishing method. The reasons for set net boats was the size of the boats, from expert advice to change to longline, as boats needed to be of at least 20 metres in length. All the set net boats were under 20 metres in length, and therefore unable to be longline boats. For the 9 trawl boats, it was assumed that 75 percent of the 12 trawl boats currently fishing in the area would be unable to change to longline based on the configuration of the boat.

Of the 177 owners and crew of these 84 boats, it was assumed that 25 percent would retire, with the remainder then undergoing retraining to enable to find work in other industries. The 25 percent retirement assumption was based on the high average age of the set net and trawl fishermen on the West Coast of the North Island from studies undertaken in 2007.

Under this alternative optimistic scenario, we still assume that 25 percent of the owners and crew would choose to retire rather than continue to operate in the fishing industry through the transition to longline fishing. This would mean that:

- Of the 54 set net boats operating inside the harbours, the crew and owners of 14 boats would retire.
- Of the 21 set net boats operating outside the harbours, the crew and owners of 5 boats would retire.
- Of the 9 trawl boats operating, the crew and owners of 2 boat would retire.

The retirements would leaving **63 boats** to be swapped for second hand boats suitable for longlining.

To determine the cost of swapping the boats, we used information on current commercial boats available for purchase on the following websites:

- www.maritime.co.nz
- www.nzboatsales.com
- www.gulfgroup.co.nz

From the information collected from these sites, an analysis of the price of available commercial boats suitable for longline fishing, along with the price of set net and trawl boats was conducted. This analysis showed that on average:

- A suitable commercial longline boat could be purchased for $700,000,
- A commercial set net boat could be sold for $100,000, a net difference of $600,000
- And a commercial trawl boat could be sold for $225,000, a net difference of $475,000.

This analysis revealed that to swap each set net boat, financing of $600,000 would be needed to cover the difference between the purchase and sale prices. For a trawl boat, financing of $475,000 would be needed. Given the number of boats involved this would total:

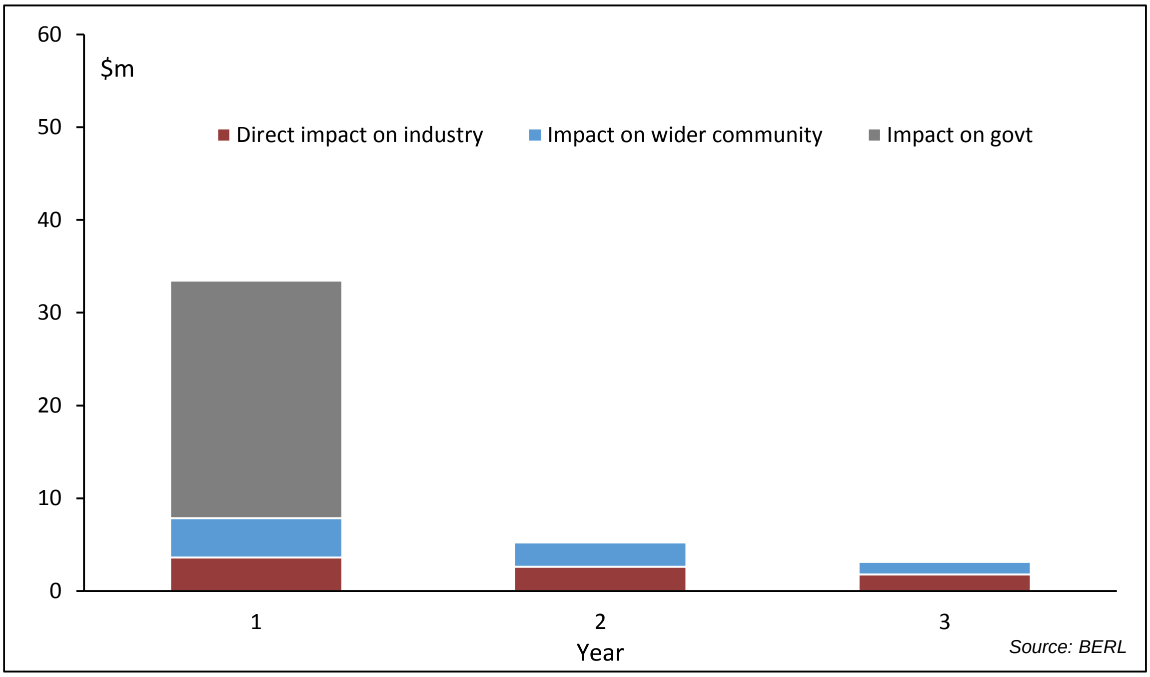
- $36.6 million for set net boats, with 61 swapped at a coat of 600,000 per boat,
- And $3.3 million for trawl boats, with 7 swapped at a cost of $475,000 per boat.

So a total of **$25.63 million** would be needed to swap all 63 commercial boats to commercial boats suitable for longlining.

4.2.3 Summary

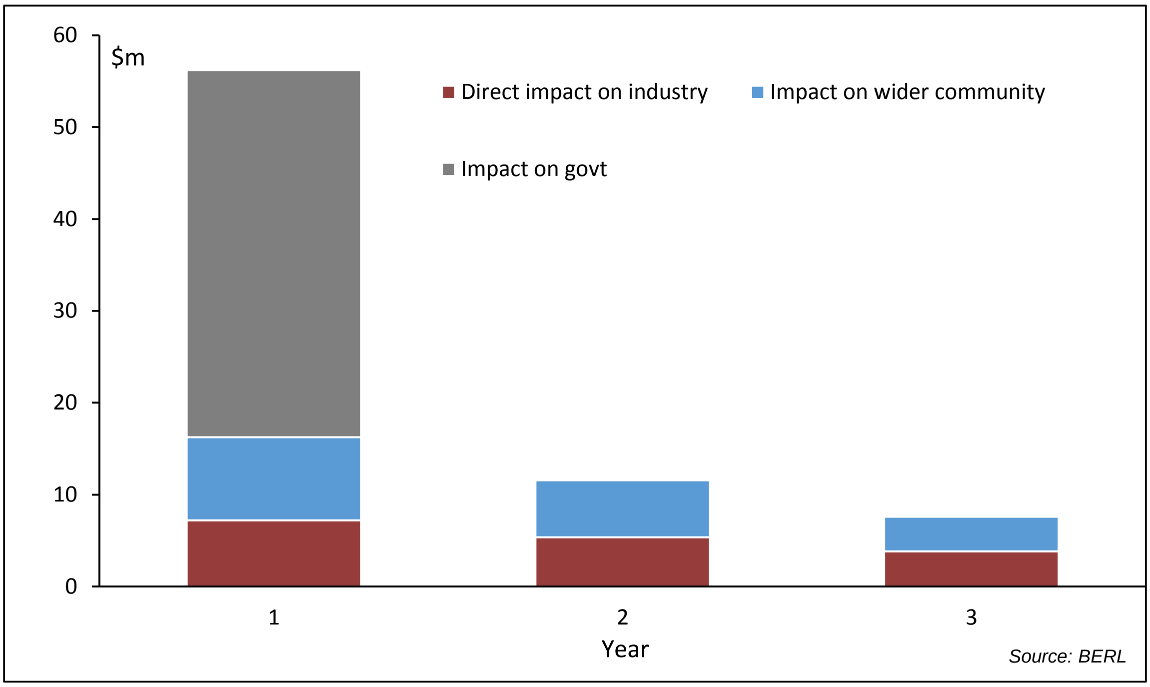
In summary, both the optimistic and the pessimistic scenarios show that the largest impact of the transition occurs in year one. As illustrated in Figure 4-3 and Figure 4-4 the net year one impact ranges from $33.47 million to $56.18 million.

Figure 4-3 Overall net impact of alternative optimistic scenario across three years



As discussed earlier, the first year sees the biggest upheaval with between 20 and 21 fishing boats potentially leaving the industry, between 3 and 9 boats changing their fishing methods from trawling to longline, and between 63 and 68 boats being replaced with second hand boats suitable for longline fishing. In addition, the greatest decline in revenue is in year one as the boats remaining in the industry retrain to use longline fishing methods and people who are unable to work in the industry retrain and gain new qualifications and skills.

Figure 4-4 Overall net impact of alternative pessimistic scenario across three years



It is also clear from these figures that the largest impact of this transition is in the form of direct costs on the Government in both scenarios, from financing the joint venture investment in replacing the majority of the boats in the set netting and trawl fishing fleets in the area. Compared to our principal scenarios, the direct impact on the industry and the impact of the wider community are reduced in these alternative scenarios. This is because of the reduced number of boats leaving the industry, enabling a greater proportion of the current fishing industry to remain in place.

Overall across the three year period examined in both the principal and alternative scenarios, the total net impact is similar for the optimistic and pessimistic scenarios. The difference in the two scenarios is where the net impact of the transition falls. In the principal scenario the largest impact falls directly on the fishing industry, while in the alternative scenario the largest impact falls directly on Government. This shows that the net impact of the transition is similar, and it is a case of where the impact falls.

5 Concluding comments

Specifically, WWF-New Zealand asked BERL to answer the following questions:

1. What is the capacity of the commercial fishing industry to transition from set net and trawling to alternative fishing methods?
2. What are these methods?
3. What would be the potential cost (or level of capital investment) required to make this transition? Here, capital investment includes machinery and equipment as well as human capital.

In addition to these questions, BERL added two further questions:

- What are the incentives for fishers to change their behaviour?
- What are the potential mitigation approaches that could limit the number of exits from the industry?

What is the capacity of the commercial fishing industry to transition from set net and trawling to alternative fishing methods?

We focused our analysis on the predominant type of fishing in the area - using set nets and trawling between zero and 12 nautical miles offshore. This analysis was to determine whether there are opportunities to use alternative fishing methods in these areas based on the fish stock, the total allowable catch, and the market value of the fish stock.

We found that Snapper is the most valuable fish in this area and fetches the highest price per kilogram, with an approximate annual value of $2.2 million for the total catch. We also found that in addition to Snapper, Grey Mullet, Rig, Trevally, Gurnard, and John Dory had the highest values in 2014.

At face value the capacity of the commercial fishing industry to transition from set net and trawling to alternative fishing methods is very limited. The fish stock that is of most value is caught in-shore using mostly trawling. Snapper, Gurnard, Trevally, Rig and School Shark could be caught using longline fishing methods, but greater effort would be required and the amount of fish caught (catch volumes) could potentially decline. There is also the associated risk of by-catch using this method and the associated impact on juvenile fish species, as well as penalties such as Deemed Values.

However, the New Zealand inshore fishing industry is already changing in the face of market influence. Investment in the value chain is being undertaken by the large commercial fishing companies, and the Government and private sector is investing in R&D through projects such as Precision Seafood Harvesting.

This means the transition from set net and trawling to different fishing methods, such as longline fishing or methods yet to be determined, could be encouraged, within the context of these broader industry changes. The challenge will be to minimise the short-term costs and impact on individuals that may arise due to this transition.

What are these methods?

Fishers use set nets and trawling because this is currently the most efficient means of catching the fish species they are targeting. They catch these target species to meet market needs, as part of the Quota Management System (QMS) and the TACC.

The challenge that the fishing industry faces is complex, with many layers operating. At a basic level, there appears to be three options:

1. Change the method of fishing from commercial set-netting and trawling to another method

Some Snapper and Gurnard are already caught using longline fishing methods in this area, but the volumes are currently small. The industry advice we have received indicates that it is possible to catch Snapper, Rig and School Shark by longline fishing. Trevally can also be caught using this method but greater effort is required. If this method was considered the preferred method that fishers should convert to, there could also be some associated reduction in catch volumes, due to the method employed.

It should also be noted that longline fishing can lead to by-catch. By-catch is when a fish or other marine species is caught unintentionally when catching a certain target species. In New Zealand, by-catch of non-target fish can lead to penalties. These penalties could be particularly problematic when the by-catch is Snapper given the price per kilogram.

2. Change the fishing area, away from shallower, inshore water

The relocation of fishing effort provides no guarantee of catching the same fish. This lack of guarantee means that there could be a significant reduction in the revenue of the quota owners and the associated fishers. This means there is the capital cost of the property right of the relocation of the fishing effort (quota value per tonne of fish caught) and the loss of sales. This acts as a disincentive to shift from the current fishing area and to change the method of fishing currently employed.

3. Change the target fish stock from fish that prefer shallower water and are caught using set nets or trawling

Many inshore fishers hold quota or source Annual Catch Entitlement (ACE) for a relatively small number of species. The consequences of a limited quota portfolio is that it makes it difficult to change the focus of the fishing effort through changing the targeted fish stock; particularly among small operators as they are not able to source different combinations of ACE.

It has not been possible for this analysis to examine the non-target fish by-catch issue in detail. Despite this it is clear that if a transition is to take place, it is important that the Government and the relevant quota holders consider potential modifications to the ACE on the West Coast of the North Island to better enable fishers to make longlining commercially viable.

There is also the potential for new trawling technology to be developed that does not pose a threat to dolphins and could replace traditional trawling with minimal impact on the type and quantity of fish caught. Installing such technology might have significant up-front costs that warrant transitional assistance.

What would be the potential cost (or level of capital investment) required to make this transition? Here, capital investment includes machinery and equipment as well as human capital

The cost of conversion from commercial set-netting or trawling involves many variables. Some that are easily identifiable include:

- The cost of converting boats that currently undertake set net and trawl fishing
- The purchase of ACE from others to cover any changes in catch plans due to using an alternative fishing method
- The additional fuel costs to fish further offshore
- The additional labour costs of putting in more effort
- The additional crew that may be required to work the boats
- The cost of training existing staff how to fish using this new, alternative method.

Under our principal scenario, the estimated total net costs of the transition to longlining could range from $40.1 million to $65.6 million, over a three year period.

What are the potential incentives that will drive change and lead to this investment?

- Market demand for fish that are caught using methods other than set net and trawling
- The price of these fish
- Customer preference, including taste.

The challenge is to shift – to shift the industry from volume to value – to catch less and to make more from what it catches, by building a value chain from the ocean to the plate. For fish such as Rig, Gurnard and Trevally the current industry focus is on the volume of fish rather than creating additional value from the fish that is caught.

Further investment is required to make this shift, and to consider other options such as increasing the shelf life of fresh fish, changing how the fish is used, or what species of fish is further processed. The suite of seafood products that are available could be extended. To attract a premium price, and increase the number of consumers and markets that seafood reaches there is a need to add value to seafood and to move beyond whole fish and fish fillets.

The New Zealand fishing industry has the opportunity to be world leaders in fisheries resource management. Research and development such as Precision Seafood Harvesting illustrates this, along with government support for such ventures. Some steps have already been taken in the fishing industry to move with market changes and consumer preferences - certification of fishing practices and fishers by the Marine Stewardship Council, product provenance, and the use of labelling, QR codes, and websites. Further restrictions on fishing areas, and commercial set-netting and trawling, could provide the industry with further incentives to undertake change to ensure future sustainability and profitability. Investment, innovation and technology will be required to take these next steps.

What are the potential mitigation approaches that could limit the number of exits from the industry?

We see three broad approaches that could mitigate the negative effects of a change from netting and trawling to longlining:

- New commercial boats

A number of commercial fishers will potentially need to exit the fishing industry, as their current boats are potentially ill-suited to making the change to longlining. There commercial fishers could be potentially stopped from exiting the industry if they were able to be acquire new boats capable of longlining. These new boats could be acquired with good access to capital, such as low-interest finance, or through the development of business partnerships.

- Development of new fishing methods

Another way of potentially stopping or limiting the exit of commercial fishers from the industry would be the development of new fishing methods. New fishing methods could allow these fishers to continue fishing with their current boats and within their current areas, but operate in a different way. These new fishing methods would need to be dolphin friendly and allow the fishers to continue targeting their current fish species. The Precision Seafood Harvesting programme is an example of an ongoing research and development into a new fishing method, and the fishing industries willingness to develop new methods.

- Development of new markets for low value fish species

Snapper is currently one of the most targeted fish species on the West Coast of the North Island. Along with snapper there are numerous other fish species able to be caught by commercial fishers, but many currently have little value to commercial fishers.

The development of new markets for fish species that are currently of little value, could potentially increase the value of the fishing industry and the ability of fishers to continue in the industry. New markets could include the development of new products which add value to these low value fish species. This could be achieved through further processing such as different cuts of fish, frozen fish products or as an ingredient within other products. Development of the fish species as an ingredient could enable it to be used potentially in the pharmaceutical, nutraceutical or cosmetics industries.

The first priority for any development in this area would be in fish species that can be targeted using alternative fishing methods to trawling and set-netting and can be caught from small commercial fishing boats. Developments in this area could potentially see fishers who would otherwise leave the industry, remain operating in the industry.

Appendix A Current protection measures

Hector's and Māui dolphin are found only in New Zealand waters and are our only endemic dolphin species. Māui dolphin have short lifespans, they are slow to reproduce and they produce one calf every two to four years. Females have their first calf between seven and nine years of age. This means Māui dolphin may only be able to grow their population by two percent per annum. This means that a population of 63 can only increase by one individual per year (DOC).

Māui dolphin are generally found close to shore in pods. They are often seen in water less than 20 metres deep but may also range further offshore (DOC). They appear to feed mostly in groups and are opportunistic feeders. This means they take a variety of species from throughout the water column, including the ocean floor.

In 2012, MPI and DOC jointly funded an independent risk assessment of the human impacts on Māui dolphin. This assessment was conducted by scientists and chaired by the Royal Society of New Zealand. This research informed the review of the Māui dolphin portion of the Threat Management Plan (TMP).

The method for the risk assessment involved five key steps: defining Māui dolphin' distribution, threat identification, and threat characterisation including the spatial distribution of the threat, threat scoring, and subsequent analysis. The outcome of this scoring was to determine the cumulative impact and associated population risk posed by all threats combined to identify those threats that pose the greatest risk to the Māui dolphin. It also identified several threats that may have a low likelihood but given the small population size of Māui dolphin may have detrimental consequences for the population (TMP, 2012). Overall, this assessment indicated that fishing is the greatest known human-induced impact on Māui dolphin.

The TMP is not statutory; it is a management plan with strategies to mitigate risk. It includes management options and tools, and discusses the threats including actual, potential, human and non-human. Monitoring activities and the outcome of these activities is also discussed.

Māui dolphin habitat

Research and sighting information suggests that Māui dolphin off the West Coast of the North Island (WCNI) are most prevalent in the area between shore and four nautical miles, but are also sometimes present in the area beyond four nautical miles from shore. These offshore sighting heavily rely on aerial research surveys, so no tissue samples have been collected for genetic testing.

Information suggests that Māui dolphin do use WCNI harbours although the frequency and extent of that use is unknown. The uncertainty of this harbour use is influenced by a range of factors including:

- Small population size
- Lack of genetic sampling to confirm subspecies
- Snapshot nature of aerial or boat-based surveys
- Limited survey effort in WCNI harbours, particularly the Raglan, Kawhia and Aotea harbours.

The TMP risk assessment panel suggested that fishing-related activities accounted for about 95 percent of the total estimated mortalities, compared with five percent from mining and oil activities, vessel traffic, pollution and disease combined.

Fishing restrictions

Three types of fishing are most likely to entangle Māui dolphin and have restrictions associated with them. These are set nets, trawls and drift nets.

- Set nets are fixed in place in the water and pose the greatest fishing related threat to Māui dolphin.
- Trawling involves pulling a net through the water using a vessel. Hector's dolphins have been caught in trawl nets in the South Island so restrictions have been put in place in the West Coast North Island Marine Mammal Sanctuary to prevent this from happening to Māui dolphin.
- Drift nets catch marine life by drifting in or on the surface of the water. They are not attached to a vessel, point of land, or the seafloor.

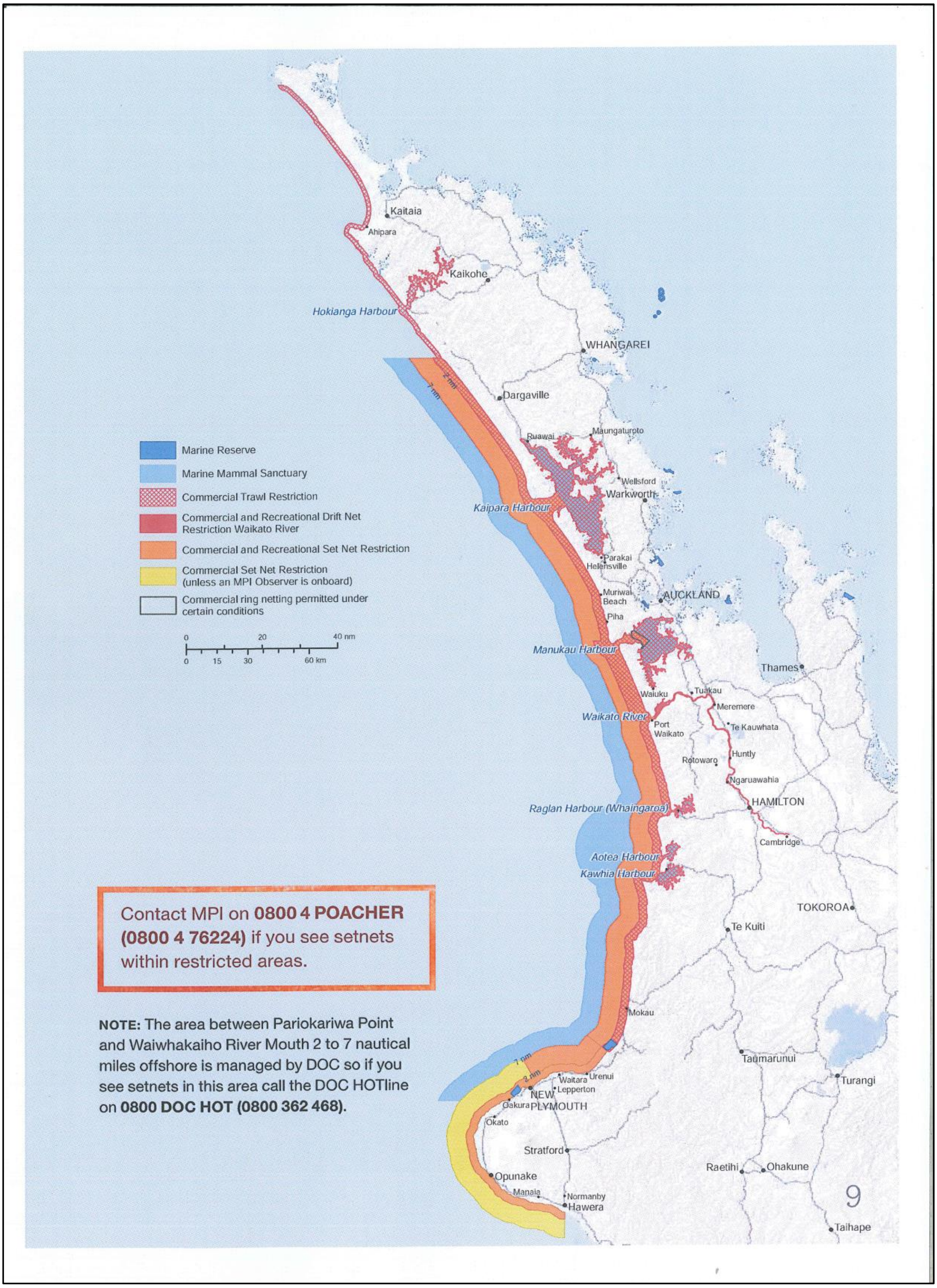
The fishing restrictions off the West Coast of the North Island therefore include:

- Commercial and amateur set-netting is prohibited from Maunganui Bluff to Waiwhakaiho River between zero and seven nautical miles offshore. These activities are also prohibited inside the entrances to the Kaipara, Manukau and Raglan harbours, and around Port Waikato river mouth.
- Commercial and amateur set-netting from Waiwhakaiho River to Hawera out to two nautical miles is banned. Commercial set-netting from Waiwhakaiho River to Hawera between two and seven nautical miles is not allowed unless an observer is on board.
- Trawling is prohibited from Maunganui Bluff to Hawera out to two nautical miles, and out to four nautical miles between Manukau Harbour to Port Waikato. Trawling is also prohibited within the West Coast North Island harbours.

The following six fishing statistical areas are affected by current restrictions:

- 040 Egmont
- 041 Taranaki
- 042 Waikato
- 043 Manukau Harbour
- 044 Kaipara Harbour
- 045 Helensville

Figure 5-1 Department of Conservation map of fishing restrictions[8]



[8] Sourced from West Coast North Island Marine Mammal Sanctuary User Guide published by the Department of Conservation, 2015.

West Coast North Island Marine Mammal Sanctuary

In addition to the fishing restrictions, a Marine Mammal Sanctuary has been put in place from Manganui Bluff to Oakura Beach, out to 12 nautical miles offshore. This Sanctuary creates restrictions on seabed mining activities and acoustic seismic work.

Appendix B The fishing industry

As of 1 October 2013, there were 1,475 quota owners, 1,300 registered fishing vessels, and 231 licensed fish receivers.[9] Many of these entities are interconnected through contractual arrangements to supply ACE, to use fishing vessels and to receive catch for processing and sale.[10]

The Quota Management System (QMS) in New Zealand

The Quota Management System (QMS) was introduced in New Zealand in October 1986. This system sets and controls the overall catches of all the main fish stocks found within New Zealand's Exclusive Economic Zone (EEZ). The EEZ is divided into 10 Fisheries Management Areas, and these are based on likely stock boundaries. These areas are known as Quota Management Areas (QMA).

The QMS controls the harvest levels of fish species within the QMA. New Zealand currently has 100 fish species subject to the QMS, and these species are divided in to separate stocks.

The Total Allowable Catch (TAC) is the total quantity of fishing-related mortality allowed for a QMS stock in a given fishing year. From the TAC an allowance is made to provide for recreational fishing and customary uses before the Total Allowable Commercial Catch (TACC) is set. The TACC is the total quantity of each fish stock that the commercial fishing industry can catch for that year. Once the TACC is set, the fishing rights are distributed to quota owners.

ACE is a property right that gives the holder the right to take a certain weight of fish stock during a fishing year. The amount of ACE that is allocated for each fish stock is determined by the TACC for that fish stock. At any stage during the fishing year a person is able to sell their ACE and ACE can be bought and sold without any encumbrance of catch. ACE is generated at the start of each new fishing year. The fishing year for most fisheries is from 1 October to 30 September.

There are various national organisations that represent the interests of quota owners, ACE holders and commercial fishers. For example, there are five national organisations representing deep-water fisheries, rock lobster, paua, aquaculture and inshore finfish. Fisheries Inshore New Zealand represents inshore finfish, pelagic and tuna quota owners, ACE holders and commercial fishers.

Permitting of Commercial Fishers

Any person who wishes to take fish for the purpose of sale can only do so under the authority of a commercial fishing permit issued under the Fisheries Act 1996.

Permits are issued for a period of between one and five years, and it is up to the applicant to choose the duration of the permit. All permits that are issued allow fishers to target most species. Fishers generally land their catch to approved licensed fish receivers (LFR), who sell or further process the catch.

Deemed values

There are high mixes of species in some fisheries, which make it difficult to catch one without catching others. Fishers have to balance their catch of quota stocks with ACE. If their catch of quota stock exceeds their ACE holding they will be charged deemed values (DV). A deemed value invoice is incurred for excess catch by the Ministry for Primary Industries (MPI).

[9] Ministry for Primary Industries. (www.mpi.govt.nz).
[10] Inshore Fisheries. (www.inshore.co.nz).

All permit holders are required to supply a Monthly Harvest Return (MHR) by the 15th of the month following the month the catch was taken. This catch is balanced against ACE held by the permit holder as at the 15th of each month. If the catch is not 'balanced' by ACE when the balances are run the permit holder will incur Deemed Value invoices for the excess catch.

The fisher can either pay the invoiced amount by the 20th of the month following the invoice or purchase ACE to cover the weight of fish for which they were invoiced.

Inshore fishing

Inshore commercial fisheries are an important part of our fishing industry. Inshore fish are generally considered fish within either the 12 nautical mile limit of the territorial sea or the 200m water depth contour.

MPI reports that eight fishing companies provide 80 percent of production, while the rest is made up of small to medium-sized fishing operations who fish inshore. The inshore fishing fleet includes independent fishers who are contracted to companies that have large quota, and smaller owner-operators.

Companies or organisations with large quota ownership in inshore finfish stocks include Te Ohu Kai Moana Trustee Limited, Sanford Limited, Aotearoa Fisheries Limited, SeaLord Limited, Talley's Fisheries Limited and Ngai Tahu Fisheries Settlement Limited.

There are approximately 40 different inshore finfish species in New Zealand that are managed within the QMS and these comprise 200 individual stocks. The predominant fish species caught by New Zealand's inshore fishers are Snapper, Blue Cod, Bluenose, Tarakihi, Warehou, Gurnard, Rig, Blue Moki, Flounder, Hapuka, Trevally, Turbot, School Shark and John Dory. Tuna and pelagic fishers catch Southern Blue Fin Tuna, Skipjack Tuna, Albacore, Kahawai and Mackerel. Blue Cod, Kahawai, Snapper, Tarakihi and Trevally are valuable to the inshore commercial sector.

Various methods are used by commercial fishers including trawling, set-netting, potting, trolling, purse seining and line fishing. Most vessels within inshore fisheries are between five and 20 metres in length.

Fish is exported chilled or frozen or sold fresh in to the domestic market. In excess of 90 percent of all fish landed is exported, so much of the income from commercial fishing is from exports. However, for some inshore finfishers the domestic market is also important. Snapper is the largest and most valuable inshore fish stock.

Total fish exports for the 2014 year, totalled $765 million. The total value of exported fish has declined over the last two years from $828 million. Frozen fish still makes up just over half of the value of fish exports, with fish fillets (frozen, chilled or fresh) making up a further 33 percent of the value of fish exports. According to 2008/09 asset values, Snapper has an asset value of $262 million. Ling is the second most valuable inshore finfish species with an asset value of $246 million, while Tarakihi has an asset value of $75 million.[11]

[11] Ministry of Fisheries. 2011. Inshore Finfish Draft Plan 2011. (www.fish.govt.nz).

Appendix C Data on the fishing catch in the range of Māui dolphin

The data presented in this appendix provides a detailed picture of the 2014 commercial catch in each of the statistical fishing areas in the Māui dolphin range, and are arranged by fishing method and catch volume. The data shows the main species targeted in each of the six statistical areas by set netting trawling, and how these species and the volumes caught change across the statistical areas.

In particular the data tables show that no trawling takes place within the Kaipara or Manukau Harbours, and that no set netting took place in the Waikato statistical area.

Egmont fishery

The Egmont fishery extends from the mouth of the Whanganui river north around the coast to Oakura just south of New Plymouth. Within this area, set nets are banned out to two nautical miles from Oakura south to Hawera, and between two and seven nautical miles fishing boats set-netting need an on-board MPI observer. Between Hawera and the mouth of the Whanganui river there are no restrictions on fishing.

In 2014 approximately 211,000 kgs of fish was caught in the inshore fishery within this statistical area, which represents around eight percent of the total inshore fishery from the six statistical areas.

The top five fish species caught by set-netting in 2014 are shown in Table C-1.

Table C-1 Top five fish species caught in Egmont fishery by set net, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC
RIG	45,649	6.6%
SCHOOL SHARK	14,752	2.1%
COMMON WAREHOU	11,603	0.0%
TREVALLY	3,413	0.2%
SNAPPER	3,209	0.2%

Source: Ministry for Primary Industries and BERL

Rig is the main fish species caught by set-netting within this area, with small amounts of School Shark, Warehou, Trevally and Snapper also caught.

The top five fish species caught by trawling are shown in Table C-2.

Table C-2 Top five fish species caught in Egmont fishery by trawl, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC
BARRACOUTA	30,248	0.3%
SNAPPER	19,177	1.5%
TREVALLY	17,367	0.8%
GURNARD	17,213	0.8%
TARAKIHI	6,880	0.5%

Source: Ministry of Primary Industries and BERL

While Barracouta is the main fish species caught, given the very low estimated value per kilogram for Barracouta, it is likely that trawlers in this area are catching this fish more as a bycatch, and the more valuable Snapper, Trevally and Gurnard are the main targeted species.

Taranaki fishery

The Taranaki fishery extends from Oakura just south of New Plymouth to just north of Aotea Harbour. Within this area, set nets are banned out to two nautical miles and are banned out to seven nautical miles from Pariokariwa Point north, while south of Pariokariwa Point set-netting between two and seven nautical miles requires the fishing boat to have an on-board MPI observer. Trawling is banned out to four nautical miles from Pariokariwa Point north.

In 2014 approximately 730,000 kgs of fish was caught in the inshore fishery within this statistical area, which represents around 27 percent of the total inshore fishery from the six statistical areas. In 2014 around 315,000 kgs caught in this area was Skip Jack Tuna caught by purse seiners. As the Skip Jack Tuna are highly migratory they are normally caught outside the inshore fisheries we are interested in, and therefore they have been excluded from our analysis. The top five fish species caught by set-netting are shown in Table C-3.

Table C-3 Top five fish species caught in Taranaki fishery by set net, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC
RIG	33,960	4.9%
SCHOOL SHARK	32,103	4.7%
COMMON WAREHOU	20,270	0.0%
TREVALLY	12,207	0.6%
SNAPPER	11,591	0.9%

Source: Ministry for Primary Industries and BERL

Rig is again the main fish species caught by set-netting within this statistical area, though unlike within the Egmont fishery area, much larger numbers of School shark, Warehou, Trevally and Snapper are caught.

The top five fish species caught by trawl are shown in Table C-4.

Table C-4 Top five fish species caught in Taranaki fishery by trawl, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC
GURNARD	68,722	3.0%
BARRACOUTA	55,635	0.5%
SNAPPER	35,613	2.7%
TREVALLY	29,985	1.4%
JOHN DORY	18,036	6.7%

Source: Ministry for Primary Industries and BERL

Gurnard is the main fish species caught in 2014 by bottom trawl in the Taranaki fishery area, ahead of Barracouta, though large amounts of Snapper, Trevally and John Dory are also caught by trawlers in this fishery. In this area almost all of the top five fish species in 2014 were caught within eight nautical miles of the shore, only Trevally was caught in large numbers further out.

Waikato fishery

The Waikato fishery extends from just north of Aotea Harbour to the entrance to the Manukau Harbour. Within this area, set nets are banned out to seven nautical miles and trawling is banned out to four nautical miles. Within the Waikato fishery less than 1,000 kgs of fish were caught by set-netting and therefore the focus in this fishery is on the trawling fishing method.

In 2014, approximately 230,000 kgs of fish was caught in the inshore fishery within this statistical area, which represents around eight percent of the total inshore fishery from the six statistical areas.

The top five fish species caught by trawling are shown in Table C-5.

Table C-5 Top five fish species caught in Waikato fishery by trawl, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC
GURNARD	62,109	2.7%
SNAPPER	55,049	4.2%
TREVALLY	40,738	1.9%
KAHAWAI	10,484	2.0%
JOHN DORY	9,320	3.5%

Source: Ministry for Primary Industries and BERL

Barracouta, while caught in large numbers in the southern areas, is not caught in the two northern areas. This demonstrates how the fish species caught alters due to the local area and conditions, which impacts on what fish live in each area.

A small amount of Kahawai and John Dory is caught in this area, while Gurnard, Snapper and Trevally are caught in much larger numbers. A significant percentage of the Gurnard, Trevally, Kahawai and John Dory is caught between four and eight nautical miles, with smaller amounts caught between eight and 12 nautical miles from shore, almost half of the Snapper is caught further from shore.

Manukau Harbour fishery

The Manukau Harbour fishery area is the Manukau Harbour to the harbour mouth. Trawling is currently banned within the Harbour, which means that the main commercial fishing method used in this area is set-netting and ring netting. Our focus therefore is only on the set-netting taking place in this area.

In 2014 approximately 292,000 kgs of fish was caught in the inshore fishery within this statistical area, which represents around 11 percent of the total inshore fishery from the six statistical areas. The top five fish species caught by set net are shown in Table C-86 below.

Table C-6 Top five fish species caught in Manukau Harbour fishery by set net, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC
GREY MULLET	68,931	7.4%
RIG	36,194	5.2%
FLATFISH	30,689	2.6%
TREVALLY	15,020	0.7%
KAHAWAI	8,913	1.7%

Source: Ministry for Primary Industries and BERL

Set-netters caught just 62 percent of the total catch within this area in 2014. Grey Mullet was the main fish caught by set-netters in the Manukau Harbour, with almost 70,000 kgs caught in 2014. Rig and Flatfish are the second and third most caught fish, followed by small numbers of Trevally and Kahawai.

Kaipara Harbour fishery

The Kaipara Harbour fishery area is the Kaipara Harbour to the harbour mouth. Trawling is currently banned from this harbour, which means that the main commercial fishing method we have focused on is set-netting.

In 2014 approximately 506,000 kgs of fish was caught in the inshore fishery within this statistical area, which represents around 19 percent of the total inshore fishery from the six statistical areas. The top five fish species caught by set net are shown in Table C-7 below.

Table C-7 Top five fish species caught in Kaipara Harbour fishery by set net, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC
GREY MULLET	145,478	15.7%
YELLOWBELLY FLOUNDER	50,065	0.0%
RIG	46,031	6.7%
FLATFISH	29,714	2.5%
TREVALLY	24,008	1.1%

Source: Ministry for Primary Industries and BERL

Almost half of the fish caught by set-netting in this statistical area are Grey Mullet. Yellowbelly Flounder, Rig, Flatfish and Trevally are also caught in this statistical area.

Helensville fishery

The Helensville fishery area extends from the entrance of Manukau Harbour to the halfway point between the Kaipara Harbour entrance and Omamari. Within this area, set nets are banned out to seven nautical miles and trawling is banned out to four nautical miles.

Within the Helensville fishery area less than 1,000 kgs of fish was caught by set-netting, and therefore the focus in this fishery area is on the trawling fishing method.

In 2014 approximately 763,000 kgs of fish was caught in the inshore fishery within this statistical area, which represents around 28 percent of the total inshore fishery from the six statistical areas. The top five fish species caught by trawling are shown in Table C-8 below.

Table C-8 Top five fish species caught in Helensville fishery by trawl, by catch volume

Species	2014 Catch greenweight (kgs)	Estimated percentage of 2014 TACC
TREVALLY	256,931	11.9%
SNAPPER	235,064	18.1%
GURNARD	112,414	4.9%
KAHAWAI	76,828	14.8%
JOHN DORY	17,084	6.4%

Source: Ministry for Primary Industries and BERL

At least 65 percent of all Trevally, Snapper and Kahawai caught in the six fishery areas was caught by trawling in the Helensville area. This makes it the largest inshore fishery area within the areas of interest.

This is also shown by the catch in this area for Trevally, Snapper and Kahawai being estimated at more than 10 percent of the TACC.[12] With its dominance of the Snapper catch, the Helensville statistical fisheries area is also the most valuable of the inshore fishing areas examined.

[12] BERL received industry advice that indicated that these fish species were unable to be caught outside of 12 nautical miles.

Appendix D Multiplier analysis methodology

Multiplier analysis uses multipliers derived from inter-industry input-output tables for New Zealand. Input-output tables are produced from the national input-output tables and other data by Butcher Partners, Canterbury - a recognised source for regional input-output tables and multipliers.

Multipliers allow us to identify the direct, indirect and induced effects of additional activity or expenditure in terms of output (GDP) and full-time equivalent (FTE) employment.

Measures

Gross Output Multipliers

Gross output is the value of production, built up through the national accounts as a measure, in most industries, of gross sales or turnover. This is expressed in $ million at constant prices. Gross output is made up of the sum of:

- compensation of employees (i.e. salaries and wages)
- income from self-employment
- profits
- indirect taxes less subsidies
- intermediate purchases of goods (other than stock in trade)
- intermediate purchases of services.

Value Added (GDP) Multipliers

Value added multipliers measure the increase in output generated along the production chain, which, in aggregate, totals Gross Domestic Product (GDP). Value added is made up of the sum of:

- compensation of employees (i.e. salaries and wages)
- income from self-employment
- profits
- indirect taxes less subsidies.

Employment Impact Multipliers

Employment impact multipliers determine the number of FTE roles that are created for every $1 million spent in an industry for one year. It provides a measure of total labour demand associated with gross output.

An FTE is an estimate of numbers employed assuming full-time positions equal one employee and part-time positions equal 0.5 employees.

Direct, indirect and induced effects

The underlying logic of multiplier analysis is relatively straightforward. An initial expenditure (direct effect) in an industry creates flows of expenditures that are magnified, or "multiplied", as they flow on to the wider economy.

This flow occurs in two ways:

- The industry purchases materials and services from supplier firms, who in turn make further purchases from their suppliers. This generates an indirect (upstream) effect.
- People employed in the direct development and in firms supplying services earn income (mostly from wages and salaries, but also from profits) which, after tax is deducted, is then spent on consumption. There is also an allowance for some savings. These are the induced (downstream) effects.

Hence, for any amount spent in an area (direct effect), the actual output generated from that spend is greater once the flow-on activity generated (indirect and induced effects) is taken into account.

Leakages

Generally the more developed, or self-sufficient an industry in a region is, the higher the multiplier effects. Conversely, the more reliant an industry is on supply inputs from outside the region, the lower the multipliers. These outside factors can be referred to as "leakages".

To put this another way, if a house was purchased in the Taranaki region, and all the materials and labour were sourced in the Taranaki region, and all the materials and labour that went into making the housing materials were made in the Taranaki region, and then the labour spent their wages or salaries in the Taranaki region, again on goods or services produced solely in the Taranaki region, then all the multiplier effects would be captured by the Taranaki region. Where inputs or outputs come from outside the Taranaki region, leakages are said to exist, and the multiplier effect is reduced.

Limitations of multiplier analysis

Partial equilibrium analysis

Multiplier analysis is only a "partial equilibrium" analysis, assessing the direct and indirect effects of the development being considered, without analysing the effects of the resources used on the wider national and regional economy.

In particular, it assumes that the supply of capital, productive inputs and labour can expand to meet the additional demand called forth by the initial injection and the flow-on multiplier effects, without leading to resource constraints in other industries. These constraints would lead to price rises and resulting changes in the overall patterns of production between industries.

To assess inter-industry impacts in full would require economic modelling within a "general equilibrium" framework. Applying such models becomes more relevant where the particular development is considered significant within the overall economy.

Additionality

Related to partial equilibrium, using multipliers for economic impact assessments assumes that the event is something that would not have been undertaken anyway and that it will not displace existing activity. That is, the event is additional to existing activity. If it does either of the above, then the economic impact is less than that determined by the multiplier and it would be necessary to subtract both the activity that would have occurred anyway and the displacement effect.

Impact

Again related to "partial equilibrium", multiplier analysis assumes that an event will not have an impact on relative prices. However, in a dynamic environment, it can be assumed that a large event would have an impact on demand and supply and hence prices. Hence, the larger the event and the more concentrated it is in a single industry or region, the more likely it is that the multipliers would give an inaccurate analysis of impacts. For example, if multiplier analysis was used to determine the effect of residential building construction nationally it would likely be inaccurate as residential building construction accounts for over six percent of GDP.

Aggregation

Industries outlined in input-output tables are aggregates of smaller sub-industries. Each sub industry has unique inputs and outputs. The higher the level of aggregation the less accurate these inputs and outputs become. Thus, if determining the multiplier effect of a very specific event using highly aggregated data, there will be a lower level of accuracy. Similarly, if an event encompasses a range of industries and multipliers from a single industry are applied the accuracy levels will diminish.

Regions and boundaries

The smaller or less defined a region and its boundaries, the less accurate the multiplier analysis will be. Similarly, the easier it is to move across boundaries, the less accurate the analysis will be. For example, at the national level, the multipliers will be very accurate as it is easy to determine the inputs and outputs crossing through the New Zealand borders.

Similarly, it would also be more accurate to determine a North Island/South Island split. As smaller regions without obvious geographic boundaries are selected, a higher level of assumptions needs to be made and the multipliers become less accurate. For example, an individual could work in the Auckland region but live in the Waikato region and spend a large proportion of his/her recreation money in the Bay of Plenty region.

For any regional analysis the level of accuracy will have to be accepted. As a rule of thumb, the larger and more defined the region, the more accurate the analysis will be.

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