Fisheries New Zealand
Tini a Tangaroa

Proposed Fisheries Research Services for 2021/22

Lists all proposed new fisheries research projects for the 2021/22 year. It does not include already approved ongoing multiyear research projects

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Introduction

Context

This document lists all proposed new fisheries research projects for the 2021/22 year. It does not include already ongoing multiyear research projects. All projects have been the subject of some form of engagement and discussion with stakeholders.

The project descriptions provided here serve the dual purpose of:

1) Outlining the purpose and management need that the research seeks to support, and
2) Providing sufficient technical details for research providers to develop proposals.

Additional information on reporting requirements for these projects is covered in 'Conducting Fisheries Research with Fisheries New Zealand available online here. The appendix contains a list of all management documents referenced in the research specifications.

In light of the impacts of COVID-19, Fisheries New Zealand has reviewed, and will continue to review, our planned fisheries research. This may result in further changes to this plan in future.

In addition to the projects listed in the body of this document the Fisheries Research Budget supports two additional items for the 2021/22 financial year:

1. The Customary Fisheries Research Fund is available to assist tangata whenua manage their customary fisheries by providing financial assistance to undertake fisheries research. It is also available to enable tangata whenua who are working towards gazettal, or are currently gazetted, under the Kaimoana Customary Fishing Regulations 1998 or the South Island Customary Fishing Regulations 1999. More details are available at: https://www.fisheries.govt.nz/funding-and-programmes/maori-in-the-primary-industries/customary-fisheries-research-fund/

2. Fisheries New Zealand has allocated funding to support the inclusion of mātauranga Māori into its science programme and fisheries management. This approach will be developed in line with that taken by the wider Ministry for Primary Industries.

Cost summary table

Project title	Cost
Eel Fisheries	**$0**
Inshore Finfish Fisheries	**$3,530,000**
Relative abundance of blue cod in the Marlborough Sounds	$300,000
Relative abundance of blue cod in South Otago (BCO3)	$200,000
Relative abundance of blue cod in North Otago (BCO3)	$220,000
Monitoring length and age structure of commercial landings of blue cod in BCO 5	$400,000
Characterisation and CPUE for FLA 1	$60,000
Design for a longline survey to estimate the age structure of New Zealand hāpuku	$60,000
Management procedures for GUR 7, RCO 7 and JDO 7	$50,000
Stock assessment of rough and smooth skates	$50,000
Multispecies East Coast South Island Trawl survey	$1,150,000
Characterisation and CPUE for JDO 1	$60,000
Catch-at-age of recreational catch of kingfish in KIN 1 Bay of Plenty	$150,000
Estimation of snapper year class strength in SNA8	$200,000
Fishery characterisation and CPUE analysis of SPO 1, 2, 3, 7 and 8	$80,000
Monitoring length and age structure of commercial landings of trevally in TRE 7	$550,000
Inshore Shellfish Fisheries	**$1,215,000**
Northern intertidal shellfish survey	$450,000
Establishing a framework for community shellfish monitoring	$100,000
PAU 3 stock assessment	$85,000
Accounting for catch in genetic sink and source modelling in PAU 3	$90,000
Effects of new reporting scheme on commercial pāua catch effort	$50,000
Incidental mortality of surf clams in commercial dredge fishery	$150,000
SCA7 biomass survey for core scallop beds (Marlborough Sounds, Golden Bat and Tasman Bay)	$130,000
SCA CS evaluation of the CPUE limit rule management procedure	$60,000
Biomass survey and condition index for kina in SUR 7A	$100,000
Rock Lobster Fisheries	**$1,470,000**
Rock lobster stock assessments	$1,050,000
Rock lobster puerulus settlement monitoring	$420,000
Highly Migratory Species Fisheries	**$690,000**
Albacore catch sampling	$210,000
Age and growth of striped marlin	$30,000
Catch-at-age data for southern bluefin tuna	$150,000
Estimation of recreational harvest of southern bluefin tuna in New Zealand waters in 2021/22	$300,000
Deepwater Fisheries	**$21,564,000**
Stock assessment of hake in HAK 7	$75,000
Hoki population modelling and stock assessment	$200,000

Stock assessment of jack mackerel in JMA 7	$75,000
Stock assessment of ling in LIN 3 and LIN 4	$93,000
Routine age determination of middle depth and deepwater species from commercial fisheries and resource surveys	$1,500,000
Multi-species deepwater trawl surveys	$14,900,000
Stock assessment of the orange roughy Mid-East Coast Stock	$70,000
Stock assessment of orange roughy in ORH 3B	$90,000
Estimation of the abundance of orange roughy on the southwest Challenger Plateau (ORH 7A including Westpac Bank)	$1,400,000
Biomass estimation of the Campbell Island southern blue whiting stock using acoustic surveys	$2,900,000
Stock assessment of scampi in SCI 1 and SCI 2	$90,000
Analysis of Bounty Plateau southern blue whiting (SBW 6B) acoustic survey	$96,000
Assessment of biomass for silver warehou in SWA 3 and SWA 4	$75,000
Marine Amateur Fisheries	**$3,020,000**
Multispecies- National Panel Survey (NPS) of marine amateur fishers 2022/23	$2,600,000
Multispecies- National fish weights survey for 2022/23	$400,000
Multispecies- enabling recreational charter fishing operations in Fiordland to report fishing activity and catch	$20,000
Aquatic Environment Research	**$1,770,000**
Characterisation of benthic habitats and their potential as habitats of particular significance for fisheries management	$100,000
Marine habitat mapping Māhia Peninsula	$50,000
Taxonomic identification of benthic invertebrate samples	$240,000
Exploring options for balancing habitat protection and fishing in the Hauraki Gulf	$50,000
An assessment of impacts to blue cod habitats and the effects of habitat change on blue cod populations	$150,000
Trialling a semi-quantitative shark and turtle risk assessment	$200,000
Protected Chondrichthyan captures characterisation	$40,000
Bycatch monitoring and quantification in deepwater fisheries	$260,000
Review, cataloguing, and continuation of footage collected from the 2020/21 Black Petrel Electronic Monitoring project	$300,000
Estimation of warp capture cryptic mortality multipliers by deployment of corpse catcher devices	$50,000
Antipodean albatross multi-threat risk assessment	$100,000
Comparison of results of protected seabird species capture interactions based on different data collection methods	$40,000
Identification of seabird capture 'hotspots' in the Regional Fisheries Management Organisation CCSBT	$60,000
Habitat degradation impacts on fishery productivity in northern harbours	$130,000
High Seas Fisheries (Antarctic and South Pacific)	**$0**

Eel Fisheries

There are no new eel research projects being considered for 2021/22.

Inshore Finfish Fisheries

Project code	Project title
BCO2021-01	Relative abundance of blue cod in the Marlborough Sounds
BCO2021-02	Relative abundance of blue cod in South Otago (BCO 3)
BCO2021-03	Relative abundance of blue cod in North Otago (BCO 3)
BCO2021-04	Monitoring length and age structure of commercial landings of blue cod in BCO 5
FLA2021-01	Characterisation and CPUE for FLA 1
HPB2021-01	Design for a longline survey to estimate the age structure of New Zealand hāpuku
INS2021-01	Management procedures for GUR 7, RCO 7, and JDO 7
INS2021-02	Stock assessment of rough and smooth skates
INT2021-01	Multispecies East Coast South Island Trawl survey
JDO2021-02	Characterisation and CPUE for JDO 1
KIN2021-01	Catch-at-age of recreational catch of kingfish in KIN 1 Bay of Plenty
SNA2021-01	Estimation of snapper year class strength in SNA 8
SPO2021-01	Fishery characterisation and CPUE analysis of SPO 1, 2, 3, 7, and 8
TRE2021-01	Monitoring the length and age structure of commercial landings of trevally in TRE 7

BCO2021-01 Relative abundance of blue cod in the Marlborough Sounds

Project code:	BCO2021-01
Project title:	Relative abundance of blue cod in the Marlborough Sounds
Start date:	1 July 2021
Completion date:	30 June 2022
Vessel use:	*As required*
Estimated cost:	$300,000

Overall Research Objective:

To estimate relative abundance, maturity state, sex ratio, and age structure of blue cod (*Parapercis colias*) in the Marlborough Sounds.

Specific Research Objectives:

1. To undertake a potting survey in the Marlborough Sounds (BCO 7) to estimate relative abundance, age structure, size- and age-at-maturity, and sex ratio and collect otoliths from pre-recruited and recruited blue cod.
2. To analyse biological samples collected from this potting survey.
3. To determine stock status of blue cod populations in this area and establish how this has changed in response to management interventions.

Note:
The sampling design will be reviewed by the Inshore Working Group in July 2021, prior to sampling commencing in September, using the criteria set out in the "Blue cod potting surveys: standards and specifications - Version 2" (Beentjes 2019).

Reporting Requirements:

Objectives 1–3:

1. Present a detailed description of the survey design to the Inshore Working Group by 30 July 2021.
2. To submit to the MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a progress report as specified in Research Reporting Form 4 by 31 March 2022.
3. To present the report in 2 above to meetings of the Inshore Fishery Assessment Working Group in 31 March 2022 in Wellington. Presentations to more than one meeting may be required.
4. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 for blue cod by 15 April 2022.
5. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager, a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 31 May 2022.

6. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager, if required, a draft revised manual for blue cod potting surveys: standards and specifications by 30 June 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 June 2022 to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

National Blue Cod Strategy 2018

- Objective 1: Get the right information: Information is the bedrock of our fisheries management system. We need the right information and science, and we need to figure out the best way to get it.
- Objective 3: Set and manage to the right targets: Setting targets for fish stocks is about making sure we're keeping stocks at sustainable levels that are right for the fishery and the people using it.

General
Blue cod populations supporting important recreational fisheries off the South Island are monitored using potting surveys that provide indices of relative biomass and estimates of mortality based on age structure of the catch. These surveys take place predominantly in areas where recreational fishing is common, but, in some areas, there is substantial overlap between the commercial and recreational fishing grounds. There are currently nine areas surveyed around the South Island, and the aim is to repeat each survey every four years: Marlborough Sounds, Kaikōura, Motunau, Banks Peninsula, north Otago, south Otago, Paterson Inlet, Dusky Sound, and Foveaux Strait. In the Marlborough Sounds, potting surveys have been carried out in 1995, 1996, 2001, 2004, 2007, 2010, 2013, and 2018.

The time series of blue cod potting surveys provide a valuable tool, contributing to the recent management setting changes proposed by The National Blue Cod Strategy 2018 (NBCS). A primary objective from the NBCS is getting the right information to allow better management

of blue cod at a finer spatial scale than the current FMAs. Better management is potentially achieved by the introduction of a traffic light zone system in different areas. The results of these blue cod potting surveys have guided this management initiative in terms of setting restrictions in each zone, related to the relative abundance within these blue cod areas, based in part on the blue cod potting surveys.

The blue cod potting surveys were reviewed by an international panel of experts in 2009 (Stephenson et al. 2009). A recommendation from that review, and from the subsequent Southern Inshore Working Group (SINSWG) meetings, is that surveys initiated with a fixed site design should transition to a random survey design. In keeping with this recommendation, the 2010 survey included an experimental component using fixed sites as per 1995 to 2007 surveys, and mixed, fixed and random survey strata 4, 5, and 6 (EOPE, OPEL, and DURE). Half of the total sites sampled in these three strata were allocated randomly and half were fixed sites. In addition, four sites were randomly allocated around Maud Island no-take fishing zone. All sites in the Cook Strait were randomly allocated. The 2013 survey consisted of two independent surveys: one with fixed and the other with random site design. The SINSWG subsequently concluded that in transitioning from fixed site to random surveys, at least two dual surveys should be conducted in each area. After a review of the results of the 2017 survey, the Working Group concluded that all future surveys should be random only. It was acknowledged that additional stations may be required to achieve target CVs with random surveys.

Objective 1
Under this objective a random site potting survey will be undertaken in the Marlborough Sounds, including the Tory Channel and areas in the Cook Strait surveyed in 2017. The Long Island Marine Reserve should also be surveyed, but all fish captured in the marine reserve area are to be returned to the sea alive.

The previous survey design should be considered, and any necessary improvements implemented. All physical environmental data thought to influence catchability of the pots should be collected at each sample site.

Biological samples should be collected to allow determination of the size and age composition of the blue cod populations and other important biological characteristics such as sex ratio and age-/size-at-maturity. While ensuring that sufficient biological samples are available, care should be taken to minimise the impact of the sampling on the population. No fish are to be killed within the Long Island Marine Reserve area.

Objective 2
Biological samples should be analysed to describe the size, age, and sex composition of blue cod in the region. The spatial distribution of samples should be considered when producing raised estimates of population quantities, e.g., size and age structure. The personnel involved in ageing are expected to age the blue cod otolith reference library and the results must be presented to the Working Group along with the other analyses, to assess the quality of the data.

Objective 3
Age structure provides a tool with which exploitation rate can be measured, allowing for both temporal and spatial comparisons. Monitoring age structure also provides a means to better evaluate the response of a population to changes in regulations. Some outputs from this objective will include:

- estimates of total fishing mortality that incorporate uncertainty in key parameters (e.g., age-at-full recruitment and other selectivity issues) and the different properties of regression and Chapman-Robson estimators; and
- discussion of the consistency of spatial signals should be included, e.g., are the estimates of *Z* stable between this area and other surveyed areas.

Finally, the length, age, maturity, and mortality data should then be used to determine estimates of spawner biomass per recruit for the development of MSY-related proxies that will provide a basis for determining likely stock status based on the estimates of *Z* from the catch curve analysis.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4, 0.3, and 0.3.

References:

Beentjes, M.P. (2019). Blue cod potting surveys: standards and specifications. Version 2. *New Zealand Fisheries Assessment Report 2019/21.*

Stephenson, P.; Sedberry, G.; Haist, V. (2009). Expert review panel report. Review of blue cod potting surveys in New Zealand. Draft 14 May 2009. BCOREV-2009-22, 14 p. (Unpublished report held by Fisheries New Zealand, Wellington.)

BCO2021-02 Relative abundance of blue cod in South Otago (BCO 3)

Project code:	BCO2021-02
Project title:	Relative abundance of blue cod in South Otago (BCO 3)
Start date:	1 October 2021
Completion date:	30 November 2023
Vessel use:	Subject to tender
Estimated cost:	$200,000

Overall Research Objective:

To estimate relative abundance, maturity state, sex ratio, and age structure of blue cod (*Parapercis colias*) between Otago Peninsula and the Catlins.

Specific Research Objectives:

1. To undertake a potting survey between Otago Peninsula and the Catlins (BCO 3) to estimate relative abundance, age structure, size- and age-at-maturity, and sex ratio and collect otoliths from pre-recruited and recruited blue cod.
2. To analyse biological samples collected from the potting survey.
3. To determine stock status of blue cod populations in this area and compare with other survey areas.

Note:
The sampling design will be reviewed by the Southern Inshore Working Group, prior to sampling commencing in April, using the criteria set out in the "Blue cod potting surveys: standards and specifications - Version 2" (Beentjes 2019).

Reporting requirements:

Objectives 1–3:

1. To present a detailed description of the survey design to the Southern Inshore Working Group in November 2021.
2. To submit to the MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager, a progress report as specified in Research Reporting Form 4 by 30 September 2022.
3. To present the report in 2 above to meetings of the Inshore Fishery Assessment Working Group in October 2022 in Wellington. Presentations to more than one meeting may be required.
4. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 November 2022.
5. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager, if required, a draft revised manual for blue cod potting surveys: standards and specifications by 30 November 2022.

6. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager, a draft revised Working Group Report as specified in Research Reporting Form 8 for blue cod by 30 November 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 November 2022 to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

National Blue Cod Strategy 2018

- Objective 1: Get the right information: Information is the bedrock of our fisheries management system. We need the right information and science, and we need to figure out the best way to get it.
- Objective 3: Set and manage to the right targets: Setting targets for fish stocks is about making sure we're keeping stocks at sustainable levels that are right for the fishery and the people using it.

General
BCO 3 falls into Group 2 within the draft Inshore Finfish Fisheries Plan. The management approach is relatively cautious to reflect the stock's vulnerability and aims to ensure sustainability, by ensuring that the stock size is at or above an established target reference level with at least 50% probability. It is widely acknowledged that blue cod could be managed at a smaller scale than an FMA, and that understanding the local stock dynamics is therefore important.

The time series of blue cod potting surveys provide a valuable tool, contributing to the recent management setting changes proposed by The National Blue Cod Strategy 2018 (NBCS). A primary objective from the NBCS is getting the right information to allow better management of blue cod at a finer spatial scale than the current FMA. Better management is potentially achieved by the introduction of a traffic light zone system in different areas. The results of

these blue cod potting surveys have guided this management initiative in terms of setting restrictions in each zone, related to the relative abundance within these blue cod areas, based in part on the blue cod potting surveys

National diary surveys of marine recreational fishing have found blue cod to be the third most frequently landed finfish species nationally, and the most frequently landed species in the South Island. The total take nationally declined by 12.8% in 2017. Blue cod is an important species for Māori customary fishers, but the catch is unknown. Recreational take in BCO 3 was estimated at 98 t in 2017, and commercial catches over the last five years have ranged between 159 t and 183 t. Anecdotal reports from recreational fishers suggest that current catch rates are low in some areas compared to the past.

Blue cod populations on important recreational fishing grounds in BCO 3 are currently monitored using relative biomass indices and age structure generated by cyclical potting surveys (every fourth year). The first survey in this area was undertaken in 2010 (BCO2009-01), but that survey only covered half the strata due to experimentation required to compare random vs. fixed site surveys. The second survey, conducted two years later (BCO2012-02) and based on a random design, therefore represents the first data point in the series. All subsequent surveys have been based on random site design.

Objective 1
Under this objective a random design potting survey will be undertaken between Otago Peninsula and the Catlins. When designing the survey, the survey manual protocols are expected to be followed, and the previous survey should be considered and any necessary improvements implemented. All physical environmental data thought to influence catchability of the pots should be collected at each sample site.

Biological samples should be collected to allow the determination of the size and age composition of the blue cod populations and other important biological characteristics such as sex ratio and age-/size-at-maturity. While ensuring that sufficient biological samples are available, care should be taken to minimise the impact of the sampling on the fish population.

Objective 2
Biological samples should be analysed to describe the size, age, and sex composition of blue cod in the region. The spatial distribution of samples should be considered when producing raised estimates of population quantities, e.g., size and age structure. Prior to ageing the otoliths, the research provider is expected to age the blue cod otolith library to show that they have the adequate blue cod ageing skills and that their estimates of age are compatible with those of previous surveys.

Objective 3
Although a formal stock assessment (based on a stock assessment model) is not proposed for blue cod in BCO 3 at this time, there are multiple sources of information that can be used to provide information on stock status and the sustainability of current removals.

Under this objective, four primary tasks are envisaged:

- calculation of a standardised abundance index from the potting survey;
- estimation of total mortality (Z) from catch composition data;
- estimation of spawning biomass per recruit reference points; and

- comparison of these estimates with those obtained from other blue cod potting surveys.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.5, 0.3, 0.2.

References:

Beentjes, M.P. (2019). Blue cod potting surveys: standards and specifications. Version 2. *New Zealand Fisheries Assessment Report 2019/21.*

BCO2021-03 Relative abundance of blue cod in North Otago (BCO 3)

Project code:	BCO2021-03
Project title:	Relative abundance of blue cod in North Otago (BCO 3)
Start date:	1 October 2021
Completion date:	30 April 2023
Vessel use:	Subject to tender
Estimated cost:	$220,000

Overall Research Objective:

To estimate relative abundance, maturity state, sex ratio, and age structure of blue cod (*Parapercis colias*) between Oamaru and Shag Point.

Specific Objectives:

1. To undertake a potting survey between Oamaru and Cornish Head (BCO 3) to estimate relative abundance, age structure, size- and age-at-maturity, sex ratio and collect otoliths from pre-recruited and recruited blue cod.
2. To analyses biological samples collected from the potting survey.
3. To determine stock status of blue cod populations in this area and compare to other surveys.

Note:
The sampling design will be reviewed by the Southern Inshore Working Group, prior to sampling commencing in January, using the criteria set out in the "Blue cod potting surveys: standards and specifications - Version 2" (Beentjes 2019).

Reporting Requirements:

Objectives 1–3:
1. To present a detailed description of the survey design to the Southern Inshore Working Group in November 2021.
2. To submit to the MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a progress report as specified in Research Reporting Form 4 by 30 September 2022.
3. To present the report in 2 above to meetings of the Southern Inshore Fishery Assessment Working Group in October 2022 in Wellington. Presentations to more than one meeting may be required.
4. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 November 2022.
5. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager, if required, a draft revised manual for blue cod potting surveys: standards and specifications by 30 November 2022.

6. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 for blue cod by 30 March 2023.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 June 2022 to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

National Blue Cod Strategy 2018

- Objective 1: Get the right information: Information is the bedrock of our fisheries management system. We need the right information and science, and we need to figure out the best way to get it.
- Objective 3: Set and manage to the right targets: Setting targets for fish stocks is about making sure we're keeping stocks at sustainable levels that are right for the fishery and the people using it.

General
BCO 3 falls into Group 2 within the Inshore Finfish Fisheries Plan. The management approach is relatively cautious to reflect the stock's vulnerability and aims to ensure sustainability, by ensuring that the stock size is at or above an established target reference level ($F_{SPR40\%}$) with at least 50% probability. It is widely acknowledged that blue cod could be managed at a smaller scale than an FMA, and that understanding the local stock dynamics is therefore important.

The time series of blue cod potting surveys are a valuable tool contributing to the recent management setting changes proposed by The National Blue Cod Strategy 2018 (NBCS). A primary objective from the NBCS is getting the right information to allow better management of blue cod at a finer spatial scale than the current FMA. Better management is potentially achieved by the introduction of a traffic light zone system in different areas. The results of

these blue cod potting surveys have guided this management initiative in terms of setting restrictions in each zone, related to the relative abundance within these blue cod areas, based in part on the blue cod potting surveys.

National diary surveys of marine recreational fishing have found blue cod to be the third most frequently landed finfish species nationally, and the most frequently landed species in the South Island. The total take nationally declined by 12.8% in 2017. Blue cod is an important species for Māori customary fishers, but the catch is unknown. Recreational take in BCO 3 was estimated at 98 t in 2017, and commercial catches over the last five years have ranged between 159 t and 186 t. Anecdotal reports from recreational fishers suggest that current catch rates are low in some areas compared to the past.

Blue cod populations on important recreational fishing grounds in BCO 3 are currently monitored using relative biomass indices and population age structure generated by cyclical potting surveys (every fourth year). This series was initiated with a random design potting survey in 2012.

Four BCO potting surveys have now been conducted in North Otago: 2005, 2009, 2013, and 2017. In 2009 an additional stratum (stratum 6) was added to the survey area. The 2005 and 2009 surveys were fixed site surveys, whereas simultaneous fixed site and random site surveys were conducted in 2013 and 2017. Catch rates for fixed and random sites in each stratum were similar, and relative trends across space were nearly identical. The working group concluded that dual surveys should be conducted in 2017, and, if similar patterns for fixed and random sites were again observed, then only random surveys should be undertaken thereafter. Upon reviewing the results of the 2017 survey the working group concluded that all future surveys should be random surveys. It was acknowledged that additional stations may be required to achieve target CVs with random surveys.

Objective 1
Under this objective a random site survey will be undertaken between Oamaru and Shag Point. When designing the survey, the survey manual protocols are expected to be followed, and the previous survey should be considered, and any necessary improvements implemented. All physical environmental data thought to influence catchability of the pots should be collected at each sample site.

Biological samples should be collected to allow the determination of the size and age composition of the blue cod populations and other important biological characteristics such as sex ratio and age-/size-at-maturity. While ensuring that sufficient biological samples are available, care should be taken to minimise the impact of the sampling on the fish population.

Objective 2
Biological samples should be analysed to describe the size, age, and sex composition of blue cod in the region. The spatial distribution of samples should be considered when producing raised estimates of population quantities, e.g., size and age structure. Prior to ageing the otoliths, the research provider is expected to age the blue cod otolith library to show that they have the adequate blue cod ageing skills and that their estimates of age are compatible with those of previous surveys.

Objective 3
Although a formal stock assessment (based on a stock assessment model) is not proposed for blue cod in BCO 3 at this time, there are multiple sources of information that can be used to provide information on stock status and the sustainability of current removals.

Under this objective, four primary tasks are envisaged:

- calculation of a standardised abundance index from the potting survey;
- estimation of total mortality (Z) from catch composition data;
- estimation of spawning biomass per recruit reference points; and
- comparison of these estimates with those obtained from other blue cod potting surveys.

Weighting of Objectives:
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.5, 0.3 and 0.2.

References:

Beentjes, M.P. (2019). Blue cod potting surveys: standards and specifications. Version 2. *New Zealand Fisheries Assessment Report 2019/21.*

BCO2021-04 Monitoring length and age structure of commercial landings of blue cod in BCO 5

Project code:	BCO2021-04
Project title:	Monitoring length and age structure of commercial landings of blue cod in BCO 5
Start date:	1 August 2021
Completion date:	30 June 2024
Vessel use:	None
Estimated cost:	$400,000

Overall Research Objective:

To determine the length and age structure of commercial landings of blue cod in BCO5.

Specific Research Objectives:

1. To characterise the BCO 5 fishery by analysing existing commercial catch and effort data to the end of 2022–23 fishing year.
2. To conduct representative sampling to determine the length, sex, and age composition of the commercial catch of blue cod (*Parapercis colias*) in BCO 5 during the 2021–22 fishing year. The target coefficient of variation (CV) for the catch-at-age is 20% (mean weighted CV across all age classes) combined across sexes.
3. To conduct representative sampling to determine the length, sex, and age composition of the commercial catch of blue cod (*Parapercis colias*) in BCO 5 during the 2022–23 fishing year. The target coefficient of variation (CV) for the catch-at-age is 20% (mean weighted CV across all age classes) combined across sexes.

Note:
The sampling design will be reviewed by the Inshore Working Group prior to the sampling commencing.

Reporting Requirements:

Objectives 1–3:

1. To present the sampling design to a meeting of the Inshore Fishery Assessment Working Group in September 2021.
2. To submit results to MPI Contracts Monitoring and Administration Team and Administration Team and the Fisheries New Zealand Science Officer and Project Manager in a Progress Report as specified in Research Reporting Form 4 by 30 May 2022.
3. To present the report in 2 above to meetings of the Inshore Fishery Assessment Working Group in June 2022.
4. To submit results to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager in a Progress Report as specified in Research Reporting Form 4 by 30 November 2023.

5. To present the report in 4 above to meetings of the Inshore Fishery Assessment Working Group in December 2023.
6. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 May 2024.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 June 2024.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 1: Maximise the social, economic and cultural benefits from stocks that provide the greatest benefit using fully quantitative stock assessments to maintain the biomass of the stock at or around the management target.

National Blue Cod Strategy 2018

- Objective 1: Get the right information.
- Objective 3: Set and manage to the right targets.

General
Blue cod, *Parapercis colias*, in BCO 5 support important commercial and recreational fisheries. Commercial landings in 2018–19 were 827 t and the recreational harvest was estimated to be 67 t in 2018. In terms of the Inshore Finfish Fish Plan, BCO 5 is a Group 1 stock which is assessed using formal type 1 statistical stock assessments. The age composition of the commercial pot fishery targeting blue cod is a primary input to the stock assessment model and is sampled two consecutive years in every five (see Medium Term Research Plan for Inshore Finfish available at https://www.mpi.govt.nz/dmsdocument/41722/direct). The age composition of commercial BCO landings was last sampled in 2016–17. Results from BCO2021-04 will feed into a stock assessment for BCO 5 planned for 2024 (i.e., 2023–24 project).

The last assessment for BCO 5, completed in 2020, showed that the stock was below the target but above the soft limit. This led to a reduction in TACC from 1239 to 850 t on 1 October 2020.

Objective 1
Results of an initial characterisation will be used to design the sampling programme. An updated characterisation is required to determine the representativeness of the sampled catch.

Objectives 2&3
The commercial blue cod pot fishery operates in Statistical Areas 025, 027, and 030 and is markedly seasonal. The sampling design for this project should therefore reflect spatial and temporal patterns. Otolith preparation and age determination should follow the Blue Cod Age Determination Protocol.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.2, 0.4, and 0.4.

FLA2021-01 Characterisation and CPUE for FLA 1

Project code:	FLA2021-01
Project title:	Characterisation and CPUE for FLA 1
Start date:	1 October 2021
Completion date:	30 November 2022
Vessel use:	None
Estimated cost:	$60,000

Overall Research Objective:

To monitor the relative abundance of flatfish in FLA1.

Specific Research Objectives:

1. To characterise the FLA 1 fishery.
2. To update the standardised CPUE index for flatfish (FLA1), with the inclusion of data up to the end of the 2020–21 fishing year.

Reporting Requirements:

All Objectives:

1. To submit results to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager in a Progress Report as specified in Research Reporting Form 4 by 30 March 2022.
2. To present the report in 1 above to meetings of the Inshore Fishery Assessment Working Group in April 2022.
3. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 for flatfish by 15 April 2022.
4. To submit to the MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report, as specified in Research Reporting Form 7, by 30 September 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 November 2022 to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

General
FLA 1 support an important inshore fishery with commercial, recreational, and customary interest. The TACC for FLA 1 has never been fully caught. Since 2000–01 commercial landings have averaged 810 tonnes or 68% of the TACC. The highest recent catch was 1038 tonnes in 2004–05, and the catch has not exceeded 500 t since 2009–10.

Although FLA 1 is a multi-species complex, catches are dominated by two species: sand flounder (SFL) and yellowbelly flounder (YBF). According to the MTRP for Inshore Finfish (MPI 2020), sand flounder and yellowbelly flounder in FLA 1 are monitored using standardised CPUE updated on a three-year cycle. The last analysis updated the series to 2016–17.

Objectives 1 & 2
The flatfish characterisation should include an analysis of changes in reported mesh size during the analysis period.

CPUE indices for the four west coast statistical areas should be based on combined YBF+FLA catch and effort data because most of the catch from the west coast is yellow belly flounder. Separate SFL and YBF CPUE indices should be generated for the Hauraki Gulf, but if either index is not accepted by the working group a FLA index will be required. The Bay of Plenty (Statistical Areas 008–010) should not be included in the analysis because little catch is made there. Because of the small size of the data set, the East Northland index should be based on all species (FLA+SFL+YBF), assuming sufficient data exist.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4, 0.6.

References:

Starr P.J.; Kendrick, T.H. (2019). FLA1 Characterisation and CPUE. *New Zealand Fisheries Assessment Report 2019/09.*
MPI (2020). Medium Term Research Plan Inshore Finfish. *MPI Information Paper No: 2020/06*. 50 p.

HPB2021-01 Design for a longline survey to estimate the age structure of New Zealand hāpuku

Project code:	HPB 2021-01
Project title:	Design for a longline survey to estimate the age structure of New Zealand hāpuku
Start date:	1 October 2021
Completion date:	30 November 2022
Vessel use:	None
Estimated cost:	$60,000

Overall Research Objective:

To design a bottom longline survey to determine the age structure of New Zealand hāpuku, *Polyprion oxygeneios*.

Specific Objectives:

1. To design a bottom longline survey to determine the age structure of New Zealand hāpuku, *Polyprion oxygeneios*.

Reporting Requirements:

Objective 1:

1. To submit to the MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a progress report as specified in Research Reporting Form 4 by 30 June 2022.
2. To present the report in 2 above to meetings of the Inshore Finfish Assessment Working Group in August 2022. Presentations to more than one meeting may be required.
3. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 September 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 November 2022 to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

General
Hāpuku currently support commercial fisheries of 1500 t (hāpuku and bass). They are taken predominately with hook and line on rocky underwater features. There is currently no accepted index of relative abundance for hāpuku, a commercial and non-commercial species, because commercial catches are reported together with those of bass, *P. americanus*, as 'HPB'.

Fishery independent surveys can provide information on the relative abundance and age structure of fish populations, which is not influenced by changes in fishing gear or fisher behaviour. Based on a random stratified design these surveys are less prone to hyperstability than commercial CPUE, e.g., when fishers maintain catch rates, independent of population size, by focusing on areas or seasons where/when fish are most abundant. Although fishery independent bottom trawl surveys are conducted in several areas supporting important bottom trawl fisheries around New Zealand, no longline surveys currently exist.

A recent project (INS2018-02) investigated the use of fishery independent longline surveys to monitor hāpuku and bass. Upon reviewing the results (12 December 2019), the Inshore Working Group noted that anecdotal evidence indicated that there had been a marked decline in the distribution of hāpuku, and, given that they are currently targeted on features where they are known to aggregate, CPUE would likely be hyperstable, regardless of whether it was based on commercial effort or a fishery independent survey. This led the Working Group to conclude that the most likely tool for monitoring exploitation rates would be a survey designed to provide information on the age structure of the population.

Objective 1
Hāpuku aggregate on underwater features, and previous ageing studies indicate that the age structure between features may vary considerably. The stock structure of hāpuku is currently not well known. Tagging nevertheless reveals that this species may move considerable distances, and anecdotal reports from fishers indicate biomass of large fish on features may replenish in a few months.

A survey designed to estimate the age structure of hāpuku would need to sample features throughout the distribution of the species, with age structure from each site weighted according to relative biomass. Consideration given to: 1) whether the survey should take place during or outside of the spawning season, 2) how age structure from specific features would be weighted to produce a population estimate.

A survey of this nature could be conducted from a charter vessel or through co-ordinated commercial fisher directed effort. Licensed Fish Receiver grading data, linked to individual vessels, should be used to design the survey.

Indications of survey cost are required.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objective in this project are (in order): 1.0.

INS2021-01 Management Procedures for GUR 7, RCO 7, and JDO 7

Project code:	INS2021-01
Project title:	Management Procedures for GUR 7, RCO 7, and JDO 7
Start date:	1 October 2021
Completion date:	30 November 2022
Vessel use:	None
Estimated cost:	$50,000

Overall Research Objective:

To develop Management Procedures for GUR 7, RCO 7, and JDO 7 based on WCSI trawl survey indices of abundance.

Specific Objectives:

1. To develop management procedures, including decision rules and performance indicators, for GUR 7, RCO 7, and JDO 7.
2. To develop appropriate operating models for GUR 7, RCO 7, and JDO 7.
3. To test the management procedures and decision rules against performance indicators using suitable operating models.

Reporting Requirements:

All Objectives:

1. To submit results to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager in a Progress Report as specified in Research Reporting Form 4 by 30 March 2022.
2. To present the report in 1 above to meetings of the Inshore Fishery Assessment Working Group in April 2022.
3. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft revised Working Group Reports as specified in Research Reporting Form 8 for John dory, red gurnard, and red cod by 20 April 2022.
4. To submit to the MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 September 2022.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 November 2022 to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

General
A time series of inshore trawl surveys have been conducted in the Challenger Fisheries Management Area by R.V. *Kaharoa* from 1992 to 2021 (15 surveys). The trawl survey encompasses the area off the west coast of the South Island and Tasman Bay/Golden Bay and monitors a range of inshore finfish species. The target species for the survey include John dory, red gurnard, and red cod; these species are characterised by being relatively fast growing and short-lived. For each of these species, there has been considerable variation in both the time series of survey biomass indices and annual catches, indicating relatively high variation in recruitment and stock abundance. There is a relatively strong correlation between trawl survey abundance and annual catch for each of the three species.

The trawl survey biomass indices have been used to monitor trends in stock abundance and inform management decisions, resulting in relatively small (10–20%) and infrequent changes in the TACCs for these fishstocks (GUR 7, RCO 7, and JDO 7). The development of Management Procedures linking changes in TACC directly to the magnitude of trawl survey biomass indices has the potential to improve the management of these three fishstocks by enabling more responsive changes in the TACCs relative to species abundance.

Objectives 1 - 3
During 2020, a simulation study was conducted to evaluate a simple set of Management Procedures based on the trawl survey biomass indices. The simulation study was formulated to approximate the dynamics of the three potential candidate species and considered a range of management responses, specifically the frequency and magnitude of the changes in TACC relative to the trawl survey biomass indices. Overall, the results of the simulation study indicated that relatively high average catches could be achieved while maintaining the stock at levels of abundance approximating default target references points (e.g., 40% *SB0*), especially under scenarios with higher variation in the TACC.

The current project is to further develop the Management Procedures from the simulation study and evaluate the procedures directly for each of the three fishstocks (GUR 7, RCO 7, and JDO 7) within a simulation framework utilising species specific biological parameters and catch and trawl survey data, incorporating appropriate levels of uncertainty. The evaluation of the Management Procedures would include a range of performance indicators related to stock status indicators and utilisation (TACC and catch). The range of Management Procedures and performance indicators would be developed through consultation and engagement with Inshore

Fishery Managers and key stakeholder groups, including industry, recreational sector, and Māori.

Operating models are required to capture apropriate levels of uncertainy in population dynamic parameters — such as growth rate, recruitment, and age at maturity — and in the index of relative abundance.

Weighting of Objectives
The relative importance weightings for the objectives in this project are (in order): 0.3, 0.3, 0.4.

INS2021-02 Stock assessment of rough and smooth skates

Project code:	INS2021-02
Project title:	Stock assessment of rough and smooth skates
Start date:	1 October 2021
Completion date:	30 November 2022
Vessel use:	None
Estimated cost:	$50,000

Overall Research Objective:

To assess the status of smooth skates in SSK 1, SSK 3, SSK 7, and SSK 8, and rough skates in RSK 1, RSK 3, RSK 7, and RSK 8 based on trawl survey series of relative abundance.

Specific Objectives:

1. To determine which trawl surveys provide reliable indices of abundance for rough and smooth skates in each QMA.
2. To undertake Partial Quantitative assessments for each QMA for which reliable relative abundance series are available.

Reporting Requirements:

Objectives 1–2:

1. To submit results to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager in a Progress report as specified in Research Reporting form 4 by 1 March 2022.
2. To present the report in 1 above to meetings of the Inshore Fishery Assessment Working Group in March 2022 in Wellington.
3. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager draft revised Working Group Reports as specified in Research Reporting Form 8 for rough and smooth skates by 16 April 2022.
4. To submit to the to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 September 2022.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 November 2022 to the Research Data Manager, MPI, in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

General
Rough skate (*Zearaja nasuta*, RSK) are fished commercially in New Zealand in close association with smooth skates (*Dipturus innominata*, SSK), which are also known as barndoor skates. Smooth and rough skates occur throughout New Zealand, but are most abundant around the South Island in depths down to 500 m. Most of the catch is taken as bycatch by bottom trawlers, but skates are also taken by longliners. There is no clear separation of the depth ranges inhabited by rough and smooth skates; however, smooth skate tend to occur slightly deeper than rough skate (Beentjes & Stevenson 2000, 2001, Stevenson & Hanchet 2000).

Many fishers and processors did not distinguish between rough and smooth skates in their landing returns prior to introduction to the QMS and coded them as 'skates' ('SKA'). Further, following introduction into the QMS in 2003, the two skate species have not always been correctly identified by fishers, and substantial unreported discarding is also possible. Commercial catch and effort data are therefore unlikely to provide reliable indices of abundance for skate stocks.

Rough and smooth skate are, nevertheless, captured in the following fishery independent trawl surveys: Inshore ECSI and Chatham Rise surveys (RSK 3 and SSK 3); Inshore WCSI (RSK 7 and SSK 7); WCNI (RSK 8 and SSK 8); and Hauraki Gulf and Bay of Plenty (RSK 1 and SSK 1). The aim of this project is to use trawl survey series to complete Partial Quantitative Stock Assessments for each skate stock where data are sufficiently reliable.

Objective 1
Under this objective the research provider is required to determine which skate species are likely to be reliably monitored by each trawl survey. Conclusions will likely be based on inter-annual variability in relative abundance and magnitude of CVs.

For the first survey of each of two series — east coast South Island and Chatham Rise — the two skate species were not (fully) distinguished. For the recently re-instated WCSI trawl survey, the survey area has varied over time, and it will be necessary to produce series of relative abundance based on a consistent survey area, e.g., as done recently for SNA 8.

Objective 2
Partial Quantitative Stock Assessments, based on series of relative abundance, aim to establish target reference points and soft and hard limits based on periods in the series where the stock

is determined to be in either good or poor shape. Although reference periods will ultimately be agreed upon by the Inshore Fisheries Assessment Working Group, the research provider is required to produce a straw man Status of Stock Summary (SOSS) table. Potential research providers are referred to the SOSS tables for other species assessed using relative indices of abundance in the Plenary for more detail, e.g., GUR 1.

Weighting of Objectives
The relative importance weightings for the objectives in this project are (in order): 0.5, 0.5.

INT2021-01 East Coast South Island trawl survey

Project code:	INT2021-01
Project title:	East Coast South Island trawl survey
Start date:	1 October 2021
Completion date:	30 March 2023
Vessel use:	R.V. *Kaharoa*
Estimated cost:	$1,150,000

Overall Research Objective:

To determine the relative abundance and distribution of southern inshore finfish species off the east coast of the South Island; focusing on red cod (*Pseudophycis bachus*), stargazer (*Kathetostoma giganteum*), sea perch (*Helicolenus percoides*), tarakihi (*Nemadactylus macropterus*), spiny dogfish (*Squalus acanthius*), elephant fish (*Callorhinchus milii*), red gurnard (*Chelidonichthys kumu*), and dark ghost shark (*Hydrolagus novaezelandiae*).

Specific Research Objectives:

1. To determine the relative abundance and distribution of red cod, stargazer, sea perch, tarakihi, spiny dogfish, dark ghost shark, elephant fish, and red gurnard, off the east coast of the South Island from the Waiau River to Shag Point by carrying out a trawl survey over the depth range 10 to 400 m. The target coefficients of variation (CVs) of the biomass estimates for these species are as follows: red cod (30%), sea perch (20%), giant stargazer (20%), tarakihi (20%), spiny dogfish (20%) elephant fish (30%), red gurnard (20%), and dark ghost shark (30%).
2. To collect the necessary data and determine the length frequency, length-weight relationship, and reproductive condition of red cod, giant stargazer, sea perch, tarakihi, spiny dogfish, elephant fish, red gurnard, and dark ghost shark.
3. To collect otoliths from giant stargazer, sea perch, red gurnard, red cod, and tarakihi.
4. To collect the data to determine the length frequencies and catch weight of all other Quota Management System (QMS) species.
5. To identify benthic macro-invertebrates collected during the trawl survey.

Reporting Requirements:

Objectives 1–5:

1. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a Voyage Programme as specified in Research Reporting Form 2, one month before the beginning of the survey.
2. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a Voyage Report as specified in Research Reporting Form 3 by 15 July 2022.

3. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 1 November 2022.
4. To present the report detailed in 3 above to a meeting of the Inshore Fishery Assessment Working Group by 30 November 2022.
5. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft revised Working Group Reports as specified in Research Reporting Form 8 for key species, by 30 March 2023.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 November 2022 to the Research Data Manager, MPI, in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 1: Maximise the social, economic and cultural benefits from stocks that provide the greatest benefit using fully quantitative stock assessments to maintain the biomass of the stock at or around the management target.
- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

General
The New Zealand Fisheries Act (1996) was amended in 2008 to allow the possibility to set a total allowable catch that is "not inconsistent with the objective of maintaining the stock at or above, or moving the stock towards or above, a level that can produce the maximum sustainable yield", even if the current level of the stock or the level of stock that can produce MSY is not able to be estimated reliably using the best available information. This implies the use of proxies for MSY reference points where they cannot be estimated directly. The Harvest Strategy Standard for New Zealand Fisheries incorporates this approach, which is further operationalised in the 2020 draft National Fisheries Plan for Inshore Finfish (Inshore Fishplan). Trawl surveys provide an opportunity to provide information on stock trends and population structure of a wide variety of species spanning several of the Inshore Fishplan species groupings, and development of proxies for B_{msy} reference points.

The South Island trawl survey series was reviewed by an independent international expert panel who found that the east and west coast South Island surveys have been designed and conducted according the best standards practised worldwide and that the surveys are highly suitable for monitoring the inshore demersal fish stocks.

Given that analytical stock assessments are not currently planned for the species covered by the surveys, with the exception of tarakihi, the survey estimates of biomass will be used directly to determine stock status. Targets and limits have not been explicitly defined for many stocks and it may be possible to derive proxies for these limits from the survey time series. Furthermore, basic methods such as estimating relative fishing mortalities (catch/survey biomass index) may provide a useful proxy for estimates of fishing intensity over years.
Other management objectives such as maintaining biodiversity; protecting endangered, threatened, or protected species such as the National Plan of Action for Sharks (2013; and other aspects of ecosystem-based management plans are supported through survey data in many other countries. In addition, surveys often provide information needed to support Principle 2 (ecosystem impacts) requirements for Marine Stewardship Council certification.
Surveys provide early indications of year-class strength, changes in maturity-at-age, growth, and mortality that can be difficult to determine from commercial fishery data due to the effects of gear selectivity and distribution of fishing activity. Although these indicators may not feed directly into the stock status for management objectives, they do indicate potential changes to productivity that should be taken into account when making management decisions.

Because of the importance of the east coast South Island (ECSI) inshore finfish fisheries and problems associated with alternative abundance indices for some trawl caught species, the ECSI trawl survey is considered to provide the most accurate measure of abundance for many South Island inshore species. These surveys are conducted biennially.

A review of the biology and distribution of species targeted with bottom trawl revealed that a survey depth range of 10–400 m is likely to monitor abundance of the following species in FMA 3: red cod, sea perch, stargazer, tarakihi, dark ghost shark, rough skate, and sub-adult school shark. The reported commercial landings of these species in FMA 3 totalled 11 656 tonnes in 2010–11, and an analysis undertaken in 2012 showed that, though the survey was not optimised for any other species, acceptable CVs on biomass estimates and useful length frequency information were obtained for a number of other species. This led the Southern Inshore Working Group to recommend that the following eight species be included in the survey reports (BAR, LSO, LIN, RSK, SSK, SCH, SPO, and SWA). The Working Group determined that results will be presented on catch rates, biomass (by sex, total, and recruited), and length frequency by depth range (10–30 m and 30–400 m) for the 2012 and each subsequent survey. Time series of catch rates (for each tow), total biomass, and length frequency for the winter survey core strata (30–400 m) will be presented, whereas for core plus shallow strata (10–400 m) this will include 2007, 2012, 2014, and 2016 surveys. Although these additional species do not all conform to fishstocks that match FMA 3 exclusively, and are not all solely taken by inshore fleets, they accounted for a total commercial catch of 20 286 tonnes in 2010–11.

Objectives 1-4
A long-term time series of fishery-independent relative abundance indices is a useful tool to monitor fish stocks and interpret fluctuations in abundance. The proposed ECSI trawl survey would extend a valuable time series of relative abundance indices for red cod, sea perch, stargazer, tarakihi, spiny dogfish, dark ghost shark, rough skates, and sub-adult school shark.

Survey design should be based on cost benefit analysis incorporating the interplay between simulated CV and the power to detect change in relative biomass. The research provider must ensure that the 5 inshore strata (10–30m) are sampled with the appropriate number of stations to achieve the CVs required for ELE and GUR. The survey design will be reviewed by the Inshore Working Group prior to the survey commencing.

In 2014, the survey was expanded to include the following eight species in the survey reports (BAR, LSO, LIN, RSK, SSK, SCH, SPO, and SWA). Results will be presented on catch rates, biomass (by sex, total, and recruited), and length frequency by depth range (10–30 m and 30–400 m) for the 2012 and each subsequent survey.

Time series (all nine previous surveys) of catch rates (for each tow), total biomass, and length frequency for the winter survey core strata (30–400 m) will be presented, whereas for core plus shallow strata (10–400 m) this will include 2007, 2012, and 2014 surveys.

The service provider must undertake an assessment of the representativeness of this survey.

Objective 5
This objective will provide information on the community structure of benthic invertebrates in the trawl survey area as a means of monitoring the environmental effects of fishing. There are other public good benefits from collecting these data.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.5, 0.2, 0.1, 0.1, and 0.1.

JDO2021-02 Characterisation and CPUE for JDO 1

Project code:	JDO2021-02
Project title:	Characterisation and CPUE for JDO 1
Start date:	1 October 2021
Completion date:	30 November 2022
Vessel use:	None
Estimated cost:	$60,000

Overall Research Objective:

To monitor the relative abundance of John dory in JDO 1

Specific Research Objectives:

1. To characterise the JDO 1 fishery
2. To update the standardised CPUE index for John dory (JDO 1), with the inclusion of data up to the end of the 2020/21 fishing year.

Reporting Requirements:

All Objectives:

1. To submit results to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager in a Progress Report as specified in Research Reporting Form 4 by 30 March 2022.
2. To present the report in 1 above to meetings of the Inshore Fishery Assessment Working Group in April 2022.
3. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 for John dory by 20 April 2022.
4. To submit to the MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 September 2022.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 November 2022 to the Research Data Manager, MPI, in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

General
Commercial landings of John dory from JDO 1 have ranged between around 300 and 500 tonnes over the last decade. It is mostly taken by bottom trawl and Danish seine during tows targeting snapper, John dory, tarakihi, red gurnard, and trevally. John dory are also targeted by recreational fishers using line and spearfishing methods.

According to the draft Inshore Finfish Fisheries Plan (2020), JDO 1 is a Group 2 stock. The management objective for Group 2 stocks is to maintain relative stock abundance at or above an established minimum reference level. The primary indices of abundance used for monitoring JDO 1 are based on standardised CPUE of bottom trawl catches. According to the MTRP for Inshore Finfish (MPI 2020), CPUE series for JDO 1 are updated every 3 years. The series were previously updated to 2016–17.

Objective 1
Fishery characterisations inform both the methods and results of CPUE analyses and provide valuable management information. The fishery characterisation should include density maps of JDO 1 catch and effort using high resolution spatial data provided by TCER forms.

Objective 2
The JDO 1 population is monitored using three spatially related CPUE series, each one pertaining to a separate sub-stock: West Coast, East Northland + Hauraki Gulf, and Bay of Plenty. The West Coast sub-stock analysis may include data from the northern part of the west coast portion of JDO 2, if the characterisation indicates that this is appropriate.

Trawl surveys have been reinstated in the Hauraki Gulf, Bay of Plenty, and off the west coast of the North Island since the last JDO 1 analysis. CPUE trends should be compared with the trawl survey series in each of these areas.

The B_{MSY} proxies and associated soft and hard limits accepted for the three JDO 1 sub-stocks are based on trends in standardised CPUE. The research provider is expected to provide some basic analyses to support the assessment of each stock against the respective reference points. Also required are plots showing trends in relative fishing mortality.

Weighting of Objectives
The weightings for the objectives in this project are (in order): 0.5, 0.5.

References:

Langley, A.D. (2018). Fishery characterisation and Catch-Per-Unit-Effort indices for John dory in JDO 1. *New Zealand Fisheries Assessment Report 2018/36.*

MPI (2020). Medium Term Research Plan Inshore Finfish. *MPI Information Paper No: 2020/06*. 50 p.

KIN2021-01 Catch-at-age of recreational catch of kingfish in KIN 1 Bay of Plenty

Project code:	KIN2021-01
Project title:	Catch-at-age of recreational catch of kingfish in KIN 1 Bay of Plenty
Start date:	1 September 2021
Completion date:	31 August 2023
Vessel use:	None
Estimated cost:	$150,000

Overall Research Objective:

To monitor the status of kingfish (*Seriola lalandii*) stocks in KIN 1.

Specific Objectives:

1. To characterise the fisheries to inform and review the sampling design.
2. To conduct representative sampling to determine the length, sex, and age composition of the recreational landings of kingfish in the Bay of Plenty in KIN 1 for the 2021–22 fishing year to assess the status of the stock. The target coefficient of variation (CV) for the catch-at-age will be 30% (mean weighted CV across all age classes).

Note:
Sampling design will be reviewed by the Inshore Working Group prior to the start of sampling. Samples from offshore areas, such as White Island and Ranfurly Bank, are obtained from charter boats. Offshore charter boat effort targeting kingfish has declined dramatically with the COVID-related lack of overseas visitors. If this fishery has not recovered by the time the sample design is due to be presented to the WG, it may be necessary to delay the project and associated reporting requirements by one year.

Reporting Requirements:

Objectives 1–3:
1. To present the proposed sampling design for specific objective 1 to the Inshore Working Group in September 2021.
2. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a Progress Report as specified in Research Reporting Form 4 by 1 September 2022.
3. To present the report in 2 above to meetings of the Inshore Fishery Assessment Working Group in October 2022.
4. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a Final Research Report as specified in Research Reporting Form 5 or a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 28 February 2023.

5. To present the report in 4 above to meetings of the Inshore Fishery Assessment Working Group in March 2023 (potentially in Auckland).
6. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 for kingfish by 15 April 2023.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 June 2023 to the Research Data Manager, MPI, in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

General
Kingfish are highly regarded by recreational fishers in New Zealand for their sporting attributes and large size. Kingfish are most often caught by recreational fishers from private boats and from charter boats but are also a prized catch for spearfishers and shore-based game fishers. Kingfish are recognised internationally as a sport fish, and kingfish caught in New Zealand waters hold 20 of the 22 International Gamefish Association World Records.

Recreational fishers have voiced concerns over a perceived marked decline in the size of kingfish available to them. Many clubs, competitions, and charter boats have implemented a voluntary 'one kingfish per person per day' limit in response. A number of gamefish clubs have also adopted a voluntary minimum size limit of 100 cm for kingfish.

The recreational harvest of kingfish in KIN 1 is estimated to be between 500 t and 600 t. Commercial landings, mostly taken as a bycatch in bottom trawl fisheries and by longline targeting snapper, have ranged between 48 and 100 t since 2001; although the number of kingfish reported as returned alive under Schedule 6 has increased in the last few years.

KIN 1 is a Group 2 stock in the draft 2020 Fisheries Plan for Inshore Finfish. It consists of two biological stocks — one in East Northland and Hauraki Gulf and the other in the Bay of Plenty —

which have been monitored using five yearly estimates of fishing mortality derived from the age composition of the recreational catch.
In 2020 an index of abundance, based on snapper longline CPUE, was accepted by the Inshore Working Group for the East Northland/Hauraki Gulf stock. There is currently no index of abundance for adult kingfish in the Bay of Plenty.

Objective 1
Results of the characterisation will be used to determine spatio-temporal sampling effort and which fisheries need to be sampled to obtain representative samples. Apart from club records, data generated by the charter boat catch and activity reporting system may prove useful.

Objective 2
Although a formal stock assessment (based on a stock assessment model) is not proposed for kingfish at this time, age composition of the catch has been shown by previous studies to provide information on stock status and the sustainability of current removals. It is, however, critical that accurate information on the size (and age) composition of released fish is collected.

Age structure provides a tool with which exploitation rate can be measured, allowing for both temporal and spatial comparisons. Monitoring age structure also provides a means to better evaluate the response of a population to changes in regulations. Some outputs from this objective will include:

- Estimation of the age structure of the population/s.
- Estimates of total fishing mortality that incorporate uncertainty in key parameters (e.g., age at full recruitment and other selectivity issues) and the different properties of regression and Chapman-Robson estimators.
- Proxies for *Fmsy* based on spawner biomass per recruit analyses (e.g., $F_{40\%SBR}$).

Mortality estimates should be provided separately for offshore and inshore areas within the Bay of Plenty. Kingfish appear to move offshore with age, and larger/older fish appear to congregate near offshore islands and on banks.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.25, 0.75.

References:

Holdsworth, J.C.; *McKenzie*, J.R.; Walsh, C.; Bian, R.; Ó Maolagáin, C. (2016a). Catch-at-age of yellowtail kingfish (*Seriola lalandi*) caught by recreational fishers 2014-15. *New Zealand Fisheries Assessment Report 2016/45.* 35 p.

SNA2021-01 Estimation of snapper year class strength in SNA 8

Project code:	SNA2021-01
Project title:	Estimation of snapper year class strength in SNA 8
Start date:	1 August 2021
Completion date:	30 December 2022
Vessel use:	None
Estimated cost:	$200,000

Overall Research Objective:

To estimate the year class strengths of snapper (*Pagrus auratus*) in SNA 8.

Specific Research Objectives:

1. To characterise the SNA 8 fishery by analysing existing commercial catch and effort data to the end of 2020–21 fishing year.
2. To carry out sampling and estimate the relative proportion-at-age and -length of recruited snapper sampled from the commercial catch in SNA 8 in spring-summer of 2021–22. The target coefficient of variation (CV) for the catch-at-age will be 20% (mean weighted CV across all age classes).

Reporting Requirements:

Objectives 1–2:

1. To present the sampling design to a meeting of the Northern Inshore Fishery Assessment Working Group in September 2021.
2. To submit results to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager in a Progress Report as specified in Research Reporting Form 4 by 1 October 2022.
3. To present the report in 2 above to meetings of the Northern Inshore Fishery Assessment Working Group in October 2022.
4. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report, as specified in Research Reporting Form 7 by 30 November 2022.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 December 2022 to the Research Data Manager, MPI, in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 1: Maximise the social, economic and cultural benefits from stocks that provide the greatest benefit using fully quantitative stock assessments to maintain the biomass of the stock at or around the management target.

General
The snapper fishery is New Zealand's largest inshore finfish fishery by value. SNA 8 is the second largest snapper fishery, with a current TACC of 1250 t. Snapper also form important fisheries for Māori and recreational fishers. The recreational harvest of SNA 8 was estimated at 892 t in 2017.

In the current stock assessment model, yearly recruitment indices are estimated using catch-at-age data sampled from the commercial fisheries. The catch-at-age data are currently collected on a cycle of one in three years. The fishery was last sampled in 2018/19.

Information on age and length composition may, together with estimates of selectivity-at-age, be used to estimate stock age composition and is an important input into the age-structured models used for the assessment of SNA 8, including estimation of productivity and yields.

Objectives 1&2
The aim of shed sampling is to estimate the age and length structure of the commercial landings of snapper. SNA8 is sampled in the spring-summer period. Results of an initial characterisation will be used to design the sampling programme. An updated characterisation will be required to determine the representativeness of the sampled catch.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.25, 0.75.

SPO2021-01 Fishery characterisation and CPUE analysis of SPO 1, 2, 3, 7, and 8

Project code:	SPO2021-01
Project title:	Fishery characterisation and CPUE analysis of SPO 1, 2, 3, 7, and 8
Start date:	1 October 2021
Completion date:	30 November 2022
Vessel use:	None
Estimated cost:	$80,000

Overall Research Objective:

To characterise all rig (*Mustelus lenticulatus*) fisheries and undertake CPUE analyses in SPO 1, 2, 3, 7, and 8.

Specific Research Objectives:

1. To characterise the SPO 1, 2, 3, 7, and 8 fisheries.
2. To analyse existing commercial catch and effort data to the end of 2020–21 fishing year and undertake CPUE standardisations for each stock.

Reporting Requirements:

Objectives 1–2:

1. To submit results to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager in a Progress Report as specified in Research Reporting Form 4 by 1 March 2022.
2. To present the report in 1 above to meetings of the Northern Inshore Fishery Assessment Working Group in March 2022 (potentially in Auckland).
3. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 for rig by 16 April 2022.
4. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager as specified in Research Reporting Form 5 or a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 September 2022.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 Nov 2022 to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Group 2: Provide social, economic and cultural benefits from stocks that provide moderate benefits using partial quantitative stock assessments while maintaining relative stock abundance at or above the management target.

General
Rig (*Mustelus lenticulatus*) are caught in coastal waters throughout New Zealand. Most of the catch is taken in water less than 50 m deep, during spring and summer when rig aggregate inshore. Before the introduction of the QMS in 1986, 80% of the commercial catch was taken by bottom setnet and most of the remainder by trawl. Total reported landings of rig increased rapidly during the 1970s and averaged about 3200 t per year during the late 1970s and early 1980s. Since then, a larger proportion has been taken by trawlers as bycatch, but the exact split by method is unknown (because method data were available only for a portion of the rig catch in the CELR database). The most important bottom setnet fisheries are at Ninety Mile Beach, Kaipara Harbour, Manukau Harbour, South Taranaki Bight to Tasman Bay/Golden Bay, Canterbury Bight, Kaikōura, and Hauraki Gulf.

All rig stocks reside within Group 2 of the draft Inshore Finfish Fish Plan and are monitored using standardised CPUE updated every three years. A recent investigation of the stock structure of New Zealand rig suggests they comprise multiple stocks. Rig CPUE analyses for each QMA are therefore conducted simultaneously. CPUE indices for each of the rig stocks was last updated to 2017–18.

Objective 1
Results of the characterisation will be used to determine the data grooming procedures for the CPUE analysis and the spatio-temporal analyses required to ensure CPUE analyses reflect each fishery.

Objective 2
Under this objective the catch and effort of key fisheries should be examined to assess population trends.

Much of the SPO 1 catch is taken by small vessels in harbours using setnets (SN). These fishers often accumulate catch ashore before landing to an LFR, thereby breaking the link between catch and effort. The use of estimated catch for CPUE analysis is problematic because some fishers report trunk weight instead of green weight. Work on deriving appropriate fisher specific conversion factors is therefore necessary before SN CPUE can be accepted as a reliable index of abundance for SPO 1.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.5, 0.5.

References:

Starr, P.J.; Kendrick, T.H. (2020). SPO 1, 2, 3, 7, and 8 fishery characterisation and CPUE report. *New Zealand Fisheries Assessment Report 2020/40.*

TRE2021-01 Monitoring length and age structure of commercial landings of trevally in TRE 7

Project code:	TRE2021-01
Project title:	Monitoring length and age structure of commercial landings of trevally in TRE 7
Start date:	1 October 2021
Completion date:	31 August 2024
Vessel use:	None
Estimated cost:	$550,000

Overall Research Objective:

To determine the length and age structure of the commercial catch of trevally in TRE 7.

Specific Research Objectives:

1. To characterise the TRE 7 fishery by analysing existing commercial catch and effort data to the end of 2020–21 fishing year.
2. To conduct representative sampling to determine the length, sex, and age composition of the commercial catch of trevally (*Pseudocaranx dentex*) in TRE 7 during the 2021–22 fishing year. The target coefficient of variation (CV) for the catch-at-age is 20% (mean weighted CV across all age classes) combined across sexes.
3. To conduct representative sampling to determine the length, sex, and age composition of the commercial catch of trevally (*Pseudocaranx dentex*) in TRE 7 during the 2022–23 fishing year. The target coefficient of variation (CV) for the catch-at-age is 20% (mean weighted CV across all age classes) combined across sexes.
4. To explore the times series of catch sampling data, in particular, for any significant changes in the length and age composition of commercial catches.

Note:
The sampling design will be reviewed by the Inshore Working Group prior to the sampling commencing.

Reporting Requirements:

Objectives 1–4:
1. To present the sampling design to a meeting of the Inshore Fishery Assessment Working Group in September 2021.
2. To submit results to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager in a Progress Report as specified in Research Reporting Form 4 by 1 June 2023.
3. To present the report in 2 above to meetings of the Inshore Fishery Assessment Working Group in June 2023.

4. To submit results to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager in a Progress Report as specified in Research Reporting Form 4 by 15 March 2024.
5. To present the report in 2 above to meetings of the Inshore Fishery Assessment Working Group in April 2024.
6. To submit to MPI Contracts Monitoring and Administration Team and the Fisheries New Zealand Science Officer and Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 June 2024.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided by 30 June 2024 to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required.

Rationale:

Management Objectives:
Draft National Inshore Finfish Fisheries Plan 2019

- Group 1: Maximise the social, economic and cultural benefits from stocks that provide the greatest benefit using fully quantitative stock assessments to maintain the biomass of the stock at or around the management target.

General
Trevally, *Pseudocaranx dentex*, in TRE 7 support important commercial and recreational fisheries. Commercial landings in 2012–13 were 1842 t and the recreational harvest was estimated to be 29 t in 2012. In terms of the Inshore Finfish Fish Plan, TRE 7 is a Group 1 stock which should be assessed using formal Type 1 statistical stock assessment. The age composition of the commercial bottom trawl fishery is a primary input to the stock assessment model and is sampled two consecutive years in every five (see Medium Term Research Plan for Inshore Finfish, MPI 2020). The age composition of TRE 7 landings was last sampled in 2012–13 (TRE2012/02). Subsequent sampling programmes have been delayed for a variety of reasons.

Objective 1
Results of an initial characterisation will be used to design the sampling programme. An updated characterisation will be required to determine the representativeness of the sampled catch.

Objectives 2–4

Catch-at-age studies covering the 2006–07, 2007–08, 2009–10, and 2012–13 fishing years revealed consistent differences in the age structures of catches from four spatial areas: Ninety Mile beach, Kaipara/Manukau, North Taranaki Bight, and South Taranaki Bight. Research providers should therefore aim to sample each of these sub-areas in a representative manner, and to provide a separate age composition for the commercial catch from each area. It may also be necessary to include any dominant fishing vessels with different selectivity and/or catchability as separate sampling strata.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.25, 0.3, 0.3, and 0.15.

References:

MPI (2020). Medium Term Research Plan Inshore Finfish. *MPI Information Paper No: 2020/06*. 50 p.

Inshore Shellfish Fisheries

Project code	Project title
AKI2021-01	Northern intertidal shellfish survey
CSM2021-01	Establishing a framework for community shellfish monitoring
PAU2021-01	PAU 3 stock assessment
PAU2021-02	Accounting for catch in genetic sink and source modelling in PAU 3
PAU2021-03	Effects of new reporting scheme (ER/GPR) on commercial PAU catch and effort
PDO2021-01	Incidental mortality of surf clams in commercial dredge fishery
SCA2021-01	SCA7 biomass survey for core scallop beds (Marlborough Sounds, Golden Bay and Tasman Bay)
SCA2021-02	SCA CS evaluation of the CPUE limit rule management procedure
SUR2021-01	Biomass survey and condition index for kina in SUR 7A

AKI2021-01 Northern intertidal shellfish survey

Project code:	AKI2021-01
Project title:	Northern intertidal shellfish survey
Start date:	1 July 2021
Completion date:	30 July 2024
Vessel use:	Yes
Estimated cost:	$450,000

Overall Research Objective:

To determine the distribution, abundance and size frequency of cockles and pipi on selected beaches in the Auckland Fisheries Management Area for each year of this project.

Specific Research Objectives:

1. To determine the distribution, abundance, and size frequency of cockles and pipi on selected beaches[1] in the Auckland Fisheries Management Area for each year of this project.
2. To sample sediment at these beaches to provide a baseline of sediment composition against which any changes in shellfish distribution, abundance, and size frequency can be compared.
3. Report the abundances and trends over time at the surveyed sites, and within the context of all surveyed sites under the Auckland Intertidal monitoring series, and compare these with the findings of the Hauraki Gulf community shellfish monitoring programme and the Northland Regional Council programme (where possible).

Note: For each year of the project the selected beaches to be surveyed will be determined after consultation between MPI and relevant stakeholders. The list of beaches will be made available to prospective research providers prior to December, but a list of sites we are consulting on will be available prior to that date.

Reporting Requirements:

1. To present methods to the Shellfish Working Group by 30 November 2021.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Project Manager, and the Fisheries New Zealand Science Officer a draft Fisheries Assessment Report as specified in the Research Reporting Form 7 by 31 May for each year of the project.
3. To present the results to the Shellfish Working Group by 30 May 2024.
4. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Project Manager, and the Fisheries New Zealand Science Officer a final Fisheries Assessment Report as specified in the Research Reporting Form 7 by 30 June for each year of the project.

[1] This project has usually funded surveys of 12 beaches, but tenders should cost on a per beach basis.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 June 2022, 30 June 2023, and 30 June 2024.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Group 3 Objectives: 1) Secure social, cultural and economic benefits from each stock and 2) Maintain stock size at or above target reference level.

The relevant stocks (COC 1A, 1B, 1C, COC 9, PPI 1A, 1B, 1C, and PPI 9) are primarily in Group 3 in the draft National Fisheries Plan for Inshore Shellfish (the Plan). The stocks are of high importance to the recreational and customary sectors, with negligible commercial interest. As described in the Plan, Group 3 stocks can be susceptible to localised depletion, particularly near urban areas (i.e., the Auckland region).

To secure the benefits obtained from these stocks, the management approach involves monitoring fishery status. The characteristics of this fishery, including the proximity to densely populated urban areas, require a monitoring presence because of the speed at which localised depletion can sometimes occur.

In the absence of fishery-dependent monitoring from the commercial sector (such as CPUE) the best source of information for this fishery comes from the long-term series of periodic shellfish surveys. Information on trends over time enables fisheries management to monitor local population abundance and size distribution, and to take steps to avoid localised overfishing in areas which are identified as being at risk.

The tools for management of these fisheries include daily bag limits, size limits, seasonal closures, customary authorisations, customary management areas (taiāpure/mātaitai) and temporary closures. The fishing pressure within greater Auckland and the depletion of some shellfish beds have led to the introduction of a range of the above measures (but not size limits). Temporary closures to shellfish harvesting (under s 186A of the Act) are in place in the following locations: Marsden Bank and Mair Bank, Maunganui Bay, Te Mata and Waipatukahu, and Umupuia Beach. Gazetted (under s 11 sustainability measures) closures are in place for Ngunguru estuary and Whangateau Harbour. A seasonal closure is in place for Cockle Bay (a proposal for a permanent closure is before the Minister). There are also

permanent shellfish closures at Cheltenham, Eastern Beach, and Karekare. Survey information is needed to support these closures and any reopenings. Since 1998, 36 beaches have been surveyed a total of 211 times under the AKI project. The most recent surveying occurred in early 2020 under the AKI2018-01 project. The amount of times a beach has been surveyed has varied from once (when no shellfish were found) to 17 times (for Umupuia Beach).

Survey sites in recent years have been selected using 3 criteria (in decreasing order of importance):

1. Where information is needed to support proposed closures or reopenings,
2. Where concern is being voiced about local shellfish resources,
3. To achieve a geographic spread throughout Northland, Auckland, Waikato, and the Bay of Plenty.

Community-led intertidal shellfish surveying has also occurred in the Hauraki Gulf, supported by Auckland Council and Waikato Regional Council. The Ministry has supported this through aiding with survey design and analysis. As the Hauraki Gulf time series improves it is hoped this will improve the number of beaches surveyed and/or frequency of sampling at already sampled beaches so that more information is available to support local-scale management.

The Northland Regional Council is also surveying several areas which have been identified as 'ecological significant marine area' in their Proposed Regional Plan.

Sediment sampling has also been initiated, parallel to biological samples, to build a baseline against which changes in shellfish abundances can be compared (as change in sediments is often associated with changes in distribution, abundance or size structure of shellfish).

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4, 0.4, and 0.2.

CSM2021-01 Establishing a framework for community shellfish monitoring

Project code:	CSM2021-01
Project title:	Establishing a framework for community shellfish monitoring
Start date:	1 July 2021
Completion date:	30 June 2023
Vessel use:	None
Estimated cost:	$100,000

Overall Research Objective:

Working with iwi and hapū, co-develop appropriate tools and supporting frameworks to enable community groups to monitor shellfish populations to inform local management.

Specific Research Objectives:

1. Co-develop survey protocols for intertidal (and subtidal) bivalves, rock lobster, and kina and pāua, including data management aspects, to enable community groups to undertake monitoring of local shellfish stocks.
2. Support community implementation of each of the protocols.

Reporting Requirements:

1. To attend a scoping meeting with Fisheries New Zealand before 31 August 2021.
2. To present project progress at an Shellfish Fishery Assessment Working Group (SFWG) meeting before 31 May 2022.
3. To present final results at an SFWG meeting before 31 March 2023.
4. To submit a draft Fisheries Assessment Report (as per Research Reporting Form 6) for internal review by Fisheries New Zealand Science to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 April 2023.
5. To submit a final Fisheries Assessment Report (as per Research Reporting Form 6) to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 31 May 2023.

Project Update Reports
No Project Update Reports are required for this work.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required, by 30 June 2023.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Group 3 Objectives: 1) Secure social, cultural and economic benefits from each stock and 2) Maintain stock size at or above target reference level.

General
Through Treaty of Waitangi obligations, Fisheries New Zealand are committed to making better provision for Māori participation in the management and conservation of New Zealand's fisheries. In ensuring the management of inshore fisheries meets the Crown's obligations to Iwi and Māori and provides for their rights and interests, the draft National Inshore Finfish Fisheries Plan (Fisheries New Zealand 2019) specifically aims to support Iwi and Māori to establish and implement customary fisheries management tools. A range of management options are available, including mātaitai or taiāpure, (where tangata kaitiaki/tiaki can recommend changes to fishing rules) or temporary closures (section 186A or 186B of the Fisheries Act 1996). These management actions would ideally be informed by monitoring programmes, and local iwi have expressed interest in conducting surveys and ongoing monitoring of local taonga shellfish stocks.

This project will co-develop the tools and frameworks required to monitor local shellfish populations and provide the information in a form suitable to inform local management decisions. Given the varying nature of the species of interest and habitats they occupy, different approaches are likely to be required for intertidal bivalves (e.g., cockles, pipi, tuatua, toheroa), subtidal bivalves and grazers (e.g., scallops, pāua, kina), and crustaceans (e.g., rock lobster).

Objective 1
Iwi and hapū have expressed a strong desire to monitor local shellfish stocks, and to support this the Ministry of Fisheries has previously developed different community monitoring guides for a range of (mostly shellfish) species of interest to customary groups (e.g., Blair 1999, Cassidy et al 1997, MacDiarmid & Blair 2002). Given the potential changes in available technology and management needs since these guides were developed, it is timely to work with both kaitiaki and MPI to review these guides (and others that may exist) and update them to ensure they use the most appropriate sampling and analytical approaches, still deliver kaitiaki and MPI fishery manager needs, and provide the data in formats compatible with appropriate MPI databases. We anticipate at least monitoring guides will be updated (relevant for monitoring intertidal bivalves, subtidal bivalves and grazers, and crustaceans).

Objective 2
Having co-developed and updated the monitoring protocols and framework, the project will support local community groups in testing their implementation, to ensure approaches are suitable and provide a robust monitoring approach. This will involve supporting the completion of at least 3 monitoring surveys, to ensure that each of the anticipated protocols (intertidal bivalves, subtidal bivalves and grazers, and crustaceans) can be tested.

Weighting of Objectives:
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4, 0.6.

References:

Blair, T. (1999). A community guide to monitoring paua and kina populations. 40 p. (Report held by Fisheries New Zealand, Dunedin, New Zealand).

Cassidy, M.; Suter, H.; McGee, I. (1997). A community guide to monitoring a cockle population. 24 p. (Report held by Fisheries New Zealand, Dunedin, New Zealand)

MacDiarmid, A.; Blair, T. (2002). A community guide to monitoring crayfish (rock lobster) populations. 52 p. (Report held by Fisheries New Zealand, Dunedin, New Zealand)

PAU2021-01 PAU 3 stock assessment

Project code:	PAU2021-01
Project title:	PAU 3 stock assessment
Start date:	1 July 2021
Completion date:	31 August 2022
Vessel use:	No
Estimated cost:	$85,000

Overall Research Objective:

To undertake a stock assessment in PAU 3.

Specific Research Objectives:

1. To update the most recent standardised CPUE analysis for PAU 3.
2. To conduct a stock assessment in PAU 3 to estimate the status of the stock.

Reporting Requirements:

1. Present the methodologies and data inputs for Objectives 1 & 2 to the Shellfish Fishery Assessment Working Group (SFWG) by 31 October 2021.
2. Present updates on the CPUE standardisation and stock assessment progress to the SFWG as required between the dates 31 October 2021 to 31 March 2022.
3. Present the results of the SFWG by 31 March 2022.
4. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 15 April 2022.
5. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Working Group Report as specified in Research Reporting Form 8 by 30 April 2022.
6. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fisheries Assessment Report as specified in Research Reporting Form 7 by 31 May 2022.
7. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Form 7 by 31 July 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
1 All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 May 2022.
2 On completion of the stock assessment, provide relevant stock assessment inputs and outputs to the RAM Legacy database project by populating the spreadsheets provided. These are to be sent to the project scientist to check and send to the University of Washington by 30 July 2022.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Group 1 Objectives: 1) Maximise the overall social, economic, and cultural benefit obtained from each stock and 2) Maintain biomass of each stock at or above BMSY (or accepted proxy).

General
The purpose of this project is to undertake a new stock assessment in PAU 3.

The Kaikōura earthquakes caused significant uplift along parts of the PAU 3 coastline north of the Conway River. Following the earthquakes, the area from Conway River to the northern boundary of PAU 3 (and beyond, to Marfells Beach in PAU 7) was closed for the taking of shellfish (excluding scampi and rock lobster) and seaweed. In response to the increased risk of displacement of fishing effort to area south of the closure, a TAC was set at 79.3 tonnes (which includes customary and recreational fishing allowances), the TACC was halved from 91.62 tonnes in 2017 to 45.8 tonnes, and the recreational daily limit for pāua was reduced from 10 to 5 per person per day. The pāua fishery is still closed under section 11 of the Fisheries Act 1996.

An annual biomass survey for adult pāua has been conducted since the earthquakes through the project KAI2016-08 and the stock seems to be rebuilding. Industry representative body PāuaMAC3 on behalf of all PAU 3 quota owners and harvesters, and with the involvement and support of Ngāi Tahu, Te Korowai, and Fisheries New Zealand, developed the Kaikōura / Canterbury pāua (PAU 3) Fisheries Plan in 2019. The Plan focuses on managing commercial harvesting activity. It sets out actions that will be undertaken primarily by the fishing industry – that is, PAU 3 quota owners, ACE holders, harvesters, and Licensed Fish Receivers. These actions are implemented within government management settings – i.e., within the constraints of the TACC and current regulatory settings such as the Minimum Legal Size. The Fisheries Plan was presented at the end of 2019 to the Minister, who agreed that it proceed to public consultation. Fisheries New Zealand carried out public consultation on the PAU 3 Fisheries Plan from 28 May to 2 July 2020. Central to the Plan is subdividing the PAU 3 QMA under sections 25 and 25A of the Act. It is anticipated that the Minister will make a decision regarding the proposed subdivision and fisheries plan in early 2021.

Currently the stock assessment process for most pāua QMAs is being revamped to become more cost effective, efficient, and informative for management purposes. The model used in previous pāua stock assessments is being revised and further developments are taking place. Part of the revamp is developing a process whereby the status of all assessed stocks is updated each year and one or two stocks are assessed in detail. It is envisaged this project will continue the developments that are currently underway.

The required outputs from the stock assessment process will include the following indicators and projections of stock status:

- Indicators:
    - B_0, $B_{current}$, B_{msy}, $B_{current}$ as $\%B_0$, $B_{current}$ as $\%B_{msy}$, $U_{current}$, MSY, $U_{40\%B0}$

  Note indicators apply to both spawning and recruited biomass.

- Projections (for the 3 years following the current year estimates) at the current catch level, +20% and -20% of the current catch level. Projections at different catch levels may also be required.
    - $B_{projected}$ as $\%\ B_0$, $\%\ B_{msy}$, $\%\ B_{current}$
    - $\Pr(B_{projected} > B_{current})$
    - $\Pr(B_{projected} > B_{msy})$
    - $\mathrm{P}(B_{projected} > 40\%\ B_0)$
    - $\Pr(B_{projected} < 20\%\ B_0)$
    - $\Pr(B_{projected} < 10\%\ B_0)$
    - $\Pr(U_{projected} > U_{40\%B0})$

  Note projections apply to both spawning and recruited biomass

- A graph of the trajectory of exploitation rate as a ratio of $U_{\%40B0}$ and spawning stock biomass as a ratio of B_0 from the start of the assessment period to the current assessment date.

- Other reference points may also be considered in discussion with the SFWG.

Objective 1

A preliminary step of this project will be to determine, in discussion with the SFWG, whether the available data (including the credibility of CPUE as an index of abundance) are adequate to provide useful outputs from the stock assessment model. With the uptake of Electronic Reporting of catch and effort it is envisaged that CPUE could well become less reliable as an index of abundance. This project should include suggestions on how to manage this change from paper to electronic reporting in the scope of the stock assessment process.

If it is decided by the SFWG that the available data are inadequate to provide reliable outputs from the stock assessment model, then discussions will be directed towards alternative options for assessing the status of the stock.

Objective 2

Presuming a full stock assessment is undertaken discussions with the SFWG will also include:

- The appropriate spatial scale over which the assessment should be undertaken.

- Refining data inputs into the model (presuming data and CPUE analyses are accepted as adequate). For example, weighting data sets appropriately.
- Required sensitivity runs and diagnostics.
- Other aspects of the model structure, dynamics, data inputs, priors, and other inputs that need to be discussed.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.6 and 0.4.

PAU2021-02 Accounting for catch in genetic sink and source modelling in PAU 3

Project code:	PAU2021-02
Project title:	Accounting for catch in genetic sink and source modelling in PAU 3
Start date:	1 July 2021
Completion date:	30 August 2022
Vessel use:	No
Estimated cost:	$90,000

Overall Research Objective:

To develop a spatially explicit sink and source model of pāua along the Kaikōura coastline.

Specific Research Objective:

1. To develop a spatially explicit sink and source model of pāua along the Kaikōura coastline.

Reporting Requirements:

1. Present proposed methods to the Shellfish Fishery Assessment Working Group (SFWG) by 30 October 2021.
2. More than one presentation to the SFWG may be required between October 2021 and 30 December 2021. This should be taken into consideration when providing costs for this project.
3. Present the results to the SFWG by 30 March 2022.
4. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group report as specified in Research Reporting Form 8 by 15 April 2022.
5. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final revised Working Group report as specified in Research Reporting Form 8 by 30 April 2022.
6. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fisheries Assessment Report as specified in Research Reporting Form 7 by 30 May 2022.
7. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Form 7 by 30 July 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 May 2022.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Group 1 Objectives: 1) Maximise the overall social, economic, and cultural benefit obtained from each stock and 2) Maintain biomass of each stock at or above BMSY (or accepted proxy).

General
The November 2016 Kaikōura earthquake caused extensive coastal uplift resulting in massive pāua (*Haliotis iris*) mortality and loss of critical pāua habitats. Following the earthquakes, the area from Conway River to the northern boundary of PAU 3 (and beyond, to Marfells Beach in PAU 7) was closed for the taking of shellfish (excluding scampi and rock lobster) and seaweed. In response to the increased risk of displacement of fishing effort to area south of the closure, a TAC was set at 79.3 tonnes (which includes customary and recreational fishing allowances), the TACC was halved from 91.62 tonnes in 2017 to 45.8 tonnes, and the recreational daily limit for pāua was reduced from 10 to 5 per person per day. The pāua fishery is still closed under the section 11 of the Fisheries Act 1996. The closed area spans portions of two pāua quota management areas, the southern aspect of PAU 7 (Marlborough, TACC: 93.62 tonnes) and the northern aspect of PAU 3 (Kaikōura, TACC: 45.8 tonnes). The closed area historically accounted for approximately 60 t of annual commercial catch and supports significant customary and recreational pāua fisheries.

Following the immediate closure, a marine recovery package was put in place to assess the ecological impact of the earthquake and to inform future marine management options to optimise recovery of biota and habitats in the region. As part of this package, two research projects have been conducted that are relevant to pāua:

- *Rocky reef impact quantification and monitoring for the Kaikōura earthquake.* The objective of this project was to quantify the impact of the Kaikōura earthquake on rocky reef intertidal and subtidal fauna and either quantify or establish long-term monitoring sites to quantify the recovery from the earthquake to inform future marine management decisions. This provides quantification of the number of pāua juveniles at selected locations in the lower intertidal.
- *Pāua stock monitoring survey for the Kaikōura region*. The objective of this project was to estimate and monitor the abundance of adult pāua populations to inform management decisions at the scale of the Kaikōura fisheries closure.

These two projects were renewed as part of the 2020/21 research projects for another 2 to 3 years. Results from the most recently completed rocky reef intertidal and subtidal survey indicate that these habitats are in early stages of recovery post-earthquakes and are subjected to dynamic physical conditions and a range of local stressors (e.g., sediment run off). The annual biomass surveys for adult pāua have shown that the stock seems to be rebuilding.

In parallel to these two projects, three other research projects are in progress:

- *Shawn Gerrity's PhD* — The goal of this work is to gauge the recovery of juvenile pāua populations along the earthquake-affected coastline through time, and to fill gaps in knowledge about early life stages that are difficult to study. This involves thorough assessment of key habitat requirements, estimation of juvenile habitat availability, and detailed assessments of juvenile pāua abundance, distribution, and demographic patterns through time.
- *Moana Project* — The Moana Project aims to vastly improve understanding of coastal ocean circulation, connectivity, and marine heatwaves to provide information that supports sustainable growth of the seafood industry. As part of this project, MetOcean Solutions is currently working on hydrodynamic models at 5-km resolution nationwide and plans to focus on the Kaikōura region for validation of models and development of particle tracking tools.
- *Genetic research of the Kaikōura pāua populations* — Linked to the objectives of the Moana project, MBIE is also funded genetic research on the connectivity of the Kaikōura pāua populations through Victoria University of Wellington.

Industry representative body PāuaMAC3 on behalf of all PAU3 quota owners and harvesters, and with the involvement and support of Ngāi Tahu, Te Korowai, and Fisheries New Zealand, developed the Kaikōura / Canterbury pāua (PAU 3) Fisheries Plan in 2019. The Plan focuses on managing commercial harvesting activity and proposes reopening of the fishery to all sectors in October 2021. Public consultation on this plan has occurred and the plan is with the Minister for consideration and possible approval.

Objective 1:
This Kaikōura pāua depletion modelling project would investigate local scale depletion following reopening of the fishery (and how this may affect source and sink populations). It would validate and develop tools for particle tracking and forecasting of the Kaikōura marine communities. The Kaikōura region would be used as an exemplar for the tools and would assist with potential adaptive management of the region. Data from the current recovery package research would be used to parameterise and then validate meta-community models. In addition, it is proposed that additional snap-shot samples be taken of the reefs at each of the newly established carparks along SH1 where most visiting fishers will be accessing the coastal resources (in the 2020/21 summer and the 2021/22 summer). These data will be invaluable in tracking the impact of potentially high-density fishing and signal local depletions before they happen.

The Project Moana team are building basic hydrodynamic models for the area but are not resourced for the addition of biological tracking to these models. Other research providers have been approached to contribute to the project and there is support from Te Korowai, Dragonfly Data Science, MetOcean, Victoria University, and Canterbury University.

At this stage, we expect the initial hydrodynamic model to be available in early 2021 and the genetics results in late 2021. Research providers have provided feedback that building the model could progress in 2021 for inclusion of genetic information later in the year and sampling to test model predictions over the summer of 2021/22.

Weighting of Objectives
The relative importance weighting for the objective in this project is 1.

PAU2021-03 Effects of new reporting scheme on commercial pāua catch effort

Project code:	PAU2021-03
Project title:	Effects of new reporting scheme on commercial pāua catch effort
Start date:	01 July 2021
Completion date:	30 August 2022
Vessel use:	No
Estimated cost:	$50,000

Overall Research Objective:

To investigate patterns and bridging data gaps/discrepancies before and since the introduction of ER/GPR.

Specific Research Objectives:

1. To investigate patterns and bridging data gaps/discrepancies before and since the introduction of ER/GPR for pāua fishery data.

Reporting Requirements:

1. Present proposed methods to the Shellfish Fishery Assessment Working Group (SFWG) by 30 November 2021.
2. More than one presentation to the SFWG may be required between October 2021 and 30 December 2021. This should be taken into consideration when providing costs for this project.
3. Present the results to the SFWG by 30 March 2022.
4. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fisheries Assessment Report as specified in Research Reporting Form 7 by 30 May 2022.
5. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Form 7 by 30 July 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 July 2022.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Group 1 Objectives: 1) Maximise the overall social, economic, and cultural benefit obtained from each stock and 2) Maintain biomass of each stock at or above BMSY (or accepted proxy).

General
Some changes in the CPUE have been observed since the introduction of the Electronic Reporting (ER) / Geospatial Position Reporting (GPR). With the new reporting scheme, divers are required to report the time they get in and out of the water, for each diving event. It is thought that in the past, divers reported a round number for their day rather than the finer time scale now required.

In 2020, Phil Neubauer (Dragonfly Data Science) was asked to assist in getting some CPUE data for PAU 2. It turned out that the ER CPUE looked quite different — CPUE increased, but in PAU 2, at least, this was due to a massive decline in the average reported fishing time. That may well be a reflection of the new reporting system, but is concerning because it may mean that we cannot interpret ER CPUE as a continuation of PCELR CPUE — from Catch/day, the CPUE showed a 20% decline since 2017–18, but in the ER data the reported time in water plummeted, which gave the impression that CPUE increased in 2019-20. The same effect may occur in other QMAs.

Catch levels are not expected to have changed from previous reporting; however, CPUE at a finer scale of effort has proved to be higher. Investigating patterns and bridging data gaps/discrepancies before and since the introduction of ER/GPR could provide a basis for enabling data series to bridge the gap between reporting schemes.

Fisheries New Zealand is working alongside representatives from the Pāua Industry Council to address some reporting issues that have been highlighted since the inception of ER/GPR. These include reinstating reporting of effort at a finer scale, statistical area level, and introducing data collection of environmental factors that reflect diving conditions on the day.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weighting for the objective in this project is 1.

PDO2021-01 Incidental mortality of surf clams in commercial dredge fishery

Project code:	PDO2021-01
Project title:	Incidental mortality of surf clams in commercial dredge fishery
Start date:	1 July 2021
Completion date:	31 August 2022
Vessel use:	Yes
Estimated cost:	$150,000

Overall Research Objective:

To estimate the incidental mortality of surf clams in commercial dredge fishery.

Specific Research Objectives:

1. Conduct a hydraulic dredge survey in FMA 8 (Waitarere Beach or Hokio Beach) and/or FMA 7 (Cloudy Bay or Clifford Bay)
2. Estimate the incidental mortality of surf clams in the commercial dredge fishery.

Note: Waitarere/Hokio beach would be the priority due to large amount of interest in surf clam mortality events.

Reporting Requirements:

1. Present proposed methods to the Shellfish Fishery Assessment Working Group (SFWG) by 31 October 2021.
2. More than one presentation to the SFWG may be required between 31 October 2021 and 31 March 2022. This should be taken into consideration when providing costs for this project.
3. Present the results to the SFWG by 31 March 2022.
4. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group report as specified in Research Reporting Form 8 by 15 April 2022.
5. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final revised Working Group report as specified in Research Reporting Form 8 by 30 April 2022.
6. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fisheries Assessment Report as specified in Research Reporting Form 7 by 31 May 2022.
7. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Form 7 by 31 July 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 May 2022.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Objectives for all groups: 1) Minimise adverse effects of fishing on the aquatic environment, including on biological diversity.

General
Surf clams mainly inhabit the surf zone, a high-energy environment characterised by high sand mobility (Michael et al. 1990). Divers observed that the rabbit dredge (which has been used for surf clam surveys) formed a well-defined track in the substrate, but within 24 hours the track could not be distinguished, indicating that physical recovery of the substrate was rapid (Michael et al. 1990). Commercially, a hydraulic dredge is used and its impacts should theoretically be less, but the impacts of this dredge have not been tested. Shallow water environments such as the surf zone or those subjected to frequent natural disturbance tend to recover faster from the effects of mobile fishing gears compared with those in deeper water (Kaiser et al. 1996, Collie et al. 2000, Hiddink et al. 2006, Kaiser et al. 2006).

Surf clam species show zonation by substrate type which is generally, although not always, correlated with depth and wave exposure. Species with good burrowing ability are generally found in shallow, mobile sediment zones (for example, deepwater tuatua (*Paphies donacina*)), and those species less able to burrow (for example, fine silky dosinia (*Dosinia subrosea*) and frilled venus shell (*Bassina yatei*)) are generally found in softer, more stable sediments. The presently high-value species (triangle shell (*Spisula aequilatera*), large trough shell (*Mactra murchisoni*), deepwater tuatua (*Paphies donacina*), and trough shell (*Mactra discors*)) generally occur in shallower zones. Little fishing presently takes place in the most vulnerable areas characterised by stable, soft fine sediment communities.

Surf clams are managed under Schedule 6 of the Fisheries Act 1996. This allows them to be returned to the sea soon after they are taken, provided they are likely to survive. They are currently harvested with a hydraulic dredge. An Italian study showed that widespread intensive hydraulic dredging can adversely modify some depths within this environment (4–6 m), although recovery in this study occurred within 6 months (Morello et al. 2006). The

applicability of this study's finding to New Zealand is unknown. The incidental mortality of surf clams in commercial dredge fishery is also unknown.

According to the catch landing reports, only a small portion of the catch is returned to the sea. In addition, the majority of the surf clams that come up in the dredge are in very good condition so there is assumed to be a minimal number of damaged clams from this harvesting method.

Due to this turbulent environment in which surf clam populations live, they can be subject to large mortality events. These events are usually caused by excessive sedimentation and freshwater outflows during storms, as well as high temperatures and low oxygen levels during summer periods. Despite this, many members of the public, and some tangata whenua, directly associate the mass mortality events that sometimes occur along these beaches with the commercial dredge activity with no strong evidence to back up the claim. Recently, this has been getting increasing media attention and in May 2020 the Mayor of the Kapiti District Council called a meeting between tangata whenua, Industry (Cloudy Bay Clams), members of the public, Fisheries New Zealand, and the regional council.

Given the public concerns, Fisheries New Zealand is interested in knowing what the incidental mortality for surf clams in the commercial dredge fishery is. The main location of interest is FMA 8 (Waitarere Beach or Hokio Beach). If, within the estimated budget for this project, a second location can be surveyed, it would either be Cloudy Bay or Clifford Bay in the top of the South Island. The species of interest are those close to the shore which are also likely to be targeted by recreational and customary fishers.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weighting for the objective in this project is 1.

References:

Collie, J.; Escanero, G.; Valentine, P. (2000) Photographic evaluation of the impacts of bottom fishing on benthic epifauna. *ICES Journal of Marine Science 57*: 987–1001.

Hiddink, J.; Jennings, S.; Kaiser, M.; Queiros, A.; Duplisea, D.; Piet, G. (2006). Cumulative impacts of seabed trawl disturbance on benthic biomass, production, and species richness in different habitats. *Canadian Journal of Fisheries and Aquatic Sciences 63*: 721–736.

Kaiser, M.; Clarke, K.; Hinz, H.; Austen, M.; Somerfield, P.; Karakassis, I. (2006). Global analysis of response and recovery of benthic biota to fishing. *Marine Ecology Progress Series 311*: 1–14.

Kaiser, M.; Hill, A.; Ramsay, K.; Spencer, B.; Brand, A.; Veale, L.; Prudden, K.; Rees, E.; Munday, B.; Ball, B.; Hawkins, S. (1996). Benthic disturbance by fishing gear in the Irish Sea: a comparison of beam trawling and scallop dredging. *Aquatic Conservation: Marine and Freshwater Ecosystems 6*: 269–285.

Michael, K.; Olsen, G.; Hvid, B.; Cranfield, H. (1990). Design and performance of two hydraulic subtidal clam dredges in New Zealand. *New Zealand Fisheries Technical Report No. 21*. 16 p.

Morello, E.B.; Froglia, C.; Atkinson, R.G.A.; Moore, P.G. (2006). Medium-term impacts of hydraulic clam dredgers on a macrobenthic community of the Adriatic Sea (Italy). *Marine Biology 149(2)*: 401–413.

SCA2021-01 SCA7 biomass survey for core scallop beds (Marlborough Sounds, Golden Bay, and Tasman Bay)

Project code:	SCA2021-01
Project title:	SCA7 biomass survey for core scallop beds (Marlborough Sounds, Golden Bay, and Tasman Bay)
Start date:	1 July 2021
Completion date:	30 November 2022
Vessel use:	Yes
Estimated cost:	$130,000

Overall Research Objective:

Estimate the status of the scallop stocks in Marlborough Sounds, Golden Bay, and Tasman Bay.

Specific Research Objectives:

1. Conduct a biomass survey in Marlborough Sounds, Golden Bay, and Tasman Bay that will provide estimates of current relative and absolute abundance (numbers and biomass in tonnes greenweight and meatweight), length frequency profile, density, and distribution of recruited and pre-recruit scallops in Marlborough Sounds, Golden Bay, and Tasman Bay.
2. Estimate the biomass of scallops in Marlborough Sounds, Golden Bay, and Tasman Bay using a range of commercial density thresholds from 0.00 to 0.4 recruited scallops per square metre.
3. Compare the estimates from Objective 1 with other relevant data from previous surveys and, if available, all relevant fine scale catch data.
4. For each area (Marlborough Sounds, Golden Bay, and Tasman Bay), collect bycatch information in a form suitable for later analysis.

Note: Could trial sampling methods other than dredges and adjust survey to include areas outside of traditional survey areas to be surveyed by diving / video. To be confirmed after discussion with the Working Group.

Reporting Requirements:

1. Present proposed methods to the Shellfish Fishery Assessment Working Group (SFWG) by 30 November 2021.
2. More than one presentation to the SFWG may be required between November 2021 and 30 April 2022. This should be taken into consideration when providing costs for this project.
3. Present the results to the SFWG by 30 July 2022.
4. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 30 August 2022.

5. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fisheries Assessment Report as specified in Research Reporting Form 7 by 30 August 2022.
6. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final revised Working Group Report as specified in Research Reporting Form 8 by 30 October 2022.
7. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Form 7 by 30 October 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 October 2022.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Group 2 Objectives: 1) Maximise social, economic and cultural benefits obtained from each stock by enabling annual yield to be maximised, and 2) Maintain stock size at or above an established minimum reference level.

Southern Scallop Strategy: Marlborough Sounds 2020

- Objective 1: Set an appropriate biomass threshold for reopening that ensures there are sufficient scallops to support fishing activity.
- Objective 6: Get better information and use it to improve fisheries management.

General

Pre-fishing season biomass surveys have been conducted annually in May-June in important fishery areas within SCA 7 since 1994 to assess scallop population status and inform management of the fishery before the start of the commercial fishing season (nominally 1 September); the surveys provide data for estimating scallop population distribution, size structure, abundance, biomass, and yield (Williams et al. 2014). In 2015 three surveys were conducted; a pre-fishing season survey in May (Williams et al. 2015a), an in-fishing season

survey of key scallop beds in October (Williams et al. 2015c), and a post-fishing season survey in November (Williams et al. 2015b). There was no survey in 2016.

The survey series has shown that in Marlborough Sounds, recruited biomass generally followed an increasing trend from 1999 to 2009, and overall followed a declining trend since 2009. The 2015 surveys showed that recruited biomass in the Marlborough Sounds was restricted to a small number of scallop beds located mainly in the outer Sounds.

The most recent assessment of SCA 7 stock status was accepted by the Fishery Assessment Plenary in May 2016 (Ministry for Primary Industries 2016a). Subsequently, following consultation on an MPI review of sustainability measures for SCA 7, in July 2016 the Minister for Primary Industries made a decision to close the scallop fishery in the Marlborough Sounds and the eastern part of Tasman Bay for the 2016–17 scallop season (15 July 2016 to 14 February 2017); the closures aimed to "rest the beds, allowing mature scallops to spawn uninterrupted and juvenile scallops to grow and help prevent a further decline of this important fishery, while longer-term management options are developed" (Ministry for Primary Industries 2016b). Following the results of the January 2017 biomass survey (Williams et al. 2017), the Minister decided to extend the closure to the entire SCA 7 QMA plus Port Underwood for the 2017–18 fishing year (Ministry for Primary Industries 2017).

In June 2018, the Southern Scallop Working Group (SSWG) was created. The SSWG comprises representatives from tangata whenua, Te Ohu Kaimoana, Challenger Scallop Enhancement Company (CSEC), recreational stakeholders, and NIWA. Its role is to support Fisheries New Zealand to develop recommendations on:

- integrated research and management plans
- an agreed opening regime that allows for utilisation while ensuring the rebuild in the Marlborough Sounds is not compromised
- statutory decisions relating to SCA7
- proposals made by sectors, including CSEC and the recreational fishing sector.

A dredge survey of scallops was conducted in Marlborough Sounds in May 2019 and 2020. The key finding is that the SCA 7 recruited biomass for 2020 remains low. Recruited biomass in Golden and Tasman bays remains very low overall, and in Marlborough Sounds virtually all of the recruited biomass at potentially commercially fishable densities is held in five scallop beds, at Guards Bay, Ship Cove, the Chetwodes, Wynens Bank, and Dieffenbach Point. Population projections predicted the Marlborough Sounds recruited biomass in September 2020 to be 242 t meat weight, which was not statistically different from that in 2019. The estimated abundance of Marlborough Sounds pre-recruit scallops (53–89 mm) in 2020 is low compared with historical estimates, especially from the early 2000s, suggesting that recruitment in the short term is likely to be relatively poor in most areas. However, the abundance of small juvenile scallops (less than 60 mm) in Marlborough Sounds was noticeably higher in 2020 that in recent years, presumably the result of favourable larval settlement and spat survivorship since the 2019–20 spring–summer spawning period.

The management strategy developed by the SSWG for Marlborough Sounds has been approved by the Minister and the group is working on the implementation plan. Once this is done, the group will start developing a management strategy for Golden Bay and Tasman Bay and the two biomass surveys (2020 and 2021) will provide some valuable information regarding the current status of the stocks.

Estimated costs should be provided for each area: Marlborough Sounds, Golden Bay, and Tasman Bay.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4, 0.3, 0.2, and 0.1.

SCA2021-02 SCA CS evaluation of the CPUE limit rule management procedure

Project code:	SCA2021-02
Project title:	SCA CS Evaluation of the CPUE limit rule management procedure
Start date:	1 July 2021
Completion date:	31 August 2022
Vessel use:	None
Estimated cost:	$60,000

Overall Research Objective:

To evaluate the CPUE limit rule management procedure for the Coromandel scallop fishery.

Specific Research Objectives:

1. To review the CPUE limit rule management procedure for the Coromandel scallop fishery to determine if the rule is appropriate for that fishery.
2. To compare the CPUE limit rule management procedure with other approaches such as CAY.
3. To propose alternative approaches for the management of the Coromandel scallop fishery if Objective 1 shows that the CPUE limit rule is not appropriate for the management of the Coromandel scallop fishery.

Reporting Requirements:

1. Present the methodology to the Shellfish Working Group (SFWG) by 31 October 2021.
2. More than one presentation to the SFWG may be required between November 2021 and 30 March 2022. This should be taken into consideration when providing costs for this project.
3. Present the results to the SFWG by 31 March 2022.
4. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 15 April 2022.
5. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Working Group Report as specified in Research Reporting Form 8 by 30 April 2022.
6. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fisheries Assessment Report as specified in Research Reporting Form 7 by 31 May 2022.
7. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Form 7 by 31 July 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 31 May 2022.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Group 2 Objectives: 1) Maximise social, economic and cultural benefits obtained from each stock by enabling annual yield to be maximised, and 2) Maintain stock size at or above an established minimum reference level.

General
There has been a commercial dredge fishery for scallops off eastern Northland since the early 1970s. SCA CS supports a regionally important commercial fishery situated between Cape Rodney at Leigh in the north and Town Point near Tauranga in the south. Fishing has been conducted within discrete beds around Little Barrier Island, east of Waiheke Island (though not in recent years), at Colville, north of Whitianga (to the west and south of the Mercury Islands), and in the Bay of Plenty (principally off Waihi, and around Motiti Island and Slipper Island).

Standardised CPUE from the statutory catch and effort returns is not considered a reliable index of abundance at the stock level. Simulation studies have, however, examined the use of local area CPUE as a basis for some management strategies. Since 2010, in addition to CELR reporting, the Coromandel Scallop Fishermen's Association (CSFA, representing the SCA CS commercial fishing industry) has implemented a voluntary management strategy, the 'CPUE limit rule' that aims to ensure that scallop beds will not be fished below a specified level of CPUE. Once a specified lower CPUE limit has been reached, fishing within that area of the fishery ceases for the remainder of the season. To inform this approach, CSFA have carried out a logbook programme that involves recording fishery data (catch and effort) at a fine spatial scale within the broader CELR statistical reporting areas. Meatweight recovery, and the proportion of legal-size scallops in the catch, are also monitored and used to determine fishing patterns. In addition, the fishery is open for five days per week and daily catch limits apply, by agreement of the quota holders.

Objective 1
A Review of New Zealand's scallop fishery stock assessment data and methods was conducted in 2015 and showed the limitations of the CPUE limit rule model. The CPUE rule does not translate into a fixed fishing mortality. In productive areas, where CPUE can exceed 200 kg/hr, a reduction to a limit of 75 kg/hr translates into an instantaneous fishing mortality rate of almost 1 (~63% per annum), so that growth overfishing can occur in these areas. Additionally, these higher density areas may contribute most of the larvae because scallops likely need to be in close proximity for eggs to be successfully fertilised. Thus, removing a high proportion of scallops in these areas may

remove important spawning aggregations and reduce fertilised egg production, which may have negative implications for sustainability. In less productive areas, for example where the CPUE starts at 100 kg/hr, a reduction to 75 kg/hr corresponds to an annual fishing mortality of less than 0.3, so that these areas will be underfished from a yield per recruit perspective. This means that the CPUE rule will underfish some areas and overfish others, and hence the realised YPR will be far less than optimal, regardless of the overall mean fishing mortality.

Objective 2
Coromandel scallops are managed using a TACC of 50 t meatweight, which could be augmented with additional ACE after considering information about the abundance during the current fishing year. Previous in-season increases were based on the results from a pre-season biomass survey and the subsequent Current Annual Yield (CAY) estimates, using $F_{0.1}$ as a reference point. The last comprehensive survey was conducted in 2012 (Williams et al. 2013) with the aim to provide an estimate of abundance representative of the status of the overall SCA CS stock.

There was no survey conducted in 2013. Industry-based surveys were conducted in 2014 (D. Middleton, unpublished data) and 2015 (Williams 2015), with design and analytical assistance provided by research providers. Surveys have not been conducted since 2016.

Objective 3
If Objective 1 shows that the CPUE limit rule is not appropriate for the management of the Coromandel scallop fishery, some alternative approaches for the management of the Coromandel scallop fishery would need to be investigated.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.34, 0.33, and 0.33.

References:

Williams, J R (2015) CSFA survey of scallops in SCA CS, June–July 2015. Report to Coromandel Scallop Fishermen's Association. 7 p. (Unpublished report held by NIWA, Auckland.)

Williams, J R; Parkinson, D M; Bian, R (2013) Biomass survey and yield calculation for the Coromandel scallop fishery, 2012. *New Zealand Fisheries Assessment Report 2013/18*. 57 p.

SUR2021-01 Biomass survey and condition index for kina in SUR 7A

Project code:	SUR2021-01
Project title:	Biomass survey and condition index for SUR 7A
Start date:	1 July 2021
Completion date:	30 November 2022
Vessel use:	Yes
Estimated cost:	$100,000

Overall Research Objective:

To assess the status of the stock and to investigate reports of "skinny" kina and any potential relationship to kina barrens in SUR 7A in the Marlborough Sounds. This project is intended to incorporate mātauranga Māori.

Specific Research Objectives:

To conduct a biomass survey that will:

1. provide estimates of current relative and absolute abundance (numbers and biomass in tonnes greenweight), length frequency, density, and depth profile for kina in SUR 7A in the Marlborough Sounds.
2. allow the development of a condition index following reports of "skinny" kina.
3. allow the investigation of a potential relationship between "skinny" kina and habitat characteristics including kina barrens.

Reporting Requirements:

1. Present and discuss proposed methodology to the appropriate iwi fisheries forum by 30 October 2021.
2. Present proposed methods to the Shellfish Fishery Assessment Working Group (SFWG) by 30 November 2021.
3. More than one presentation to the SFWG may be required between November 2021 and 30 April 2022. This should be taken into consideration when providing costs for this project.
4. At the request of the appropriate iwi fisheries forum, present the agreed methodology to the iwi forum by 30 April 2022.
5. Present the results to the SFWG by 30 July 2022.
6. Present and discuss the results to the appropriate iwi fisheries forum by 30 August 2022.
7. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group report as specified in Research Reporting Form 8 by 30 August 2022.
8. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fisheries Assessment Report as specified in Research Reporting Form 7 by 30 August 2022.

9. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final revised Working Group report as specified in Research Reporting Form 8 by 30 October 2022.
10. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Form 7 by 30 October 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 October 2022.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Group 3 Objectives: 1) Secure social, cultural and economic benefits from each stock and 2) Maintain stock size at or above target reference level.

Te Waipounamu Iwi Forum Fisheries Plan

- Objective 1: To create thriving customary non-commercial fisheries that support the cultural well-being of South Island Iwi and our whanau.
- Objective 2: South Island iwi are able to exercise kaitiakitanga.
- Objective 3: To develop environmentally responsbile, productive, sustainable and culturally appropriate commercial fisheries that create long-term commercial benefits and economic development opportunities for South Island Iwi.
- Objective 4: To develop environmentally responsible, sustainable and culturally aligned aquaculture ventures that create long-term commercial benefits and economic development opportunities for South Island iwi,
- Objective 5: To restore, maintain and enhance the mauri and wairua throughout the South Island,
- Objective 6: South Island Iwi have sufficient capacity to achieve the objectives in this plan in partnership with Mfish and other fisheries stakeholders.

General

Kina represent a highly significant Māori customary fishery and are considered a taonga species. Although limited information is available on customary harvest levels within Te Tau Ihu, it is likely to be significant, particularly in the Marlborough Sounds. The SUR 7A TAC includes a customary allowance of 80 tonnes. The SUR 7A stock also supports commercial (135 tonnes TACC) and recreational fisheries around the top of the South Island.

The Te Waka a Māui me Ōna Toka Iwi Fisheries Forum has requested research to provide information on biomass and barrens to support their participation in the ongoing sustainable management of this important fishery. Fisheries New Zealand supports this request. Note, Te Waka a Māui me Ōna Toka Iwi Fisheries Forum will advise if it remains the appropriate forum to engage on this project or if their preference is Te Tau Ihu Iwi Fisheries Forum.

There is anecdotal information that there is a growing number of "skinny" kina within the SUR 7A fishery. These kina, though large in size, contain an unusually low roe content than has previously been observed, and this may reflect habitat condition and food availability (e.g., kina barrens). Information is needed to determine the extent of "skinny" kina within the fishery and identify environmental factors that may be causing this condition. This could enable local and central Government to work with iwi to look as ways to address this issue.

An integrated approach is envisaged, addressing the three objectives together. A stratified survey approach across the area of interest (identified with local iwi) could be undertaken (e.g., by conducting a camera survey) to estimate habitat type, kina density, and size composition. The survey would provide data for an abundance estimate, and also inform more detailed habitat sampling and kina collection across gradients of kina density and anticipated environmental drivers, to investigate the relationships between kina density, habitat, and kina condition. Collection of physical samples would also allow examination of age structure within kina populations at different sites and be used to infer habitat relationships with kina growth rate.

Recent Sustainable Seas funded survey work could contribute to this research.

Kina are a taonga species, so a western science and mātauranga Māori co-approach is appropriate when undertaking the proposed research. We would expect that the research provider would work in collaboration with Iwi on this proposal.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.2, 0.4, and 0.4.

Rock Lobster Fisheries

Project code	Project title
CRA2021-01	Rock lobster stock assessments
CRA2021-02	Rock lobster puerulus settlement monitoring

CRA2021-01 Rock lobster stock assessments

Project code:	CRA2021-01
Project title:	Rock lobster stock assessments
Start date:	15 May 2021
Completion date:	30 June 2024
Vessel use:	Yes
Estimated cost:	$1,050,000 ($350,000 annually)

Overall Research Objective:

Conduct assessments of rock lobster stocks including estimation of biomass and sustainable yields and contribute to operationalising new management approaches.

Specific Research Objectives:

1. To provide input on the sampling design of the ongoing rock lobster fishery and stock monitoring work.
2. To evaluate the impacts of the 2019 switch to electronic reporting and update the standardised CPUE analyses for rock lobster stocks when feasible.
3. To carry out full stock assessments for around 2 rock lobster stocks annually including estimating biomass and sustainable yields, the status of the stock in relation to management reference points, and future projections of stock status as required to support management.
4. To conduct rapid update assessments and run projections and analyses to determine reference levels for the remaining rock lobster stocks.

Reporting Requirements:

1. To provide input on the sampling design of project 'CRA 2020-01 Tagging Programme and Biological Data Collection for Rock Lobster' (including data collected through on-board observers, logbooks and tagging programmes) as required in 2021.
2. To present progress and updates to meetings of the Rock Lobster Working Group (RLWG), Stock Assessment Plenary, National Rock Lobster Management Group (NRLMG), and provide scientific support to management discussions with stakeholders as required in 2021.
3. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager draft revised Working Group Reports including stock assessment, rapid assessment, and projection results for all stocks evaluated as specified in Research Reporting Form 8 by 30 September 2021.
4. Present the draft revised Working Group Reports to the RLWG by 15 October 2021.
5. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager draft Fishery Assessment Reports as specified in Research Reporting Form 7 by 30 April 2022.

6. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager final Fishery Assessment Reports (including changes as requested by the chair of the RLWG) as specified in Research Reporting Form 7 by 30 June 2022.
7. To provide input on the sampling design of project 'CRA 2020-01 Tagging Programme and Biological Data Collection for Rock Lobster' (including data collected through on-board observers, logbooks and tagging programmes) as required in 2022.
8. To present progress and updates to meetings of the Rock Lobster Working Group (RLWG), Stock Assessment Plenary, National Rock Lobster Management Group (NRLMG), and provide scientific support to management discussions with stakeholders as required in 2022.
9. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager draft revised Working Group Reports including stock assessment, rapid assessment, and projection results for all stocks evaluated as specified in Research Reporting Form 8 by 30 September 2022.
10. Present the draft revised Working Group Reports to the RLWG by 15 October 2022.
11. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager draft Fishery Assessment Reports as specified in Research Reporting Form 7 by 30 April 2023.
12. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager final Fishery Assessment Reports (including changes as requested by the chair of the RLWG) as specified in Research Reporting Form 7 by 30 June 2023.
13. To provide input on the sampling design of project 'CRA 2020-01 Tagging Programme and Biological Data Collection for Rock Lobster' (including data collected through on-board observers, logbooks, and tagging programmes) as required in 2023.
14. To present progress and updates to meetings of the Rock Lobster Working Group (RLWG), Stock Assessment Plenary, National Rock Lobster Management Group (NRLMG), and provide scientific support to management discussions with stakeholders as required in 2023.
15. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager draft revised Working Group Reports including stock assessment, rapid assessment and projection results for all stocks evaluated as specified in Research Reporting Form 8 by 30 September 2023.
16. Present the draft revised Working Group Reports to the RLWG by 15 October 2023.
17. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager draft Fishery Assessment Reports as specified in Research Reporting Form 7 by 30 April 2024.
18. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager final Fishery Assessment Reports (including changes as requested by the chair of the RLWG) as specified in Research Reporting Form 7 by 30 June 2024.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting is required for this project in accordance with the conducting Research with the Ministry document. A Work In Progress Report Form 13 is to

be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting

1. All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 May 2022, 30 May 2023, and 30 May 2024.
2. On completion of the stock assessment, provide relevant stock assessment inputs and outputs to the RAM Legacy database project by populating the spreadsheets provided. These are to be sent to the project scientist to check and send to the University of Washington by 30 June 2022, 30 June 2023, and 30 June 2024.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Group 1 Objectives: 1) Maximise the overall social, economic, and cultural benefit obtained from each stock, and 2) Maintain biomass of each stock at or above B_{MSY} (or accepted proxy).

General

Rock lobster stocks (CRA 1 to 9) are in Group 1 of the Draft National Fisheries Plan for Inshore Shellfish which comprises New Zealand's most sought-after shellfish stocks. Rock lobsters are taonga (treasured) for many iwi, prized by recreational fishers, and support the most valuable inshore fishery in New Zealand.

Group 1 stock objectives have a strong focus on ensuring that each stock is healthy and can continue to provide benefits over the long term. Given the high biological vulnerability of rock lobster stocks and their easy accessibility, a close monitoring and responsive management approach is required to secure benefits for all fisheries sectors into the future.

Rock lobster monitoring is conducted under project 'CRA 2020-01 Tagging Programme and Biological Data Collection for Rock Lobster' and includes the collection of length frequency and other biological data at sea from the catch of the commercial fishery through logbook and catch sampling programmes. Tagging projects are also conducted to measure the growth rate of lobsters.

An ongoing assessment programme is required to enable estimation of biomass and sustainable yields for each rock lobster stock. The assessment model for rock lobsters has been extensively improved in recent years to use all the available data in the model and to consider uncertainty in the model predictions. The assessment model is subject to ongoing improvements and minor changes to suit the stocks being assessed at any time.

The main data inputs to the stock assessment model normally include: 1) standardised commercial catch-per-unit-effort (CPUE) indices — CPUE is used as the main indicator of

relative stock abundance within rock lobster fisheries; 2) length frequency distributions; and 3) growth rates.

The impact of recent fundamental changes to the collection of catch and effort data in the rock lobster potting fishery resulting from the switch from paper forms to electronic reporting was investigated by the RLWG in 2020. It was concluded that the CPUE estimated based on the new electronic reporting system for the CRA 4 and CRA 5 stocks was not comparable with CPUE based on the previous paper form system.

In 2019, the management of CRA 4, CRA 5, CRA 7, and CRA 8 was controlled by the operation of management procedures (MPs), which were based on a 'harvest control rule' that converted standardised CPUE into a TACC for the following year. These MPs could no longer be used in 2020 due to the impact of the electronic reporting on rock lobster CPUE indices.

An alternative approach to estimating rock lobster reference levels was recently developed by the RLWG. It is expected that this approach will be operationalised in 2021 to help ensure management objectives are met for each stock. This approach requires running annual rapid stock assessment updates for those stocks that are not subjected to a full stock assessment in any given year.

The rapid update assessments are automated, based on the most recent available base case assessment for each stock, and fit to all available data. In years without CPUE, the model will continue to extract information from catch, length frequency, and tag data. Using this information, the model can continue to provide information on stock status although estimates will be less precise in years without CPUE.

Specific Objective 1
The sampling design used to monitor the commercial rock lobster fishery under project CRA 2020-01 is reviewed on an annual basis. Catch sampling for individual stocks is done with technicians, (CRA 6 and CRA 7), volunteer fisher logbooks (CRA 5, CRA 8, and CRA 9), or both (CRA 1, CRA 2, CRA 3, CRA 4, CRA 6).

To ensure catch sampling is representative, the sampling schedule is specified in terms of observer days by statistical area and quarter based on the month/area catch proportions of the previous fishing year. Periodic review of logbook coverage is also required to ensure data representativeness.

Tagging locations are also reviewed on an annual basis based on the tagging data already available to the stock assessment, the size distribution of tagged lobsters, and the expected rate of return of tagged animals. Once the target number of releases has been determined for a given QMA, the most appropriate statistical area(s) in which to tag is determined.

Specific Objective 2
Annual standardised CPUE indices for each rock lobster stock are normally used in stock assessments, as input to management procedures, and in stock monitoring. The introduction of an electronic reporting system in 2019 has however impacted rock lobster CPUE timeseries due to changes to manner in which catch and effort data are being recorded.

Further investigation into changes in the rock lobster CPUE timeseries is required, and potential alternative CPUE indices (for instance based on rock lobster logbook data) should be

explored. Where appropriate, the project should continue to update existing standardised CPUE indices.

Specific Objective 3
Stock assessments will include new catch information, new growth data from tagging studies, length frequency data from the commercial fishery, and updated CPUE indices from commercial fisheries where possible. The assessments should evaluate alternate model structures (sensitivities) and assumptions as well as the associated levels of uncertainty. The alternative assumptions to be evaluated should include consideration of issues that arose, but were not fully resolved, in the previous assessment of the relevant rock lobster stocks, or new issues identified during the assessments.

Projections (for the 5 years following the current year estimates) at the current catch levels should be carried out as part of the stock assessments. Projections at different catch levels may also be required to support management.

Rock lobster stock assessments are carried out based on a roster, which is reviewed annually. Management needs determine which stocks are prioritised.

Specific Objective 4
Management procedures (or decision rules) have been used in the main rock lobster stocks since 1993 as a basis for annual management decisions. The focus of the rules has been to ensure that stocks are maintained at or above agreed reference levels using a 'harvest control rule' that converted standardised CPUE into a TACC for the following year.

As a result of changes to the collection of catch and effort data in the rock lobster potting fishery resulting from the switch from paper forms to electronic reporting, rock lobster QMAs could not be managed through the operation of management procedures in 2020.

An alternative approach based on rapid stock assessment updates (in years where no full stock assessment is conducted) and harvest control rule projections to find options that maximise catch while meeting risk constraints was recently developed. Further work will be undertaken in 2021 and 2022 to confirm management targets through the involvement of stakeholders and the NRLMG; science support may be required to facilitate these discussions.

Weighting of Objectives:
Weightings indicate the relative importance of each of the objectives. All objectives have equal weighting.

CRA2021-02 Rock lobster puerulus settlement monitoring

Project code:	CRA2021-02
Project title:	Rock lobster puerulus settlement monitoring
Start date:	1 July 2021
Completion date:	30 June 2024
Vessel use:	Yes
Estimated cost:	$420,000 ($140,000 annually)

Overall Research Objective:

Correlate trends in puerulus settlement with trends in abundance for selected stocks.

Specific Research Objective:

1. To estimate monthly and annual indices of puerulus settlement at key sites in CRA 3, CRA 4, CRA 5, CRA 7, and CRA 8 (Gisborne, Napier, Castlepoint, Kaikōura, Moeraki, Halfmoon Bay, and Jackson Head) for the 2021–2022, 2022–23, 2023–24 April fishing years.

Reporting Requirements:

1. Standardised indices determined up to 2020–21 fishing year and results of detailed analysis for stock assessment presented to Rock Lobster Working Group by 30 September 2021.
2. First 3-month collector checks completed by 30 September 2021.
3. Preliminary indices for the 2021–22 fishing year (April to September 2021) determined and presented to NRLMG by 30 November 2021.
4. Draft Fishery Assessment Report as specified in Research Reporting Form 7 submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 November 2021.
5. Second 3-month collector checks completed by 31 December 2021.
6. Final Fishery Assessment Report as specified in Research Reporting Form 7 submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 31 March 2022.
7. Third 3-month collector checks completed by 31 March 2022.
8. Fourth 3-month collector checks completed by 30 June 2022.
9. Submit to MPI Research Data Manager all data as per the Data Management Plan by 30 June 2022.
10. Standardised indices determined up to 2021–22 fishing year and results of detailed analysis for stock assessment presented to Rock Lobster Working Group by 30 September 2022.
11. First 3-month collector checks completed by 30 September 2022.
12. Preliminary indices for the 2022–23 fishing year (April to September 2022) determined and presented to NRLMG by 30 November 2022.

13. Draft Fishery Assessment Report as specified in Research Reporting Form 7 submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 November 2022.
14. Second 3-month collector checks completed by 31 December 2022.
15. Final Fishery Assessment Report as specified in Research Reporting Form 7 submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 31 March 2023.
16. Third 3-month collector checks completed by 31 March 2023.
17. Fourth 3-month collector checks completed by 30 June 2023.
18. Submit to MPI Research Data Manager all data as per the Data Management Plan by 30 June 2023.
19. Standardised indices determined up to 2022–23 fishing year and results of detailed analysis for stock assessment presented to Rock Lobster Working Group by 30 September 2023.
20. First 3-month collector checks completed by 30 September 2023.
21. Preliminary indices for the 2023–24 fishing year (April to September 2023) determined and presented to NRLMG by 30 November 2023.
22. Draft Fishery Assessment Report as specified in Research Reporting Form 7 submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 November 2023.
23. Second 3-month collector checks completed by 31 December 2023.
24. Final Fishery Assessment Report as specified in Research Reporting Form 7 submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 31 March 2024.
25. Third 3-month collector checks completed by 31 March 2024.
26. Fourth 3-month collector checks completed by 30 June 2024.
27. Submit to MPI Research Data Manager all data as per the Data Management Plan by 30 June 2024.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting is required for this project in accordance with the conducting Research with the Ministry document. A Work In Progress Report Form 13 is to be submitted to MPI Contracts Monitoring and Administration Team by the fifth working day of each month for the duration of the project.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 June 2022, 30 June 2023, and 30 June 2024.

Rationale:

Management Objectives:

Draft National Fisheries Plan for Inshore Shellfish 2011

- Group 1 Objectives: 1) Maximise the overall social, economic, and cultural benefit obtained from each stock, and 2) Maintain biomass of each stock at or above B_{MSY} (or accepted proxy).

General
Rock lobster stocks (CRA 1 to 9) are in Group 1 of the Draft National Fisheries Plan for Inshore Shellfish which comprises New Zealand's most sought-after shellfish stocks. Rock lobsters are taonga (treasured) for many iwi, prized by recreational fishers and support the most valuable inshore fishery in New Zealand.

Group 1 stock objectives have a strong focus on ensuring that each stock is healthy and can continue to provide benefits over the long term. Given the high biological vulnerability of rock lobster stocks and their easy accessibility, a close monitoring and responsive management approach is required to secure benefits for all fisheries sectors into the future.

The benefits of prediction of recruitment trends in a rock lobster fishery have been well demonstrated in Western Australia, where more than 30 years of settlement data allow improved financial planning and investment by fishers and processors, and proactive rather than just reactive fisheries management. Almost every major rock lobster fishery in the world now has in place, or is developing, a settlement monitoring programme.

In New Zealand, the puerulus settlement programme was established in 1974 and spread to most areas over the years. In September 2006 the programme was reviewed, and a decision was made to discontinue non-core collectors at the main sites and to discontinue monitoring in some areas. This decision was based on an analysis of including and excluding non-core collectors and then comparing these indices and their confidence levels.

In November 2011 the programme was reviewed by an independent consultant in conjunction with the Rock Lobster Fisheries Assessment Working Group. This review concluded that the puerulus settlement dataset is a valuable source of long-term fishery-independent information and should be continued with recommended improvements, which have since been implemented.

The main value of puerulus settlement data to stock assessment and fishery management in New Zealand lies in the relationship between any trends in settlement levels and trends in stock abundance, rather than definitive measures of annual recruitment. This is because recruitment to the fishery occurs across a range of ages (i.e., at least 4 years after settlement), which leads to blurring of annual recruitment signals present in fishery length frequency and catch rate information.

Ideally, an understanding of the relationship between settlement levels and trends in stock abundance will help to ensure responsive management approaches are implemented. Although the settlement data show some internal consistency along the East Coast North Island and in

southern areas, suggesting that they are measuring real changes in settlement indices, it has been difficult to find any strong relationship between settlement and subsequent recruitment to the fisheries.

The utility of puerulus indices for stock assessment purposes will be further examined in the context of the CRA 7 and CRA 8 assessments planned for 2021. Depending on the outcome of this work a further independent review of the puerulus programme may be undertaken.

Specific Objective 1
From 2007 the long-term key sites to be monitored have been at Gisborne, Napier, Castlepoint, Kaikōura, and Moeraki. Only the core sites that have the longest record of settlement continue to be checked. Halfmoon Bay and Jackson Bay will continue to be monitored at the wharf sites only. The aim is to check collectors monthly, at least during the main settlement season, leading to an annual index of settlement. The calculation of regional settlement indices (e.g., including data from the entire east coast) should be explored.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weighting for the objective in this project is 1.0.

Highly Migratory Species Fisheries

Project code	Project title
ALB2021-01	Albacore catch sampling
STM2021-01	Age and growth of striped marlin
STN2021-01	Estimation of recreational harvest of southern bluefin tuna in New Zealand waters in 2021
STN 2021-02	Estimation of recreational harvest of southern bluefin tuna in New Zealand waters in 2022

ALB2021-01 Albacore catch sampling

Project code:	ALB2021-01
Project title:	Albacore catch sampling
Start date:	1 October 2021
Completion date:	30 December 2024
Vessel use:	None
Estimated cost:	$210,000 over 3 years

Overall Research Objective:

To determine the length composition of the commercial catch of albacore (*Thunnus alalunga*) in New Zealand fisheries waters.

Specific Research Objectives:

1. To conduct representative sampling to determine the length composition of albacore tuna during the 2021–22 fishing year. The target coefficient of variation (CV) for the length composition is 20% (mean weighted CV across all length classes).
2. To conduct representative sampling to determine the length composition of albacore tuna during the 2022–23 fishing year. The target coefficient of variation (CV) for the length composition is 20% (mean weighted CV across all length classes).
3. To conduct representative sampling to determine the length composition of albacore tuna during the 2023–24 fishing year. The target coefficient of variation (CV) for the length composition is 20% (mean weighted CV across all length classes).

Reporting Requirements:

Objective 1

1. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a Progress Report as specified in Research Reporting Form 4 by 1 June 2022.
2. To present the report detailed in 1 above to a meeting of the Highly Migratory Species Working Group in November 2022. Presentations to more than one meeting of the working group may be required.

Objective 2

3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a Progress Report as specified in Research Reporting Form 4 by 1 June 2023.
4. To present the report detailed in 1 above to a meeting of the Highly Migratory Species Working Group in November 2023. Presentations to more than one meeting of the working group may be required.

Objective 3

5. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a Progress Report as specified in Research Reporting Form 4 by 1 June 2024.
6. To present the report detailed in 1 above to a meeting of the Highly Migratory Species Working Group in November 2024. Presentations to more than one meeting of the working group may be required.

All Objectives

7. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 September 2024.
8. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report as specified in Research Reporting form 7 by 30 November 2024.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required, by 30 November 2024.

Rationale:

Management Objectives:

National Fisheries Plan for Highly Migratory Species 2017

- Objective 1: Support viable and profitable commercial tuna fisheries in NZ.
- Objective 2: Maintain and enhance world class game fisheries in NZ fisheries waters.

General

Albacore tuna caught in New Zealand fisheries waters are part of a single South Pacific Ocean stock that ranges from the equator to about 45° S. The 2019 annual catch from the South Pacific stock was 86 706 t; about 70% of which is caught by longline vessels with the rest taken mainly by pole and line. Trolling typically takes less than 5% of the total South Pacific Ocean catch.

The New Zealand fishery is predominantly a summer fishery in which over 95% of landings occur between December and May. A total of 2752 t of albacore were landed in 2019, 96% from trolling. The troll fishery occurs mainly off the west coasts of both main islands, although recently fishing has also occurred off the east coast of the North Island. The troll fishery is an important component of the annual fishing plan of several inshore fisheries targeting a wide range of species with different gear types throughout the year. The albacore catch is also an important and stable component of the tuna longline fishery.

The early assessments for South Pacific albacore were somewhat uncertain but have been improved in recent years. The South Pacific albacore stock is assessed using MULTIFAN-CL, a length-based assessment package. The New Zealand albacore size data were used as direct inputs into the 2018 albacore stock assessment and also in the estimation of albacore growth. One concern was the inability of the model to adequately predict the length modes in the troll fisheries. Therefore, all the troll size data, including that from New Zealand were not incorporated in the reference set but included in the model runs using a wider data set. It is clear that there was conflict between signals from the size data and those from the other data sets, and it is intended to examine this further in the 2021 assessment.

Based on the assessment results the WCPFC Scientific Committee concluded in 2018 that the South Pacific albacore stock was then not overfished and overfishing was not occurring. Current biomass was considered sufficient to support current levels of catch. However, for several years the Scientific Committee has also noted that any increases in catch or effort are likely to lead to declines in catch rates in some regions, especially for longline catches of adult albacore, with associated impacts on vessel profitability. The next assessment of the South Pacific albacore stock is scheduled for 2021.

Due to the size-selectivity of troll for smaller albacore, the New Zealand length data allow the assessment model to estimate the growth rates of small fish, and these data are the only current reliable source of this vital piece of information. These data provide the assessment with a clear growth signal. The time series of better-quality data is not very long and more data will provide better certainty. These data provide some information about relative cohort strength from year to year.

Albacore are currently managed outside the QMS. The Ministry for Primary Industries (MPI) is monitoring the status of albacore stocks in New Zealand's fisheries waters as part of New Zealand's contribution to the regional stock assessment. A stock assessment of albacore specifically for New Zealand fisheries waters is not currently possible because the proportion of the South Pacific stock that migrates through, and/or, resides in New Zealand fisheries waters is unknown and likely to be a small portion of the stock.

In the absence of a formal stock assessment for New Zealand fisheries waters, monitoring occurs through an annual catch sampling programme. Changes to the population structure, such as a pronounced reduction in catches of larger fish, or the absence of small fish, are the types of indicators that have proven useful in the past. These data also form an important input into the MSC certification of the New Zealand albacore troll fishery.

This research is necessary because:

- Annual length estimates from New Zealand are a critical data input into the regional assessment model; and
- The project supports objectives in the albacore component of the draft Medium Term Research Plan for Highly Migratory Species.

Within this context, this research project is considered a high priority.

Objectives 1–3
Under these objectives, the research provider will collect samples to determine the representative length composition and length-weight relationships of albacore tuna during the 2021–22, 2022–23, and 2023–24 fishing years. Sampling should occur throughout the albacore

troll season. The target coefficient of variation (CV) for the length composition is 20% (mean weighted CV across all length classes).

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.33, 0.33, 0.34.

STM2021-01 Age and growth of striped marlin

Project code:	STM2021-01
Project title:	Age and growth of striped marlin
Start date:	1 October 2021
Completion date:	30 November 2023
Vessel use:	None
Estimated cost:	$30,000 over 2 years

Overall Research Objective:

Improve the understanding of the age and growth of striped marlin and input into the Western and Central Pacific Fisheries Commission (WCPFC) stock assessment

Specific Research Objective:

1. To estimate the age and growth of striped marlin.

Reporting Requirements:

Objective 1

1. To present a draft Fishery Assessment Report (Research Reporting Form 7) to the Highly Migratory Species (HMS) Fishery Assessment Working Group in May 2023.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fishery Assessment Report (Research Reporting Form 7) by 30 June 2023.
3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a Final Fishery Assessment Report (Research Reporting Form 7) by 30 September 2023.

Project Update Reports:
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required, by 30 September 2023.

Rationale:

Management Objectives:
National Fisheries Plan for Highly Migratory Species 2017

- Objective 1: Support viable and profitable commercial tuna fisheries in NZ.
- Objective 2: Maintain and enhance world class game fisheries in NZ fisheries waters.

General
Striped marlin form the basis of a significant recreational gamefish fishery in New Zealand. About 1500 striped marlin are caught each year although there are annual fluctuations in catch levels. Typically, 65% of the striped marlin that are caught in the recreational fishery are tagged and released. There is also an incidental catch in the pelagic longline fishery; however, commercial fishers are not allowed to retain striped marlin. Information on this component of the catch is collected by observers and fisher reporting.

SC15 noted that while there are no agreed limit reference points for the Western Central Pacific Ocean billfish, the southwest Pacific striped marlin (the marlin species most frequently caught in New Zealand) assessment results indicate that the stock is likely overfished and close to undergoing overfishing according to Maximum Sustainable Yield-based reference points. The recent spawning biomass depletion relative to the unfished condition was close to the Limit Reference Point adopted for tunas ($SB_{recent}/SB_{F=0}$ = 0.2) and the recent F was only slightly below F_{MSY}. In 2019 WCPFC16 noted with concern the current status of southwest Pacific striped marlin.

Objective 1
Accurate life history parameters are required for robust stock assessments and to develop management advice. Age, growth, and maturity parameters were estimated for southwest Pacific striped marlin in the late 2000s (Kopf et al. 2009, 2011). Age was estimated using counts of assumed annuli in sectioned dorsal fin spines (Kopf et al. 2011) and growth parameters were included in the 2012 stock assessment (Davies et al. 2012). A recent study, however, recommended that estimating age from otoliths should be investigated for billfish stocks because they are likely to be more reliable than spines, especially in larger/older fish (Farley et al. 2016). In 2019 a preliminary assessment of 17 otoliths from fish 222 to 269 cm LJFL indicated that striped marlin may live longer than previously estimated based on fin spines.

An initial von Bertalanffy growth model was fitted to the new otolith annual age data and daily age data from Kopf et al. (2011) for use in the 2019 stock assessment (Ducharme-Barth et al. 2019). The stock status estimates had a high degree of uncertainty that was attributed to uncertainty in biological information, including growth parameters. It was recommended that additional work on age and growth be prioritised to reduce the uncertainty in future assessments (Ducharme-Barth et al. 2019).

SC15 recommended that, to progress the assessment of southwest Pacific striped marlin, improved estimates of life history parameters including growth, maturity, and natural mortality should be obtained. This should include verifying the ageing method used to derive the growth relationship to inform meta analyses for M and steepness specific to southwest Pacific striped marlin. Additionally, efforts should be made to increase sampling of smaller individuals. WCPFC subsequently funded Project 99, the aim of which is to (i) continue to evaluate the

suitability of striped marlin otoliths to provide estimates of age and growth of SW Pacific striped marlin and (ii) determine if the estimate of proportion mature-at-length by Kopf et al (2009) is unbiased and precise. Project 99 results were reported to the WCPFC SC in August 2020 (Farley et al. 2020).

Some of the largest southwest Pacific striped marlin caught are taken in New Zealand waters. The aim of Project STM2021-01 is to collect and age southwest Pacific striped marlin otoliths from New Zealand waters to complement and build on the results of Project 99. The revised age and growth estimates will be used in the next update of the striped marlin stock assessment scheduled for 2024.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weighting for the objective in this project is 1.0.

References:

Farley, J.; Krisic-Golub, K.; Kopf, K. (2020). Southwest Pacific Striped Marlin population biology (Project 99). WCPFC-SC16-2020/SA_IP-21.

STN2021-01 Catch-at-age of southern bluefin tuna

Project code:	STN2021-01
Project title:	Catch-at-age of southern bluefin tuna
Start date:	1 October 2021
Completion date:	30 December 2025
Vessel use:	None
Estimated cost:	$150,000 over 3 years

Overall Research Objective:

To determine the age composition of the commercial catch of southern bluefin tuna (*Thunnus maccoyii*) in New Zealand fisheries waters.

Specific Research Objectives:

1. To age up to 150 otoliths from southern bluefin tuna collected from vessels fishing in New Zealand fisheries waters during the 2021–22 fishing season (2022 calendar year)
2. To age up to 150 otoliths from southern bluefin tuna collected from vessels fishing in New Zealand fisheries waters during the 2022–23 fishing season (2023 calendar year)
3. To age up to 150 otoliths from southern bluefin tuna collected from vessels fishing in New Zealand fisheries waters during the 2023–24 fishing season (2024 calendar year)

Reporting Requirements:

Objective 1

1. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a Progress Report as specified in Research Reporting Form 4 by 30 June 2023.
2. To present the report detailed in 1 above to a meeting of the Highly Migratory Species Working Group in November 2023. Presentations to more than one meeting of the Working Group may be required.

Objective 2

3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a Progress Report as specified in Research Reporting Form 4 by 30 June 2024.
4. To present the report detailed in 1 above to a meeting of the Highly Migratory Species Working Group in November 2024. Presentations to more than one meeting of the Working Group may be required.

Objective 3

5. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a Progress Report as specified in Research Reporting Form 4 by 30 June 2025.

6. To present the report detailed in 1 above to a meeting of the Highly Migratory Species Working Group in November 2025. Presentations to more than one meeting of the Working Group may be required.

All Objectives

7. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 September 2025.
8. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report as specified in Research Reporting Form 7 by 30 November 2025.

Project Update Reports:
No Project Update Reporting is required for this project.

Work In Progress Reports:
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required, by 30 November 2025.

Rationale:

Note: This project is a continuation of work started under IFA2004-03, STN2006-01, STN2007-01, STN 2009-01, STN2011-01, STN2013-01, STN2016-01, and STN2018-01 to monitor the ages of southern bluefin taken in the New Zealand fishery.

Management Objectives:
National Fisheries Plan for Highly Migratory Species 2017

- Objective 1: Support viable and profitable commercial tuna fisheries in NZ.
- Objective 2: Maintain and enhance world class game fisheries in NZ fisheries waters.

General
Southern bluefin tuna are managed by the Commission for the Conservation for Southern bluefin tuna and form a valuable fishery in New Zealand waters. They are taken by domestic longline vessels.

Given the low current biomass levels for the stock, information on recent year class strength is particularly important. Previously cohort strength has been determined using cohort slicing to convert catch-at-length to catch-at-age, but it has been increasingly realised that it is preferable to use direct age estimation. To this end, a workshop was held in June 2002 to develop protocols for reading and interpreting southern bluefin otoliths.

Sub-samples of otoliths collected during 2000–01 to 2020–21 have been aged under the previous projects. The results of this work were found to be useful within both a local and stock context in terms of providing an indication of recruitment strength. This project will add to the time series for the recent history of the New Zealand fishery.

This research is required in support of the National Fisheries Plan for HMS and is necessary because:

- southern bluefin tuna form a valuable target longline fishery; and
- accurate estimation of recent cohort strength is important to assessing the status of the stocks and likely future abundance levels.

Objectives 1, 2, and 3

Scientific observers aboard New Zealand domestic vessels routinely collected otoliths from southern bluefin tuna. To obtain an adequate sample for determination of catch-at-age, Morton & Bravington (2003) concluded that 100–200 per year is sufficient for the Australian surface fishery, 200 for the Japanese longline fishery, and 500 for the Indonesian fishery. IFA2004/03 aged 200 fish per year, and though the patterns in the data were generally consistent across years, it was apparent that an increased number of otoliths would likely reduce the uncertainty in the proportions of younger ages taken in the catch. Based on this conclusion, the target number of otoliths collected was increased to 250 otoliths per year, which were mostly collected on board the chartered vessel fleet.

Since foreign chartered fishing vessels were excluded from fishing in New Zealand waters beginning in May 2015, the number of otoliths collected by fishery observers has decreased substantially. Due to issues with sampling logistics, the number collected from the remaining domestic vessels has decreased to less than 100 otoliths per year. This shortfall has been partially offset during the past few years by otolith collection from recreational vessels participating in an intercept survey when returning to shore at Waihau Bay in the eastern Bay of Plenty (STN2019-02). As a result, the target number of otoliths aged for this project has been modified to 150.

The output from this project will be estimates of age-selected individuals in the format recommended by the 10th Scientific Committee, i.e., Year, Month, Fleet, Gear type, Latitude, Longitude, Length, Otolith ID, Age estimate, Sex, Readability, and Comments. Annual and /or combined age-length keys should also be developed. Images from otoliths aged should also be collected and archived.

An additional output of this work should be input into the New Zealand Annual report to the CCSBT.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.33, 0.33, 0.34.

STN2021-02 Estimation of recreational harvest of southern bluefin tuna in New Zealand waters in 2022

Project code:	STN2021-02
Project title:	Estimation of recreational harvest of southern bluefin tuna in New Zealand waters in 2022
Start date:	1 November 2021
Completion date:	31 December 2022
Vessel use:	None
Estimated cost:	$300,000

Overall Research Objective:

1. To improve the estimates of the recreational catch and size composition of southern bluefin tuna (*Thunnus maccoyii*) in New Zealand fisheries waters during the 2022 fishing season.

Specific Research Objectives:

1. To update and undertake an on-site survey to estimate amateur harvest of southern bluefin tuna in the eastern Bay of Plenty.
2. Design and undertake a survey to estimate the amateur harvest of southern bluefin tuna on the west coast South Island.
3. To estimate the amateur southern bluefin tuna harvest for the 2022 southern bluefin tuna fishing season using the method developed in Specific Objectives 1 and 2, data from the amateur charter vessels, section 111 landings, sport fishing club records and any other appropriate reporting methods.
4. To characterise the biological and temporal nature of the marine amateur harvest of southern bluefin tuna.
5. To collect otoliths from southern bluefin tuna caught by recreational fishing vessels fishing in the eastern Bay of Plenty.

Reporting Requirements:

Objectives 1 and 2

1. To present details of proposed survey design to a meeting of the Highly Migratory Species (HMS) Fishery Assessment Working Group in November 2021.

Objectives 3 and 4

2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fishery Assessment Report (Research Reporting Form 7) by 30 September 2022.
3. To present the draft Fishery Assessment Report (Research Reporting Form 7) to a meeting of the HMS Fishery Assessment Working Group by 30 November 2022.

4. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report (Research Reporting Form 7) by 31 December 2022.

Objective 5

5. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Research Report (Research Reporting Form 5) **or** a final Fishery Assessment Report (Research Reporting Form 7) by 31 December 2022.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting:

All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required, by 31 December 2022.

Rationale:

Management Objectives:

National Fisheries Plan for Highly Migratory Species 2017

- Objective 1: Support viable and profitable commercial tuna fisheries in NZ.
- Objective 2: Maintain and enhance world class game fisheries in NZ fisheries waters.
- Objective 3: Māori interests (including customary, commercial, recreational, and environmental) are enhanced.

General

Southern bluefin tuna are managed by the Commission for the Conservation for Southern bluefin tuna (CCSBT) and form a valuable fishery in New Zealand waters. They are taken primarily by domestic longline vessels. There is also a recreational fishery for the species. CCSBT have passed a resolution that members are required to account for all fishing mortality of southern bluefin (including commercial fishing, discards, recreational catches).

This research is required in support of the National Fisheries Plan for HMS and is necessary because:

- Southern bluefin tuna are a valuable target longline fishery and important recreational and customary fishery.
- New Zealand has an international obligation to account for all sources of fishing mortality of southern bluefin, including recreational catches, when managing its allocation of the TAC.

Objectives 1, 2, 3, and 4

In 2017, recreational fishers started catching southern bluefin tuna in late June and early July off Cape Runaway. Good weather and social media coverage led to significant fishing effort

and catch by recreational anglers which peaked in mid-July. This recreational fishery continued in 2018 and was surveyed in project SEA2018-09, 2019 (surveyed in project SEA2019-40), and 2020 (surveyed in project STN2019-02) and will be surveyed in 2021 in STN2020-01.

Most effort in the first three years of the fishery (2017–19) came from trailer boats launching from Waihau Bay and the weigh station at the local sportfishing club collected accurate weights for a high proportion of landed catch. Some fish were also taken back to home clubs and weighed.

However, an unknown proportion of landed catch was not weighed. In 2018, an access point survey at the main boat ramps in the area was implemented to measure and record southern bluefin tuna catch and provided data on the total harvest, including fish not weighed by clubs. It also provided data on the number of fish released and on fishing effort.

An access point survey on East Cape could also be considered and would likely be relatively short, covering late June to early August. It is possible that fishers in other areas will be fishing offshore later in the season targeting tuna.

There is also some recreational catch from private boats off the South Island west coast, which has been occurring for a number of years. In 2018, the number of recreationally taken southern bluefin tuna from the west coast South Island was estimated at between 60–100 fish based on a number of sources. However, this estimate needs to be refined.

The project should also collate data from the amateur charter vessel reporting scheme, section 111 retention by commercial fishers, sport fishing club records, and any other sources of relevant information.

Objective 5
The purpose of this objective is to collect otoliths from southern bluefin tuna caught by recreational fishers, to increase the number of otoliths analysed in project STN2021-01.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.2, 0.2, 0.2, 0.2, 0.2.

Deepwater Fisheries

Project code	Project title
HAK2021-01	Stock assessment of hake in HAK 7
HOK2021-01	Hoki population modelling and stock assessment
JMA2021-01	Stock assessment of jack mackerel in JMA 7
LIN2021-01	Stock assessment of ling in LIN 3 and LIN 4
MID2021-01	Routine age determination of middle depth and deepwater species from commercial fisheries and resource surveys
MID2021-02	Multi-species deepwater trawl surveys
ORH2021-01	Stock assessment of the orange roughy Mid-East Coast Stock
ORH2021-02	Stock assessment of orange roughy in ORH 3B
ORH2021-03	Estimation of the abundance of orange roughy on the southwest Challenger Plateau (ORH 7A including Westpac Bank)
SCI2021-02	Stock assessment of scampi in SCI 1 and SCI 2
SBW2021-01	Biomass estimation of the Campbell Island southern blue whiting stock using acoustic surveys
SBW2021-02	Analysis of Bounty Plateau southern blue whiting (SBW 6B) acoustic survey
SWA2021-01	Assessment of biomass for silver warehou in SWA 3 and SWA 4

HAK2021-01 Stock assessment of hake in HAK 7

Project code:	HAK2021-01
Project title:	Stock assessment of hake in HAK 7
Start date:	1 October 2021
Completion date:	30 September 2022
Vessel use:	None
Estimated cost:	$75,000

Overall Research Objective:

To carry out a stock assessment of hake (*Merluccius australis*) off the west coast of the South Island (HAK 7) including estimating stock biomass and stock status.

Specific Research Objectives:

1. To carry out a descriptive analysis of the commercial catch and effort data for hake off the west coast of the South Island and update the standardised catch and effort analyses.
2. To update the stock assessment of the west coast South Island hake stock including estimates of current biomass, the status of the stock in relation to management reference points, and future projections of stock status as required to support management.

Reporting Requirements:

1. To present the results to meetings of the Deepwater Fishery Assessment Working Group by 30 April 2022 in Wellington.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 30 April 2022.
3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager Fishery Assessment Reports for each of the specific research objectives as specified in Research Reporting Form 7 by 30 August 2022.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

1. All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 September 2022.

2. On completion of the stock assessment, provide relevant stock assessment inputs and outputs to the RAM Legacy database project by populating the spreadsheets provided. These are to be sent to the project scientist to check and send to the University of Washington by 30 August 2022.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Hake is an important middle depth species on the Chatham Rise, Sub-Antarctic, and off the west coast of the South Island. It is a common bycatch of hoki target fisheries, especially off the west coast of the South Island, though hake target fisheries do exist.

Historically, HAK 7 has been the largest hake fishery, caught either as bycatch of the hoki fishery or as a target species. Changes in the fishery, including TACC changes to both hoki and hake and changes in fishing practices including gear type, tow duration, and strategies to limit hake bycatch, have led to reduced catches of hake. The TACC for HAK 7 was reduced to 5064 t in 2017 and then to 2272 t in 2019. Catches have been well below the respective TACCs for over a decade.

The most recent stock assessment for HAK 7 was accepted in 2019 and indicated that overfishing was likely to be occurring. Status in relation to Target was estimated to be Exceptionally Unlikely to be at or above the target. The 2019 assessment has since been reviewed independently and suggestions for improvement and future work have been made and should be considered.

Objective 1
Descriptive analyses should be completed for the west coast South Island hake fishery, and the standardised catch and effort (CPUE) analyses updated.

Objective 2
New catch-at-age data, CPUE analyses, all available biological and fisheries data, and abundance indices from trawl surveys (including the updated indices from the trawl survey off the west coast South Island in July-August 2021 will be used to update the assessment of west coast South Island hake.

Where appropriate, the project should continue to improve and refine the previous methods and stock assessment for west coast South Island hake. Areas for improvement include refining area-based age compositions, relative weighting of key input data, detailed evaluation of CPUE indices, reliability of age compositions, and magnitude of ageing error. Other potential HAK 7 recruitment indices should also be considered.

The Working Group report should be updated, including with the updated CPUE and the stock assessment model if accepted by the Deepwater Fishery Assessment Working Group.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4 and 0.6.

HOK2021-01 Hoki population modelling and stock assessment

Project code:	HOK2021-01
Project title:	Hoki population modelling and stock assessment
Start date:	1 October 2021
Completion date:	30 October 2022
Vessel use:	None
Estimated cost:	$200,000

Overall Research Objective:

To carry out a stock assessment of hoki (*Macruronus novaezelandiae*) stocks including estimating biomass and sustainable yields.

Specific Research Objectives:

1. To complete a descriptive analysis of the commercial catch and effort data, trawl survey data, and observer data for hoki in New Zealand.
2. To complete a stock assessment for hoki including estimates of current biomass and yields, the status of the stock in relation to management reference points, and future projections of stock status as required to support management.

Reporting Requirements:

1. To present the progress and results to meetings of the Deepwater Fishery Assessment Working Group as appropriate.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 30 April 2022.
3. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a Fishery Assessment Report as specified in Research Reporting Form 7 for each of the specific research objectives by 30 September 2022.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

1. All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 September 2022.

2. On completion of the stock assessment, provide relevant stock assessment inputs and outputs to the RAM Legacy database project by populating the spreadsheets provided. These are to be sent to the project scientist to check and send to the University of Washington by 30 August 2022.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Hoki is New Zealand's largest finfish fishery and is managed within a single quota management area (HOK 1) although hoki is assessed as two separate stocks, western and eastern. The current hypothesis is that juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity.

Because this fishery is New Zealand's most valuable deepwater fishery, the hoki stock assessment is updated annually. New data are taken from four fishery-independent surveys: 1) the Cook Strait acoustic survey which provides abundance information about the eastern spawning stock; 2) the Chatham Rise trawl survey which provides incoming recruitment estimates for both stocks and an eastern stock biomass index; 3) the sub-Antarctic trawl survey which provides the main abundance index for the western stock; and 4) the West Coast acoustic survey, undertaken less regularly. Catch at age data from the spawning fisheries on the WCSI and Cook Strait are also collected each year.

From 1 October 2019 the TACC for HOK 1 was reduced from 150 000 t to 115 000 t, with a non-regulatory catch split arrangement of 60 000 t from eastern stock areas and 55 000 t from western stock areas.

The hoki stock assessment model is complex and confidence in the model used until 2018 declined in later years. After the 2018 stock assessment, it was agreed that the model was not estimating the population status well and that a thorough investigation was required. In 2019 the Deepwater Working Group agreed to forego the hoki stock assessment in favour of focusing resources on a thorough analysis of data inputs and the development of a new stock assessment model for hoki that better reflects the performance of the commercial fishery, especially off the west coast South Island. The new model will be used to conduct the 2021 hoki stock assessment. Although the 2021 model is likely to be a significant improvement, it is expected that the process of model refinement will continue in the 2022 stock assessment.

Objective 1
A descriptive analysis for all hoki fisheries should be updated to the most recent fishing year using all available data. In addition, the 'data collation report' will be updated with new catch information, abundance indices, and other hoki data used in the stock assessment. Development

of an automated process to collate the data would improve the efficiency of this process and should be investigated and progressed as is reasonable within this contract.

Objective 2

The stock assessment for hoki should be carried out using the most recent data available to provide an estimate of current biomass and the status of the stock in relation to management reference points. The assessment model should also be used to provide information on current yields and provide projections of future stock status as required to support management. This may involve re-parametrisation of the current hoki stock assessment model, depending upon outcomes from the 2021 stock assessment.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.3, 0.7.

JMA2021-01 Stock assessment of jack mackerel in JMA 7

Project code:	JMA2021-01
Project title:	Stock assessment of jack mackerel in JMA 7
Start date:	1 July 2021
Completion date:	30 November 2022
Vessel use:	None
Estimated cost:	$75,000

Overall Research Objective:

To carry out a stock assessment of the main jack mackerel species off the west coast of the South Island (JMA 7) including estimating stock biomass and sustainable yields.

Specific Research Objectives:

1. To carry out a descriptive analysis of the commercial catch and effort data for jack mackerel species off the west coast of the South Island and update the standardised catch and effort analyses.
2. Investigate methods to estimate the distribution of catch by species and develop species-specific CPUE series for JMN and JMD in JMA 7.
3. To assess stock status of JMN and JMD in JMA 7 where abundance indices are available.

Reporting Requirements:

1. To present the results to meetings of the Deepwater Fishery Assessment Working Group by 30 April 2022 in Wellington.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 30 April 2022.
3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report as specified in Research Reporting Form 7 by 30 September 2022.
4. Submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final revised Working Group report as specified in Research Reporting Form 7 by 30 October 2022.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

1. All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 September 2022.

2. On completion of the stock assessment, provide relevant stock assessment inputs and outputs to the RAM Legacy database project by populating the spreadsheets provided. These are to be sent to the project scientist to check and send to the University of Washington by 30 August 2022.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
New Zealand's jack mackerel fisheries comprise three separate species that are managed as a species complex. Until the mid-1980s only two jack mackerel species had been reported in New Zealand waters. The third species (*Trachurus murphyi*, also called 'Chilean' or 'redtail' jack mackerel) was first positively identified in 1986 but may have been present since 1984.

Since 2000, the extensive distribution of *T. murphyi* has decreased and, although still the dominant species in JMA 3, it is far less abundant than it was during the 1990s and is not present in large numbers in JMA 7. Landings in JMA7 represent the greatest proportion of total JMA landings and are mainly taken by midwater trawlers. The TACC for JMA 7 is 32 537 t and this has been exceeded four times in the past seven years. Landings have been over 30 000 t in each year for the past 7 years.

There are currently no estimates of stock status for jack mackerel species in any area. The assessment of stock status is complicated by difficulties estimating species composition in the catch when developing abundance indices (i.e., CPUE). There is currently an investigation to understand the representativeness of observer sampling and whether information on species composition can reliably be used in the assessment. There is also a project that aims to identify jack mackerel species using otolith morphology. Results from these studies, if informative, should be incorporated into this assessment.

Objective 1
A descriptive analysis of the jack mackerel fishery in JMA 7, including characterisation of both commercial and observer data focusing on species composition. This should also include an investigation of stock structure.

Objective 2
Investigate methods to estimate the distribution of catch by species and develop species-specific CPUE series for JMN and JMD in JMA 7.

Objective 3
To assess stock status of JMN and JMD in JMA 7 where abundance indices are available.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4, 0.2, and 0.4.

LIN2021-01 Stock assessment of ling in LIN 3 and LIN 4

Project code:	LIN2021-01
Project title:	Stock assessment of ling in LIN 3 and LIN 4
Start date:	1 July 2021
Completion date:	31 October 2022
Vessel use:	None
Estimated cost:	$93,000

Overall Research Objective:

To carry out a stock assessment of ling (*Genypterus blacodes*) on the Chatham Rise (LIN 3 and LIN 4) including estimating biomass and stock status.

Specific Research Objectives:

1. To carry out a descriptive analysis of the commercial catch and effort data for ling (LIN 3 and LIN 4) on the Chatham Rise, including analyses of standardised catch per unit effort.
2. To carry out a stock assessment of the Chatham Rise ling stock including estimates of current biomass, the status of the stock in relation to management reference points, and future projections of stock status as required to support management.

Reporting Requirements:

1. To present the results to meetings of the Deepwater Fishery Assessment Working Group by 30 April 2022 in Wellington.
2. To update the Working Group report for ling as appropriate for inclusion in the May 2022 Fisheries Assessment Plenary.
3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fishery Assessment Report for each of the specific research objectives as specified in Research Reporting Form 7 by 31 August 2022.
4. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report for each of the specific research objectives as specified in Research Reporting Form 7 by 31 September 2022.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

1. All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 September 2022.
2. On completion of the stock assessment, provide relevant stock assessment inputs and outputs to the RAM Legacy database project by populating the spreadsheets provided. These are to be sent to the project scientist to check and send to the University of Washington by 30 August 2022.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Ling is an important middle depth species taken mainly on the Chatham Rise, off the west coast of the South Island, and on the Southern Plateau. It supports substantial bottom longline fisheries, target trawl fisheries, and is a major bycatch in middle depth trawl fisheries. Some near-shore setnet and longline targeting for ling is also undertaken. Recreational and customary take of ling is negligible in all areas.

Landings of ling have ranged from 12 000 t to 18 000 t over the most recent 10 years. Stock assessments for the Chatham Rise stock (LIN 3/4), Sub-Antarctic stock (LIN 5/6), and West Coast South Island stock (LIN 7) are updated regularly.

In 2019, Chatham Rise ling (LIN3/4) was estimated to be Very Likely above the target and the biomass trend is estimated to have been increasing or stable since 2003.

Objective 1
A descriptive analysis for the ling fisheries in LIN 3/4 (Chatham Rise) should be completed, including analyses of standardised catch per unit effort (CPUE).

Objective 2
New catch-at-age data, CPUE analyses, all available biological and fisheries data, and abundance indices from relevant trawl surveys will be used to update the assessment of the ling stocks. New abundance information for the assessment of LIN 3/4 includes a trawl survey of the Chatham Rise in January 2020.

The project should consider improvements and refinements to the previous methods and stock assessment for Chatham Rise ling.

The Working Group report should be updated, including with the updated CPUE and the stock assessment model if accepted by the Deepwater Fishery Assessment Working Group.

Weighting of Objectives:
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4 and 0.6.

MID2021-01 Routine age determination of middle depth and deepwater species from commercial fisheries and resource surveys

Project Code:	MID2021-01
Project title:	Routine age determination of middle depth and deepwater species from commercial fisheries and resource surveys
Start date:	1 July 2021
Completion date:	30 September 2024
Vessel use:	None
Estimated cost:	$1,500,000 ($500,000/yr)

Overall Research Objective:

To age samples of middle depth and deepwater species from commercial fisheries and resource surveys as input data to the stock assessments for those species.

Specific Research Objectives:

1. To determine catch-at-age for commercial catches and resource surveys of specified middle depth and deepwater fishstocks.
2. To age other species as required for targeted studies to meet specific research requirements.

Reporting Requirements:

1. To present the results as they become available to meetings of the Deepwater Fishery Assessment Working Group from December 2021 to August 2024 in Wellington.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager draft Fishery Assessment Reports, as specified in the Research Reporting Form 7, for stocks identified in the table under Objective 1 (see Rationale) for 2021 and as determined in the 2022 and 2023 research years, by 30 September 2024.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 September 2024.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.

Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Information on the age structure of catches from commercial fisheries and resource surveys (acoustic and trawl surveys) are key inputs to a number of stock assessments for middle depth and deepwater species. Sampling designs have been developed to provide otolith material from the major species in each major fishery each year. There are 2 main protocols used to provide catch-at-age from these fisheries. Where the fishery is discrete in time (e.g., spawning fisheries), this may take the form of an age-length key which is used with the length frequency samples to determine the age distribution of the catch. Similarly, a resource survey may use an age-length key to determine the age structure of the population sampled during the survey. In the other approach (direct ageing), otoliths are collected at random throughout the year to represent the age distribution of the catch. The latter method generally requires a larger number of otoliths to be read to obtain a representative age distribution.

Samples are collected from the commercial fisheries by Scientific Observers together with length frequency data. Scientists aboard research trips also collect ageing material as part of the project objectives for the resource surveys.

Objective 1
Observer programme (OP) coverage and research surveys will provide samples of length frequency, spawning state, and otoliths from middle depth and deepwater species. For the 2021–22 year, ageing will be carried out for the fishstocks listed in the table.

Fishery or stock	Area	Source	Method	Number of readings
BAR 4 & 5	Chatham Rise and Southland	OP & Research	ALK	900
HOK 1	WCSI spawning	OP & Research	ALK	750
	Cook Strait spawning	OP & Research	ALK	750
	Eastern non-spawning	OP	Direct	1200
	Western non-spawning	OP	Direct	1200
	WCSI trawl survey	Research	ALK	750
	Chatham Rise trawl survey	Research	ALK	750
HAK 1	Sub-Antarctic fishery	OP	ALK	600
HAK 4	Chatham Rise fishery	OP	ALK	600
	Chatham Rise trawl survey	Research	ALK	600
HAK 7	WCSI fishery	OP	ALK	600
	WCSI trawl survey	Research	ALK	600
LIN 3 & 4	Chatham Rise trawl fishery	OP	ALK	500
	Chatham Rise BLL fishery		ALK	500
	Chatham Rise trawl survey	Research	ALK	600
LIN 5 & 6	Sub-Antarctic trawl fishery	OP	ALK	500
	Sub-Antarctic BLL fishery spawn	OP	ALK	500

	Sub-Antarctic BLL fishery non-spawn	OP	ALK	500
LIN 7	WCSI fishery	OP	ALK	500
	WCSI trawl survey	Research	ALK	600
SBW 6I	Campbell Islands spawning	OP	ALK	600
SBW 6B	Bounty Plateau spawning	OP & Research	ALK	600
JMA 7	WCSI/WCNI fisheries	OP	ALK	1800 (600 per spp)
ORH MEC	ORH acoustic survey	Research	Direct	900
ORH 3B	ORH acoustic survey	Research	Direct	900

Objective 2
To support additional research not yet specified, the ageing of up to 2400 additional otoliths will be funded for 2021–22.

For 2022–23 and 2023–24, the number of otolith samples to be read will be determined in collaboration with the research provider.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.9 and 0.1.

MID2021-02 Multi-species deepwater trawl surveys

Project code:	MID2021-02
Project title:	Multi-species deepwater trawl surveys
Start date:	1 July 2021
Completion date:	30 June 2026
Vessel use:	R.V. *Tangaroa*
Estimated cost:	$14,900,000

Overall Research Objectives:

1. To continue a time series of relative abundance indices for hoki (*Macruronus novaezelandiae*), hake (*Merluccius australis*), and ling (*Genypterus blacodes*) in the Southland and Sub-Antarctic area (December 2022, 2024).
2. To continue a time series of relative abundance indices for hoki (*Macruronus novaezelandiae*), hake (*Merluccius australis*), and ling (*Genypterus blacodes*) on the Chatham Rise (January 2024, 2026).
3. To continue a time series of relative abundance indices for hake (*Merluccius australis*) and ling (*Genypterus blacodes*) off the west coast South Island (June/July 2024).
4. To collect data to increase New Zealand's understanding of the wider marine ecosystem and support an ecosystem approach to fisheries management.

Specific Research Objectives:

Sub-Antarctic surveys

1. To carry out trawl surveys in December 2022 and December 2024 to continue the time series of relative abundance indices for hoki (HOK 1), hake (HAK 1), and ling (LIN 5 and 6) on the Southern Plateau.
2. To collect data for determining the population age, size structure, and reproductive biology of hoki, hake, and ling and other middle depth species on the Southern Plateau.
3. To collect acoustic and related data during the trawl survey.
4. To collect and preserve specimens of unidentified organisms taken during the trawl survey for later identification ashore.

Chatham Rise surveys

1. To continue the time series of relative abundance indices of recruited hoki and other middle depth and deepwater species on the Chatham Rise in January 2024 and January 2026 using trawl surveys and to determine year class strengths of juvenile hoki (1, 2, and 3 year olds), with target CV of 20% for the number of two year olds.
2. To collect data for determining the population age, size structure, and reproductive biology of hoki, hake, and ling and other middle depth species on the Chatham Rise.
3. To collect acoustic and related data during the trawl survey.
4. To collect and preserve specimens of unidentified organisms taken during the trawl survey and identify them later ashore.

5. To sample deeper strata for deepwater species using a random trawl survey design.

West coast South Island surveys

1. To estimate relative abundance indices for hake (*Merluccius australis*) and ling (*Genypterus blacodes*) off the west coast South Island (WCSI) in June/July 2024 using trawl surveys with a target coefficient of variation (CV) of the estimate of 30%.
2. To collect data for determining the population age, size structure, and reproductive biology of hoki, hake, and ling and other middle depth species off the WCSI.
3. To collect acoustic and related data during the trawl survey.
4. To collect and preserve specimens of unidentified organisms taken during the trawl survey for later identification ashore.

Reporting Requirements:

1. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a voyage programme three weeks before each scheduled survey.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a voyage report one month after each executed survey.
3. To present the results to meetings of the Deepwater Fisheries Assessment Working Group as required in Wellington.
4. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fishery Assessment Report for each survey as specified in Research Reporting Form 7 by three months after completion of the relevant survey.

Rationale:

Management Objectives:

National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.
- Objective 6: Identify and avoid or minimise adverse effects of deepwater and middle-depth fisheries on associated or dependent and incidentally caught fish species.

General

Hoki, hake, and ling fisheries are three of New Zealand's largest fisheries, with combined total catches of over 127 000 tonnes in 2019–20 worth an estimated combined $230 million in export values in 2020.

The main fisheries for hoki, hake, and ling are on the Chatham Rise (year round), in the Sub-Antarctic, Southern Plateau (summer), and off the west coast of the South Island (WCSI) and in Cook Strait (during spawning season June-August) where hoki aggregate to spawn.

These wide area trawl surveys are valuable to our understanding of non-target species for which information can be hard to obtain. In particular, the deepwater component of the surveys provides abundance estimates and biological data for a range of deepwater species that are not well indexed by core surveys, especially deepwater sharks. Research trawl surveys help us to understand the midwater and deepwater environment and observe any changes that may be occurring.

Sub-Antarctic
The continuation of the time series of trawl surveys on the Southern Plateau is a high priority to provide information required to update the assessment of hoki and other middle depth species. The survey is scheduled to be completed biennially. The next in this time series is December 2022.

Trawl surveys have been carried out in this area since 1991, initially targeting hoki but also for hake and ling. The timing of the survey has varied with the first series of surveys carried out in December from 1991 to 1993. After a break, further surveys took place in April 1996 and in April 1998. However, from 2000, the survey was transferred to December. The change was made for two main reasons: uncertainty over recent assessment for hoki stocks, and a concern that the hake age structure was not well represented by the small samples taken in the April surveys. The longer daylight hours in December allow more stations to be occupied than in April and therefore more hake samples are likely to be taken, which improves the determination of the age structure for this species.

Hoki, hake, and ling biomass in this area are monitored by carrying out trawl surveys at two-year intervals. Information on age structure and reproductive biology is also obtained during the survey.

Chatham Rise
This trawl survey on the Chatham Rise was carried out in January each year from 1992 to 2014, and biennially since. The most recent survey was in January 2020. An objective of the survey has been to measure the abundance of both juvenile and adult hoki on the Chatham Rise. Other commercial middle depth species (particularly hake and ling) and a wide range of non-commercial fish and invertebrate species are also monitored by this survey. A review of the time series showed that biomass was estimated for 142 species or groups, with 49 of these species considered relatively well estimated (CV less than 40%)[2].

To manage the hoki fishery and minimise potential risks, it is important to have some predictive ability concerning recruitment into the fishery. Extensive sampling throughout the EEZ has shown that the Chatham Rise is the main nursery ground for juvenile hoki. Abundance estimation of two year old hoki provides the best index of potential recruitment to the adult fisheries, and the index of one year old hoki is also informative. The survey data from both juvenile and adult abundance are used directly in the stock assessment to estimate recruitment parameters and determine current stock size and inform projections of future stock status.

The continuation of the time series of trawl surveys on the Chatham Rise is a high priority to provide information required to update the assessment of hoki, hake, and ling and other middle depth species and to provide abundance information for a wide range of non-target species.

[2] O'Driscoll et. al (2011). A review of hoki and middle-depth trawl surveys of the Chatham Rise 1992–2010. *New Zealand Fisheries Assessment Report 2011/47*. 72 p.

West coast South Island
The waters off the west coast South Island comprise the main fishery for spawning hoki, but key fisheries for a number of other middle depth species including hake and ling also exist here. A wide range of commercial and non-commercial fish as well as invertebrate species are also sampled in the survey. For many of these species, this survey provides the only fisheries independent estimate of abundance in this area and provides additional biological data (length, sex, reproductive condition, ageing material, etc.).

A series of combined trawl/acoustic surveys were carried out between 1998 and 2013, with the acoustic portion of the survey focused on acquiring a biomass estimate of spawning hoki in the area. In 2012 and 2013, the survey design was reviewed to ensure the results of the trawl component of the survey would be comparable to the 2000 survey, and the survey area was increased to better cover the distribution of other middle depth species (i.e., hake).

Objective 2 (all)
Otolith samples will be collected throughout survey strata. These will be aged to determine an age-length key, which can be used with the length frequency distribution of the commercial catches to determine the proportion at age of fish in the population. This will be used as inputs to relevant stock assessments. (Note: the ageing of otoliths will be completed under a separate project.)

Objective 3 (all)
Throughout the survey an acoustic recording should be made during each trawl and when steaming between survey stations.

Objective 4 (all)
All catch taken during the trawl survey should be recorded at each station. Specimens of unidentified organisms should be sampled and preserved for future analysis and identification.

Objective 5 (Chatham Rise only)
In January 2010, the survey was extended to sample deeper strata (800 to 1300 m) in the north and east of the Chatham Rise. Extension of the survey to these deeper strata to the south and west of the Chatham Rise from 2015 was intended to provide additional information on the abundance of the suite of deepwater fish species that are bycatch in the oreo and orange roughy fisheries.

The multi-year project is estimated to cost $14,900,000 as per below:

2021/22: - (in previous contract)
2022/23: $2,800,000
2023/24: $3,800,000
2024/25: $4,600,000
2025/26: $3,700,000

ORH2021-01 Stock assessment of orange roughy Mid-East Coast stocks

Project code:	ORH2021-01
Project title:	Stock assessment of the orange roughy Mid-East Coast stock
Start date:	1 July 2021
Completion date:	30 October 2022
Vessel use:	None
Estimated cost:	$70,000

Overall Research Objective:

To carry out stock assessments of the orange roughy (*Hoplostethus atlanticus*) Mid-East Coast (ORH 2A South, ORH 2B, and ORH 3A) stocks.

Specific Research Objectives:

1. To carry out a descriptive analysis of the commercial catch and effort data, survey data, and observer data for orange roughy fisheries on the Mid-East Coast.
2. To complete stock assessments of the Mid-East Coast orange roughy stock including estimating biomass and sustainable yields, the status of the stocks in relation to management reference points, and future projections of stock status as required to support management.

Reporting Requirements:

All Objectives

1. To present the progress and results to meetings of the Deepwater Fishery Assessment Working Group as appropriate.
2. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 30 April 2022.
3. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 May 2022.
4. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report as specified in Research Reporting Form 7 by 30 August 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

1. All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 September 2022.
2. On completion of the stock assessment, provide relevant stock assessment inputs and outputs to the RAM Legacy database project by populating the spreadsheets provided. These are to be sent to the project scientist to check and send to the University of Washington by 30 August 2022.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Orange roughy is one of the most valuable deepwater fisheries in New Zealand and one of the largest sources of orange roughy in the world. It is also one of the oldest fisheries and was subject to intense fishing pressure in the 1980s and 1990s before the life history and biological characteristics of the species were fully understood. It was estimated that most of New Zealand's orange roughy stocks were depleted and many were closed to fishing or subject to very low TACCs by the late 1990s.

The Mid-East Coast (MEC) fishery started in the south in the early 1980s and then extended to the north in the mid-1980s with total catches peaking at about 10 000 t in the early 1990s. The first of a series of TACC/catch-limit cuts occurred in 1994–95 and significantly reduced catches to below 2000 t in recent years. Currently the catch limit for this stock is 725 t.

Technology has provided an improved capacity to estimate the biomass of some orange roughy stocks, and ongoing surveys have been incorporated into a new stock assessment model. An acoustic survey of ORH MEC was completed in 2013 and the stock assessment, that incorporated the 2013 survey, was completed in 2014 and estimated the stock to be at 14% B_0. A plan is in place to rebuild the stock back towards the management target. There is another acoustic survey of ORH MEC planned for 2021, the results of which will be incorporated into these assessments.

The 2013 assessment model indicated that at the current catch limit the MEC orange roughy stock is likely to increase slowly but still be below the soft limit in 2019. The minimum rebuild period to reach 30% B_0 with 70% probability is estimated to be 21 years with no catch. In addition, a Management Strategy Evaluation was run which underpinned a Harvest Control Rule defining how catch limits will be set in relation to stock status. Continuing appropriate management of orange roughy stocks will require regular monitoring and a stock assessment model to provide estimates of biomass, stock status, and yields.

Objective 1
A descriptive analysis for these orange roughy fisheries should be completed prior to the assessment.

Objective 2
All available biological and fisheries data, and abundance indices from acoustic surveys, will be used to update the assessment of these stocks. New abundance information for these stocks includes a further acoustic survey of both areas in winter 2021.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4 and 0.6.

ORH2021-02 Stock assessment of orange roughy in ORH 3B

Project code:	ORH2021-02
Project title:	Stock assessment of orange roughy in ORH 3B
Start date:	1 July 2021
Completion date:	30 August 2022
Vessel use:	None
Estimated cost:	$90,000

Overall Research Objective:

To carry out stock assessments of the orange roughy (*Hoplostethus atlanticus)* stocks within ORH 3B on the Northwest Chatham Rise and on the East & South Chatham Rise including estimating biomass and sustainable yields.

Specific Objectives:

1. To carry out a descriptive analysis of the commercial catch and effort data, survey data, and observer data for orange roughy on the Northwest Chatham Rise and in the East & South Chatham Rise.
2. To complete stock assessments of the Northwest Chatham Rise and East & South Chatham Rise orange roughy stocks including estimating biomass and sustainable yields, the status of the stocks in relation to management reference points, and future projections of stock status as required to support management.

Reporting Requirements:

All Objectives

1. To present the progress and results to meetings of the Deepwater Fishery Assessment Working Group as appropriate.
2. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 30 April 2022.
3. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 May 2022.
4. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report as specified in Research Reporting Form 7 by 30 July 2022.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

1. On completion of the stock assessment, provide relevant stock assessment inputs and outputs to the RAM Legacy database project by populating the spreadsheets provided. These are to be sent to the project scientist to check and send to the University of Washington by 30 July 2022.
2. All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 August 2022.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Orange roughy is one of the most valuable deepwater fisheries in New Zealand and one of the largest sources of orange roughy in the world. The ORH 3B fishery is the largest orange roughy fishery in New Zealand. In the 1980s and 1990s, before the life history and biological characteristics of the species were fully understood, TACCs were high and the ORH 3B TACC achieved a peak of over 38 000 t from 1986 to 1989, with landings reaching a maximum of 32 785 t in 1988–89. As a consequence of the lack of scientific understanding, it was estimated that most of New Zealand's orange roughy stocks were depleted and many were closed to fishing or subject to very low TACCs by the late 1990s.

New technology has provided an improved capacity to estimate the biomass of some orange roughy stocks, and ongoing surveys have been incorporated into a new stock assessment model. This model indicates that several stocks have rebuilt and, as a result, catch limits were increased for several main stocks beginning in 2014. In addition, a Management Strategy Evaluation was run which underpinned a Harvest Control Rule defining how catch limits will be set in relation to stock status. Continuing appropriate management of orange roughy stocks will require regular monitoring and a stock assessment model to provide estimates of biomass, stock status, and yields.

An acoustic survey of the Northwest Chatham Rise and the East & South Chatham Rise spawning biomass will be completed in the winter of 2021 and the results will be incorporated into these assessments.

A technical review of the derivation and operation of the orange roughy Management Procedure is currently underway and findings from this review should also be incorporated into the application of the Harvest Control Rule.

Objective 1
A descriptive analysis for these orange roughy fisheries should be completed prior to the assessment.

Objective 2
All available biological and fisheries data, and abundance indices from acoustic surveys, will be used to update the assessment of these stocks. New abundance information for these stocks includes a further acoustic survey of both areas in winter 2021.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4 and 0.6.

ORH2021-03 Estimation of the abundance of orange roughy on the southwest Challenger Plateau (ORH 7A including Westpac Bank)

Project code:	ORH2021-03
Project title:	Estimation of the abundance of orange roughy on the southwest Challenger Plateau (ORH 7A including Westpac Bank)
Start date:	1 October 2021
Completion date:	30 June 2023
Vessel use:	R.V. *Tangaroa* June/July 2022
Estimated cost:	$ 1,400,000

Overall Research Objective:

To estimate the abundance of orange roughy (*Hoplostethus atlanticus*) on the southwest Challenger Plateau (ORH 7A including Westpac Bank) using trawl and acoustic methods.

Specific Research Objectives:

1. To calibrate acoustic equipment used in the survey.
2. To estimate the abundance of orange roughy (*Hoplostethus atlanticus*) in ORH 7A (including Westpac Bank) using trawl and acoustic surveys.

Reporting Requirements:

1. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a voyage programme three weeks before the survey.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a voyage report one month after the survey.
3. To present the results to meetings of the Deepwater Fisheries Assessment Working Group by 15 December 2022 in Wellington.
4. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report as specified in Research Reporting Form 7 by 31 March 2023.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 June 2023.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Orange roughy is an important species in New Zealand deepwater fisheries with current annual landings of about 6500 t. The Medium-Term Research Plan for Deepwater Fisheries includes a programme of surveys for orange roughy stocks on a four-year cycle. This includes a survey of the ORH 7A stock in winter 2022.

Because orange roughy lack a swim bladder and have a low target strength relative to other deepwater species, acoustic survey biomass estimates were historically restricted to aggregations of fish where the species identification of the mark is known to be almost 100% orange roughy. In more recent years, a net-attached Acoustic Optical System (AOS) has been used successfully to survey orange roughy in several areas including the Chatham Rise and Challenger Plateau. The advantage of this system is that the multi-frequency and optical components of the system can be used to significantly improve species identification in orange roughy aggregations.

Using a dual frequency towed acoustic system (for example, either an AOS or other towed body system) places the echo sounder closer to the fish and allows the use of higher acoustic frequencies that can also be used for species discrimination. This also reduces the depth of the acoustic dead zone near the sea floor and avoids the bubble layer that impedes the signal on hull mounted acoustic systems in rough weather.

The orange roughy fishery on the southwest Challenger Plateau includes both fishing on underwater features and also on flat areas.

Objective 1
The acoustic equipment on board the fishing vessel requires calibration to ensure accurate biomass estimates can be calculated from snapshots.

Objective 2
The ORH 7A fishery was last surveyed in 2018. This survey should consider recommendations from the last survey and stock assessment which include revision of the acoustic survey design and implementation to ensure (i) improved estimation of the abundance in the 'East'

aggregation and (ii) abundance estimates are obtained for all three aggregations ('East', 'West', and Volcano) in the same year.

The otolith sampling approach should also be reconsidered to ensure that adequate otoliths are obtained from each aggregation and that these are obtained from multiple tows to support the stock assessment.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.1, 0.9.

SBW2021-01 Biomass estimation of the Campbell Island southern blue whiting stock using acoustic surveys

Project code:	SBW2021-01
Project title:	Biomass estimation of the Campbell Island southern blue whiting stock using acoustic surveys
Start date:	1 July 2021
Completion date:	30 April 2023
Vessel use:	R.V. *Tangaroa*, September 2022
Estimated cost:	$2,900,000

Overall Research Objective:

To estimate the biomass of southern blue whiting (*Micromesistius australis*) on the Campbell Plateau (SBW 6I) using acoustic surveys.

Specific Research Objective:

To estimate pre-recruit and spawning biomass on the Campbell Plateau using an acoustic survey, with a target coefficient of variation (CV) of the estimate of 30%.

Reporting Requirements:

1. To present the results to meetings of the Deepwater Fishery Assessment Working Group by 30 November 2022 in Wellington.
2. To update the Working Group report for southern blue whiting as appropriate for inclusion in the May 2023 Fisheries Assessment Plenary.
3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 31 January 2023.
4. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report as specified in Research Reporting Form 7 by 31 March 2023.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 28 February 2023.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Fisheries for southern blue whiting (SBW) were developed in the early 1970s. Landings have fluctuated considerably, peaking at 75 000 t in the 1991–92 fishing year, when almost 60 000 t was taken from the Bounty Plateau stock (SBW 6B) and 15 000 t was estimated taken from SBW 6I. Southern blue whiting was introduced into the QMS in 1999 with separate TACs for each of the four main stocks within FMA 6. The Campbell Island stock is the largest of the four southern blue whiting stocks. The TACC is currently 39 200 t and landings in 2019–20 were 26 517 t.

A time series of wide area surveys of the Campbell Plateau was started in 1993. These surveys measure relative abundance of adult SBW and predict pre-recruit numbers. Because the fish recruit at 2 and 3 years to the fishery, surveys are currently scheduled every 3–4 years to keep the assessment up to date. The movement of fish during the survey period has required the development of an adaptive survey design to increase efficiency and ensure all spawning aggregations are included in the survey strata. Alternative survey designs result in different biases in the estimate of biomass. The most recent acoustic survey of the Campbell Island stock was completed in September 2019.

Objective 1
The time series of acoustic surveys provide fishery independent monitoring of both the recruited part of the population as well as prediction of the strength of year classes about to enter the fishery. In September 2022, a wide-area acoustic survey will be carried out on the Campbell Island stock (SBW 6I) to continue the time series.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weighting for the objective in this project is: 1.0.

SBW2021-02: Analysis of Bounty Plateau southern blue whiting (SBW 6B) acoustic survey

Project Code:	SBW2021-02
Project title:	Analysis of Bounty Plateau southern blue whiting (SBW 6B) acoustic survey
Start date:	1 July 2021
Completion date:	30 September 2022
Vessel use:	None
Estimated cost:	$96,000

Overall Research Objective:

To analyse acoustic data collected during the SBW 6B acoustic aggregation survey.

Specific Research Objectives:

1. To calibrate acoustic equipment on the vessel carrying out the SBW 6B acoustic survey.
2. To analyse acoustic data collected during the SBW 6B aggregation acoustic survey to estimate current stock biomass.

Reporting Requirements:

1. To present the progress and results to meetings of the Deepwater Fishery Assessment Working Group as appropriate.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 30 April 2022.
3. To submit to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report as specified in Research Reporting Form 7 by 30 September 2022.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 September 2022.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Southern blue whiting (*Micromesistius australis*) is found in Sub-Antarctic waters with known spawning grounds on the Bounty Plateau, Pukaki Rise, Auckland Islands Shelf, and Campbell Island Rise. The four spawning grounds are treated as separate stocks for stock assessment. Spawning occurs on the Bounty Plateau from mid-August to early September and 3–4 weeks later in other areas.

Landings in SBW 6B have declined in recent years from 7054 t in 2015 to 787 t in 2020. Acoustic surveys were not completed in 2019 and 2020 because of lack of effort in this fishery due to other fleet priorities (hoki and squid) and the distance of the Bounty Plateau from other fishing areas. Given the ongoing uncertainty about the status of the Bounty Plateau stock, it is important to continue to monitor acoustic estimates of spawning SBW in this area. Acoustic data will be obtained using an industry vessel fishing SBW 6B and analysed to provide a biomass estimate for the stock.

Objective 1
The acoustic equipment on board the fishing vessel requires calibration to ensure accurate biomass estimates can be calculated from snapshots.

Objective 2
An aggregation-based acoustic survey of the Bounty Plateau will be carried out by an industry vessel in 2021. The surveys of southern blue whiting on the Bounty Plateau have been completed by an industry vessel annually since 2004 with the exception of 2019 and 2020 using a local area aggregation acoustic survey. The raw acoustic data collected are required to be analysed to provide a biomass estimate for the stock. This will be used to inform management of the stock based on the harvest control rule that was agreed in early 2017.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.1 and 0.9.

SCI2021-02 Stock assessment of scampi in SCI 1 and SCI 2

Project code:	SCI2021-02
Project title:	Stock assessment of scampi in SCI 1 and SCI 2
Start date:	1 October 2021
Completion date:	30 September 2022
Vessel use:	None
Estimated cost:	$90,000

Overall Research Objective:

To carry out stock assessments of scampi (*Metanephrops challengeri*) in SCI 1 and SCI 2 including estimating biomass and sustainable yields.

Specific Research Objectives:

1. To update the descriptive analysis of the commercial catch and effort and observer data for scampi in SCI 1 and SCI 2.
2. To carry out stock assessments for SCI 1 and SCI 2 including estimating biomass and sustainable yields, the status of the stock in relation to management reference points, and future projections, of stock status as required to support management.

Reporting Requirements:

1. To present the results to meetings of the Deepwater Fishery Assessment Working Group by 30 April 2022 in Wellington.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 30 April 2022.
3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report as specified in Research Reporting form 7 by 30 September 2022.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

1. All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 September 2022.

2. On completion of the stock assessment, provide relevant stock assessment inputs and outputs to the RAM Legacy database project by populating the spreadsheets provided. These are to be sent to the project scientist to check and send to the University of Washington by 30 August 2022.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Scampi was introduced into the QMS in 2004. The commercial scampi fishery is a low volume, high value fishery which operates in four main areas, SCI 1 and SCI 2 around the north and east of the North Island, SCI 3 off the east coast of the South Island, and SCI 6A which operates around the Auckland Islands. In 2019–20 the total TACC for scampi was 1312 t and total landings were 974 t. Scampi in SCI 1 was slightly overcaught at 123 t with a TACC of 120 t. In SCI 2 catches were 152 t which was very close to the TACC of 153 t.

Preliminary electrophoretic analyses suggest that there is substantial heterogeneity in samples from SCI 1, 2, and 4A. Studies using newer mitochondrial DNA and microsatellite approaches are underway and are likely to be more sensitive to differences between stocks.

In 2011 the Shellfish Fishery Assessment Working Group (SFWG) accepted the stock assessments for SCI 1 and SCI 2, undertaken using a length-based population model and updated assessments were accepted in 2013, 2016, and 2019. Data inputs included CPUE, trawl and photographic survey indices, and associated length frequency distributions.

The 2019 stock assessment for SCI 1 and SCI 2 indicated that these stocks are Very Likely to be at or above target.

Objective 1
A descriptive analysis of the commercial catch and effort data and observer data should be updated to the most recent fishing year using all available data.

Objective 2
The stock assessment(s) for SCI 1 and SCI 2 should be updated with the latest survey data and should evaluate alternate model structures (sensitivities) and assumptions as well as the associated levels of uncertainty. Examples of sensitivities that may be run are: exploring the reliability of catch history and parameter estimates; evaluating whether a parameter (e.g., natural mortality) should be estimated or fixed and evaluating the degree of weighting assigned to different data sets (including the possibility of omitting a data set); evaluating if new data sets help reduce model uncertainty and changing the assumptions about the fishery or survey selectivity (e.g., allowing it to be domed, or to have different shape in different time periods).

The alternative assumptions to be evaluated may concern issues that arose, but were not fully resolved, in the previous assessment, or those identified at stage one of the current assessment (e.g., recent changes in the fishery or new knowledge about the species biology). The main evaluation criteria for these alternative model runs are the extents to which (a) the fits to the data are improved or degraded, and (b) the estimated stock status is changed.

Outputs from the model will include:

- Indicators:
  - B_0
  - B_{current}
  - B_{msy}
  - B_{current} as % B_0
  - B_{current} as % B_{msy}
  - U_{current}
  - MSY
  - U_{msy}
  - $U_{40\%B0}$

Note: indicators apply to both spawning and recruited biomass

- Projections (for the 3 years following the current year estimates) at the current catch level. Projections at different catch levels may also be required.
  - $B_{projected}$ as % B_0
  - $B_{projected}$ as % B_{msy}
  - $B_{projected}$ as % $B_{current}$
  - $Pr(B_{projected} > B_{current})$
  - $Pr(B_{projected} > B_{msy})$
  - $P(B_{projected} > 40\% B_0)$
  - $Pr(B_{projected} < 20\% B_0)$
  - $Pr(B_{projected} < 10\% B_0)$
  - $Pr(U_{projected} > U_{40\%B0})$

Note: projections apply to both spawning and recruited biomass

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.2 and 0.8.

SWA2021-01 Assessment of biomass for silver warehou in SWA 3 and SWA 4

Project code:	SWA2021-01
Project title:	Assessment of biomass for silver warehou in SWA 3 and SWA 4
Start date:	1 July 2021
Completion date:	30 October 2022
Vessel use:	None
Estimated cost:	$75,000

Overall Research Objective:

To develop an assessment of biomass in relation to management targets for silver warehou (*Seriolella punctata*) in SWA 3 and SWA 4.

Specific Research Objectives:

1. To update the descriptive analysis of the commercial catch and effort data for silver warehou on the Chatham Rise and Southland and update standardised catch and effort analyses.
2. To review all options and approaches to providing stock status advice (including but not limited to the possibility of again attempting a Level 1 fully quantitative stock assessment for the ECSI stock).

Reporting Requirements:

1. To present the results to meetings of the Deepwater Fishery Assessment Working Group by 30 April 2022 in Wellington.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft revised Working Group Report as specified in Research Reporting Form 8 by 30 April 2022.
3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 July 2022.
4. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Fishery Assessment Report as specified in Research Reporting Form 7 by 30 September 2022.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

1. All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 September 2022.
2. On completion of the stock assessment, provide relevant stock assessment inputs and outputs to the RAM Legacy database project by populating the spreadsheets provided. These are to be sent to the project scientist to check and send to the University of Washington by 30 August 2022.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 1: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 3: Ensure effective management of deepwater and middle-depth fisheries is achieved through the availability of appropriate, accurate and robust. Information.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.

General
Silver warehou are common around the South Island and on the Chatham Rise in depths of 200–800 m. The majority of the commercial catch is taken from the Chatham Rise, Canterbury Bight, southeast of Stewart Island, and off the west coast of the South Island.

Most of the silver warehou catch in SWA 3 and SWA 4 is as bycatch of hoki, squid, barracouta, and jack mackerel trawl fisheries, although some targeting does occur. Landings have generally fluctuated around the TACC in SWA 3 for many years, with landings exceeding the TACC in 3 of the past 5 years. SWA 4 landings have exceeded the TACC more frequently, including in 4 of the 5 most recent years.

Silver warehou is a schooling species, aggregating to both feed and spawn. During spring-summer, both adult and juvenile silver warehou migrate to feed along the continental slope off the east and southeast coast of the South Island. The stock structure for silver warehou remains poorly known, so this project should consider recommendations of the Deepwater Working Group as well as novel options.

An assessment of the East Coast South Island silver warehou stock was attempted in 2018 (McGregor 2019a, b) but not accepted by the Deepwater Fisheries Assessment Working Group. However, biomass information derived from the assessment was considered adequate to provide sustainability advice on this stock. This assessment was based on the following biological stock structure assumption: there was a break in the spatial distribution of catches between the fishery on Chatham Rise and East Coast South Island down to about 45.4° S, and the Stewart-Snares shelf comprising the northwestern side of QMA 4 and the northern part of QMA 3, and in the known timing and location of spawning.

Further work was completed in 2019–20 to describe the distribution of fish and fishing within the East Coast South Island biological stock area and to examine the hypothesis that changes in CPUE may have resulted from operational changes in the fishery (Dutilloy & Dunn 2020). These analyses concluded that the inshore and offshore fisheries within the stock area should

have different fishery selectivities, that the trend in revised CPUE analyses was similar to that reported by McGregor (2019a), and that a peak in CPUE around 2006–07 was most likely a consequence of increased abundance rather than just a consequence of fisher behaviour.

The most recent update of CPUE for the Southland stock was by McGregor (2019a) using data to the end of the 2015–16 fishing year. The Sub-Antarctic trawl survey index and CPUE indices) have been generally flat, except that the increase in 2008 and 2009 in the trawl survey is not reflected in the CPUE index. Intermittent peaks in biomass have occurred in the trawl survey, and the survey is not currently considered a reliable index.

The eastern Chatham Rise stock was last assessed in 2015 (McGregor 2016) by examination of CPUE trends and trawl survey estimates to the end of the 2010–11 fishing year. Both indices indicated a slight increasing trend.

Objective 1
An update of the descriptive analysis of the commercial catch and effort data for silver warehou on the Chatham Rise and Southland should be completed and the standardised catch and effort analyses should be updated.

Objective 2
Review all options and approaches to providing stock status advice (including but not limited to the possibility of a Level 1 fully quantitative stock assessment for the ECSI stock). A recent assessment was attempted but rejected (McGregor 2019b). Since then, further research has been conducted on the spatial structure of the fish stock and fisheries, CPUE indices have been refined, and additional age data have been collected.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4 and 0.6.

References:

Dutilloy, A.; Dunn, M.R. (2020). Fishery and stock structure for silver warehou (*Seriolella punctata*) in SWA 3 and SWA 4. *New Zealand Fisheries Assessment Report 2020/19.* 70 p.

McGregor, V. (2016). Fishery characterisation and standardised CPUE analyses for silver warehou (*Seriolella punctata*) in SWA 1, 3, and 4, 1997–98 to 2010–11. *New Zealand Fisheries Assessment Report 2016/07.* 220 p.

McGregor, V. (2019a). Fishery characterisation and standardised CPUE analyses for silver warehou (*Seriolella punctata*) in SWA 3 and 4, 1989–90 to 2015–16. *New Zealand Fisheries Assessment Report 2019/59.* 57 p.

McGregor, V. (2019b). Silver warehou (*Seriolella punctata*) western Chatham Rise preliminary stock assessment. *New Zealand Fisheries Assessment Report 2019/60.* 21 p.

Marine Amateur Fisheries

Project code	Project title
MAF2021-01	Multispecies – national panel survey
MAF2021-02	Multispecies – national fish weights survey 2022–23
MAF2021-03	Multispecies – enabling rec charter fishing operations in Fiordland to report fishing activity and catch

MAF2021-01 Multispecies – National Panel Survey (NPS) of marine amateur fishers 2022–23

Project Code:	MAF2021-01
Project Title:	Multispecies – National Panel Survey (NPS) of marine amateur fishers 2022–23
Start Date:	October 2021
Completion Date:	July 2024
Vessel Use:	None
Estimated Cost	$2,600,000

Overall Research Objective:

To continue the implementation of an integrated amateur harvest estimation system by providing estimates of absolute total amateur harvest on a stock basis to inform fisheries management.

Specific Research Objectives:

1. To deliver a repeat of the 2017–18 National Panel Survey (project MAF2016-01) in FMAs 1, 2, 3, 5, 7, 8, and 9 during the period 1 October 2022 to 30 September 2023.
2. To estimate total amateur harvest by fishstock for all species recorded during the survey.
3. To collaborate with concurrent onsite survey project(s) to provide robust comparisons of harvest estimates for specified areas.

Reporting Requirements:

1. To finalise, through the MAFWG, the design of a repeat National Panel Survey for the 2022–23 fishing year and summarise this in a Research Progress Report (Form 4) submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 June 2022.
2. To recruit panellists for the survey by 31 August 2022.
3. To summarise data collected from panellists up to 31 March 2023 in a Research Progress Report (Form 4) submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 April 2023.
4. To present and discuss results of reporting requirement 3 to the MAFWG by 31 May 2023.
5. To summarise data collected from panellists up to 30 September 2023 in a draft Fisheries Assessment Report (Form 7) submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 November 2023.
6. Present results of reporting requirement 5 to the MAFWG by 30 November 2023.

7. To submit a final Fisheries Assessment Report as specified in the Research Reporting (Form 7) to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 28 February 2024.
8. To contribute results of the NPS to all relevant plenary chapters by 30 April 2024.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required, by 30 June 2024.

Rationale:

Management Objectives:
Draft National Inshore Finfish Fisheries Plan 2019

- Enhance benefits to the recreational sector.
- Optimise the management of high value shared stocks.

General
Amateur fishing is highly valued by many New Zealanders and Fisheries New Zealand has strategic goals to modernise fisheries management and increase engagement and transparency. Following a comprehensive design process, the first National Panel Survey (NPS), conducted over the 2011–12 fishing year, provided estimates of the amateur harvest for a wide variety of species in all management areas around mainland New Zealand, with a repeat survey completed in 2017–18 (and planned here for the 2022–23 fishing year). These estimates were supported by surveys at boat ramps to estimate the average size of fish caught by recreational fishers (by species) and corroborated by independent onsite surveys. Panel surveys have been conducted once every 5 or 6 years and, between these intensive efforts, monitoring of key boat ramps using web cameras and onsite interviewing provides information on the year-by-year variation in catch and effort. Collectively, these research programmes can be used to inform on recreational harvest and contribute to the setting of sustainable total allowable catch (TAC) limits, for adjusting controls on recreational fisheries, and potentially for allocation of catch between sectors and in spatial planning processes throughout government.

The NPS was designed to be part of a system where each component helps to inform the others, rather than a series of discrete activities. This integrated system approach involves off-site surveys with on-site validation, ongoing effort monitoring using web cameras, various regional studies/characterisations, amateur charter boat reporting, and the development of new tools and approaches. It was envisaged that the NPS would be repeated approximately every 5 years, with validation surveys, and other work conducted in the intervening years. Experience has shown that extensive effort in the design phase is critical to the delivery of statistically robust results.

The NPS was repeated over the 2017–18 fishing year after commencing design work in 2016–17. This project is scheduled to resume a 5-year cycle by factoring in a year to design the survey. The importance of this information to fisheries management and future stock assessments makes this project a high priority.

Specific Objectives 1–3
The purpose of the survey is to estimate the 12-month marine harvest of amateur fishers in FMAs 1, 2, 3, 5, 7, 8, and 9 during the period 01 October 2022 to 30 September 2023. Harvest is expressed initially in terms of number of each species caught and kept. Numbers are subsequently converted to fish weight to provide absolute estimates of harvest.

The harvest figure is to be national in geographical scope and encompass all methods used by amateur fishers. Harvest drawn from defined Ministry fishing management areas (especially FMAs and QMAs for each QMS stock) is to be estimated. Collection of the data needed to allow harvest estimation begins with the design, drawing, and contacting of a nationwide sample of the population. The statistical paradigm for projecting from the sample survey to the population and for calculating estimates of precision will need to reflect the initial contact design and stratification.

Recognising that at least one complementary harvest estimation approach will be run concurrently, the survey is to capture ancillary data such as platform, method, date, location, and charter/private vessel to enable linkage across the different approaches. Care must be taken to ensure that harvest estimates from the two complementary surveys can be directly compared.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.7, 0.2, 0.1.

References:

Wynne-Jones, J.; Gray, A.; Heinemann, A.; Hill, L; Walton, L. (2019). National Panel Survey of Marine Recreational Fishers 2017–2018. *New Zealand Fisheries Assessment Report 2019/24*. 104 p.

Wynne-Jones, J; Gray, A; Hill, L; Heinemann, A. (2014). National panel survey of marine recreational fishers 2011–12: Harvest estimates. *New Zealand Fisheries Assessment Report 2014/67*. 139 p.

MAF2021-02 Multispecies – National fish weights survey for 2022–23

Project Code:	MAF2021-02
Project Title:	Multispecies – National fish weights survey for 2022–23
Start Date:	October 2021
Completion Date:	June 2024
Vessel Use:	None
Estimated Cost	$400,000

Overall Research Objective:

To continue the implementation of an integrated amateur harvest estimation system by providing estimates of absolute total amateur harvest on a stock basis to inform fisheries management.

Specific Research Objectives:

1. To collate and collect length data describing amateur fisheries catch of key species throughout New Zealand.
2. To convert length data to weight data to inform estimation of the harvest of amateur fisheries.
3. To collaborate with concurrent onsite and offsite survey projects to provide information to corroborate, and if possible, calibrate harvest estimates.

Reporting Requirements:

1. To finalise, through the MAFWG, the design of survey to estimate the mean weights of recreationally harvested fish for the 2022–23 fishing year and summarise this in a Research Progress Report (Form 4) submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 June 2022.
2. To recruit interviewers for the survey by 31 August 2022.
3. To summarise fish weight data collected up to 31 March 2023 in a Research Progress Report (Form 4) submitted to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 April 2023.
4. To present and discuss results to the MAFWG by 31 May 2023.
5. To submit a draft Fishery Assessment Report as specified in Research Reporting Form 7 to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 November 2023.
6. Present results to the MAFWG by 30 November 2023.
7. To submit a final Fisheries Assessment Report as specified in the Research Reporting Form 7 to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 28 February 2024.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 March 2024.

Rationale:

Management Objectives:
Draft National Inshore Finfish Fisheries Plan 2019

- Enhance benefits to the recreational sector.
- Optimise the management of high value shared stocks.

General
Amateur fishing is highly valued by many New Zealanders and Fisheries New Zealand has developed strategic goals to modernise fisheries management and increase engagement and transparency. Following a comprehensive design process, the first National Panel Survey (NPS), conducted over the 2011–12 fishing year, provided estimates of the amateur harvest for a wide variety of species in all management areas around mainland New Zealand, with a repeat survey completed in 2017–18 (and planned for the 2022–23 fishing year in MAF2021-01). These estimates were supported by surveys at boat ramps to estimate the average size of fish caught by recreational fishers (by species) and corroborated by independent onsite surveys. Panel surveys have been conducted once every 5 or 6 years and, between these intensive efforts, monitoring of key boat ramps using web cameras and onsite interviewing provides information on the year-by-year variation in catch and effort. Collectively, these research programmes can be used for the setting of sustainable total allowable catch (TAC) limits, for adjusting controls on recreational fisheries, and potentially for allocation of catch between sectors and in spatial planning processes throughout government.

The NPS was designed to be part of a system where each component helps to inform the others, rather than a series of discrete events. This integrated system approach involves off-site surveys with on-site validation, ongoing effort monitoring using web cameras, various regional studies/characterisations, amateur charter boat reporting, and the development of new tools and approaches. It was envisaged that the NPS would be repeated approximately every 5 years, with validation surveys, and other work would be conducted in the intervening years. Experience has shown that extensive effort in the design phase is critical to the delivery of statistically robust results.

The NPS was repeated over the 2017–18 fishing year after commencing design work in 2016–17. This project, along with the actual NPS (MAF2021-01) are now planned to occur on a 5-year cycle contracted a year prior to factor in a year to design the survey. This project will provide for an independent onsite survey to generate estimates of average fish weight for amateur fishers necessary to convert NPS estimates of catch by number to weight. The

importance of this information to fisheries management and future stock assessments makes this project a high priority.

Specific Objectives 1–3
The purpose of the survey is to enable NPS estimates of the 12-month marine harvest of amateur fishers in FMAs 1, 2, 3, 5, 7, 8, and 9 during the period 01 October 2022 to 30 September 2023 to be converted into weight. Harvest is estimated initially in terms of number of each species caught and kept and this project provides the information on fish weight to develop absolute estimates of harvest.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.7, 0.2, 0.1.

MAF2021-03 Multispecies – Enabling recreational charter fishing operators in Fiordland to report fishing activity and catch

Project Code:	MAF2021-03
Project Title:	Multispecies – Enabling recreational charter fishing operators in Fiordland to report fishing activity and catch
Start Date:	October 2021
Completion Date:	June 2023
Vessel Use:	None
Estimated Cost	$20,000

Overall Research Objective:

To assess the potential utility to inform fisheries management of the catch and effort information collected by recreational charter fishing operators in Fiordland.

Specific Research Objectives:

1. To characterise all available catch and effort information collected by recreational charter fishing operators in Fiordland.
2. To compare estimates of catch per unit of effort, bag distribution, and other metrics in the information collected by recreational charter fishing operators and research surveys in Fiordland.
3. To describe the situations in which catch and effort information collected by recreational charter fishing operators in Fiordland are likely to be useful to support existing research programmes or otherwise inform fisheries management.

Reporting Requirements:

1. Present to the MAFWG preliminary results from the characterisation under Objective 1, and propose the methodology for assessing Objective 2, by 30 November 2021.
2. Present to the MAFWG, or other technical group identified by Fisheries New Zealand, results of Objectives 2 and 3 by 31 March 2022.
3. Submit a draft Fisheries Assessment Report as specified in Research Reporting Form 7 to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 April 2022.
4. Submit a final Fisheries Assessment Report as specified in Research Reporting Form 7 to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 31 May 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 June 2023.

Rationale:

Management Objectives:
Draft National Inshore Finfish Fisheries Plan 2019

- Enhance benefits to the recreational sector.
- Optimise the management of high value shared stocks.
- Enable communities to provide for local area fisheries management solutions that ensure the sustainable use of localised fisheries resources.

General
Amateur fishing is highly valued by many New Zealanders and Fisheries New Zealand has developed strategic goals to modernise fisheries management and increase engagement and transparency. Following a comprehensive design process, the first National Panel Survey (NPS), conducted over the 2011–12 fishing year, provided estimates of the amateur harvest for a wide variety of species in all management areas around mainland New Zealand, with a repeat survey completed in 2017–18 (and planned for the 2022–23 fishing year in MAF2021-01). These estimates were supported by surveys at boat ramps to estimate the average size of fish caught by recreational fishers (by species) and corroborated by independent onsite surveys. Panel surveys have been conducted once every 5 or 6 years and, between these intensive efforts, monitoring of key boat ramps using web cameras and onsite interviewing provides information on the year-by-year variation in catch and effort. Collectively, these research programmes can be used for the setting of sustainable total allowable catch (TAC) limits, for adjusting controls on recreational fisheries, and potentially for allocation of catch between sectors and in spatial planning processes throughout government.

The combined cost of the above research surveys, focused primarily at QMA-scale management, means that relatively few resources are available for assessing or monitoring smaller-scale issues of relevance to recreational fisheries. Many fishers and organisations collect additional information, and some suggest that it should be useful for addressing some of these issues. Previous reviews have indicated that unstructured, self-selected information is of limited utility for fisheries management, but more structured information may be useful. This project provides for an exploration of the utility of some of the more structured information known to Fisheries New Zealand.

Specific Objectives 1–3
The purpose of this study is to collate, characterise, and analyse information from structured records of recreational fisher catch and effort held by recreational charter fishing operators in Fiordland to assess the extent to which that information can support or complement existing research programmes (focussed on management at the QMA level) or to contribute to assessing more locally-focused issues.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.4, 0.4, 0.2.

Aquatic Environment and Biodiversity Research

Project code	Project title
BEN2021-01	Characterisation of benthic habitats and their potential as habitats of particular significance for fisheries management
BEN2021-02	Marine habitat mapping Māhia Peninsula
BEN2021-03	Taxonomic identification of benthic invertebrate samples
BEN2021-04	Exploring options for balancing habitat protection and fishing in the Hauraki Gulf
BEN2021-05	Habitat degradation and impacts on blue cod populations
BYC2021-01	Trialling a semi-quantitative shark risk assessment
BYC2021-02	Protected Chondrichthyan captures characterisation
BYC2021-03	Catch composition in deepwater fisheries
PRO2021-02	Estimation of warp capture cryptic mortality multipliers by deployment of corpse catcher devices
PRO2021-03	Antipodean albatross multi-threat risk assessment
PRO2021-04	Comparison of results of protected seabird species capture interactions based on different data collection methods
PRO2021-06	Identification of seabird capture 'hotspots' in the Regional Fisheries Management Organisation CCSBT
PRO2021-07	Review, cataloguing and continuation of footage collected from the 2020/2021 Black Petrel Electronic Monitoring project.
ZBD2021-02	Habitat degradation impacts on fishery productivity in northern harbours

BEN2021-01 Characterisation of benthic habitats and their potential as habitats of particular significance for fisheries management

Project code:	BEN2021-01
Project title:	Characterisation of benthic habitats and their potential as habitats of particular significance for fisheries management
Start date:	1 July 2021
Completion date:	31 October 2022
Vessel use:	None
Estimated cost:	$100,000

Overall Research Objective:

To characterise benthic habitats and determine their potential as habitats of particular significance to fisheries management (HPSFM) in high profile locations. This project will cover the Bay of Islands, the Marlborough Sounds, and Tasman Bay and Golden Bay.

Specific Research Objectives:

1. Identify and characterise benthic habitats in the Bay of Islands, Marlborough Sounds, Tasman Bay and Golden Bay areas.
2. Determine their potential as habitats of particular significance for fisheries management in conjunction with fisheries managers at Fisheries New Zealand and the work they are doing to develop guidance on determining such habitats.

Reporting Requirements:

1. To attend a scoping meeting with Fisheries New Zealand before 31 August 2021.
2. To present methods at an Aquatic Environment (Benthic & Habitats) Working group (AEWG) meeting before 31 October 2021.
3. To present preliminary results at an AEWG meeting before 31 March 2022.
4. To present final results at an AEWG meeting before 30 May 2022.
5. To submit a draft Aquatic Environment and Biodiversity Report (as per Research Reporting Form 6) for internal review by Fisheries New Zealand Science to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 June 2022.
6. To submit a final Aquatic Environment and Biodiversity Report to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 31 August 2022.

Project Update Reports
No Project Update Reports are required for this work

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required, by 31 October 2022.

Rationale:

Management Objectives:
Fisheries Act 1996

- Section 9: Those making decisions under the Act should take into account that "habitats of particular significance for fisheries management should be protected". Fisheries New Zealand is developing guidance on defining such areas and determining the need and means for protection.

Draft National Inshore Finfish Fisheries Plan 2019

- Improving environmental performance: Ensure habitats of significance for inshore fisheries and the benthic environment are protected from the impacts of fishing, non-fishing activities and land-based effects.

Southern Scallop Strategy: Marlborough Sounds 2020

- Objective 5: Improve scallop habitat quality and quantity in the Marlborough Sounds.
- Objective 6: Get better information and use it to improve fisheries management.

General
Certain habitat types have been identified as significant for economically and culturally important marine species and include seagrass meadows, rhodolith and bryozoan beds, kelp forests, rocky reefs, and estuaries (Fisheries New Zealand 2020, Morrison et al. 2014). These habitats may have important ecological roles (e.g., nursery grounds, spawning areas, etc.) to one or more marine species across different life-history stages that may be vulnerable to degradation from a range of anthropogenic and environmental impacts. These areas have potential as habitats of particular significance for fisheries management.

Identifying and protecting such habitats and their features is an important component of maintaining biodiversity and healthy ecosystem function, helping to meet management objectives, protecting biodiversity and dependent species, and contributing to an Ecosystem Based Fisheries Management (EBFM) approach.

This project aims to characterise benthic habitats within the Bay of Islands, the Marlborough Sounds, and Tasman and Golden bays and, in conjunction with fisheries managers, to progress a methodology to identify benthic habitats of particular significance based on the definition under development by fisheries management. The project may also inform fishstock recovery plans.

Regional Councils have begun to identify 'significant areas of marine habitat' as part of their planning processes. The results of this project may also inform the development of area-

specific marine habitat protection as part of regional council coastal plans and habitat recovery plans.

Objective 1
Within the Fisheries Act 1996 there is provision for the protection of habitats of particular significance for fisheries management (HPSFM). The definition of HPSFMs is currently an active area of deliberation by Fisheries New Zealand.

Building on previous Fisheries New Zealand research projects (HAB2007-01, ZBD2008-01, ENV2009-07, and ENV2010-03; outputs available upon request) and the wider literature for best-practice criteria nationally and internationally, and working with a definition of HPSFM provided by Fisheries New Zealand, this objective will characterise benthic habitats in the four locations and contribute towards a methodology that can be used to inform the identification of HPSFM.

Objective 2
Objective 2 will apply the methodology developed in Objective 1 to identify HPSFM within the Bay of Islands, the Marlborough Sounds, and Tasman and Golden bays. A range of both local marine (e.g., fishing impacts, navigation dredging), land based (e.g., land use change and terrestrial sediment inputs), and global anthropogenic effects (e.g., climate change) may be impacting on these habitats and their ability to provide the ecosystem services that support fisheries. Identification of the major threats to benthic habitats within each region will support fisheries managers and regional councils to prioritise issues and address these threats.

When identifying benthic HPSFM, consideration should also be given to the connectivity between areas to recognise ontogenetic shifts in habitat use by species as an important part of their life-history and population sustainability.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.5, 0.5.

References:

Fisheries New Zealand (2020). Chapter 14 - Habitats of Particular Significance for Fisheries Management. Aquatic Environment and Biodiversity Annual Review 2019-20. Compiled by the Aquatic Environment Team, Fisheries Science and Information, Fisheries New Zealand, Wellington New Zealand. 765 p

Morrison, M., Jones, E. G., Consalvey, M., & Berkenbusch, K. (2014). Linking marine fisheries species to biogenic habitats in New Zealand: a review and synthesis of knowledge. *New Zealand Aquatic Environment and Biodiversity Report No. 130.* 156 p.

BEN2021-02 Marine habitat mapping Māhia Peninsula

Project code:	BEN2021-02
Project title:	Marine habitat mapping Māhia Peninsula
Start date:	1 July 2021
Completion date:	30 June 2023
Vessel use:	Ikatere*(NIWA vessel platform funded outside of Fisheries New Zealand project component)
Estimated cost:	$50,000

Overall Research Objective:

Characterise and define the spatial extent of different marine habitats around Māhia Peninsula.

Specific Research Objectives:

1. Conduct a multibeam survey to map and characterise marine habitat around Māhia Peninsula.
2. Construct a benthic terrain model for the surveyed area.

Reporting Requirements:

1. To attend a scoping session with Fisheries New Zealand before 31 July 2021.
2. To submit a Voyage Programme (as per Research Reporting Form 2) to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager at least one month before the mapping voyage.
3. To submit a Voyage Report (as per Research Reporting Form 3) to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager within one month of the completion of the mapping voyage.
4. To submit a copy of the final Client project report (as provided by NIWA to the Hawke Bay Regional Council) to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 May 2023.

Project Update Reports
No Project Update Reports are required for this work.

Work In Progress Reports
No Work In Progress Reports are required for this work.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required by 30 June 2023.

Rationale:

Management Objectives:
Draft National Inshore Finfish Fisheries Plan 2019

- Improving environmental performance: Ensure habitats of significance for inshore fisheries and the benthic environment are protected from the impacts of fishing, non-fishing activities and land-based effects.

General
Fisheries New Zealand is mandated to manage the effects of fishing in the aquatic environment (Fisheries Act 1996), and regional councils are required to meet their obligations under the Resource Management Act (1991) of: "Avoiding, remedying, or mitigating any adverse effects of activities on the environment", where the environment here extends to the outer limits of the Territorial Sea. The Inshore management team is working closely with Regional Councils on these overlapping areas of responsibility and the draft National Inshore Finfish Fisheries Plan (Fisheries New Zealand 2019) includes aims related to improving environmental performance, particularly in relation to habitats of significance for fisheries. Characterising and defining the extent of different marine habitats is an essential first step in this process, and this project provides co-funding to support an ongoing initiative to multibeam specific areas of the seabed in the Hawkes Bay region by the Hawke's Bay Regional Council and NIWA (Kane et al. 2018). This work follows on from previous work also partially funded by Fisheries New Zealand in 2018 for the mapping of the Wairoa Hard area in Hawke Bay and will follow similar protocols and survey design (Kane et al. 2018).

Objective 1
Multibeam mapping is a standard technique used to characterise subtidal marine habitats over relatively large areas. Multibeam bathymetric, water column, and backscatter data will be collected using an appropriate dual-channel, high-resolution multibeam echo sounder (e.g., Konigsberg EM0240D) in conjunction with appropriate data acquisition and vessel position control (dGPS).

Objective 2
Benthic Terrain Modeller (Lundblad et al. 2006) is a collection of tools used to classify the benthic environment using bathymetry data. Bathymetry and backscatter data will be groomed and used to map the surveyed area in relation to depth, slope, rugosity, and curvature, which will then be used to categorise areas into benthic terrain classes.

Backscatter data can also be used to classify areas into seafloor acoustic habitats. These may be classified on the basis of analyst experience but would ideally also involve ground-truthing through physical or video data collected within the area. If these data are available, then they should be utilised in the classification.

The habitat maps produced (particularly where ground-truthing is available) can be used to help inform council as to the location of habitats of particular significance for fisheries management. Water column data will be analysed to identify water column features (e.g., fish biomass accumulations, kelp beds) where possible.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.75, 0.25.

References:

Kane, T. Mackay, K. Steinmetz, T. Wilcox, S. Quinn, W. Pallentin, A. (2018). Wairoa Hard Habitat Maps. NIWA Client report 2018274WN.

Lundblad, E.R.; Wright, D.J.; Miller, J.; Larkin, E.M.; Rinehart, R.; Naar, D.F.; Donahue, B.T.; Anderson, S.M.; Battista, T. (2006). A benthic terrain classification scheme for American Samoa. *Marine Geodesy 29*: 89–111.

Note: This project is only partially funded by Fisheries New Zealand.

BEN2021-03 Taxonomic identification of benthic invertebrate samples

Project code:	BEN2021-03
Project title:	Taxonomic identification of benthic invertebrate samples
Start date:	1 July 2021
Completion date:	30 June 2024
Vessel use:	None
Estimated cost:	$240,000

Overall Research Objective:

To taxonomically identify benthic invertebrates in samples taken during research trawls and by observers on fishing vessels.

Specific Research Objectives:

1. To taxonomically identify deepwater benthic invertebrates to species level where possible in samples taken during research trawls and by observers on fishing vessels targeting deepwater stocks.
2. To update relevant databases recording the catch of invertebrates in research trawls and commercial fishing.

Reporting Requirements:

1. To present the results to meetings of the Aquatic Environment (Benthic & Habitats) Working Group annually before the end of each financial year.
2. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Aquatic Environment and Biodiversity Report for FNZ review as specified in Research Reporting Form 6 by 31 March 2024.
3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 by 31 April 2024.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
To submit any data generated, collected, or modified during this project to the Research Data Manager, MPI by 30 June 2024.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Improving environmental performance: Ensure habitats of significance for inshore fisheries and the benthic environment are protected from the impacts of fishing, non-fishing activities and land-based effects.

National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 5: Ensure that maintenance of biological diversity of the aquatic environment and protection of habitats of particular significance for fisheries management are explicitly considered in management.
- Objective 7: Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the adverse effects of these fisheries on the benthic habitat.
- Objective 8: Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the adverse effects of these fisheries on the long-term viability of endangered, threatened and protected species populations.

General

Samples of unidentifiable benthic invertebrates are routinely collected during research trawl surveys and held in freezers at NIWA. Observers also collect information on benthic invertebrates on board fishing vessels. Although an increasing proportion of such material has been identified at sea using field guides, some material is retained for expert identification. Over time, the frozen samples deteriorate and need to be processed while in good enough condition for identification. This project aims to identify the back-log of benthic invertebrate samples retained for expert identification during research trawls and by observers on fishing vessels. This project continues the time series of identifications for a further 3-year cycle.

Assessing the extent to which management action is required to meet management objectives 5, 7 and 8 of the National Fisheries Plan for Deepwater and Middle-Depth Fisheries 2019 will require knowledge and assessment of the risks. This project will provide for the identification and enumeration of benthic invertebrates in accumulated samples taken during research trawls and by observers on deepwater fisheries vessels.

Objectives 1 & 2

Samples of benthic invertebrates have been taken during research trawl surveys and accumulated for several years. Observers also collect information on benthic invertebrates on board fishing vessels and, although they have been able to identify an increasing proportion of such material at sea using field guides, some material is still returned for expert identification. Invertebrates should be identified to the lowest feasible taxonomic level, counted, and the information should be reported in relevant databases. This project continues the time series of identifications as documented by Tracey & Mills (2014, 2016) and Mills et al. (2020).

References

Fisheries New Zealand (2019). National Fisheries Plan for Deepwater and Middle-depth Fisheries 2019. *Fisheries New Zealand Technical Paper No: 2019/03*. 34 p.

Mills, S.; Schnabel, K.; Tracey, D. (2020). Identification of benthic invertebrate samples from research trawls and observer trips 2019-2020. (Unpublished Final Research Report held by Fisheries New Zealand.) 71 p.

Tracey, D.; Mills, S. (2014). Identification of benthic invertebrate samples from research trawls and observer trips 2013-2014. (Unpublished Final Research Report held by Fisheries New Zealand.) 62 p.
Tracey, D.; Mills, S. (2016). Identification of benthic invertebrate samples from research trawls and observer trips 2015-2016. (Unpublished Final Research Report held by Fisheries New Zealand.) 57 p.

BEN2021-04 Exploring options for balancing habitat protection and fishing in the Hauraki Gulf

Project code:	BEN2021-04
Project title:	Exploring options for balancing habitat protection and fishing in the Hauraki Gulf
Start date:	1 July 2021
Completion date:	31 October 2022
Vessel use:	None
Estimated cost:	$50,000

Overall Research Objective:

To identify options for balancing fishing activities (trawling and Danish seining) while conserving benthic biodiversity within the Hauraki Gulf Marine Park.

Specific Research Objectives:

1. To identify areas that contain habitat types or biodiversity vulnerable to trawling and Danish seine fishing methods using existing data on the distribution of benthic habitats within the Hauraki Gulf Marine Park.
2. To quantify benthic impacts and habitat naturalness using available data on spatial and temporal patterns of fishing effort by bottom trawl and Danish seine fisheries in the Hauraki Gulf Marine Park.
3. To develop value/cost GIS layers in conjunction with Fisheries New Zealand and the fishing industry to determine spatial patterns in the value of fished areas to the fishing industry and to benthic biodiversity.
4. Based on the outputs of Specific Research Objectives 1, 2, and 3, identify the efficacy of corridors within the Hauraki Gulf Marine Park that could be utilised for trawling and Danish seine fishing activities while minimising impact and conserving benthic biodiversity.

Reporting Requirements:

1. To attend a scoping meeting with Fisheries New Zealand before 31 July 2021.
2. To present methods at an Aquatic Environment (Benthic & Habitats) Working Group (AEWG) meeting before 30 September 2021.
3. To present preliminary results at an AEWG meeting before 28 February 2022.
4. To present final results at an AEWG meeting before 31 May 2022.
5. To submit a draft Aquatic Environment and Biodiversity Report (as per Research Reporting Form 6) for internal review by Fisheries New Zealand Science to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 June 2022.

6. To submit a final Aquatic Environment and Biodiversity Report to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 31 October 2022.

Project Update Reports
No Project Update Reports are required for this work.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
To submit any data generated, collected, or modified during this project to the Research Data Manager, MPI by 31 October 2022.

Rationale:

Management Objectives:
Draft National Inshore Finfish Fisheries Plan 2019

- Improving environmental performance: Enable communities to provide for local area fisheries management solutions that ensure the sustainable use of localised fisheries.
- Improving environmental performance: Ensure habitats of significance for inshore fisheries and the benthic environment are protected from the impacts of fishing, non-fishing activities and land-based effects.

General
The Sea Change process was initiated in 2013 to develop a marine spatial plan that seeks to restore the health of the Hauraki Gulf Marine Park (HGMP). The Sea Change – Tai Timu Tai Pari Hauraki Gulf Marine Spatial Plan (the Plan), developed by a Stakeholder Working Group, was released in 2016. The Plan identified several opportunities for action, and as part of the Government's response, Fisheries New Zealand is seeking to explore the concept of trawl corridors as a way to balance utilisation with conservation of benthic habitats in the HGMP.

Fishing corridors have the potential to constrain the footprint of trawl and Danish seine fishing and conserve vulnerable benthic habitats that provide important ecosystem services (Morrison et al. 2014) in the Hauraki Gulf Marine Park. To be effective, the corridors would need to be placed in such a way as to recognise and conserve benthic habitats and the ecosystem services they provide that are vulnerable to these fishing practices (e.g., nurseries, spawning grounds, biodiversity etc.; Morrison in press).

The results of this project will inform future consultation on spatial planning and may inform an ecosystem-based approach to fisheries management in the Hauraki Gulf Marine Park. In so doing, the project will also provide support to inshore Fisheries Management in meeting key objectives related to the protection of HPSFM and benthic environments (Fisheries New Zealand 2019).

Objective 1
Substantial habitat and biodiversity datasets from the Hauraki Gulf have been collated in previous work under Sea Change, and further analyses will be conducted within Fisheries New

Zealand project ZBD2020-06 (Recovery of biogenic habitats: assessing the recovery potential offered by spatial planning scenarios proposed in the Sea Change Plan). Areas of high conservation value have already been identified from these data through Sea Change and subsequently reviewed regarding their biodiversity value (Lundquist et al. 2020). This objective seeks to explore if these data can provide an understanding of the spatial distribution of habitats/biodiversity vulnerable to trawl and Danish seine fishing practices. Available (and updated) habitat and biodiversity spatial data as well as literature on impacts and recovery for different habitat types/species and status of habitat types/species should be used.

Objective 2
Fisheries New Zealand is able to provide GIS data layers indicating the spatial and temporal distribution of catch and effort by trawl and Danish seine fisheries within the Hauraki Gulf since the 2007–08 fishing year generated by project BEN2019-01 (Monitor the extent and intensity of bottom contact by trawl and dredge fishing in the Territorial Sea and Exclusive Economic Zone). A second project BEN2019-04 (A spatially explicit benthic impact assessment for inshore and deepwater fisheries in New Zealand) already underway involves the characterisation of benthic impacts by different fishing gears. Objective 2 will combine data from these two previous studies to quantify impacts on biodiversity and habitats and to assess habitat naturalness.

Objective 3
Objective 3 seeks to develop an industry value layer for fishers in the Hauraki Gulf. Understanding how the different benthic biodiversity and species, and catch and effort, layers relate to values of relevance to fishers is a key input to the process. Such input layers have previously been used to inform workstreams for both SPRFMO and CCAMLR, and incorporating measures of value to the fishing industry into spatial planning is an active area of investigation under Fisheries New Zealand's project BEN2019-05 (Towards the development of a spatial support decision tool for managing the impacts of bottom fishing on in-zone, particularly vulnerable or sensitive habitats). The research provider should work closely with the fishing industry and Fisheries New Zealand to agree upon appropriate metric(s) that would best represent value to fishers, the temporal scales that should be considered, and any other considerations (e.g., species complexes versus target species versus aggregate) for the inshore environment.

Objective 4
Based on the outputs of Specific Research Objectives 1, 2, & 3, this objective seeks to assess the feasibility of identifying appropriate corridors within the Hauraki Gulf Marine Park that could be utilised for trawling and Danish seine fishing practices while conserving biodiversity in the benthic environment. Identification of such corridors should be done using a spatial decision support tool that allows for the exploration of different options with different criteria as a basis for recommendations on potential fishing corridors.

The project must review similar studies elsewhere and advise on the feasibility and effectiveness of fishing corridors in balancing benthic protection against fishing utilisation in multi-use marine areas.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.2, 0.2, 0.2 0.4.

References:

Lundquist, C.; Tablada, J.; Watson, S. (2020) Evaluation of Biodiversity Protected by Sea Change Te Tai Timu – Marine Protected Areas Proposal. NIWA Client Report held by the Department of Conservation.

Department of Conservation & Fisheries New Zealand (2020) Sea Change Tai Timu Tai Pari Plan - Marine Protected Area (MPA) proposals. Internal Report held by Department of Conservation.

Morrison, M.A. (in press). Hauraki Gulf Marine Park habitat restoration potential. Draft Aquatic Environment and Biodiversity Report.

Morrison, M.A.; Jones, E.; Consalvey, M.; Berkenbusch, K. (2014). Linking marine fisheries species to biogenic habitats in New Zealand: a review and synthesis of knowledge. *New Zealand Aquatic Environment and Biodiversity Report No. 130*. 156 p.

Seachange Stakeholder Working Group (2017). Sea Change – Tai Timu Tai Pari (Hauraki Gulf Marine Spatial Plan). https://www.seachange.org.nz/read-the-plan/

BEN2021-05 Habitat degradation and impacts on blue cod populations

Project code:	BEN2021-05
Project title:	Habitat degradation and impacts on blue cod populations
Start date:	1 July 2021
Completion date:	30 June 2023
Vessel use:	None
Estimated cost:	$150,000

Overall Research Objective:

To provide an assessment of the impacts of water degradation on blue cod habitats in northern Canterbury and the Marlborough Sounds, and any potential effects these may have on local blue cod populations.

Specific Research Objectives:

1. To identify key benthic habitats utilised by different life stages of blue cod in the northern Canterbury and the Marlborough Sounds regions.
2. To review and identify environmental stressors to blue cod habitats around Kaikōura, Motunau, Banks Peninsula, and the Marlborough Sounds, and assess the extent/footprint of each stressor.
3. To determine if and how key habitat features have been modified in the four locations and examine the relationship between habitat change and blue cod populations within each of the locations.

Reporting Requirements:

1. To attend a project scoping meeting with Fisheries New Zealand before 31 August 2021.
2. To present methods at an Aquatic Environment (Benthic & Habitats) Working group (AEWG) meeting before 30 September 2021.
3. To present preliminary results at an AEWG meeting before 30 May 2022.
4. To present final results at an AEWG meeting before 28 Feb 2023.
5. To submit a draft Aquatic Environment and Biodiversity Report (as per Research Reporting Form 6) for internal review by Fisheries New Zealand Science to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 March 2023.
6. To submit a final Aquatic Environment and Biodiversity Report to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 April 2023.

Project Update Reports
No Project Update Reports are required for this work.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
All data and data files upon which analyses are undertaken for this project must be provided to the Research Data Manager, MPI in the appropriate format and level of detail to allow the analysis to be repeated if required, by 30 May 2023.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Improving environmental performance: Ensure habitats of significance for inshore fisheries and the benthic environment are protected from the impacts of fishing, non-fishing activities and land-based effects.

National Blue Cod Strategy 2018

- Objective 1: Get the right information: Information is the bedrock of our fisheries management system. We need the right information and science, and we need to figure out the best way to get it.
- Objective 5: Get buy in: For this to work, we need everyone to understand their responsibility to our blue cod fisheries.

General
Three key blue cod fishing areas in Fisheries Management Area BCO 3 (Kaikōura, Motunau, and Banks Peninsula) have shown differing levels of decline in blue cod (*Parapercis colias*) populations over time (Beentjes & Page in press, Beentjes & Miller in press), and the National Blue Cod Strategy (Fisheries New Zealand 2018) identifies local depletion as a top issue to the public in this FMA. Meanwhile, populations in the Marlborough Sounds (part of BCO 7) appear to be increasing as of 2017 (Beentjes et al. 2018), but with significant public concern around localised habitat loss (Fisheries New Zealand 2018). BCO 3 and BCO 7 are managed within Group 2 of the draft Inshore Finfish Fisheries Plan (Fisheries New Zealand 2019) with a management approach that is defined in the National Blue Cod Strategy (Fisheries New Zealand 2018) and Inshore Medium Term Research Plan (Ministry for Primary Industries 2020). Understanding the drivers of localised population dynamics is critical for the successful management of these populations and may contribute towards understanding of habitats of particular significance for fisheries management (HPSFM).

The concept of habitat degradation and loss as a driver of fish population declines has been highlighted elsewhere (e.g., Morrison et al. 2014). It is unclear whether habitat degradation is a driver of the observed local blue cod population declines and, if so, to what extent. However, the National Blue Cod Strategy identifies proposals to examine the level of environmental impacts on blue cod fisheries and the level of habitat loss, and also to include the level of environmental impact on blue cod fisheries within decision rules that are used to inform management action.

This project aims to identify and quantify stressors that impact on blue cod habitats around Kaikōura, Motunau, Banks Peninsula, and the Marlborough Sounds; assess the extent/footprint of each stressor; determine if and how key habitat features have been modified; and examine the effect of habitat change on blue cod populations. Synergies with HPSFM concepts must be considered.

Objective 1

Blue cod are a benthic fish species commonly occurring at 15–150 m depths on rocky reef edge habitat near sandy or gravel seabed, with preference shown for areas containing some level of three-dimensional soft structure such as macroalgae or sponge (Roberts et al. 2015) and selective habitat use by juveniles and adults (Mutch 1983). Available information on habitat use, benthic habitats, and the distribution of fishing activity will be used to identify and quantify blue cod habitat in the locations of interest.

Objective 2

The Canterbury coast and Marlborough Sounds have come under increasing environmental pressure over the last decade with some commonalities between them, e.g., marine heatwaves (Thomsen et al. 2019), land-based stressors (Morrison et al. 2009, Schiel et al. 2018), fishing practices, and anchor damage. However, other stressors may be more closely associated with a respective region due to differences in geography at the coastal-marine interface, e.g., earthquakes along the Canterbury coast (Alestra et al. 2019), differences in resource use such as aquaculture intensification in the Marlborough Sounds. Each of these stressors are likely to have modified the local environment individually and synergistically to some extent and could potentially have resulted in habitat loss for blue cod.

This objective will review the literature to identify environmental stressors over the last decade that may have had an impact on blue cod habitats around Kaikōura, Motunau, Banks Peninsula, and the Marlborough Sounds. Spatial layers of each stressor will be generated to highlight the spatial extent of each and explore how they may overlap.

Objective 3

Based on identification of blue cod habitat (Objective 1) and the spatial and temporal patterns of stressors on blue cod habitat (Objective 2), this objective will determine a timeline of if, and how, key features of blue cod habitat may have been modified by the identified stressors. Using available blue cod population data, relationships between the change in habitat condition and blue cod abundance around Kaikōura, Motunau, Banks Peninsula, and the Marlborough Sounds will be examined, taking into account ontogenetic differences in habitat use.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.3, 0.3, 0.4.

References:

Alestra, T.; Gerrity, S.; Dunmore, R.; Marsden, I.; Pirker, J.; Schiel, D. (2019). Rocky reef impacts of the Kaikōura earthquake: quantification and monitoring of nearshore habitats and communities. *New Zealand Aquatic Environment and Biodiversity Report No. 212.* 120 p.

Beentjes, M.; Miller, A. (in press) Relative abundance, size and age structure, and stock status of blue cod off Motunau in 2020. Draft Fisheries Assessment Report.

Beentjes, M.; Page, M. (in press). Relative abundance, size and age structure, and stock status of blue cod off Kaikoura in 2019. Draft Fisheries Assessment Report.

Beentjes, M.P.; Page, M.; Sutton, C.; Olsen, L. (2018). Relative abundance, size and age structure, and stock status of blue cod from the 2017 survey in Marlborough Sounds, and review of historical surveys. *New Zealand Fisheries Assessment Report 2018/33*. 103 p.

Fisheries New Zealand (2018) National Blue Cod Strategy. https://www.mpi.govt.nz/dmsdocument/32533-National-Blue-Cod-Strategy-2018

Fisheries New Zealand (2020). National Inshore Finfish Fisheries Plan. *Fisheries New Zealand Discussion Paper No: 2019/18*. 24 p.

Ministry for Primary Industries (2020). Medium Term Research Plan - Inshore Finfish. *Fisheries New Zealand Discussion Paper No: 2020/06*. https://www.mpi.govt.nz/dmsdocument/41722/direct

Morrison, M.A.; Lowe, M.L.; Parsons, D.M.; Usmar, N.R.; McLeod, I.M. (2009). A review of land-based effects on coastal fisheries and supporting biodiversity in New Zealand. *New Zealand Aquatic Environment and Biodiversity Report No. 37*. 100 p.

Morrison, M.A.; Jones, E.; Consalvey, M.; Berkenbusch, K. (2014). Linking marine fisheries species to biogenic habitats in New Zealand: a review and synthesis of knowledge. *New Zealand Aquatic Environment and Biodiversity Report No. 130*. 156 p

Mutch, P.G. (1983). Factors influencing the density and distribution of blue cod (*Parapercis colias*) (Pisces: Mugiloidae). Unpublished thesis, University of Auckland, Auckland, New Zealand. 76 p.

Roberts, C. D.; Stewart, A. L.; Struthers, C. D. (Eds) (2015). *The fishes of New Zealand. Vol 4*. Te Papa Press, Wellington. 2008 p.

Schiel, D.R.; Lilley, S.A.; South, P.M. (2018). Ecological tipping points for an invasive kelp in rocky reef algal communities. *Marine Ecology Progress Series 587*: 93–104.

BYC2021-01 Trialling a semi-quantitative shark and turtle risk assessment

Project code:	BYC2021-01
Project title:	Trialling a semi-quantitative shark and turtle risk assessment
Start date:	1 November 2021
Completion date:	30 November 2022
Vessel use:	None
Estimated cost:	$200,000

Overall Research Objective:

To develop and trial a semi-quantitative risk assessment for a selected subset of QMS/non-QMS/protected species of sharks, and of turtles.

Specific Research Objectives:

1. To develop distribution maps for a selected subset of species (to be agreed at the start of the project) using available data.
2. Utilise these maps, and other available distribution maps, to trial an overlap-based semi-quantitative risk assessment.

Reporting Requirements:

1. To attend a scoping meeting with Fisheries New Zealand (science and fisheries management) to discuss potential data sources and methods, and to finalise the list of species to be included by 30 November 2021.
2. To present methods at an Aquatic Environment Working Group (AEWG) meeting before 28 February 2022.
3. To present results at an AEWG meeting before 30 August 2022.
4. To submit a draft Aquatic Environment and Biodiversity Report (as per Research Reporting Form 6) for internal review by Fisheries New Zealand Science to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 September 2022.
5. To submit a final Aquatic Environment and Biodiversity Report (AEBR) to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 October 2022.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
To submit any data generated, collected, or modified during this project to the Research Data Manager, MPI by 30 November 2022.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Improving environmental performance: Manage inshore fisheries to avoid, remedy or mitigate the adverse effects of fishing on endangered, threatened and protected (ETP) species.

National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 2: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.
- Objective 6: Identify and avoid or minimise adverse effects of deepwater and middle-depth fisheries on associated or dependent and incidentally caught fish species.
- Objective 8: Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on the long-term viability of ETP species.

National Plan of Action for the Conservation and Management of Sharks 2013

- Objective 1.1 Biodiversity and long-term viability of shark populations: Develop and implement a risk assessment framework to identify the nature and extent of risks to shark populations.
- Objective 1.4 Biodiversity and long-term viability of shark populations: Mortality of all sharks from fishing is at or below a level that allows for the maintenance at, or recovery to, a favourable stock and/or conservation status giving priority to protected species and high risk species.
- Objective 6.2 Research and information: Ensure information collection systems and processes are sufficient to inform management of shark populations.
- Objective 6.3 Research and information: Implement research to inform the development of recovery plans appropriate to protected species.

General
The New Zealand National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks 2013) aims to "..maintain the biodiversity and the long-term viability of all New Zealand shark populations", especially through objectives under its Goals 1 and 6. The previous New Zealand shark risk assessment explored fisheries-related threats for 50 shark species (i.e., Chondrichthyans) under a qualitative framework (Ford et al. 2018). One of the main recommendations was the need to progress from a qualitative to a quantitative (or semi-quantitative) risk assessment. Several challenges were highlighted by Ford et al. (2018), and most of these persist today: lack of biological parameters (especially those related to productivity) and lack of distribution and abundance information. However, since the 2018 risk assessment, progress in the form of habitat suitability (e.g., POP2020-03) and distribution (e.g., project ENV2018-06) maps for shark species have become available, allowing the development of spatial overlap-based risk assessments.

All reptiles, including sea turtles, are protected under the Wildlife Act 1953, and all species of sea turtle are listed by Appendix 1 of CITES prohibiting all international trade in specimens and products derived from sea turtles. Projects like the currently ongoing PSB2020-07 (Factors affecting protected species captures in domestic surface longline fisheries) aim to model and characterise the captures of protected species, including turtles, in domestic longline fisheries, and other research efforts have focused on turtle captures in the high-seas fisheries of the Western and Central Pacific Fisheries Commission area. However, no risk assessment has been attempted for turtles in New Zealand.

Risk assessments have already been performed for sharks in the Pacific (e.g., Georgesson et al. 2020); these used semi-quantitative tools such as the productivity-susceptibility analysis (PSA) by Stobutzki et al. (2002). However, the PSA does not account for spatial overlap and other approaches (e.g., the Sustainability Assessment for the Effects of Fishing approach, SAFE, of Zhou & Griffiths 2008) can be used to perform a risk assessment that accounts for the spatial component of fisheries. These approaches are typically less data-demanding than the fully-quantitative, spatial overlap-based approach used by Fisheries New Zealand, e.g., with marine mammals (the Spatially Explicit Fisheries Risk Assessment (SEFRA) approach; see Fisheries New Zealand 2020).

Some flexibility might be required in the selection of the most appropriate approach to accommodate the different levels of information available for different species.

The main objective of this project is to test the feasibility and limits of a semi-quantitative risk assessment, which could be used to prioritise management actions for shark and turtle taxa. Outputs of this project therefore need to be able to determine both the feasibility and limits of the method/s as well as informing management, so an initial meeting between Fisheries New Zealand managers and scientists and the researcher will be required (as well as ongoing dialogue) to ensure that outputs will be fit for purpose.

Objective 1
This objective will provide new distribution maps for a selected subset of QMS/non-QMS/protected shark species, as well as for turtles, from existing data. Criteria for subset selection might include: availability of data useful to develop distribution maps, management interest in some species, conservation status, risk levels, volume of catches, or information currently available. It is not expected that this project will cover more than about 10 shark species, or the 5 species of turtles occurring in New Zealand waters, but rather that it develops an approach (or a few different approaches) that could be used in the future to develop more distributions.

Distribution maps will draw from existing data, e.g., from fisheries captures or fisheries surveys, and will be produced through modelling approaches that use additional fisheries and environmental data as covariates in the models. Part of Objective 1 will be to attend a scoping meeting with Fisheries New Zealand in the early stage of the project to discuss and finalise species and methods to be trialled by the project.

Objective 2
This objective will trial semi-quantitative overlap-based risk assessment methods on sharks and turtles. The approaches trialled should produce risk estimates containing a description of uncertainty and an indication of where the uncertainties arise during the risk assessment process. The semi-quantitative risk assessment should be overlap-based where possible, and

this will likely require the development of gear-specific effort maps, alongside species-specific biological productivity and susceptibility to different fishing gears. Methods that align with existing risk assessment approaches used in New Zealand should be considered alongside with new ideas and other approaches. Consideration needs to be given to the spatial scale at which different data are currently available, because utilisation of existing data is one of this project's priorities.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.35: 0.65.

References:

Fisheries New Zealand (2020). Aquatic Environment and Biodiversity Annual Review 2019– 20 *Compiled by the Aquatic Environment Team, Fisheries Science and Information, Fisheries New Zealand, Wellington New Zealand.* 765 p.

Ford, R.B.; Francis, M.P.; Holland, L.; Clark, M.R.; Duffy, C.A.J.; Dunn, M.R.; ... Wells, R. (2018). Qualitative (Level 1) risk assessment of the impact of commercial fishing on New Zealand chondrichthyans: an update for 2017. *New Zealand Aquatic Environment and Biodiversity Report No. 201.* 103 p.

Georgeson, L.; Rigby, C.L.; Emery, T.J.; Fuller, M.; Hartog, J.; Williams, A.J.; ... Nicol, S.J. (2020). Ecological risks of demersal fishing on deepwater chondrichthyan populations in the Southern Indian and South Pacific Oceans. *ICES Journal of Marine Science 77(5)*: 1711–1727.

Ministry for Primary Industries (2013). National Plan of Action for the conservation and management of sharks 2013. Ministry for Primary Industries, Wellington. 32p. (Unpublished report held by Fisheries New Zealand, Wellington.)

Stobutzki, I.C.; Miller, M.J.; Heales, D.S.; Brewer, D.T. (2002). Sustainability of elasmobranchs caught as bycatch in a tropical prawn (shrimp) trawl fishery. *Fishery Bulletin 100*: 800–821.

Zhou, S.; Griffiths, S.P. (2008). Sustainability assessment for fishing effects (SAFE): a new quantitative ecological risk assessment method and its application to elasmobranch bycatch in an Australian trawl fishery. *Fisheries Research 91*: 56–68.

BYC2021-02 Protected chondrichthyan species captures characterisation

Project code:	BYC2021-02
Project title:	Protected chondrichthyan species captures characterisation
Start date:	1 November 2021
Completion date:	30 May 2022
Vessel use:	None
Estimated cost:	$40,000

Overall Research Objective:

To characterise captures of protected Chondrichthyan species in fisheries (commercial, recreational, and customary) and identify factors that increase captures risk.

Specific Research Objectives:

1. Describe and characterise captures of all protected Chondrichthyans in New Zealand waters, using all available data.
2. Analyse gears/fisheries, locations, status at release, and capture trends, and identify factors that appear to lead to captures.

Reporting Requirements:

1. To present methods at an Aquatic Environment (Bycatch) Working group (AEWG) meeting before 30 November 2021.
2. To present final results at an AEWG meeting before 28 February 2022.
3. To submit a draft Aquatic Environment and Biodiversity Report (as per Research Reporting Form 6) for internal review by Fisheries New Zealand Science to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 March 2022.
4. To submit a final Aquatic Environment and Biodiversity Report to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 April 2022.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
To submit any data generated, collected, or modified during this project to the Research Data Manager, MPI by 30 May 2022.

Rationale:

Management Objectives:
Draft National Inshore Finfish Fisheries Plan 2019

- Improving environmental performance: Manage inshore fisheries to avoid, remedy or mitigate the adverse effects of fishing on endangered, threatened and protected (ETP) species.

National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 2: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.
- Objective 6: Identify and avoid or minimise adverse effects of deepwater and middle-depth fisheries on associated or dependent and incidentally caught fish species.
- Objective 8: Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on the long-term viability of ETP species.

National Plan of Action for the Conservation and Management of Sharks 2013

- Objective 1.1 Biodiversity and long-term viability of shark populations: Develop and implement a risk assessment framework to identify the nature and extent of risks to shark populations.
- Objective 1.4 Biodiversity and long-term viability of shark populations: Mortality of all sharks from fishing is at or below a level that allows for the maintenance at, or recovery to, a favourable stock and/or conservation status giving priority to protected species and high risk species.
- Objective 6.2 Research and information: Ensure information collection systems and processes are sufficient to inform management of shark populations.
- Objective 6.3 Research and information: Implement research to inform the development of recovery plans appropriate to protected species.

General
In New Zealand, seven species of Chondrichthyans are protected under the Wildlife Act 1953, these are:
Chondrichthyes (cartilaginous fishes)—
Carcharhiniformes (ground sharks)—
Oceanic whitetip shark (*Carcharhinus longimanus*)
Lamniformes (mackerel sharks)—
Basking shark (*Cetorhinus maximus*)
Deepwater nurse shark (*Odontaspis ferox*)
White pointer shark (*Carcharodon carcharias*)
Orectolobiformes (carpet sharks)—
Whale shark (*Rhincodon typus*)
Rajiformes (skates and rays)—
Manta ray (*Manta birostris*)
Spinetail devil ray (spinetail mobula) (*Mobula japanica*)

The Fisheries Act 1996 provides for the utilisation of fisheries resources while ensuring sustainability, which includes avoiding, remedying, or mitigating any adverse effects of fishing on the aquatic environment. In addition, the New Zealand National Plan of Action for the

It is therefore crucial to collect information about the captures of protected species of Chondrichthyans and to identify potential factors that could contribute to the risk of captures. So far, protected Chondrichthyans captures have been the subject of single-species reviews, commissioned by DOC, in 2014 for oceanic whitetip shark (Francis & Lyon 2014) and in 2017 for white shark and basking shark (Francis 2017a, b).

This project aims to update and expand previous shark capture characterisation work, to include all protected Chondrichthyan species in New Zealand waters, with a secondary aim to investigate trends and factors that may be increasing the risk of captures.

This project will provide useful information that may contribute to the identification of specific issues in the interaction between fisheries and protected sharks, which could then be used to direct the most appropriate management measures, and ultimately contributing to the achievement of the NPOA- Sharks 2013 Goals.

Objective 1
This objective will provide a reviewed and consolidated list of all captures of protected Chondrichthyans, considering the year when each species protection came into force, include all available information associated with capture reports, and utilise all available fisheries information. Data or reporting gaps, if any, should be highlighted in this phase.

Objective 2
This objective will provide a review of gears/fisheries, locations, status at release, and capture trends, and explore factors that lead to chondrichthyan captures.
Different approaches might be needed to address different species which can have profoundly different catch rates and temporal trends. Ideally any analysis, even qualitative, would take into account fishing effort and reported status at release, at a minimum.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order) 0.5: 0.5.

References:

Francis, M.P.; Lyon, W.S. (2014). Review of commercial fishery interactions and population information for the oceanic whitetip shark, a protected New Zealand species. Prepared for Department of Conservation. https://www.doc.govt.nz/our-work/conservation-services-programme/csp-reports/2013-14/review-of-commercial-fishery-interactions-and-population-information-for-the-oceanic-whitetip-shark/

Francis, M.P. (2017a). Review of commercial fishery interactions and population information for New Zealand basking shark. Prepared for Department of Conservation. https://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/reports/pop2016-03-basking-shark-bycatch-final-report.pdf

Francis, M.P. (2017b). Bycatch of white sharks in commercial set nets. Prepared for Department of Conservation. https://www.doc.govt.nz/Documents/conservation/native-animals/marine-mammals/int2016-03-post-release-white-pointer-sharks-final-report.pdf

Ministry for Primary Industries (2013). National Plan of Action for the conservation and management of sharks 2013. Ministry for Primary Industries, Wellington. 32p. (Unpublished report held by Fisheries New Zealand, Wellington.). https://www.mpi.govt.nz/dmsdocument/1138-National-Plan-of-Action-for-the-Conservation-and-Management-of-Sharks-2013

BYC2021-03 Bycatch monitoring and quantification of fish in deepwater fisheries

Project code:	BYC2021-03
Project title:	Bycatch monitoring and quantification in deepwater fisheries
Start date:	1 December 2021
Completion date:	30 November 2024
Vessel use:	None
Estimated cost:	$260,000

Overall Research Objective:

To estimate the composition of catch (including non-target fish catch and discards of target and non-target fish species) in deepwater fisheries.

Specific Research Objective:

1. Estimate catch composition in target deepwater fisheries (various fisheries to be addressed cyclically). This should include an estimation of the quantity of non-target fish species caught, and the target and non-target fish species discarded, in a format that meets management needs. Estimated rates and amounts of bycatch and discards in the different deepwater fisheries are to be compared with previous estimates to identify trends over time.

Reporting Requirements:

1. Complete a meeting between Fisheries New Zealand managers and scientists and the research provider to decide on which species or species groups will be reported on in each year of the project, and to ensure the analytical methods proposed and outputs are fit for purpose by 28 February 2022.
2. Complete data selection, checking, grooming and analysis, and analyse bycatch and discards trends (year 1) by 30 June 2022.
3. Present results to an Aquatic Environment (Bycatch) Working group (AEWG) (year 1) by 31 August 2022.
4. Submit a draft Aquatic Environment and Biodiversity Report (AEBR, as per Research Reporting Form 6) for internal review by Fisheries New Zealand Science to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager (year 1) by 30 September 2022.
5. Submit a final AEBR to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager (year 1) by 30 November 2022.
6. Submit data to Research Data Manager, MPI (year 1) by 30 November 2022.
7. Complete data selection, checking, grooming and analysis, and analyse bycatch and discards trends (year 2) by 30 June 2023.
8. Present results to the AEWG (year 2) by 31 August 2023.

9. Submit a draft AEBR, for internal review by Fisheries New Zealand Science to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager (year 2) by 30 September 2023.
10. Submit a final (approved) AEBR to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager (year 2) by 30 November 2023.
11. Submit data to Research Data Manager, MPI (year 2) by 30 November 2023.
12. Complete data selection, checking, grooming and analysis, and analyse bycatch and discards trends (year 3) by 30 June 2024.
13. Present results to the AEWG (year 3) by 31 August 2024.
14. Submit a draft AEBR, for internal review by Fisheries New Zealand Science to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager (year 3) by 30 September 2024.
15. Submit a final (approved) AEBR to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager (year 3) by 30 November 2024.
16. Submit data to Research Data Manager, MPI (year 3) by 30 November 2024.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
To submit any data generated, collected, or modified during this project to the Research Data Manager, MPI by 30 November 2024.

Rationale:

Management Objectives:
National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 2: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.
- Objective 6: Identify and avoid or minimise adverse effects of deepwater and middle-depth fisheries on associated or dependent and incidentally caught fish species.
- Objective 8: Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on the long-term viability of ETP species.

General
Fisheries management uses bycatch estimates for various purposes, including contributing to assessments of the effects of fishing on the marine environment. This project will provide detailed monitoring of trends in the volume of catch, bycatch, and discard rates for a wide variety of non-target species for use in monitoring and assessments of the effects of fishing.

The project continues a rolling programme (formerly project DAE2018-01, scheduled to be completed at the end of November 2021) that documents and characterises in detail the volume of discarded and non-target fish catch in each of the major deepwater target fisheries approximately once every four years. Estimates of volumes of bycatch and discards across all deepwater Tier 1 fisheries are also generated, to aid detection of any trends, approximately every two years.

Fisheries are only able to indicate one target species on their catch records, but generally derive economic value from a wide range on non-target fish species that they catch. Non-target fish species can be processed in many ways, but unwanted fish, whether target or non-target, can be legally discarded if certain conditions are met.

Trawlers over 28 m began reporting electronically in October 2017, and electronic reporting was rolled out in stages across all remaining commercial fisheries during 2019. Now, all commercial fishers must report their catch and position electronically. Reports include an estimate of the top 8 species in the catch. Reports for trawl fisheries include the top 5 quota management system (QMS) species and top 3 non-QMS species. All other methods report the top 8 species whether QMS or not. Previously fishers reported catch through TCEPR and TCER reporting forms, providing a similar level of information.

MPI observers record the weight of all species caught on each observed tow, but not all tows are observed. Observer data have historically been used to estimate bycatch and discards in deepwater fisheries because observers are trained to identify species and are tasked with recording all fish caught to the lowest taxonomic detail.

Objective 1

This objective will provide modelled bycatch and discards using data available in MPI databases of commercial catch and effort and observer records. Modelling approaches can be varied as needed, but continuity with previous estimates (or recalculation of the whole time series) is required. This includes estimation of the quantity of non-target fish species caught, and fish species returned to the sea, in a format that meets management needs. An initial meeting between Fisheries New Zealand managers and scientists and the research provider will be required (as well as ongoing dialogue), to decide on which species or species groups will be reported on in each year of the project, and to ensure the analytical methods proposed and outputs are fit for purpose.

These outputs are to be compared with previous estimates for an assessment of trends in rates or amounts and should thus be consistent with recently applied methods. If the modelling approach or model outputs from this study cannot be readily compared with previous studies, it may be necessary to re-model the whole time series.

PRO2021-02 Estimation of warp capture cryptic mortality multipliers with seabird corpse catcher devices

Project code:	PRO2021-02
Project title:	Estimation of warp capture cryptic mortality multipliers with seabird corpse catcher devices
Start date:	1 October 2021
Completion date:	30 June 2022
Vessel use:	None
Estimated cost:	$50,000

Overall Research Objective:

To inform seabird risk assessment and risk management responses for seabird bycatch in different trawl fisheries.

Specific Research Objectives:

1. To improve estimates of cryptic mortality for input to the SEFRA method by attaching seabird corpse catchers to the warps of a deepwater vessel targeting squid and an inshore vessel targeting snapper to increase the probability that a seabird killed on a warp will be retained until hauling.
2. These observations will then be used to create an estimate of the number of unobservable captures that occur; this will be compared with observed captures to work out the cryptic multiplier scalar for use in the multi-species seabird SEFRA.

Reporting Requirements:

1. To present methods to an Aquatic Environment Working Group (AEWG) meeting before 30 November 2021.
2. Submit a Progress Report as specified in Research Reporting Form 4 before 28 February 2021.
3. To present a draft Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 to an Aquatic Environment Working Group (AEWG) meeting before 30 June 2022.
4. To submit a draft Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 July 2022.
5. To submit a final AEBR as specified in Research Reporting Form 6 for publication to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 August 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
To submit any data generated, collected, or modified during this project to the Research Data Manager, MPI by 30 June 2022.

Rationale:

Management Objectives:
Draft National Inshore Finfish Fisheries Plan 2019

- Improving environmental performance: Manage inshore fisheries to avoid, remedy or mitigate the adverse effects of fishing on endangered, threatened and protected (ETP) species.

National Plan of Action Seabirds 2020

- Objective 8: A research programme provides information to reduce uncertainty in estimates of risk to seabirds from fishing.

National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A 2017

- Objective 2: Ensure the deepwater and middle-depths fisheries resources are managed so as to provide for the needs of future generations.
- Objective 4: Ensure deepwater and middle-depth fish stocks and key bycatch fish stocks are managed to an agreed harvest strategy or reference points.
- Objective 6: Identify and avoid or minimise adverse effects of deepwater and middle-depth fisheries on associated or dependent and incidentally caught fish species.
- Objective 8: Manage deepwater and middle-depth fisheries to avoid or minimise adverse effects on the long-term viability of ETP species.

General
The risk assessment framework developed to assess fisheries-associated risks to New Zealand seabirds defines population-level risk as a function of the ratio between the total estimated fisheries-related death rate and the population productivity of individual seabird species (Sharp et al. 2011). Subsequent implementation of this framework estimated risk with reference to seabird captures rather than all fishery-related fatalities. This reflected the availability of data at the time. However biological risk is properly a function of total mortality rates rather than rate of capture, where cryptic mortality is a significant component of total mortality, and a reliance on capture data alone will under-estimate risk. Conversely where birds are captured but released alive with a significant probability of survival, reliance on captures alone may over-estimate species risk. Proper risk estimation requires that both cryptic mortality and live releases be estimated effectively for different species and different fishery groups.

Richard et al. (2011) incorporated cryptic mortality multipliers to convert estimated capture rates to estimate total fishery-related fatality rates for each species/ fishery group combination. These multipliers were generated by applying assumptions derived from a review of available data.

The results from two studies, the Watkins et al. (2008) study using 190 hours of dedicated observations from the Southern African deepwater hake fishery in 2004 and 2005 and the Abraham (2010) study looking at 7266 warp strike observations in New Zealand's trawl fisheries, were used for the cryptic mortalities in the most recent multi-species risk assessment. Cryptic mortality multipliers are subject to considerable uncertainty arising from the need to apply very

limited observations to inform assumptions across the full range of New Zealand species and fishery groups and the uncertainty was not fully propagated into the risk ratios.

In 2013 Parker et al. (2013) undertook research into undetected seabird mortality in a demersal trawl fishery at the Falkland Islands. A device was attached to the warps to increase the probability that a seabird killed on a warp was retained until hauling. Preliminary results from this study suggested that 23% of total mortalities were not able to be observed, i.e., they had detached from the warp before hauling. This estimate was then compared with the total observable captures to estimate a cryptic mortality scalar. It is of interest to assess whether this method could improve estimates of cryptic mortality in New Zealand's inshore and deepwater trawl fisheries.

Objective 1

This objective aims to improve estimates of cryptic mortality for input to the Spatially Explicit Fisheries Risk Assessment (SEFRA) method (Fisheries New Zealand 2020) by attaching seabird corpse catchers to the warps of a deepwater vessel targeting squid (256 observed captures in 2017–18) and an inshore vessel targeting snapper (6 observed captures in 2017–18) to increase the probability that a seabird killed on a warp will be retained until hauling. All observations will be recorded and compared with observed captures over the same time period.

Objective 2

Observations will be used to create an estimate of the number of unobservable captures that occur; this will be compared with observed captures to work out the cryptic multiplier scalar for use in the multi-species seabird SEFRA. The methodology for this can be found in appendix A of Richards et al. 2020, and in PSB2020-08.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.6, 0.4.

References:

Abraham, E.R. (2010). Warp strike in New Zealand trawl fisheries, 2004–05 to 2008–09. *New Zealand Aquatic Environment and Biodiversity Report No. 60*. 29 p.

Fisheries New Zealand (2020). Aquatic Environment and Biodiversity Annual Review 2019– 20 *Compiled by the Aquatic Environment Team, Fisheries Science and Information, Fisheries New Zealand, Wellington New Zealand.* 765 p.

Ministry for Primary Industries (2013). National Plan of Action – 2013 to reduce the incidental catch of seabirds in New Zealand Fisheries. *Ministry for Primary Industries. 63 p.*

Parker, P.; Brickle P.; Crofts, S.; Pompert, J.; Wolfaardt, A. (2013). Research into undetected seabird mortality in a demersal trawl fishery. *Fifth Meeting of the Seabird Bycatch Working Group, ACAP.*

Sharp, B.R.; Waugh, S.M.; Walker, N.A. (2011). A risk assessment framework for incidental seabird mortality associated with New Zealand fishing in the New Zealand EEZ. (Unpublished report held by the Ministry for Primary Industries, Wellington.)

Watkins, B.P.; Petersen, S.L.; Ryan, P.G. (2008). Interactions between seabirds and deep water hake trawl gear: An assessment of impacts in South African waters. *Animal Conservation 11*: 247–254.

PRO2021-03 Antipodean albatross multi-threat risk assessment

Project code:	PRO2021-03
Project title:	Antipodean albatross multi-threat risk assessment
Start date:	1 October 2021
Completion date:	30 August 2022
Vessel use:	None
Estimated cost:	$100,000

Overall Research Objective:

To identify potential sources of risk to Antipodean albatross from both within New Zealand's EEZ and extending to the entire population distribution.

Specific Research Objectives:

1. Construct a population model for the Antipodean albatross colony/sub-population using data from ongoing monitoring by DOC.
2. Map fishery and non-fishery threats to Antipodean albatross and estimate the overlap between multi-year albatross distributions and threats.
3. Apply the SEFRA method to estimate fisheries impact and risk to Antipodean albatross, using the new information from specific Objectives 1 and 2 above. This analysis should include estimation and partition of total mortalities attributable to different threats (with uncertainty).
4. In consultation with government scientists and managers examine a range of spatial management scenarios through both modelling and participation in a multi-threat risk assessment workshop.

Reporting Requirements:

1. To present methods to an Aquatic Environment Working Group (AEWG-PRO) meeting before 30 November 2021.
2. To present a draft Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 to an Aquatic Environment Working Group (AEWG) meeting before 30 June 2022.
3. To submit a draft Aquatic Environment and Biodiversity Report for internal Fisheries Science Review as specified in Research Reporting Form 6 to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 August 2022.
4. To submit a final Aquatic Environment and Biodiversity Report (revised after science review) as specified in Research Reporting Form 6 to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 August 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
To submit any data generated, collected, or modified during this project to the Research Data Manager, MPI by 30 August 2022.

Rationale:

Management Objectives:
National Plan of Action - Seabirds 2020

- Objective 3: Research, monitoring, and management actions are prioritised for seabird populations of particular concern, and their risk ratios reduce.
- The number of fishing-related mortalities is decreasing towards zero.
- Objectives 3 – 12: "Research and/or management actions are undertaken specifically for species or populations of particular concern".

National Fisheries Plan for Deepwater and Middle-depth Fisheries – Part 1A

- Objective 8: Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the adverse effects of these fisheries on the long-term viability of endangered, threatened and protected species populations.

National Fisheries Plan for Highly Migratory Species Fisheries

- Support the objectives of the National Plan of Action Seabirds
- Avoid, remedy, or mitigate the adverse effects of fishing on associated and dependent species (including protected species), using a risk assessment approach.

Draft National Inshore Finfish Fisheries Plan 2019

- Manage inshore fisheries to avoid, remedy or mitigate the adverse effects of fishing on endangered, threatened and protected species.

General
The Antipodean albatross has been recognised by the Agreement on the Conservation of Albatrosses and Petrels (ACAP) as a Priority Population for Conservation and listed in CMS Appendix I due to a significant decline in population levels since 2005, especially for females. The current population of breeding females is only 42% of the 2004 abundance (Elliott & Walker 2020), and current risk assessments estimate that risk from fisheries has a low chance of having an adverse impact on the population's long-term stability. More information is needed to identify this continued population decline. The New Zealand seabird risk assessment identified the Antipodean albatross as medium risk (Richard et al. 2020). The preliminary southern hemisphere seabird risk assessment for high seas surface longline fisheries considered the Antipodean albatross (including the Gibson's albatross) at medium risk and Antipodean as low risk (Abraham et al. 2019), after previously assessing Gibson's and Antipodean as high risk (Abraham et al. 2017).

Quantitative and spatially explicit information about the distribution and likely magnitude of various threats potentially affecting these albatrosses will inform risk management decisions to achieve New Zealand's population recovery goals.

Objective 1
This objective seeks to quantify apparent or plausible threat impacts on different population parameters, including differential impacts on different population components (e.g., juvenile vs. adult mortality; impacts affecting reproductive success). Outputs from PSB2020-09 – Southern Hemisphere seabird risk assessment should be used to inform fisheries risk.

The population model should be constructed so that types of threats inform or constrain the attribution of impact and risk to different threats, in situations where no single model has sufficient power to differentiate between threats. Ongoing demographic monitoring has been undertaken by DOC project Antipodean wandering albatross: satellite tracking and population study Antipodes Island 2020.

Objective 2
The spatio-temporal distribution of non-commercial fisheries threats, habitat destruction, predation, disease, pollution, and climate change will be characterised, estimated, and, to the extent possible, mapped at spatial and temporal scales compatible with the albatross distribution. Threat overlap will be estimated for all threats using updated Antipodean albatross distribution maps produced under Fisheries New Zealand project, code PRO2019-09.

Objective 3
The Spatially Explicit Fisheries Risk Assessment method (SEFRA) as described in Chapter 3 of the Fisheries New Zealand Aquatic Environment and Biodiversity Annual Review 2019/20 (Fisheries New Zealand 2020) has been applied to Antipodean albatross as part of the multi-species Seabird Risk Assessment (Richard & Abraham 2020). Updated demographic parameterisation (derived from the DOC Antipodean wandering albatross: satellite tracking and population study Antipodes Island 2020) and updated spatial distributions (Objectives 1–2) should be used to produce an improved estimation of fisheries risk using a single integrated model for the Antipodes Island Antipodean albatross population, by partitioning and assigning total deaths to their most likely source (including fishery threats, non-fishery threats, and natural mortality).

Objective 4
Hold a workshop to quantitatively compare spatial management scenarios within the SEFRA framework relative or absolute risk levels by generating hypothetical threat distribution maps and re-estimating the corresponding spatial overlap with the species. This objective will require close consultation with the managers overseeing Highly Migratory Species fisheries management. Under this objective the research provider will work closely with government scientists and managers to make the outputs of this research available to the workshop in useful formats as required, will participate actively in the workshop itself, and will contribute substantially to the preparation and write-up of workshop outcomes.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.3, 0.3, 0.2, and 0.2.

References:

Abraham, E.; Richard, Y.; Walker, N.; Roux, M-J; (2019). Assessment of the risk of commercial surface longline fisheries in the southern hemisphere to ACAP seabird species. *Paper prepared for the 12th Meeting of the Ecologically Related Species Working Group (ERSWG12)*

Elliott, G.; Walker, K. (2020). Antipodean wandering albatross: satellite tracking and population study Antipodes Island 2020. Department of Conservation, Conservation Services Programme report. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/final-reports/antipodean-albatross-2020-final-report.pdf

Fisheries New Zealand (2020). Aquatic Environment and Biodiversity Annual Review 2019– 20 *Compiled by the Aquatic Environment Team, Fisheries Science and Information, Fisheries New Zealand, Wellington New Zealand.* 765 p.

Ministry for Primary Industries (2013). National Plan of Action – 2013 to reduce the incidental catch of seabirds in New Zealand Fisheries. *Ministry for Primary Industries. 63 p.*

Richard, Y.; Abraham, E.; Berkenbusch, K. (2017). Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006–07 to 2014–15. *New Zealand Aquatic Environment and Biodiversity Report 191.* 104 p.

Richard, Y; Abraham, E; Berkenbusch, K. (2020) Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006–07 to 2016–17. *New Zealand Aquatic Environment and Biodiversity Report 237.* 57 p.

PRO2021-04 Comparison of results of protected seabird species capture interactions based on different data collection methods

Project code:	PRO2021-04
Project title:	Comparison of results of protected seabird species capture interactions based on different data collection methods
Start date:	1 October 2021
Completion date:	30 September 2022
Vessel use:	None
Estimated cost:	$40,000

Overall Objective:

Compare estimates of protected seabird species captures interactions using data from observers and electronic monitoring data from the black petrel electronic monitoring trial in FMA 1.

Specific Objectives:

1. To conduct a review of PRO2019-12 SEFRA outputs for the FMA 1 bottom longline fishery targeting snapper, comparing estimates derived from observer data and when combined with electronic monitoring data.
2. To carry out a power analysis to assess levels of EM coverage needed to achieve varying level of precision in capture estimates.
3. To compare these estimates with fisher reported data.

Reporting Requirements:

1. To present methods to an Aquatic Environment Working Group (AEWG-PRO) meeting before 30 November 2021.
2. Submit a Progress Report as specified in Research Reporting Form 4 to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager before 28 February 2022.
3. To present a draft Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 to an Aquatic Environment Working Group (AEWG) meeting before 30 June 2022.
4. To submit a draft Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 for Science Team Review to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 August 2022.
5. To submit a final Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 August 2022.
6. Prepare an article in collaboration with Fisheries New Zealand for primary literature describing the results from this research.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
To submit any data generated, collected, or modified during this project to the Research Data Manager, MPI by 30 September 2022.

Rationale:

Management Objectives:
National Plan of Action - Seabirds 2020

- Objective 3: Research, monitoring, and management actions are prioritised for seabird populations of particular concern, and their risk ratios reduce.
- The number of fishing-related mortalities is decreasing towards zero.
- Objective 3 – 12: "Research and/or management actions are undertaken specifically for species or populations of particular concern".

National Fisheries Plan for Deepwater and Middle-depth Fisheries – Part 1A

- Objective 8: Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the adverse effects of these fisheries on the long-term viability of endangered, threatened and protected species populations.

National Fisheries Plan for Highly Migratory Species Fisheries

- Support the objectives of the National Plan of Action Seabirds
- Avoid, remedy, or mitigate the adverse effects of fishing on associated and dependent species (including protected species), using a risk assessment approach.

Draft National Inshore Finfish Fisheries Plan 2019

- Manage inshore fisheries to avoid, remedy or mitigate the adverse effects of fishing on endangered, threatened and protected species.

General
Black petrels breed on Little Barrier and Great Barrier Islands during the summer months, forage in the outer Hauraki Gulf or in pelagic waters near continental shelf breaks or seamounts during the breeding season and migrate to South America once the breeding season is over. In the seabird risk assessment for commercial fisheries black petrels were found to be the species most at risk from New Zealand commercial fisheries (Richard & Abraham 2015, Richard et al. 2017, Richard et al. 2020).

Achieving adequate levels of observer coverage in inshore fisheries has traditionally been a challenge. Current levels are not sufficient to allow the production of robust seabird capture estimates and limit the ability to demonstrate success of current mitigation measures and achievement of the NPOA objective "the number of fishing-related mortalities is decreasing towards zero". Traditional observer programmes tend to be costly and require significant resource input. Finding alternative, smart technological monitoring tools that complement the existing observer services programme is an important step towards improving commercial

fishing impacts and tracking progress against the NPOA objective "observations and monitoring methods are researched, developed and implemented across all sectors".

In 2015, an experimental assessment of video observation in an inshore bottom longline vessel, primarily targeting snapper, undertaken by Trident Systems under contract to Southern Seabirds Solutions Trust (SSST) (Middleton et al. 2016). The key aim was to assess whether video observation is a valid approach for monitoring seabirds captured directly on hooks. The ability for cameras to detect other interaction events such as deck strike and identify seabirds to species level was not specifically assessed. Known numbers of seabird proxies were deployed on longlines during line setting and subsequently detected by shore-based observers reviewing video footage during line hauling. It was found that 89% of seabird capture events were detected during camera footage review (94% with multiple reviews) (Middleton et al. 2016).

From 2018–19 to 2020–21, commercial fishers and quota owners, together with Fisheries New Zealand (FNZ), the Department of Conservation (DOC), and the Black Petrel Working Group (BPWG), operated a trial of electronic monitoring (EM) of seabird captures in the FMA 1 bottom longline fishery, as a continuation of the work undertaken in 2016–17 and 2017–18.

As part of PRO2019-12, data from the Black Petrel EM trial for 2016–17 and 2017–18 were added into the Protected Species Captures database and used to estimate the captures of black petrel and flesh-footed shearwaters. Adding the 2310 fishing events between 2016 and 2020, and the associated 173 captures, resulted in a decrease in estimated black petrel captures. A potential explanation for this drop being that the distribution of EM events better represents fishing in FMA 1 compared to observer placement.

The overall purpose of the wider proof of concept project is: *'to assess the effectiveness of EM relative to human observation in detecting and recording seabird bycatch to species level.'* Specifically, the project here is a desk-top exercise that aims to improve the accuracy of the estimates of total captures, and capture rates, of seabirds (particularly black petrel and flesh-footed shearwater) in FMA 1 bottom longline (BLL) fisheries.

Objective 1
To conduct a review of PRO2019-12 SEFRA outputs for the FMA 1 bottom longline fishery targeting snapper, comparing estimates derived from observer data alone with observer data electronic monitoring data combined. Estimates available for comparison will be available for 2017–18, 2018–19, and 2019–20 fishing years. The review should discuss changes in the temporal and spatial spread of data and what effect this could have on how representative this sample is of BLL fishing in FMA 1.

Objective 2
Power analysis to assess levels of EM coverage needed to achieve varying levels of precision in capture estimates is required. This power analysis should also assess if precision could be increased by changing the sampling distribution.

Objective 3
This Objective requires a comparison of the results from Objective 1 with results for fisher reported data over the same time period.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.7, 0.2, 0.1.

References:

Middleton, D.A.J.; Guard, D.P.; Orr, T.J. (2016). Detecting seabird captures via video observation. 27 p. Final Report for the Southern Seabirds Solutions Trust. Report published in February 2016.

Ministry for Primary Industries (2013). National Plan of Action – 2013 to reduce the incidental catch of seabirds in New Zealand Fisheries. *Ministry for Primary Industries. 63 p.*

Richard, Y.; Abraham, E.R. (2015). Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006–2007 to 2012–13. *New Zealand Aquatic Environment and Biodiversity Report 162*. 85 p.

Richard, Y.; Abraham, E.; Berkenbusch, K. (2017). Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006–07 to 2014–15. *New Zealand Aquatic Environment and Biodiversity Report 191.* 104 p.

Richard, Y; Abraham, E; Berkenbusch, K. (2020) Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006–07 to 2016–17. *New Zealand Aquatic Environment and Biodiversity Report 237.* 57 p.

PRO2021-06 Identification of seabird capture 'hotspots' in the CCSBT RFMO

Project code:	PRO2021-06
Project title:	Identification of seabird capture 'hotspots' in the CCSBT RFMO
Start date:	1 October 2021
Completion date:	30 June 2022
Vessel use:	None
Estimated cost:	$60,000

Overall Research Objective:

The project aims to update the interannual variability in seabird distributions and fishing effort presented to the Commission for the Conservation of Southern Bluefin Tuna – Ecologically Related Species (CCSBT ERS) Working Group in May 2019. This work will include further tracking data collected over multiple years and each year's respective effort data to identify the interannual variability in seabird distributions and fishing effort.

Specific Objectives:

1. Summarise existing tracking and demographic information from 2018, 2019, and 2020 for the 26 species listed by the Agreement for the Conservation of Albatrosses and Petrels (ACAP) that have breeding colonies in the southern hemisphere.
2. Summarise risk for all species as a ratio of estimated annual captures to a measure of the population productivity (the Population Sustainability Threshold, PST; Abraham et al. 2019).
3. Identify annual risk within high-risk areas. Summarise and compare these to CCSBT effort and seabird risk.

Reporting Requirements:

1. To present data and methods to an Aquatic Environment Working Group (AEWG) meeting before 30 November 2021.
2. To present a draft Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 to an Aquatic Environment Working Group (AEWG) meeting before 30 March 2022.
3. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a draft Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 for Science Team review to Fisheries New Zealand by 30 March 2022.
4. To submit to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager a final Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 to Fisheries New Zealand by 30 April 2022.

Project Update Reports
No Project Update Reporting is required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting
To submit any data generated, collected, or modified during this project to the Research Data Manager, MPI by 30 June 2022.

Rationale:

Management Objectives:
Hoiho (*Megadyptes antipodes*) recovery plan 2000-2025

- Objective 2: To manage terrestrial habitat primarily for hoiho
- Objective 3: To protect habitat areas to allow for an increase in population
- Objective 4: To improve habitats for hoiho by revegetation and other strategies
- Objective 5: To protect hoiho chicks from predators and ensure that the most cost-effective methods are utilised
- Objective 6: To identify the proportion of adult and juvenile mortality resulting from fishing activity and develop strategies to reduce this
- Objective 9: To identify and undertake research on hoiho that will assist in achieving the objectives of this plan

National Plan of Action - Seabirds 2020:

- Objectives 3-12: Research, monitoring, and management actions are prioritised for seabird populations of particular concern, and their risk ratios reduce.
- The number of fishing-related mortalities is decreasing towards zero.
- Objective 9–30: "New Zealand actively engages with governments and fishing industries whose vessels create the greatest risk to New Zealand seabirds".

National Fisheries Plan for Deepwater and Middle-depth Fisheries – Part 1A:

- Objective 8: Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the adverse effects of these fisheries on the long-term viability of endangered, threatened and protected species populations.

National Fisheries Plan for Highly Migratory Species Fisheries:

- Support the objectives of the National Plan of Action Seabirds.
- Avoid, remedy, or mitigate the adverse effects of fishing on associated and dependent species (including protected species), using a risk assessment approach.

Draft National Inshore Finfish Fisheries Plan 2019:
Manage inshore fisheries to avoid, remedy or mitigate the adverse effects of fishing on endangered, threatened and protected species.

General
New Zealand has been utilising and refining a spatially explicit risk assessment (SEFRA) to seabirds from commercial fishing (e.g., Richard et al. 2020). The risk assessment method

developed by Fisheries New Zealand (Sharp 2011) was applied to surface longline fishing, first by using New Zealand bycatch data to estimate seabird bycatch in surface longline fishing throughout the Southern Hemisphere (Abraham et al. 2017); second by using observer data from New Zealand and Japan to estimate the bycatch of great albatross species in surface longline fishing throughout the Southern Hemisphere (Daisuke et al. 2018). These studies were intended to demonstrate the application of the SEFRA method and define high-risk areas with this approach (MPI 2016), while acknowledging limitations in the input data, in particular in the distributions of seabirds, and in the use of observer data from a limited number of fleets. This risk assessment method was also used as part of a Common Oceans project, led by Birdlife International, to estimate seabird bycatch of species listed by the Agreement on the Conservation of Albatrosses and Petrels (ACAP).

In the Common Oceans ACAP project analysis, the work presented to the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) Ecologically Related Species Working Group (ERSWG) 12 was updated by Abraham et al. (2017), to estimate seabird bycatch and associated risk for 26 albatross and petrel taxa that breed in the Southern Hemisphere (table 1 of Abraham et al. 2017). These taxa are the 25 species listed by the Agreement for the Conservation of Albatrosses and Petrels (ACAP), and which breed south of 20° S, with Antipodean albatross being split into two subspecies. Abraham et al. 2017 made several key changes to the analysis: 1. observer data were used from all CCSBT member countries that have species-specific observer data on seabird bycatch (Japan, South Africa, Australia, and New Zealand); 2. effort data, derived from regional fisheries management organisations (RFMOs), used for estimating total seabird bycatch were revised and updated; 3. for seabird species with sufficient tracking data, the analysis used seabird distribution information that was derived from the tracking data; 4. a separate catchability was estimated for each fleet.

Objective 1
Objective 1 will summarise existing tracking and demographic information from 2018, 2019, and 2020 for the 25 species listed by the Agreement for the Conservation of Albatrosses and Petrels (ACAP) that have breeding colonies in the southern hemisphere. These should then be split into those with high quality distributional data and those without, for the specified years.

Objective 2
Objective 2 will summarise risk for all species as a ratio of estimated annual captures to a measure of the population productivity (the Population Sustainability Threshold, PST; AEBAR 2019–20); estimate captures from observer data, on the assumption that, for any species and fleet, the captures are the product of a vulnerability term and the overlap between the species distribution and the distribution of fishing effort (Abraham et al. 2019). The captures are to be estimated for 2018, 2019, and 2020 calendar years.

Objective 3
Objective 3 will identify annual risk within high-risk areas that accounts for 26%, 50%, and 100% of total risk; within these, the amount of CCSBT effort and at-risk seabirds with more risk inside the area than outside will be identified. This analysis should be repeated for all species and using only those species with high quality distributional data. Results should be compared between years and data sources and with Abraham et al. (2018) to assess robustness to distribution change.

Weighting of Objectives

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.2, 0.5, 0.3.

References:

Abraham, E.; Richard, Y.; Walker, N.; Roux, M-J; (2019). Assessment of the risk of commercial surface longline fisheries in the southern hemisphere to ACAP seabird species. *Paper prepared for the 12th Meeting of the Ecologically Related Species Working Group (ERSWG12)*

Abraham, E. R., & Richard, Y. (2018). Estimated capture of seabirds in New Zealand trawl and longline fisheries, 2002–03 to 2014–15. *New Zealand Aquatic Environment and Biodiversity Report 197. 97 p.*

Abraham E.; Richard Y.; Walker N.; Roux M.; (2017). Assessment of the risk of commercial surface longline fisheries in the southern hemisphere to ACAP seabird species. 12th Meeting of the Ecologically Related Species Working Group (ERSWG12), CCSBT.

Daisukue, O; Abraham, E.; Inoue, Y.; Oshima, K.; Walker, N.; Richard, Y.; Tsuji, S. (2018). Preliminary assessment of the risk of albatrosses by longline fisheries. WCPFC-SC14-2018 / EB-WP-09.

Fisheries New Zealand (2020). Aquatic Environment and Biodiversity Annual Review 2019–20. Compiled by the Aquatic Environment Team, Fisheries Science and Information, Fisheries New Zealand, Wellington, New Zealand. 765 p.

Richard, Y.; Abraham, E.; Berkenbusch, K. (2020). Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006-07 to 2016-17. *New Zealand Aquatic Environment and Biodiversity Report 237.* 57p.

Sharp, B.R.; Waugh, S.M.; Walker, N.A. (2011). A risk assessment framework for incidental seabird mortality associated with New Zealand fishing in the New Zealand EEZ. (Unpublished report held by the Ministry for Primary Industries, Wellington.)

PRO2021-07 Review, cataloguing, and continuation of footage collected from the 2020/21 Black Petrel Electronic Monitoring project

Project code:	PRO2021-07
Project title:	Review, cataloguing, and continuation of footage collected from the 2020/21 Black Petrel Electronic Monitoring project
Start date:	30 April 2021
Completion date:	31 August 2022
Vessel use:	No
Estimated cost:	$300,000

Overall Objective:

To continue the electronic monitoring and review of the snapper bottom longline fishery in FMA 1 for seabird captures (particular focus is for black petrel captures) for the 2021–22 fishing year. Catalogue footage to create an image training library of the snapper bottom longline fishery in FMA 1.

Specific Objectives:

1. To collect footage via an electronic monitoring programme for the snapper bottom longline fishery in FMA1.
2. To conduct a review of electronic monitoring footage collected from the snapper bottom longline fishery in FMA1, consistent with project PSB2020-10.
3. To submit data in a format that enables data to be parsed into the PSC database.
4. Link catch composition and protected species capture to the relevant clips to create an image training library for assessing catch composition and protected species captures.

Reporting Requirements:

1. To present results for 2020–21 and 2021–22 to an Aquatic Environment Working Group (AEWG) meeting in June 2022.
2. To submit a final Aquatic Environment and Biodiversity Report as specified in Research Reporting Form 6 to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager before 31 July 2022.
3. To submit a copy of the image training library, associated annotations, and metadata to Fisheries New Zealand Research Data Manager before 31 August 2022.
4. To submit the review effort and capture data in the same format as for PSB2020-10 to Fisheries New Zealand Research Data Manager before 31 August 2022.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

To submit the final image training library and annotation data created during this project to the Research Data Manager, Fisheries New Zealand by 31 August 2022.

Rationale:

Management Objectives:
National Plan of Action Seabirds 2020

- Objectives 3-12: Research, monitoring, and management actions are prioritised for seabird populations of particular concern, and their risk ratios reduce.
- The number of fishing-related mortalities is decreasing towards zero.
- Objective 9–30: "New Zealand actively engages with governments and fishing industries whose vessels create the greatest risk to New Zealand seabirds".

National Fisheries Plan for Deepwater and Middle-depth Fisheries – Part 1A

- Objective 8: Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the adverse effects of these fisheries on the long-term viability of endangered, threatened and protected species populations.

National Fisheries Plan for Highly Migratory Species Fisheries

- Support the objectives of the National Plan of Action Seabirds.
- Avoid, remedy, or mitigate the adverse effects of fishing on associated and dependent species (including protected species), using a risk assessment approach.

Draft National Inshore Finfish Fisheries Plan 2019

- Manage inshore fisheries to avoid, remedy or mitigate the adverse effects of fishing on endangered, threatened and protected species.

General
Commercial fishers and quota owners, together with Fisheries New Zealand (previously Ministry for Primary Industries), the Department of Conservation (DOC), and the Black Petrel Working Group (BPWG) have successfully deployed electronic monitoring (EM) of seabird captures since 2016/17. This project looks to continue the review of footage collected from these bottom longline vessels for the 2021–22 fishing year, with the data submitted in a format so that total seabird captures can be estimated. Additionally, this project aims to create an image training library of the snapper bottom longline fishery in FMA 1 for assessing catch composition and protected species captures (particularly black petrel and flesh-footed shearwater).

Achieving adequate levels of observer coverage in inshore fisheries has traditionally been a challenge; current levels are not sufficient to allow the production of robust seabird capture estimates, which limits the ability to demonstrate success of current mitigation measures and achievement of the NPOA and BPFFSW objectives. Looking for alternative, smart technological monitoring tools that complement the existing observer services programme and

add confidence to fisher's self-reporting is an important step to accurately demonstrate the effect of commercial fishing and track progress against specific objectives.

In July 2020, Cabinet agreed (DEV-20-MIN-0126) to make available Crown funding to implement on-board cameras across the inshore fishing fleet focusing on priority areas for monitoring, subject to potential future consultation and a business case.

Included in this programme is the provision of a research initiative to develop and test lower cost and more effective technical solutions using emerging technology such as Artificial Intelligence. Fisheries New Zealand will start to initiate research using currently available resources to ensure the full benefits of on-board cameras can be realised by providing greater certainty that technological and/or Artificial Intelligence solutions can over time reduce the need for manual review. The aim of this project is to provide greater certainty around how applicable current Artificial Intelligence solutions would be to bottom longline fisheries.

Objective 1
This objective covers the continued collection of electronic monitoring onboard a sub-sample of snapper bottom longline vessels operating in FMA 1. Continued involvement from the owner or skipper will need to be voluntary, and continued fishing by the vessels involved should be within the known distribution of black petrels and provide a spatial representation of the entire distribution if possible (i.e., not purely focused in the area closest or furthest away from the main colonies on Great Barrier Island).

Objective 2
This objective includes providing footage review in accordance with the previous methodology outlined in project PSB2020-10. The successful tenderer will review the trips according to the agreed review protocol and record seabird capture data.

Objective 3
This objective includes providing data from the reviewed footage in accordance with the data schema of the Protected Species Capture database for integration into estimated captures analyses and risk assessments.

Objective 4
Link catch composition and protected species capture data to the relevant clips (i.e., clips that cover the haul only) to create an image training library for assessing catch composition and protected species captures. Only the haul activity is in scope for this project.

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.5, 0.25, 0.05, 0.2.

ZBD2021-02 Habitat degradation impacts on fishery productivity in northern harbours

Project code:	ZBD2021-02
Project title:	Habitat degradation impacts on fishery productivity in northern harbours
Start date:	1 July 2021
Completion date:	30 June 2023
Vessel use:	None
Estimated cost:	$130,000

Overall Research Objective:

To assess the effect of habitat changes on key fisheries species that are dependent on harbour habitats during their life cycle.

Specific Research Objectives:

1. Assess the nature and extent of habitat change in key northern harbours in New Zealand.
2. Assess the effect of habitat changes on key fisheries species dependent on the harbour environments for all or part of their life cycle, including implications for wider stock level recruitment for species that use these harbour habitats as nurseries.

Reporting Requirements:

1. To attend a scoping session with Fisheries New Zealand and iwi representatives before 31 August 2021.
2. To present and discuss methods at an Aquatic Environment (Benthic & Habitats) Working group (AEWG) meeting before 31 October 2021.
3. To present preliminary results to an AEWG meeting and provide a copy of the presentation to the Project Scientist before 31 August 2022 (note a second presentation may be required).
4. To submit a draft Aquatic Environment and Biodiversity Report for internal Fisheries New Zealand science review (as per Research Reporting Form 6) to MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 30 November 2022.
5. To submit a final Aquatic Environment and Biodiversity Report (as per Research Reporting Form 6) to the MPI Contracts Monitoring and Administration Team, Fisheries New Zealand Science Officer, and Fisheries New Zealand Project Manager by 31 March 2023.
6. To submit any data generated, collected, or modified during this project to Research Data Manager, MPI by 31 May 2023.

Project Update Reports
No Project Update Reports are required for this project.

Work In Progress Reports
Monthly Work In Progress Reporting (Form 13) is required for this project in accordance with the Conducting Research with the Ministry document.

Rationale:

Management Objectives:

Draft National Inshore Finfish Fisheries Plan 2019

- Objectives for groups 1, 2 and 3: Managing Individual Stocks
- Improving environmental performance: Ensure habitats of significance for inshore fisheries and the benthic environment are protected from the impacts of fishing, non-fishing activities and land-based effects

General
The northern harbours provide a key food source for local iwi and are important for inshore fisheries such as snapper *Chrysophrys auratus* and flatfish species. Monitoring and anecdotal evidence suggests that some habitats in the northern harbours of New Zealand have been affected by changes in water quality, sediment input, eutrophication, pollution, and other factors, largely as a result of land use change and development. Previous work in the Manukau Harbour showed correlations between a decline in yellowbelly flounder *Rhombosolea leporina* abundance and reduced oxygen and increased ammonia and turbidity (McKenzie et al. 2013). Additionally, the Kaipara Harbour, where 98% of the 2003-year class was found to be recruited from, is experiencing anthropogenic change due to land use change (Morrison et al. 2014b, 2014c). However, the extent to which habitat change may determine recruitment levels in snapper is poorly known, and essentially unquantified (Morrison et al. 2014c).

Harbour environments provide important nursery habitats for several fish species, and young of the year (1+) fish are often found in shallow waters in harbours and bays around most of New Zealand (Ayling & Cox 1987). Harbours which have better water quality, lower sedimentation and pollution rates, and more pristine habitats can better provide sufficient food resources and shelter from predators in biogenic habitats, such as seagrasses and horse mussel beds. However, our understanding of how harbour habitats may contribute to fisheries production is at an early stage, and data explicitly linking habitats to fish production are rare.

Fisheries New Zealand is in the process of defining 'habitats of particular significance for fisheries management (HPSFM)', including those areas which support important fisheries functions both for localised areas and the wider ecosystem (see proposed project BEN2021-01). Several northern harbours, which are important habitats for coastal finfish species, particularly for spawning, settlement, and recruitment are likely candidates for HPSFM (Morrison et al 2014a, 2014b, Fisheries New Zealand 2020). Negative impacts on juvenile fish production in harbours can cascade into the wider coastal ecosystem and may affect fish abundance and subsequent fishery yields along the coastline (Morrison et al. 2014b, 2014c, Fisheries New Zealand 2020).

This project aims to assess the nature and extent of habitat change in selected northern harbours of New Zealand and the effects they have on populations of key fishery species that are dependent on harbour environments for all or part of their life cycle. This will help to inform the management of fisheries which target species in harbours, thereby supporting the National Inshore Finfish Fisheries Plan which refers to 1) "improving environmental performance with

a focus on protecting habitats of significance for fisheries management from the impacts of fishing and land-based effects, and ensuring the long-term viability of protected species" and 2) "protecting marine biodiversity as a strategy to build the resilience of marine ecosystems" (Fisheries New Zealand 2019). The project should also provide an indication of the effect of habitat change on recruitment of species that use these harbour habitats as nurseries.

Objective 1
Land use change and development in the northern harbours appear to have resulted in changes to harbour habitats. This study aims to determine the nature and extent of habitat change in key northern harbours (such as the Kaipara and Manukau), in terms of both habitat quality and area of impact, building on evidence from monitoring from previous studies and anecdotal evidence (e.g., Morrison et al. 2014c).

Relevant aspects of habitat change will differ for each species. Candidate harbours, potential indicators of habitat change, and data availability (maximum 50 years) to be analysed in this project are to be discussed during the scoping meeting at the start of the project. The methods developed will be presented to the AEWG.

Objective 2
Several important species exist in the northern harbours, including snapper grey mullet *Mugil cephalus,* yellow-eyed mullet *Aldrichetta forsteri*, flounder *Rhombosolea* spp., trevally *Pseudocaranx dentex*, rig *Mustelus lenticulatus,* and scallops *Pecten novaezelandiae.* Objective 2 will assess the effects of habitat change in the selected harbours (identified in Objective 1) for key fish and shellfish species, by relating habitat change with the health and abundance of species that are dependent on these harbours for one or more stages of their life-cycle. Species to be included in the work will also be discussed as part of the scoping meeting for the project and will depend in part on how much data are available for each species. If data have been collected over a long time period, such as 50 years, the project should also provide an indication of the effect of habitat change on recruitment for those species.

This project provides the opportunity for research providers knowledgeable in coastal habitat effects on fisheries to develop and test new ideas, and the outcomes of this work may be used to inform fisheries management approaches to coastal habitat management. A better understanding of the effect of habitat change on these fishery species will help inform fisheries management towards a more holistic, ecosystem-based approach, in line with the National Inshore Finfish Fisheries Plan Strategy (Fisheries New Zealand 2019).

Weighting of Objectives
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.3, 0.7.

References:

Alying, T.; Cox, G. (1987). *Collins guide to the Sea Fishes of New Zealand*. William Collins Publishers Ltd, Auckland, New Zealand.

Fisheries New Zealand (2020). Aquatic Environment and Biodiversity Annual Review 2019–20. Compiled by the Aquatic Environment Team, Fisheries Science and Information, Fisheries New Zealand, Wellington New Zealand. 765 p.

McKenzie, J.R.; Parsons, D.M.; Bian, R. (2013). Can juvenile yellowbelly and sand flounder abundance indices and environmental variables predict adult abundance in the Manukau and Mahurangi Harbours? *New Zealand Fisheries Assessment Report 2013/10*.

Morrison, M.; Jones, E.G.; Parsons, D.M.; Grant, C.M. (2014a). Habitats and areas of particular significance for coastal finfish management in New Zealand: A review of concepts and life history knowledge, and suggestions for future research. *New Zealand Aquatic Environment and Biodiversity Report No. 125.* 202 p.

Morrison, M.; Jones, E.G.; Consalvey, M.; Berkenbusch, K. (2014b). Linking marine fisheries species to biogenic habitats in New Zealand: a review and synthesis of knowledge. *New Zealand Aquatic Environment and Biodiversity Report No. 130.* 156 p.

Morrison, M.; Lowe, M.L.; Jones, E.G.; Makey, L.; Shankar, U.; Usmar, N. R.; ...Middleton, C. (2014c). Habitats of particular significance for fisheries management: the Kaipara Harbour. *New Zealand Aquatic Environment and Biodiversity Report No. 129.* 169 p.

High Seas Fisheries (Antarctic and South Pacific)

There are no new high sea fisheries research projects being considered for 2021/22.

Appendix 1. Fisheries New Zealand Management Plan Documents

Fisheries New Zealand (2020). Southern Scallop Strategy Marlborough Sounds. Fisheries New Zealand, Wellington New Zealand.
Southern Scallop Strategy Marlborough Sounds (mpi.govt.nz)

Fisheries New Zealand (2019). National Inshore Finfish Fisheries Plan. MPI Discussion Paper No: 2019/18, Fisheries New Zealand, Wellington New Zealand.
Draft - Inshore Finfish plan (mpi.govt.nz)

Fisheries New Zealand (2019). National Plan of Action – Seabirds 2020. Fisheries New Zealand, Wellington New Zealand.
National Plan of Action - Seabirds 2020 draft for consultation (mpi.govt.nz)

Fisheries New Zealand (2018). National Blue Cod Strategy. Fisheries New Zealand, Wellington New Zealand.
National Blue Cod Strategy 2018 (mpi.govt.nz)

Fisheries New Zealand (2017). National Fisheries Plan for Highly Migratory Species. MPI Discussion Paper No: 2017/27. Fisheries New Zealand, Wellington New Zealand.
National Fisheries Plan for Highly Migratory Species (mpi.govt.nz)

Fisheries New Zealand (2017). National Fisheries Plan for Deepwater and Middle-depth Fisheries- Part 1A. MPI Discussion Paper No: 2017/26. Fisheries New Zealand, Wellington New Zealand.
National Fisheries Plan for Deepwater and Middle-depth Fisheries - Part 1A (mpi.govt.nz)

Department of Conservation and the Ministry for Primary Industries (2017). New Zealand sea lion/rāpoka Threat Management Plan 2017-2022. Joint paper of the Department of Conservation and the Ministry for Primary Industries. Wellington New Zealand.
New Zealand sea lion/rāpoka Threat Management Plan (doc.govt.nz)

Ministry for Primary Industries (2013). National Plan of Action for the Conservation and Management of Sharks. Ministry for Primary Industries, Wellington New Zealand.
National Plan of Action for the Conservation and Management of Sharks 2013 (mpi.govt.nz)

Fisheries New Zealand (2011). Draft National Fisheries Plan for Inshore Shellfish. Fisheries New Zealand, Wellington New Zealand.
Draft National Fisheries Plan- Inshore Shellfish (mpi.govt.nz)