



# Medium Term Research Plan for Deepwater Fisheries

2018/19 – 2022/23

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## Introduction

This medium term research plan (MTRP) is intended to reflect research needs to inform management of New Zealand’s deepwater fisheries. Research needs in this MTRP are based on the longer term planning that has previously been consulted on with stakeholders but not provided publically with descriptions, context and rationale for the planned work.

This MTRP remains a living document and will be updated regularly to reflect changes in management priorities where these occur, and identification of new areas of research. Annual research plans will continue to be consulted with stakeholders through the National Deepwater Fisheries Plan forums, and reported in the Annual Operational Plans and Annual Review Reports for deepwater fisheries.

## Surveys

Surveys provide important fishery-independent information for monitoring of a number of key deepwater fishstocks.

### TRAWL SURVEYS

#### Wide-area multi-species trawl surveys

Wide-area trawl surveys collect biological information and provide an abundance index for a wide range of species. There are three wide-area trawl surveys in deepwater fisheries which cover the three main fishing grounds: Chatham Rise, Sub-Antarctic, and the West Coast of the South Island (WCSI). The surveys are optimised to provide information on relevant Tier 1 middle-depth fish stocks, but also provide valuable information on a range of Tier 2 and non-QMS species, including data that informs risk assessments for sharks, and important environmental data in these key fishery areas.

Table 1: Wide-area trawl survey schedule by financial year (incl. month of delivery)

	2018/19	2019/20	2020/21	2021/22	2022/23
Chatham Rise		Jan 2020		Jan 2022	
Sub-Antarctic	Dec 2018		Dec 2020		Dec 2022
WCSI	June/July 2018			June/July 2021	

#### *Chatham Rise wide-area trawl survey*

The Chatham Rise trawl survey was completed annually from 1992-2014 at which point the frequency was decreased to completion every other year. Information collected during all Chatham Rise trawl surveys was compiled in 2012. The survey provides biomass trend and distribution information on 142 species and is included as a data input to stock assessments for a number of species including hoki, hake and ling on the Chatham Rise.

The Chatham Rise trawl survey will continue to be carried out every other year in January.

#### *Sub-Antarctic wide-area trawl survey*

The Sub-Antarctic trawl survey was completed annually 1992-1994 and 2001-2010. The survey frequency was then changed to be biennial, although surveys were completed in sequential years in 2012 and 2013. The Sub-Antarctic trawl survey is considered to provide

information on 134 species and is included as a data input to stock assessments for a number of Tier 1 species including hoki, hake and ling.

The Sub-Antarctic trawl survey will continue to be carried out every other year in December in the opposite financial year to the Chatham Rise trawl survey.

*West Coast South Island (WCSI) wide-area trawl survey*

The WCSI trawl survey was initially developed and designed as an acoustic survey focused on indexing spawning hoki abundance on the WCSI each winter. The survey was completed annually from 1988 to 1993, again in 1997. In 2000, a trawl survey component was added to the survey which was repeated in 2012, 2013, and 2016. The survey methodology has been amended to focus on hake and ling rather than hoki following a review of the hoki model which concluded that the west coast acoustic index was not significantly influential in the model, and the need to better monitor other stocks in the area.

The WCSI trawl survey is scheduled for completion in 2018 and every three years thereafter.

**Scampi surveys**

Scampi is fished in 4-5 key areas using bottom trawl gear. Export statistics for scampi are not readily available, but were estimated at ~\$21M in the 2016 calendar year.

The key scampi stocks, where most fishing occurs, are currently monitored using trawl/photographic surveys completed every three years.

**Table 2: Scampi survey schedule**

	2018/19	2019/20	2020/21	2021/22	2022/23
SCI 1			2020		
SCI 2			2020		
SCI 3		2019			2022
SCI 4A					
SCI 6A	2018			2021	

**Acoustic Surveys**

Acoustic surveys are often used to monitor and estimate abundance for stocks which aggregate for either spawning or feeding. Acoustic surveys rely on the reflection of sound waves to estimate the abundance of fish as the vessel (or acoustic system) passes above the aggregation or fishing grounds.

Acoustic technology has improved significantly in recent years, with the development of multi-frequency and acoustic-optical systems which have allowed the technology to be used to monitor species where the lack of air-filled swim bladders or mixture of fish species in schools had previously made acoustics unfeasible.

For some species/stocks, to successfully measure abundance, any acoustic survey must deploy either a towed acoustic system (a towbody), a multi-frequency acoustic system, or an acoustic optical system. For clarity, this requirement is specified in the description of each planned acoustic survey below.

Acoustic surveys on regular cycles are employed to monitor hoki in the Cook Strait, orange roughy, southern blue whiting, and some oreo stocks. Survey outputs are used as a key input to stock assessments. Specific details for these are provided below.

#### *Hoki (HOK)*

Cook Strait is the main area for spawning of the eastern hoki stock. Because of the aggregated nature of the fish during this time, acoustic surveys are considered more effective than trawl surveys. The survey may be completed using a hull mounted echosounder and in recent years has been carried out from an industry vessel platform during a commercial fishing trip.

The Cook Strait hoki acoustic survey is scheduled to be completed every 2 years.

**Table 3: Cook Strait hoki survey schedule**

	2018/19	2019/20	2020/21	2021/22	2022/23
Cook Strait		July/Aug 2019		July/Aug 2021	

#### *Orange roughy (ORH)*

Orange roughy is a long-lived, deepwater species that occurs throughout the New Zealand EEZ with the largest fisheries occurring on the Chatham Rise, Challenger Plateau, and around the north of the North Island. In the 2016 calendar year, exports of orange roughy were worth an estimated \$61.9M.

In 2014, a Management Strategy Evaluation indicated that surveys and assessments of orange roughy could be completed every four years to provide for utilisation while ensuring that stocks are not overfished and to allow the TACC to respond to any changes in abundance.

There are not currently any surveys planned for ORH 1 or ORH 3B-Subantarctic. In ORH 1, there remain uncertainties around stock structure, however there have been some efforts to develop a standard acoustic snapshot protocol to allow vessels fishing in ORH 1 to take acoustic snapshots of aggregations they locate to provide some information on biomass. MPI will continue to work with the ORH 1 quota owners to develop a research programme specific to ORH 1 in future. For ORH 3B Sub-Antarctic (Subants), there is a low level of fishing and little information on stock structure.

**Table 4: Orange roughy survey schedule**

	2018/19	2019/20	2020/21	2021/22	2022/23
ORH 1					
ORH 2A North	Jun 2018				June 2022
ORH MEC				June 2021	
ORH 3B – NW Rise			July 2020		
ORH 3B – ES Rise			July 2020		
ORH 3B – Puysegur		July 2019			
ORH 3B – Subants					
ORH 7A	July 2018				July 2022
ORH 7B	June/July '19		June 2021		

### *Oreos (OEO, BOE, SSO, WOE, SOR)*

There are four species of oreo in New Zealand that are commercially fished. Of those, the vast majority of effort and catch is black and smooth oreos. The species mix in the catch varies from area to area.

Surveying of oreos has proved to be difficult, in the early years of the fishery, trawl surveys were used to estimate abundance, however the aggregated nature of the fishery led to very uncertain abundance estimates. In more recent years (since 1997), acoustic surveys have been employed to survey oreos. There are some issues with species composition in acoustic marks and weather affecting hull-mounted acoustic system performance.

Work is currently ongoing to review the design of the oreo surveys prior to any additional surveys being undertaken. This work is expected to be completed in 2017/18 and should inform planning and design of future oreo surveys. There are no surveys planned for OEO 1 or OEO 6 at this stage due to low levels of fishing effort and high levels of uncertainty regarding survey design. Oreo surveys for other stocks are scheduled to be completed every 4 years.

**Table 5: Oreo survey schedule**

	2018/19	2019/20	2020/21	2021/22	2022/23
OEO 1					
OEO 3A	Nov 2018				Nov 2022
OEO 4			Nov 2020		
OEO 6					

### *Southern blue whiting (SBW)*

Southern blue whiting mainly occurs in the sub-Antarctic waters of New Zealand, with the largest stock found around the Campbell Islands. Smaller stocks are also found around the Auckland Islands, Bounty Island, and on the Pukaki Rise. In the 2016 calendar year, exports of southern blue whiting were worth an estimated \$11.8M.

Southern blue whiting are known to exhibit highly variable year class strength and are characterised by episodic recruitment events. This leads to a need to survey these stocks regularly, both to allow for utilisation of significant recruitment events, but also to respond when large year classes leave the fishery or fish abundance declines suddenly.

There is currently very little fishing in SBW 1, 6A, and 6R, so no dedicated acoustic surveys are planned for these stocks. If landings from any of these stocks exceed 500 tonnes for 2 years in a row, consideration will be given to additional monitoring/assessment.

The survey for SBW 6B is planned to be completed annually, this hull-mounted acoustic survey is currently completed using a commercial fishing vessel.

The survey for SBW 6I is scheduled to be completed every three years using the *RV Tangaroa*.

**Table 6: Southern blue whiting survey schedule**

	2018/19	2019/20	2020/21	2021/22	2022/23
SBW 1					
SBW 6A					
SBW 6B	Sept 2018	Sept 2019	Sept 2020	Sept 2021	Sept 2022



SBW 6I		Sept 2019			Sept 2022
SBW 6R					

## Stock Assessments & Monitoring

### STOCK ASSESSMENTS

#### Tier 1 species

##### *Hoki (HOK)*

Hoki is New Zealand's largest fishery with a current TACC of 150 000 tonnes. Although managed as a single stock, hoki is assessed as two biological stocks, western and eastern. Juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity. In the 2016 calendar year, hoki exports were worth an estimated \$213.3M. Hoki first achieved MSC Certification in 2001 and has been re-certified twice.

Stock assessments for hoki have historically been completed annually. With the status of both stocks currently estimated to be near or above the top of the management target range (30-50% B<sub>0</sub>), and a desire to have a stable TACC, full stock assessments for hoki will be completed biennially, with the intervening years possibly used for investigation of issues raised during a previous assessment.

**Table 7: Hoki Assessment schedule**

	2018/19	2019/20	2020/21	2021/22	2022/23
HOK 1	Assessment		Assessment		Assessment

##### *Hake*

Hake fisheries have changed significantly in recent years, mainly as the result of changes in the fleet following new regulations. In the 2016 calendar year, hake exports were worth an estimated \$14.4M. New Zealand's three hake fisheries achieved MSC Certification in 2013. Hake stocks are currently assessed on three year cycles.

**Table 8: Hake Assessment schedule**

	2018/19	2019/20	2020/21	2021/22	2022/23
HAK 1			Assessment		
HAK 4		Assessment			Assessment
HAK 7	Assessment			Assessment	

##### *Ling*

Ling is fished by a variety of fishing methods and fleets. Just over half of targeted ling catch is from vessels fishing using bottom longlines. A significant amount of ling is also taken in the hoki trawl fishery. The ling biological stocks do not line up with the ling Quota Management Areas. Assessments are completed based on assumed biological stock structure, although this remains uncertain, especially for the Cook Strait and North Island stocks.

In the 2016 calendar year, ling exports were worth \$55.2M. Five of New Zealand’s ling stocks (10 fisheries) were certified by the MSC in 2013. Key ling stocks are currently assessed on three year cycles. No assessments are currently planned for LIN 2, LIN CS (Cook Strait), or LIN 6B. For LIN 2 and LIN CS this is because of uncertainty in stock structure. For LIN 6B, there is very little fishing effort making it unlikely there is any sustainability risk and little information on which to base an assessment. If the catch from LIN 6B exceeds 200 tonnes in 2 consecutive years, the requirement for an assessment will be revisited.

**Table 9: Ling Assessment timing**

	2018/19	2019/20	2020/21	2021/22	2022/23
LIN 2					
LIN CS					
LIN 3/4	Assessment			Assessment	
LIN 5/6			Assessment		
LIN 6B					
LIN 7		Assessment			Assessment

*Southern blue whiting*

Southern blue whiting mainly occurs in the sub-Antarctic waters of New Zealand, with the largest stock found around the Campbell Islands. Smaller stocks are also found around the Auckland Islands, Bounty Island, and on the Pukaki Rise. In the 2016 calendar year, exports of southern blue whiting were worth an estimated \$11.8M.

Southern blue whiting are known to exhibit highly variable year class strength and are characterised by episodic recruitment events. This leads to a need to survey these stocks regularly, both to allow for utilisation of significant recruitment events, but also to respond when large year classes leave the fishery or fish abundance declines unexpectedly.

Southern blue whiting at the Bounties (SBW 6B) is currently managed using a harvest control rule (HCR) that provides guidance on an appropriate fishing mortality level to be applied based on the annual acoustic survey.

There is currently very little fishing in SBW 1, 6A, and 6R, so no dedicated stock assessments are planned for these stocks. If landings from any of these stocks exceed 500 tonnes for 2 years in a row, consideration will be given to additional monitoring/assessment.

**Table 10: Southern blue whiting assessment schedule**

	2018/19	2019/20	2020/21	2021/22	2022/23
SBW 1					
SBW 6A					
SBW 6B	HCR	HCR	HCR	HCR	HCR
SBW 6I		Assessment			Assessment
SBW 6R					

*Orange roughy*

Orange roughy is a long-lived, deepwater species that occurs throughout the New Zealand EEZ with the largest fisheries occurring on the Chatham Rise, Challenger Plateau, and around the north of the North Island. In the 2016 calendar year, exports of orange roughy

were worth an estimated \$61.9M. Three key orange roughy stocks were certified by the MSC in 2016.

In 2014, a Management Strategy Evaluation indicated that surveys and assessments of orange roughy could be completed every four years to provide for utilisation while ensuring that stocks are not overfished and to allow TACC to respond to any changes in abundance.

The orange roughy stock assessments are scheduled to line up with the relevant acoustic survey. There are not currently assessments planned for ORH 1 or ORH 3B-Subantarctic. For ORH 1, this is because of uncertainties in stock structure and a lack of agreed biomass estimates. For ORH 3B-Subantarctics, this is because of the limited fishing effort and lack of available data in the fishery. Note that work is specified elsewhere to better understand the stock structure of ORH 1 to enable assessment of stock(s) in future.

Table 11: Orange roughy assessment schedule

	2018/19	2019/20	2020/21	2021/22	2022/23
ORH 1					
ORH 2A North	Assessment				Assessment
ORH MEC				Assessment	
ORH 3B – NW Rise			Assessment		
ORH 3B – ES Rise			Assessment		
ORH 3B – Puysegur		Assessment			
ORH 3B – Subants					
ORH 7A	Assessment				Assessment
ORH 7B		Assessment		Assessment	

### *Oreos*

There are four species of oreo in New Zealand that are commercially fished. Of those, the vast majority of catch is black and smooth oreos. Full assessments of stock status are generally limited to the higher volume target fisheries for black and smooth oreos.

Stock assessments of oreo species have historically been challenging. Uncertainties regarding stock structure, biological parameters, and the issues identified in interpreting acoustic survey data have led to a number of stock assessments not being accepted by the MPI Working Groups.

Additional investigations into survey and assessment methodologies will be included in the ‘Informing Management’ category detailed below.

Table 12: Oreo assessment schedule

	2018/19	2019/20	2020/21	2021/22	2022/23
Smooth oreo					
OEO 1 Southland					
OEO 3A	Assessment				
OEO 4				Assessment	
OEO 6 Pukaki					
OEO 6 Bounties					
Black oreo					
OEO 3A		Assessment			
OEO 4					
OEO 6 Pukaki					

### Scampi

Scampi is fished in 4-5 key areas using bottom trawl gear. Export statistics for scampi are not readily available, but were estimated at ~\$21M in the 2016 calendar year.

Scampi stocks are scheduled for assessments to line up with the planned survey every three years. It has been proposed that a management strategy evaluation be completed for scampi to inform the harvest strategy and potentially the frequency of surveys and assessments.

Table 13: Scampi assessment schedule

	2018/19	2019/20	2020/21	2021/22	2022/23
SCI 1			Assessment		
SCI 2			Assessment		
SCI 3		Assessment			
SCI 4A					
SCI 6A	Assessment			Assessment	

### Jack mackerels

There are three species of jack mackerel in New Zealand (*Trachyurus novaezealandiae*, *T. declivis*, *T. murphyi*) which occur in varying proportions in different areas. Two of the species are considered native to New Zealand (*T. declivis* and *T. novaezealandiae*), while *T. murphyi*, or ‘Chilean jack mackerel’, is considered to have been an ‘invasion’ from the wider south Pacific stock and do not spawn or reproduce in New Zealand waters. Exports of jack mackerel are worth an estimated \$34M.

Two of the three main jack mackerel quota management areas are managed by the deepwater fisheries management team and are therefore covered by this research plan.

There are not currently any estimates of stock status for any of the three jack mackerel species, although an assessment is scheduled, with a new, CPUE-based, methodology, for JMA 7 in 2017/18. If the assessment is successful, the methodology will be applied to JMA 3. Based on the life history characteristics of jack mackerel species (and maximum age of ~30 years), it is proposed that assessments would be required every three years.

Table 14: Jack mackerels assessment schedule

	2018/19	2019/20	2020/21	2021/22	2022/23
JMA 3	Assessment			Assessment	
JMA 7			Assessment		

### Arrow squid

New Zealand’s squid fishery is comprised of two species *Nototodarus sloanii* and *N. gouldi*. There are two main squid fisheries, the first on the Stewart-Snares shelf and the second around the Auckland Islands. There is a small amount of squid taken in other areas (e.g. Chatham Rise). Squid exports from New Zealand are worth an estimated \$116M.

Squid have a very different life-cycle to most fish, which does not fit with standard fish population modelling approaches. Most squid live for around one year, spawn and then die. The result of this is an entirely new stock each year, the size of which tends to be driven by environmental factors; there may be high variability in abundance from year to year with recruitment varying between years by a factor of ten.

Attempts were made to estimate stock status for New Zealand squid in 2012-2014, however because of the lack of any pre-recruit indicators and the apparent pulses in squid recruitment in the New Zealand fishery, the method was not successful.

A new approach has been proposed to monitor the sustainability of the squid fishery, which will be trialled in the 2017/18 financial year. Depending on the success of that method, assessments/monitoring of squid stocks may be added to the research plan on an annual basis.

## Tier 2 Species

Tier 2 species are those which are typically less valuable bycatch fisheries or are only target fisheries at certain times of the year. Because of the nature of these fisheries, Tier 2 fisheries are often data limited making full stock assessments unrealistic. The abundance of Tier 2 species may be monitored using a number of approaches including stock assessment, CPUE indices, age and/or size structure, and trawl survey indices.

In 2016, a workshop was held at which New Zealand fisheries experts ran through the Tier 2 deepwater species to characterise available information and potential monitoring approaches for each fishstock.

Reviews of stock status for Tier 2 species are currently completed based either on significant changes in catch volume (e.g. decrease in bycatch suggesting sustainability concern), or where raised by a stakeholder.

MPI is also progressing a programme of policy review with regards to fisheries management called Future of our Fisheries. One initiative of this project is the 'Low Information Stocks Project', which is focusing on developing a framework to monitor and manage those stocks where there is not sufficient data to complete a comprehensive stock assessment. This initiative does include a number of Tier 2 deepwater species, and the planned monitoring of those species will be determined through that process.

In the interim, reviews of available data and stock status will continue to be completed on an ad hoc basis.

In addition, trends in bycatch of Tier 2 (and non-QMS) species will continue to be monitored through bycatch reports prepared through the Aquatic Environment research stream, and the three main wide area multi-species trawl surveys.

## Informing Management

Information and data that underpins the management of New Zealand's fish stocks is wider than those surveys and stock assessments detailed in the previous sections.

This section of the research plan covers data collection (land-based sampling and observer coverage planning), ageing of observer samples, management strategy evaluations, and methods development work (e.g. survey design).

### DATA COLLECTION

#### Land-based sampling

Sampling of commercial catches is a key input to a number of stock assessments. For these stocks, sufficient, representative samples of the length and/or age of the commercial catch must be available for the stock assessments to accurately estimate stock status.

For most deepwater fisheries, at-sea observers provide adequate sampling to support the stock assessment. However, for some fisheries, getting sufficient observer coverage to collect representative samples can be challenging. For these fisheries where fish are not fully processed at sea, research providers can be contracted to visit the landing sites for vessels in the fishery and take the required samples at that point.

This mechanism is currently in place for the hoki fishery to collect samples from fishing in Cook Strait and fishing on the West Coast South Island inside the 25nm. Exclusion zone. This project is scheduled to be completed annually.

#### Observer Coverage

MPI plans observer coverage based on biological sampling targets for stock monitoring (length frequency (LF) and otolith samples) and percentage coverage targets for the estimation of protected species interactions. Observer coverage is planned and delivered based on number of 'observer days' required for each fishery on a financial year basis.

The number of observer days necessary to achieve biological sampling requirements are calculated using the following information for the most recent fishing year:

- The total number of target tows for Tier 1 species in each area
- The number of observed target tows for Tier 1 species in each area
- The number of samples collected by observers for each Tier 1 species/area combination
- The number of sea days delivered for each Tier 1 species/area combination

Because of the variability in fishing effort in fisheries each year, it is challenging to plan required observer coverage in advance, and delivery can be affected by fishing activities during a year (e.g. if there is no fishing in a particular fishery, it will appear that coverage did not meet the target).

The table below provides indicative estimates of the required coverage in each of the main deepwater fisheries, and also the information on the main objectives which drive the setting of coverage requirements.

**Table 15: Planned deepwater observer coverage requirements**

Fishery complex & stocks covered	Planned days from 2017/18	Main objective(s) of observer coverage planning	Rationale and comment
<b>Deepwater trawl fisheries</b>			
North Island Deepwater ORH 1, 2A, 2B, 3A BYX 2, CDL 2	90	Biological sampling of ORH	30 ORH LFs per area (ORH 1 A, B, C, D, ORH 2ANorth, Mid-East Coast) (total 180 LFs) Estimated 2 LFs per day
Chatham Rise Deepwater ORH 3B OEO 3A, 4 BYX 3	220	Biological sampling of ORH 30% effort coverage target for MSC stocks Biological sampling of OEO	50 LFs (300 otoliths) per ORH sub-stock (600 total) – Estimated 2 LFs per day Coverage of ~2.2 tows/day 30 LFs per OEO species per area (BOE/SSO in OEO 3A, SSO in OEO 4)(400 otoliths BOE 3A, 300 otoliths SSO 4)
Sub-Antarctic Deepwater ORH 3B OEO 1, 6	60	Biological sampling of ORH Biological sampling of OEO	100 LFs for Puysegur (300 otoliths), no target for Sub-Antarctic ORH stock – Estimated 3 LFs per day No target for OEO 1 or OEO 6 at this point, however coverage should provide for coverage of any OEO target trips
West Coast Deepwater ORH 7A, 7B	40	Biological sampling of ORH 30% effort coverage target for MSC stocks	50 LFs for ORH 7A (300 otoliths), same to apply for ORH 7B if re-surveyed or re-opened – Estimated 2 LFs per day 30% effort coverage for ORH 7A only (Coverage of ~2.2 tows/day)
<b>Hoki &amp; Middle depth trawl fisheries</b>			
West Coast North Island JMA 7, EMA 7, BAR 7	635	Biological sampling of JMA Protected species capture monitoring	200 LFs (900 otoliths) for each JMA species – Estimated 1LF per species per day 20-30% effort coverage to allow estimation of protected species interactions
West Coast SI (FMA7) HOK 1 HAK 7, LIN 7 SWA 1	1,100	Biological sampling of HOK, HAK, LIN 30% effort coverage target for MSC stocks Protected species capture monitoring	400 LFs (1600 otoliths) for HOK, 200 LFs (1,000 otoliths) for HAK, 200 LFs (1,100 otoliths) for LIN – Estimated 2 LFs per day, species are generally not sampled at the same time as one another
WCSI HOK (Inside the line) HOK 1	80	Biological sampling of HOK Protected species capture monitoring	200 LFs (600 otoliths) for HOK (note sampling is supplemented by shore-based sampling) 20-30% effort coverage to allow estimation of protected species interactions
Cook Strait HOK HOK 1	100	Biological sampling of HOK Protected species capture monitoring	200 LFs (1600 otoliths) for HOK 20-30% effort coverage to allow estimation of protected species interactions

Fishery complex & stocks covered	Planned days from 2017/18	Main objective(s) of observer coverage planning	Rationale and comment
<b>Chatham Rise Middle depths (FMA3 /FMA4)</b> HOK 1 HAK 1, 4 LIN 3, 4 SWA 3, 4, JMA 3, BAR 1, BAR 4	760	Biological sampling of HOK, HAK, LIN 30% effort coverage target for MSC stocks Protected species capture monitoring	400 LFs (1600 otoliths) for HOK, 100 LFs (1000 otoliths) for HAK, 100 LFs (1100 otoliths) for LIN – Estimated 2 LFs per day, species are generally not sampled at the same time as one another
<b>Sub-Antarctic Middle depths (ex SQU/SBW)</b> HOK 1 HAK 1 LIN 5, 6 SWA 4, WWA 5B, BAR 5, JMA 3	850	Biological sampling of HOK, HAK, LIN 30% effort coverage target for MSC stocks Protected species capture monitoring	400 LFs (1600 otoliths) for HOK, 100 LFs (1000 otoliths) for HAK, 100 LFs (1100 otoliths) for LIN – Estimated 2 LFs per day, species are generally not sampled at the same time as one another
<b>Southern blue whiting</b> SBW (All)	480	Protected species capture monitoring Biological sampling of SBW	100% coverage required for monitoring of interactions with New Zealand sea lions 100 LFs (900 otoliths) for SBW 6I, 50 LFs (600 otoliths) for SBW 6B – Estimated 2 LFs/day
<b>Squid</b> SQU 1T, 6T	1,020	Protected species capture monitoring	50% coverage required for monitoring of interactions with New Zealand sea lions and seabirds
<b>Squid jig fishery</b>			
<b>Squid jig</b>	0		No squid jig effort
<b>Bottom longline fishery</b>			
<b>Bottom longline</b> LIN 3-7	400	Protected species capture monitoring 20% effort coverage target for MSC stocks Biological sampling of LIN	20-30% effort coverage target to monitor protected species interactions
<b>Shellfish fishery</b>			
<b>Scampi</b> SCI (All)	400	Protected species capture monitoring Catch composition Biological sampling of SCI	20-30% effort coverage target to monitor protected species interactions 50 LFs per area (SCI 1, 2, 3, 4A, 6A) – Estimated 2 LFs/day
<b>Total</b>	<b>6,785<sup>1</sup></b>		

<sup>1</sup> Does not include 60 days for vessel specific conversion factor testing or 450 days for high/medium risk vessels



## AGEING OF DEEPWATER FISH SPECIES

Information on the age structure of catches from commercial fisheries and resource surveys are key inputs to stock assessments of middle depth and deepwater species. There are two main protocols used to provide catch at age from fisheries. Where the fishery is discrete in time (e.g. spawning fisheries) this may take the form of an age-length key (ALK) which is used with length frequency samples to determine the age distribution of the catch. The second is the ageing of otoliths collected throughout the year to represent the age distribution of the catch, which requires a larger number of otoliths to obtain a representative age distribution.

Key Tier 1 species are aged each year, even if assessments are on longer cycles. This provides a basic monitoring tool, and could potentially identify significant changes in age structure that occurred in an interim year. Other fisheries are aged specifically to inform planned projects. There are also some species where the ageing data is either not used in the stock assessment, or it is not yet possible to accurately age the fish. For some of these species, otoliths are still collected, but are not aged on a regular basis.

**Table 16: Details of ageing for Tier 1 species, including planned frequency**

Fishery	Area	Source	Method	# to be read	Planned freq.
<b>Hoki</b>					
HOK 1	WCSI Spawning	Obs.	ALK	750	Annual
		Research	ALK		Annual
	Cook Strait Spawn	Obs.	ALK	750	Annual
		Research	ALK		Annual
	Chatham Rise	Obs.	Direct	1200	Annual
		Research	ALK	750	Biennial
	Sub-Antarctic	Obs.	Direct	1200	Annual
		Research	ALK	750	Biennial
<b>Hake</b>					
HAK 1	Sub-Antarctic	Obs.	ALK	600	Annual
		Research	ALK	600	Biennial
HAK 4	Chatham Rise	Obs.	ALK	600	Annual
		Research	ALK	600	Biennial
HAK 7	WCSI	Obs.	ALK	600	Annual
		Research	ALK	600	Triennial
<b>Ling</b>					
LIN CS	Cook Strait	Obs.	ALK	600	Not currently planned
LIN 3&4	Chatham Rise	Obs.	ALK	600	Annual
		Research	ALK	600	Biennial
LIN 5&6	Sub-Antarctic	Obs.	ALK	600	Annual
		Research	ALK	600	Biennial
LIN 7	WCSI	Obs.	ALK	600	Annual
		Research	ALK	600	Triennial
<b>Southern blue whiting</b>					
SBW 6A	Auckland Islands	Obs.	ALK		Not currently planned
SBW 6B	Bounty Platform	Obs.	ALK	600	Annual
SBW 6I	Campbell Island	Obs.	ALK	600	Annual
		Research	ALK	600	Triennial
SBW 6R	Pukaki Rise	Obs.	ALK		Not currently planned
<b>Orange roughy</b>					
ORH 1		Obs.	ALK		Not currently planned

ORH 2AN		Obs.	ALK		
		Research	ALK		
ORH MEC		Obs.	ALK		
		Research	ALK	900	
ORH 3B	Northwest Rise	Obs.	ALK		
		Research	ALK		
	East & South Rise	Obs.	ALK		
		Research	ALK		
	Puysegur	Obs.	ALK		
		Research	ALK		
	Sub-Antarctic	Obs.	ALK		
ORH 7A	WCSI	Obs.	ALK		
		Research	ALK		
ORH 7B	Southern WCSI	Obs.	ALK		
		Research	ALK		
ORH ET					
Oreos					
OEO 3A	Black oreo	To be confirmed following ageing protocol validation			
	Smooth oreo				
OEO 4	Smooth oreo				
OEO 1 & 6	Pukaki smooth				
	Pukaki black				
	Southland smooth				
	Bounty smooth				
Jack mackerels					
JMA 3	Murphyi	Obs.	ALK	600	
	Novaezealandae	Obs.	ALK	600	
	Declivis	Obs.	ALK	600	
JMA 7	Murphyi	Obs.	ALK	600	
	Novaezealandae	Obs.	ALK	600	
	Declivis	Obs.	ALK	600	

Ageing of Tier 2 species is done on an as-needed basis to support assessments, characterisations, or other analyses to estimate stock status. The scheduling of this work will be based on the scheduling of other work, and therefore is not detailed here.

As needs for ageing of additional species are often not identified until after the beginning of the financial year, MPI will generally provide flexibility within the ageing project to age a significant number of additional otoliths as needed over the course of the fishing year (e.g. 2400 otoliths in addition to those explicitly detailed in 2017/18).

## MANAGEMENT STRATEGY EVALUATION

Management Strategy Evaluation (MSE) is a general term used to describe the use of simulations to compare the effectiveness of management strategies (data collection, harvest strategies/rules, analysis methods) to achieve specified management objectives.

MSEs can take a wide range of forms, and the objectives against which management strategies are being assessed can range from developing a harvest control rule or informing research frequency to working through voluntary measures to maximise economic yield from a fishery.

Under the National Deepwater Plan, MPI intends to run MSEs for Tier 1 stocks wherever possible. The first MSE of a deepwater stock was completed for hoki in 2011 and defined a management target range to manage the fishery for economic yields and desired fish size.

An MSE was completed in 2014 for orange roughy. That MSE supported definition of biological reference points, research frequency, and a harvest control rule to maintain stocks within the management target range.

Once completed, MSEs should be updated at regular intervals to ensure the outcomes remain consistent with management objectives for the relevant fishery and incorporate any updated information on biology, stock status, or other factors. No MSEs are planned for OEO as there is not currently considered to be an operating model on which to base an evaluation.

**Table 17: Deepwater MSE Schedule**

	2018/19	2019/20	2020/21	2021/22	2022/23
Hoki					Update
Hake				New MSE	
Ling	New MSE				
Southern blue whiting				Update	
Orange roughy			Update		
Oreo					
Scampi					Update
Jack mackerel		New MSE			
Squid			Update		

## METHODOLOGY & DEVELOPMENT

Methodology and development work will be required on an ongoing basis to ensure that there is continuous improvement in methodologies and models used to inform the management of deepwater fisheries. This kind of work can be difficult to plan in advance, and is not planned in a structured way as many other categories of research are.

At present, this section serves to identify areas where there is likely methodology and/or development work that is required or may be required in future to be prioritised as resources allow.

Earlier in this MTRP, it was identified that there is significant work required in regards to oreo biomass surveys and stock assessments in terms of survey design and methodology as well as assessment approaches. Work in this space may be prioritised based on outputs of work planned for 2017/18.

In addition, recent discussions with stakeholders have highlighted the ambition of continuous improvement in the availability of information to inform management including new approaches to be more cost effective or efficient, and regular external reviews of stock assessments to prompt innovation and progress.

## Aquatic Environment specific to Deepwater

Under the Fisheries Act 1996, significant adverse impacts on the aquatic environment should be avoided, remedied or mitigated. In addition, the biological diversity of the aquatic environment must be maintained. Drivers of this research in this area also include the National Plan of Action (NPOA)-Seabirds, NPOA-Sharks, Threat Management Plan (TMP) for New Zealand Sea Lions and TMP for Hector's and Maui's Dolphins.

Research to monitor impacts of fisheries on the aquatic environment is planned and contracted through the Aquatic Environment research planning process, and the projects listed below are taken from the Aquatic Environment research plan. This MTRP will be updated to maintain consistency with the Aquatic Environment research plan.

Research planning for aquatic environment research is often less certain than stock assessment research as the latter can be planned in regular cycles. Aquatic environment research is often planned and specified in response to outputs from other research or events that have occurred. This plan currently specifies, at a high level, three years of planned research, but will be updated annually as further research is planned or those projects already identified change or become more clearly specified.

**Table 18: Schedule of Deepwater Aquatic Environment projects**

	2018/19	2019/20	2020/21	2021/22	2022/23
<b>Seabirds</b>	Antipodean albatross - demographics	Northern Bullers - demographics	Cryptic mortality		
		Deepwater – mitigation	Risk assessment inputs		
<b>Marine mammals</b>	Risk Assessment – simulations to inform management	NZ Sea Lions – Auckland Islands population	Fur seals – WCSI population		
	Fur seals - distribution	NZ Sea Lions – Campbell Island PST	Risk assessment inputs		
	NZ Sea Lions – South Island distribution		NZ Sea Lions – population (for TMP)		
	NZ Sea Lions - SLED				
<b>Fish</b>	Sharks – Deepwater sharks	Fish bycatch quantification – Jack mackerel	Fish bycatch quantification – orange roughy/oreo	Fish bycatch quantification – Squid/scampi	Fish bycatch quantification – hoki/hake/ling trawl
	Fish bycatch quantification – LIN BLL	Fish bycatch quantification – Deepwater summary			
<b>Benthic</b>	Taxonomic ID	Taxonomic ID	Taxonomic ID	Taxonomic ID	Taxonomic ID
	Trawl footprint	Trawl footprint			
		Risk Assessment			
<b>Biodiversity</b>		Benthic survey			