Proposed Fisheries Research Services for 2019-20

Contents

Introduction

Context

This document lists all proposed new fisheries research projects for the 2019/20 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.

Cost summary table

Project title	Cost
Eel Fisheries	**$80 000**
Catch per unit effort analysis of the South Island commercial eel fishery	$80 000
Inshore Finfish Fisheries	**$3 340 000**
Abundance of blue cod around Banks Peninsula (BCO3)	$220 000
Abundance of blue cod off North Canterbury (BCO 3)	$320 000
Characterisation and CPUE analysis of FLA 3	$60 000
Characterisation and CPUE analysis of FLA 7	$45 000
In season TACC adjustment calculations for FLA3, RCO3 and RCO2	$15 000
ECSI inshore trawl survey	$1 050 000
Feasibility of FMA2 inshore trawl survey	$75 000
Low Information Stock Status Assessment	$400 000
Fishery characterisation and CPUE analysis of SCH 1, 2, 3, 4, 5, 7 and 8	$75 000
Estimation of Snapper Year Class Strength in SNA1	$800 000
Catch-at-age of snapper in SNA 7	$80 000
Stock assessment of SNA 8	$200 000
Inshore Shellfish Fisheries	**$1 100 000**
Biomass survey for COC3	$90 000
PAU7 Stock Assessment	$85 000
Paua commercial catch sampling programme	$650 000
PAU 5A Stock Assessment	$85 000
SCA7 biomass survey-Sounds only	$100 000
Distribution and abundance of toheroa on Ninety Mile Beach	$90 000

Rock Lobster Fisheries	**$1 000 000**
Rock lobster stock assessments	$1 000 000
Highly Migratory Species Fisheries	**$630 000**
Data reports for New Zealand HMS fisheries for national and international obligations	$120 000
Multi-year stock monitoring of striped marlin including logbook programme implementation	$165 000
Characterisation of commercial fisheries that catch striped marlin	$30 000
Estimation of recreational harvest of Southern Bluefin Tuna in New Zealand	$60 000
Characterisation of the fishery for and analysis of CPUE for swordfish from the commercial longline fishery in NZ waters	$30 000
Management of data from gamefish tag-recapture programme	$225 000
Deepwater Fisheries	**$5 774 000**
Stock assessment of hake in HAK4	$57 000
Estimation of spawning hoki biomass in Cook Strait using acoustic surveys	$350 000
Land based catch sampling of hoki	$80 000
Hoki population modelling and stock assessment	$130 000
Stock assessment of ling in LIN7	$92 000
Routine age determination of middle depth and deepwater species from commercial fisheries and resource surveys	$500 000
Estimation of the abundance of orange roughy using acoustic surveys (ORH 3B Northwest Rise and East and South Chatham Rise)	$1 090 000
Biomass estimation of the Campbell Island southern blue whiting stock (SBW6I) using acoustic surveys	$2 500 000
Stock assessment of southern blue whiting in SBW6I	$103 000
Estimation of the abundance of scampi in SCI3 using photographic surveys	$780 000
Stock assessment of scampi in SCI6A	$92 000
Marine Amateur Fisheries	**$2 550 000**
Web camera monitoring of key marine amateur fisher access points	$1 500 000

Implementation of computer image analysis for web cameras	$300 000
Monitoring of recreational harvest of rock lobsters in CRA 2	$750 000
Aquatic Environment Research	**$2 285 000**
Monitor the extent and intensity of bottom contact by trawl and dredge fishing in the Territorial Sea and Exclusive Economic Zone	$55 000
A spatially explicit benthic impact assessment for inshore and deepwater fisheries in New Zealand	$150 000
Spatial decision support tool development for managing the impacts of bottom fishing on in-zone, particularly vulnerable or sensitive habitats	$150 000
Update Campbell Island NZSL PST (Population Sustainability Threshold) estimation	$15 000
Preparation and documentation of a standardized linked database—including commercial fisheries effort data, fisheries observer data, and protected species captures	$250 000
Maintenance of PSC (protected species captures) website displaying updated observed commercial fisheries captures, and total estimated captures for selected species	$75 000
Spatial distribution modelling of at-risk seabirds in New Zealand commercial fisheries	$300 000
Refine SEFRA model parameterisation for at-risk protected species (seabirds)	$125 000
Historical reconstruction and characterisation of spatially explicit historical set-net fishing effort data	$150 000
Estimation of total captures of seabirds using standardised estimation methods	$100 000
Distributional study of Antipodean Albatross using satellite reporting GPS tags	$125 000
Black petrel population monitoring and distribution study	$100 000
Review of footage collected from the 2018/19 Black Petrel Electronic Monitoring Project	$150 000
Continuation of the Black Petrel Electronic Monitoring Project for the 2019/20 summer	$350 000
Feasibility trial of underwater baitsetter	$110 000
Aerial survey of white-capped albatross on the Auckland Islands	$80 000
High Seas Fisheries (Antarctic and South Pacific)	**$500 000**

Antarctic Fisheries	$400 000
Antarctic research - Ross Sea region MPA	$100 000
Marine Biodiversity Research	**$1 110 000**
Quantifying Benthic Biodiversity - Phase 2	$750 000
Plastics and marine debris across the ocean floor in New Zealand waters	$80 000
Sources of suspended sediment load and impact on coastal kaimoana	$100 000
Development of Electronic Automated Reporting System (EARS) to improve seabird bycatch monitoring	$180 000
Miscellaneous	**$200 000**
Development of imaging analysis technology to determine ages from otoliths	$200 000
Total cost	**18 569 000**

Eel Fisheries

EEL2019-01	South Island Eel CPUE

EEL2019-01

Project Code:	EEL2019-01
Project title:	Catch per unit effort analysis of the South Island commercial eel fishery
Start date:	1 October 2019
Completion date:	30 March 2021
Vessel use:	Nil
Cost:	$80 000

Overall Objective:
To analyse trends in CPUE in commercial eel fisheries.

Specific Objectives:
1. To characterise South Island commercial eel fisheries

2. To analyse CPUE trends in the South Island commercial eel fisheries (LFE and SFE 11, LFE and SFE 12, LFE and SFE 13, LFE and SFE 14, LFE and SFE 15, and LFE and SFE16) using data up to the end of the fishing year 2018/19.

Reporting Requirements:

All Objectives:
1. To submit results to MPI Contracts Monitoring in a Progress Report as specified in Research Reporting Form 4 by 30 August 2020.

2. To present the report in 1 above to meetings of the EEL Fishery Assessment Working Group in September 2020 in Hamilton or Wellington.

3. To submit to MPI Contracts Monitoring a draft revised Working Group Report as specified in Fishery Assessment Document form 2 for Freshwater Eels by 15 March 2021.

4. To submit to the MPI Contracts Monitoring 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 30 September 2020.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 Nov 2020.

Rationale:

General:
The commercial freshwater eel fishers target both species of eel found throughout New Zealand, the shortfin *Anguilla australis* and the longfin *A. dieffenbachii*. The South Island fishery was introduced into the QMS in October 2000, the Chatham Island fishery in October 2003, and the North Island fishery from 1 October 2004. The combined South Island landings for the 2015/16 fishing year were 201 t (combined TACC 421 t), whereas the combined North Island landings totalled 254 t (combined TACC 429 t). Eel stocks are severely impacted by other anthropogenic (non-fishing) activities including habitat destruction and modification, blockage to upstream fish passage and direct mortality through the effects of hydro-electric turbines and drainage clearance.

Conventional stock assessment techniques are difficult to apply to eels because of their biology and stock structure. For the successful management of any fishery it is desirable to have some index of relative abundance to monitor the effects of fishing on the population. Many conventional fisheries sampling and survey techniques for determining relative abundance indices cannot validly be applied in the freshwater eel fishery, with the exception of CPUE analyses. For the freshwater eel fishery CPUE analyses may provide the only index of relative abundance that can be practically and cost effectively measured. To effectively manage these stocks under the QMS there is a need for information on abundance and sustainability.

Objectives 1-2:
Standardised CPUE analyses for the South Island eel fishery were previously updated to the 2012/13 fishing year. According to the National Fisheries Plan for Freshwater eel CPUE analyses are to be updated every three years. South Island eel CPUE analyses are done by species and statistical area. Owing to changes in the fishing power of individual permit holders with the introduction of eels to the QMS it was necessary to produce two separate series, one pre and one post QMS, for each species and statistical area during the previous analysis. It is consequently only necessary update the post-QMS series for the current project. As a result of insufficient catch and effort data it may not be possible to generate post-QMS indices of abundance for each species in all statistical areas. The fishery characterisations will be used to identify statistical areas for which sufficient data exist for CPUE analysis. Fishery characterisations should be produced for all South Island statistical 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): 0.5, 0.5.

Inshore Finfish Fisheries

BCO2019-01	Abundance of blue cod around Banks Peninsula (BCO3)
BCO2019-02	Abundance of blue cod off North Canterbury (BCO 3)
FLA2019-01	Characterisation and CPUE analysis of FLA 3
FLA2019-02	Characterisation and CPUE analysis of FLA 7
INS2019-01	In season TACC adjustment calculations for FLA3, RCO3 and RCO2.
INT2019-01	ECSI inshore trawl survey
INT2019-02	Feasibility of FMA2 inshore trawl survey
LSP2019-02	Low Information Stock Status Assessment
SCH2019-01	Fishery characterisation and CPUE analysis of SCH 1, 2, 3, 4, 5, 7 and 8
SNA2019-01	Estimation of Snapper Year Class Strength in SNA1
SNA2019-02	Catch-at-age of snapper in SNA 7
SNA2019-03	Stock assessment of SNA 8

BCO2019-01

Project Code:	BCO 2019-01
Project title:	Abundance of blue cod around Banks Peninsula (BCO3)
Start date:	1 October 2019
Completion date:	30 November 2020
Vessel use:	Subject to tender
Estimated cost:	$220 000

Overall Objectives:
To estimate relative abundance, sex ratio, and age structure of blue cod (*Parapercis colias*) around Banks Peninsula.

Specific Objectives:

1. To undertake a potting survey around Banks Peninsula to estimate relative abundance, size- and age-at-maturity, and sex ratio. Collect otoliths during the survey from pre-recruited and recruited blue cod.
2. To analyse biological samples collected from this potting survey and to age the otoliths.
3. To determine stock status of blue cod populations in this area, and compare this with other previous surveys in this area and other survey areas.
4. To determine F_{MSY} proxies for Banks Peninsula blue cod.

Note:

Prior to the commencement of sampling, the sampling design will be reviewed by the Inshore Working Group in September 2019 using the criteria set out in the "Review of the blue cod potting survey". This contains details of what is expected in relation to designing and implementing a blue cod potting survey.

Reporting Requirements:

Objectives 1 to 4:

1. To submit to MPI a Voyage Programme as specified in Research Reporting form 2, one month before the beginning of the survey.
2. To submit to MPI a Voyage Report as specified in Research Reporting form 3, one month after the completion of the survey.
3. To submit to MPI Contracts Monitoring a draft revised Working Group Report as specified in Fishery Assessment Document form 2 for bluecod by 30 September 2020.

4. To submit to the MPI Contracts Monitoring 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 30 September 2020.

5. To present the report in 4 above to meetings of the Southern Inshore Fishery Assessment Working Group in August-September 2020 in Wellington. Presentations to more than one meeting may be required.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 November 2020.

Rationale:

General:
The national diary surveys of marine recreational fishing found blue cod to be the second most frequently landed finfish species nationally, and the most frequently landed species in the South Island. Blue cod is an important species for Maori customary fishers, but the catch is unknown. Recreational take in BCO 3 was estimated at 101 t in 2012. A modest amount (150-160 t) of blue cod is landed annually by commercial fishers in BCO 3. Recreational fishers around Banks Peninsula are concerned about the local populations of blue cod. The reef area around the Peninsula supporting blue cod is not extensive. Recreational catch rates are reported to be low. Recreational fishers are also concerned that the recent lowering of the blue cod bag limit to 10 per day for the northern area of BCO 3 (from Waimakariri River to Clarence Point), and the changes to the regulations in the Marlborough Sounds may result in a transfer of fishing effort to Banks Peninsula blue cod populations.

During the 2000-01 Sustainability Round the Ministry undertook to work with stakeholders in the Banks Peninsula area to monitor local blue cod populations. A series of relative biomass estimates based on potting surveys was consequently initiated with a view to conducting surveys every four years (see Inshore Medium Term Research Plan). The first survey was conducted in Jan-Apr 2002 with a second in 2005, a third in 2008, the fourth in 2012 and the fifth in 2015. The Banks Peninsula Potting Survey series is now part of the National Blue Cod Management Strategy released in 2018.

Objective 1:
Under this objective another potting survey will be undertaken around Banks Peninsula. The previous surveys 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. The design, to be presented to the SINSWG, should be based on random site allocation and simulation using results from previous surveys.

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 minimize the impact of the sampling on population density.

Objective 2:
The analysis of biological samples should 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.

Objective 3:
Provision of information on stock status and the sustainability of current removal from the multiple sources of information available.

Note: A formal stock assessment (based on a stock assessment model) is not proposed for blue cod at this time.

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
- comparison of the above estimates with those from other blue cod potting surveys.

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. Outputs from this information 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 e.g. are the estimates of *Z* stable between this area and other surveyed areas.

Objective 4:
Development of MSY-related information will provide a basis for determining likely stock status based on the estimates of *Z* from the catch curve analysis.

Length, age, maturity and mortality data should then be used to determine estimates of spawner biomass per recruit that can be used to develop MSY-related proxies

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, 0.2, 0.1, 0.1

BCO2019-02

Project Code:	BCO2019-02
Project title:	Abundance of blue cod off North Canterbury (BCO 3)
Start date:	1 October 2019
Completion date:	30 November 2020
Vessel use:	Subject to tender
Cost:	$320 000

Overall Objectives:
To estimate age structure and the relative abundance of blue cod (*Parapercis colias*) off North Canterbury

Specific Objectives:

1. To undertake a potting survey off North Canterbury to estimate relative abundance, size- and age-at-maturity, and sex ratio. Collect otoliths during the survey from pre-recruited and recruited blue cod.

2. To analyse biological samples collected from this potting survey.

3. To estimate the age structure and relative abundance of blue cod off Kaikoura.

4. To estimate the age structure and relative abundance of blue cod off Motunau.

5. To determine stock status of blue cod populations in this area, and compare this with other previous surveys in this area and other survey areas.

Note:

Prior to the commencement of sampling, the sampling design will be reviewed by the Inshore Working Group in September 2019 using the criteria set out in the "Review of the blue cod potting survey". This contains details of what is expected in relation to designing and implementing a blue cod potting survey.

Reporting Requirements:

Objectives 1 to 5:

1. To submit to MPI a Voyage Programme as specified in Research Reporting form 2, one month before the beginning of the survey.

2. To submit to MPI a Voyage Report as specified in Research Reporting form 3, one month after the completion of the survey.

3. To submit to MPI Contracts Monitoring a draft revised Working Group Report as specified in Fishery Assessment Document form 2 for bluecod by 30 September 2020.

4. To submit to the MPI Contracts Monitoring 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 30 September 2020.

5. To present the report in 4 above to meetings of the Southern Inshore Fishery Assessment Working Group in August-September 2020 in Wellington. Presentations to more than one meeting may be required.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 November 2020.

Rationale:
General:
The national diary surveys of marine recreational fishing found blue cod to be the second most frequently landed finfish species nationally, and the most frequently landed species in the South Island. Blue cod is an important species for Maori customary fishers, but the catch is unknown. Recreational take in BCO 3 was estimated at 101 t in 2012. A moderate amount (150-160 t) of blue cod is landed annually by commercial fishers in BCO 3. A number of submissions concerning the *Review of Sustainability Measures for 2000-01* provided anecdotal evidence of a decline in blue cod populations off North Canterbury leading to the recent lowering of the blue cod bag limit to 10 per day for the northern area of BCO 3 (from Waimakariri River to Clarence Point). Recreational fishers are also concerned about indications of increasing commercial catch around the Kaikoura area. The "reef" area off North Canterbury supporting blue cod is relatively discrete and recreational catch rates are reported to be low.

In the 2000-01 Sustainability Round, the Ministry undertook to work with stakeholders in North Canterbury to monitor blue cod populations in the area. A series of relative biomass estimates based of potting surveys was consequently initiated with a view to conducting surveys every three years (see Inshore Medium Term Research Plan). The first survey was conducted in Jan-Apr 2005 (BCO2004-01), the second in 2008 (BCO2011-02), the third in 2012 and the fourth in 2016. The North Canterbury Blue Cod potting survey is comprised of two spatially distinct components: one of Kaikoura and the other off Motunau. The survey series forms an integral part of the National Blue Cod Management Strategy, released in 2018.

Objective 1:
Under this objective another potting survey will be undertaken off north Canterbury. 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. The design, to be presented to the SINSWG, should be based on random site allocation and simulation using results from previous surveys.

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 minimize the impact of the sampling on population density.

Objective 2:
The analysis of biological samples should 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.

Objectives 3 & 4:
Provision of information on stock status and the sustainability of current removal from the multiple sources of information available.

Note: A formal stock assessment (based on a stock assessment model) is not proposed for blue cod at this time.

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
- comparison of the above estimates with those from other blue cod potting surveys.

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. Outputs from this information 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 e.g. are the estimates of *Z* stable between this area and other surveyed areas.

Objective 5:
Development of MSY-related information will provide a basis for determining likely stock status based on the estimates of *Z* from the catch curve analysis.

Length, age, maturity and mortality data should then be used to determine estimates of spawner biomass per recruit that can be used to develop MSY-related proxies

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, 0.2, 0.1, 0.1

FLA2019-01

Project title:	FLA2019-01
Project Code:	Characterisation and CPUE analysis of FLA 3
Start date:	1 October 2019
Completion date:	30 June 2020
Vessel use:	None
Cost:	$60 000

Overall Research Objective:
To review the management procedure used in FLA 3

Specific Research Objectives:
1. To characterise the FLA 3 fisheries.
2. To analyse existing commercial catch and effort data to the end of 2018/19 fishing year and undertake CPUE standardisations for each species.
3. Use the above information to update the CPUE analysis and core vessel set used in the in-season increase model.
4. To evaluate the performance of the in-season management procedure for FLA 3.

Reporting Requirements:
1. To submit results to Contracts Management, MPI in a Progress report as specified in Research Reporting form 4 by 1 March 2020.
2. To present the report in 1 above to meetings of the Inshore Fishery Assessment Working Group in March 2020 in either Wellington or Auckland.
3. To submit to Contracts Management, MPI, draft revised Working Group Reports as specified in Fishery Assessment Document form 2 for flatfish by 15 April 2020.
4. To submit to Contracts Management, MPI a Final Assessment Report as specified in Research Reporting form 7 by 30 June 2020.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 June 2020.

Rationale:

General:
The management approach for FLA 3 is designed to enable responsiveness to changing abundance levels while ensuring sustainability and increased benefits to stakeholders when abundance is high. Flatfish are included in the Second Schedule of the Fisheries Act (1996) for these stocks, s13(7) of the Fisheries Act allows the Minister to implement an in-season increase to the TAC. The TACC for flatfish in FLA 3 was reduced on the 1st of October 2007 from 2,681 to 1,430t, when the new management approach was implemented.
The Management Procedure for FLA3 includes a decision rule designed to maintain historic exploitation rates, allowing for in-season increases based on CPUE for the first three months of the fishing year. TACCs revert to the baseline TACCs at the end of the fishing year. An integral part of the use of Management Procedures is retrospective review, usually done on a five year cycle. Such reviews usually include an evaluation of the decision rule, and they provide opportunity for the development of a new decision rule and the selection of new sets of core vessels from which data will be used for predicting annual TACCs over the next five year cycle.

Objectives 1-4:
Results of the characterisation will be used to select data sets (including fisheries and core vessels) and grooming procedures for the CPUE analysis. The performance of the current decision rules should be evaluated, *inter alia*, on their ability to predict the annual catch from each stock. Consideration should also be given to identifying annual diagnostics that will provide information on situations when the Decision Rule is no longer reliable, e.g. substantial shifts in fishing behaviour, which in turn affect catchability.
Although the decision rule is based on CPUE for the generic code FLA, an important aspect of the review process is to determine how individual flatfish species have fared under the management approach. It is therefore necessary to develop series of relative abundance for every flatfish species taken in FLA3, for which sufficient data 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): 0.25, 0.25, 0.25 and 0.25.

FLA2019-02

Project Code:	FLA2019-02
Project title:	Characterisation and CPUE analysis of FLA 7
Start date:	1 October 2019
Completion date:	30 June 2020
Vessel use:	none
Cost:	$45 000

Overall Research Objective:

1. To characterise flatfish fisheries and undertake CPUE analyses in FLA7.

Specific Research Objectives:

1. To characterise the FLA 7 fisheries.
2. To analyse existing commercial catch and effort data to the end of 2018/19 fishing year and undertake CPUE standardisations for FLA 7 and species specific trends.

Reporting Requirements:

1. To submit results to Contracts Management, MPI in a Progress Report as specified in Research Reporting form 4 by 1 April 2020.
2. To present the report in 1 above to meetings of the Inshore Fishery Assessment Working Group in April 2020 in Wellington.
3. To submit to Contracts Management, MPI, draft revised Working Group Reports as specified in Fishery Assessment Document form 2 for Flatfish by 15 April 2020.
4. To submit to Contracts Management, MPI a Final Assessment Report as specified in Research Reporting form 7 by 30 June 2020.

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.

Data Reporting:

To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 June 2020.

Rationale:

General:
Flatfish species in FLA7 support a substantial fishery with a TACC of 2066 tons, although the catch has not exceeded 900 t during the last eight years. New Zealand flatfish species are mostly fast-growing and short-lived, generally only surviving to 3-4 years of age, with very few reaching 5-6 years, others such as brill and turbot are longer lived, reaching a maximum age of 21 years and 16 years, respectively (Steven *et al*. 2001).

Flatfish are shallow water species generally found in waters less than 50 m depth, taken mainly by target inshore trawl and Danish seine fleets around the South Island. Flatfish Individual Transferable Quota (ITQ) provides for the landing of eight species of flatfish all under a single code FLA. However, species specific information is most useful for assessing stock status trends. Fishers and processors are required to use a generic flatfish (FLA) code in the monthly harvest returns to report landed catches of flatfish species. Although fishers are required to use specific species codes when reporting estimated catches, they often use the generic FLA code.

According to the draft National Plan for Inshore Finfish, flatfish in FLA 7 are to be monitored with an index of relative abundance. Despite the complications of pooling species for reporting analyses, using species specific codes and the generic FLA code have proved to be useful for FLA 1 and FLA 3. No such analyses have been undertaken for FLA 7 to date.

Objective 1:
Results of the characterisation will be used to determine the data grooming procedures for the CPUE analysis and which fisheries need to be assessed and the spatio-temporal analyses required in order to ensure the CPUE analysis is reflective of the fishery. The characterisation will also provide valuable input for any fisheries planning that may take place in the future. The characterisation should provide, to the extent possible, detailed spatio-temporal information on catch and effort, including the spatial distribution of the catch of each species and, for FLA, how this has changed over time and how it changes seasonally (using the TCER forms that were introduced in 2007). Assessing the spatio-temporal distribution of the most important bycatch species would also be required.

Objective 2:
Under this objective the catch and effort of key fisheries should be examined to assess the population trends for the most important flatfish species in FLA 7 and reported catch of FLA, and assess how these have changed in recent years. Research providers should take cognisance of recent progress made in data grooming for CPUE standardisation for inshore finfish including methods used to reconcile landings with estimated catch. Potential science providers are referred to the reference list below for further details.

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:

Beentjes M.P. 2003. Review of flatfish catch data and species composition. New Zealand Fisheries Assessment Report 2003/17. 22 p

Bentley N. in press. Approaches for determining in season TAC increases for 2nd Schedule stocks. New Zealand Fisheries Assessment Report.

Kendrick T.H., Bentley N. (2011a). Fishery characterisation and setnet catch-per-unit-effort indices for flatfish in FLA 1; 1989–90 to 2007–08. New Zealand Fisheries Assessment Report 2011/3.

Kendrick T., Bentley N. 2012. Fishery characterisation and setnet catch-per-unit-effort indices for flatfish in FLA 1; 1989–90 to 2010–11. New Zealand. Draft FAR

INS2019-01

Project Code:	INS2019-01
Project title:	In season TACC adjustment calculations for FLA3, RCO3 and RCO2
Start date:	1 October 2019
Completion date:	30 June 2020
Vessel use:	none
Cost:	$15 000

Overall Research Objective:

To apply decision rules for Inshore Finfish stocks managed using in-season TACC adjustments during the 2019-20 fishing year.

Specific Research Objectives:

1. To apply the decision rule and calculate the in-season TACC adjustment predicted for FLA 3 for the 2019-20 fishing year.

2. To apply the decision rule and calculate the in-season TACC adjustment predicted for RCO 3 for the 2019-20 fishing year.

3. To apply the decision rule and calculate the in-season TACC adjustment predicted for RCO 2 for the 2019-20 fishing year.

Reporting Requirements:

1. To submit results to Contracts Management, MPI in a Fisheries Research Report as specified in Research Reporting form 7 by 15 February 2020.

2. To present the report in 1 above to meetings of the Inshore Fishery Assessment Working Group in February 2020 in Wellington.

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.

Data Reporting:

To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 June 2020.

Rationale:

General:
RCO2, RCO3 and FLA 3 are included in the Second Schedule of the Fisheries Act (1996) and managed under s13(7), which allows the Minister to implement an in-season increase to the TAC. This management approach allows for a rapid response to increased abundance, thereby increasing utilisation of productive short-lived species, with low risk to sustainability. TACCs revert to the baseline TACCs at the end of the fishing year.

Calculation of in-season TACC adjustments are based on decision rules designed to maintain historic exploitation rates, and which utilise catch and effort data collected during the first two or three months of the fishing year. An integral part of the use of Management Procedures is retrospective review, usually done on a five year cycle. Such reviews usually include an evaluation of the decision rule, and they provide opportunity for the development of a new decision rule and the selection of new sets of core vessels from which data will be used for predicting annual TACCs over the next five year cycle. RCO 2 & 3 were reviewed in 2018 and FLA3 will be reviewed in 2020.

The purpose of this project is to implement the currently accepted decision rules for RCO2, RCO 3 and FLA 3.

Objectives 1 -3:
Apart from applying the decision rule the research provide is also required to provide diagnostic analyses and plots that allow for the evaluation of CPUE as a reliable indicator of abundance within the current fishing year.

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.

INT2019-01

Project Code:	INT2019-01
Project title:	ECSI inshore trawl survey
Start date:	1 October 2019
Completion date:	30 November 2020
Vessel use:	R.V. *Kaharoa*
Cost:	$1 050 000

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*), elephantfish (*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 and spiny dogfish 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 400m. The target coefficients of variation (c.v.s) of the biomass estimates for these species are as follows: red cod (20-25 %), sea perch (20 %), giant stargazer (20 %), tarakihi (20 – 30%), spiny dogfish (20%) elephantfish (20-30%), red gurnard (20%), and dark ghost shark (20-30%).

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, elephantfish, 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:

Objective 1:

1. To submit to MPI Contracts Monitoring 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 a Voyage Report as specified in Research Reporting Form 3 by 15 June 2020.

3. To submit to MPI Contracts Monitoring a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 1 November 2020.

4. To present the report detailed in 3 above to a meeting of the Inshore Fishery Assessment Working Group by 30 November 2020.

Objectives 2- 4:

1. To submit to MPI Contracts Monitoring a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 November 2020.

2. To present the report detailed in 1 above to a meeting of the Inshore Fishery Assessment Working Group by 30 November 2020.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 November 2020.

Rationale:

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 2011 draft National Fisheries Plan for Inshore Finfish (Inshore Fishplan). This plan classifies stocks into seven 'groups' to facilitate multi-stock objective-setting. These groupings relate to commercial and recreational importance, vulnerability and other characteristics that determine priorities for data collection and management expenditure. 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 Bmsy 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, the survey estimates of biomass will be used directly to determine stock status. Further, 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 (2008); 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. While 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.

Owing to the importance of the 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 – 400m 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, while 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 lead 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 and 30 to 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, but 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 of ELE and GUR. The survey design for the first 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 and 30 to 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.

INT2019-02

Project Code:	INT2019-02
Project title:	Feasibility of FMA2 inshore trawl survey
Start date:	1 October 2019
Completion date:	30 November 2020
Vessel use:	None
Cost:	$75 000

Overall Research Objective:

Determine the feasibility of a fishery independent bottom trawl survey for monitoring abundance and age structure of inshore finfish in FMA2

Specific Objectives:

1. To design a bottom trawl survey for estimating relative abundance and age structure for the following inshore finfish in 20-400m between Cape Runaway and Turakirae Head: snapper (*Pagrus auratus)*, tarakihi (*Nemadactylus macropterus*), red gurnard (*Chelidonichthys kumu*), trevally (*Pseudocaranx dentex*) and John dory (*Zeus faber*).

2. To determine other species that will be effectively monitored by a survey with target species listed above.

3. To estimate the cost of the above survey.

Reporting Requirements:

Objectives 1-3:

1. To submit to MPI Contracts Monitoring a draft Fishery Assessment Report as specified in Research Reporting Form 7 by 30 September 2020.

2. To present the report detailed in 1 above to a meeting of the Inshore Fishery Assessment Working Group in Auckland or Wellington in September 2020.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 November 2020.

Rationale:

General:
Between 1993 and 1996 four annual R.V. Kaharoa trawl surveys were undertaken on the east coast of the North Island between Cape Runaway and Turakirae Head. The survey area covered all trawlable ground between 20 and 400 meters in order to collect distribution and abundance information on commercial coastal finfish species vulnerable to trawl. The initial 1993 survey placed specific emphasis on obtaining precise abundance estimates for red cod (*Pseudophycis sp*.), gemfish (*Rexea solandri*), snapper (*Pagrus auratus*), tarakihi (*Nemadactylus macropterus*), and trevally (*Pseudocaranx dentex*). After the 1993 survey red cod and gemfish were dropped from the target survey list (presumably due to higher than expected cv's). The survey cvs for the remaining target species were "acceptable" most being below 0.30 with a general trend for improvement with each subsequent survey (series mean weighted cvs: snapper 0.24; tarakihi 0.21; trevally 0.29).

In addition to the main survey target species the series also produced "acceptable" mean weighted cvs for other East Coast North Island commercially important species: John Dory (*Zeus faber*) 0.22; red gurnard (*Chelidonichthys cuculus*) 0.25; school shark (*Galeorhinus galeus*) 0.21; barracouta (*Thyrsites atun*) 0.27; rig (*Mustelus lenticulatus*) 0.20.

By resuming the *R.V. Kaharoa* east coast North Island trawl surveys it should be possible to assess the relative change in abundance of important commercial species such as tarakihi and snapper between early 1990's and present. Indices of relative abundance based on commercial CPUE are not believed to be reliable prior to 2000 as a result of inaccurate reporting of target species, with the result that accepted relative abundance series for SNA2 begin in 2000. The trawl survey would therefore likely provide reliable relative abundance information for a longer period, and one spanning a perceived increase in snapper abundance.

The resumption of East Coast North Island trawl surveys would also provide better sub-regional scale spatial information on age and length structure; which particularly important for snapper and tarakihi. It is known from commercial catch sampling that significant differences in spatial age structure for these two species occur between East Cape and the Wairarapa coast, but it is uncertain as the where these changes occur.

Objectives 1 – 3:
When designing the survey researchers should make use of both previous survey data and recent catch and effort data recorded by commercial bottom trawl within the survey area. It is necessary to use commercial data because abundance and distribution of target species is likely to have changed since the last trawl survey was completed in the mid-1990s. The survey design should be based on two phases and appropriate spatial stratification, and the estimated cost should include a cost benefit analysis of either building new survey nets or refurbishing the original nets. The survey design should also take cognisance of the fact that

we now know there are two snapper stocks within the area - one in the north and the other in the south – with each monitored by the survey.

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

LSP2019-02

Project:	Low Information Stock Status Assessment
Project Code:	LSP2019-02
Start date:	1 July 2019
Completion date:	30 September 2020
Vessel use:	None
Estimated cost:	$400 000

Overall Objective:

1. Develop and implement a low information stock status assessment model using spatially explicit catch, abundance, and harvest rate estimates for inshore finfish stocks.

Specific Objectives:

1. Further develop a low information stock status assessment model that estimates stock status from spatially explicit harvest rate estimates for inshore finfish species informed by research survey data, research observations, catch and effort data, and estimates of life history parameters.

2. Implement and improve the models on inshore finfish stocks in the South Island of New Zealand to estimate spatially explicit estimates of catch, abundance, and harvest rate to estimate their stock status.

3. To evaluate the model and the resulting estimates for the selected low information finfish stocks in providing suitable scientific advice on their status.

Management Objectives from the relevant fisheries plan(s) (or elsewhere):

- 2018 National Fisheries Plans for Inshore Fisheries –
- MPI Harvest Strategy Standard

Reporting requirements:

1. To present results for specific objectives 1-3 relating to methodology to the Statistical Assessment Methods Working Group (SAMWG) and relating to specific fish stocks to the Southern Inshore Working Group (SINSWG) by 30 August 2020

2. To present the results covering each objective as a draft FAR by 30 September 2020.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 September 2020.

Rationale:

General:
Low information stocks are difficult to assess using traditional stock assessment methods. Many low information inshore finfish stocks do not currently have an adequate assessment of stock status and it is not known if current catches are sustainable.

Recent developments in spatially explicit risk assessment allow for the evaluation of stock status assessments for low information stocks. These methods may allow a more formal evaluation of the data and uncertainty in estimating the status of stocks than qualitative or semi-qualitative assessments, and may be more suitable for situations where there is inadequate information for a fully quantitative stock assessment. Project LSP2017-02 initiated methods development for the consideration of low information stocks using low information and spatially explicit methods.

MPI consider that the methods development initiated under LSP2017-02 will be further developed and applied to additional stocks and areas, as appropriate.

The stock status estimates from this project will need to be explicit with respect to uncertainty. The outputs will allow MPI to identify sources of uncertainty for individual stock estimates and hence allow prioritisation of additional information or research required to ensure that the estimates are suitable for decision making. The method will also allow testing of assumptions and alternate management scenarios, including spatial management, mitigation uptake, changes to gear or fishing methods, and additional investments in monitoring (i.e., observer coverage and electronic reporting) on predicted outcomes.

Specific objective 1:
Develop a low information stock status assessment model that estimates stock status from spatially explicit harvest rate estimates for inshore finfish species informed by research survey data, research observations, catch and effort data, and estimates of life history parameters.

The low information stock status assessment will require iterative development of spatially explicit tools and methods in order to undertake the assessment and further develop methods identified under LSP2017-02.

In particular, under this objective, the project will deliver

(i) Further develop and update the methods and definition for the determining the spatial/environmental domain for the specific fish stocks and fish stock assemblages. This will include a range of stocks of current information states (i.e. from unknown status to well estimated status) in order to allow evaluation of the method under specific objective 3.

(ii) Further develop and update the methods for determining the catchability estimates q_s of research surveys, so that these can be applied to relative abundance estimates to determine spatially explicit absolute abundance.

(iii) Further develop and update the methods, if required, to categorise fishery groups that reflect common gear configurations and patterns of vessel or other fisher behaviour that may affect catch rates

(iv) Further develop and update the methods for determining spatially explicit catch (removal) estimates for the selected stocks for each fishery group, including reported catch, discards, and other incidental mortality.

(v) Further develop and update the methods for determining species and stock specific utilisation and sustainability harvest rates targets and thresholds from life history characteristics that can be applied to the selected stocks.

(vi) Further develop and update the methods for calculating the stock status relative to thresholds and targets for the selected stocks, including explicit consideration of uncertainty bounds, using the estimates obtained from applying the methods above.

(vii) Further develop and update the methods for reporting the stock status for the selected stocks once the calculations are complete.

Specific objective 2:
Implement the model on selected inshore finfish stocks in the South Island of New Zealand to estimate spatially explicit estimates of catch, abundance, and harvest rate to estimate their stock status.

The development of the methods for the stock status assessment of low information will be applied to selected low information inshore finfish stocks of New Zealand, in particular, those identified under Project LSP2017-02 as required.

In particular, under this objective, the project will deliver

(i) Updated and improved spatially explicit relative abundance estimates for the selected stocks, including uncertainty estimates using the methods developed in specific objective 1.

(ii) Updated estimates of research survey stock catchability estimates q_s, including uncertainly, that can be applied to the spatially explicit relative abundance estimates to determine absolute abundance using the methods developed in specific objective 1.

(iii) Updated categories of fishery groups, if required, using the methods developed in specific objective 1.

(iv) Updated spatially explicit estimates of removals (catch, discards, and incidental mortality) for each fishery group using the methods developed in specific objective 1.
(v) Updated stock specific utilisation and sustainability harvest rates targets and thresholds using stock specific life history characteristics using the methods developed in specific objective 1.
(vi) Updated estimates of stock status relative to the sustainability and utilisation thresholds and targets using the methods developed in specific objective 1
(vii) Updated stock status reports for the selected stocks using the methods developed in specific objective 1.

Specific objective 3:
To evaluate the model and the resulting estimates for the selected low information finfish stocks in providing suitable scientific advice on their status.

The development of a spatially explicit low information stock status assessment model will need to be evaluated to determine what assumptions and calculations may need refinement to improve the robustness of the method. This objective will update and improve on methods developed under Project LSP2017-02.

In particular, under this objective, the project will deliver

(i) Update and improve on the statements of the assumptions and calculations used to develop the estimates of stock status for the selected fish stocks.
(ii) Update and improve estimates of the uncertainty in resulting outcomes, and an evaluation of any biases and or uncertainties in those estimates
(iii) Continue to evaluate and improve data, model modifications, or analyses that would result in more robust estimates or reduced uncertainty in the estimates of stock status for the selected low information stocks

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, 0.3, and 0.1

SCH2019-01

Project Code:	SCH2019-01
Project title:	Fishery characterisation and CPUE analysis of SCH 1, 2, 3, 4, 5, 7 and 8
Start date:	1 October 2019
Completion date:	30 July 2020
Vessel use:	None
Cost:	$75 000

Overall Research Objective:

1. To characterise all school shark (*Galeorhinus galeus*) fisheries and undertake CPUE analyses in SCH 1, 2, 3, 4, 5, 7 and 8.

Specific Research Objectives:

1. To characterise the SCH 1, 2, 3, 4, 5, 7 and 8 fisheries.

2. To analyse existing commercial catch and effort data to the end of 2018/19 fishing year and undertake CPUE standardisations for each stock.

Reporting Requirements:
Objectives 1 & 2:

1. To submit results to MPI Contracts Monitoring in a Progress report as specified in Research Reporting form 4 by 30 March 2020.

2. To present the report in 1 above to meetings of the Inshore Fishery Assessment Working Groups in April 2020 in Wellington or Auckland. More than one presentation may be necessary.

3. To submit to MPI Contracts Monitoring a draft revised Working Group Report as specified in Fishery Assessment Document form 2 for school shark by 15 April 2020.

4. To submit to the to MPI Contracts Monitoring 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 30 September 2020.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 Nov 2020.

Rationale:

General:
School sharks are distributed across the shelf, generally being inshore in summer and offshore in winter. They extend in smaller numbers near the seafloor down the upper continental slope, to at least 600 m. The capture of school sharks by tuna longliners shows that their distribution extends well offshore, up to 180 nm off the South Island, and 400 nm off northern New Zealand towards the Kermadec Islands.

This moderate-sized shark has supported a variety of fisheries around New Zealand from the early 1940s onwards. Landings rose steeply from the late 1970s until 1983 (Table 1), with the intensification of setnetting targeting this and other species, and a general decline in availability of other, previously more desirable, coastal species. However, because of the earlier discarding and under-reporting, this recorded rise in landings does not reflect an equal rise in catches. School shark are mainly caught in setnet fisheries targeting sharks (school shark, rig, elephantfish and spiny dogfish); in bottom trawl fisheries targeting red cod, tarakihi, gurnard and snapper and others; and in bottom longline fisheries targeting school shark, hapuku/bass and ling.

There is probably a single biological school shark stock in the New Zealand EEZ. However, differences in average modal length and CPUE trends between FMAs indicate that movement between areas may be viscous, and that components of the stock may aggregate in different areas. Larger females predominate in catches around Southland and west coast of the South Island. As a result of this the Inshore Working Group and Plenary recommended undertaking CPUE analyses of all SCH stocks in the same year.

According to the draft Inshore Finfish Management Plan (and associated Medium Term Research Plan), New Zealand school shark are monitored using series relative abundance, based on standardised CPUE, updated on a three year cycle. The CPUE series were last updated to the end of the 2015/16 fishing year – with the work presented to the Inshore Working Groups in 2018.

Objectives 1 & 2:

Fishery characterisations and CPUE analyses for SCH 1, SCH 2, SCH 3, SCH 4, SCH 5, SCH 7 and SCH 8 were updated in 2014 as part of a full review of these Fishstocks. As part of this review, the fine scale location data from the QMA-specific CPUE series used to monitor this species were inspected for continuity and consistency. It was noted that, in many cases, these fishery definitions were constructs of administrative boundaries and often artificially divided fisheries that should be linked. The result of this review was the creation of revised fishery

definitions for monitoring school shark, with boundaries between fisheries drawn in areas where there were gaps in catches, and, as much as possible, the same area definitions were used to define setnet and bottom longline fisheries for monitoring purposes. The fisheries were selected on the basis of fine scale positional data but use MPI statistical areas to make the definitions in order to apply these definitions to the period before fine scale positional data became available. This approach also assumes that the fine scale positional information from 2007 to the present is representation of the distribution of fishing before that year.

The main difficulty in finalising these definitions was how to deal with Cook Strait, with the decision made to place all Cook Strait catches, even those from the eastern end of Cook Strait, to the central west coast fishery (SCH 7, SCH 8 and lower SCH 1W). Setnet landings from Kaikoura and Pegasus Bay were assigned to the northern east coast fishery and bottom longline landings from the western end of the Chatham Rise were assigned to SCH 4.

When the CPUE series were updated in 2018 the spatial fishery definitions were adhered to, and, as done previously, CPUE series were generated only for set net and longline fisheries. Spatial analysis of data on the size composition of school shark taken by trawl surveys and various commercial methods, nevertheless, indicated that larger commercial trawlers may not select smaller school sharks, as previously believed, and that trawl CPUE is worth considering in areas where there are sufficient trawl catch and effort data or where longline and set-net indices are limited or have contrasting CPUE trends. Further analysis of the size composition data (e.g. comparing inshore and offshore areas in SCH 3) is required to support this approach. Additional data have been collected by observers and trawl surveys since the previous analysis.

Target reference points will be determined by the Inshore WGs based on accepted standardised CPUE indices of abundance and set in a manner that is consistent with the Harvest Strategy Standard. The research provider is expected to provide some basic analyses to support the discussion, including a series of relative fishing mortality.

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 and 0.7.

SNA2019-01

Project Code:	SNA2019-01
Project title:	Estimation of Snapper Year Class Strength in SNA1
Start date:	1 July 2019
Completion date:	30 June 2021
Vessel use:	None
Cost:	$800 000

Overall Research Objective:
To estimate the year class strengths of snapper (*Pagrus auratus*) in SNA 1

Specific Research Objectives:
1. To characterise the SNA 1 fishery by analysing existing commercial catch and effort data to the end of 2018/19 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 1 throughout the fishing year 2019/20. The target coefficient of variation (c.v.) for the catch-at-age will be 20 % (mean weighted c.v. 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 August 2019 in Auckland.
2. To submit results to MPI Contracts Monitoring in a Progress report as specified in Research Reporting form 4 by 1 June 2021.
3. To present the report in 2 above to meetings of the Northern Inshore Fishery Assessment Working Group in June 2021 in Auckland.
4. To submit to MPI Contracts Monitoring a draft Fishery Assessment Report, as specified in Research Reporting form 7, by 30 May 2020.

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 by the fifth working day of each month for the duration of the project.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 June 2021.

Rationale:
The snapper fishery is New Zealand's largest inshore finfish fishery by value. SNA 1 is the largest snapper fishery with a current TACC of 4500 t out of the total snapper TACC for all areas combined of 6557 t. Snapper also form important fisheries for Maori and recreational fishers, but the annual catch is not known.
Catch-at-age, sampled on a one year in three cycle, is an important input to SNA 1 stock assessments. Although the age composition of the longline catch was last estimated in 2017/18, the next year sampled was brought forward to 2019/20 to support a stock assessment planned for 2021. Projections based on alternative TACs are strongly influenced by recent recruitment, and the model is usually required to have at least two observations of the relative strength of each year class before it can use them in projections. Bottom trawl and Danish Seine catches were also not sampled previously, and are necessary to estimate selectivity for these two methods.

Objectives 1 & 2:
In SNA 1 the East Northland, Hauraki Gulf and the Bay of Plenty fisheries will be sampled throughout the whole year. The aim of shed sampling is to estimate the age and length structure of the commercial landings of snapper. This provides catch-at-age information, which may be combined with estimates of selectivity-at-age to estimate stock age composition. This information on age and length composition is an important input into the age-structured models used for the assessment of snapper stocks and contributes to the estimation of productivity and sustainable yields.
Recent catch-at-age studies for SNA 1 have focussed on longline fisheries, as this method provides a better indication of the age structure of the recruited population than do other fishing methods. However it is now apparent that the growth rate of SNA 1 has slowed over time and that the selectivity of bottom trawl and Danish Seine may have consequently changed. Given that Danish seine and bottom trawl are currently responsible for a substantial portion the SNA 1 catch, it is necessary that catches taken using these methods are also sampled. The longline fishery is sampled using the random age method and it may be possible to used otoliths collected from the longline fishery to create seasonal age length keys to estimate age composition from the length composition of bottom trawl and Danish seine fisheries.
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

SNA2019-02

Project title:	Catch-at-age of snapper in SNA 7
Project Code:	SNA2019-02
Start date:	1 July 2019
Completion date:	30 December 2020
Vessel use:	None
Cost:	$80 000

Overall Research Objective:

1. To determine the age composition of SNA 7 harvested in Tasman and Golden Bays.

Specific Research Objectives:

1. To characterise the SNA 7 fishery

2. To conduct representative sampling to determine the length and age structure of the commercial catch of snapper in SNA 7 during the 2019/20 fishing year. The target coefficient of variation (CV) for the catch-at-age is 20% (mean weighted CV across all age classes).

Reporting Requirements:

Specific Objectives 1&2:

1. Present a detailed description of the sample design to the Southern Inshore Working Group by September 2019.

2. To submit to the MPI, contracts management a progress report as specified in Research Reporting Form 4 by 30 September 2020.

3. To present the report in 2 above to meetings of the Southern Inshore Fishery Assessment Working Group in October 2020 in Wellington. Presentations to more than one meeting may be required.

4. To submit to MPI, contracts management a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 November 2020.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 December 2020.

Rationale:

General:
SNA 7 currently supports a modest but important shared fishery in Tasman and Golden Bays, with a TACC of 250t and a non-commercial allowance of 270t. SNA 7 reported annual commercial landings declined from 2720 t in 1978 to 142 t in 1997/98. The TACC was set at 330 t when it was introduced into the QMS in 1986/87, but was reduced to 160 t in 1989/90 and then increased to 200t in 1997/98. The fishery was unable to catch the 200 t TACC from 1997/98 to 2002/03. Stock assessments of SNA 7 conducted in 2014 and 2018 based on a statistical age structured population model suggested biomass had increased rapidly since 2009, due to the recent recruitment of one (2007) or possibly two (+2010) large year classes. This resulted in in further increases of TACC and non-commercial allowance.

The age structure of the commercial bottom trawl catch is an important input to models used to assess that status of SNA 7. Catch-at-age studies are conducted on a one in three year cycle and the last study was undertaken in 2016/17.

Objectives 1 & 2:

Results of the characterisation will be used to determine spatio-temporal sampling effort and which fisheries need to be sampled in order to obtain representative samples. The bulk (±75%) of the snapper catch in Tasman and Golden Bays (and therefore SNA 7) is landed to a single processing shed at Talley's in Nelson, so it is expected that all the samples should come from here. The proposed catch sampling and ageing will provide length and age structure information for snapper in SNA 7. These data will be used to estimate year class strength and selectivity of the fishery. This project should therefore include catches made in both target and bycatch fisheries. Sampling should be spatially and temporally representative of the catch. While the bulk of the catch comes from Tasman and Golden Bays, catches from the West Coast South Island are also landed to the same processing shed and should also be sampled to get an indication of the age structure of snapper in that area. The West Coast South Island should be considered a separate sampling stratum. Each sample must be able to be linked to a trip code on the vessels catch reporting form.

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:

Langley, A.D. (2015). Stock assessment of snapper in SNA 7. *New Zealand Fisheries Assessment Report 2015/42.*

Parker, S.J., D. Parsons, M. Stevenson, C. Sutton & C. Walsh. (2015). Landed catch sampling of snapper in SNA 7 in the 2013–14 fishing year. *New Zealand Fisheries Assessment Report 2015/14.*

SNA2019-03

Project Code:	SNA2019/03
Project:	Stock assessment of SNA 8
Start date:	1 October 2019
Completion date:	30 June 2021
Vessel use:	None
Cost:	$200 000

Overall Research Objectives:
To conduct a stock assessment for snapper (*Pagrus auratus*) in SNA 8, including estimating biomass and sustainable yields.

Specific Objectives:
1. To characterise the SNA 8 fishery and update the standardised bottom trawl CPUE to 2018-19

2. To collate and update catch histories through to 2018-19 and all observational data series required for the SNA 8 stock assessment.

3. To conduct a stock assessment for SNA 8 using age-structured modelling, including estimating biomass and sustainable yields.

4. To collate and update catch histories, CPUE and all observational data series required for the SNA 8 stock assessment to 2019/20.

5. To update the stock assessment for SNA 8

Note: The stock assessment will be conducted over two years to provide sufficient time to finalise what will be a new assessment for this stock and to include all three annual relative biomass estimates from the series of bottom trawl surveys currently being conducted (INT2018-02). The trawl surveys are conducted in November of each year (2018, 2019 & 2020).

Reporting Requirements:
Objectives 1-5:
1. To submit to MPI Contracts Management a progress report as specified in Research Reporting Form 4 by 30 November 2019.

2. To present the report in 2 above to meetings of the Northern Inshore Fishery Assessment Working Group in December 2019 in Auckland or Wellington. Presentations to more than one meeting may be required.

3. To submit to MPI Contracts Management a progress report as specified in Research Reporting Form 4 by 28 February 2020.

4. To present the report in 3 above to meetings of the Northern Inshore Fishery Assessment Working Group in March 2020 in Auckland or Wellington. Presentations to more than one meeting may be required.

5. To submit to MPI Contracts Management a progress report as specified in Research Reporting Form 4 by 30 March 2020.

6. To present the report in 5 above to meetings of the Northern Inshore Fishery Assessment Working Group in April 2020 in Auckland or Wellington. Presentations to more than one meeting may be required.

7. To submit to MPI Contracts Management a draft revised Working Group Report as specified in Fishery Assessment Document form 2 for Snapper by 20 April 2020.

8. To submit to MPI Contracts Management a progress report as specified in Research Reporting Form 4 by 28 February 2021.

9. To present the report in 8 above to meetings of the Northern Inshore Fishery Assessment Working Group in March 2021 in Auckland or Wellington. Presentations to more than one meeting may be required.

10. To submit to MPI Contracts Management a progress report as specified in Research Reporting Form 4 by 30 March 2021.

11. To present the report in 10 above to meetings of the Northern Inshore Fishery Assessment Working Group in April 2021 in Auckland or Wellington. Presentations to more than one meeting may be required.

12. To submit to MPI Contracts Management a draft revised Working Group Report as specified in Fishery Assessment Document form 2 for Snapper by 20 April 2021.

13. To submit to MPI Contracts Management a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 July 2021.

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.

Data Reporting:

To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 September 2021

Rationale:

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 Maori and recreational fishers. The recreational harvest of SNA 8 was estimated at 630 t in 2012.
According to the National Management Plan for Inshore Finfish, SNA 8 is a Group One stock, and is therefore monitored with full quantitative stock assessments. The last stock assessment for SNA 8 was undertaken in 2005, when spawner biomass was estimated to be 8 – 12% B_0. The SNA 8 stock assessment has depended heavily on an estimate of absolute biomass based on mark-recapture. The stock assessment has not been updated since 2005 because high cost and logistical difficulties, including issues related to food safety, have precluded further mark-recapture studies. A recent review of the seven WCNI surveys (from 1986 to 1999) indicated trawl surveys are likely to provide a fishery independent means of tracking relative abundance of SNA 8. On this basis the previous WCNI trawl survey was reinstated with initial surveys conducted in November of three consecutive years: 2019, 2020 and 2021. These surveys will provide estimates of relative biomass as well as age structure. The purpose of the current project is to develop a new stock assessment for SNA 8 that includes all three initial survey results.

Objectives 1-5:
Required under this project is an updated SNA 1 assessment, through to the end of 2019-20, that includes recent catch-at-age information, results from the three bottom trawl surveys, updated CPUE indices, recreational survey information (harvest and size composition), and recent catches. The CPUE analyses should take cognisance of recent developments on methods used to produce indices of relative abundance for SNA 8 (Langley, 2017) that were accepted by the Northern Inshore Working Group. The assessment should include investigations of uncertainties around natural mortality, steepness, and selectivity assumptions.

One or more plausible model scenarios will form the basis of the assessment. For these model scenarios, biological reference points (e.g. MSY and Bmsy) should be estimated with uncertainty being characterised using Bayesian or other approaches. Short and medium term projections will be undertaken for a restricted set of models based on a range of future catch scenarios to be determined later.

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, 0.1, 0.2, 0.2, 0.2

References:
Langley, A D (2017) Catch-Per-Unit-Effort indices for snapper in SNA 8. *New Zealand Fisheries Assessment Report 2017/45.*

Inshore Shellfish Fisheries

COC2019-01	Biomass survey for COC3
PAU2019-01	PAU7 Stock Assessment
PAU2019-03	Paua commercial catch sampling programme
PAU2019-04	PAU 5A Stock Assessment
SCA2019-03	SCA7 biomass survey-Sounds only
TOH2019-01	Distribution and abundance of toheroa on Ninety Mile Beach

COC2019-01

Project number:	COC2019-01
Project title:	Biomass survey for COC3
Start date:	1 July 2019
End date:	30 June 2020
Vessel use:	None
Estimated cost:	$90 000

Overall Objective:
To evaluate the status of the cockles in the Otago harbour.

Specific Objectives:

1. Conduct a biomass survey 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 cockles in the Otago harbour.
2. Compare the estimates from objective 1 with other relevant data from previous surveys.

Reporting Requirements:
Research reporting:

1. Present proposed methods to the Shellfish Fishery Assessment Working Group by 30 September 2019.
2. More than one presentation to the SFWG may be required between September 2019 and December 2019. This should be taken into consideration when providing costs for this project.
3. Submit to the project scientist a draft Fisheries Assessment Report as specified in Research Reporting Requirements Form 5 by 15 May 2020.
4. Present the report in 3 above to the SFWG by 30 May 2020.
5. Submit to the MPI project scientist a draft revised Working Group Report as specified in Research Reporting form 8 for by 30 May 2020.
6. Submit to the MPI project scientist and MPI Contracts Monitoring a final Working Group Report as specified in Research Reporting form 8 for by 30 June 2020.
7. Submit to MPI Contracts Monitoring a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Requirements Form 5 by 30 June 2020.

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 by the fifth working day of each month for the duration of the project.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 June 2020.

Rationale:

General:
Cockles (tuaki) support important commercial and recreational fisheries, and are a valued customary fishery, in the Otago region. Major cockle populations are found in Papanui and Waitati Inlets, Purakanui, and in Otago Harbour. Otago harbour is believed to hold the largest biomass of cockles in Australasia. A mataitai reserve is in place covering the outer cockle beds, and a longstanding regulation was amended in late 2018 to allow commercial fishing of cockles with two beds in the inner harbour.

Otakou runanga have expressed concern regarding the number of takeable size tuaki in the mataitai reserve. And, while regular surveys of the two inner cockle beds have been undertaken regularly over the past 8 years, no wider survey of the harbour (tuaki) has occurred since 1999. This study would provide a useful recheck of any changes to the overall population and distribution over the past 20 years.

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.

PAU2019-01

Project number:	PAU2019-01
Project title:	PAU 7 Stock Assessment
Start date:	1 July 2019
End date:	30 June 2020
Vessel use:	No
Estimated cost:	$85 000 00

Overall Objective:
To undertake a stock assessment in PAU 7

Specific Objectives:

1. To update the most recent standardised CPUE analysis for PAU 7.
2. To conduct a stock assessment in PAU 7 to estimate the status of the stocks

Reporting Requirements:

1. Present the methodologies and data inputs for objective 1 & 2 to the SFWG by 12th August 2019

2. Present updates on the CPUE standardisation and stock assessment progress to the SFWG as required between the dates 12th August 2019 to 25th September 2019

3. Submit to the project scientist a draft Fisheries Assessment Report as specified in Research Reporting Requirements Form 5 by 15th November 2019

4. Present the report in 3 above to the SFWG by 22nd November 2019

5. Submit to MPI Contracts Monitoring a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Requirements Form 5 by 20th December 2019.

6. Submit to the MPI project scientist a draft revised Working Group Report for PAU5A as specified in Research Reporting form 8 for by 28th February 2020.

7. Submit to the MPI project scientist and MPI Contracts Monitoring a final Working Group Report as specified in Research Reporting form 8 for by 31st March 2020.

Project Update Reports:

Present updates on the CPUE standardisation and stock assessment progress to the SFWG as required between the dates 12th August 2019 to 25th September 2019

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 the course of this project to the Research Data Manager, MPI by 30 June 2020.

Rationale:

General:
The purpose of this objective is to undertake a new stock assessment in PAU 7. Currently the stock assessment process for most paua QMAs is being revamped to become more cost effective, efficient and more informative for management purposes. The model used in previous paua stock assessments is being revised and further developments are taking place. Part of the revamp is developing a process whereby all 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 staus:

- Indicators:
    - B*0,* Bcurrent, Bmsy, Bcurrent as %B*0,* Bcurrent as %Bmsy, Ucurrent, 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.
    - Bprojected as %B*0,* %Bmsy, % Bcurrent
    - Pr(Bprojected > Bcurrent)
    - Pr(Bprojected > Bmsy)
    - P(Bprojected > 40%B*0*)
    - Pr(Bprojected < 20% B*0*)
    - Pr(Bprojected < 10% B*0*)
    - Pr(Uprojected > $U_{40\%B0}$)
    - *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.

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 envisaged that CPUE could well become far 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 is 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.

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:
The weightings for the objectives in this project are equal.

Notes:
To improve time efficiency it is proposed the Shellfish Working Group process for reviewing the science behind the CPUE standardisation/stock assessment will happen over the course of about 6-8 weeks from 5th August until 25th September.

PAU2019-03

Project number:	PAU2019-03
Project title:	Paua commercial catch sampling programme
Start date:	1 July 2019
End date:	30 June 2022
Vessel use:	No
Estimated cost:	$650 000

Overall Objective:
To collect representative information of the size frequency of commercially caught paua for input into the stock assessment model.

Specific Objectives:
To collect representative size frequency information on the commercial catch of paua (*Haliotis iris*) in PAU 2, PAU 3, PAU 4, PAU 5A, PAU 5B, PAU 5Dand PAU 7 for the 2019/20, 2020/21, 2021/22 fishing years. The target coefficient of variation (c.v.) is 20 %.

Note: This is a three year project that is subdivided into 3 separate fishing years - PAU2019-03A (2019/20), PAU2019-03B (2020/21) and PAU2019-03C (2021/22).

Reporting Requirements:

1. Present proposed methodologies to the SFWG by 31st August 2019

2. Submit to the project scientist a draft Fisheries Assessment Report as specified in Research Reporting Requirements Form 5 by 28th February 2021, 28th February 2022, 28th February 2023

3. Present the report in 2 above to the SFWG by 30 April 2021, 30 April 2022, 30 April 2023

4. Submit to MPI Contracts Monitoring a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Requirements Form 5 by 31st May 2021, 31st May 2022, 31st May 2023.

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 the course of this project to the Research Data Manager, MPI by 31st May 2021, 31st May 2022, 31st May 2023.

Rationale:

General:
Commercial size frequency data of all the major paua stocks is collected under the Commercial Catch Sampling Programme. This programme began in June 1990 and continued until 1994. Paua market sampling was re-instigated in PAU 5B, PAU 5D, and PAU 7 in 1997 to contribute data to the 1998-1999 length based population model stock assessments in those areas. From the 1999-2000 fishing year the programme was expanded to include sampling from all major Quota Management Areas (QMAs) where commercial landings of paua were made. The data collected from this project is used in the Stock assessment model for paua.

In 2006 a new sampling programme was developed involving industry trained technicians to sample paua at specific fishing points and also at processing sheds and this sampling design has been used since 2007. However, over the last 3-5 years the proportion of the total catch that is getting sold live or frozen has been increasing and is expected to continue increasing into the future. Because these animals are processed differently once landed at the LFR, length frequency measures from these animals are not been captured. The Shellfish Working Group has advised that the current methodologies for this project are reviewed and redesigned as appropriate to ensure data collected is as representative of the population as possible.

Weighting of Objectives:

PAU2019-04

Project number:	PAU2019-04
Project title:	PAU 5A Stock Assessment
Start date:	1 July 2019
End date:	30 June 2020
Vessel use:	No
Estimated cost:	$85 000

Overall Objective:
To undertake a stock assessment in PAU 5A

Specific Objectives:

1. To update the most recent standardised CPUE analysis for PAU 5A.
2. To conduct a stock assessment in PAU5A to estimate the status of the stocks

Reporting Requirements:

1. Present the methodologies and data inputs for objective 1 & 2 to the SFWG by 12th August 2019

2. Present updates on the CPUE standardisation and stock assessment progress to the SFWG as required between the dates 12th August 2019 to 25th September 2019

3. Submit to the project scientist a draft Fisheries Assessment Report as specified in Research Reporting Requirements Form 5 by 15th November 2019

4. Present the report in 3 above to the SFWG by 22nd November 2019

5. Submit to MPI Contracts Monitoring a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Requirements Form 5 by 20th December 2019.

6. Submit to the MPI project scientist a draft revised Working Group Report for PAU5A as specified in Research Reporting form 8 for by 28th February 2020.

7. Submit to the MPI project scientist and MPI Contracts Monitoring a final Working Group Report as specified in Research Reporting form 8 for by 31st March 2020.

Project Update Reports:
Present updates on the CPUE standardisation and stock assessment progress to the SFWG as required between the dates 12th August 2019 to 25th September 2019

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 the course of this project to the Research Data Manager, MPI by 30 June 2020.

Rationale:

General:
The purpose of this objective is to undertake a new stock assessment in PAU 5A. Currently the stock assessment process for most paua QMAs is being revamped to become more cost effective, efficient and more informative for management purposes. The model used in previous paua stock assessments is being revised and further developments are taking place. Part of the revamp is developing a process whereby all 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 staus:

- Indicators:
    - B*0,* Bcurrent, Bmsy, Bcurrent as %B*0,* Bcurrent as %Bmsy, Ucurrent, 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.
    - Bprojected as %B*0,* %Bmsy, % Bcurrent
    - Pr(Bprojected > Bcurrent)
    - Pr(Bprojected > Bmsy)
    - P(Bprojected > 40%B*0*)
    - Pr(Bprojected < 20% B*0*)
    - Pr(Bprojected < 10% B*0*)
    - Pr(Uprojected > $U_{40\%B0}$)
    - *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.

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 envisaged that CPUE could well become far 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 is 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.

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:
The weightings for the objectives in this project are equal.

Notes:
To improve time efficiency it is proposed the Shellfish Working Group process for reviewing the science behind the CPUE standardisation/stock assessment will happen over the course of about 6-8 weeks from 5th August until 25th September.

SCA2019-03

Project number:	Scallop 7 biomass survey - Sounds only
Project title:	SCA2019-03
Start date:	1 July 2019
End date:	30 September 2020
Vessel use:	Yes
Estimated cost:	$100 000

Overall Objective:
To evaluate the status of the scallop stocks in the Marlborough Sounds area of SCA 7.

Specific Objectives:

1. Conduct a biomass survey 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 the Marlborough Sounds;
2. Estimate the biomass of scallops using a range of commercial density thresholds from 0.00 to 0.2 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;

Reporting Requirements:

Research Reporting

1. Present proposed methods to the Shellfish Fishery Assessment Working Group by 30 September 2019.
2. More than one presentation to the SFWG may be required between September 2019 and 30 April 2020. This should be taken into consideration when providing costs for this project.
3. Submit to the project scientist a draft Fisheries Assessment Report as specified in Research Reporting Requirements Form 5 by 15 July 2020.
4. Present the report in 3 above to the SFWG by 30 July 2020.
5. Submit to the MPI project scientist a draft revised Working Group Report as specified in Research Reporting form 8 for by 30 August 2020.
6. Submit to the MPI project scientist and MPI Contracts Monitoring a final Working Group Report as specified in Research Reporting form 8 for by 30 September 2020.

7. Submit to MPI Contracts Monitoring a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Requirements Form 5 by 30 September 2020.

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 by the fifth working day of each month for the duration of the project.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 September 2020.

Rationale:

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).

The January 2018 biomass survey showed an increasing trend in the Marlborough Sounds recruited scallop biomass since the November 2015 survey, and most of that biomass is held in a limited number of scallop beds, mostly in the outer Sounds (Williams et al. 2018).

In June 2018, the Southern Scallops 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 MS is not compromised
- statutory decisions relating to SCA7
- proposals made by sectors, including CSEC and the recreational fishing sector.

A biomass survey in the Marlborough Sounds will occur in May 2019. It will allow us to see if the increased biomass observed in the January 2018 biomass survey has pursued in 2019. A survey in May 2020 would allow the fisheries managers to update the Minister on a potential reopening of the fishery using the management regime developed by the SSWG.

Weighting of Objectives:

References:

Ministry for Primary Industries (2016a). Fisheries Assessment Plenary, May 2016: stock assessments and stock status. Compiled by the Fisheries Science Group, Ministry for Primary Industries, Wellington, New Zealand. 1556 p.

Ministry for Primary Industries (2016b). Review of sustainability measures for the Southern Scallop Fishery (SCA 7). http://mpi.govt.nz/news-and-resources/consultations/review-of-sustainability-measures-for-the-southern-scallop-fishery-sca-7/

Ministry for Primary Industries (2017). Temporary Closure of the Southern Scallop (SCA 7) Fishery. http://mpi.govt.nz/news-and-resources/consultations/temporary-closure-of-the-southern-scallop-sca-7-fishery/

Williams, J.R.; Hartill, B.; Bian, R.; Williams, C.L. (2014). Review of the Southern scallop fishery (SCA 7). New Zealand Fisheries Assessment Report 2014/07: 71.

Williams, J.R.; Bian, R.; Parkinson, D.M.; Roberts, C.L. (2015a). Survey of scallops in Golden Bay, Tasman Bay, and Marlborough Sounds, 2015. NIWA Client Report AKL2015-019 for Challenger Scallop Enhancement Company Ltd. project CSE15301. 71 p. (Unpublished report held by NIWA, Auckland, N.Z.).

Williams, J.R.; Parkinson, D.M.; MacGibbon, D.J.; Olsen, L.; Roberts, C.L. (2015b). SCA 7 stock survey, November 2015. New Zealand Fisheries Assessment Report 2015/79: 44.

Williams, J.R.; Parkinson, D.M.; Olsen, L.; Roberts, C.L. (2015c). SCA 7 in- season survey, October 2015. New Zealand Fisheries Assessment Report 2015/72: 20.

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TOH2019-01

Project number:	TOH2019-01
Project title:	Distribution and abundance of toheroa on Ninety Mile Beach
Start date:	1 July 2019
End date:	30 September 2020
Vessel use:	None
Estimated cost:	$90 000

Overall Objective:
To determine the distribution of toheroa (*Paphies ventricosum*) beds, and the abundance and size structure of toheroa on Ninety Mile beach.

Specific Objectives:
1. To estimate the size structure and absolute abundance of toheroa on Ninety Mile Beach, during February – May 2020. The target c.v. for the estimate of absolute abundance of legal sized toheroa (≥100 mm shell length) is 20%.

2. To describe changes in the size structure and absolute abundance of toheroa on Ninety Mile Beach by comparing the results from this work with those from previous surveys.

Note: Fisheries New Zealand recognises the importance of the toheroa resource to customary fishers. The successful tenderer will consult with and involve tangata whenua in the conduct of this research project.

Reporting Requirements:

Research reporting:

1. Present proposed methods to the Shellfish Fishery Assessment Working Group by 30 September 2019.
2. More than one presentation to the SFWG may be required between September 2019 and 15 December 2019. This should be taken into consideration when providing costs for this project.
3. Submit to the project scientist a draft Fisheries Assessment Report as specified in Research Reporting Requirements Form 5 by 15 September 2020.
4. Present the report in 3 above to the SFWG by 15 September 2020.
5. Submit to MPI Contracts Monitoring a final Fisheries Assessment Report (including changes as requested by the chair of the SFWG) as specified in Research Reporting Requirements Form 5 by 30 October 2020.

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 by the fifth working day of each month for the duration of the project.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 October 2020.

Rationale:

General:
Toheroa (*Paphies ventricosum*) have historically supported customary, commercial and recreational fisheries of importance in Northland. Toheroa have been subjected to intensive harvesting over the last 100 years and fishing is now prohibited throughout New Zealand in response to declining population numbers. The only remaining fishery for toherao is the customary fishery.

Annual surveys of Muriwai, Dargaville and areas of Ninety Mile Beach were used to estimate the availability of toheroa during the 1960s. By 1967 the estimated stocks of toheroa on Northland beaches had become so low that the annual season for picking was closed to the public. Results from these surveys also showed that recruitment was highly variable and that the populations suffered large scale natural mortalities of both adults and juveniles. In 1993 surveys conducted in the north found only one animal of legal size.

Ongoing time series of abundance of toheroa are required on all major toheroa beaches, Ninety Mile Beach, Dargaville Beach, Murawai Beach (North Island), and Oreti Beach and Bluecliffs Beach (Southland).

A survey conducted on Ninety Mile Beach in May 2006 (TOH2005-01) showed that the overall population size of toheroa was 8.88 million (c.v. 31.0%), but only one individual over 74 mm was encountered. Problems were encountered in with the survey stratification, making comparison with past surveys problematical.

Another survey was conducted in 2010 in order to provide an updated assessment of the distribution and abundance of toheroa on Ninety Mile Beach (Williams et al. 2013). Toheroa densities were very low with only 38 individual toheroa (length range 7–62 mm) encountered during the survey. The estimated population abundance of toheroa 40 mm or more shell length was 1.6 million with a c.v. of 24%. No large adults (75 mm or larger) were observed.

Estimates from the time series of toheroa surveys show that the population at Ninety Mile beach has undergone major fluctuations in abundance, although substantial uncertainty is associated with most of the estimates because of differences in both the areas surveyed and the sampling methods employed over time. For large adult toheroa, estimated abundance up until about 1980 varied by an order of magnitude from over 10 million to less than 1 million (75 mm or more); there were few surveys in the 20 years that followed until 1999. Estimates between 1999 and 2011 suggest a decline to historically low levels has occurred at Ninety Mile.

Determination of the population size structure may provide an indication of the health of the toheroa population. Spatial and size information will assist kaitiaki in managing the resource available for customary 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): 0.75, 0.25.

References:

Williams, J.; Ferguson, H.; Tuck, I. (2013). Distribution and abundance of toheroa (*Paphies ventricosa*) and tuatua (*P. subtriangulata*) at Ninety Mile Beach in 2010 and Dargaville Beach in 2011. New Zealand Fisheries Assessment Report 2013/39

Rock Lobster Fisheries

CRA2019-01	Rock lobster stock assessments

CRA2019-01

Project title:	Rock lobster stock assessments
Project Code:	CRA2019-01
Start date:	1 April 2020
Completion date:	30 May 2021
Vessel use:	Yes
Estimated cost:	$1 000 000

Overall Research Objective:
To conduct assessments of rock lobster stocks including estimation of biomass and sustainable yields, and to evaluate new management procedures for the 2020-21 April fishing year.

Specific Research Objectives:

Note an annual review of the specific objectives will occur at the start of each year.

1. To collect length frequency and other biological data at sea from the catch of the commercial fishery through logbook and catch sampling programmes.
2. To conduct tagging projects to measure the growth rate of lobsters for use in a length-based population model.
3. To update the standardised CPUE analysis from all lobster QMAs and report on the operation of current management procedures.
4. To conduct assessments to estimate biomass and sustainable yields for rock lobster stocks.
5. To evaluate new management procedures for rock lobster fisheries.

Reporting Requirements:

Research reporting:

1. Logbook Programme and Catch Sampling commence by 30 April 2020.
2. Logbook Programme and Catch Sampling continues by 30 May 2020.
3. Logbook Programme and Catch Sampling continues. Tagging Commences. Data compiled and CPUE extract obtained by 31 July 2020.
4. Evaluation of new management procedures commences by 30 September 2020.

5. Tagging continues, CPUE data checked and Standardised, Preliminary Stock Assessment results reported to the RLFAWG, evaluation of new Management Procedures continues and Draft Working Group Report submitted to Fisheries New Zealand by 30 October 2020.
6. Presentations to RLFAWG and other groups as required by 30 November 2020.
7. Presentation to Plenary, RLFAWG and other groups if required. Tagging continues by 31 December 2020.
8. Logbook programme and catch sampling complete by 31 January 2021.
9. Submit draft FARs or FRRs to Fisheries New Zealand by 28 February 2021.
10. Submit final FARs or FRRs to Fisheries New Zealand by 30 March 2021.
11. Submit to Fisheries New Zealand all data as per the Data Management Plan by 30 May 2021.

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 by the fifth working day of each month for the duration of the project.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, Fisheries New Zealand by 30 May 2021.

Rationale

Rock lobster stocks (CRA 1 to 9) are in Group 1 of the Draft National Fisheries Plan for Inshore Shellfish which is comprised of 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.

An ongoing monitoring and assessment programme is required to enable estimation of biomass and sustainable yields for each rock lobster stock.

Monitoring of rock lobster stocks is based on catch rates in the commercial fishery. Sampling at-sea, using logbooks completed by commercial fishers or by catch sampling by technicians, is also used to determine the size of lobsters in the fishery (length frequency distributions).

Tagging programmes have been completed in the major stocks to determine recent growth rates of the lobsters.

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 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.

Management procedures (a tool used to guide the setting of catch limits) also rely on standardised CPUE indices. The procedures are also extensively simulation tested using an operating model (which is based on a stock assessment model) of the fishery system being managed.

This project contributes to a long-term rock lobster monitoring and assessment programme. Stock assessments and/or management procedures are currently used in most rock lobster fisheries to help ensure management objectives are met for each stock.

Management procedures are increasingly being used in New Zealand's rock lobster fisheries. The management of six of the nine rock lobster stocks (CRA 1, CRA 3, CRA 4, CRA 5, CRA 7 and CRA 8) currently involves the operation of management procedures. Management procedures should not be used for more than 5 years because fishery dynamics may have changed and it is important to ensure management objectives are being met with high probability.

Other management approaches currently apply in CRA 6 and CRA 9. Neither CRA 6 nor CRA 9 has used formal stock assessments to set catch limits; however, management procedure evaluations have been carried out for these fisheries but are not currently in place.

Specific Objective 1:
In each fishery the length frequency and sex of the rock lobster catch is collected at sea by fishers completing logbooks or by more intensive catch sampling programmes where fewer days are sampled but the number of samples measured per day is much greater. The number of additional days catch sampling required in each area will be determined from the results from previous years.

Specific Objective 2:
Tag and recapture studies have been carried out in recent years to determine the current growth rate of rock lobsters in many areas. Tag recaptures from previous studies will be combined with new tag recoveries as inputs to the assessment model. These results allow the growth rates to be determined for each of the areas within the model.

Specific Objective 3:
Annual standardised CPUE indices for each stock are used: in stock assessments, input to management procedures, and in stock monitoring.

Current standardisation of rock lobster CPUE is limited by the variables available for analysis; the most important of these have been month, area and number of potlifts. Recent work suggests that vessel may be a useful categorical variable to add to these models, to improve the explanatory power of the model. The effect of environmental variables (e.g. temperature) could also be examined using the subset of data from the logbooks.

Specific Objective 4:
Stock assessments will include new catch information, new growth data from tagging studies, length frequency data from the commercial fishery in several areas and updated CPUE indices from all commercial fisheries. The continuation of data collection in all these areas is important to further update the assessments.

The assessment depends on commercial catch data, which are of good quality, and commercial CPUE data, which are of moderately good quality. It also depends heavily on length frequency data and detailed biological data, which only have good coverage in a few areas. Recently the length-based model has been extended to all areas and further development of the model is expected. The Rock Lobster Fishery Assessment Working Group will decide which stocks will be assessed.

Specific Objective 5:
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.

Weighting of Objectives:
All objectives have equal weighting

Highly Migratory Species Fisheries

HMS2019-01	Data reports for New Zealand HMS fisheries for national and international obligations
STM2019-01	Multi-year stock monitoring of striped marlin including logbook programme implementation
STM2019-02	Characterisation of commercial fisheries that catch striped marlin
STN2019-02	Estimation of recreational harvest of Southern Bluefin Tuna in New Zealand
SWO2019-01	Characterisation of the fishery for and analysis of CPUE for swordfish from the commercial longline fishery in NZ waters
TAG2019-01	Management of data from gamefish tag-recapture programme

HMS2019-01

Project number:	HMS2019-01
Project title:	Data reports for New Zealand HMS fisheries for national and international obligations
Start date:	1 January 2020
End date:	31 December 2022
Vessel use:	None
Estimated cost	$40 000 per year, $120 000 total

Overall Objective:
To characterise the New Zealand tuna and swordfish fisheries, including catches and discards of associated and dependent species and incidental take of protected species for international reporting obligations and for monitoring of the National Fisheries Plan for Highly Migratory species (HMS).

Specific Objectives:

1. To characterise the New Zealand HMS fisheries for albacore (*T. alalunga*), bigeye tuna (*T. obesus*), Pacific bluefin tuna (*T. orientalis*), skipjack tuna (*K. pelamis*), southern bluefin tuna (*T. maccoyii*), yellowfin tuna (*T. albacares*), and swordfish (*X. gladius*) in the New Zealand fisheries waters and adjacent areas for the 2019/20 fishing year and 2019 calendar year.

2. To estimate the catches, catch rates, and discards of non-target fish, HMS sharks in tuna and swordfish longline fisheries using data from the Observer Programme and commercial fishing returns for the 2019/20 fishing year and 2019 calendar year.

3. To characterise the New Zealand HMS fisheries for albacore (*T. alalunga*), bigeye tuna (*T. obesus*), Pacific bluefin tuna (*T. orientalis*), skipjack tuna (*K. pelamis*), southern bluefin tuna (*T. maccoyii*), yellowfin tuna (*T. albacares*), and swordfish (*X. gladius*) in the New Zealand fisheries waters and adjacent areas for the 2020/21 fishing year and 2020 calendar year.

4. To estimate the catches, catch rates, and discards of non-target fish, HMS sharks in tuna and swordfish longline fisheries using data from the Observer Programme and commercial fishing returns for the 2020/21 fishing year and 2020 calendar year.

5. To characterise the New Zealand HMS fisheries for albacore (*T. alalunga*), bigeye tuna (*T. obesus*), Pacific bluefin tuna (*T. orientalis*), skipjack tuna (*K. pelamis*), southern bluefin tuna (*T. maccoyii*), yellowfin tuna (*T. albacares*), and swordfish (*X. gladius*) in the New Zealand fisheries waters and adjacent areas for the 2021/22 fishing year and 2021 calendar year

6. To estimate the catches, catch rates, and discards of non-target fish, HMS sharks in tuna and swordfish longline fisheries using data from the Observer Programme and commercial fishing returns for the 2021/22 fishing year and 2021 calendar year.

Rationale:

General:

New Zealand has a range of HMS fisheries both within New Zealand fishery waters (NZFW), the EEZs of Pacific Island States, and on the high seas. Many of the fish target and bycatch species taken in these fisheries are highly migratory species (HMS) which are managed under Regional Fisheries Management Organizations (RFMOs). The Commission for the Conservation of Southern Bluefin Tuna (CCSBT) is responsible for managing southern bluefin tuna (STN) and has an interest in ecologically related species taken in STN fisheries. The Western and Central Pacific Fisheries Commission (WCPFC) is responsible for managing stocks of HMS in the western and central Pacific Ocean of which New Zealand's fisheries waters are a part. These two Commissions have memberships that include both coastal states and distant water fishing nations which fish for these stocks. As a member of CCSBT and WCPFC, New Zealand has many obligations, including the provision of data and submission of annual reports describing the fisheries and research activities.

Many of these species were brought into New Zealand's Quota Management System (QMS) in 2004, with skipjack and albacore tuna the only major components of New Zealand tuna fisheries (target or bycatch species) outside the QMS. Those introduced to the QMS were added to the Third Schedule of the Fisheries Act (1996) to reflect their HMS status.

Over the past three years New Zealand-registered vessels have taken approximately 14,000 - 24,000 t of tuna and swordfish. Most of this catch is skipjack tuna (9,000 – 19,000 t), with albacore and southern Bluefin tuna making up most of the remainder. Whilst the longline catch is quite low, these catches are often of high value species (e.g. southern bluefin tuna and swordfish). A number of shark species (e.g. blue and mako sharks) are also taken as bycatch.

Tuna comprise a significant fishery for highly migratory species in New Zealand fisheries waters, and by New Zealand fishers on the high seas. Understanding these fisheries is important for both domestic management and the development of New Zealand's position in RFMOs.

New Zealand is required to submit data to both WCPFC and CCSBT and produce National Country Reports (NCR) summarising these data. The outputs of this project will be major inputs to NFRs to the WCPFC and CCSBT Scientific Committees and Commission reports and the CCSBT Ecologically Related Species Working Group. It is also likely that the successful tenderer will be required to provide input to other papers that could be required for these fora.

Outputs of this research project will also be used to monitor progress against objectives and performance criteria identified in the national fisheries plan for HMS.

This research is necessary because:

- New Zealand has international obligations to report annually on our HMS fisheries;

- These species support valuable commercial fisheries;
- The project contributes to achieving Objective 6 of the National Fisheries Plan for Highly Migratory Species (Maintain a sustainable fishery for HMS within environmental standards), in particular 6.3: Improve knowledge of HMS fisheries; and
- The project has been identified as integral to the tuna and billfish components of the 5-year Research Plan for HMS.

Objectives 1, 3 and 5:
Analyses under this objective will focus on the describing the various HMS fisheries operating within New Zealand fisheries waters, on the high seas and in the EEZs of other countries (if available) by New Zealand flagged vessels. This will include analysis of all current data to provide detailed gear characteristics for all fleets, and should include logbook and observer data analysis. Inputs and report updates will be required for the NCRs for the WCPFC and CCSBT Scientific Committees and Commissions and the CCSBT Ecologically Related Species Working Group. Previous NCRs should be consulted for examples of the types of analyses to be included, but it is noted that the requirements could differ depending on specific requests from the Commissions.
The National Fisheries Plan establishes a process of on-going monitoring against the objectives and performance criteria identified in the plan, particularly through an annual review report (ARR) that is prepared in December for the fishing year finishing in September. On-going monitoring tasks are identified in the annual operational plan (AOP) and will need to be provided by the end of November of each year.

Outputs will include:
- total catch and effort per species by December for the fishing year just ended;
- analyses of the spatial and temporal distribution of effort and catches of key tuna and billfish species including assessment of trends for any signs of stock contraction for all tuna species;
- developing plots of the number of vessels per year in each fishery for the history of the New Zealand fleets;
- unstandardised CPUE data for important species (e.g. southern bluefin tuna, bigeye tuna, and swordfish);
- estimates of observer coverage in terms of effort and catch for the purse seine, troll and longline fisheries;
- number of vessels catching albacore;
- review trends in NZ domestic catches of skipjack and albacore;

Available information on the destination of New Zealand's tuna exports and estimates of recreational catches and spatial trends in catch of southern bluefin tuna and Pacific bluefin tuna from the Amateur Charter Vessel Reporting Forms reporting and other HMS activity reports should be collated.

Objective 2, 4 and 6:
Analyses under this objective will focus on non-target fish, HMS shark, and other bycatch taken in tuna and swordfish fisheries. This will include analysis of all current data to provide detailed gear characteristics for all fleets, and should include logbook and observer data

analysis. Inputs and report updates will be required for the NCRs for the WCPFC Scientific Committee and Commissions, and if relevant the CCSBT Ecologically Related Species Working Groups.

Outputs will include:

- estimates of catches and discards of sharks and commonly caught (e.g. top ten) teleost fish bycatch species in tuna and swordfish longline fisheries based on ratio estimators or other approaches;
- summaries of the life status of discards in the longline and troll fishery;
- catch in weight and numbers from the longline, troll and purse seine fleets of blue, silky, oceanic whitetip, mako, porbeagle, hammerhead and thresher sharks as well as any other relevant shark species, including reported landings (by processed state) and discards including 6th schedule releases. If no catch of the species is recorded then the report must indicate zero catch;
- unstandardised CPUE data for bycatch species with reliable catch data and summaries of any information on bycatch from the skipjack purse seine fishery, both EEZ and ex EEZ;
- ensure that this information is provided in early April to enable completion of the annual CCSBT and WCPFC country reports.

Weighting of Objectives:
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.17, 0.16, 0.17, 0.16, 0.17, 0.17.

Notes:
The outputs of this project will include reports for various international fisheries organisations and the data analysed under this project will be that submitted by New Zealand to WCPFC and CCSBT.

STM2019-01

Project Code:	STM2019-01
Project title:	Multi-year stock monitoring of striped marlin including logbook programme implementation
Start date:	1 January 2020
Completion date:	30 December 2022
Vessel use:	None
Estimated cost:	$55 000 per year, $165 000 total

Overall Research Objective:
To monitor recreational fisheries for billfish within New Zealand fisheries waters.

Specific Research Objectives:

1. To update time series of catches, landings, and size composition data collected from recreational sources for the 2019/20, 2020/21 and 2021/22 fishing years.

2. To undertake a logbook programme for striped marlin for the recreational fishery for the 2019/20, 2020/21 and 2021/22 fishing years.

Rationale:
General:
Striped marlin forms 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 for sale. Information on this component of the catch is collected by observers and fisher reporting.
New Zealand fishers encounter some of the largest and likely oldest striped marlin in the Pacific, so the abundance of fish found within New Zealand fisheries waters will be sensitive to the status of the stock in addition to environmental factors that may also influence availability. For these reasons monitoring of the components of the stock that migrate through, or reside within, New Zealand fisheries waters will be important input for any future regional stock assessment.
The Oceanic Fisheries Programme of the Secretariat of the Pacific Community (OFP-SPC) has compiled catch estimates for the western and central Pacific Ocean, and the Australian Bureau of Rural Sciences in collaboration with OFP-SPC developed a stock assessment for the southwest Pacific Ocean in 2012. The model showed that stock biomass declined rapidly through the 1960s, the stock decline was more gradual from 1970 through to 2011. Overall fishing mortality has shown a slow but continuous increase from the 1950s through to 2011.
This research project is a continuation of monitoring of striped marlin catches by recreational and commercial fishing. Recreational catch and size composition data are available for the

major sports fishing clubs for well over 50 years and catch and effort data are available for the east Northland charter fleet for 30 years. The quality of the catch data is very high and was a critical input to the regional stock assessment. The Southwest Pacific striped marlin stock assessment is scheduled to be updated in 2019.

The stock structure of striped marlin in the Pacific Ocean is not well known, but is the focus of current research activities. The two most frequently considered hypotheses are: (1) a single-unit stock in the Pacific, which is supported by the continuous "horseshoe-shaped" distribution of striped marlin; and (2) a two-stock structure, with the stocks separated roughly at the Equator, albeit with some intermixing in the eastern Pacific. Concern was expressed at the WCPFC Science Committee meeting in 2008 about the decline in the large north Pacific striped marlin fishery.

Monitoring of striped marlin in New Zealand fisheries waters is based on monitoring the catches of striped marlin in the recreational fishery and the levels of bycatch in the commercial longline fisheries targeting tuna.

This research is necessary because:

- striped marlin supports a significant recreational fishery;
- stock status and stock structure of striped marlin is largely unknown, the stock assessment available for this region is highly uncertain;
- as the striped marlin found in New Zealand waters are among the largest encountered in the Pacific, trends in the abundance of this component of the stock could provide important indicators of the status of the stock and provide important information for future regional stock assessments; and
- if this project does not go ahead, future regional stock assessments for striped marlin will be less reliable due to the lack of information on the largest individuals.

Objective 1:

Future stock assessments for striped marlin will rely heavily on accurate catch statistics. It is important that the various data series are clearly defined. For example, estimates of the numbers and sizes of fish landed may be collected from the various sport-fishing clubs, but these data will be reported separately from estimates of the numbers and estimated sizes of fish released. Size composition information could include both lengths and weights.

This project will not collect commercial estimates of catches as these will be provided from other MPI projects (e.g., HMS2016-01).

This objective is a continuation of the work undertaken under objective 1 of STM2003/01, STM2005/01, STM2007/01, STM2009-01, STM2011-01, STM2013-01, and STM2016-01 with the inclusion of catch data on other billfish.

Objective 2:

Under this objective the logbook programme implemented under Objective three of project STM2007/01 will be extended for a further three years. The focus will be on collecting high quality catch and effort data for the purpose of deriving CPUE indices for the striped marlin fishery though data on other billfish species (excluding swordfish) will also be collected. The CPUIE time series will be used as an input to the 2019 stock assessment

The tenderer is expected to work closely with logbook holders to ensure high quality data and participation rates, and to ensure that the data collection complements rather than duplicates compulsory charter boat reporting. This will need to be reviewed by the Highly Migratory Species Working Group prior to commencement. Part of this will be providing good feedback to fishers, including data summaries. The tenderer will also ensure that the data is

captured and provided to MPI for inclusion in the appropriate data base, and be presented annually to the Highly Migratory Species Working Group.
To improve understanding of the CPUE/abundance relationship the sensitivity of CPUE standardisation to predictor variable inputs should be investigated using the long time series of data. Abundance indices in HMS assessments tend to use predictor data acquired during the fishing process (time, position, sea surface temperature) together with other readily available data (bathymetry, SOI). This project should compare such indices with indices developed using remote sensed data (SST, surface chlorophyll) and model-based sources (ocean currents).
With the long time series of fisheries catch rates and environmental data available, it is possible to aggregate data at a variety of temporal and spatial scales and to investigate specific regions of interest such as where there has been continuous fishing. This should help address unfished area and change in range issues in the analyses.

The derived indices will have considerable use for the assessment of HMS stock status through CPUE standardisation and stock assessment (such as building on the current swordfish and striped marlin work).

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:

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Francis, M.P.; Griggs, L.H.; Baird, S.J. (2004). Fish bycatch in New Zealand tuna longline fisheries, 1998–99 to 1999–2000. *New Zealand Fisheries Assessment Report 2004/22*. 62 p.

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Notes:

This is a project is a continuation of the time series of striped marlin monitoring projects extended to include the small recreational catches of other billfish taken in New Zealand fisheries waters.

The outputs of this project will possibly include reports for various international fisheries organisations; however, these will be contracted separately as required.

The design of the logbook programme should be cross-checked against the compulsory charter vessel reporting scheme now in place to avoid duplicate reporting where possible.

STM2019-02

Project number:	STM2019-02
Project title:	Characterisation of commercial fisheries that catch striped marlin
Start date:	1 October 2019
End date:	30 September 2020
Vessel use:	None
Estimated cost:	$30 000

Overall Objective:
To improve the understanding of bycatch of striped marlin in the commercial surface longline fishery.

Specific Objective:
To characterise the surface longline fisheries for New Zealand commercial vessels taking striped marlin as bycatch in New Zealand waters.

Rationale:
General:
Striped marlin forms 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 for sale. Information on the commercial component of the catch is collected by observers and fisher reporting.
Monitoring of striped marlin in New Zealand fisheries waters is based on monitoring the catches of striped marlin in the recreational fishery and the levels of bycatch in the commercial longline fisheries targeting tuna. Between 2013-14 and 2016-17 a total of between 200 and 600 striped marlin were observed by fisheries observers being caught and discarded from commercial longline vessels.

This research is necessary because:

- striped marlin supports a significant recreational fishery;
- as the striped marlin found in New Zealand waters are among the largest encountered in the Pacific, trends in the abundance of this component of the stock could provide important indicators of the status of the stock and provide important information for future regional stock assessments

Objective 1:

The characterisation will use all existing reported catch and effort returns and observer catch and effort data to the end of the 2018/19 fishing year to describe the vessels, fisheries and spatio-temporal characteristics of the New Zealand surface longline fisheries in the New Zealand EEZ. The work should describe the spatio-temporal catch and effort distribution patterns of these fisheries catching striped marlin as bycatch and document changes in fishing areas over time.

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

Note:
The outputs of this project will possibly include reports for various international fisheries organisations; however, these will be contracted separately as required.

STN2019-02

Project number:	STN2019-02
Project title:	Estimation of recreational harvest of Southern Bluefin Tuna in New Zealand
Start date:	1 April 2020
Completion date:	31 December 2020
Vessel use:	None
Estimated cost:	$60 000

Overall Objective:

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

Specific Objectives:

1. To design an on-site survey to estimate amateur harvest of southern bluefin tuna in the eastern Bay of Plenty.

2. To design and implement 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 2020 southern bluefin tuna fishing year using the method developed in Specific Objectives 1 and 2, data from the amateur charter vessels, section 111 landings and sport fishing club records.

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

Rationale:

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 by domestic longline vessels. There is also a recreational fishery for the species.

The 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 also required in support of the National Fisheries Plan for HMS and is necessary because:

- Southern bluefin tuna form a valuable target longline fishery; and
- New Zealand is required 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.
Most effort in both years 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.
An unknown proportion of landed catch was not weighed. In 2018 an access point survey at the main boat ramps in the area to measure and record southern bluefin tuna catch 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. In 2018 the number of southern Bluefin tuna harvest from the west coast South Island was estimated as between 60-100 fish based on a number of sources. However, this estimate is very approximate and needs to be refined.

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

Objective 5:
The purpose of this objective is to collect otoliths from Southern Bluefin tuna caught by the recreational fleet to increase the number of otoliths analysed in project STN2018-01.

Weighting of Objectives:
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.15, 0.15, 0.4, 0.15, and 0.15.

SWO2019-01

Project number:	SWO2019-01
Project title:	Characterisation of the fishery for and analysis of CPUE for swordfish from the commercial longline fishery in NZ waters
Start date:	1 July 2019
End date:	30 June 2020
Vessel use:	None
Estimated cost:	$30 000

Overall Objective:
To characterise the fishery for and analyse the CPUE of swordfish from the commercial longline fishery in NZ waters

Specific Objectives:

1. To characterise the commercial longline fishery for swordfish in NZ waters

2. To carry out unstandardised and standardised CPUE analyses of catch and effort data from the commercial longline fishery for swordfish in NZ waters

Rationale:

General:
WCPFC is planning to conduct a stock assessment for swordfish in the Southwest Pacific in 2022. The most recent assessment for this species in the region was conducted in 2017. Swordfish are either targeted or caught in the tuna longline fishery as a bycatch when targeting bigeye and to a lesser extent when targeting southern bluefin tuna. Swordfish can be caught in most FMAs and adjacent high seas areas although most catches are from waters north of 40ºS. Most of the catch is from FMAs 1, 2 and 9. Swordfish catch by domestic vessels increased rapidly from 1994–95 to peak at 1100 t in 2000–01. Since 2000–01, swordfish catches declined in each year coinciding with the decline in effort in the surface-longline fishery, until 2005–06 when they increased again, reaching a peak of about 800 t in 2012-13. This increase is attributed to the development of a target fishery. Landings have declined since reaching a low of 475 t in 2017-18. Members of the recreational sector have expressed concerns at this decline in commercial landings as well as the increased retention of small swordfish by the commercial fleet.

There have also been changes in fishing gear and practices in the commercial longline fishery that may have been wide ranging and are often target species specific. For example, fishers targeting swordfish using longline gear have changed to using light sticks, and changed the depth of their fishing gear, specifically to try and increase catch rates of swordfish. As a result of seabird mitigation requirements, longline fishers have changed to

night setting and using tori lines, with an unknown effect on catchability. These and other changes have undoubtedly resulted in changes in catchability over time, which need to be estimated and incorporated into any future CPUE standardisations or assessments for these stocks.

Objective 1:
The first step in this project will be to update the characterisation of the commercial longline fishery for swordfish with the addition of data through the 2017-18 fishing year. Results of this characterisation will be used to determine the most appropriate vessels, fisheries and spatio-temporal characteristics of the data to be used and form the basis for the update of the CPUE analyses of the commercial swordfish fishery.

Objective 2:
The next step in this project is to carry out unstandardised and standardised CPUE analyses of catch and effort data from the commercial swordfish longline fishery in NZ waters with the addition of data through the 2017-18 fishing year. The results of this analysis will be evaluated to determine possible causes for the decline in the commercial longline swordfish landings during recent years.

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.

TAG2019-01

Project number:	TAG2019-01
Project title:	Management of data from the gamefish tag recapture programme
Start date:	1 January 2020
End date:	30 November 2022
Vessel use:	None
Estimated cost:	$75 000 per year, $225 000 total

Overall Objective:

1. To manage and report the data obtained from the co-operative tag recapture programme for gamefish.

Specific Objectives:

1. To characterise the New Zealand recreational gamefish fishery.

2. To collect and key punch tagging and recapture data for gamefish species in the 2019/20, 2020/21 and 2021/22 fishing years.

3. To compile annual summaries of the results of the tag recapture programme for 2019/20, 2020/21 and 2021/22 fishing years.

4. To develop graphical descriptions of linear displacements for each species tagged, released and recaptured by the programme; review displacements in terms of time-at-liberty, fish size, season and area.

Rationale:

General:

Participation in this programme is supported by the New Zealand Sport Fishing Council (who purchase and distribute tags to recreational fishers). The current process of contracted programme management and annual reporting is also providing good results from the gamefish tagging programme and further promotes participation. The annual reports provide stakeholders with an understanding of the fish tagged, and the tag returns annually. The reports and programme data are also in demand internationally with requests from Australia, the United States of America and international fisheries management organisations.

The co-operative tagging programme has been underway since 1975 mainly tagging billfish, kingfish, mako and blue sharks. More recently yellowfin tuna have been included in the

programme. Participation in the gamefish tagging programme increased dramatically in 1988 when the Billfish Moratorium was implemented in the Auckland FMA. The moratorium and subsequent regulations prohibits the retention of any commercially caught billfish with the exception of swordfish caught by domestic vessels.

In the cooperative tagging programme, recreational anglers voluntarily tag and release gamefish and report release and recapture information. For species such as striped marlin, Pacific bluefin tuna, mako and blue sharks the majority of the recreational catch is released. The spatio-temporal data are used to characterise these fisheries.

This research is necessary because:

- gamefish catches are significant to the recreational sector and the gamefish tagging programme is seen by that sector as particularly important;
- the programme has also provided important background information on a variety of species for fisheries management purposes including, in the case of marlin, as the primary source of information on the fishery; and
- the project has been identified as integral to the gamefish component of the Medium Term Research Plan for Highly Migratory Species.
- This project supports the relevant fish plan objective to maintain/enhance world class gamefisheries in New Zealand fisheries waters

Objective 1:
Characterise the recreational fishery for Highly Migratory Species (including tunas, billfish, and sharks) in New Zealand. This work should include a description of the fisheries; size of the fleets; distribution of the fleets and clubs; and catch and effort trends. The proportion of catch that is tagged and released by species should be reporting using New Zealand Sport Fishing Council catch records.

Objectives 2 and 3:
In recent years the programme has been supported by the New Zealand Sport Fishing Council who have purchased and distributed tags; and by the Ministry for Primary Industries who has funded the recording and processing of release and recapture information. The successful tenderer will be expected to liaise with the New Zealand Sport Fishing Council to ensure the successful outcome of this project.
An annual report will be required for each year of the programme covered by this project. These reports should summarise information such as the number of fish tagged and recaptured for each species, and information on movements (see TAG2016-01 reports). In addition, the report should include figures showing:

- tuna (albacore, bigeye, bluefin, slender and yellowfin) annual catch by recreational fishing zone from club records pooled and by year;
- shark annual catch by species (where enough data exist) by recreational fishing zone from club records pooled and by year; and
- billfish annual catch by recreational fishing zone from club records pooled and by year;

and tabulated data for

- national catch tallies for the smaller and bycatch gamefish HMS species by year; and
- national landed catch tallies for the big gamefish HMS species by year.

Objective 4:
Develop graphical distribution patterns for all species that have been tagged and released by the programme, including spatial maps and plots. The displacements should be presented and analysed in terms of time-at-liberty, fish size, season, area and fisher. A detailed description of fishers' success and probability of a tagger's fish being recaptured needs to be undertaken. In particular, fishers whose released fish recapture rates are above average need to be identified for future specialist work. Also those with high release rates but low recapture rates need to be identified as well.

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, 0.1, 0.3, 0.3.

Note:

- This project continues an extensive time series of work with PEL2000-01, PEL2003-01, TAG2006-01, TAG 2009-01, TAG 2012-01, TAG2013-01, and 2016-01 being the most recent projects).

- The data collected in this programme are to be updated on the MPI *tag* database (managed by NIWA) annually.

Deepwater Fisheries

HAK2019-01	Stock assessment of hake in HAK4
HOK2019-01	Estimation of spawning hoki biomass in Cook Strait using acoustic surveys
HOK2019-02	Land based catch sampling of hoki
HOK2019-03	Stock assessment of hoki in HOK1
LIN2019-03	Stock assessment of ling in LIN7
MID2019-02	Routine age determination of middle depth and deepwater species from commercial fisheries and resource surveys
ORH2019-02	Estimation of the abundance of orange roughy using acoustic surveys (ORH 3B Northwest Rise and East and South Chatham Rise)
SBW2019-01	Biomass estimation of the Campbell Island southern blue whiting stock using acoustic surveys
SBW2019-03	Stock assessment of southern blue whiting in SBW6I
SCI2019-01	Estimation of the abundance of scampi in SCI3 using photographic surveys
SCI2019-02	Stock assessment of scampi in SCI6A

HAK2019-01

Project number:	HAK2019-01
Project title:	Stock assessment of hake in HAK4
Start date:	1 July 2019
Completion date:	30 September 2020
Vessel use:	None
Estimated cost:	$57 000

Overall Objective:
To carry out stock assessments of hake (*Merluccius australis*) on the Chatham Rise (HAK 1 and 4).

Specific Objectives:

1. To carry out a descriptive analysis of the commercial catch and effort data for hake on the Chatham Rise in preparation for the quantitative stock assessment.

2. To complete a standardised catch and effort analyses from the Chatham Rise hake fisheries.

3. To complete a stock assessment of the Chatham Rise hake stocks including estimating biomass, sustainable yields, and status of the stock, and projecting biomass and stock status trajectories as required to support management.

Reporting Requirements:

All Objectives:

1. To present the progress and updates to meetings of the Deepwater Fishery Assessment Working Group as appropriate.

2. To submit to MPI Contracts Monitoring a draft revised Working Group Report as specified in Fishery Assessment Document form 2 by 30 April 2020.

3. To submit to the MPI Contracts Monitoring a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 September 2020.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 September 2020.

Rationale:

General:
Hake is an important middle depth species taken mainly in the sub-Antarctic and on the west coast of the South Island. It is both a target species and also a common bycatch of hoki target fisheries, especially on the west coast of the South Island. Historical catches from the Chatham Rise were also large, but have declined to almost negligible levels in recent years with very little targeting of hake in that area.

The Chatham Rise stock is considered to include the whole of the Chatham Rise (HAK 4), including the western end currently forming part of the HAK 1 management area; therefore, catches from this area are subtracted from the Sub-Antarctic stock and added to the Chatham Rise stock. Catches of both areas combined are considerably less than the HAK 4 TACC of 1,800 tonnes (348 tonnes in 2014/15).

In 2014, all three hake stocks were certified by Marine Stewardship Council as sustainable fisheries, and were recertified as part of the combined Hoki, Hake and Ling Trawl Fishery in 2018. Regular stock assessments are essential to retain the certification of these fisheries.

Objective 1:
Descriptive analyses should be completed for the Chatham Rise a hake fisheries prior to the assessment.

Objective 2:
Catch and effort data will be analysed for the Chatham Rise and bycatch fisheries and used to determine a CPUE series where appropriate.

Objective 3:
New catch-at-age data, CPUE analyses, all available biological and fisheries data, and abundance indices from trawl surveys will be used to provide an assessment of the hake stocks. New abundance information for these assessments include a further trawl survey of the Chatham Rise in January 2020.

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, 0.2, 0.5.

HOK2019-01

Project number:	HOK2019-01
Project title:	Estimation of spawning hoki biomass in Cook Strait using acoustic surveys
Start date:	01 June 2019
Completion date:	30 June 2020
Vessel use:	TBC, July/August 2019
Estimated cost:	$350 000

Overall Objectives:
1. To estimate the spawning biomass of hoki (*Macruronus novaezelandiae*) in the Cook Strait using acoustic surveys.

Specific Objectives:
1. To continue the time series of relative abundance indices of spawning hoki in Cook Strait using acoustic surveys, with a target coefficient of variation (CV) of the estimate of 30%.

2. To provide a relative abundance index of hoki in Pegasus Canyon using acoustic surveys, with a target CV of the estimate of 30%

*Reporting Requirements***:**

All Objectives:
1. To submit to MPI Contracts Manager a voyage programme one month before the survey.

2. To submit to MPI Contracts Manager a voyage report one month after the survey.

3. To present the progress and results to meetings of the Deepwater Fishery Assessment Working Group as appropriate.

4. To submit to the MPI Contracts Monitoring a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 June 2020.

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.

Data Reporting

To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 June 2020.

Rationale:

General:
Hoki is one of New Zealand's largest fisheries with a TACC of 150,000 tonnes. Although managed as a single stock, hoki is assessed as two stocks, western and eastern. Juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity.

The main spawning fisheries for hoki operate from mid-July to late August on the west coast of the South Island (WCSI) and in Cook Strait where hoki aggregate to spawn. Because of the importance of this fishery the hoki stock assessment is updated each year with new information from a wide range of data collection and research programmes.

Acoustic surveys of the Cook Strait hoki spawning grounds are planned to occur be completed biennially to update the biomass indices for the eastern spawning stock. Although the acoustic results from Cook Strait have not been very influential on the stock assessment model results, it is considered necessary to monitor the abundance of the eastern spawning stock independently of the Chatham Rise, where both eastern and western hoki are mixed together.

This project has high priority to continue the time series of biomass estimates for the eastern spawning stock in Cook Strait.

Objective 1:
Previous acoustic surveys of Cook Strait were carried out on research vessels in 1991 and continuously from 1993-2006 (except 2000 and 2004). A further acoustic survey was completed in winter 2008 (HOK2007/03) that also surveyed the east coast South Island areas of Pegasus and Conway Trough. More recently, industry vessels have surveyed part of Cook Strait during the hoki spawning season biennially since 2009. This project continues the same approach, where the main fishing grounds in Cook Strait will be surveyed throughout the spawning season from an industry vessel during commercial fishing trips.

Both bottom and midwater trawling should be completed during the acoustic survey to determine the relative abundance of hoki and other species. The abundance of the other species is required in order to estimate the biomass of hoki in the survey area.

Objective 2:
Previous acoustic surveys of Pegasus Canyon have been carried out opportunistically in some previous years, in particular in winter 2008 (HOK2007/03). This objective aims to provide an updated relative index of abundance in the Pegasus Canyon that is consistent with estimates from previous surveys.

Both bottom and midwater trawling should be completed during the acoustic survey to determine the relative abundance of hoki and other species. The abundance of the other species is required in order to estimate the biomass of hoki in the survey area.

This objective will only be completed if weather and circumstances allow completion without the addition of significant time or compromising the completion of Objective 1.

Weighting of Objectives:
Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are 0.8 and 0.2.

HOK2019-02

Project Code:	HOK2019-02
Project title:	Land-based sampling of hoki
Start date:	1 June 2019
Completion date:	31 December 2020
Vessel use:	None
Estimated cost:	$80 000

Overall Objective:
1. To determine the catch at age from the main hoki spawning fisheries as input data to the stock assessment of this species.

Specific Objective:
To collect otolith samples from commercial landings of hoki from Cook Strait and inside the 25 nautical mile line on the west coast of the South Island during winter 2019.

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 a draft Fishery Assessment Report as specified in Research Reporting form 7 by 31 December 2020.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 31 December 2020.

Rationale:

General:
Hoki is one of New Zealand's largest fisheries with a TACC of 150,000 tonnes. Although managed as a single stock, hoki is assessed as two stocks, western and eastern. Juveniles

from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity.

The main spawning fisheries for hoki operate from mid-July to late August on the west coast of the South Island (WCSI) and in Cook Strait where hoki aggregate to spawn. Because of the importance of this fishery the hoki stock assessment is updated each year with new information from a wide range of data collection and research programmes.

Size and age data from the commercial fisheries continue to be crucial inputs into the stock assessment providing information on the strength of recruited cohorts. Catch at age data from the spawning fisheries on the WCSI and Cook Strait have been collected every year since 1988.

In recent years, the Ministry's Observer Programme has collected samples of length data and otoliths from the catch in the hoki fishery. However, sampling of certain groups of vessels has been inadequate, and it is therefore necessary to supplement these samples with shore-based sampling. The Cook Strait catch-at-age data was not able to be used in 2013 and 2014 hoki stock assessments, except as a sensitivity, as it was not considered to be representative of the commercial catch in those years due to the low observer coverage. Samples from the WCSI show size differences from catches taken inside and outside the 25 nm management boundary, which excludes larger vessels from inshore waters. Further sampling is required to ensure representative catch sampling is undertaken throughout the fishing season.

Land-based sampling of Cook Strait hoki catches has been carried out from 2014-18 and has provided sufficient data to input into the stock assessment model. This catch sampling remains a high priority to ensure reliable distributions of catch at age are obtained from the Cook Strait hoki spawning fishery.

Objective 1:
Cook Strait
In winter 2006, during the shore sampling programme, it became apparent that three larger vessels from one company were sorting fish (by size) at sea to decrease onshore processing time and improve product quality. From 2007 vessels longer than 40 m were therefore no longer sampled by the shed sampling programme and the Ministry's Observer Programme undertook to sample these vessels at sea.
The Cook Strait fishery has previously been stratified by time of the season, size of vessel and point of landing (Wellington or Nelson/Picton). Samples are required from each of the main strata throughout July and August but some sampling in June and September may be necessary.

Previous sampling of hoki catches from the Cook Strait fishery indicate the minimum numbers of samples required to meet the target of 20% mean weighted CV across the age distribution. The number of otoliths aged in the annual deepwater ageing contract is about 750 (combined males and females) each year.

West Coast, South Island

Size frequency data from previous years show differences between the hoki caught by vessels fishing inside the line and those caught by the larger vessels fishing outside the 'line'. In many years insufficient samples are available from Observer sampling inside the line for some months of the season.

Weighting of Objectives:

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project is 1.0.

HOK2019-03

Project number:	HOK2019-03
Project title:	Hoki population modelling and stock assessment
Start date:	1 October 2019
Completion date:	30 September 2020
Vessel use:	None
Estimated cost:	$130 000

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

Specific 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:

All Objectives:

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 a draft revised Working Group Report as specified in Fishery Assessment Document form 2 by 30 April 2020.

3. To submit to the MPI Contracts Monitoring a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 September 2020.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 September 2020.

Rationale:

General:
Hoki is New Zealand's largest fishery with a 2017/18 TACC of 150,000 tonnes. Although managed within a single quota management area (HOK 1), hoki is assessed as two stocks, western and eastern, with a voluntary catch agreement in place to limit catch in each area to 90,000 tonnes and 60,000 tonnes, respectively. 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 (next in July/August 2019), which provides abundance information about the eastern spawning stock; 2) the Chatham Rise trawl survey (next in January 2020), which provides incoming recruitment estimates for both stocks and an eastern stock biomass index; 3) the sub-Antarctic trawl survey (next in December 2018), which provides the main abundance index for the western stock; and 4) the West Coast acoustic survey, undertaken less regularly (last in June/July 2018). Catch at age data from the spawning fisheries on the WCSI and Cook Strait are also collected each year.

For the 2016/17 and 2017/18 fishing years, hoki catch rates have been lower than usual, in particular on the west coast of the South Island. Reasons why remain unclear at present. Currently, Fisheries New Zealand research providers are re-testing the methodology underpinning the stock assessment model to ensure that it is as robust as possible. Outcomes of this research may inform the stock assessment model parametrisation for HOK2019-03.

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.

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-parametrization of the current hoki stock assessment model, depending upon outcomes from HOK2018-01.

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

LIN2019-03

Project Number:	LIN2019-03
Project title:	Stock assessment of ling in LIN7
Start date:	1 July 2019
Completion date:	30 September 2020
Vessel use:	None
Project Cost:	$92 000

Overall Objective:
To carry out stock assessments of ling (*Genypterus blacodes*) from the west coast of the South Island including estimating biomass and sustainable yields.

Specific Objectives:

1. To carry out a descriptive analysis of the commercial catch and effort data for ling from WCSI in preparation for the quantitative stock assessment.

2. To complete a standardised catch and effort analyses from the relevant ling fisheries, including both longline and trawl fishing methods.

3. To complete a stock assessment of the WCSI ling stock including estimating biomass, sustainable yields and status of the stock, and projecting biomass and stock status trajectories 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 MPI Contracts Monitoring a draft revised Working Group Report as specified in Fishery Assessment Document form 2 by 30 April 2020.

3. To submit to the MPI Contracts Monitoring a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 September 2020.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 September 2020.

Rationale:

General:
Ling is an important middle depth species taken mainly around the South Island. It supports a substantial bottom longline fishery, a target trawl fishery, and is a major bycatch in middle depth trawl fisheries. Some near-shore set net and longline targeting for ling is also conducted. Recreational and Maori customary take of ling is believed to be negligible in all areas.

Landings of ling have ranged from 12,000 tonnes to 19,000 tonnes over the most recent 10 years. Stock assessments for the Cook Strait stock (part of LIN 2 and part of LIN 7), Chatham Rise stock (LIN 3& 4), Sub-Antarctic stock (LIN 5&6), and West Coast South Island stock (LIN 7) have been updated regularly. The current TACC for LIN 7 of 3,080 tonnes, which has been in place since 2013/14, has been overcaught every year since.

In 2014, LIN3-7 were certified by Marine Stewardship Council as sustainable fisheries, and were recertified in 2018 within the newly-combined Hoki, Hake and Ling trawl fishery. Regular stock assessments are essential to retaining the certification of these fisheries.

Objective 1:
A descriptive analysis for the ling fisheries in LIN 7 (west coast South Island) should be completed prior to the assessment.

Objective 2:
Catch and effort data will be analysed for the target longline and trawl bycatch fisheries and used to provide a CPUE series where appropriate.

Objective 3:
New catch-at-age data, CPUE analyses, all available biological and fisheries data, and abundance indices from relevant trawl and/or acoustic surveys will be used to complete a assessment of the ling stocks. New abundance information for the assessment of LIN 7 includes a further trawl survey of the WCSI in July 2018.

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, 0.2, 0.5.

MID2019-02

Project Code:	MID2019-02
Project title:	Routine age determination of middle depth and deepwater species from commercial fisheries and resource surveys
Start date:	1 July 2019
Completion date:	30 September 2020
Vessel use:	None
Estimated cost:	$500 000

Overall 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 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 2019 to August 2020 in Wellington.

2. To submit to MPI Contracts Management 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 30 September 2020.

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 the course of this project to the Research Data Manager, Fisheries New Zealand by 30 September 2020.

Rationale:

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 coverage and research surveys will provide samples of length frequency, spawning state, and otoliths from middle depth and deepwater species. For the 2019/20 year, ageing will be carried out for the following fishstocks:

Fishery or stock	Area	Source	Method	Number of readings
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
	Sub-Antarctic trawl survey	Research	ALK	750
HAK 1	Sub-Antarctic fishery	OP	Direct	600
	Sub-Antarctic trawl survey	Research	ALK	600
HAK 4	Chatham Rise fishery	OP	Direct	600
HAK 7	WCSI fishery	OP	ALK	600
	WCSI trawl survey	Research	ALK	600
LIN 3 & 4	Chatham Rise fishery	OP	Direct	600
LIN 5 & 6	Sub-Antarctic fishery	OP	Direct	600
	Sub-Antarctic trawl survey	Research	ALK	600
LIN 7	WCSI fishery	OP	ALK	600
	WCSI trawl survey	Research	ALK	600
SBW 6I	Campbell Islands spawning	OP	ALK	600
SBW 6B	Bounty Platform spawning	OP & Research	ALK	600

JMA 7 (3 species)	WCSI/WCNI fisheries	OP	Direct	1800
ORH 7A	ORH acoustic survey (ORH 7A)	Research	ALK	900
OEO 3A	Fishery/survey	OP & Research	??	600

Objective 2:
To support additional research not yet specified, the ageing of up to 2 400 additional otoliths will be funded for 2018-19.

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.

ORH2019-02

Project Code:	ORH2019-02
Project title:	Estimation of the abundance of orange roughy using acoustic surveys (ORH 3B Northwest Rise and East and South Chatham Rise)
Start date:	1 June 2019
Completion date:	30 May 2020
Vessel use:	Subject to tender, June 2019
Estimated cost:	$1 090 000

Overall Objective:
To estimate the abundance of orange roughy (*Hoplostethus atlanticus*) in selected areas of ORH 3B.

Specific Objectives:

1. To estimate the abundance of orange roughy from an acoustic survey with a target coefficient of variation (c.v.) of the estimate of 20-30% in July 2020 for the Northwest Chatham Rise.

2. To estimate the abundance of orange roughy from an acoustic survey with a target coefficient of variation (c.v.) of the estimate of 20-30% in July 2020 for the main spawning plumes in the East and South Chatham Rise stock.

Reporting Requirements:

All Objectives:

1. To submit to MPI Contracts Manager a voyage programme one month before the survey.

2. To submit to MPI Contracts Manager a voyage report one month after the survey.

3. To present the progress and results to meetings of the Deepwater Fishery Assessment Working Group as appropriate.

4. To submit to the MPI Contracts Monitoring a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 May 2020.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 September 2020.

Rationale:

The Chatham Rise orange roughy fishery is currently New Zealand's largest orange roughy fishery. Based on analyses of available data, the Chatham Rise has been divided into two areas: The Northwest Chatham Rise, and the East and South Chatham Rise combined. The Northwest stock spawns on the Graveyard hills (at the Morgue seamount, which has been closed to fishing since 2001 as a Seamount Closure). The East and South Rise stock spawns in the Spawning Box where two main spawning plumes occur ('Old Plume', 'Mount Muck'), and at 'Rekohu Plume', a plume that was first detected in 2010. Non-regulatory catch limits apply to each area, which currently provide for up to 4,350 tonnes to be caught on the Chatham Rise (1,250 tonnes on the Northwest and 3,100 tonnes on the East and South Chatham Rise).

A management strategy evaluation completed in 2014 indicated that orange roughy stocks should be monitored with regular surveys every 3-4 years feeding into regular stock assessments. The Chatham Rise orange roughy stocks were most recently surveyed in 2016 and assessed in 2017.

Objective 1:
The Northwest Rise has been surveyed using three acoustic systems; towed-bodies, hull-mounted, and most recently, a multi-frequency acoustic optical system. Because of issues identifying species in acoustic marks, the estimates using hull-mounted acoustic systems are not considered to be reliable.

The survey of the Northwest Chatham Rise area will require the use of a multi-frequency system, either a towed body or net-mounted.

Objective 2:
Surveying the abundance of orange roughy in the East and South Chatham Rise stock requires acoustic surveying of the three main spawning plumes ('Old Plume', 'Mt. Muck' and 'Rekohu'). The plumes may be surveyed using a hull-mounted acoustic system as per the time series of surveys carried out 2002-2013.

A small proportion of the stock biomass is found in the 'Crack', which has been surveyed sporadically. Because of the terrain in this area and uncertainty regarding species mix, a multi-frequency system must be used in this area.

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

SBW2019-01

Project number:	SBW2019-01
Project title:	Biomass estimation of the Campbell Island southern blue whiting stock (SBW6I) using acoustic surveys
Start date:	1 July 2019
Completion date:	31 January 2020
Vessel use:	RV Tangaroa, September 2019
Estimated cost:	$2 500 000

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

Specific Objectives:

1. To estimate pre-recruit and spawning biomass at Campbell Island using an acoustic survey, with a target coefficient of variation (c.v.) of the estimate of 30%.

2. To collect in situ data on tilt-angle distribution and target strength of southern blue whiting and update the length to tilt-averaged target strength relationship as appropriate.

Reporting Requirements:

All Objectives:
1. To submit to MPI Contracts Manager a voyage programme one month before the survey.

2. To submit to MPI Contracts Manager a voyage report one month after the survey.

3. To present the results to meetings of the Deepwater Fisheries Assessment Working Group as appropriate.

4. To submit to MPI Contracts Management 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 31 January 2020.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 September 2020.

Rationale:

General:
Fisheries for SBW were developed in the early 1970s. Landings have fluctuated considerably, peaking at 75,000 tonnes in the 1991/92 fishing year, when almost 60,000 tonnes were taken from the Bounty Platform stock (SBW6B) and 15,000 tonnes were estimated taken on SBW6I. SBW 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 SBW stocks and the TACC is currently 39,200 tonnes.

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. As the fish recruit at 2 and 3 years to the fishery, surveys are 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 last acoustic survey of the Campbell Island stock was completed in September 2016 (deferred from September 2015).

Objective 1:
In September 2019 a wide-area acoustic survey will be carried out on the Campbell Island stock (SBW6I). The time series of acoustic surveys are providing fishery independent monitoring of both the recruited part of the population as well as predicting the strength of year classes about to enter the fishery.

Objective 2:
The 2019 spawning season provides an opportunity to collect in situ data on the tilt-angle distribution and target strength of spawning SBW on the Campbell Island Rise. The data are required to supplement the available data so that the length to tilt-averaged target strength relationship can be estimated.

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, 0.1.

SBW2019-03

Project number:	SBW2019-03
Project title:	Stock assessment of southern blue whiting in SBW 6I
Start date:	1 July 2019
Completion date:	30 May 2020
Vessel use:	None
Estimated cost:	$103 000

Overall Objective:
To carry out stock assessments of southern blue whiting (Micromesistius australis) around Campbell Island (SBW 6I), including estimating biomass and sustainable yields.

Specific Objectives:

1. To complete a descriptive analysis of the commercial catch and effort, and observer data for SBW 6I.

2. To complete a SBW 6I stock assessment 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 within required timeframes.

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 MPI Contracts Monitoring a draft revised Working Group Report as specified in Fishery Assessment Document form 2 by 31 January 2020.

3. To submit to the MPI Contracts Monitoring a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 May 2020.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 31 January 2020.

Rationale:

Southern blue whiting are primarily distributed in Sub-Antarctic waters where spawning aggregations, including near Campbell Island in SBW 6I, occur in August and September. The fishing year runs from 1 April to 31 March to reflect the timing of the main fishing season. The majority of the catch is currently taken by foreign owned vessels (predominantly large factory trawlers) producing headed and gutted or dressed frozen product. Southern blue whiting was introduced into the QMS in 1999 with separate TACs for each of the four main stocks within FMA 6. Landings in SBW 6I (Campbell Island Rise) have fluctuated considerably, peaking at 33,445 tonnes in the 2002/03 fishing year. The Campbell Island stock is the largest of the four southern blue whiting stocks and has a current TACC of 39,200 tonnes, which has been undercaught ever since it was increased from 29,400 in 2014/15 (18,334 tonnes were caught in 2017/18).

The current SBW 6I TACC was set using projections from a two-sex, single area, Bayseian catch-at-age model. The model used information from wide-area acoustic surveys which have been completed on the Campbell Island Rise regularly since 1993, most recently in 2016. Uncertainty around the size and timing of future age classes affects the reliability of stock projections. The 2017stock assessment indicated that stock biomass is Very likely to be above the management target but will decrease slightly over the next 1-2 years if catches are taken at the level of the TACC. Due to large fluctuations in recruitment and observed variation in growth, it is important to monitor and assesses biomass levels at regular intervals to ensure harvest levels are set appropriately.

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

Objective 2:
An acoustic survey of the Campbell Islands stock will be completed in September 20162019. The results of this survey should be used to update the stock assessment together with new catch at age data from the commercial fishery. 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.

Objective 3:
The last stock assessment of SBW 6B was completed in 2017 based on an acoustic survey completed in September 2016. An additional acoustic survey will have taken place in September 2019, the results of which should be incorporated into the model along with any new catch at age data from the commercial fishery. 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.

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, 0.3, 0.5.

SCI2019-01

Project number:	SCI2019-01
Project title:	Estimating the abundance of scampi in SCI 3 using photographic surveys
Start date:	1 July 2019
Completion date:	30 June 2021
Vessel use:	*Kaharoa*, September 2020
Estimated cost:	$780 000

Overall Objective:
To estimate the abundance of scampi (*Metanephrops challengeri*) in SCI 3.

Specific Objectives:

1. To estimate the relative abundance of scampi using photographic techniques in SCI 3.

2. To estimate growth of scampi from tagging in SCI 3.

*Reporting Requirements***:**

All objectives:
1. To submit to MPI Contracts Manager a voyage programme one month before the survey.

2. To submit to MPI Contracts Manager a voyage report one month after the survey.

3. To present the results to meetings of the Deepwater Fisheries Assessment Working Group as appropriate.

4. To submit to MPI Contracts Management 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 30 June 2021.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 31 January 2020.

Rationale:

The scampi fishery is based on the species *Metanephrops challengeri,* which is widely distributed around New Zealand. The total scampi catches in 2016/17 were 1,043 tonnes (total TACC 1,244 tonnes) including catches for scampi in SCI 6A of 289 tonnes (TACC 306 tonnes). The other major fisheries are SCI 1 (TACC 120 tonnes), SCI 2 (TACC 153 tonnes), SCI 3 (TACC 340 tonnes), and SCI4A (TACC 120 tonnes). Scampi are taken by light trawl gear that catch scampi that have emerged from their burrows. Emergence rates, and therefore catch rates, vary due to environmental cycles (i.e. moon phase, tidal, etc.). The main fisheries are in waters 300–500 m deep. Little is known about the growth rate and maximum age of scampi although available information suggests they may live up to 15 years.

Stock assessment of scampi is problematic and there are contradictory trends between CPUE indices and photographic survey series in some stocks. The use of CPUE indices in stock assessments has been questioned because of concerns that changes in these indices may be strongly influenced by changes in catchability caused by the behaviour of scampi rather than by changes in abundance. Photographic surveying has been used extensively to estimate the abundance of scampi in European fisheries. Photographic surveys have been carried out in New Zealand since 1998. To date, data from five surveys in SCI 3 are available (2001, 2009, 2010, 2013, and 2016).

A stock assessment of SCI 3 was accepted for the first time in 2015. The length-based population model was sensitive to the inclusion of the surveys, and sensitivities were done using the trawl and photographic biomass estimates separately. Photographic surveys every three years will provide indices of relative abundance for priority scampi stocks.

Objective 1:
The last survey of the SCI 3 stock occurred in 2016. To continue the time series of abundance estimates in this stock, this objective will undertake photographic surveys to estimate the relative abundance of scampi in SCI 3. The establishment of an ongoing time series of abundance estimates derived from photographic surveys for the major scampi stocks has been accepted by the Shellfish Fishery Assessment Working Group as an important component in the stock assessment of scampi.

Objective 2:
Better information on scampi growth is required for all scampi stock assessments as they are progressively developed for each major scampi stock. Previous tag release events occurred in SCI6A in 2007, 2008, 2009, and 2013. Tag recapture from the SCI6A stock has been the most successful, and ranged from 6.3% to 2.2%. Information from the tag recapture are fitted within the assessment model to help estimate growth. Tag recapture information from SCI 6A can also be used in other scampi stock assessments.

This Objective would continue the tagging of scampi in SCI6A as part of the programme on estimating abundance from photographic surveys in Objective 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): 0.8, 0.2.

SCI2019-02

Project number:	SCI2019-02
Project title:	Stock assessment of scampi in SCI 6A
Start date:	1 November 2019
Completion date:	30 September 2020
Vessel use:	None
Estimated cost:	$92 000

Overall Objective:
To carry out a stock assessment of scampi (*Metanephrops challengeri*) in SCI 6A including estimating biomass and sustainable yields.

Specific Objectives:
1. To complete a descriptive analysis of the commercial catch and effort, and observer data for scampi SCI 6A

2. To complete stock assessment for SCI 6A 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:

All objectives:

1. To present proposed methodologies to the Shellfish Fisheries Assessment Working Group (SFWG) by December 2019.

2. To present progress updates to the SFWG as required during the course of conducting the stock assessment.

3. To submit to MPI Contracts Management a draft Final Research Report as specified in Research Reporting Form 5 or a draft Fishery Assessment Report as specified in Research Reporting Form 7 by mid-February 2020, and a final report by June 2020.

4. To present the report in 3 above to the SFWG by 28 February 2020.

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 the course of this project to the Research Data Manager, Fisheries New Zealand by 30 June 2020.

Rationale:

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. Total landings over the last five years have averaged around 720 tonnes, mostly taken from SCI 3. Total landings in SCI 6A have averaged 184 tonnes over the past five years, but in the last fishing year (2016/17), 300 tonnes were landed which is nearer to the 306 tonne TACC than the five year average.

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

Objective 2:
The stock assessment for SCI 6A should be updated with the latest survey data. 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(Bprojected > 40%B0)*

- Pr(B*projected < 20%* B*0)*
- Pr(B*projected < 10%* B*0)*
- *Pr(Uprojected > $U_{40\%B0}$)*
- *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): 0.3, 0.7.

Marine Amateur Fisheries

MAF2019-01	Web camera monitoring of key marine amateur fisher access points
MAF2019-02	Implementation of computer image analysis for web cameras
MAF2019-05	Monitoring of recreational harvest of rock lobsters in CRA 2

MAF2019-01

Project number:	MAF2019-01
Project title:	Web camera monitoring of key marine amateur fisher access points
Start date:	01 July 2019
End date:	30 September 2024
Vessel use:	None
Estimated cost:	The project is estimated to cost $1 500,000 spread over 5 years.

Overall Objectives:
To continue the implementation of an integrated amateur harvest estimation system by providing annual indices of amateur effort and harvest in key stocks to inform fisheries management.

Specific Objectives:

1. To maintain and operate the web camera network in FMAs 1, 2, 7, 8 and 9 for the 2019/20 to 2023/24 fishing years.

2. To monitor boat ramp traffic and fishers to determine the proportion of fishing effort and estimate relative catch rates for key species at selected web camera sites for the 2019/20 to 2023/24 fishing years.

3. To derive regional indices of recreational fishing effort and harvest in FMAs 1, 2, 7, 8 and 9 for the 2019/20 to 2022/23 fishing years.

Rationale:

General:
Amateur fishing is highly valued by many New Zealanders and, following a comprehensive design process, Fisheries New Zealand has adopted an integrated "systems" based approach to estimating and monitoring the harvest of amateur fishers. National Panel Surveys (NPS), were conducted over the 2011/12 and 2017/18 fishing years, and these provided estimates of the amateur harvest for a wide variety of species in all management areas around mainland New Zealand. These national surveys are part of a system that includes off-site surveys with on-site validation, various regional surveys and characterisations, amateur charter boat reporting, ongoing effort monitoring using web cameras, and the development of new tools and approaches. This project provides for the continuation of web-camera monitoring at selected high-traffic boatramps to enable the calculation of annual indices of recreational effort and harvest in key shared fish stocks.

Specific Objectives 1-3:

This project provides for the continued operation, maintenance, and upgrading (as necessary) of the network of web cameras developed and tested under a series of previous projects (REC2005/06, REC2007/02, REC2009/04, MAF2011/07, MAF2013/03, MAF2014/04, and MAF2015/03). Monitoring of boat ramp effort has been underway in FMA 1 since 2004 and in FMAs 8 and 9 since 2006. Since 2011, the information from these cameras has been combined with boat ramp interview sessions at times of high fisher traffic to support reliable estimates of recreational fishing effort and harvest from key shared stocks in the years between major NPS surveys. The cameras in FMAs 2 and 7 and parts of FMA 8 have been in place for shorter periods (since 2014 or 2015) and the development and testing of annual indices is still underway.

This project will cover all existing web camera sites (Waitangi, Takapuna, Half Moon Bay, and Sulphur Point in FMA 1, Gisborne and Napier in FMA2, Waikawa and Nelson in FMA 7, New Plymouth and Twin Bridges in FMA 8, and Raglan and Shelly Beach in FMA 9), and provide for the collection of data for annual indices for the 2019/20 to 2023/24 fishing years. However, because of the timing of projects, it is accepted that annual harvest estimates will be calculated only for the 2019/20 to 2022/23 fishing years. It is expected that the third NPS will cover the 2022/23 fishing year, and it is important that data are collected in such a way that harvest estimates from the two approaches can be compared under future projects.

During the course of this project, it is expected that automatic computerised analysis of images from web cameras will be implemented on a practical level (using project MAF2019/02), building on the trial work conducted under project MAF2013/08. This should decrease the cost of interpreting the imagery and provide a census rather than a sample of traffic at the selected ramps, but it may also indicate the need to consider upgrades to the cameras or their operating procedures to facilitate computerised analysis. Researchers should contemplate these developments in developing proposals.

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, 0.3, 0.1

MAF2019-02

Project number:	MAF2019-02
Project title:	Implementation of computer image analysis for web cameras
Start date:	1 July 2019
End date:	30 September 2021
Vessel use:	None
Estimated cost:	The project is estimated to cost $300 000 spread over 2 years.

Overall Objectives:

To continue the implementation of an integrated amateur harvest estimation system by automating the calculation of annual indices of recreational fishing effort using computerized image analysis

Specific Objectives:

1. To develop robust computerized methods of estimating the number of boat movements each day at all ramps included in the recreational web-camera monitoring programme, project MAF2019/01.

2. To apply the methods developed in Specific Objective 1 to all suitable images collected under project MAF2014/04 and previous projects to generate estimates of fishing effort on each day cameras were working at these ramps.

3. To recommend any changes to camera specifications or operating procedures to facilitate automatic computerized analysis in the future, including in project MAF2019/01.

Rationale:

General:

Amateur fishing is highly valued by many New Zealanders and, following a comprehensive design process, Fisheries New Zealand has adopted an integrated "systems" based approach to estimating and monitoring the harvest of amateur fishers. National Panel Surveys (NPS), were conducted over the 2011/12 and 2017/18 fishing years, and these provided estimates of the amateur harvest for a wide variety of species in all management areas around mainland New Zealand. These national surveys are part of a system that includes off-site surveys with on-site validation, various regional surveys and characterisations, amateur charter boat reporting, ongoing effort monitoring using web cameras, and the development of new tools and approaches. This project provides for the development of a computerised image analysis capability to support and enhance the calculation of annual indices of recreational effort and harvest in key shared fish stocks using web-cameras.

Specific Objectives 1-3:

The purpose of this project is to develop a fully automatic computer-based method to interpret images from web-cameras placed at high traffic boat ramps to generate indices of boat traffic and, hence, recreational fishing effort. Some developmental work was conducted under project MAF2013/08 and it is expected that the lessons from that study will be incorporated in work under this project. Key outputs expected from this project are robust software to reliably interpret web camera images, time series of daily boat traffic at selected boat ramps, and recommendations on how to optimise the generation of data and information from the web camera monitoring programme, project MAF2019/01.

Weighting of Objectives:

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.7, 0.2, 0.1

MAF2019-05

Project number:	MAF2019-05
Project title:	Monitoring of recreational harvest of rock lobsters in CRA 2
Start date:	1 July 2019
End date:	30 September 2024
Vessel use:	The project is estimated to cost $750,000 spread over 5 years.
Estimated cost:	$750 000

Overall Objectives:
To monitor the amateur harvest of rock lobsters from the CRA 2 stock.

Specific Objectives:
To monitor the amateur harvest of rock lobsters from the CRA 2 stock over the 2019/20 to 2022/23 April-March fishing years.

Rationale:
General:
Amateur fishing is highly valued by many New Zealanders and, following a comprehensive design process, Fisheries New Zealand has adopted an integrated "systems" based approach to estimating and monitoring the harvest of amateur fishers. National Panel Surveys (NPS), were conducted over the 2011/12 and 2017/18 fishing years, and these provided estimates of the amateur harvest for a wide variety of species in all management areas around mainland New Zealand. These national surveys are part of a system that includes off-site surveys with on-site validation, various regional surveys and characterisations, amateur charter boat reporting, ongoing effort monitoring using web cameras, and the development of new tools and approaches.

In response to stock assessment results indicating that the stock was probably overfished and still being overfished, a multi-staged rebuild plan is in place to increase abundance in CRA 2. On 1 April 2018, allowable catches and allowances were reduced, including a new total allowable catch (TAC) of 173 t (down from 416.5 t), a new total allowable commercial catch (TACC) of 80 t (down from 200 t), and a new recreational allowance of 34 t (down from 140 t). In order to monitor the recreational harvest relative to the recreational allowance as the stock rebuilds and, potentially, as management settings for recreational fishers change, annual estimates of the harvest are required. This project therefore provides for the development and implementation of a programme to monitor the annual recreational harvest of rock lobsters from the CRA 2 stock, given that national surveys are not sufficiently frequent for management needs over the next 5 years.

Specific Objective 1:
This project includes an on-site survey to estimate the relative annual harvest of rock lobsters by recreational fishers (using all methods) from the CRA 2 stock. An on-site survey is required that can reliably monitor stock-wide harvest using intercepts and/or interviews at selected access points and can detect modest changes in the stock-wide harvest between years. In preparation for this study, a characterisation and simulation study of the CRA 2 recreational fishery has been commissioned (project SEA2018/25). Researchers should consider the results of that study when designing their proposed monitoring programmes and, especially, how they will use new monitoring data to estimate stock-wide recreational harvest and the expected precision of such estimates.

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

Aquatic Environment Research

BEN2019-01	Monitor the extent and intensity of bottom contact by trawl and dredge fishing in the Territorial Sea and Exclusive Economic Zone
BEN2019-04	A spatially explicit benthic impact assessment for inshore and deepwater fisheries in New Zealand
BEN2019-05	Spatial decision support tool development for managing the impacts of bottom fishing on in-zone, particularly vulnerable or sensitive habitats
PMM2019-10	Update Campbell Island NZSL PST (Population Sustainability Threshold) estimation
PRO2019-01	Preparation and documentation of a standardized linked database—including commercial fisheries effort data, fisheries observer data, and protected species captures
PRO2019-02	Maintenance of PSC (protected species captures) website displaying updated observed commercial fisheries captures, and total estimated captures for selected species
PRO2019-09	Spatial distribution modelling of at-risk seabirds in New Zealand commercial fisheries
PRO2019-10	Refine SEFRA model parameterisation for at-risk protected species (seabirds)
PRO2019-11	Historical reconstruction and characterisation of spatially explicit historical set-net fishing effort data
PSB2019-01	Estimation of total captures of seabirds using standardised estimation methods
PSB2019-02	Distributional study of Antipodean Albatross using satellite reporting GPS tags
PSB2019-04	Black petrel population monitoring and distribution study
PSB2019-06	Review of footage collected from the 2018/19 Black Petrel Electronic Monitoring Project
PSB2019-07	Continuation of the Black Petrel Electronic Monitoring Project for the 2019/20 summer
PSB2019-08	Feasibility trial of underwater baitsetter
PSB2019-09	Aerial survey of white-capped albatross on the Auckland Islands

BEN2019-01

Project number:	BEN 2019-01
Project title:	Monitor the extent and intensity of bottom contact by trawl and dredge fishing in the Territorial Sea and Exclusive Economic Zone
Start date:	1 November 2019
End date:	31 August 2020
Vessel use:	None
Estimated cost:	$55 000

Overall Objective:
To monitor the extent and intensity of bottom contact by trawl and dredge fishing for all inshore and deepwater target species in the Territorial Sea and Exclusive Economic Zone.

Specific Objectives:
To help MPI groom data, develop and compile summary statistics for all deepwater and inshore trawl and dredge fishing by year, depth zone, sediment categories, fishable area, and any other agreed habitat classifications or proxies, and to identify any trends or changes to meet management needs.
To update any relevant sections in the Aquatic Environment and Biodiversity Annual Review and Environmental and Ecosystem considerations sections of the Fisheries Assessment Plenary documents with new results.

Reporting Requirements:
To present methods to an Aquatic Environment Working Group (AEWG) meeting before 20 February, 2020.
To present a draft AEBR to an AEWG meeting before 30 July, 2020.
To submit a draft AEBR (as per Reporting Form 6) to the Ministry for Primary Industries by 31 August 2020, payment will be on acceptance following review.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the MPI Research Data Manager by 31 August 2020.

Rationale:

General:
This project will provide for the spatial description and monitoring of the areas contacted by mobile bottom fishing gear (trawl and dredge) for the 2007/8 to 2018/19 fishing years for all inshore stocks and for the 1989/90 to 2018/19 fishing years for all deepwater stocks. The outputs from this project will support inshore and deepwater Fisheries Management in meeting their objectives provided in the respective management plans.

Management objective MO7 of the National Fisheries Plan for Deepwater and Middle-depth Fisheries – Part 1A is to "Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the impacts of deepwater fisheries on the benthic habitat".

The draft inshore finfish plan includes an environmental objective to "Minimise adverse effects of fishing on the aquatic environment, including on biological diversity" and lists as a performance indicator that where there are no policy objectives "interactions with the benthos and protected species are not increasing."

Objective 1:
The MPI spatial team have developed 'CatchMapper' a GIS tool that has been used to map the areas where mobile fishing gear (trawl and dredge) is used on or near (within 1 metre of) the seabed in each year. The extent and intensity of bottom contact by mobile fishing gear has been assessed using CatchMapper for all deepwater stocks between the 2007/08 and 2016/17 fishing years under project BEN2017-01, and will be assessed for all deepwater stocks (1989/90 - 2017/18) and inshore stocks (2007/08 - 2017/18) under project BEN2018-01. BEN2019-01 proposes to update CatchMapper with the spatial data for the 2018/19 fishing year and provide summary statistics and figures using some internal expertise, and in concert with an external research provider, to ensure compatibility with previous work and write the accompanying AEBR.

The project will be restricted to vessels fishing for inshore and deepwater QMS stocks or to the relevant groups of target species agreed with MPI fisheries managers and lead scientist. Fishing effort reported on all form types will be included in the analyses. The types of graphics and figures produced should replicate those provided in BEN2018-01.

The research provider should work with MPI staff to groom data and develop in-house summary statistics that can be used to describe trends in the fisheries. Summary statistics must include, for particular fisheries or groups of target species (e.g. those groups identified by fisheries managers) and for the aggregate of all deepwater and inshore finfish and shellfish fisheries:
The total number of bottom contacting trawls/dredges each year and for all years
The intensity of dredge effort per management area,
The total spatial area affected ("footprint") by trawl gear each year and for all years,
The intensity of trawl impact provided as the aggregated swept area each year and for all years,
Years since last bottom-contact within the trawl footprint,

The spatial area affected by depth zone, sediment category, fishable area, and predicted BOMEC habitat class,
The spatial area affected in relation to the preferred habitat of key target species,

Discussions with MPI science and fisheries management staff will be required to finalise management needs including details of deliverables and the precise summary statistics and maps that are required. A final report will be generated by the research provider as part of this project to summarise and discuss the maps and summary statistics.

References:

Ministry for Primary Industries (2017). Aquatic Environment and Biodiversity Annual Review 2017. Compiled by the Fisheries Management Science Team, Ministry for Primary Industries, Wellington, New Zealand. 724p.

BEN2019-04

Project number:	BEN2019-04
Project title:	A spatially explicit benthic impact assessment for inshore and deepwater fisheries in New Zealand.
Start date:	1 October 2019
End date:	30 November 2020
Vessel use:	None
Estimated cost:	$150 000

Overall Objective:
Conduct a spatially explicit benthic impact assessment to describe and quantify the likely nature and extent of impacts to benthic taxa or communities by mobile bottom fishing methods in New Zealand.

Specific Objectives:

1. Characterise all mobile bottom fishing gear configurations used since 2007/8 for inshore fisheries, and since 1989/90 for deepwater fisheries.
2. Determine the spatial and temporal extent of bottom contact by different fishing gear configurations.
3. Characterise the impacts of different gear configurations on key benthic taxa and/or communities.
4. Use the outputs of objectives 1-3 to provide a measure of the potential nature and extent of impacts of bottom contact fishing to benthic taxa or communities across New Zealand's Territorial Sea and Exclusive Economic Zone.
5. Update any relevant sections in the Aquatic Environment and Biodiversity Annual Review and Environmental and Ecosystem considerations sections of the Fisheries Assessment Plenary documents with results from this work.

Reporting Requirements:

1. To present methods to an Aquatic Environment Working Group (AEWG) meeting before 20 February, 2020.
2. To present a draft AEBR to an AEWG meeting before 30 September, 2020.
3. To submit a draft AEBR (as per Reporting Form 6) to the Ministry for Primary Industries by 31 October 2020, payment will be on acceptance following review.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the MPI Research Data Manager by 30 November 2020.

Rationale:
General:
A wide variety of species are harvested on or near the seabed in New Zealand's Territorial Sea (TS) and Exclusive Economic Zone (EEZ). Mobile bottom fishing methods that target these species can significantly impact benthic communities and numerous studies have been conducted in New Zealand to understand the effects of fishing on different benthic habitats. The spatial extent of bottom contact by mobile fishing gear by New Zealand's inshore and deepwater fisheries has been mapped (Baird et al 2015, Baird & Wood 2018, Baird and Mules in prep.), however understanding the effect of bottom fishing on benthic communities over this area is far more complex and dependent on knowledge of both the spatial distribution of taxa or communities and the actual impact of fishing to that taxon or community.

This project seeks to provide a spatially explicit estimation of fishing impact to key benthic taxa or communities within New Zealand's TS and EEZ. The outputs of this project will be used to inform a spatially explicit quantitative risk assessment for benthic habitats in New Zealand and in so doing, will support inshore and deepwater Fisheries Management in meeting their objectives provided in the respective management plans.

Management objective MO7 of the National Fisheries Plan for Deepwater and Middle-depth Fisheries – Part 1A is to *"Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the impacts of deepwater fisheries on the benthic habitat".*

The draft inshore finfish plan includes an environmental objective to *"Minimise adverse effects of fishing on the aquatic environment, including on biological diversity"* and lists as a performance indicator that where there are no policy objectives *"interactions with the benthos and protected species are not increasing."*

Objectives 1 - 4:
Risk assessment approaches are currently being used to evaluate the effects of fishing on various components of the marine ecosystem in New Zealand and a national scale risk assessment for the benthic habitat is planned. A necessary step in the risk assessment process is the assessment of impacts (Sharp et al. 2009). A spatially explicit benthic impact assessment framework was developed and implemented to quantify the likely bottom impact of longline fishing gear in the Convention of the Conservation of Marine Living Resources (CCAMLR) area (Sharp et al. 2009, Sharp 2010, Webber 2012). The framework considers gear types, gear deployment, vulnerability of taxa, and historical fishing effort, and does not rely on knowledge of the distribution of benthic taxa or communities. The output of the framework is a spatially explicit quantification of the likely impacts of bottom fishing (an impact index) which can be used to inform a benthic risk assessment. The utility of this framework has been demonstrated for areas in the South Pacific Regional Fisheries

Management Organisation (SPRFMO) Convention Area, where benthic impacts of bottom trawling have been estimated (Mormede et al. 2017, Cryer et al. 2018).

This project aims to implement an impact assessment framework to assess the impacts of bottom fishing in New Zealand's TS and EEZ. This will involve the characterisation of all mobile bottom contact fishing methods used, including descriptions of all of the gear components. The physical impact of separate gear components on the seabed will be investigated and the bottom contact footprint by gear configuration and year will be mapped, building on previous footprint assessment projects (Baird et al. 2015, Baird & Wood 2018, and Baird & Mules, in prep). A biological trait analysis involving the classification of the relative fragility and vulnerability of benthic taxa to disturbance by different gear configurations used, as well as their recovery rate, will be conducted. Factors such as morphology, position on the seabed, life history characteristics and functional traits should be taken into consideration. The bottom contact footprint and the classification of the relative fragility and vulnerability of organisms will be used in the impact assessment framework to provide a spatially explicit impact index across the TS and EEZ.

An inception meeting with Fisheries New Zealand will be required early in the project to discuss and agree upon key details.

Weighting of Objectives: 1 – 0.25, 2 – 0.25, 3 – 0.25, 4 – 0.2, 5 – 0.05

References:

Baird, S. J., J. E. Hewitt and B. A. Wood (2015). Benthic habitat classes and trawl fishing disturbance in New Zealand waters shallower than 250 m. New Zealand Aquatic Environment and Biodiversity Report No. 144. : 184p.

Baird, S J; Wood, B A (2018) Extent of bottom contact by New Zealand commercial trawl fishing for deepwater Tier 1 and Tier 2 target fishstocks, 1989–90 to 2015–16. *New Zealand Aquatic Environment and Biodiversity Report No. 193*. 102 p.

Baird, S.J.; Mules, R. (in prep). Extent of bottom contact by New Zealand commercial trawl fishing for deepwater Tier 1 and Tier 2 target species determined using CatchMapper software, 2008–17. Draft New Zealand Aquatic Environment and Biodiversity Report prepared for BEN201701. 87 p.

Cryer, M., Finucci, B., Anderson, O. (2018). Cumulative bottom impact for line fisheries in the western SPRFMO Area, 2007 to 2018. SC6-DW10. 6th Meeting of the Scientific Committee, Puerto Varas, Chile 9-15 September 2018

Mormede, S., Sharp, B., Roux, M.J., Parker, S. (2017). Methods development for spatially-explicit bottom fishing impact evaluation within SPRFMO: 1. Fishery footprint estimation. SC5-DW06. 5th Meeting of the Scientific Committee Shanghai, China, 23 - 28 September 2017

Sharp, B. (2010). Updated impact assessment framework to estimate the cumulative footprint and impact on VME taxa of bottom longline fisheries in the CCAMLR area. CCAMLR, Hobart, Australia. WG-FSA-10/31, 16 pp.

Sharp, B., Parker, S. and Smith, N. (2009). An impact assessment framework for bottom fishing methods in the CCAMLR area. CCAMLR Science 16. 195–210 pp.

Webber, D. (2012).PlotImpact v2.0-2012. CCAMLR, Hobart, Australia. WG-FSA-12/55, 4 pp.

BEN2019-05

Project number:	BEN2019-05
Project title:	Spatial decision support tool development for managing the impacts of bottom fishing on in-zone, particularly vulnerable or sensitive habitats.
Start date:	1 October 2019
End date:	31 October 2021
Vessel use:	None
Estimated cost:	$150 000

Overall Objective:
To develop a decision support tool to support the spatial management of inshore and deepwater bottom fishing.

Specific Objectives:

1. Compile relevant inputs to be used in a spatial planning tool. This should include benthic biodiversity inputs, naturalness and the value to resource users.
2. Apply the outputs of objective 1 to a spatial decision support tool to be used by fisheries management that will enable scenario testing and allow for the cost to fishing to be determined.
3. Update any relevant sections in the Aquatic Environment and Biodiversity Annual Review with new results.

Reporting Requirements:

1. To present methods to an Aquatic Environment Working Group (AEWG) meeting before 30 July, 2020.
2. To present a draft AEBR to an AEWG meeting before 31 August, 2021.
3. To submit a draft AEBR (as per Reporting Form 6) to the Ministry for Primary Industries by 30 September 2021, payment will be on acceptance following review.
4. To submit a Final AEBR (as per Reporting Form 6) to the Ministry for Primary Industries by 31 October 2021, payment will be on acceptance following review.

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.

Data Reporting:
To submit any data generated, collected or modified during the course of this project to the MPI Research Data Manager by 31 October 2021.

Rationale:

General:
Many of New Zealand's inshore and offshore fisheries target fish and invertebrate species living on or near the seabed. Mobile fishing gear used to harvest these species can significantly impact benthic habitats. Management objective MO7 of the National Fisheries Plan for Deepwater and Middle-depth Fisheries – Part 1A is to "*Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the impacts of deepwater fisheries on the benthic habitat*". The draft inshore finfish plan includes an environmental objective to "*Minimise adverse effects of fishing on the aquatic environment, including on biological diversity".*

Bottom-fishing is currently managed in New Zealand's Territorial Sea (TS) and Exclusive Economic Zone (EEZ) using spatial management. A variety of inshore trawl fishery closures and Benthic Protected Areas (BPAs) have been established to protect benthic biodiversity by excluding all bottom-fishing. A recent preliminary assessment of the efficacy of current BPAs in protecting benthic biodiversity (Clark et al. in prep), using the spatial management planning software Zonation, revealed that the current levels of protection afforded by the BPAs could be improved upon and that potential increases in biodiversity protection could be high relative to a small increase in closures to bottom-fishing. Similarly an assessment of various marine protected area planning scenarios in New Zealand's TS using Zonation revealed that biodiversity protection could be improved with low costs to users, through the use of planning tools that provide the means to test scenarios and understand trade-offs between biodiversity protection and resource use (Geange et al. 2017).

This project aims to develop a decision support tool to support the spatial management of bottom-fishing in New Zealand's TS and EEZ by enabling scenario testing to ensure benthic biodiversity is maintained while costs to fisheries are minimized.

Objective 1 and 2:
Fisheries New Zealand uses various spatial tools to inform management. CatchMapper is an application that was developed for the spatial assessment of catch (Osborne 2018) and more recently allows for the assessment of the spatial extent and intensity of bottom contact by deepwater fisheries (Baird & Mules in prep). The inshore footprint (including both trawl and dredging) will be added under project BEN2018-01. Both inshore and deepwater footprints will be updated annually in CatchMapper and allow for in house queries. This spatial tool provides information about the extent of bottom-fishing activities and catch, but management would be better informed if biological and physical characteristics of benthic habitats were also considered.

Various spatial management planning software tools have been used globally to identify representative areas to protect biodiversity while minimising the cost to existing users. Spatial management planning software has been used in New Zealand to develop options for the spatial management of the South Pacific Regional Fisheries Management Organisation (SPRFMO) area (Rowden et al. 2019), to explore marine protected area

planning options in the TS (Geange et al. 2017), and to conduct a preliminary assessment the efficacy of current BPAs in protecting benthic biodiversity (Clark et al in prep). Zonation software was used in the development of spatial management options for the SPRFMO area. It enabled a collaborative approach with multiple stakeholders where various inputs could be discussed and weighted, sensitivities to different inputs could be determined, and multiple scenarios could be assessed (Cryer et al. 2017).

This project will involve the development of several input layers, including layers for benthic biodiversity, naturalness and value to resource users. This could draw on the outputs of various projects:

- Project ZBD2016-11 is currently in progress and aims to develop new benthic habitat suitability models based on a new seabed photographic dataset.
- A marine spatial planning project is in progress within New Zealand's EEZ through a marine protected area Science Advisory Group. Key Ecological Areas have been identified and data sets consistent with these criteria have been mapped (Stephenson et al. 2018). The application SeaSketch is being used to view and interact with spatial data and the use of the Zonation tool has been recommended as a potential next step for spatial planning for Marine Protected Areas in New Zealand.
- A benthic impact assessment is planned under project BEN2019-04, the outputs of which could be used to inform a naturalness layer.

Using spatial planning software and the input layers, a decision support tool will be developed to support spatial management of bottom-fishing in New Zealand.

An inception meeting with Fisheries New Zealand will be required early in the project to discuss and agree upon key details.

Weighting of Objectives: 1 – 0.45, 2 – 0.45, 3 – 0.1

References:

Baird, S.J.; Mules, R. (in prep). Extent of bottom contact by New Zealand commercial trawl fishing for deepwater Tier 1 and Tier 2 target species determined using CatchMapper software, 2008–17. Draft New Zealand Aquatic Environment and Biodiversity Report prepared for BEN201701. 87 p.

Clark, M.R.; Mills, S.; Leduc, D.; Anderson, O.F.; Rowden, A.A. (in prep). Biodiversity of Benthic Protection Areas and Seamount Closure Areas: a description of available benthic invertebrate data, and a preliminary evaluation of the effectiveness of BPAs on biodiversity protection. Draft New Zealand Aquatic Environment and Biodiversity Report prepared for ZBD2014-10. 246 p.

Cryer, M.; Nicol, S.; Geange, S.; Rowden, A.; Lundquist, C.; Stephenson, F. (2017). Report from a series of stakeholder workshops to gather and document stakeholder views on the nature and content of a revised conservation and management measure for bottom fisheries in the SPRFMO area. SPRFMO Scientific Committee Report SC5-DW05. 36 p. [website:https://www.sprfmo.int/assets/00-SC5-2017/SC5-DW05-Report-from-

Stakeholder-workshops-held-to-gather-views-on-revising-the-current-CMM-for-Bottom-Fisheries.pdf]

Geange, S.W.; Leathwick, J.;, Linwood, M.; Curtis, H.; Duffy, C.; Funnell, G.; Cooper, S. (2017) Integrating conservation and economic objectives in MPA network planning: A case study from New Zealand. Biological Conservation 210: 136–144.

Osborne, T.A. (2018). Forecasting quantity of displaced fishing Part 2: CatchMapper - Mapping EEZ catch and effort. New Zealand Aquatic Environment and Biodiversity Report No. 200. 168 p.

Rowden, A.A., Stephenson, F., Clark, M.R., Anderson, O.F., Guinotte, J.M., Baird, S.J., Roux, M.-J., Wadhwa, S., Cryer, M., Lundquist, C.J. (2019). Examining the utility of a decision-support tool to develop spatial management options for the protection of vulnerable marine ecosystems on the high seas around New Zealand, Ocean & Coastal Management 170: 1-16

Stephenson, F., A. Rowden, T. Anderson, J. Hewitt, M. Costello, M. Pinkerton, M. Morrison, M. Clark, S. Wadhwa, T. Mouton and C. Lundquist (2018). Mapping Key Ecological Areas in the New Zealand Marine Environment NIWA Client Report for the Department of Conservation (available upon request).

PMM2019-10

Project number:	PMM2019-10
Project title:	Update Campbell Island NZSL PST (Population Sustainability Threshold) estimation
Start date:	1 October 2019
End date:	30 June 2020
Vessel use:	None
Estimated cost:	$15 000

Overall Objective:
To update the estimation of biological parameters to inform setting the population sustainability threshold for Campbell Island New Zealand Sea Lions.

Specific Objectives:

1. Compile and update population demographic data indicative of population size and trend, and indicators of relevant demographic rates, from the Campbell Islands New Zealand Sea Lion population

2. Update population models available from previous and ongoing research projects (i.e. Roberts et al. 2014 and PRO2018-01) to approximate the current population consistent with Objective 1 and simulate future population trajectories under alternate management and climatic scenarios, applying a range of sensitivities chosen in consultation with FNZ.

3. Apply the model(s) and sensitivities in Objective 2 to estimate Population Sustainability Threshold (PST) values consistent with a range of relevant population outcomes (selected in consultation with FNZ).

Rationale:
General:
Evaluating commercial fisheries performance against protected species risk management targets requires understanding of both impact levels and the way in which the population is likely to respond to that level of impact, relative to natural variability. The latter consideration requires some understanding of population dynamics, especially in the context of a variable environment in which the population may be expected to fluctuate even in the absence of human impact.

Weighting of Objectives: 1 – 0.4, 2 – 0.4, 3 – 0.2

References:

Roberts, J; Rou, M-J; Ladroit, Y (2014). PBR assessment for the Campbell Island sub-populaiton of New Zealand sea lions. NIWA Client Report WLG2014-8, prepared for the Deepwater Group.

PRO2019-01

Project number:	PRO2019-01
Project title:	Preparation and documentation of a standardized linked database—including commercial fisheries effort data, fisheries observer data, and protected species captures
Start date:	1 October 2019
End date:	30 June 2021
Vessel use:	None
Estimated cost:	$250 000

Overall Objective:
Prepare and document a standardised, comprehensive database -- linking commercially reported catch and effort, fisheries observer data, and protected species captures – providing a standard platform for all protected species research projects

Specific Objectives:

1. Describe and catalog existing MPI databases (including their history and custody chain) containing data relevant to understanding protected species/ commercial fisheries interactions

2. Host a data linking/grooming workshop (including FNZ, industry, research providers, and technical/database experts) to discuss, document, and modify existing data linking and grooming algorithms used to combine and modify these databases (especially regarding the linking of trip level data from COD and WAREHOU)

3. Utilising existing databases , prepare a comprehensive database linking data from commercial catch/effort databases (e.g. WAREHOU), fisheries observer databases (i.e. COD), and protected species captures databases owned by MPI (e.g. OREO, sea lion SLED database, etc)

4. Audit, document, and catalog in a standardised way the error-trapping and grooming code that are applied to modify these data before they are used in protected species research, both for the standard 'root' database and at the 'branch' level, i.e. as applied in the course of delivering individual research projects

5. Build and update a standardised and easily queried repository for metadata documenting the database, its genesis and structure, version control, and all grooming/linking/error-trapping code, including those arising from future protected species research projects

Rationale:

General:

- The COD and WAREHOU databases were structured with fisheries catch/effort data in mind; in isolation neither of these are ideally suited as a basis for protected species research. As a consequence, currently all protected species projects utilise the OREO database, groomed and maintained by Dragonfly DataScience. However this database was produced in the past for a different purpose (to inform the online Protected Species Captures website) and was only adopted subsequently as the basis for protected species projects delivered by other research providers. With the emergence of more sophisticated analytical methods applied to protected species research (especially spatially explicit analyses such as SEFRA) there is a need to ensure that databases underlying protected species research projects are structured appropriately and documented clearly, to allow consistent and efficient interpretation and analysis, including by new research providers not familiar with the origins of existing databases.

- The structure of the existing databases is sometimes not fit for purpose; the metadata accompanying it is not clear or accessible to new research providers; in the past the choices that were made in the course of grooming/linking/error-trapping these data have not been well documented. This has created substantial obstacles for new research providers seeking to bid for or deliver new protected species projects, and has led to delays in the delivery of protected species research outputs (while new research providers seek to understand the data they are using).

- That individual research providers may interpret and apply the data in these databases anew in the course of delivering individual projects, with no standardised means of recording what has been done, creates inefficiencies (i.e. FNZ may end up paying repeatedly for the same grooming, imputation, or error trapping that has been done already under previous projects). It also creates risks for FNZ, when different projects produce the appearance of conflicting results without clear justification, or when research providers use data incorrectly due to lack of documentation about how the data have previously been groomed and modified.

Weighting of Objectives: 1 – 0.1; 2 – 0.1; 3 – 0.4; 4 – 0.2; 5 – 0.2.

PRO2019-02

Project number:	PRO2019-02
Project title:	Maintenance of PSC (protected species captures) website displaying updated observed commercial fisheries captures, and total estimated captures for selected species
Start date:	November 2019
End date:	July 2021
Vessel use:	None
Estimated cost:	$75 000

Overall Objective:
To maintain a public website displaying a time series of fishing effort, observer effort, observed captures and available estimates of total captures/mortalities in trawl, longline, set net and purse seine fisheries within the New Zealand EEZ.

Specific Objectives:
To maintain a public website displaying a time series of fishing effort, observer effort, observed captures and available estimates of total captures/mortalities in trawl, longline, set net and purse seine fisheries within the New Zealand EEZ.

*Reporting Requirements***:**

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 June 2023.

Rationale:

General:
Stakeholders have greatly appreciated the ability to interrogate data about fishing effort, observer coverage, observed captures of protected species and estimate total captures at a variety of scales, by fishing method, target fishery, area or vessel size (or a combination of these). It has also been useful to examine these data for a species across a fishing method.

Objective 1:
Maintain a publicly accessible website displaying an interactive time series of fishing effort, observer effort, observed captures and available estimates of total captures/mortalities in trawl, longline, set net and purse seine fisheries within the New Zealand EEZ.

Over the term of this project, risk assessment results should be incorporated into this website platform to allow for comparison of results between stratified model based estimates (e.g. results from PRO2016-03 and PSB2019-01) and the spatial risk assessment estimates of observable mortalities (e.g. results from the various spatially explicit risk assessments), where both are available.

To date this data has been displayed on an independent website once approved for release by Fisheries New Zealand, however it is desirable that this data would be displayed within the Fisheries New Zealand website.

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

References:
https://psc.dragonfly.co.nz/2018v1/

PRO2019-09

Project number:	PRO2019-09
Project title:	Spatial distribution modelling of at-risk seabirds in New Zealand commercial fisheries
Start date:	1 October 2019
End date:	31 December 2020
Vessel use:	None
Estimated cost:	$300 000

Overall Objective:
Using available data, estimate the spatial density of at-risk seabird species, including seasonal variation, estimated separately for breeding and non-breeding birds

Specific Objectives:

1. Secure access to existing satellite telemetry for New Zealand seabird populations, including via the Global Procellariform Tracking Database

2. Compile available data indicative of seabird distributions -- including satellite telemetry, sightings data, fisheries captures, and colony-specific population estimates -- for up to ten seabird species chosen in consultation with FNZ.

3. Apply spatial modelling techniques to estimate the spatial distribution and density of selected seabird species (including seasonal variation, and estimated separately for breeding and non-breeding birds), using seabird data from Objective 2 and spatially comprehensive environmental data layers available from other FNZ funded projects.

4. In collaboration with researchers delivering updated parameterisation of the seabird SEFRA model, examine the spatial goodness-of-fit of captures estimates using the updated spatial distribution layers from Objective 3, and modify these layers as appropriate where poorly fitted patterns seem to reflect poorly estimated spatial distribution layers.

Rationale:
General:

- An updated multi-species seabird risk assessment consistent with the SEFRA framework is expected in mid-2019 under PRO2016-06, to inform performance metrics under the updated NPOA-Seabirds. Outputs under the existing project will include incorporation of all seabird species into Risk Atlas, a flexible user interface that allows FNZ scientists and managers to query and disaggregate the spatial risk assessment model to answer particular management questions and test management scenarios at different spatial scales. The utility of this tool has recently

been illustrated by its application to Maui and Hector's dolphins to inform stakeholder engagement and options development under the Maui-Hector's dolphin TMP.

- Once the update seabird risk assessment is delivered, the statistical modelling framework will be mature. The rate-limiting step on our ability to apply this model to understand and manage seabird risk will then be the quality of the inputs.

- Despite the availability of satellite telemetry and sightings data, the seabird distribution layers used as inputs in previous and current implementations of the seabird risk assessment have utilised subjectively derived spatial distribution input layers from NABIS. These layers were subjectively derived using expert knowledge, with a different purpose in mind (i.e. the identification of important bird areas, rather than to inform quantitative risk assessment) and may be out of date.

- Recent innovations in spatial modelling approaches applied to cetaceans, including in the use of sightings data (e.g. PRO2014-01, PRO2017-12), suggest that the use of these data applying empirical spatial modelling methods have the potential to generate substantially improved spatial distribution layers to inform the seabird risk assessment. The accuracy of spatial inputs is particularly important under the SEFRA method, because spatial overlap used in the estimation of both species catchability and in the subsequent estimation of total captures and risk, and it is difficult to illustrate spatial uncertainty statistically.

- Once the seabird risk assessment can be interrogated and evaluated within the Risk Atlas framework, it will be possible to test spatial goodness of fit and iteratively improve the spatial input layers.

- With accurate spatial inputs, scenario testing in Risk Atlas can be used to test the efficacy of spatial management measures to achieve risk reduction, which may be especially important for coastally associated at risk species such as yellow-eyed penguins, black petrels, and flesh-footed shearwaters.

Weighting of Objectives: 1 – 0.1; 2 – 0.2; 3 – 0.5; 4 – 0.2;

PRO2019-10

Project number:	PRO2019-10
Project title:	Refine SEFRA model parameterisation for at-risk protected species (seabirds)
Start date:	1 October 2019
End date:	31 December 2020
Vessel use:	None
Estimated cost:	$125 000

Overall Objective:
Test and refine input parameterisation and underlying structural assumptions of the multi-species seabird SEFRA model.

Specific Objectives:

1. Use available published and unpublished data to test and refine biological input parameterisation (i.e. definition of priors) in the mulita-species seabird risk assessment model produced under project PRO2016-06, with an emphasis on at-risk and high-capture species

2. Within the existing Risk Atlas platform, test and refine the underlying structural assumptions affecting the estimation of vulnerability in the multi-species seabird risk assessment model (i.e. the definition of fisheries vulnerability groups, species vulnerability groups, and time periods over which vulnerability is estimated).

3. Illustrate the effects of input and structural changes applied under Objectives 1 and 2 in a transparent way, using sensitivities, and document their scientific justification.

4. Using the Risk Atlas platform, query, disaggregate and summarise the outputs of the updated multi-species seabird risk assessment in consultation with FNZ scientists and managers, to inform relevant questions at the scale of particular fisheries or to address the particular information needs of fisheries managers at smaller scales, rather than only at the species scale.

5. Create a publicly accessible online repository of risk assessment inputs (biological parameters, spatial data layers, and vulnerability group definitions under objectives 1 and 2) and summarised risk assessment outputs, with a simple user interface to facilitate transparency

Rationale:

General:

- An updated multi-species seabird risk assessment consistent with the SEFRA framework is expected in mid-2019 under PRO2016-06, to inform performance metrics under the updated NPOA-Seabirds. Outputs under the existing project will include incorporation of all seabird species into Risk Atlas, a flexible user interface that allows FNZ scientists and managers to query and disaggregate the spatial risk assessment model to answer particular management questions and test management scenarios at different spatial scales. The utility of this tool has recently been illustrated by its application to Maui and Hector's dolphins to inform stakeholder engagement and options development under the Maui-Hector's dolphin TMP.
- Once the update seabird risk assessment is delivered, the statistical modelling framework will be mature. The rate-limiting step on our ability to apply this model to understand and manage seabird risk will then be the quality of the model inputs.
- The input parameterisation of previous seabird risk assessments (biological and demographic parameters) has not been revisited recently, and the evidential basis supporting the current input parameterisation is not recorded in a way that facilitates transparent peer review and iterative improvement as new data become available.
- The structural assumptions underlying the definition of fishery and species groups in the model should reflect expert knowledge of the behaviour and configuration of fishing vessels and mitigation deployment, which changes over time. However these definitions have not been revisited in a systematic way since 2011. Now that the statistical framework is mature, it will possible for the first time to test and refine these assumptions using empirical model diagnostics within Risk Atlas.
- The seabird risk assessment has generated confusion with some stakeholders in the past because structural changes that were made were not always easily interpreted or justified to people not familiar with the model structure. By publishing both the conceptual and statistical framework (currently Chapter 3 of the AEBAR) and also the input parameterisation of the seabird risk assessment (under Objective 5 of this contract) FNZ will achieve greater transparency about the means by which we are estimating fisheries risk to seabirds, to allow review against performance objectives under the updated NPOA-Seabirds. Greater transparency will also facilitate uptake of new biological or demographic data as these become available from new seabird research.

Weighting of Objectives: 1 – 0.3; 2 – 0.3; 3 – 0.1; 4 – 0.2; 5 – 0.1.

PRO2019-11

Project number:	PRO2019-11
Project title:	Historical reconstruction and characterisation of spatially explicit historical set-net fishing effort data
Start date:	1 October 2019
End date:	31 December 2020
Vessel use:	None
Estimated cost:	$150 000

Overall Objective:
Using available data and spatial modelling approaches, construct a spatially explicit estimation and characterisation of historical set-net fishing effort around New Zealand at the decadal scale, in the 20th and 21st centuries.

Specific Objectives:

1. Compile and summarise available fisheries catch/effort data, landings data, and other historical data indicative of spatial patterns of setnet fishing (including subsistence, recreational, and commercial setnetting) in the period before there were requirements to report fisheries catch and effort data at finer spatial scales (and as early as 1900).

2. Compile and summarise available data indicative of historical protected species capture rates in setnet fisheries, especially in the period before there were requirements to report protected species captures in a standardised way.

3. Host a workshop including fisheries managers, scientists, fishing industry experts and historians to identify relevant data under Objectives 1 and 2 and to discuss its interpretation, with the aim of turning qualitative or summarised data into spatially and temporally resolved estimates of historical setnet effort and protected species captures.

4. Using spatial modelling approaches, generate spatially explicit estimates of setnet fishing effort intensity at decadal scales during the 20th and 21st centuries, within fishery groups corresponding to gear or deployment characteristics likely to affect protected species capture rates (e.g. net material, mesh size, target species).

5. Consistent with the SEFRA approach, intersect spatial effort characterisations under Objective 4 with protected species and fish distribution layers available from other

projects, to estimate spatially resolved estimates of historical encounter rates (i.e. spatial overlap) at a decadal scale.

6. Combining estimated encounter rates from Objective 5 with evidence of historical captures from Objectives 1 and 2, estimate catchability, total captures, and population-level risk in historical setnet fisheries for up to four species of interest, chosen in consultation with FNZ (including Hector's – Maui dolphins).

Rationale:

General:

With the high profile of fisheries impacts on Hector's and Maui dolphins during the update of the dolphin TMP, there is renewed interest in understanding the historical rather than just the current impacts of commercial setnets. The New Zealand and international Threat Status Classification Schemes, and Maui-Hector's dolphin TMP objectives, make reference to the current status of the dolphin population (rather than just current risk levels); thus there is a need to be able to hind-cast to estimate historical impact levels. With the outputs of a fitted spatially explicit risk model for dolphins (produced under PRO2017-12), it is now possible to estimate impacts including at a local and subpopulation scale for any period in which we have spatially resolved estimates of fishing effort, after which it will be possible for the first time to estimate historical impact and population trend, thus current status.

The same capability will can also usefully be applied for fish historically targeted in setnet fisheries. This has particular relevance for those stocks that were historically overfished (e.g. in the 1970s-1990s) and are now recovering. Under the Low Information Stocks (LISP) project, it is recognised that reported catch data are inadequate to understand observed population trends or current stock status, especially where the species were heavily impacted before the introduction of the QMS. Especially for longer-lived species, historical reconstructions will provide necessary context to estimate Bo and current status, and to understand population trends.

Weighting of Objectives: 1 – 0.15; 2 – 0.15; 3 – 0.1; 4 – 0.4; 5 – 0.1; 6 – 0.1

PSB2019-01

Project number:	PSB2019-01
Project title:	Estimation of total seabird captures using standardised estimation methods
Start date:	1 November 2019
End date:	30 June 2023
Vessel use:	None
Estimated cost:	$100 000

Overall Objective:
To estimate capture rates and total captures of seabirds by method, area, and target fishery, and where possible, by species for the 2019/20, 2020/21 and 2021/22 fishing years.

Specific Objectives:
To estimate capture rates and total captures of seabirds (plus fur seals) by method, area, and target fishery, and where possible, by species for the 2019/20, 2020/21 and 2021/22 fishing years.

Reporting Requirements:

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 June 2023.

Rationale:

General:
Estimates of captures of seabirds are required for monitoring purposes and to design mitigation approaches. Sophisticated modelling approaches have been developed to combine observer and catch-effort information to estimate captures of seabirds (albatross, petrels, sooty shearwater, and a variety of small birds), and this project provides for a continuation of that work. The development conducted over recent years has led to a relatively mature modelling framework.

Estimates of captures of seabirds, marine mammals, and other protected species are required for fisheries managers to understand the magnitude of the impact on these species and to identify trends in captures and capture rates, allowing avoidance and mitigations measures to be developed and implemented. The results from this project will feed into the revised NPOA-Seabirds.

Objective 1:
This project should utilise the groomed datasets linking commercial and observer datasets developed by PRO2019-01, and follow the methods developed by Abraham and Thompson (2017) which applied an updated modelling approach to the estimation of the total number of seabird captures. Statistical models in previous assessments had become increasingly complex, from estimating seabird captures for individual fisheries to a New Zealand wide approach. The most recent estimation included a total of 35 different models (Abraham et al. 2016), with varying structures. Abraham and Thompson (2017) took a more unified modelling approach allowing more direct comparisons across species.

Specifically, a single model was used for each species group, including all trawl and longline fisheries; all covariates were based on a set of strata (fishing year, area, fishery, season), so that the data could be aggregated before the modelling; and covariates that reflected the distribution of seabirds (e.g., area and season) were shared across different fisheries. An identical model structure was used for each species 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): 1.0.

References:

Abraham, E.R.; Richard, Y. (2017). Summary of the capture of seabirds in New Zealand commercial fisheries, 2002–03 to 2013–14. *New Zealand Aquatic Environment and Biodiversity Report No. 184*. 88 p.

Abraham, E.R.; Richard, Y.; Berkenbusch, K.; Thompson, F. (2016). Summary of the capture of seabirds, marine mammals, and turtles in New Zealand commercial fisheries, 2002–03 to 2012–13. *New Zealand Aquatic Environment and Biodiversity Report No. 169*. 205 p.

PSB2019-02

Project number:	PSB2019-02
Project title:	Distributional study of Antipodean albatross using satellite reporting GPS tags
Start date:	1 September 2019
End date:	1 April 2021
Vessel use:	None
Estimated cost:	$125 000

Overall Objective:
To collect information on the distribution to reduce uncertainty or bias in estimates of risk for Antipodean albatross

Specific Objectives:
To collect spatial data to allow refinement of the spatial overlap with fishing throughout New Zealand's EEZ and the South Pacific, with tracking devices to be deployed on a wider range of ages/breeding stages.

Reporting Requirements:

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 August 2019.

Rationale:

NPOA-Seabirds 2013 gives high priority to research to understand the effects of fishing-related mortality on seabird species at highest risk and on factors that are leading to the greatest level of uncertainty in the risk scores. Specific guidance on areas where uncertainty can best be reduced for each seabird taxon comes from the sensitivity analysis of the current risk assessment and the recommendations from the risk assessment review workshop held in November 2013.

Categorisation of seabirds as being at high risk based on the results of the level-2 risk assessment can come about from genuinely high fishing-related mortality or poor information. The 2013 NPOA-seabirds has targets to reduce the risk categorisation for seabirds currently assessed to be at high or very high risk from commercial fishing.

The Antipodean Albatross has recently been recognised by ACAP as a Priority Population for Conservation due to a significant decline in population levels since 2005, especially for females. The New Zealand seabird risk assessment identified the Antipodean albatross at high risk (Richard et al. 2017), while the preliminary southern hemisphere seabird risk assessment for high seas surface longline fisheries considered the Antipodean albatross including the Gibson's albatross at high risk (Abraham et al. 2017). This project provides for research to better understand the distribution and habitat use of Antipodean albatross. Better understanding of the distribution and habitat use by the Antipodean albatross, will also lead to better understanding of the overlap with fisheries throughout the Pacific Ocean.

This project extends the work being undertaken under projects PRO2017-15 and PSB2018-01A, which are tracking the movement of Antipodean albatross in 2019 using satellite tags. Further tagging of this species is considered necessary to adequately understand the overlap with various fisheries through the southern Pacific.

Objective 1:
To provide tracking devices to the field team monitoring the population (subject to DOC funding) for deployment, and subsequent grooming of the resulting seabird tracks. Devices that can track the seabirds throughout their non-breeding stages will be preferred and consideration will be given to the use of the innovative tags that can also detect ship radar.

References:

Abraham, E., Richard, Y., Walker, N., Roux, M-J., (2017) Assessment of the risk of commercial surface longline fisheries in the southern hemisphere to ACAP seabird species. CCSBT-ERS/1703/12

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 No. 191*. 108 p

PSB2019-04

Project number:	PSB2014-04
Project title:	Black petrel population monitoring and distributional study
Start date:	1 October 2019
End date:	30 November 2020
Vessel use:	None
Estimated cost:	$100 000

Overall Objective:
To collect information on demographic parameters to reduce uncertainty or bias in estimates of risk for black petrel

Specific Objectives:

1. To collect information on population size, adult survival, age at first reproduction and key demographic parameters for black petrel to reduce uncertainty or bias in estimates of risk.
2. To collect spatial data to allow refinement of the spatial overlap with fishing, with tracking devices to be deployed on a wider range of ages/breeding stages.

Reporting Requirements:

Specific Objective 1:

1. To submit to MPI contracts management, a progress report as specified in Research Reporting Form 4 by 30 March 2019.

2. To present the report in 1 above to meetings of the Aquatic Environment Working Group by 20 April 2020 in Wellington. Presentations to more than one meeting may be required.

3. To submit to MPI fisheries science, a draft contribution to the 2017 Aquatic Environment and Biodiversity Annual Review summarising the results, for the consideration of the AEWG, by 31 May 2020.

4. To submit to MPI contracts management, a draft Aquatic Environment and Biodiversity Report as specified in Research Reporting form 6 by 31 May 2020.

Specific Objective 2:

1. To submit to MPI contracts management, a progress report as specified in Research Reporting Form 4 by 15 March 2019.

2. To present the report in 1 above to meetings of the Aquatic Environment Working Group by 30 October 2020 in Wellington. Presentations to more than one meeting may be required.

3. To submit to MPI fisheries science, a draft contribution to the 2017 Aquatic Environment and Biodiversity Annual Review summarising the results, for the consideration of the AEWG, by 15 October 2020.

4. To submit to MPI contracts management, a draft Aquatic Environment and Biodiversity Report as specified in Research Reporting form 6 by 30 October 2020.

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 by the fifth working day of each month for the duration of the project.

Rationale:

General:
NPOA-seabirds 2013 gives high priority to research to understand the effects of fishing-related mortality on seabird species at highest risk and on factors that are leading to the greatest level of uncertainty in the risk scores. Specific guidance on areas where uncertainty can best be reduced for each seabird taxon comes from the sensitivity analysis of the current risk assessment.

Categorisation of seabirds as being at high risk based on the results of the level-2 risk assessment can come about from genuinely high fishing-related mortality or poor information. The 2013 NPOA-seabirds has targets to reduce the risk categorisation for seabirds currently assessed to be at high or very high risk from commercial fishing. This project provides for research to better understand population size and demographics of the black petrels. Estimated risk levels and uncertainty, and therefore potentially the risk category, may be reduced where the high risk categorisation comes from poor information. Black petrel is the species estimated to be at most risk from commercial fisheries but there is considerable uncertainty in this estimate because of uncertainty about capture rates in longline fisheries, adult survival, population size and distribution. This project will address the latter three uncertainties. Importantly there seems to be a disagreement between some of the results of the risk assessment, population monitoring and modelling in that more captures are predicted than could be explained given the trends seen at the major colony.

This project continues the population monitoring work undertaken for DOC and MPI (i.e. under PRO2017-01A).

Objective 1:
This project continues the study work done on Great Barrier Island (since 1995-96) and Little Barrier Island, to monitor the population of black petrels using study quadrats in the main colony to track burrow usage, reproduction and survival of individually identified black petrels. This work also includes assessing burrow density and occupancy along transects to allow for extrapolation to total population size. Further efforts need be directed to improve the understanding of migration and emigration of black petrels between the study areas and surrounding habitat, and whether juveniles recruiting into the colony will establish burrows close to their natal burrow.

Objective 2:
The distribution of black petrels is not well understood, many of the black petrels tracked at sea have been done so mainly during their chick rearing period. This limits the understanding of the areas utilised by the birds during other breeding stages or as juveniles. Note that pre-laying exodus do occur in other seabirds where the birds travel greater distances than during chick rearing to forage in different areas. This information is essential to understand the spatial overlap with fishing and the resulting risk fisheries pose to the species.

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, 0.3

References:

Bell, E. A., Mischler, C., Sim, J. L., & Scofield, P. 2015. Population parameters of the black petrels (Procellaria parkinsoni) on Great Barrier Island (Aotea Island), 2014/15. Report prepared by Wildlife Management International for the New Zealand Department of Conservation, Wellington. 49p.

Bell, E. A., Mischler, C., & Sim, J. L. 2015. Preliminary survey and population monitoring of black petrels (Procellaria parkinsoni) on Hauturu-o-Toi/Little Barrier Island, 2014/15. Report prepared by Wildlife Management International for the New Zealand Department of Conservation, Wellington. 16p.

PSB2019-06

Project number:	PSB2019-06
Project title:	Review of footage collected from the 2018/19 Black Petrel Electronic Monitoring project
Start date:	1 July 2019
End date:	1 December 2019
Vessel use:	None
Estimated cost:	$150 000

Overall Objective:
To provide review services and comparative analysis of the various data collected from the 2018/19 trial of electronic monitoring in the FMA1 bottom longline fisheries.

Specific Objectives:
1. To conduct footage review of electronic monitoring footage collected from the snapper and bluenose bottom longline fisheries in FMA1.
2. To conduct a comparative analysis of the various datasets collected regarding seabird captures.

Reporting Requirements:
1. To present methods to an Aquatic Environment Working Group (AEWG) meeting before August 20th, 2019.
2. To present a draft AEBR to an Aquatic Environment Working Group (AEWG) meeting before 30 September, 2019.
3. To submit a draft AEBR (as per Reporting Form 6) to the Ministry for Primary Industries by 1 November 2019, payment will be on acceptance following review.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 1 December 2019.

Rationale:

Commercial fishers and quota owners, together with the Ministry for Primary Industries (MPI), the Department of Conservation (DOC), and the Black Petrel Working Group (BPWG)

have continued the develop electronic monitoring (EM) of seabird captures in a proof of concept project in 2018/19, a continuation of the work undertaken in 2016/17 and 2017/18.

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 this project 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 BLL fisheries.

The "National Plan of Action – 2013 to reduce the incidental catch of seabirds in New Zealand fisheries" (NPOA) has an overarching goal of reducing the fishing pressure on New Zealand seabirds through avoidance or mitigation and ensuring New Zealand fisheries are globally recognised as being seabird friendly. One of the 5 year practical objectives of the NPOA is, "capture rates are reducing in all New Zealand fisheries in accordance with reduction targets in the relevant planning documents for those fisheries". The 5 year biological risk objective is "the level of mortality of New Zealand seabirds in New Zealand commercial fisheries are reduced so that species currently categorised as at very high (e.g. black petrel) or high risk from fishing move to a lower category of risk.

In the seabird risk assessment for commercial fisheries (Richard & Abraham 2015, Richard et al. 2017), black petrels were found to be the species most at risk from New Zealand commercial fisheries, with bottom longline fisheries targeting SNA or BNS contributing the greatest risk. Black petrels breed on Little Barrier and Great Barrier Islands during the summer months, foraging in the outer Hauraki Gulf or in pelagic waters near continental shelf breaks or sea-mounts during the breeding season and migrating to South America once the breeding season is over.

One of the main objectives of the Black Petrel and Flesh-footed Shearwater (BPFFSW) Action Plan is to reduce the cumulative effects of longline and trawl fisheries on black petrels (*Procellaria parkinsoni*) and flesh-footed shearwaters (*Puffinus carneipes*) such that both species move to a lower category of risk, according to the seabird risk assessment, by 2018. This objective closely aligns with the NPOA biological risk objective.

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, limiting the ability to demonstrate success of current mitigation measures and achievement of the NPOA objectives. Traditional observer programmes tend to be cost heavy requiring significant resource input. 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 the NPOA objectives.

In 2015, an experimental assessment of video observation in an inshore bottom longline vessel, primarily targeting snapper, was funded by DOC and 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).

As a result of the success of the previous trial, it is proposed that the use of video observation to monitor seabird captures be further developed to assess whether cameras can be as effective at monitoring seabird captures as human observers. This project will directly assess the ability for cameras to detect captures of both live and dead seabirds, during all seabird interaction events and identify captured seabirds to species level. On a wider scale the project will provide an assessment of camera utility over a wider range of vessels and in different environmental and operating conditions. Using both cameras and observers will produce relative detection rates enabling direct comparison between the two, something not previously done for the BLL fishery.

If successful, the results from this project will help inform the integration of seabird EM objectives into the wider Digital Monitoring programme and progress the use of EM as a complementary tool to the existing observer programme to improve overall monitoring of seabird captures in commercial BLL fisheries.

Exploring alternative monitoring tools such as video observation is in line with the second research and development objective in the NPOA, "new observation and monitoring methods, especially in relation to poorly observed fisheries, are researched, developed and implemented". Information collected as part of this proof of concept project will also help to inform progress against the NPOA biological risk objective (and one of the BPFFSW action plan objectives), and the third practical objective, "capture rates are reducing in all New Zealand fisheries…".

Objective 1:
This objective includes providing footage review in accordance with the project plan. The successful tenderer will review the trips according to the agreed review protocol and record seabird capture data.

Objective 2:
An analysis is to be conducted comparing the video observation data and data collected by human on-board observers (on the trips but on a smaller subset of trips covered by video observation). The video observations will be provided by review of video footage under objective 1.

This analysis will address the following:-

- the relative detection rates of seabird captures by human and video observation;
- the ability for human and video observers to identify captured seabirds to species;
- the impact of human observers on the detection of captures by video observers; and
- the representativeness of the coverage achieved by human and video observation.

It is likely that the resulting total number of fishing operations with capture events of certain key species will be small and that detection rates from human and video observation will need to be quite different for them to be statistically significant. A power analysis should be conducted to assess the effect of sample size (true number of seabird captures) on our ability to obtain a statistical difference in detection rate with alterative assumptions of probability distribution (e.g. binomial or negative binomial). These analyses will include data from the previous trials conducted in 2016/17 and 2017/18 to increase the statistical power.

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.

References:

Middleton, D.A.J., Guard, D.P., and Orr, T.J. (2016). Detecting seabird captures via video observation, 27 pages. Final Report for the Southern Seabirds Solutions Trust. Report published in February 2016 and presented to the Aquatic Environment Working Group (AEWG) in March 2016.

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, Wellington, New Zealand.

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.

PSB2019-07

Project number:	PSB2019-07
Project title:	Continuation of the Black Petrel Electronic Monitoring project for the 2019/20 summer
Start date:	1 July 2019
End date:	1 December 2019
Vessel use:	None
Estimated cost:	$350 000

Overall Objective:
To continue the electronic monitoring of the snapper and bluenose bottom longline fisheries in FMA1 for seabird captures (particular focus is for black petrel captures).

Specific Objectives:

1. To collect footage via an electronic monitoring programme on snapper and bluenose bottom longline fisheries in FMA1.
2. To review footage to
3. To conduct a comparative analysis of the various datasets collected regarding seabird captures.

Reporting Requirements:

1. To present methods to an Aquatic Environment Working Group (AEWG) meeting before August 20th, 2019.
2. To present a draft AEBR to an Aquatic Environment Working Group (AEWG) meeting before 30 September, 2019.
3. To submit a draft AEBR (as per Reporting Form 6) to the Ministry for Primary Industries by 1 November 2019, payment will be on acceptance following review.

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 1 December 2020.

Rationale:

Commercial fishers and quota owners, together with the Ministry for Primary Industries (MPI), the Department of Conservation (DOC), and the Black Petrel Working Group (BPWG) proposes to further develop electronic monitoring (EM) of seabird captures in a proof of concept project in 2017-18, a continuation of the work undertaken in 2016-17.

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 this project 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 BLL fisheries.

The "National Plan of Action – 2013 to reduce the incidental catch of seabirds in New Zealand fisheries" (NPOA) has an overarching goal of reducing the fishing pressure on New Zealand seabirds through avoidance or mitigation and ensuring New Zealand fisheries are globally recognised as being seabird friendly. One of the 5 year practical objectives of the NPOA is, "capture rates are reducing in all New Zealand fisheries in accordance with reduction targets in the relevant planning documents for those fisheries". The 5 year biological risk objective is "the level of mortality of New Zealand seabirds in New Zealand commercial fisheries are reduced so that species currently categorised as at very high (e.g. black petrel) or high risk from fishing move to a lower category of risk.

In the seabird risk assessment for commercial fisheries (Richard & Abraham 2015, Richard et al. 2017), black petrels were found to be the species most at risk from New Zealand commercial fisheries, with bottom longline fisheries targeting SNA or BNS contributing the greatest risk. Black petrels breed on Little Barrier and Great Barrier Islands during the summer months, foraging in the outer Hauraki Gulf or in pelagic waters near continental shelf breaks or sea-mounts during the breeding season and migrating to South America once the breeding season is over.

One of the main objectives of the Black Petrel and Flesh-footed Shearwater (BPFFSW) Action Plan is to reduce the cumulative effects of longline and trawl fisheries on black petrels (*Procellaria parkinsoni*) and flesh-footed shearwaters (*Puffinus carneipes*) such that both species move to a lower category of risk, according to the seabird risk assessment, by 2018. This objective closely aligns with the NPOA biological risk objective.

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, limiting the ability to demonstrate success of current mitigation measures and achievement of the NPOA objectives. Traditional observer programmes tend to be cost heavy requiring significant resource input. 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 the NPOA objectives.

In 2015, an experimental assessment of video observation in an inshore bottom longline vessel, primarily targeting snapper, was funded by DOC and 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).

As a result of the success of the previous trial, it is proposed that the use of video observation to monitor seabird captures be further developed to assess whether cameras can be as effective at monitoring seabird captures as human observers. This project will directly assess the ability for cameras to detect captures of both live and dead seabirds, during all seabird interaction events and identify captured seabirds to species level. On a wider scale the project will provide an assessment of camera utility over a wider range of vessels and in different environmental and operating conditions. Using both cameras and observers will produce relative detection rates enabling direct comparison between the two, something not previously done for the BLL fishery.

If successful, the results from this project will help inform the integration of seabird EM objectives into the wider Digital Monitoring programme and progress the use of EM as a complementary tool to the existing observer programme to improve overall monitoring of seabird captures in commercial BLL fisheries.

Exploring alternative monitoring tools such as video observation is in line with the second research and development objective in the NPOA, "new observation and monitoring methods, especially in relation to poorly observed fisheries, are researched, developed and implemented". Information collected as part of this proof of concept project will also help to inform progress against the NPOA biological risk objective (and one of the BPFFSW action plan objectives), and the third practical objective, "capture rates are reducing in all New Zealand fisheries…".

Objective 1:
This objective covers the implementation of electronic monitoring on board a sub-sample of the vessels in the snapper and bluenose bottom longliners operating in FMA1. Involvement from the owner or skipper will need to be voluntary, and selection of vessels to be 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 focussed 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 project plan. The successful tenderer will review the trips according to the agreed review protocol and record seabird capture data.

Objective 3:
An analysis is to be conducted comparing the video observation data and data collected by human on-board observers (on the trips but on a smaller subset of trips covered by video

observation). The video observations will be provided by review of video footage under objective 2.

This analysis will address the following:-

- the relative detection rates of seabird captures by human and video observation;
- the ability for human and video observers to identify captured seabirds to species;
- the impact of human observers on the detection of captures by video observers; and
- the representativeness of the coverage achieved by human and video observation.

It is likely that the resulting total number of fishing operations with capture events of certain key species will be small and that detection rates from human and video observation will need to be quite different for them to be statistically significant. A power analysis should be conducted to assess the effect of sample size (true number of seabird captures) on our ability to obtain a statistical difference in detection rate with alterative assumptions of probability distribution (e.g. binomial or negative binomial). These analyses will include data from the previous trials conducted in 2016/17 and 2017/18 to increase the statistical power.

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.

References:

Middleton, D.A.J., Guard, D.P., and Orr, T.J. (2016). Detecting seabird captures via video observation, 27 pages. Final Report for the Southern Seabirds Solutions Trust. Report published in February 2016 and presented to the Aquatic Environment Working Group (AEWG) in March 2016.

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, Wellington, New Zealand.

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.

PSB2019-08

Project number:	PSB2019-08
Project title:	Feasibility trial and of underwater baitsetter
Start date:	1 July 2019
End date:	30 November 2020
Vessel use:	Chartered use of surface longline vessel (possibly in-kind)
Estimated cost:	$110 000 in total, with cost sharing arrangements to be confirmed with DOC, fishing industry and other funders.

Overall Objective:
Feasibility trial to determine the operational performance and effectiveness of the underwater baitsetter as a new seabird bycatch mitigation method for use in the surface longline commercial fishery in New Zealand.

Specific Objectives:
1. Feasibility trial of the underwater baitsetter in New Zealand surface longline
2. Assessment of the behavioural response of seabirds to the underwater baitsetter

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 1 December 2019.

Rationale:

General:
Surface longline fisheries globally have been noted to be a source of seabird bycatch of concern, leading to the development of the International Plan of Action for Seabirds. Baited hooks deployed onto the sea surface attract seabirds to fishing vessels leading to attacks on baits, capture and death by drowning. There are existing mitigation devices, such as tori lines, line weighting, setting at night, and the use of hook shielding devices that are regulated in various jurisdictions, with varying levels of successful utilisation and effectiveness in various fleets.
An alternative mitigation method has been developed that allows the baits to be deployed underwater where they are less detectable, more difficult to reach and less likely to be taken

by seabirds. In 2010 and 2012 proof-of-concept experiments were conducted in the Uruguayan pelagic longline fishery with a newly developed device designed to set baits underwater (Robertson et al. 2018). The experiments demonstrated significant differences between setting baits at the sea surface and setting baits underwater with regard to the abundances of seabirds following the vessel, incidences of attacks on baits and mortality.

Objective 1:
The proposed delivery model is for an engineer to be trained by Amerro Engineering between August and September 2019 to enable the newly trained engineer to be able to provide support for the underwater baitsetter during the trials. Following this training, Amerro Engineering and the newly trained engineer will travel to Nelson to fit a participating vessel with the underwater baitsetter.
It is proposed to equip a participating vessel with an underwater baitsetter in October 2019 and charter the vessel for 2 months to test the operation and durability of the underwater baitsetter and components. The trained engineer will be the technical support for the feasibility trial and be responsible for all activities associated with the promulgation and maintenance of the underwater baitsetter on the participating vessel, including vessel fit-out, initial inshore trials, fishing trials, crew training at sea (machine operations, safety and maintenance), and troubleshooting as required. He will be on board for the whole period, collecting data on the performance of the underwater baitsetter in a range of sea states. The data collected during this period will primarily be operationally focused as well as ensuring that its use does not impact normal commercial operations nor impact the catch per unit effort of the vessel (commercial viability of the vessel).
The collection of operational data on the equipment's use and robustness will be used as part of the stop/go assessment to assess its wider use in the fishery.
The engineer, with the assistance of a project manager, will prepare a report on this part of the project.

Objective 2:
If the underwater baitsetter is found to be robust and not impact on fishing, as determined by the stop/go assessment under objective 1, it will be used for the southern bluefin tuna season in 2020. The objective of this part of the project is to assess seabird behaviour when the bait is released at different depths, and as well, carry out an iterative roll back on alternative forms of mitigation. A special exemption permit will be needed for this part of the project. A scientific report will be prepared and published on this part of the trial.

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.

References:
Robertson, G., Ashworth. P., Ashworth, P., Carlyle, I., Jiménez, J., Forselledoc, R., Domingo, A., Steven G. Candy, S.G., 2018. Setting baited hooks by stealth (underwater) can prevent the incidental mortality of albatrosses and petrels in pelagic longline fisheries. *Biological Conservation* 225, pages 134-143.

PSB2019-09

Project number:	PSB2019-09
Project title:	Aerial survey of white-capped albatross on the Auckland Islands
Start date:	1 August 2019
End date:	30 November 2021
Vessel use:	None
Estimated cost:	$80 000

Overall Objective:

1. To continue the long term population monitoring dataset for white-capped albatross on the Auckland Islands and assess the population trend throughout the dataset.

Specific Objectives:

1. To undertake aerial surveys of the white-capped albatross on Auckland Islands in 2019/20 and 2020/21, and undertaking analysis of total counts for each field season.
2. Based on the counts in Objective 1 and previous counts on the resulting dataset covering 14 years, assess the population trend, taking into account the proportion of loafers identified in the photo montages and by ground counts.

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.

Data Reporting

To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 1 December 2019.

Rationale:

General:

White-capped albatrosses *Thalassarche steadi* are endemic to New Zealand, breeding on Disappointment Island, Adams Island and Auckland Island in the Auckland Island group, and Bollons Island (50-100 pairs) in the Antipodes Island Group (Gales, 1998). Previous population estimates that we have developed (Baker et al. 2014) show that most (95%) of the global population breeds on Disappointment Island, an area where access is restricted to maintain environmental values at the site.

Between 2006/07 and 2017/18 repeated population censuses have been undertaken of the white-capped albatrosses breeding in the Auckland Islands using aerial photography. These population censuses were carried out in either December or January each year to estimate population size and track population trends (Baker et al. 2014, Baker et al. 2015). The latest survey conducted in 2017/18 was undertaken under contract to Fisheries New Zealand under SEA2017-15 which essentially funded only the helicopter time. No aerial survey was conducted for the 2018/19 summer due to challenges around changing field season work programmes and receiving access permit to conduct the survey.

Count data over 11 years show strong inter-annual fluctuations, a characteristic we have observed for many other seabird species. Trend analysis of 11 years of counts using regression splines showed no clear evidence for systematic increase or decline over the eleven years of the study.

Large numbers of white-capped albatrosses are still estimated to be killed each year as a result of interactions with trawl and longline fisheries in the Southern Ocean (Baker et al 2007). This level of estimated mortality highlights the need to continue to acquire accurate population estimates and trends for white-capped albatross populations to assess the impact of fisheries operations on this species. While uncertainty still exists around the population trend, ongoing annual monitoring is recommended to build on the existing data set, clarify the population's status and provide certainty around the sustainability of current levels of fishing mortality.

Objective 1:

Undertake aerial surveys in 2019/20 and 2020/21 of the white-capped albatross colonies on the Auckland Islands. For each survey prepare photo montages and count nesting and loafing albatross according to existing methodology (see Baker et al 2015) for the aerial surveys undertaken during the summers of 2019/20 and 2020/21.

Objective 2:

Assess population trend from the resulting 14 years of total count data using an appropriate Generalised Linear Model considering over dispersion in the 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): 0.9, 0.1.

References:

Baker, G. B., Double, M.C., Gales, R., Tuck, G. N., Abbott, C. L., Ryan, P.G., Petersen, S. L., Robertson, C. J. R, and Alderman, R. 2007. A global assessment of the impact of fisheries-related mortality on shy and white-capped albatrosses: Conservation implications. Biological Conservation 137, 319—333.

Baker, G.B., Jensz, K., Cunningham, R. 2014. White-capped albatross aerial survey 2014. Final Report. Report by Latitude 42 for the Department of Conservation, Wellington. Latitude 42 Environmental Consultants, Kettering, Australia (www.latitude42.com.au).

Baker, G.B., Jensz, K., Cunningham, R., Holdsworth, M., Chilvers, B.L. 2015. White-capped albatross aerial survey 2015. Final Report. Report by Latitude 42 for the Department of Conservation, Wellington. Latitude 42 Environmental Consultants, Kettering, Australia (www.latitude42.com.au), and http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/reports/white-capped-albatross-aerial-survey-2015-final.pdf

Gales, R.P. 1998. Albatross populations: status and threats. Pp. 20–45 in *Albatross: Biology and Conservation.* Robertson, G. and Gales, R. (eds.). Surrey Beatty and Sons, Chipping Norton.

High Seas Fisheries (Antarctic and South Pacific)

ANT2019-01	Antarctic Fisheries
ANT2019-02	Antarctic research - Ross Sea region MPA

ANT2019-01

Project number:	ANT2019-01
Project title:	Antarctic fisheries
Start date:	1 July 2019
End date:	30 June 2020
Vessel use:	yes
Estimated cost:	$400 000

Overall Objective:
To conduct research to support the maintenance of the Antarctic toothfish stock status and ecosystem structure in the Ross Sea region, Amundsen Sea region, and other areas as appropriate.

Specific Objectives:

1. To provide scientific advice to support the sustainability and management of the Antarctic toothfish stock status in the Ross Sea region, Amundsen Sea region, and other areas as appropriate.
2. To provide scientific advice to support the sustainability and management of the ecosystem structure in the Ross Sea region, Amundsen Sea region, and other areas as appropriate.
3. To provide other scientific advice for MPI and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) activities as required.

Reporting Requirements:
Prior to starting the research, a work programme will need to be developed and agreed between the research provider and MPI. The work programme will consist of a list of milestones with deadlines to achieve the specific research objectives above.

Specific Objectives 1-3:

1. Provide reports to CCAMLR and Final Research Reports (FFRs) on achievements on specifics of the agreed work programme.
2. Prepare reports and presentations on 3 above.

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 by the fifth working day of each month for the duration of the project.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MPI by 30 June 2020.

Rationale:

General:
New Zealand has significant interest in the Southern Ocean. Research activities are directed towards protecting the health of the aquatic environment and enabling New Zealanders to get the best value from the sustainable and efficient use of fisheries - n particular, the Ross Sea region toothfish fishery, in which New Zealand vessels and scientists have been at the forefront of developing a well-managed and profitable MSC-certified fishery. The fishery itself is worth approximately $30 million NZD per annum to our fishing industry with up to four New Zealand vessels participating each year.
The same research also contributes significantly to meeting New Zealand's international obligations to the management of Antarctic fisheries through the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). New Zealand is one of twenty five CCAMLR members tasked with ensuring the conservation of Antarctic Marine Living Resources in the area, in accordance with the CCAMLR Convention's principles of conservation.
As New Zealand holds a special interest in the Ross Sea area and is a key player as a responsible fishing presence in the Ross Sea fishery, New Zealand leads the development of science and responsible fishing practices in this area. Our efforts help to ensure that the fishery continues to be sustainably managed and that New Zealand's interests in the region remain protected.
MPI in collaboration with NIWA and the Fishing Industry have documented notable research successes to date which include:

- the validation of age, growth, spawning maturity, and life-cycle movements of Antarctic toothfish;
- development of new tag-based stock assessment methods now adopted widely within CCAMLR;
- development of world-leading VME (benthic habitat) impact assessment and mapping techniques using fishery-dependent data;
- development of trophic ecosystem models; and
- the development of spatially explicit population models.

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.

ANT2019-02

Project number:	ANT2019-02
Project title:	Antarctic research - Ross Sea region MPA
Start date:	01 July 2019
End date:	30 June 2020
Vessel use:	Yes
Estimated cost:	$100 000

Overall Objective:
To provide scientific knowledge to MPI to allow the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) Scientific Committee to advise the Commission on: (i) the degree to which the specific objectives of the Marine Protected Area (MPA) are being achieved; (ii) the degree to which the MPA objectives are still relevant in different areas of the MPA; and (iii) what management actions may be required to improve the achievement of the objectives for this MPA.

Specific Objectives:

1. To provide advice and scientific knowledge to MPI that would allow the CCAMLR Scientific Committee to advise the Commission on the degree to which the specific objectives of the MPA are being achieved.
2. To provide advice and scientific knowledge to MPI that would allow the CCAMLR Scientific Committee to advise the Commission on the degree to which the MPA objectives are still relevant in different areas of the MPA.
3. To provide advice and scientific knowledge to MPI that would allow the CCAMLR Scientific Committee to advise the Commission on what management actions may be required to improve the achievement of the objectives for this MPA.

Reporting Requirements:
Prior to starting the research, a work programme will need to be developed and agreed between the research provider and MPI. The work programme will consist of a list of milestones with deadlines to achieve the specific research objectives above.

Research reporting:
Specific Objectives 1-3:

1. Provide reports to CCAMLR and Final Fisheries Reports (FFRs) on specifics achievements of the agreed work programme.
2. Prepare reports and presentations on 3 above.

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 by the fifth working day of each month for the duration of the project.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the MPI Research Data Manager by 30 June 2020.

Rationale:

General:
New Zealand has significant interest in the Southern Ocean. Research activities are directed towards protecting the health of the aquatic environment, and enabling New Zealanders to get the best value from the sustainable and efficient use of fisheries - in particular, the Ross Sea region toothfish fishery, in which New Zealand vessels and scientists have been at the forefront of developing a well-managed and profitable MSC-certified fishery.
New Zealand is one of twenty five members of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) tasked with ensuring the conservation of Antarctic Marine Living Resources in the area, in accordance with the CCAMLR Convention's principles of conservation.
In October 2016, the Ross Sea region MPA was agreed by CCAMLR following a joint proposal by New Zealand and the United States. A Research and Monitoring Plan (RMP) for the MPA has been developed. The objectives of the RMP associated with the MPA is to deliver sufficient scientific knowledge to allow the Scientific Committee to advise the Commission on: (i) the degree to which the specific objectives of the MPA are being achieved; (ii) the degree to which the MPA objectives are still relevant in different areas of the MPA; and (iii) what management actions may be required to improve the achievement of the objectives for this MPA.

Weighting of Objectives:

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.8, 0.1, 0.1.

Marine Biodiversity Research

ZBD2019-01	Quantifying Benthic Biodiversity - Phase 2
ZBD2019-04	Plastics and marine debris across the ocean floor in New Zealand waters
ZBD2019-08	Sources of suspended sediment load and impact on coastal kaimoana species
ZBD2019-11	Halting the decline of seabird biodiversity through the development of an innovative approach, EARS, Electronic Automated Reporting System

ZBD2019-01

Project number:	ZBD2019-01	
Project title:	Quantifying Benthic Biodiversity - Phase 2	
Start date:	1 July 2019	
End date:	30 May 2021	
Vessel use:	RV Tangaroa 30 days March-April 2020	
Estimated cost:	$750 000	[$200 k in year 1, $550 k in year 2)

Overall Objective:

To expand and develop initiatives to improve confidence in predictive models of seabed fauna and habitat distributions started under ZBD2016-11: "Quantifying benthic biodiversity to improve predictive habitat modelling potential".

Specific Objectives:

1. Predict gradients in benthic faunal turnover across Campbell Plateau (CP) using relationships between faunal distributions and environmental gradients developed for Chatham Rise (CR) under ZBD2016-11;
2. Run a dedicated photographic survey of seabed habitats and fauna across CP, structured on the basis of predictions from (1);
3. Use quantitative data from the CP survey to assess the utility of predictions from the existing CR models when applied to a neighbouring area of the EEZ;
4. Generate updated models with a spatial domain encompassing both regions by merging data from the CP survey with the existing CR dataset.

The Tangaroa Reference Group has approved 30 days of RV *Tangaroa* time for survey work in March-April 2020, based on the original Expression of Interest submitted in 2016 for ZBD2016-11.

Reporting Requirements:
Voyage Programme; Voyage Report; progress reporting to BRAG/AEWG; final research report(s) (as AEBR and/or journal publication)

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.

Data Reporting

To submit any data generated, collected or modified during the course of this project to the MPI Research Data Manager by 31 May 2021.

Rationale:

Promoting an adaptive and environmentally responsible primary sector is a Key Focus Area of MPI. A key component of ecosystem-based management of bottom-contact fisheries is quantification of benthic impacts[1]. An MPI-funded initiative to assess the utility of, and improve confidence in, predictive models of benthic distributions using fisheries-independent data is nearing completion (ZBD2016-11)[2,3]. The current proposal is to build on results from ZBD2016-11 by testing the applicability of species-environment relationships developed for CR to a neighbouring area of high fisheries importance (CP) with overlapping environmental characteristics. The work proposed will contribute to assessment of benthic impacts by delivering: (i) new quantitative data on seabed fauna distributions in a key fisheries area largely unsampled at present; (ii) assessment of potential for using environmental relationships developed using dedicated benthic surveys in one region to predict to neighbouring regions, and (iii) updated benthic distribution models with wider spatial relevance across the EEZ and based on consistent, independent, non-destructive survey data.

Weighting of Objectives: (1) 5 %; (2) 40 %; (3) 35 %; (4) 20 %

References:

Pitcher, C.R.; Ellis, N.; Jennings, S.; Hiddink, et al. (2016). Estimating the sustainability oftowed fishing-gear impacts on seabed habitats: a simple quantitative risk assessment method applicable to data-limited fisheries. *Methods in Ecology and Evolution*: n/a-n/a. <http://dx.doi.org/10.1111/2041-210X.12705

Bowden, D.A.; Rowden, A.A.; Anderson, O.F.; Clark, M.R., et al. (in press). Quantifying Benthic Biodiversity: developing a dataset of benthic invertebrate faunal distributions from seabed photographic surveys of Chatham Rise. *Aquatic Environment and Biodiversity Report.* 35 p.

Anderson, O.F.; Bowden, D.A.; Rowden, A.A.; Clark, M.R. (accepted 2019). Quantifying benthic biodiversity: assessing the utility of existing models of benthic fauna distributions on Chatham Rise. MPI MS *No. 3249*. 34 p.

ZBD2019-04

Project number:	ZBD2019-04
Project title:	Plastics and marine debris across the ocean floor in New Zealand waters
Start date:	July 2019
End date:	May 2020
Vessel use:	nil
Estimated cost:	$80 000

Overall Objective:
To assess the occurrence and distribution of plastics and marine debris in New Zealand's marine seafloor environment from existing data sources

Specific Objectives:

1. Create a metadatabase of all potential sources of data on plastics and marine debris in New Zealand waters.
2. Select and analyse appropriate sets and subsets of data that will provide density estimates of plastics and map debris on the seabed.
3. Provide summary statistics of benthic debris density, types of debris, and heat maps of occurrence throughout the TS and EEZ.

Reporting Requirements:
Voyage Programme; Voyage Report; progress reporting to BRAG/AEWG; final research report(s) (as AEBR and/or journal publication)

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the MPI Research Data Manager by 31 May 2020.

Rationale:

General:

Plastic debris in the ocean is a pollution related issue attracting worldwide concern. As well as unsightliness, the debris is on a scale that causes harm to many marine species and threatens the health of marine ecosystems across the globe. All species are affected, but attention has particularly focused on marine mammals, seabirds, other protected species and fish. New Zealand is no exception, and plastic debris are visible along much of our coastline. Within New Zealand, beach surveys and clean-up events for visible (macro) plastics are underway and the findings are available online (Sustainable coastlines URL).

Far less is known about the occurrence of plastics in our offshore environment. Microplastics have been found in the plankton recorder time series samples between New Zealand and the Ross Sea (Antarctica) and are being quantified as part of the ongoing Continuous Plankton Recorder Programme supported by Fisheries New Zealand and Sanford Ltd.

This project aims to quantify the occurrence and distribution of macroplastics in New Zealand's sub-tidal marine environment, from shallows through to depths of 1800m (or more if data are available). An important component will be to identify and quantify the types of plastic according to the UNEP guidelines for monitoring and surveying marine litter (benthic) https://www.nrc.govt.nz/media/10448/unepioclittermonitoringguidelines.pdf .

Objective 1:
Create a metadatabase of all potential sources of data on plastics and marine debris in New Zealand waters.
This objective aims to determine data available in in New Zealand that can be used to scale the problem. This objective will document all known sources of information on plastic debris in New Zealand territorial and EEZ waters. This includes micro and macroplastics, and will identify categories of plastic (see UNEP Guidelines), data type (ie where data are held, such as Observer data; DTIS footage; stomach content analyses of fish, seabirds, marine mammals etc) as well as descriptors that usefully describe the data for analysis potential**.**

Objective 2:
Select and analyse appropriate sets or subsets of data that will provide density estimates and maps of plastics debris on the seabed.
This objective aims to prepare and analyse datasets that can provide estimates of the abundance and distribution of benthic debris in New Zealand TS and EEZ waters. This objective will focus on macroplastics for the analysis, but the possibility of reporting on the presence or microplastics on the seabed should also be considered.

Objective 3.
Provide summary statistics of benthic debris density, types of debris, and heat maps of occurrence throughout the TS and EEZ.
The aim of this objective is to scale the size of the problem, determine the key types of seabed plastics, identify hotspots, and compare data from New Zealand with other parts of the world.

Weighting of Objectives:
Equal*.*

ZBD2019-08

Project number:	ZBD2019-08
Project title:	Sources of suspended sediment load and impact on coastal kaimoana
Start date:	July 2019
End date:	May 2021
Vessel use:	Nil
Estimated cost:	$100 000

Overall Objective:
To identify key sources of sedimentation in estuarine and coastal environments

Specific Objectives:

1. Compare and contrast sedimentation datasets from different estuaries and determine how different sedimentation histories have impacted on a range of kaimoana species.

Reporting Requirements:
Scoping discussion; progress reporting to BRAG/AEWG; final research report(s) (as AEBR and/or journal publication)

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.

Data Reporting
To submit any data generated, collected or modified during the course of this project to the MPI Research Data Manager by 31 May 2021.

Rationale:
NIWA has developed an extensive data set of sediment accumulation rates based on 85 cores collected from North Island estuaries and coastal bays over the last ~15 years. The data are based on consistent dating methods, "comparing apples with apples", and enable valid comparisons to be drawn between habitat types and estuaries.

The results, based on ^{210}Pb dating, show that over the last 150 years estuaries with relatively large catchments and/or small sediment accommodation space (the unfilled volume of an estuary below high tide) have filled with sediment most rapidly, with sediment accumulation rates reaching 25 mm/yr in tidal creeks. Expressed as estuary-average values,

Auckland's largely intertidal east-coast estuaries and Kaipara Harbour have accumulation rates averaging ~5 mm/yr, which is substantially higher than in the Bay of Islands and in Pauatahanui Inlet (Porirua), where the average accumulation rate is < 2.5 mm/yr. Although these numbers might seem small, New Zealand estuaries are now filling with catchment sediments ten times faster than before large-scale deforestation of catchments. For example, annual sediment deposition in the Bay of Islands has averaged ~500,000 tonnes per year over the last century, which compares with less than 50,000 tonnes per year since the bays were formed ten thousand years ago by rising sea levels.

For the first time, CSSI dating of sediment cores provides new insights into how the sources of catchment sediments have shifted from natural to anthropogenic over the last several thousand years.

The environmental record preserved in sediment cores in the Bay of Islands shows that natural disturbance of the landscape occurred thousands of years before humans arrived. This is indicated by the presence of bracken-labelled soils in prehistoric estuarine sediments; bracken typically colonises areas which have been deforested by landslides and/or fire. Over the last hundred years, soils eroded from agricultural and horticultural land have increasingly dominated sedimentation, not only in the estuaries but also in the Bay of Islands and beyond to the inner continental shelf. For example, at a core site in the inner Bay of Islands (water depth 30 m), most of the soil deposited since the early 1960s has been derived from dry-stock (i.e. sheep and beef) pasture.

This new, innovative approach to environmental reconstruction based on sediment cores allows us to measure how various soil sources change over time. This, in turn, will allow resource managers to target catchment management and restoration efforts more effectively in estuaries and coastal waters.

Weighting of Objectives:
Equal

ZBD2019-11

Project number:	ZBD2019-11
Project title:	Development of Electronic Automated Reporting System (EARS) to improve seabird bycatch monitoring
Start date:	1 July 2019
End date:	30 June 2021
Vessel use:	Yes, a short vessel charter.
Estimated cost:	$180 000 total cost

Overall Objective:
Develop the EARS proof of concept through further development, ruggedization and at-sea trials.

Specific Objectives:

1. Develop and ruggedize technology and test on NZ domestic vessel
2. At sea trials in New Zealand and Japan

Rationale:
General:
The opportunity lies in managing the declining population by intervening with threats on the high seas. The current bycatch levels of seabirds, including the Antipodean Albatross is poorly known. We are concentrating on international distant water longline fishing fleets as what evidence there is indicates they are likely to be the major cause of Antipodean albatross mortality from incidental bycatch. While we acknowledge that other factors may play a role in their decline, reducing bycatch mortality is the one place that human intervention can be applied.

The distant water longline fleets operating in the South Pacific collectively operate approximately 300 longline vessels operating on the high seas below 25°S. The largest of these vessels set 4,000 hooks daily on a 100km longline.

Much of the ocean has regulations promulgated through member states of Regional Fisheries Management Organisations (RFMOs). The RFMO that has jurisdiction over most of the Antipodean albatross foraging area is the Western and Central Pacific Fisheries Commission (WCPFC) and it requires mitigation techniques are used to reduce seabird bycatch in certain areas.

The regulated mitigation tools within the WCPFC are the use of two of three of the following;

- Tori (bird scaring) lines
- Weighted branch lines (hooks)
- Night setting

These mitigation techniques have been shown to reduce seabird bycatch by up to 80-90% if used appropriately (e.g. Melvin et al 2004). These three mitigation techniques are supported as best practice by the Agreement for the Conservation of Albatrosses and Petrels (ACAP), noting they recommend all three are used in conjunction. Other mitigation devices are either under development (i.e. underwater baitsetting) or are in process of being considered as a regulated option (i.e. hook shielding devices).

With the compliance monitoring of the current mitigation tools can be achieved for comparatively modest costs across the international distant water longline fishing fleets by gathering data directly from the mitigation tools and pairing that information with fish species identification data as a value adding proposition.

Our engagement has told us adoption of mitigation monitoring would be more likely if we incentivised fishing companies.

We have developed the concept of EARS, an Electronic Automated Reporting System, which monitors compliance with bycatch mitigation. The mitigation monitoring system uses robust sensor technology already proven across a range of industries and applying it to the high seas in a new configuration:

- GPS tracker on the back of the boat and also attached to the end of the tori line - with the distance between the two trackers as the indicator of compliance.
- The GPS also records the time of day for night setting compliance.
- Then there are RFID tags on each weighted hook recording their use as they pass a sensor on the back of the boat.

This data is then automatically sent from the vessel by satellite connection to member states, fishing companies, or whomever is agreed to receive it.

An additional component is envisaged that has 'value add' technology that would be an advantage to the fishing company. The 'value add' technology is fish species and morphometric data captured from a camera located above the fish-landing platform of the vessel. The camera would take images of fish as they came on-board triggered by the RFID tag coming back on the vessel. The images would be processed using machine vision algorithms. This 'value-add' component could be considered for further development in the future.

Objective 1:
Develop and ruggedize technology and test on NZ domestic vessel
Undertake a static vessel trial of the equipment developed under the bench-testing (conducted with partial funding from SEA2018-19) and verify that the data is being produced as expected. Purchase and set up further equipment for a further three more complete technology packages and ruggedize the total four equipment packages for at-sea trialling. The final step is to under a short vessel charter and test the ruggedized units in New Zealand.

Objective 2:
At sea trials in New Zealand and Japan

This objective is to undertake at-sea trials on co-operative longline vessels. There is an opportunity to trial our devices on a Japanese research longliner and there may be other opportunities with vessels based in Chile and Fiji.

Weighting of Objectives: 0.4, 0.6.

References:

Melvin EF, Guy TJ, Read LB (2014) Best practice seabird bycatch mitigation for pelagic longline fisheries targeting tuna and related species. Fisheries Research 149:5–18. doi: 10.1016/j.fishres.2013.07.01

Miscellaneous

SAM2019-02	Development of imaging analysis technology to determine ages from otoliths

SAM2019-02

Project number:	SAM2019-02
Project title:	Development of imaging analysis techniques to determine ages from otoliths
Start date:	1 July 2019
Completion date:	30 June 2020
Vessel use:	None
Estimated cost:	$200 000

Overall Objective:
To develop a database of high-quality otolith images for use in developing an automated ageing system using machine learning.

Specific Objectives:

1. 1.To establish a reference collection database of approximately 2000 high-resolution otolith images from each of 3-5 selected species

2. To use these images and associated data to develop a reliable ageing algorithm

Rationale:
General:
Information on the age structure of fish species is essential to understanding stock characteristics and developing fisheries management strategies. Otolith analysis is the standard method of age determination but this process is time consuming and therefore represents a significant cost to Fisheries New Zealand.

Digital image analysis could save a significant amount of time that is currently spent manually ageing otoliths as well as reducing subjectivity in otolith reading, which is currently subject to the accuracy of the individual otolith reader. This would enable more otoliths to be read per year as well as providing a digital archive of otolith information.

A number of computer assisted ageing analysis systems have been described in the literature but few systems have evaluated performance on a significant number of fish (N>30). In order to train the system to develop the algorithm, a large number of samples is required. A realistic aim is to collect 2000 otolith images per species. Species should be selected such that a range of characteristics are covered including both short and long lived species and otoliths for which validated ageing has occurred. Developing a standard procedure for obtaining high quality otolith images is critical to the success of this system.

Otoliths are routinely collected as part of standard fisheries sampling to monitor the age structure of catches and the population. Therefore a large collection of otoliths from a number of representative species is currently available for the creation of digital images.

Objective 1:
To establish a reference collection database of approximately 2000 high resolution otolith images from each of 3-5 selected species.

Objective 2:
In this phase, we would provide 1500 otoliths per species for interested participants to develop a program to age otoliths. The remaining 500 otoliths will be held back in order to cross-check and evaluate the program on new data. The best algorithm will win a prize of $15000.

Weighting of Objectives: 0.9, 0.1