

DEEPWATER FISHERIES

PROPOSED PROJECTS FOR 2005/06

<u>Code</u>	<u>Title</u>	<u>Priority</u>
CDL2005/01	Cardinalfish stock assessment	Medium
DEE2005/01	Age validation of black oreo, smooth oreo, and black cardinalfish using bomb radiocarbon techniques	High
DEE2005/02	Age validation of orange roughy and black cardinalfish using radiometric techniques	High
OEO2005/01	Estimation of the abundance of black oreo and smooth oreo in selected areas	High
OEO2005/02	Oreo stock assessment	High
ORH2005/01	Estimation of the abundance of orange roughy in selected areas	High
ORH2005/02	Orange roughy stock assessment	High
ORH2005/03	Stock assessment of orange roughy fisheries outside the New Zealand EEZ	High
ORH2005/04	Maturity and vulnerability of orange roughy	High
OBS2004/01	Research Observer Services – Deepwater Fisheries	High

Project: Cardinalfish stock assessment

Project Code: CDL2005/01

Start Date: 1 October 2005

Completion Date: 30 September 2006

Vessel Use: None

Overall Objectives:

1. To carry out a stock assessment of cardinalfish (*Epigonus telescopus*), including estimating biomass and sustainable yields.

Specific Objectives:

1. To update the descriptive analysis of the commercial catch and effort data for cardinalfish for the CDL 1, CDL 2, and CDL 3 fisheries with the inclusion of data up to the end of the 2004/05 fishing year.
2. To carry out both unstandardised and standardised catch per unit effort analyses with the inclusion of data up to the end of the 2004/05 fishing year for the CDL 2 fishery.
3. To analyse, length frequency, sex ratio, and reproductive condition data for cardinalfish collected from CDL 2 by the Observer Programme and other sources during the 2004/05 fishing year for input into stock assessment models.

Rationale:

General

The two largest fisheries for cardinalfish are in CDL 2 and CDL 1, with 2002-03 landings of 1845 t (CDL 2) and 583 t (CDL 1). Results for Specific Objective 1 using information up to the end of the 2002/03 fishing year were presented to the Deepwater Working Group on 17 September 2004. Based on this analysis, the Working Group decided to drop a previous proposal to develop standardised indices of abundance and stock assessments for CDL 1 due to insufficient data and lack of contrast in the unstandardised indices for CDL 1. Therefore, Specific Objectives 2 and 3 are now restricted to CDL 2.

The first stock assessment for black cardinalfish was conducted in 1997, although no estimates of biomass or yield were made. A second assessment for CDL 2 was attempted in 2001 using abundance indices from a standardised CPUE analysis and estimates of age and growth from CDL 2 fish. However, this assessment was rejected by the Plenary because of data limitations and contradictions.

A description of the fishery through the end of the 2002-03 year has now been completed and provides further background information for Specific Objectives 1 – 3 in the current proposal. It is proposed to attempt to carry out the first quantitative assessment for cardinalfish in CDL 2 in this project.

The status of all cardinalfish stocks is currently unknown.

The Ministry of Fisheries *Strategic Plan* for 2003-08 identifies a single goal: “Maximise the value New Zealanders obtain through the sustainable use of fisheries resources and protection of the aquatic environment”.

In the absence of a Fisheries Plan for cardinalfish, and while Stock Strategies are being developed, the Ministry of Fisheries is attempting to monitor the status of cardinalfish stocks in relation to the average biomass associated with the maximum sustainable yield, B_{MSY} . The management purpose of this project is therefore to update annual catch and effort statistics and develop reliable indices of abundance from CPUE analyses of CDL 2 that will allow the status of the stock to be assessed in relation to average biomass associated with the maximum sustainable yield, B_{MSY} .

This research project is considered medium priority because:

- The status of all cardinalfish stocks is currently unknown;
- The fisheries are relatively small with a total catch of 3000 t in 2002-03
- Unstandardised CPUE indices in CDL 2 show a decreasing trend and current catch rates of 1.5–2 t/tow are less than or about one-half those recorded in the early years of the fishery
- Unvalidated otolith readings indicate that this species is slow-growing and long-lived and therefore has a relatively low productivity
- The MFish Deepwater Medium Term Research Plan recommends that the feasibility of estimating the relative abundance in the largest fishery, CDL, 2 should be revisited by developing standardised CPUE indices and comparing them with unstandardised CPUE indices

Although the fishery is relatively small, it is important to develop a meaningful method to monitor the stock status of cardinalfish Fishstocks, particularly since methods to date have given confusing results. Catches have been sustained at around 2000 t or more since 1986, but catch rates and CPUE indices to date show a declining trend. Essentially there has not been an agreed stock assessment of cardinalfish since 1997, and the project is therefore seen as medium priority primarily because of the time that has elapsed with little progress in developing a satisfactory index of abundance.

Objectives 1 and 2

In order to update the stock assessment for each fishery, commercial catch and effort data should be monitored and the descriptive analysis of the commercial catch and effort data should be updated on an annual basis.

In addition unstandardised CPUE analyses will be carried out with the inclusion of data for the 2004/05 year for the CDL 1 and CDL 2 fisheries. Standardised CPUE will be attempted for the CDL 2 fishery only.

Objective 3

The purpose of this objective is to analyse length frequency, sex ratio, and reproductive condition data for cardinalfish collected from CDL 2 by the Observer Programme and other sources during the 2004/05 fishing year as part of ongoing monitoring of biological parameters that will be required for input to stock assessment models developed in the future.

Cost Recovery Information:

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 9 (2) of the Fisheries (Cost Recovery) Rules 2001:

- CDL 1, CDL 2 and CDL 3.

The project is estimated to cost \$50,000.

Project: Age validation of black oreo, smooth oreo, and black cardinalfish using bomb radiocarbon techniques

Project Code: DEE2005/01

Start Date: 1 October 2005

Completion Date: 30 September 2006

Vessel Use: None

Overall Objectives:

1. To carry out bomb radiocarbon age validation of deepwater fish species, including black oreo (*Allocyttus niger*), smooth oreo (*Pseudocyttus maculatus*), and black cardinalfish (*Epigonus telescopus*).

Specific Objectives

1. To apply a high-resolution bomb radiocarbon age validation to at least 15 black oreo and smooth oreo otoliths, and also to define life history through use of stable isotope (O & C) analysis and build information towards a deep radiocarbon curve for these species.
2. To apply a high-resolution bomb radiocarbon age validation to at least 15 black cardinal otoliths, in consort with radiometric age validation, also requiring definition of life history through use of stable isotope (O & C) analysis and building information towards a deep radiocarbon curve for this species.

Rationale:

General

Black and smooth oreos form the basis of important deepwater fisheries in New Zealand with combined landings of about 17 600 t in 2002-03. Cardinalfish are of lesser importance, with landings of about 3000 t in 2002-03, but their stock status is completely unknown. Age determination has proved difficult for deepwater oreos and cardinalfish but there is a consensus that all of these species are slow growing and long-lived. Both have a pelagic phase in their early life-cycle which renders them as possible candidates for the bomb radiocarbon technique proposed here, unlike orange roughy

Maximum estimated ages for black and smooth oreo is 153 yrs and 86 yrs, respectively. These are largely based on otolith annual growth zone counts. Radiometric techniques which infer age from measurements of radionuclide pairs have been attempted on oreos using pooled otoliths, and support the high estimated longevity of each species. A recent improved radiometric feasibility study suggested however that a full radiometric age validation study of these species using otolith cores would be challenging because of technical difficulties such as small otolith size and lack of available individuals (particularly juveniles) through the range of age possibilities. In contrast, preliminary bomb radiocarbon dating study that also supported longevity in oreos, has the potential to improve ageing of oreos. The age validation in the preliminary studies requires improved resolution of each application.

, There has been only one study of black cardinalfish otolith growth zones to establish estimates of age and growth. Interpretation of the zones in the whole juvenile otolith samples aided interpretation of zones in the sections of the adult black cardinal fish. A slow growth rate and apparent high ages at recruitment (about 45yr) were found. A maximum age of 104 yrs was recorded. Validation of age estimated was possible for young fish because of clear marginal increments in juvenile otoliths. This provided some estimates for the annual periodicity of growth zone formation into adult ages, but it is strictly an extrapolation. A recent feasibility study using radiometric ageing to validate age estimates produced promising results.

This research project is considered high priority because:

- Black and smooth oreos form the basis of important deepwater fisheries in New Zealand; cardinalfish are of lesser importance but the status of all cardinalfish Fishstocks is currently unknown;
- Accurate age data are essential for estimating the productivity and therefore the long-term potential yields of fish stocks; and
- The MFish Deepwater Medium Term Research Plan specifies the need for further refinement of age estimates for these species.

The management purpose of this project is to validate the maximum ages of black and smooth oreos and black cardinalfish as inputs to stock assessment of these species.

Objective 1

Use of the refined (finer scale transect sampling) bomb radiocarbon age validation method combined with integration of zone counts, isotope analysis, oceanographic data and existing knowledge used in a recent study on bluenose and rubyfish, should provide for a more precise age validation.

Objective 2

It is proposed that a combination of a full radiometric age validation study (see separate proposal) with a refined (finer scale transect sampling) bomb radiocarbon age validation method be used. This will allow for a precise age validation with significantly reduced experimental uncertainties. It will also provide a valuable comparison of the two ageing techniques on a species that will respond to both methodologies.

Cost Recovery Information:

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 9 (2) of the Fisheries (Cost Recovery) Rules 2001:

- all CDL and OEO.

The project is estimated to cost between \$100,000 - \$150,000.

Project: Age validation of orange roughy and black cardinalfish using radiometric techniques

Project Code: DEE2005/02

Start Date: 1 October 2005

Completion Date: 30 September 2006

Vessel Use: None

Overall Objectives:

1. To carry out radiometric age validation of deepwater fish species, with particular reference to New Zealand orange roughy and black cardinalfish.

Specific Objectives:

1. To carry out radiometric age validation of deepwater fish species, with particular reference to New Zealand orange roughy (~ 6 pooled samples) and black cardinalfish (~10 pooled samples).

Rationale:

General

Orange roughy is the most important of the deepwater species in New Zealand with current annual landings of about 14,600 t.

The current status of all orange roughy stocks is summarised under project ORH2005/02.

Black cardinalfish are of lesser importance, with landings of about 3000 t in 2002-03, but their status is completely unknown.

Age determination has proved difficult for orange roughy and cardinalfish but there is a consensus that all of these species are slow growing and long-lived. Bomb radiocarbon trials for deepwater species found the technique to be unsuitable for orange roughy because it lacks a pelagic phase in its life-cycle. While cardinal fish do have a pelagic phase, trials suggest that this species will respond favourably to both bomb radiocarbon and the radiometric techniques proposed here, thereby providing a unique opportunity to cross validate methodologies.

The management purpose of this project is to validate the ages of orange roughy and black cardinalfish as inputs to stock assessment of these species.

This research project is considered high priority because:

- Orange roughy is the mainstay of the deepwater fishing industry in New Zealand; cardinalfish are of lesser importance but the status of all cardinalfish Fishstocks is currently unknown;

- Accurate age data are essential for estimating the productivity and therefore the long-term potential yields of fish stocks; and
- The MFish Deepwater Medium Term Research Plan specifies the need for further refinement of age estimates for these species.

Objective 1

Andrews & Tracey (2003) presented results of a radiometric age validation feasibility study conducted at Moss Landing Marine Laboratories (MLML) on the otolith core samples of four deepwater species, orange roughy, black oreo, smooth oreo, and black cardinalfish. The study was funded by Ministry of Fisheries project DEE2000/02. Results indicated application of the refined radiometric technique to each of the species was feasible to varying degrees.

The refined radiometric technique was applied to four samples of pooled orange roughy otolith cores. The measured radiometric ages were to be compared with ages from growth zone counts in otolith thin sections. For the orange roughy, measurable ^{226}Ra was determined from one of the smallest samples ever processed. Calculated radiometric age was in fairly close agreement for all samples except one. However, the trend of increasing age set by these samples and the strong agreement of the oldest sample (77 yr) indicate that applying the refined radiometric technique to core material of orange roughy otoliths is feasible.

A feasibility study was carried out to determine if otolith cores from black oreo, smooth oreo, and black cardinalfish could be isolated and then measured to ascertain what amount of material (and hence the size of otolith cores that represent the first few years of growth) was required to perform radiometric age validation and then, determine if radiometric ages could be obtained.

The preliminary study for the black cardinalfish was optimal. ^{210}Pb increased as expected with increasing age and the corresponding measured ^{226}Ra value ($0.0222 \pm 4.1\%$ dpm/g) supported the trend. Application of a full radiometric age validation study to the black cardinalfish is the most promising of all species examined in the Andrews & Tracey (2003). We propose to complement this work with a refined bomb radiocarbon age validation method. This will be a first instance of applying two validation methods in tandem.

For the oreo species it was decided a full radiometric age validation study of these species using otolith cores would be challenging due to technical reasons e.g., small otolith size and lack of available individuals (particularly juveniles) through the range of age possibilities. Use of the refined bomb radiocarbon age validation method is proposed separately to provide for a more precise age validation for these two species.

Cost Recovery Information:

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 9 (2) of the Fisheries (Cost Recovery) Rules 2001:

- all ORH and CDL.

The project is estimated to cost between \$100,000 - \$150,000.

Project: Estimation of the abundance of black oreo and smooth oreo in selected areas

Project Code: OEO2005/01

Start Date: 1 October 2005

Completion Date: 30 September 2007

Vessel Use: Subject to tender

Overall Objectives:

1. To estimate the abundance of black oreo (*Allocyttus niger*) and smooth oreo (*Pseudocyttus maculatus*) in selected areas.

Specific Objectives:

1. To estimate the abundance, with a target coefficient of variation (c.v.) of the estimate of 20-30% for smooth oreo in OEO 4 on the Chatham Rise.

Rationale:

General

The smooth oreo fishery in OEO 4 currently produces landings of about 4000 – 6000 t annually. Based on the current stock assessments for the various oreo Fishstocks, smooth oreo in OEO 4 have the largest estimates of current biomass, the largest estimates of sustainable yield, and the largest stock size in relation to virgin biomass (and conversely the lowest level of depletion) of any of the oreo Fishstocks. Therefore, it appears that this fishery has the potential to produce the largest sustainable yield over the long term of any of the oreo Fishstocks. Without a time series to monitor relative abundance in this fishery, it will not be possible to carry out an OEO4 stock assessment.

The results of the 2003 stock assessment indicated that the stock of smooth oreo in OEO 4 was above B_{MSY} , and that recent catches are sustainable, at least in the short to medium term.

The Ministry of Fisheries *Strategic Plan* for 2003-08 identifies a single goal: “Maximise the value New Zealanders obtain through the sustainable use of fisheries resources and protection of the aquatic environment”.

In the absence of a Fisheries Plan for oreos, and while Stock Strategies are being developed, the Ministry of Fisheries is attempting to monitor the status of oreo stocks in relation to the average biomass associated with the maximum sustainable yield, B_{MSY} .

The MFish Deepwater Medium Term Research Plan discusses the need to estimate the abundance of oreos in each of the main fisheries on a regular basis. The main oreo fisheries are:

- The Southland area of OEO 1;
- OEO 3A on the Chatham Rise;
- OEO 4 on the Chatham Rise; and
- The major fisheries in the Bounty and Pukaki areas of OEO 6.

The MFish Deepwater Medium Term Research Plan has a programme of updating the biomass indices for each of the main oreo fisheries in the New Zealand EEZ every 3 to 5 years. Two acoustic surveys have been carried out for smooth oreo in OEO 4 – in 1998 and 2001. In the early years of developing a time series of acoustic biomass indices it is important to update the indices more frequently, especially as new information is gained on the dynamics affecting the indices. Therefore, it is proposed to obtain an acoustic biomass estimate for smooth oreo in OEO 4 in 2005 – 4 years since the previous survey.

The acoustic survey technique has been under development in New Zealand for orange roughy and oreos for a number of years. Issues that still need further work include:

- Determination of target strength of oreos and associated species;
- Identification of acoustic targets;
- Determination of the impact of the shadow zone on acoustic estimates;
- Estimation of the absorption coefficient of sound in seawater;
- Determination of the optimal survey design, particularly on hills; and
- Estimation of the apparently large proportion of oreos away from the main aggregations that is found in low background densities.

These issues were addressed during work carried out during winter 1997 (DEOR02 and DEOE04) and November 1997 (OEO9701). An acoustic survey of OEO 3A and part of OEO 4 on the Chatham Rise was conducted during November - December 1997 (OEO9701) and of OEO 4 in September – October 1998 (OEO9801). Acoustic research conducted in 2000 and 2001 (OEO2000/01) focused on determination of target strength of oreos and associated species and species composition of oreo mark-types. An acoustic survey to estimate the abundance of smooth oreo in OEO 4 was carried out in October – November 2001 in project OEO2001/01. An acoustic survey to estimate the abundance of black oreo in OEO 3A was carried out in October – November 2002 in project OEO2002/01.

The following is a summary of the acoustic surveys that have provided estimates of abundance of black and smooth oreos and that have been used as inputs into the stock assessments for these species:

- 1997 – black oreo and smooth oreo in OEO 3A and 4;
- 1998 – black oreo and smooth oreo in OEO 4;
- 2001 – smooth oreo in OEO 4; and
- 2002 – black oreo in OEO 3A.

Based on biological and technical considerations, smooth oreo in OEO 4 appear more amenable to biomass estimation using acoustics than do oreos in the other Fishstocks.

This research project is considered high priority because:

- Smooth oreo in OEO 4 is likely to be the largest and most important of the smooth oreo stocks;
- It will have been four years since the most recent fishery-independent survey;
- The MFish Deepwater Medium Term Research Plan specifies the need to update the biomass indices for each of the main oreo fisheries in the New Zealand EEZ every 3 to 5 years; and
- The acoustic survey for smooth oreo in OEO 4 has already been deferred once – it was originally scheduled to take place in November 2004.

Objective 1

It is proposed to estimate the abundance, with a target coefficient of variation (c.v.) of the estimate of 20-30% for smooth oreo in OEO 4.

Cost Recovery Information:

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 9 (1) (a) of the Fisheries (Cost Recovery) Rules 2001:

- OEO 4.

The project is estimated to cost > \$1.5 million

Project: Oreo stock assessment

Project Code: OEO2005/02

Start Date: 1 October 2005

Completion Date: 30 September 2006

Vessel Use: None

Overall Objectives:

1. To carry out a stock assessment of black oreo (*Allocyttus niger*) and smooth oreo (*Psuedocyttus maculatus*), including estimating biomass and sustainable yields.

Specific Objectives:

1. To update the descriptive analysis of the commercial catch and effort data for black oreo and smooth oreo from selected fisheries with the inclusion of data up to the end of the 2004/05 fishing year. These fisheries include OEO 1, OEO 3A, OEO 4 and OEO 6.
2. To develop both unstandardised and standardised catch per unit effort analyses with the inclusion of data up to the end of the 2004/05 fishing year for the following area:
 - Black and smooth oreo in the Pukaki East area (OEO 6).
3. To analyse length frequency, sex ratio, and reproductive condition data for black oreo and smooth oreo collected by the Observer Programme and other sources during the 2004/05 fishing year for input into stock assessment models. The target number of samples that will be provided by the Observer Programme for each fishery in 2004/05 is specified in the Rationale below.
4. To analyse length frequency, sex ratio, and reproductive condition data for black oreo and smooth oreo in the Pukaki East area (OEO 6) collected by the Observer Programme and other sources through the 2004/05 fishing year for input into stock assessment models.
5. To carry out a stock assessment, including estimating biomass and sustainable yields for the following areas:
 - Black and smooth oreo in the Pukaki East area (OEO 6).

Rationale:

General

For the years 2000-01 to 2002-03, recorded landings of oreos in OEO 6 were higher than those in any other QMA, ranging between 5700 and 6100 t per annum.

However, no information (other than catch) is available to enable assessments to be made for black oreo and smooth oreo for fisheries within OEO 6.

The TACC was increased from 3000 t to 6000 t in 1996-97, but this was not based on historical catch levels or on estimates of biomass and productivity. It is not known if recent catch levels or the current TACC are sustainable or if they are at levels that will allow this stock to move towards a size that will support the maximum sustainable yield.

The Ministry of Fisheries *Strategic Plan* for 2003-08 identifies a single goal: “Maximise the value New Zealanders obtain through the sustainable use of fisheries resources and protection of the aquatic environment”.

In the absence of a Fisheries Plan for oreos, and while Stock Strategies are being developed, the Ministry of Fisheries is attempting to monitor the status of oreo stocks in relation to the average biomass associated with the maximum sustainable yield, B_{MSY} .

The MFish Deepwater Medium Term Research Plan specifies the need to update the biomass indices for each of the main oreo fisheries in the New Zealand EEZ every 3 to 5 years. For all the main oreo fisheries (OEO 1, 3A, 4, and 6), there is a need to carry out regular monitoring programs and stock assessments to determine stock status and estimate sustainable yields. The fisheries included in this project were selected on the basis of having new information upon which to update the stock assessment. The results of this project will provide information that supports that objective.

This research project is considered high priority because:

- No stock assessment has yet been conducted for OEO6, even though landings from this QMA are currently higher than those from any other QMA;
- The TACC was increased from 3000 t to 6000 t in 1996-97, but this was not based on historical catch levels or on estimates of biomass and productivity; and it is not known if recent catch levels or the current TACC are sustainable or if they are at levels that will allow this stock to move towards a size that will support the maximum sustainable yield; and
- The MFish Deepwater Medium Term Research Plan specifies the need to update the biomass indices for each of the main oreo fisheries in the New Zealand EEZ every 3 to 5 years.

Objective 1

In order to update the stock assessment for each fishery, commercial catch and effort data should be monitored and the descriptive analysis of the commercial catch and effort data should be updated on an annual basis. The descriptive analysis for OEO 1, 3A, 4, and 6 will be updated with the inclusion of data from the 2003/04 fishing year.

Objective 2

Recent mean annual catches from the smooth oreo and black oreo fisheries in Pukaki Rise East area have been about 1300 and 1100 t respectively. There are no fishery independent data available for these fisheries and the stocks have never been assessed. It is unknown if the catches from these fisheries are sustainable.

Project: Estimation of the abundance of orange roughy in selected areas

Project Code: ORH2005/01

Start Date: 1 October 2005

Completion Date: 30 September 2007

Vessel Use: Subject to tender

Overall Objectives:

1. To estimate the abundance of orange roughy (*Hoplostethus atlanticus*) in selected areas.

Specific Objectives:

1. To estimate the abundance from an acoustic survey, with a target coefficient of variation (c.v.) of the estimate of 20-30 %, of orange roughy over a short time period for the Mid East Coast (MEC) fishery.

Note:

The duration of this project will be 24 months, 1 October 2005 to 30 September 2007. This is to allow time for the successful tenderer to analyse the results from the abundance survey conducted in winter 2006 and present them to the fishery assessment meetings during 2007. The nature and scope of this project will be finalised after the 2005 stock assessment results are reviewed by the Deepwater Fishery Assessment Working Group.

Rationale:

General

Landings of Mid East Coast orange roughy peaked at 10,500 t in 1989-90 during the fishing down phase. The 2002-03 and 2003-04 catch limits were 800 t, with the 2002-03 catch being 886 t.

The stock was most recently assessed in 2004 and it was concluded that biomass reached a minimum in the mid 1990s and appears to have been slowly increasing since. The estimated current status of the stock is strongly dependent on how the CPUE data are treated. When the relationship between CPUE and biomass is assumed to be linear, the current stock is estimated to be below B_{MSY} (17-18% B_0). When this constraint is relaxed, the current stock is estimated to be near B_{MSY} (28-30% B_0). A similar result is obtained when the CPUE data are excluded (30-32% B_0). Model projections indicate that the current catch limit of 800 t is sustainable and that stock size will increase at any catch level less than 3000 t. These projections are uncertain because the magnitude and rates of future increases in stock size are driven by the assumption that future recruitment will be constant at the virgin level. This observation is not supported by any direct observations or data. As a result of this assessment the catch limit was increased to 1500 t (?) for the 2004-05 fishing year.

The Ministry of Fisheries *Strategic Plan* for 2003-08 identifies a single goal: “Maximise the value New Zealanders obtain through the sustainable use of fisheries resources and protection of the aquatic environment”.

In the absence of a Fisheries Plan for orange roughy, and while Stock Strategies are being developed, the Ministry of Fisheries is attempting to monitor the status of orange roughy stocks in relation to the average biomass associated with the maximum sustainable yield, B_{MSY} .

Estimates of abundance are required to assess the status of the stocks relative to B_{MSY} . Acoustic surveys to estimate the abundance of orange roughy have been completed during the winter spawning period for orange roughy as follows:

1998

- the spawning box and Northeast hills of the Chatham Rise (ORH 3B) – MFish survey;
- the spawning box of the Chatham Rise (ORH 3B) – ORMC funded survey;

1999

- the Northwest hills part of the Chatham Rise (ORH 3B) – MFish survey;

2000

- the spawning box and Northeast and Eastern hills of the Chatham Rise (ORH 3B) – MFish survey;

2001

- the Ritchie Bank (ORH 2A South) and the Wairarapa (ORH 2B) – MFish survey;

2002

- the Northwest hills part of the Chatham Rise (ORH 3B) – MFish survey;
- the spawning box of the Chatham Rise (ORH 3B) – ORMC funded survey;

2003

- Mid East Coast stock – MFish survey;
- the spawning box and northeast hills of the Chatham Rise (ORH 3B) – ORMC funded survey;

2004

- the background, flat areas and northeast hills of the Chatham Rise (ORH 3B) – MFish survey;
- the spawning box of the Chatham Rise (ORH 3B) – ORMC funded survey; and

2005

- the Northwest hills part of the Chatham Rise (ORH 3B) – proposed MFish survey.

Two acoustic surveys have been conducted for the MEC stock – one in 2001 and another in 2003. The acoustic biomass estimates from both surveys have been used in the stock assessment for this area. The stock assessment for this area was updated during 2004.

Another acoustic abundance estimate obtained in winter 2006 will allow the stock assessment to be updated during the stock assessment meetings in 2007.

This research project is considered high priority because:

- The MEC orange roughy stock has historically supported one of the more important of the orange roughy fisheries and it has the potential to contribute substantially to long-term sustainable yields now that the fishing down phase is over;
- The catch limit was increased from 800 t to 1500 t (?) in 2004-05 based on highly uncertain stock projections; therefore, it is essential that this fishery be closely monitored to ensure that the anticipated increased catches are sustainable; and
- The MFish Deepwater Medium Term Research Plan specifies the need to update the biomass indices for each of the main orange roughy fisheries in the New Zealand EEZ every 3 to 5 years.

Objective 1

The aim of this research project is to estimate the abundance, with a target coefficient of variation (c.v.) of the estimate of 20-30 %, of orange roughy over a short time period for the MEC stock.

The MFish Deepwater Medium Term Research Plan has a programme of updating the biomass indices for each of the main orange roughy fisheries in the New Zealand EEZ every 3 to 5 years. Two acoustic surveys have been carried out for orange roughy for the MEC stock – in 2001 and 2003. In the early years of developing a time series of acoustic biomass indices it is important to update the indices more frequently, especially as new information is gained on the dynamics affecting the indices. Therefore, it is proposed to obtain an acoustic biomass estimate for the MEC stock in winter 2006 – 3 years since the previous survey.

Cost Recovery Information:

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 9 (2) of the Fisheries (Cost Recovery) Rules 2001:

- ORH 2A South, ORH 2B and ORH 3A.

The project is estimated to cost > \$1.5 million.

Project: Orange roughy stock assessment

Project Code: ORH2005/02

Start Date: 1 October 2005

Completion Date: 30 September 2006

Vessel Use: None

Overall Objectives:

1. To carry out a stock assessment of orange roughy (*Hoplostethus atlanticus*), including estimating biomass and sustainable yields.

Specific Objectives:

1. To update the descriptive analysis of the commercial catch and effort data from selected orange roughy fisheries with the inclusion of data up to the end of the 2004/05 fishing year. These fisheries include ORH 1, ORH 2A (North and South), ORH 2B, ORH 3A, ORH 3B (Chatham Rise and other areas), and ORH 7B.
2. To update the unstandardised and standardised catch per unit effort analyses with the inclusion of data up to the end of the 2004/05 fishing year for the following areas:
 - Northwest Chatham Rise (ORH 3B);
 - East Cape stock (ORH 2A North); and
 - Auckland Islands and other fisheries in the southern part of ORH 3B.
3. To analyse length frequency, sex ratio, and reproductive data for orange roughy collected by the Observer Programme and from other sources during the 2004/05 fishing year for input into stock assessment models. The target number of samples that will be collected by the Observer Programme for each fishery in 2004/05 is specified below in the Rationale.
4. To analyse the results of the winter 2004 combined trawl – acoustic surveys on the Northeast Chatham Rise to determine how frequently, if at all, these surveys should be repeated.
5. To update the stock assessment, including estimating biomass and sustainable yields for the following areas:
 - Northwest Chatham Rise (ORH 3B);
 - East Cape stock (ORH 2A North); and
 - Auckland Islands and other fisheries in the southern part of ORH 3B.

Rationale:

General

Orange roughy is the most important of the deepwater species in New Zealand with current annual landings of about 14,600 t.

The current status of all orange roughy stocks is summarised below:

Summary of the Stock Status of Orange Roughy by Management Unit from the 2004 Plenary report. AMP = Adaptive Management Programme; CAY = Current Annual Yield; MCY = Maximum Constant Yield; B_0 = unfished biomass. Ranges apply to medians from alternative assessment runs and do not include confidence

Stock Management Unit	Harvest Strategy	2002-03 TACC (t)	2002-03 catch (t)	Date of most recent assessment	B_0 (t)	B_{current} / B_0 (%)	Likely to be above B_{MSY} ?
ORH1 Northern North Island	AMP	1400	1123	-	-	-	Yes
(ORH1: Mercury-Collville box)	(AMP)	(30)	-	(2001)	(3000-3200)	(10-15%)	(No)
ORH2A North – East Cape	CAY	200	173	2003	21,100-21,200	24-25%	No
Mid East Coast – 2A South, 2B, 3A	CAY	800	886	2004	93,000-105,400	17-32%	Possibly
ORH3B NW Chatham Rise	CAY	2000	2200 (01/02)	2004	57,500-79,600	17-45%	Probably
ORH3B East Chatham Rise	CAY	7000	6700 (01/02)	2002	315,000-404,000	34-54%	Yes
ORH3B South Chatham Rise	CAY	1400	1500	2004	94,900-112,900	29-41%	Probably
ORH3B Puysegur	CAY	0	1300 (01/02)	1998	17,000	7%	No / closed
ORH3B Arrow Plateau	Exploratory	1000		-	-	-	Unknown
ORH3B Sub-Antarctic	Exploratory	1300		-	-	-	Unknown
ORH7A Challenger Plateau	CAY	1	< 1	2000	91,000	3%	No / closed
ORH7B West Coast South Island	MCY	110	90	2004	12,100-17,900	17-45%	Possibly
ORH10	None	10	0	-	-	-	-

intervals. B_{MSY} is assumed to be 30% B_0 for all stocks. The Puysegur and Challenger Plateau fisheries have been closed to enable these stocks to rebuild.

The Ministry of Fisheries *Strategic Plan* for 2003-08 identifies a single goal: “Maximise the value New Zealanders obtain through the sustainable use of fisheries resources and protection of the aquatic environment”.

In the absence of a Fisheries Plan for orange roughy, and while Stock Strategies are being developed, the Ministry of Fisheries is attempting to monitor the status of orange roughy stocks in relation to the average biomass associated with the maximum sustainable yield, B_{MSY} .

There is a need to carry out regular monitoring programs and stock assessments to determine stock status and estimate sustainable yields for all orange roughy fisheries. The fisheries included in this project will be selected on the basis of having new information upon which to update the stock assessment. The results of this project will provide information that supports that objective.

This research project is considered high priority because:

- Orange roughy is the most important commercially-exploited deepwater species in New Zealand; and
- The MFish Deepwater Medium Term Research Plan specifies the need to update the biomass indices for each of the main orange roughy fisheries in the New Zealand EEZ every 3 to 5 years.

Objectives 1 and 2

In order to update the stock assessment for each fishery, commercial catch and effort data should be monitored and the descriptive analysis of the commercial catch and effort data should be updated on an annual basis.

In addition standardised CPUE analyses will be updated with the inclusion of data for the 2004/05 year for the following areas:

- Northwest Chatham Rise (ORH 3B) – standardised CPUE analysis last updated in 2003;
- East Cape stock (ORH 2A North) - standardised CPUE analysis last updated in 2003; and
- Auckland Islands and other fisheries in the southern part of ORH 3B - standardised CPUE analysis last updated in 2001.

Objective 3

The current stock assessments for all fisheries incorporate information on fish length, sex ratios, length-weight data, and reproductive information of orange roughy from both commercial at-sea sampling and research surveys.

It is proposed to estimate biological parameters for input into the stock assessments by analysing length frequency and sex ratio data collected by the Observer Programme and from other sources during the 2004/05 fishing year.

A total of about 320 samples are expected from these fisheries as follows:

- ORH 3B
Chatham Rise 220 samples;
South of 46° S and Arrow Plateau 40 samples;
- ORH 2A (South) 40 samples; and
- ORH 1 20 samples.

Objective 4

During winter 2004 a combined trawl – acoustic survey programme was conducted on the Northeast Chatham Rise. The programme consisted of a wide area trawl survey of the background, flat areas using the R.V. *Tangaroa*, a wide area acoustic survey using the F.V. *Tasman Viking*, an acoustic survey of the main spawning plume using the F.V. *San Waitaki*, and an acoustic survey of the Northeast hills using the R.V. *Tangaroa*. The purpose of this objective is to analyse the results of the winter 2004 combined trawl – acoustic surveys to determine how frequently, if at all, these surveys should be repeated.

Objective 5

It is proposed to update the stock assessments for the fisheries for which abundance estimates become available, including estimating biomass and sustainable yields, using the available information. These fisheries, and the data available for them, are:

- Northwest Chatham Rise (ORH 3B) – new acoustic biomass estimate from winter 2005 survey and standardised CPUE analysis last updated in 2003;
- East Cape stock (ORH 2A North) - standardised CPUE analysis last updated in 2003; and
- Auckland Islands and other fisheries in the southern part of ORH 3B - standardised CPUE analysis last updated in 2001.

Cost Recovery Information:

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 9 (2) of the Fisheries (Cost Recovery) Rules 2001:

- ORH 1, ORH 2A, ORH 2B, ORH 3A, ORH 3B, and ORH 7B.

The project is estimated to cost between \$100,000 - \$150,000.

Project: Stock assessment of orange roughy fisheries outside the New Zealand EEZ

Project Code: ORH2005/03

Start Date: 1 October 2005

Completion Date: 30 September 2006

Vessel Use: None

Overall Objectives:

1. To monitor orange roughy (*Hoplostethus atlanticus*) fisheries in the New Zealand region outside the EEZ.

Specific Objectives:

1. To update descriptive analyses of commercial catch and effort data from orange roughy fisheries in the mid Tasman Sea (Lord Howe Rise and Northwest Challenger), Louisville Ridge, and South Tasman Rise with the inclusion of data up to the end of the 2004/05 fishing year.
2. To analyse length frequency, sex ratio, and reproductive data for orange roughy from fisheries outside the New Zealand EEZ collected by the Observer Programme and from other sources during the 2004/05 fishing year for input into stock assessment models. The expected number of samples that will be collected by the Observer Programme for each fishery in 2004/05 is specified below in the Rationale.

Rationale:

General

Fisheries for orange roughy occur in waters outside the EEZ, but within the general New Zealand region (e.g. Lord Howe Rise, Northwest Challenger, Louisville Ridge, and South Tasman Rise). The fishery in the mid Tasman Sea (Lord Howe Rise and Northwest Challenger) began in the mid to late 1980s, on the Louisville Ridge, east of the Chatham Rise, in 1994, and on the South Tasman Rise in 1997. The fisheries in the former two areas currently are not subject to any management measures. The fishery on the South Tasman Rise is managed through an Arrangement between the Australian and New Zealand governments, which includes a catch limit.

The Ministry of Fisheries *Strategic Plan* for 2003-08 identifies a single goal: “Maximise the value New Zealanders obtain from the sustainable use of fisheries resources and protection of the aquatic environment”.

New Zealand has an ongoing obligation to monitor the status of its fisheries in international waters.

This research project is considered high priority because:

- Orange roughy is the most important deepwater species exploited commercially by New Zealand vessels; and
- New Zealand has an ongoing obligation to monitor the status of its fisheries in international waters.

Objective 1

In order to assess the status of these fisheries, commercial catch and effort data should be monitored and the descriptive analysis of the commercial catch and effort data should be updated on an annual basis.

Objective 2

The current stock assessments for all fisheries incorporate information on fish length, sex ratios, length-weight data, and reproductive information of orange roughy from both commercial at-sea sampling and research surveys. It is proposed to estimate biological parameters for input into the stock assessments by analysing length frequency and sex ratio data collected by the Observer Programme and from other sources during the 2004/05 fishing year. A total of about 120 samples are expected from these fisheries as follows:

- Lord Howe Rise 60 samples; and
- Louisville Ridge 60 samples.

Cost Recovery Information:

This project is 100% Crown funded.

The project is estimated to cost between \$50,000 - \$100,000.

Project: Maturity and vulnerability of orange roughy

Project Code: ORH2005/04

Start Date: 1 October 2005

Completion Date: 30 September 2007

Vessel Use: None

Overall Objectives:

1. To reconcile estimates of maturity and vulnerability ogives for orange roughy (*Hoplostethus atlanticus*) in selected areas.

Specific Objectives:

1. To examine gonad and otoliths samples and/or to conduct new analyses to investigate the discrepancy between maturity and vulnerability ogives observed in 2004 stock assessments for orange roughy.

Note:

The nature and scope of this project will be dependent on work currently underway to analyse female gonads using histological techniques and to conduct aging studies to better characterise the “transition zone” and to estimate the age of maturity. If discrepancies between maturity and vulnerability ogives can be resolved based on current research, this project will be withdrawn. However, it is not yet certain whether work now underway will resolve current problems associated with substantial differences between maturity and selectivity ogives (see below).

Rationale:

General

In initial runs for the 2004 stock assessments for Northwest Chatham Rise and Mid-East Coast orange roughy, the age of 50% vulnerability was estimated to be 7-20 years higher than the age of 50% maturity. As a result, the vulnerable biomass was estimated to be as little as 1/6th of the mature biomass. The Deepwater Fishery Assessment Working Group rejected this conclusion because it was not consistent with other knowledge about the operation of the fishery. Instead, the maturity ogive (originally estimated outside the model based on transition zone data) was forced to be equal to the selectivity ogive estimated within the model based on age or length frequency samples.

The purpose of this proposal is to examine all plausible reasons for the discrepancy. First it is useful to break vulnerability (commonly referred to as partial recruitment) into its two components: availability and selectivity.

Availability refers to the relative proportion of each age or size class that is vulnerable to capture by the fishing fleet. A common reason fish might not be available is because they do not frequent the fishing grounds during the fishing season. Selectivity refers to the relative proportion of each age or size class available to the fishery that is vulnerable to capture by the fishing gear. Different gear types tend to target or retain a different mix of sizes of fish.

There are at least five possible reasons for the large discrepancy between maturity and selectivity ogives.

1. The discrepancy is real and is a result of a lack of availability of small or young mature fish to the fishing fleet.
2. The discrepancy is real and is a result of the fishing gear differentially excluding small or young mature fish.
3. The discrepancy is not real (it is considerably smaller or even the other way around) and is the result of some form of model misspecification.
4. The discrepancy is not real (it is considerably smaller or even the other way around) and is the result of a misinterpretation of the transition zone in otoliths, or miscounting of annual rings inside the transition zone.
5. The discrepancy is not real (it is considerably smaller or even the other way around) and is the result of biased sampling of the length composition of the commercial catch.

The management objective of this project is to ensure that a more accurate stock assessment of the status of orange roughy stocks can be achieved, so that estimation of long-term sustainable yields can be made more reliable.

This research project is considered high priority because:

- Orange roughy is the most important commercially-exploited deepwater species in New Zealand
- These five alternative hypotheses have very different implications for long-term sustainable yields in orange roughy fisheries, and therefore it is important to distinguish between them.
- Failure to reconcile maturity and selectivity ogives was identified by the Deepwater stock assessment working group as a major problem in orange roughy stock assessments conducted in 2004; and

Objective 1

The aim of this research project is to examine gonad or otolith samples and/or to conduct new analyses to investigate the discrepancy between maturity and vulnerability ogives observed in some 2004 stock assessments for orange roughy. The discrepancy was only observed in the Northwest Chatham Rise and the Mid-East Coast orange roughy assessments. However, for the other two assessments, South Chatham Rise and West Coast South Island,

the problem did not arise because no commercial length data were available. It is possible that discrepancies will arise in all orange roughy assessments using length or age data; therefore, investigation of the problem should not necessarily be restricted to the Northwest Chatham Rise and Mid-East Coast orange roughy fisheries.

As mentioned above, the nature and scope of this project will depend on work currently underway. This makes it difficult to specify exactly what type of research will be conducted. Depending on the success of histological examinations of female orange roughy gonads currently in progress, one logical extension may be to also examine male gonads. This would likely require examination of about 200-300 samples, along with their corresponding otoliths. Other work that may help differentiate between the above hypotheses is analyses to examine potential model mis-specification problems. Ultimately, it may turn out that the problem cannot be resolved without additional fieldwork, which would not be able to be covered by the estimated costs associated with the project at present.

Cost Recovery Information:

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 9 (2) of the Fisheries (Cost Recovery) Rules 2001:

- all ORH.

The project is estimated to cost between \$50,000 - \$100,000

Project: Research Observer Services – Deepwater Fisheries

Project Code: OBS2005/01

Start Date: 1 July 2005

Completion Date: 30 September 2006

Vessel Use: Deployments on commercial fishing vessels

Overall Objectives:

1. To collect specified data describing deepwater fisheries for deepwater fisheries research.
2. To collect specified data describing the effects of fishing in deepwater fisheries.

Specific Objectives:

1. To describe the catch including discards in the ORH fisheries.
2. To collect biological data about ORH and other species as directed in the ORH fisheries.
3. To describe the catch including discards in the OEO fisheries.
4. To collect biological data about OEO and other species as directed in the OEO fisheries.
5. To describe the catch including discards in the CDL fisheries.
6. To collect biological data about CDL and other species as directed in the CDL fisheries.

Observer Services Required:

790 days required for deepwater fisheries, 440 for ORH & 350 for OEO in 2004/05. No CDL days are required in 2004/05, although CDL will be sampled by observers on vessels targeting ORH & OEO. See the rationale section below for further details of the sampling plans.

Note:

The services specified in the sampling plan are subject to ongoing review and revision by the Ministry and the Deepwater Stock Assessment Working Group. This project will also provide descriptive data for Aquatic Environment research. No Department of Conservation services are known to be planned in these fisheries at this time.

Rationale:

General

Observer data represent the only detailed quantification of catch on a tow-by-tow basis available to scientists. Observer data provide valuable insight into fishery dynamics through

time. Observers collect catch effort data, biological data and biological specimens for a variety of science purposes.

In deepwater fisheries observer data often provide the only source of detailed biological information about fish in deepwater fisheries where a considerable amount of processing occurs at sea.

History

The deepwater observer programme since 2001/02 is detailed in Table 1 below.

	2001/02		2002/03		2003/04		2004/05	2005/06
	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Proposed
ORH	440	386	440	456	440	481*	440	440
OEO	350	233	350	354	350#	181	350	350
CDL	0	0	0	0	0	0	0	0
Total	790	619	790	810	790#	662	790	790

*The days in excess of the plan were industry requested services.

#The plan was revised down from 350 mid-season in consultation with industry.

Table 1: Observer sea days planned and sea days achieved from 2001/02 – 2003/04, planned sea days for 2004/05, and proposed services for 2005/06.

Sampling Plan for 2005/06

For ORH:

- ORH 1 – 20 days;
- ORH 2A – 40 days (these should be in 2A South);
- ORH 3B – 260 days (220 days on Chatham Rise & 40 days south of 46°S and on Arrow Plateau);
- ORH Lord Howe – 60 days; and
- ORH Louisville – 60 days.

For OEO:

- OEO 1 – 60 days;
- OEO 3A/4 – 190 days; and
- OEO 6 – 100 days.

The biological samples required in the target fisheries are detailed in the Observer Biological Manual. The other sampling priorities in these fisheries are the full and accurate quantification of the catch, the biological sampling of other targeted deepwater species e.g. CDL, any ORH/OEO/CDL biological samples in the ORH/OEO fishery, and other sampling as notified to the Observer Programme. Alterations to sampling plans and additional data requests will be by way of a *request for the collection of samples* or a *request for the collection of data*.

This project provides basic biological information for ORH, OEO and CDL stock assessment and fishery characterisation. It is an integral part of the Deepwater Fisheries Medium Term Research Plan. This project also forms a part of the Aquatic Environment research theme ‘...to determine the direct effects of fishing on associated or dependent species...’, a part of the research topic ‘...the effects of fishing on associated or dependent species...’, and a part of the research programme ‘...to assess the effects of fishing on non-target fish catch by obtaining accurate estimates of the size and distribution of commercial catch and estimates of fishery-induced mortality...’.

Cost Recovery Information:

The percentage allocation for this project will be attributed to the following fishstocks according to rule 8 of the Fisheries (Cost Recovery) Rules 2001:

- ORH 1 (20 days);
- ORH 2A (40 days);
- ORH 3B (260 days);
- OEO 1 (55 days);
- OEO 3A, OEO 4 (195 days combined); and
- OEO 6 (100 days).

The Lord Howe and Louisville services are **industry requested services** and costs will be recovered direct from fishers for the 120 days requested.

Project: Research Observer Services – Antarctic Fisheries

Project Code: OBS2005/02

Start Date: 1 July 2005

Completion Date: 30 September 2006

Vessel Use: Deployments on commercial fishing vessels

Overall Objectives:

1. To collect specified data describing Antarctic fisheries for Antarctic fisheries research.
2. To collect specified data describing the effects of fishing in Antarctic fisheries.

Specific Objectives:

1. To collect data to characterise the toothfish longline fishery.
2. To collect biological data about toothfish as directed in the toothfish fisheries.
3. To describe the catch including discards in the toothfish fisheries.
4. To collect biological data about non-target fish species as directed in the toothfish fisheries.
5. To collect data describing the interaction between the toothfish fishery and the Antarctic ecosystem.

Observer Services Required:

700 days required for Antarctic fisheries in the Ross Sea and 290 for toothfish fisheries in other areas in 2005/06. See the rationale section below for further details of the sampling plans.

These days are ‘**industry requested services**’ and are directly cost recovered from permit holders. They are included here to help with medium term observer programme planning. Both CCAMLR Scientific Observers and Ministry of Fisheries Observers are required to be placed on vessels in these fisheries.

Note:

The services specified in the sampling plan are subject to ongoing review and revision by the Ministry, the Antarctic Fisheries Stock Assessment Working Group and directions from the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). There are no separate Department of Conservation sea days planned for the Ross Sea fishery.

The Ministry of Fisheries will review the decisions of CCAMLR and its members to optimise observer services in the toothfish fisheries prior to the exact number of Antarctic observer days for 2005/06 being confirmed.

The services detailed in this plan relate to New Zealand deployed Ministry of Fisheries observers on New Zealand flagged vessels in CCAMLR fisheries. The deployment of CCAMLR observers on New Zealand flagged vessels and the deployment of Ministry of Fisheries observers, as CCAMLR observers on the vessels of other CCAMLR members are not covered by this plan.

Rationale:

General

In the toothfish fishery observer data represent a very detailed quantification of catch on a set-by-set basis available to scientists. Observer data are independent of the fishery and accordingly provide valuable insight into fishery dynamics through time. Observers collect catch effort data, biological data and biological specimens for a variety of science purposes. Observer data often provide the only source of detailed biological information about fish in Antarctic fisheries.

History

The Antarctic fisheries observer programme since 2001/02 is detailed in Table 1 below.

	2001/02		2002/03		2003/04		2004/05	2005/06
	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Proposed
Ross Sea	-	307	-	575	600	521*	700	700
Other	-	-	-	153	200	0*	290	290
Total	-	307	-	728	800	521*	990	990

*All requests from industry were met in full.

Table 1: Observer sea days planned and sea days achieved from 2001/02 – 2004/05, and proposed sea days for 2005/06.

Alterations to sampling plans and additional data requests will be by way of a *request for the collection of samples* or a *request for the collection of data*.

Sampling Plan for 2005/06

For *Dissostichus* spp.:

- 700 days in the Ross Sea target longline fishery
- 290 days in other target longline fisheries

At least one sample per day is required, preferably one sample per line (in co-operation with the CCAMLR Scientific Observer) for target species. Direct observation of hooks for

incidental mortality and non-target fish catch observation should be ~99% for setting operations and ~45% for hauling operations (again, in co-operation with the CCAMLR Scientific Observer).

The biological samples required in the target fisheries are detailed in the Observer Biological Manual, the CCAMLR Scientific Observer manual and the annual requests of CCAMLR.

The sampling priorities in this fishery are the full and accurate quantification of the catch, seabird interactions with the fishery, the biological sampling of target species (e.g. Antarctic and Patagonian toothfish), the biological sampling of non-target species (e.g. rattails and skates), collection of biological specimens as requested, conversion factor data and other sampling as notified to the Observer Programme. Alterations to sampling plans and additional data requests will be by way of a *request for the collection of samples* or a *request for the collection of data*.

Biological specimen collection

D. mawsoni & *D. eleginoides* stomach samples from juvenile and sub-adult toothfish (<100 cm TL) to complement existing samples.

Tissue sample and parasite sample collections for testing genetic differentiation in 'stocks' of *D. mawsoni* are needed from the Ross Sea.

Continuing collection of *D. mawsoni* otoliths are required for annual age-length keys and for international otolith microchemistry research.

Vertebral columns with intact caudal thorns for *Amblyraja georgiana*, large skates of both sexes and small females a priority with 70 specimens required in total.

Skate size at maturity data and stomach samples from any landed specimens.

Length frequency data, otoliths and stomach samples from morid cods and icefish to be collected.

Rattail random length frequency data for at least 20% of the catch, and a sub-sample of otoliths to be collected for age-length keys.

Cost Recovery Information:

The Antarctic fisheries observer services are **industry requested services** and costs will be recovered direct from fishers for the 990 days requested.