

# AQUATIC ENVIRONMENT

## PROPOSED PROJECTS FOR 2005/06

<u>Code</u>	<u>Title</u>	<u>Priority</u>
	<i>Protected species - estimation of fisheries removals</i>	
ENV2005/01	Estimation of the nature and extent of incidental captures of seabirds in New Zealand fisheries.	High
ENV2005/02	Estimation of the nature and extent of marine mammal captures in New Zealand fisheries	High
ENV2005/04	Identification of marine mammals captured in New Zealand fisheries	High
ENV2005/05	Characterisation of marine mammal captures in New Zealand fisheries	Medium
OBS2005/04	Research Observer Services to estimate the nature and extent of incidental captures of protected species in New Zealand fisheries.	High
ENV2005/06	Estimation of protected species captures in longline fisheries using electronic monitoring	High
	<i>Protected species - information for setting environmental standards for fisheries management and measuring performance</i>	
ENV2005/08	Experimental design of a programme of indicators of protected species population performance relative to fisheries mortality and fisheries management activities	High
ENV2005/09	Data collection to estimate key performance indicators in the Chatham albatross, <i>Diomedea eremita</i> population, relative to fisheries mortality and fisheries management activities	High

<u>Code</u>	<u>Title</u>	<u>Priority</u>
	<b><i>Protected species - assessing information needs for managing effects of fishing</i></b>	
ENV2005/13	Assessment of risk to Yellow-eyed Penguin <i>Megadyptes antipodes</i> from fisheries incidental mortality in New Zealand fisheries and definition of information requirements for managing fisheries-related risk	High
	<b><i>Protected species –ecosystem and trophic effects</i></b>	
ENV2005/14	Feeding relationships in New Zealand protected species higher predators	High
	<b><i>Seamounts</i></b>	
ENV2005/15	Information for managing the Effects of Fishing on Physical Features of the Deep-sea Environment	High
ENV2005/16	Investigate the Effects of Fishing on Physical Features of the Deep-sea Environment	High
	<b><i>Effects of fishing on marine ecosystems</i></b>	
ENV2005/17	Estimation of non-target fish catch and both target and non-target fish discards for jack mackerel trawl fisheries	High
ENV2005/18	Estimation of non-target fish catch and both target and non-target fish discards in orange roughy trawl fisheries	High
ENV2005/20	Benthic invertebrate sampling and species identification in trawl fisheries	High
ENV2005/21	Threat status of associated and dependent species	Medium
ENV2005/22	Relative effects of fishing and environmental degradation on northern harbour fisheries	Medium
ENV2005/23	Monitoring recovery of the benthic community between North Cape and Cape Reinga	Medium

**Project:** Estimation of the nature and extent of incidental captures of seabirds in New Zealand fisheries

**Project Code:** ENV2005/01

**Start Date:** 1 October 2005

**Completion Date:** 30 September 2006

**Vessel Use:** None

**Overall Objectives:**

1. To estimate the nature and extent of captures of seabirds in selected New Zealand fisheries for the fishing year 2004/05.

**Specific Objectives:**

1. To examine the nature and extent of the captures of seabirds in New Zealand fisheries, for the whole New Zealand EEZ, by Fishery Management Area and fishing season, or smaller metric as appropriate for the fishing year 2004/05.
2. To examine seabird capture information reported by fishing fleets in their Codes of Practice under the National Plan of Action for Seabirds, and compare with seabird capture information recorded by observers for the same fisheries strata, where levels of observer coverage or industry self-monitoring information allows, for the fishing year 2004/05.
3. To provide an assessment of the risk posed by different fisheries to the viability of New Zealand seabird taxa, and to assign a risk category to New Zealand fishing operations, in relation to seabird captures.

**Rationale:**

*General*

Monitoring of protected species captures in New Zealand fisheries is a requirement under the Fisheries Act 1996, 'to avoid, remedy or mitigate the effects of fishing on the environment, and associated and dependent species'. Monitoring of fisheries removals of seabirds is also set out in the NPOA-Seabirds. The programme described is currently the primary means of assessing the effect of fishing of incidental capture of protected species on population viability, and also allows independent assessment of the efficacy of mitigation strategies deployed in the fisheries.

Fisheries concerned with this project are all trawl, longline and set-net fisheries. These fisheries comprise a significant component of New Zealand fisheries, by landed value, quota, or tonnage.

The species concerned in this project are protected. Protected species caught in New Zealand fisheries have threat classification listings of Nationally Critical to Range Restricted (Molloy et al. 2002). As such the research to estimate the levels and describe the means of capture of

these animals is paramount to understanding the impacts of fishing related mortalities on population viability and maintenance of biodiversity.

The Ministry of Fisheries Strategic Plan 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".

The management requirements determined by the NPOA-seabirds officials group and by the developing Stock Strategies guides the Ministry of Fisheries research programme. The NPOA-Seabirds medium term research plan explicitly sets out the need for bycatch limits to be defined for key seabird species, and the gathering of information to assess the effects of target-species fisheries on specific seabird populations. This project supports the management of protected species-fishery interactions by indicating whether fisheries performance against key performance indicators is being achieved, and if they are resulting in reductions in the capture of seabirds in New Zealand fisheries through time. It also identifies the level of risk that species populations are exposed to as a result of fisheries interactions.

MFish observers currently provide the primary means of estimating seabird captures in New Zealand fisheries. This information, coupled with industry self-monitoring, allows for an examination of the efficacy of mitigation strategies at a fleet or national level in reducing seabird incidental take. By monitor the level of seabird removals occurring in New Zealand fisheries, the efficacy of management activities to reduce incidental captures can be assessed. Further, the information provided by this programme is currently the primary source of data allowing assessment to be made of whether these removals are sustainable.

This research is high priority because:

- Of the need for estimation of protected species captures across a broader range of fisheries than has been attempted previously, and for increased precision in estimating fisheries removals of seabirds throughout New Zealand fisheries, to address sustainability concerns;
- The high tonnage and high value of the fisheries concerned;

If this project is not undertaken in the next 1-3 years, New Zealand will be lax in fulfilling its responsibilities with respect to international agreements and domestic legislation.

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

### *Objective 1*

Using observer data, and any available fisher-generated information, the rates of capture and species caught in New Zealand fishing operations are to be examined for selected fisheries. Detailed information linking fishing effort to species captures is required, where available, to assess the risks to viability of seabird populations from fishing activities. This objective provides the principal measure of the effect of fishing on seabird populations of fishing activities carried out in New Zealand waters, and the assessment of the efficacy of different mitigation strategies deployed by fishing fleets. Research needs to link to the outputs of project Department of Conservation research on seabird identification and autopsy

(INT2005/03) to enable the use of species-level identifications of seabirds returned from fisheries to be integrated with capture information.

The research will report capture information detailing sex, species, type of injury, mitigation strategies deployed, provenance and age-specific information for seabirds by fishery, where possible. The representativeness of observer cover for assessing capture rates will be examined. Metrics to be reported include: by target fishery and area capture rates (and standard errors), incident rates (no of fishing events resulting in captures), between vessel differences in these rates, estimated total captures (and variance), observed captures. Species level information is to be reported by species with spatial distribution and fisheries contributing to species captures. Estimates of total captures for each species are to be produced for high- to medium-priority species where possible. Total seabirds for each FMA (observed and estimated) and for the NZEEZ are to be reported.

### *Objective 2*

The newly implemented NPOA-Seabirds relies of fisher reporting of captures to assess the efficacy of mitigation strategies deployed in fishing operations. Self-reporting by fishers is promoted, but requires audit through comparison with independently derived and statistically robust estimates of seabird captures obtained from the Ministry of Fisheries Observer Programme. For selected fisheries (NPOA Group 1 and Group 2 fisheries) information derived from fisher returns, as detailed in the NPOA Codes of Practice for these fisheries, will be compared with that analysed under objective 1 above. An assessment of the rigour and robustness of estimates of seabird captures made under reporting requirements of NPOA Codes of Practice will be made.

Any discrepancies between rates and estimates of total captures between the two sources of information will be examined, and reasons for their existence explored. Recommendations about improvements to reporting requirements under the NPOA to ease comparison between observer- and fisher-derived estimates will be made. Completion of this objective will be contingent on the delivery of Reporting Requirements of the NPOA Codes of Practice by Fishing Industry representatives. Researchers will liaise with industry representatives and government officials to ensure the timely acquisition of data for use in this project.

### *Objective 3*

This objective is designed to allow better targeting of observer coverage in key risk areas and fisheries, for assessing the nature and extent of seabird captures. The research will link to outputs of projects ENV2001/01 and ENV2004/04, which examine risk categories for New Zealand fishing areas in relation to seabird captures, and to project ENV2004/05 which examines the sustainability of captures of seabirds for selected individual seabird species in New Zealand fisheries. For fisheries where observer coverage has been adequate to estimate seabird captures, an assessment of the risk to seabirds by Fishery Management Unit will be made, using data from previous fishing years (up to five years to be considered for this analysis). This will be qualified with reference to the seabird species caught in these fisheries, so that highest risk strata contain not only those fisheries with highest catch rates of birds per unit of effort, but also catch the highest-priority seabirds. On this basis, and with reference to previous research on levels of observer coverage for estimating seabird captures (ENV2001-01, Baird and Bradford 1999) recommendations on observer coverage will be made. Areas and fisheries where risk to seabirds is not quantifiable will be treated in the analysis, in

relation to the potential risk they provide, by comparison with fisheries using similar fishing methods, areas and season. A separate prioritisation of the observer coverage in these 'information deficient' fisheries will thus be made.

Outputs under this objective will thus include:

For fisheries with historically high levels of coverage, recommendation of:

- The level of coverage (% of effort) needed to estimate seabird captures (generically) with an interval of confidence that is within 10%, 20% and 30% of the central point of the estimate of capture (median or mean as appropriate).
- The number of observer days needed to achieve these levels of accuracy, based on effort in the most recent 3 years in the fishery.
- Prioritisation of observer days between NPOA group 1 fisheries, to achieve most robust results for estimating observer coverage, statistically, given the constraints on observer days available for deployment.

For fisheries with historically poor levels of coverage, recommendation of:

- The level of coverage (% of effort) likely to be necessary to estimate seabird captures (generically) with an interval of confidence that is within 10%, 20% and 30% of the central point of the estimate of capture (median or mean as appropriate), based on fisheries with similar methods and areas of operation.
- The number of observer days needed to achieve these levels of accuracy, based on effort in the most recent 3 years in the fishery.
- Prioritisation of observer days within these fisheries, based on likely risk of seabird captures and risk to species' population viability, previously reported information of seabird captures, and availability of observer days for deployment.

### **Cost Recovery Information:**

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 7 (1) (c) schedule 4 of the Fisheries (Cost Recovery) Rules 2001:

- all ALB, BAR, BIG, BWS, HAK, HOK, JMA, LIN, MAK, MOO, ORH, OEO, POS, RBM, SBW, SCI, SNA, SQU, STN, SWA, SWO, TOR, WAR, WWA and YFN.

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

**Project:** Estimation of the nature and extent of marine mammal captures in New Zealand fisheries

**Project Code:** ENV2005/02

**Start Date:** 1 October 2005

**Completion Date:** 30 September 2006

**Vessel Use:** None

**Overall Objectives:**

1. To estimate the nature and extent of captures of marine mammals in selected New Zealand fisheries for the fishing year 2004/05.

**Specific Objectives:**

1. To examine the nature and extent of the captures of marine mammals in New Zealand fisheries, for the whole New Zealand EEZ, by Fishery Management Area and fishing season, or smaller metric as appropriate for the fishing year 2004/05.
2. Examine alternative methods for estimating sea lion captures and recommend one or more alternative standardised methods for describing and estimating sea lion captures in the SQU 6T fishery.

**Rationale:**

*General*

Monitoring of protected species captures in New Zealand fisheries is a requirement under the Fisheries Act 1996, 'to avoid, remedy or mitigate the effects of fishing on the environment, and associated and dependent species'. The research described in this project is currently the primary means of assessing the effect of fishing of incidental capture of protected species on population viability, and also for assessing the efficacy of mitigation strategies deployed in the fisheries.

Fisheries concerned with this project are all trawl, longline and setnet fisheries. These fisheries comprise a significant component of New Zealand fisheries, by landed value, quota, or tonnage.

The species concerned in this project are protected species. Protected species caught in New Zealand fisheries have threat classification listings of Nationally Critical to Range Restricted (Molloy et al. 2002). As such the research to estimate the levels and describe the means of capture of these animals is paramount to understanding the impacts of fishing related mortalities on population viability and maintenance of biodiversity.

The Ministry of Fisheries *Strategic Plan 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".

MFish observers currently provide the primary means of estimating marine mammal captures in New Zealand fisheries. This information, coupled with industry self-monitoring allows for an examination of the efficacy of mitigation strategies at a fleet or national level, in reducing marine mammal incidental take.

There is a need to monitor the level of marine mammal removals occurring in New Zealand fisheries. This allows management of incidental captures to be monitored, and an assessment to be made of whether these removals are sustainable, and whether mitigation strategies employed by fishing fleets are effective at reducing protected species captures.

This research is high priority because:

- Of a need for increased coverage and precision is recognised in estimating fisheries removals of marine mammals throughout New Zealand fisheries, to address sustainability concerns;
- the risks posed by fisheries to marine mammal populations, for fisheries not previously observed for marine mammal captures needs to be assessed;
- the high tonnage and high value of the fisheries concerned;

If this project is not undertaken in the next 1-3 years, New Zealand will be lax in fulfilling its responsibilities with respect to international agreements and domestic legislation. Within this context, this research project is considered a high priority.

### *Objective 1*

Using information derived from the Ministry of Fisheries Observer Programme and voluntary returns made by fishers, estimate the total number of removals of marine mammals, and also by target fishery, season and area where possible. Data from autopsies of stranded or beach-cast animals need to be incorporated into these estimates where available, so that estimates include those animals recovered from non-fishery sources, but where there is a high probability of fishery-caused mortality. Working Group agreement on how to classify these additional mortalities may be required. Capture estimates for individual species will be provided, for the whole NZEEZ and Fishery Management Areas as appropriate. Links to the appropriate catch-effort databases and observer information about mitigation strategies and fishing gear used are required to fully examine the factors influencing capture probability for marine mammals.

Report capture information detailing sex, species, type of injury, mitigation strategies deployed, provenance and age-specific information for marine mammals by fishery, where possible. The research needs to link to the outputs from project ENV2005/04 to obtain verified identifications of marine mammal taxa and demographic characteristics.

The representativeness of observer cover, and the robustness of estimates made will be examined, with an exploration of possible bias in estimates derived from observer information. The criteria for determining robustness of estimates will be detailed.

## *Objective 2*

The AEWG recently identified the need to provide a standardised methodology for estimating sea lion captures, both within-season and after the end of fishing seasons, and a standardised reporting these rates and total capture figures. This objective will examine alternative methods for estimating these variables, and will recommend the adoption of one (or more) standardised methods for ongoing use in this research area. Recommend the appropriateness of generalising these findings to estimation of fur seals in New Zealand fisheries.

### **Cost Recovery Information:**

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 7 (1) (c) schedule 4 of the Fisheries (Cost Recovery) Rules 2001:

- all BIG, HOK, JMA, SBW, SCI, STN, TOR, SQU and YFN.

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

**Project:** Identification of marine mammals captured in New Zealand fisheries

**Project Code:** ENV2005/04

**Start Date:** 1 October 2005

**Completion Date:** 30 September 2006

**Vessel Use:** none

**Overall Objectives:**

1. To determine the species, sex, and where possible, age and reproductive status of marine mammals captured in New Zealand fisheries.
2. To necropsy marine mammals captured incidentally to New Zealand fishing operations to determine life-history characteristics and the likely cause of mortality.

**Specific Objectives:**

1. To determine, through examination of returned marine mammal carcasses, the taxon to species-level, sex, and reproductive status, and age-class of marine mammals captured in New Zealand fisheries.
2. To detail the injuries and where possible the cause of mortality of marine mammals returned from New Zealand fisheries, along with their body condition and breeding status, and other associated demographic characteristics.
3. To detail the protocol used for the necropsy of marine mammals, to provide a standardised procedure for autopsy to determine species, age, sex and associated demographic characteristics for fishery-killed specimens.
- 4.

*Note: The project will deliver information on carcasses retrieved from New Zealand fishing operations during the fishing years 2003/04 and 2004/05.*

**Rationale:**

***General***

Monitoring of protected species captures in New Zealand fisheries is a requirement under the Fisheries Act 1996, 'to avoid, remedy or mitigate the effects of fishing on the environment, and associated and dependent species'.

Fisheries concerned with this project are all trawl, longline and setnet fisheries. These fisheries comprise a significant component of New Zealand fisheries, by landed value, quota, or tonnage.

The species concerned in this project are protected species. Species caught in New Zealand fisheries have threat classification listings of Nationally Critical to Threatened (Molloy et al. 2002). This project forms part of the work to estimate the levels and describe the means of capture of these animals, which is paramount to understanding the impacts of fishing-related mortalities on population viability and maintenance of biodiversity, and to encouraging best-practice in mitigating protected species captures. Species identification is difficult, requiring expert opinion, and as such, should not be undertaken fully by observers or industry representatives.

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 from the aquatic environment".

This project informs the management of protected species-fishery interactions. It allows the accurate identification of species, informing the national regard over the level of risk that species populations are exposed to as a result of fisheries interactions.

This research is high priority:

- Addressing sustainability concerns about the level of captures of protected species, and their species population's abilities to withstand fisheries removals;
- The high tonnage and high value of the fisheries concerned;

If this project is not undertaken in the next 1-3 years, New Zealand will be lax in fulfilling its responsibilities with respect to international agreements and domestic legislation.

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

### *Objective 1*

Accurate determination of the taxon of marine mammals captured in New Zealand fisheries is vital for examining the potential threat to population viability posed by these incidental captures. While Ministry of Fisheries observers have been tasked with making assessments of species, and sex of animals captured, verification of these identifications by trained personnel has shown that inaccuracies occur. Information gained from necropsy of marine mammals that allows the age-class, maturity and reproductive history of individuals to be determined requires specialist training. This information will support ongoing research, modelling the effects of fisheries removals for selected populations of high-risk marine mammals, and supports directly research undertaken under project ENV2005/B on the rate of capture of marine mammals in New Zealand fisheries.

### *Objective 2*

Examining the causes of mortality and types of injuries suffered by individual marine mammals is necessary to help reduce future marine mammal captures in New Zealand fisheries, by identifying the areas of risk in fishing activities. Linking this information to the species, age- and sex-class helps identify if different groups of marine mammals are vulnerable to different risks in fishing interactions. Information about body condition and breeding status is necessary to examine extraneous factors, such as environmental variability

in food availability that can influence the probability of fisheries mortalities for marine mammals. Outputs from this research need to link seamlessly with work to estimate the extent of marine mammal captures, researched in project ENV2005/02. The outcomes will also aid future modelling work on the sustainability of marine mammal captures on species populations.

### *Objective 3*

To enable standardization of methodologies through time, by different researchers, it is necessary to document the methods used to identify marine mammals, undertaken in objectives 1 and 2 above.

### **Cost Recovery Information:**

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

- All BIG, HOK, JMA, SBW, SCI, STN, TOR, SQU YFN Fishstocks.

The project is estimated to cost between 100,000 – 150,000.

**Project:** Characterisation of marine mammal captures in New Zealand fisheries

**Project Code:** ENV2005/05

**Start Date:** 1 October 2005

**Completion Date:** 30 September 2006

**Vessel Use:** None

**Overall Objectives:**

1. Characterisation of marine mammal captures in New Zealand fisheries.

**Specific Objectives:**

1. To estimate and report the total numbers, releases and deaths of marine mammals other than New Zealand Sea Lions, where possible by species, fishery and fishing method, caught in commercial and recreational fishing for 1990 up to the end of the fishing year 2004/05.
2. To analyse factors affecting the probability of fur seal captures for the last 10 fishing years up to the end of the fishing year 2004/05.
3. To classify fishing areas, seasons and fishing methods into different risk categories in relation to the probability of marine mammal incidental captures for the years from 1990 up to the end of the fishing year 2004/05.

**Rationale:**

*General*

Monitoring of protected species captures in New Zealand fisheries is a requirement under the Fisheries Act 1996, 'to avoid, remedy or mitigate the effects of fishing on the environment, and associated and dependent species'.

Fisheries concerned with this project are all trawl, longline, purse-seine and setnet fisheries. These fisheries comprise a significant component of New Zealand fisheries, by landed value, quota, or tonnage. Recreational set netting comprises a significant component of recreational fisheries in New Zealand by geographical spread and tonnage.

The species concerned in this project are protected. Marine mammal species caught in New Zealand fisheries have threat classification listings of Nationally Critical to Threatened (Molloy et al. 2002). The species targeted for this research are those with the highest relative numbers of observed mortalities to population size for the New Zealand region and New Zealand fisheries (high priority species). For this reason, these species are considered to be those for which most effect will be observable in terms of monitoring the efficacy of management actions to reduce

fishing mortalities, and also in terms of the risk posed to species viability from fishing-related mortalities.

This research is medium priority because:

- Addressing sustainability concerns about the level of captures of protected species, and their species population's abilities to withstand fisheries removals;
- The commercial fisheries concerned include those of both high tonnage; recreational fisheries concerned are significant by geographical spread and tonnage;
- While desirable to commence the research in the near future, the success of the research is not time critical.

The project is designed to analyse factors contributing to the probability of fur seal mortalities in trawl fisheries, and to present data on other species of marine mammals that are occasionally captured in New Zealand fisheries. Data on marine mammal mortalities attributable to fisheries causes are dispersed through several sources, reducing the ability for managers of fisheries to be fully cognisant of the scale of any captures at a species level. Collation of these data and examination of any likely mitigating circumstances for the projects is therefore desirable. Any delay in carrying out this project will result in delays in the uptake of effective management actions to mitigate incidental mortality of marine mammals.

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

The main data sources to be used in the work include observer data from all commercial fisheries, information from fisher returns of non-fish bycatch forms, data from autopsy work carried out by Department of Conservation. Additionally, the researchers will consider other, more anecdotal data, such as log-book returns or recreational survey information or marine mammals stranding information.

### *Objective 1*

A synopsis of the available observer, stranding and autopsy data is needed to relate changes in fishing-related marine mammal mortality across New Zealand to changes in fishing practice, observer coverage, and other variables. Information on New Zealand sealions has been treated elsewhere (e.g. project ENV2000-02). This research should encompass all available observer, stranding and autopsy data for the years 1990 up to the end of the fishing year 2004/05 to provide a robust analysis of data collected to date.

Research outputs under this objective should indicate:

- Detailed description of commercial and recreational captures as reported and fishing-related mortality as indicated by autopsy (further subdivided by fishing method where possible) through time;
- Detailed description of coincident changes in fishing effort and fishing areas that may be relevant to understanding changes in marine mammal mortalities;

- Analysis and discussion of other elements of the operation of relevant fisheries that may have resulted in changes in capture statistics through time (e.g. codes of practice, regulations for mitigation); and
- Detailed description of the accuracy and extent of estimation of marine mammal captures in New Zealand fisheries through time, including summary of which sectors of fishing effort have not been covered by observers, where the risk of marine mammal capture exists.

Capture statistics should include:

A) For all target species fisheries combined:

- Observed and estimated numbers of marine mammals caught by year, reported to species level where possible for the New Zealand EEZ, allowing a minimum level of removals to be indicated;
- Detail of what level of observer coverage was achieved in the target species fisheries, for all fisheries where marine mammal captures have been noted previously to give an understanding of how well this problem is being estimated;
- Estimation of what proportion of marine mammals captured are returned for identification, where possible to a species level, and whether there are any biases in the rates of return between target fisheries and or other variables in the dataset; and
- Examination of whether rates of reporting differ significantly between vessels with observers and those without, and whether there are any apparent biases in the species composition of marine mammals reported.

B) By target species fishery:

- Rate of capture by unit of effort in the fishery;
- Incident rate – number of fishing events catching marine mammals for each target fish species;
- Break down by strata in the target fishery in capture rates by year, season, area, or method;
- An indication of the level of heterogeneity between different vessels and vessel groups within the fishery fleets should be provided;
- Incident and capture rates by vessel will be examined for each target species fishery, and compared with the mean and 75<sup>th</sup> percentile values for that fishery in each case;
- Describe any trends in these statistics through time; and

- For fisheries with less than 10% observer coverage, heterogeneity in the fleet will be examined, and an estimate made where vessel means are homogenous and the data show homoscedasticity. Thresholds for estimation will be discussed with the Ministry of Fisheries, and criteria developed that can be applied across all fisheries.

C) By marine mammal species:

- Estimation for the period of available data how many individuals have been removed from marine mammal species populations, on a species-by-species and annual basis, based on observer data and non-fish bycatch returns from New Zealand fisheries, stranding and autopsy data and other relevant information. The sex and age of individuals by species should be reported, where available;
- Selection of reporting of species captured in New Zealand fisheries will be done in discussion with the Ministry of Fisheries and Department of Conservation, among species most at risk from fishing impacts in the New Zealand zone; and
- For selected key species, provide on a species-by-species basis a detailed analysis of fishing-related mortality patterns, spatially, seasonally and by target fishery / fishing method and any apparent changes in time through the period of data availability.

D) Other information:

- Incidental information recorded by observers which may assist in identifying problems associated with fishing practice will be noted. This may include information on factors affecting the performance of 'outlier vessels' which have either high or lower than average marine mammal captures, use of mitigation techniques, etc.

*Objective 2*

An analysis of factors affecting the probability of fur seal captures shall be performed. Work with a similar objective was reported in 2000 (Baird and Bradford 2000), but was limited to data from the Hoki fishery at the West Coast of the South Island during the period 1991-98. Further work in this area undertaken under project ENV2000-02 on the factors affecting capture probability for New Zealand Sea Lions, which has significantly advanced the analytical techniques for addressing marine mammal bycatch issues. In light of these advances, and to cover the period of data from 1990-2004, a new analysis of fur seal captures and a factor affecting capture probability is required.

Selected fisheries where high levels of observer coverage have been achieved over the past 10 fishing years up to the end of the fishing year 2004/05 will be targeted for this research. Trends through time in fur seal incidental take will be examined in relation to the changing characteristic of the fisheries.

Factors that may affect capture probability could include:

- Vessel characteristics: e.g. size, nationality, power, vessel master, presence of meal-plant;
- Fishing configuration: e.g. gear type, vessel speed, tow configuration, tow duration, length of time the net remains on the surface before hauling aboard, use of mitigation equipment, net cleaning prior to setting, offal discharge, long-line sink rate, line-weighting regime, proportion of catch discarded, catch per unit effort of target fish species;
- Temporal factors: time of day, season (period in the year), year, light levels at the time of the fishing event; and
- Species-level factors: the size, age and maturity of the individuals caught, their body condition and state of stomach fullness prior to capture;
- Environmental variables: e.g. distance to known rookeries or feeding locations, sea surface temperature, presence and abundance of marine mammals, sea state, Fisheries Statistical Area / Fishery Management Area fished.

### *Objective 3*

Marine mammal-captures in both commercial and recreational fishing are known to vary significantly by area, season and vessel within fisheries. Due to this variability, it is difficult to determine where most effort is needed in mitigating the effect of fisheries mortality is needed. An analysis is required, using observer data (as well as stranding and autopsy data for Hector's/Maui's dolphin) for the fishing years from 1990 up to the end of the fishing year 2004/05 to classify the fishery management areas in the New Zealand EEZ, into zones of high, medium, and low risk for marine mammal mortality. The risk classification should take into account the threat status and observability of captures of different marine mammal species.

In consultation with the Ministry of Fisheries, define high, medium and low risk for use in these analyses. The threat classification of marine mammal species that may be affected by fisheries mortality needs to be taken into account in defining the spatial strata of different marine mammal mortality risk. The research should include data on New Zealand sea lions under this objective. Further the analyses should indicate where information is lacking to inform decision making in light of this research, such as reporting of all fisheries-related mortality for high-risk marine mammal species.

These areas should be able to provide operational units for future sampling of marine mammal captures in New Zealand fisheries, and therefore need to take into account spatial and target-species fishery strata.

This objective is designed to allow better targeting of observer coverage in key risk areas and fisheries, for assessing the nature and extent of marine mammal captures. For fisheries where observer coverage has been adequate to estimate marine mammal captures, an assessment of the risk to marine mammals by Fishery Management Unit will be made, using data from the previous five fishing years. This will be qualified with reference to the marine mammal species caught in these fisheries, so that highest risk strata contain not only those fisheries with highest catch rates of animals per unit of effort, but also catch the highest-priority

marine mammal. On this basis, and with reference to previous research on levels of observer coverage for estimating protected species captures (ENV2001-01, ENV2000-02, Baird and Bradford 1999) recommendations on observer coverage will be made. Areas and fisheries where risk to marine mammals is not quantifiable will be treated in the analysis, in relation to the potential risk they provide, by comparison with fisheries using similar fishing methods, areas and season. A separate prioritisation of the observer coverage in these 'information deficient' fisheries will thus be made.

Outputs under this objective will thus include recommendation of:

- The level of coverage (% of effort) needed to estimate marine mammal captures by species with an interval of confidence that is within 10%, 20% and 30% of the central point of the estimate of capture (median or mean as appropriate).
- The number of observer days needed to achieve these levels of accuracy, based on effort in the most recent 3 years in the fishery.
- Prioritisation of observer days between fisheries, to achieve most robust results for estimating observer coverage, statistically, given the constraints on observer days available for deployment.

#### **Cost Recovery Information:**

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 7 (1) (c) schedule 4 of the Fisheries (Cost Recovery) Rules 2001 for Objectives 1 and 2:

- all BIG, HOK, JMA, SBW, SCI, STN, TOR, SQU and YFN.

The project is estimated to cost between \$30,000 - \$50,000.

**Project:** Research Observer Services to estimate the nature and extent of incidental captures of protected species in New Zealand fisheries.

Project Code: OBS2005/04

**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 protected species captures in squid fisheries.
2. To collect specified data describing warp-strike incidents in squid fisheries.

**Specific Objectives:**

1. To collect data describing fishing events and the incidental capture of protected species during fishing events to allow the estimation of protected species catch in squid trawl fisheries.
2. To collect biological specimens of incidentally caught protected species in squid trawl fisheries as requested.
3. To collect data describing the interaction of seabirds with trawl warps in squid trawl fisheries according to the protocol prescribed by Ministry of Fisheries during sampling periods on selected trawl fisheries operations as required.

**Observer Services Required:**

960 days in the southern SQU trawl fisheries.

**Note:**

The services specified in the sampling plan are subject to ongoing review and revision by the Ministry of Fisheries, Department of Conservation and the Aquatic Environment Working Group. This research project describes the tasks and sampling regime proposed for squid fishery/protected species interaction work required by the Ministry of Fisheries, and links to the Three-Year Forward Observer Plan currently under development for the period 2005/06 – 2007/08.

**Rationale:**

*General*

Monitoring of protected species captures in New Zealand fisheries is a requirement under the Fisheries Act 1996, 'to avoid, remedy or mitigate the effects of fishing on the environment, and associated and dependent species'.

The project concerns the observation of protected species interactions with fishing operations in New Zealand waters. The protected species observed to date in New Zealand fisheries incidental take include those with Nationally Critical to Range Restricted listings under the New Zealand Threat Classification System (Molloy et al. 2002). The threat to these species from fishing interactions has not been assessed.

The Ministry of Fisheries *Strategic Plan 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".

Ministry of Fisheries observers provide the primary means of informing assessment of the sustainability of fisheries removals of protected species on species population viability. Furthermore, MFish observers currently provide the sole source of information to enable the auditing of the performance of fisheries against performance indicators set under NPOA-Seabird Codes of Practice.

Observer services are also required to allow advancement of scientific understanding of the importance of warp-strike interactions for seabird in trawl fisheries, and to enable the rigorous assessment of new and developing mitigation strategies, intended to reduce the capture of protected species.

Observer services are needed to provide estimates of protected species captures and to inform the development of strategies for avoiding, mitigating or remedying the effects of fisheries mortality on protected species.

This research is high priority because:

- The work addresses sustainability concerns about the level of captures of protected species, and their species population's abilities to withstand fisheries removals;
- The work enables rigorous assessment of new and developing mitigation strategies;
- The fisheries concerned are of both high tonnage and high value;

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

### *Objectives 1*

Accurate reporting of protected species landed on vessels is vital to estimating the effects of fishing on species populations. Linking capture-probability to fishing practices and use of mitigation techniques is a key means for advancing the uptake of best practice in New Zealand fisheries. Revisions to reporting forms for observers, undertaken as part of the Observer Programme Strategic Review will assist with improving efficiencies in this research area. This research links to the requirements of the NPOA-Seabirds, to monitor the removals of seabird species and assess the effect of this on protected species population viability. Further, recording selected and targeted information about fishing practices and deployment of mitigation strategies

will assist with the analysis of efficacy of different mitigation strategies, and ultimately assist uptake of best practices across New Zealand fishing fleets.

### *Objective 2*

Return of biological specimens is required to allow accurate identification of the protected species captured, and to gain information about the provenance and demographic characteristics of bycaught protected species. These objectives link to projects ENV2005/01 – 04 and Department of Conservation research programmes (INT2005/03).

### *Objective 3*

The recording of trawl mortalities of seabirds is hampered by the non-return of individuals that are injured during collisions with trawl warps. To date, no standardised methods of recording warp strikes has been used in New Zealand fisheries. This project will trial methods to record warp interactions and quantify these in selected fishing operations, with the aim of allowing correction factors for trawl interactions to be quantified.

A protocol developed to allow a relative index of trawl warp-strike intensity is being trialled in fisheries in 2004. The research aims to provide a relative measure of risk of trawl warp strikes that is comparable between fisheries, areas and years. It is designed to allow examination of factors influencing the probability of warp strike. While the relationship between warp-strike probability and mortalities is not simple in trawl fisheries, risk of mortalities by seabirds is thought to increase with increasing warp-strike frequency. This will be deployed, following revisions in December 2004 in the southern squid fishery. Working Group input to review the protocols will be sought, before the deployment of the protocols in the southern SQU fishery in 2005/06.

### *Sampling Plan for 2005/06*

Sampling is intended to operate at a level to allow robust estimation of protected species captures in selected fisheries and areas for the year. Estimation of captures at species level is intended for marine mammal species. For seabirds, estimation of species-level captures is considered unfeasible with current observer availability and therefore generic estimates of total seabird captures will be generated. Identification of species caught through project ENV2005/03 will assist with the enumeration of seabird species captures, analysed in project ENV2005/01.

Coverage levels remains similar to those in previous years in the SQU fishery.

For trawl fisheries:

- Enumeration of protected species captures will be made by observing the haul for sampled portions of each trip; and
- Warp-strike protocol for approximately 1 hr per day of sampling will be instituted, to allow estimation of interactions with seabirds.

### **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:

- SQU 1T and 6T (960 days combined).

**Project:** Estimation of protected species captures in longline fisheries using electronic monitoring

**Project Code:** ENV2005/06

**Start Date:** 1 October 2005

**Completion Date:** 30 September 2006

**Vessel Use:** None

**Overall Objectives:**

1. To provide estimates of seabird and marine mammal mortalities from longline fisheries in New Zealand using electronic monitoring systems and to recommend deployment and data management options for ongoing use of these systems for estimation of protected species incidental take.

**Specific Objectives:**

1. To deploy electronic monitoring systems on fishing vessels in selected fisheries using longlining in New Zealand and estimate protected species incidental take.
2. To evaluate the efficacy of electronic monitoring in allowing enumeration and identification of protected species captures.
3. To recommend options for data management, ownership and information transfer arising from the deployment of electronic monitoring in selected fisheries.

**Rationale:**

*General*

Recent developments in technology allow the remote monitoring of catch in fisheries, through electronic monitoring. These technologies have been tested in New Zealand and extensively in North American line and net fisheries, and have potential to allow for accurate enumeration of fisheries captures of protected species. Most recently in the New Zealand context, equipment from Archipelago Marine Research was trialled on South East Finfish Management Company vessels. The work was successful in demonstrating that this technology can be used in situations where observers are difficult to deploy, and successfully recovered imagery of dolphin and seabird captures from two set netting operations in the Canterbury area. This work was a cooperative project between fishing industry groups, a research provider and government agencies. Further work is ongoing in the Hoki fishery.

Currently, enumeration of seabird or marine mammal captures is possible using existing technology. However, technological limits in image-acquisition hampers the resolution of species identification, requiring coordination of catch-effort information by fishers with electronic data-gathering systems. These limitations can be managed to yield accurate and high quality results, given appropriate incentives. The research programme aims to deploy

this electronic monitoring systems on a small fleet of long-line fishing vessels, and to examine the potential of this technology for monitoring seabird and marine mammal captures across both pelagic and demersal line fisheries. The success of large-scale deployment of this technology is contingent on appropriate systems for data capture, management and analysis being in place. These will be assessed and best approaches recommended as a result of this research programme. Cooperation with fishing industry partners in this project is vital for its success. Data ownership and access agreements need to be determined before the project can commence, and need to take into account privacy and other concerns held by industry groups.

Fisheries concerned with this project are all longline fisheries. The outcomes of the research will be applicable to all long line fishing operations, as the work focuses on the development of systems for estimation of captures of protected species, that relate to the fishing method rather than a particular fish stock or area.

The species concerned in this project are protected. Species caught in New Zealand fisheries have threat classification listings of Nationally Critical to Threatened (Molloy et al. 2002).

Enumerating captures of protected species is vital for understanding the effects of fishing-related mortalities on population viability, and for assessing the performance of fisheries in fishing sustainably. Numerous fisheries have had less than optimal levels of observer coverage for estimating protected species take levels in the past, for a variety of logistical reasons.

Under the NPOA-Seabirds, fisheries with known seabird interactions are required to monitor and report seabird take as Key Performance Indicators, and monitor their achievement of take levels below these voluntarily-set limits for bycatch. The research will allow independently derived estimates of protected species incidental captures during fishing operations. In future, these estimates can be used to audit the performance of fishing fleets against their NPOA Key Performance Indicators.

This research is high priority:

- To assess the efficacy of fisheries management activities designed to mitigate the adverse effects of fishing on protected species populations, that may place constraints on fishing operations;
- The fisheries concerned are of both high tonnage and high value;

If this project is not undertaken in the next 1-3 years, it will be difficult to meet the increasing demands for observer services to fulfil requirements under the NPOA-Seabirds.

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

### *Objective 1*

Electronic monitoring systems will be deployed on a group of vessels, and research providers will be responsible for the installation and maintenance of systems, the processing of data, and reporting on incidental take to crown agencies and the fishing industry. Data management and ownership aspects are to be defined prior to the commencement of the research, and to

take into account fishing industry concerns. Ownership of the data deriving from the research, by the companies participating in the research should be considered.

Outcomes need to be produced in a timely manner to inform the reporting of NPOA-Seabird Codes of Practice. The research requires a high degree of coordination with the fishing industry, to ensure that their requirements are met in providing useful information to assess their performance against Key Performance Indicators.

The research is designed to test an electronic monitoring system at the level of a fleet during a fishing season, to assess the potential for ongoing usage of this technology for estimating protected species incidental captures, at an operational level. The potential for large-scale deployment of this technology will be assessed, and recommendations made as to the requirements for generalisation into a larger selection of fleets and fishing methods.

The protected species captures on the vessels studied will be reported. Catch rates, incident rates, and total numbers captured during monitored periods of fishing will be reported. Species level identification will be undertaken, in conjunction with research undertaken in other Ministry of Fisheries and Department of Conservation research programmes. Comparison and analysis of catch rates between observer and electronic sources is required. Co-ordination with research reported under ENV2005/01 is recommended to attain comparable estimates of seabirds captured, derived from observer information. Potential to replace programmed observer coverage in the fisheries selected for research during this programme will be explored. This should follow a pilot programme of deployment of the systems, to ensure reliable delivery of information about protected species captures during the fishing season. Coordination with the Ministry of Fisheries will be required to obtain efficiencies in this area.

### *Objective 2*

The ability for analyses of data collected using electronic systems to distinguish between different protected species taxa will be assessed, and recommendations made as to the most effective methods for complimenting this information with other data sources (e.g. photos, reports, necropsy findings). The extent to which electronic monitoring can replace observer coverage will be explored, given the constraints of placement of observers, and the need for observers to carry out stock-assessment research requirements.

### *Objective 3*

The research will examine alternatives for data management and information transfer, including the maintenance and archiving of data sources of fisheries provenance. Recommendations for institutional arrangements to facilitate for ongoing use of electronic monitoring will be made.

### **Cost Recovery Information:**

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 7 (1) (c) schedule 4 of the Fisheries (Cost Recovery) Rules 2001 with the exception of Specific Objective 3 which is not to be cost-recovered:

- all BIG, BNS, LIN, SNA, STN, SWO, TOR and YFN.

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

**Project:** Experimental design of a programme of indicators of protected species population performance relative to fisheries mortality and fisheries management activities

**Project Code:** ENV2005/08

**Start Date:** 1 July 2005

**Completion Date:** 30 September 2005

**Vessel Use:** None

**Overall Objectives:**

1. To design a programme indicators of population performance with respect to captures of seabirds in New Zealand fisheries.
2. To design a programme indicators of population performance with respect to captures of marine mammal in New Zealand fisheries.

**Specific Objectives:**

1. To assess the feasibility of using demographic information to assess the effects of fishing on seabird populations.
2. To identify population performance indicators and to provide sampling protocols and experimental design for selected high to medium priority seabird populations, to allow:
  - Estimation of key performance indicators for assessing the effect of New Zealand fisheries-related mortality on population viability;
  - Estimation of key performance indicators for assessing the effect of major influences other than New Zealand fisheries on population viability; and
  - Assessment of the influence of fisheries management actions intended to avoid, remedy or mitigate the effects of fishing-related mortality from New Zealand fisheries.
3. To recommend experimental protocols for sampling of selected seabird populations in New Zealand influenced by fisheries mortality, employing robust-design methodology and including recommendations for inclusions of data into Ministry of Fisheries databases.
4. To assess the feasibility of using demographic information to assess the effects of fishing on marine mammal populations.
5. To identify population performance indicators and to provide sampling protocols and experimental design for selected high to medium priority marine mammal populations, to allow:
  - Estimation of key performance indicators for assessing the effect of New Zealand fisheries-related mortality on population viability;
  - Estimation of key performance indicators for assessing the effect of major influences other than New Zealand fisheries on population viability; and

- Assessment of the influence of fisheries management actions intended to avoid, remedy or mitigate the effects of fishing-related mortality from New Zealand fisheries.
6. To recommend experimental protocols for sampling of marine mammal populations in New Zealand influenced by fisheries mortality, employing robust-design methodology and including recommendations for inclusions of data into Ministry of Fisheries databases.

## **Rationale:**

### *General*

Monitoring of protected species captures in New Zealand fisheries is a requirement under the Fisheries Act 1996, 'to avoid, remedy or mitigate the effects of fishing on the environment, and associated and dependent species'.

Fisheries concerned with this project are all trawl, longline and setnet fisheries. These fisheries comprise a significant component of New Zealand fisheries, by landed value, quota, or tonnage.

The species concerned in this project are protected species. Species caught in New Zealand fisheries have threat classification listings of Nationally Critical to Threatened (Molloy et al. 2002). The species targeted for research are those with the highest relative numbers of observed mortalities to population size for the New Zealand region and New Zealand fisheries (high to medium priority species). For this reason, these species are considered to be those for which most effect will be observable in terms of monitoring the efficacy of management actions to reduce fishing mortalities, and also in terms of the risk posed to species viability from fishing-related mortalities.

The Ministry of Fisheries *Strategic Plan 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".

This project provides information for the management of protected species-fishery interactions. Under Ministry of Fisheries stock strategies, as under the NPOA- Seabirds, finding indicators for the efficacy of management activities at mitigating the adverse effects of fishing on protected species is necessary. This research targets indicators at the population level, that will enable both the outcome of management (assessment of viability) and the effectiveness of management activities (reduction in mortalities at species level) to be evaluated, for selected species that are considered to be the most sensitive in the suite of species affected by mortalities in New Zealand fisheries. Importantly, the project takes into account the influence of other factors such as climatic or out-of-zone fishing mortalities, thus provides a robust analysis of the factors likely to be most important in influencing population responsiveness to changes in fisheries mortalities within the New Zealand sector.

In order to conduct research on the adverse effects of fishing on the viability of species populations and the efficacy of fisheries management activities, such as project ENV2005/09, a robust design of research programmes, undertaken in this project, is vital.

This research is high priority:

- Addressing sustainability concerns about the level of captures of protected species, and their species population's abilities to withstand fisheries removals;
- Allowing assessment of the efficacy of fisheries management activities designed to mitigate the adverse effects of fishing on protected species populations, that may place constraints on fishing operations;
- As the fisheries concerned are of both high tonnage and high value;

If this project is not undertaken in the next 1-3 years, the assessment of the efficacy of fisheries management activities will not be undertaken, and there will be little measure of whether the constraints placed on fishing activities to mitigate the adverse effects of fishing on protected species have been effective at achieving their aim. Further, assessment of the cumulative effects of mortalities from multiple fisheries on viability of high-priority protected species will not be able to be achieved.

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

#### *Objectives 1 and 4*

The research will examine whether population information such as population surveys and mark-recaptures studies can provide managers of fisheries with information to assess the effects of fishing on protected species. The research will draw on the results of previously published studies, and use modelling where necessary to demonstrate the sensitivity of robustly-designed population research to identify and estimate the magnitude of any adverse effects of fishing. The research will recommend whether field programmes on the population biology of selected protected species can provide indicators of fisheries effects on populations, and the potential for the outcomes of fisheries management activities to be measured at population levels.

In any exercise of modelling outcomes of management, identification of management objectives is necessary. The research will identify likely population management objectives, in discussion with managers of Fisheries and protected species populations, prior to the commencement of any research. The species populations to be explored in the work are to be agreed in consultation with the Ministry of Fisheries.

#### *Objectives 2 and 5*

The research will examine which population parameters provide greatest sensitivity in assessing the effects of fishing. Examining population viability, trend, and status is important for fulfilling New Zealand's requirements under domestic legislations and international agreements. Further, management of the adverse effects of fishing on protected species populations has the potential to constrain fishing activities. Hence it is necessary to undertake a thorough examination of the likely sensitivity of population studies to demonstrate population viability, measure the effects of New Zealand fisheries mortalities, and demonstrate the benefits to populations of fisheries management actions intended to mitigate the effects of fishing.

The research will report which population parameters are likely to be able to be used to examine the effects of fishing on selected high to medium priority species, and the scope of studies necessary to do so.

### *Objectives 3 and 6*

In consultation with Ministry of Fisheries and Department of Conservation, protocols for field data gathering will be determined, and reported in a manner to allow their use in ongoing research on indicators of population performance for protected species affected by fisheries mortalities. Data collection protocols, using robust design methodology will be developed for collection of mark-recapture data.

The maximum duration of data collection periods will be determined in discussion with the Ministry of Fisheries, but should aim to provide sensitive indicators of performance within 5-6 years. The design must allow for the estimation of breeding and inter-breeding mortality rates, and influences of environmental factors on indicators to be examined. Constraints of field programmes must be taken into account in the designs. Outputs from this research need to link to data collection project ENV2005/09 and field programmes run by Department of Conservation on the effects of fishing on marine mammal and seabird populations.

### **Cost Recovery Information:**

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 7 (1) (b) schedule 3 of the Fisheries (Cost Recovery) Rules 2001:

- all ALB, BAR, BIG, BWS, HAK, HOK, JMA, LIN, MAK, MOO, ORH, OEO, POS, RBM, SBW, SCI, SNA, SQU, STN, SWA, SWO, TOR, WAR, WWA and YFN.

The project is estimated to costs between \$0 – \$50,000.

**Project:** Data collection to estimate key performance indicators in the Chatham albatross, *Diomedea eremita* population, relative to fisheries mortality and fisheries management activities

**Project Code:** ENV2005/09

**Start Date:** 1 July 2005

**Completion Date:** 1 July 2006

**Vessel Use:** None

**Overall Objectives:**

1. To gather data on key population performance parameters for Chatham albatross *Diomedea eremita*, to enable population viability to be assessed, and the responses of key parameters to fisheries mortality and fisheries management activities to mitigate fisheries removals, from within New Zealand fishing waters.

**Specific Objectives:**

1. To undertake field research to collect data on population growth rates, adult survival, inter-breeding survival, mortality due to predation at the colony, fecundity and associated parameters for Chatham Albatross, following the study design prescribed in project ENV2005/08.
2. To undertake field research to determine the range and extent foraging movements of Chatham albatrosses within New Zealand fishing waters, and examine the nature and extent of any association between Chatham albatrosses and fishing activities within this area.

**Rationale:**

*General*

Monitoring of protected species captures in New Zealand fisheries is a requirement under the Fisheries Act 1996, 'to avoid, remedy or mitigate the effects of fishing on the environment, and associated and dependent species'.

Fisheries concerned with this project are trawl and longline fisheries operating in the foraging range of the Chatham Albatross (eastern New Zealand waters). The species concerned in this project are protected with a critically endangered population threat classification (Molloy et al. 2002). The species is among those protected species with the highest relative numbers of observed mortalities to population size for the New Zealand region and New Zealand fisheries. For this reason, these species are considered to be those for which fisheries effects on population performance will be most observable, allowing for monitoring the efficacy of management actions to reduce fishing mortalities, and also monitoring of the risk posed to species viability from fishing-related mortalities. Illegal harvest of Chatham Albatrosses may

still occur, although the frequency and extent is thought to be minimal, and there is not information to assess the effect of this take on the population status (Taylor 2000).

The Ministry of Fisheries *Strategic Plan 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".

This project provides information to allow management of protected species-fishery interactions. Under Ministry of Fisheries stock strategies, as under the NPOA-Seabirds, finding indicators for the efficacy of management activities at mitigating the adverse effects of fishing on protected species is necessary. This research targets indicators at the population level, intended to allow both the outcome of management (assessment of viability) and the effectiveness of management activities (reduction in mortalities at species level) to be evaluated, for species that are considered to be the most sensitive in the suite of species affected by mortalities in New Zealand fisheries. These are likely to relate to survival parameters, in such long-lived animals, and can be sensitive to fisheries influences. Accurate measurement of inter-annual and inter-breeding survival rates through intensive mark-recapture research can indicate the growth rate of a population through time, as well as indicating how a population is able to respond to estimated levels of fisheries mortality. For species which are subject to mortality from a range of fisheries, and aggregate effects of this mortality are difficult to measure without high levels of observer coverage, population research programmes provide the most reliable indicator of the effects of fishing.

In some cases, management actions may be taken to reduce incidental mortalities in a species, either through constraining the activities of the fishery (eg through catch limits or area closure) or by implementing bycatch reduction techniques. For seabird populations which are subject to a relatively high level of fisheries mortality, the population responses to these management actions should be measurable.

Management approaches outlined in the NPOA-Seabirds comprise species-specific catch limits, area closures, input controls on mitigation technology, legal and economic incentives to improve performance at reducing seabird mortality in fishing operations.

In order to conduct research on the adverse effects of fishing on the viability of species populations and the efficacy of fisheries management activities, a robustly designed research is required that allows estimation of key indicators of population performance relative to fisheries removals. This research gathers data to allow estimation of those parameters.

This research is high priority:

- Addressing sustainability concerns about the level of captures of protected species, and their species population's abilities to withstand fisheries removals;
- Assessing the efficacy of fisheries management activities designed to mitigate the adverse effects of fishing on protected species populations, that may place constraints on fishing operations;
- As the fisheries concerned are of both high tonnage and high value;

If this project is not undertaken in the next 1-3 years, the assessment of fisheries management activities will not be undertaken, and there will be little measure of whether the constraints placed on fishing activities to mitigate the adverse effects of fishing on protected species populations have been effective at achieving their aim. Further, assessment of the cumulative effects of mortalities from multiple fisheries on viability of high-priority protected species will not be able to be achieved.

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

### *Objective 1*

Population studies of Chatham Albatross have been undertaken previously, funded most recently by private research groups and World Wide Fund for Nature New Zealand (WWF-NZ). Some of these data are to be modelled as part of project ENV2004-05, examining the sustainability of fisheries take of this species in a variety of trawl and longline fisheries. A preliminary assessment of these data has indicated that the dataset is not long enough for conclusions regarding the adverse effects of fishing to be fully addressed. However, these programmes have demonstrated the feasibility of researching the population dynamics of the Chatham Albatross, albeit with constraints imposed by the inaccessibility of the colony location.

Using protocols described in outputs from project ENV2005/08, data on key population parameters will be gathered at the Chatham Islands. Rigorous application of data collection protocols is required for effective analysis of species population performance indicators. The research will examine the fine-scaled interaction of species with fisheries in the New Zealand EEZ, and will provide information to allow the influence of fisheries management activities in mitigating risk to the species to be assessed, linking particular species performance with the fishery level data on seabird capture rates and use of mitigation strategies, reported under ENV2005/01. Further, the efficacy of management activities in producing outcomes of reduced mortalities below sustainable levels can only be assessed at the level of the population, where the cumulative effects of multiple fisheries activities are measurable. Databases of species information and meta-data on data collection methods will be managed by Ministry of Fisheries, in conjunction with Department of Conservation, to allow for the efficient running of this and associated projects. The project will deliver data following the requirements of the Ministry of Fisheries.

While it is estimated that this project will require five years of data gathering to robustly estimate indicator parameters, the project is designed to run for one year in the first instance.

This objective is conditional on the outcome of project ENV2005/08, and will continue if there is recognition of the value of population research to assessing the adverse effects of fishing on populations of seabirds.

### *Objective 2*

This research is intended to use GPS logger technology to assess the potential for interaction between fishing vessels and the species population. The high accuracy (< 10m) of GPS locations allows associations to individual fishing events to be made, allowing an examination of the risk posed to species populations by different target-species fisheries. A group of up to 20 individual will be telemetered, concurrent with work carried out under

objective 1. This component adds little additional cost to the study, while providing considerable benefit in understanding the spatial extent of fishery – species interactions.

Research using GPS loggers has recently shown how seabirds may change their behaviour in proximity to fishing vessels operating within their foraging ranges. The information makes possible the assessment of risk posed by different target fisheries to the population of origin of study birds' species, by allowing an integration of spatial usage of selected study populations and fishing fleets using bird-tracking data and fishery catch effort information. The work links to research being undertaken into the marine ecosystem functioning and trophic effects of fishing, under the BioINFO programme run by the Ministry of Fisheries, focussed on the Chatham Rise ecosystem.

### **Cost Recovery Information:**

No risk assessment of the relative contribution of New Zealand fishing to the Chatham Albatross population has been undertaken as data are considered inadequate at this time for a risk assessment. The percentage allocation for this project will be attributed to the following Fishstocks according to 7 (1) (b) schedule 3 of the Fisheries (Cost Recovery) Rules 2001:

- all ALB, BAR, BIG, BWS, HAK, HOK, JMA, LIN, MAK, MOO, ORH, OEO, POS, RBM, SBW, SCI, SQU, STN, SWA, SWO, TOR, WAR, WWA and YFN.

The project is estimated to cost between \$0-50,000.

**Project:** Assessment of risk to Yellow-eyed Penguin *Megadyptes antipodes* from fisheries incidental mortality in New Zealand fisheries and definition of information requirements for managing fisheries-related risk

**Project Code:** ENV2005/13

**Start Date:** 1 October 2005

**Completion Date:** 1 December 2006

**Vessel Use:** None

**Overall Objectives:**

1. To assess the risk posed to Yellow-eyed Penguin *Megadyptes antipodes* populations from New Zealand fishing operations as far as possible, and to define information requirements for future research programmes aimed at managing fisheries-related risk.

**Specific Objectives:**

1. To review existing data on Yellow-eyed Penguin *M. antipodes* population performance and fisheries information and provide an analysis of the potential effect of fishing mortality and other factors on population viability.
2. To recommend data collection requirements and protocols for the assessment of the effects of fishing on Yellow-eyed Penguins.

**Rationale:**

*General*

Monitoring of protected species captures in New Zealand fisheries is a requirement under the Fisheries Act 1996, 'to avoid, remedy or mitigate the effects of fishing on the environment, and associated and dependent species'. For some species, the risk posed by fishing mortalities, and the nature and extent of these interactions is difficult to quantify, because of the nature of the fisheries, which could potentially interact with species, and due to the characteristics of the species themselves. For species where adverse effects of fishing are suspected, but not proven, it is important to review existing information and identify potential approaches to managing any adverse effects of fishing, before undertaking new data gathering.

This programme is designed to use the existing datasets on population characteristics of the species and to examine whether effects of fishing through additional mortality on the population are measurable. Recommendations arising from this research will include the need for further data gathering to be undertaken, and best approaches to addressing the lack of data about fishery – species interactions for the study species.

The formulation of research and monitoring recommendations will be carried out in consultation with Department of Conservation and Ministry of Fisheries, to include feasible options for research and management within current administrative and legislative arrangements. Research recommendations should identify the degree of risk, either quantitatively or qualitatively, posed by different target-species fisheries or fishing methods to the species, relative to other known risks affecting the viability of the populations studied.

Fisheries concerned with this project are all inshore trawl and setnet fisheries operating off the coasts of Canterbury, Otago and Southland. Evidence exists that Yellow-eyed Penguins are killed accidentally as part of fishing operations using gill-nets (Darby and Dawson 2000). The extent of trawl mortalities on sub-Antarctic populations of Yellow-eyed Penguins are undocumented, and are considered outside the scope of this project. The species concerned in this project is protected, with population status of nationally vulnerable.

The Ministry of Fisheries *Strategic Plan 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". The research examines the potential for fisheries to affect populations of Yellow-eyed Penguins, and to identify potential management strategies to address any adverse effects. The research will inform the development of management approaches to be applied over the medium term.

The interaction of fishing and coastal protected species is little understood, partly due to the low levels of observer cover in these areas. Using existing data on demographic parameters of selected study populations, and other information from published and unpublished studies, this research will assess the potential for fisheries to cause adverse effects on Yellow-eyed Penguin populations and recommend research approaches for the future, if warranted.

This research is high priority:

- Addressing sustainability concerns about the level of captures of protected species, and their species population's abilities to withstand fisheries removals;
- The high tonnage and high value of the fisheries concerned;

If this project is not undertaken in the next 1-3 years, it will not be possible to assess the potential of fishing to adversely effect Yellow-eyed Penguin populations as a result of incidental mortality. This delay could result in undue effects of any mortality on Yellow-eyed Penguin populations, and delays in the delivery of effective management activities to mitigate these effects.

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

### *Objective 1*

Using existing data, from published and unpublished sources, the population performance of Yellow-eyed Penguins will be modelled. The role of fisheries in contributing to mortalities away from breeding sites will be examined, in relation to fisheries captures and fishing effort in the areas where Yellow-eyed Penguins are known to forage. Adverse effects of other sources of disturbance or threat to penguin population viability will be examined, and the

likely risk posed by fishing relative to these threats will be assessed, quantitatively, where possible.

### *Objective 2*

Drawing from the research conducted under Specific Objective 1, the researchers will recommend future data requirements and data collection protocols that can practically be deployed, and in relation to the risk to the population posed by fishing activities and the kinds management activities possible under current fisheries legislation. The researchers will need to consult with managers of the applicable fisheries, and managers of Yellow-eyed Penguin populations in the course of formulating their recommendations, to assess likely management objectives for the species, and possible fisheries management responses to the need for constraints on fishing activities to reduce Yellow-eyed Penguin mortalities, if necessary.

The role of Codes-of-Practice deployed in fisheries in reducing the potential for Yellow-eyed Penguin mortality should be examined, and recommendations made as to which elements are worth further use, or require further research to assess their efficacy.

### **Cost Recovery Information:**

No assessment of the risk posed by commercial fisheries to Yellow-eyed Penguin populations has been undertaken, as data are not accessible or compiled in an appropriate format for such work. The percentage allocation for this project will be attributed to the following Fishstocks according to rule 7 (1) (b) schedule 3 of the Fisheries (Cost Recovery) Rules 2001:

- BNS 3, BNS 7, BCO 3, BCO 5, BCO 7, MOK 1, MOK 3, MOK 5, BUT 3, BUT 5, BUT 7, ELE 3-7, FLA 3-7, GMU 3-7, HPB 3, HPB 5, HPB 7, JDO 3-7, RCO 3-7, GUR 3-7, SPO 3-7, RBY 3, RBY 5, RBY 7, SCH 3, SCH 5-7, SPE 3, SPE 5-7, SPD 3, SPD 5-7, STA 3, STA 5-7, TAR 3, TAR 5-7, TRU 3 and TRU 5-7.

The project is estimated to cost between \$30,000 – 50,000.

**Project:** Feeding relationships in New Zealand protected species higher predators

**Project Code:** ENV2005/14

**Start Date:** 1 October 2005

**Completion Date:** 30 September 2006

**Vessel Use:** None

**Overall Objectives:**

1. To examine the diet and feeding relationships in selected seabird and marine mammal species in selected New Zealand marine ecosystems, and in relation to fisheries discards and offal.

**Specific Objectives:**

1. To examine the species composition, main prey species size-composition, and total energy uptake in the diet of selected seabird and marine mammals and to examine dietary overlap of selected higher predators, with that of other consumers and with fisheries discards and offal in the Chatham Rise marine ecosystem.
2. To estimate the numbers and possible energy acquisition rates of selected seabird and marine mammal species in the Chatham Rise marine ecosystem.

**Rationale:**

*General*

Understanding the role of top predators use of resources in the marine ecosystem is vital for describing it's functioning and predicting responses to regional scale changes, such as climatic variability and fishing effects. This research links to ecosystem-scale programmes planned and managed under the BIO-INFO programme of the Ministry of Fisheries. The work takes up research opportunities available through projects ENV2005/09 and Department of Conservation research programmes on seabird populations. A comparative feeding ecology approach, involving several species and with knowledge of the range of inputs and variability within the system, is necessary to explore the effects of fishing on higher predator diet, as well as the contribution of these species to energy flow in key marine systems exploited by fishing in New Zealand.

The species concerned in this project are protected. Species caught in New Zealand fisheries have threat classification listings of Nationally Critical to Threatened (Molloy et al. 2002), while the ecosystems researched are key for productivity in New Zealand fishing.

The draft Strategy for Managing the Environmental Effects of Fishing indicates that a greater integration of trophic information and understanding of linkages between different trophic levels in the New Zealand marine ecosystem is required for management of the effects of

fishing on marine systems. This project provides some basic building-blocks to understanding the role of higher predators in key New Zealand marine systems. Understanding the trophic interactions of higher predators in key marine ecosystems is vital to managing the effects of fishing and predicting outcomes of changes that are occurring on medium-term time scales.

This research is high priority:

- The fisheries concerned are of both high tonnage and high value;
- Higher predators are key factors in the functioning in marine systems;

If this project is not undertaken in the next 1-3 years, linkages with larger programmes to research trophic interactions in selected marine systems in New Zealand will be lost, diminishing considerably the value the research can play in describing the functioning of the marine systems. Further, New Zealand has obligations under international agreements, such as the CCSBT, to examine trophic relationships between protected species top predators and high value pelagic fish stocks. Within this context, this research project is considered a high priority.

#### *Objective 1*

Diet will be sampled from live seabird and marine mammals where other research programmes allow (ENV2005/08 and Department of Conservation research programmes on seabird and marine mammal populations). Additionally, stomach contents of animals incidentally caught in New Zealand fisheries will be analysed to indicate what foods, if any, these animals are accessing (available from ENV2005/04 and Department of Conservation research programmes). Differences between bycaught and field-sampled individuals of the same species will be examined, and conclusions drawn with sampling differences in mind.

Diet composition will be examined to determine the main prey species, and size class of identifiable individual prey items. Energy content of the diet and dietary overlap will be described through comparison with studies reported in the literature. The use of discards and offal will be examined. Use of molecular techniques to identify prey species shall be considered where other methods are not practicable. The research provider will consult with MFish on the choice of techniques to employ at the establishment, and during the course of the project.

#### *Objective 2*

Using the literature, the study will describe the numbers and biomass of key higher predators (marine mammals and seabirds) with a focus on species frequenting the Chatham Rise area significantly during their annual cycle of activity, to provide inputs into research on ecosystem functioning conducted under the BIOINFO programme of the Ministry of Fisheries. This literature-based study will further draw on the results of previous published and unpublished research into dietary preferences and trophic interactions for key higher predators, to estimate energy flux and prey communities accessed by marine mammals and seabirds operating in selected marine systems in New Zealand.

**Cost Recovery Information:**

The project is 100% Crown funded.

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

**Project:** Information for managing the Effects of Fishing on Underwater Topographical Features<sup>①</sup>

**Project Code:** ENV2005/15

**Start Date:** 01 July 2005

**Completion Date:** 20 February 2006

**Vessel Use:** None

### **Overall Objectives:**

1. To provide an analytical tool to assist Mfish in assessing, researching and managing and the risks that underwater topographical features (UTF) face from bottom trawling effort.

### **Specific Objectives:**

1. To develop an analytical atlas/database that identifies all known UTF in the NZ region, encompassing the area from 24°00' – 60°00'S, 155°00'E – 165°00'W. The atlas/database will catalogue, for each feature, all information (e.g. physical, biological, location, fishing effort) that is required by Mfish from which options for managing the impacts of bottom trawling on the benthic environments of UTF of the EEZ can be developed.
2. To develop a preliminary risk assessment model from data stored in the atlas/database to predict the effects of bottom trawling on the benthic environments of UTF of the EEZ, and provide options for the management of these ecosystems.

### **Rationale**

Deepwater trawling of UTF is known to impact the benthic fauna through damage as a result of contact with fishing gear and removal as bycatch. Understanding the impacts of trawl fishing on UTF and what constitutes an adverse effect has become a priority for the Ministry of Fisheries. To this end, fisheries managers need a transparent and objective means with which to be able to manage the impacts of trawling on these features.

The topography of UTF influences the composition, abundance and distribution of the biological communities resident in and around these features, and, also if the feature can be trawled and how much of the feature can be trawled. Some UTF fished by deepwater trawl fisheries are generally conical in shape and small in size and many can be trawled in any direction resulting in a highly concentrated trawling effort. It is likely that very little area of these features is unaffected by trawling effort. In contrast however the topography of other deep-sea features restricts trawl lines to prominent uni-directional patterns. The area of these features that is impacted by trawling is therefore much reduced relative to the total area of the specific feature.

---

<sup>①</sup> For the purposes of this document 'underwater topographical features (UTF)' refers to all geographic/topographical features that rise 100m or more above the surrounding sea floor in any depth of water, whether they are stand-alone features or part of a range.

In addition, UTF may be habitats of significance for fisheries management purposes. The relationship between UTF and the aggregation of fishstocks found in their proximity is currently unknown. Given that UTF are fished due to the presence of a significant biomass of fish, it may be that unfished features are either not associated with a commercially viable fishery because they are unproductive, or fishers have not attempted fishing them to date.

## **Management Objectives**

To develop practical management options to avoid, remedy or mitigate the effects of fishing on UTF of the EEZ.

Ideally the most effective way to manage the impacts of trawling on UTF would entail surveying the biological and physical attributes of every feature of the NZ region. This level of knowledge would allow a robust risk assessment to be made regarding the immediate and long-term consequences that bottom trawling effort could have on the sustainability of the biological communities of these UTF, in both individual and overall terms. However, conducting this level of research is not economically feasible, and therefore it is essential to utilize all currently available data in an effective and efficient manner. A practical option therefore is to use all currently available data to develop a risk assessment model to be used as a tool for assessing and managing the impacts of bottom trawling on UTF of the EEZ.

Biodiversity, oceanographic, bathymetric, physical and fishing effort data has been collected on a number of UTF of the EEZ. From this data a preliminary risk assessment model can be developed and a number of benthic ecosystem management issues can be addressed, for example:

- What area of fished UTF is actually impacted by bottom trawling?
- How many UTF of the EEZ are actually fished?
- What is the actual zone of influence of the impacts of bottom trawling on specific features?
- At what point are the impacts of bottom trawling “adverse” to the benthic environment of UTF?
- How vulnerable are the benthic environments of specific UTF to bottom trawling impacts? What temporal levels of regeneration are expected?
- Which commercial species results in the largest area of impact on the benthic environments of UTF?
- What level of spatial monitoring is required to allow informed management decisions to be made?
- What level of spatial protection is required to maintain the biological diversity of the benthic ecosystems of UTF of the EEZ.

## **Objective 1**

In the past seven years various research surveys have been conducted to study UTF present in the NZ region along with their associated oceanographic, biological and physical attributes. The atlas/database development will provide:

- An analytical tool to assist in developing management options to avoid remedy or mitigate the effects of fishing on the benthic ecosystems of UTF of the EEZ.
- MFish management with the relevant information from which to determine the extent of our knowledge about fishing effort on the UTF.

- MFish management with the relevant information from which to identify gaps in the knowledge required to adequately manage the impacts of fishing on UTF of the EEZ.
- Management a more objective view as to the actual fishing history or lack of fishing potential of these deep-sea features.
- Data from which a risk assessment model can be developed/

Data fields included in the atlas/database will be: geographical location, oceanographic data, peak depth (m), elevation (m), area (km<sup>2</sup>), substrate type, bottom topography, dominant benthic fauna, Ichthyofauna, years fished, species fished, catch by year and by species, number of trawls by year and by species, direction of trawls, area of topography impacted by trawl gear per trawl and per topographical feature etc.

The format of the atlas will probably be in the form of two Geographic Information System (GIS) layers. The first information “layer” will consist of a number of polygons determining the spatial extent of each identified topographical feature in the study area. The second layer will consist of points identifying the location of UTF in the study area. The study area is determined to be the area from 24°00' - 60°00'S, 155°00'E - 165°00'W. Each polygon or point on the respective layer will be accompanied by attribute data (data about the object).

Final specifications for development and population of the atlas/database will be determined in discussion with MFish Data Management, MFish Science Group and the research provider.

## **Objective 2**

The purpose of this objective is to develop a preliminary risk assessment model that will allow MFish management to assess the potential vulnerability of benthic environments of UTF to bottom trawling and to assess the immediate and long-term risks posed to these ecosystems from bottom trawling activities. To develop this model will require collection, input and analysis of extensive data sets to determine likelihood and consequence matrices etc. The data needed will be drawn from the atlas/database developed objective 1 and from the ‘fishing effects monitoring’ programme proposed in ENV2005/16 and will include:

- Biodiversity data;
- Oceanographic data;
- Fishing intensity data; and
  - o Number of trawls per area
- Number of trawls over time
- Direction of trawls
- Regeneration of habitat and ecosystem data (includes commercial stocks and bycatch species).

This project also links to the *Biodiversity Strategy*. The project is consistent with research undertaken through the *Biodiversity Strategy*

## **Priority**

This project is considered a high priority because New Zealand has obligations under international agreements and domestic legislation to avoid, remedy or mitigate the adverse effects of fishing on the aquatic environment. This project forms a key step in enabling appropriate management responses to any adverse environmental effects of bottom trawling to be identified. Further, the fisheries concerned are of high value and of high tonnage.

## **Cost Recovery Information:**

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 7 (1) (c) schedule 4 of the Fisheries (Cost Recovery) Rules 2001:

- All ORH, BYX, OEO and CDL.

This project is estimated to cost approximately \$100,000.

<b>Project:</b>	Investigate the Effects of Fishing on Underwater Topographic Features <sup>①</sup>
<b>Project Code:</b>	ENV2005/16
<b>Start Date:</b>	1 July 2005
<b>Completion Date:</b>	30 June 2008
<b>Vessel Use:</b>	Subject to Tender

**Overall Objectives:**

1. To improve our understanding of the effects of trawl fishing on underwater topographic features (UTF) and to improve our understanding of what constitutes an adverse effect.

**Specific Objectives:**

1. To monitor changes in fauna and habitats over time on selected UTF in the Chatham Rise area that have a range of fishing histories.
2. To continue development of the risk assessment model to predict the effects of fishing, and provide options for the management of ecosystems of the UTF.

**Rationale:**

Deepwater trawling on UTF is known to effect benthic fauna through damage as a result of contact with fishing gear and removal as bycatch. Understanding the effects of trawl fishing on UTF and what constitutes an adverse effect has become a priority for the Ministry of Fisheries.

The topography of UTF influences the composition, abundance and distribution of the biological communities resident in and around these features, and, also if the feature can be trawled and how much of the feature can be trawled. Some UTF fished by deepwater trawl fisheries are generally conical in shape and small in size and many can be trawled in any direction resulting in a highly concentrated trawling effort. It is likely that very little area of these features is unaffected by trawling effort. In contrast however the topography of other deep-sea features restricts trawl lines to prominent uni-directional patterns. The area of these features that is impacted by trawling is therefore much reduced relative to the total area of the specific feature.

In addition, UTF may be habitats of significance for fisheries management purposes. The relationship between UTF and the aggregation of fishstocks found in their proximity is currently unknown. Given that UTF are fished due to the presence of a significant biomass of fish, it may be that unfished features are either not associated with a commercially viable fishery because they are unproductive, or fishers have not attempted fishing them to date.

---

<sup>①</sup> For the purposes of this document 'underwater topographical features (UTF)' refers to all geographic/topographical features that rise 100m or more above the surrounding sea floor in any depth of water, whether they are stand-alone features or part of a range.

## Management Objectives

The Ministry of Fisheries is establishing a research programme to support its management needs, it includes:

- ENV2005/15 - Developing an Atlas/database that will describe the known physical and biological attributes, and fishing history associated with each known UTF, and, allow production of maps of these features within the NZ EEZ. Information will be derived from all possible data sources (e.g. bathymetry, broad scale satellite data on current patterns, water temperature etc); and
- ENV2005/15 – Develop a preliminary risk assessment model and effective and efficient plans to manage the effects of fishing on UTF.
- ENV2005/16 – Achieve a better understanding of the actual impact (physical, biological, immediate, long-term) fishing effort has on the sustainability of the biodiversity on UTF.
- ENV2005/16 – Provide additional data to the atlas/database and risk assessment model developed in ENV2005/15 with the intent of increasing the extent of knowledge on which fisheries management decisions can be based and increasing the power of the risk assessment model.

The MFish programme has been designed to integrate strongly with research being undertaken by other agencies, including:

- NIWA's FoRST funded research programme entitled *Seamounts: Their Importance to Fisheries and Marine Ecosystems* which, to date has focused on providing fundamental information on the habitats and species found on UTF.
- MFish's Biodiversity funded work that has provided additional funding for the surveys conducted by NIWA under their FoRST funded research programme outlined above. (i.e. cataloguing the composition, distribution and abundance of fauna). To-date, this programme has supported surveys on the Northland Plateau (ZBD2001/10), northwest Chatham Rise and the southern Kermadec volcanic arc (ZBD2000/04), and the Norfolk Ridge and Lord Howe Rise (ZBD2002/16). The detailed information obtained from these surveys and those to be undertaken in the future is critical to the success of the similarity analysis.

### Objective 1

Project ENV2005/16 will undertake surveys on selected UTF with a range of fishing histories, and will monitor the temporal sustainable vulnerability of these ecosystems (especially benthic ecosystems) being impacted by bottom trawling. The Chatham Rise has been chosen as the study area because the region has a number of similar topographical features with a range of fishing histories: from heavily fished to lightly and never fished features. Several UTF that have been closed to fishing are also located in this area. Furthermore, baseline data on the composition, distribution and abundance of macro-invertebrate fauna, and ichthyofauna have already been collected from several of the features of this area.

This project will add to the work started in project ENV2005/15. The more information available on the effects of fishing on UTF the more effective and efficient management decisions can be made.

The nature and extent of the work will be determined in conjunction with the Aquatic Environment Working Group. It is envisaged that monitoring will be undertaken every 3-5 years (or longer) once the baseline work has been completed.

## **Objective 2**

The purpose of this objective is to continue development of the risk assessment model that will allow MFish management to assess risks posed to the benthic ecosystems of UTF from bottom trawling activities. To develop this model will require collection, input and analysis of extensive data sets to determine likelihood and consequence matrices etc. The data needed will be drawn from the atlas/database developed in ENV2005/15 and from the 'fishing effects monitoring' programme proposed in this project and will include:

- Biodiversity data;
- Oceanographic data;
- Fishing intensity data; and
  - o Number of trawls per area
  - o Number of trawls over time
  - o Direction of trawls
- Regeneration of habitat and ecosystem data (includes commercial stocks and bycatch species).

This project also links to the *Biodiversity Strategy*. The project is consistent with research undertaken through the *Biodiversity Strategy*

## **Priority**

This project is considered a high priority because New Zealand has obligations under international agreements and domestic legislation to avoid, remedy or mitigate the adverse effects of fishing on the aquatic environment. This project forms a key step in enabling appropriate management responses to any adverse environmental effects of bottom trawling to be identified. Further, the fisheries concerned are of high value and of high tonnage.

## **Cost Recovery Information:**

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 7 (1) (c) schedule 4 of the Fisheries (Cost Recovery) Rules 2001:

- All BYX, CDL, OEO and ORH.

This project is estimated to cost approximately \$750,000.

**Project:** Estimation of non-target fish catch and both target and non-target fish discards for jack mackerel trawl fisheries

**Project Code:** ENV2005/17

**Start Date:** 1 July 2005

**Completion Date:** 30 June 2006

**Vessel Use:** None

**Overall Objectives:**

1. To estimate the level of non-target fish catch and discards of target and non-target fish species in selected New Zealand fisheries.

**Specific Objectives:**

1. To estimate the quantity of non-target fish species caught, and the target and non-target fish species discarded, in the trawl fisheries for jack mackerel for the fishing years 2001/02, 2002/03 and 2003/04 using data from Scientific Observers and commercial fishing returns.

**Rationale:**

*General*

The Ministry of Fisheries has the responsibility to determine the impacts of fishing on associated or dependent species, the aquatic environment, and, accordingly to estimate the levels of fishing induced mortality, including discards. This includes both target and non-target fish species. These responsibilities require that estimates of the catch and catch rates of non-target fish and, estimates of the quantity of target and non-target fish discarded are made as these catches include associated and dependent species. The current programme is part of a periodic review of discard and non-target fish catch, with the last review having been undertaken covering data up to 2000/2001.

Fishing activities normally target a limited number of commercial species. However, during the capture of the target species, other fish species are also taken and processed as bycatch products. Unwanted fish whether target or non-target is often discarded.

Discards take the form of either target and non-target fish that are damaged, of an unmarketable size, or for other reasons have no commercial value.

Scientific observer data provide the only independent source of information on catch in the fishery. Due to the nature of reporting requirements, fishers only report the top five species captured on a tow by tow basis in offshore fisheries. Accordingly, observer data that provide tow by tow breakdowns of all species caught provide valuable information on the true quantity and nature of the commercial catch. Research in New Zealand in recent years has shown much lower levels of discards in most fisheries assessed than that reported from other

fisheries internationally (up to 33 % of the total catch). However, there is a need to constantly update estimates of the catch and catch rates of non-target fish and estimates of the quantity of target and non-target fish discarded to monitor any change in catch rates due to changing fleet dynamics, as well as monitoring any trends in catch rates.

Successful stock assessment and fisheries management requires good data on the true catch and mortality of fish species. Estimates are needed of the total catch, and not just that which is landed or reported. Therefore, information on non-target fish catch and fish discarded is important. This applies to both target species, and non-target species, whether the latter comprise other commercial species or non-commercial species. Such data also contribute to an improved understanding of fish communities, and the possible impact of fishing on the long-term sustainability of fisheries.

The research is considered a high priority because the fish stocks concerned are of both high value and high tonnage, and information from this project is required to allow effective management of the effects of fishing on associated and dependent species by quantifying the levels of take of these species in the jack mackerel fishery.

This research programme is therefore considered a high priority.

### *Objective 1*

During 1998/99 and 2001/02, research was undertaken to estimate the level of target and non-target fish species discarded in the New Zealand jack mackerel and arrow squid trawl fisheries between 1990/91 and 1997/98 (projects ENV98/04, ENV2001/04).

Just over 31% of total catches in the jack mackerel fishery are of non-target species. Of this non-target catch, 13.5% is discarded (approximately 82% non-ITQ, 18% ITQ). Blue mackerel (EMA), SPD, and RBT were the major non-QMS species caught in this fishery. In total, more than 32 non-ITQ species are caught in this fishery as non-target catch, including several species that are large with low productivity and thus potentially vulnerable to over exploitation.

This will be a desktop exercise, utilising data already available in MFish databases. The Scientific Observer Programme coverage on commercial vessels has routinely recorded information on bycatch and discards, and this database will be extensively used for this project. Commercial fishing returns also provide some information, and more detailed data on species composition is available from research trawl surveys carried out in a number of fisheries in recent years. These sources would need to be examined to determine which fisheries or areas had sufficient or appropriate data for estimating the level of discards. This might vary between fisheries.

Quantitative estimates of the catch of non-target fish species can be used to assess the potential impact of fishing on associated or dependent fish species. Estimates of the discards of target and non-target fish species can be used to assess the level of fishing induced mortality. Results can be incorporated into the stock assessments of target and non-target species to estimate the level of total removals from the stock.

Results will also indicate areas where the relative level of non-target fish catch or non-target/target discards is high, warranting further consideration and leading to improved management of the fishery.

**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:

- JMA 3 and JMA 7.

This project is estimated to cost between \$30,000- \$50,000.

**Project:** Estimation of non-target fish catch and both target and non-target fish discards in orange roughy trawl fisheries

**Project Code:** ENV2005/18

**Start Date:** 1 October 2005

**Completion Date:** 30 September 2006

**Vessel Use:** None

**Overall Objectives:**

1. To estimate the level of non-target fish catch and discards of target and non-target fish species in selected New Zealand fisheries.

**Specific Objectives:**

1. To estimate the quantity of non-target fish species caught, and the target and non-target fish species discarded, in the trawl fisheries for orange roughy for the fishing years 1999/2000 to 2003/04 using data from Scientific Observers and commercial fishing returns.

**Rationale:**

*General*

The Ministry of Fisheries has the responsibility to determine the impacts of fishing on associated or dependent species, the aquatic environment, and, accordingly to estimate the levels of fishing induced mortality, including discards. This includes both target and non-target fish species. These responsibilities require that estimates of the catch and catch rates of non-target fish and, estimates of the quantity of target and non-target fish discarded are made as these catches include associated and dependent species. These data may also give an indication of any changes in fish diversity as captured in the alfonsino, cardinal fish and oreo trawl fisheries. The research is part of a periodic review of discard and non-target fish take in New Zealand fisheries, with the last review reporting on data up to the 1998/99 fishing year.

Fishing activities normally target a limited number of commercial species. However, during the capture of the target species, other fish species are also taken and processed as bycatch products. Unwanted fish whether target or non-target is often discarded. Discards take the form of either target and non-target fish that are damaged, of an unmarketable size, or for other reasons have no commercial value.

Scientific observer data provide the only independent source of information on catch in the fishery. Due to the nature of reporting requirements, fishers only report the top five species captured on a tow by tow basis in offshore fisheries. Accordingly, observer data that provide tow by tow breakdowns of all species caught provide valuable information on the true quantity and nature of the commercial catch. Research in New Zealand in recent years has

shown much lower levels of discards in most fisheries assessed than that reported from other fisheries internationally. However, there is a need to constantly update estimates of the catch and catch rates of non-target fish and estimates of the quantity of target and non-target fish discarded to monitor any change in catch rates due to changing fleet dynamics, as well as monitoring any trends in catch rates.

As fisheries stock assessments become more sophisticated, especially high value fisheries such as orange roughy, there is an increasing demand for better input data, including catch and overruns, and for consideration of the ecosystem effects. Knowledge of the amount and distribution of bycatch and discards of orange roughy and associated fish species is important to inform management to ensure that associated or dependent species are maintained at levels that ensures their long term viability.

The research is considered a high priority because the fish stocks concerned are of both high value and high tonnage, and information from this project is required to allow effective management of the effects of fishing on associated and dependent species by quantifying the levels of take of these species in the orange roughy fishery.

This research programme is therefore considered a high priority

### *Objective 1*

The orange roughy fishery is one of New Zealand's largest and most valuable trawl fisheries and has the potential to catch large amounts of wanted and unwanted bycatch. Previous research has shown that this fishery, at least up until 1998–99, has been a very “clean” fishery by international standards, with only about 0.06 kg of discards per kilogram of orange roughy caught (for a total of 1000–3000 t of fish species discarded annually). The most recent study of bycatch and discards in this fishery included fishing years from 1990–91 to 1998–99 under project ENV1999/02. This project would examine a further five years up to 2003–04.

This will be a desktop exercise, utilising data already available in MFish databases. The Scientific Observer Programme coverage on commercial vessels has routinely recorded information on bycatch and discards, and this database will be extensively used for this project. Commercial fishing returns also provide some information, and more detailed data on species composition is available from research trawl surveys carried out in a number of fisheries in recent years. These sources would need to be examined to determine which fisheries or areas had sufficient or appropriate data for estimating the level of discards. This might vary between fisheries.

Quantitative estimates of the catch of non-target fish species can be used to assess the potential impact of fishing on associated or dependent fish species. Estimates of the discards of target and non-target fish species can be used to assess the level of fishing induced mortality. Results can be incorporated into the stock assessments of target and non-target species to estimate the level of total removals from the stock.

Results will also indicate areas where the relative level of non-target fish catch or non-target/target discards is high, warranting further consideration and leading to improved management of the fishery.

### **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.

This project is estimated to cost between \$30,000- \$50,000.

**Project:** Benthic invertebrate sampling and species identification in trawl fisheries

**Project Code:** ENV2005/20

**Start Date:** 1 July 2005

**Completion Date:** 30 June 2006

**Vessel Use:** None

**Overall Objectives:**

1. To quantify and map the benthic invertebrate species incidental catch in commercial and research trawling throughout the New Zealand EEZ.

**Specific Objectives:**

1. To produce identification guides for benthic invertebrate species encountered in the catches of commercial and research trawlers.
2. To test the accuracy of at-sea identifications using the benthic invertebrate species guide.

**Note:**

This project will develop and update a guide currently being produced under project ENV2002/04. The scope of that pre-existing project includes the preparation of identification sheets for 100 species and a further 10 higher taxa. At that project's inception the guide was proposed to be a "living" document that will develop and expand over time to include additional species commonly encountered in catches from both inshore and deepwater fisheries. The current project will expand the identification guide by an additional 100 species from various groups. In addition, an experiment will be carried out to "ground truth" the guide and assess the accuracy of at-sea identification. This project has strong links to *Biodiversity Strategy* research, and will enable the collection of information to monitor removals of non-target benthic organisms. Co-ordination within the Ministry of Fisheries will serve to prevent duplication of effort between biodiversity research and aquatic environment research, and to ensure that the value of the research is maximised.

The project will be carried out subject to review of the results of project ENV2002/04 which is due for completion during 2004.

**Rationale:**

*General*

Consistent with the requirements of section 8 of the Fisheries Act, there has been a move in recent years to examine trends in the abundance of "associated or dependent species", i.e. non-target fish and invertebrate species associated with, or impacted by, commercial fishing.

The level of identification of non-target fish catch has improved over time, and is now excellent on research vessels and reasonably adequate on commercial vessels. However, despite recent improvements on research vessels, the level of identification of benthic invertebrate bycatch species in commercial trawl fisheries remains low. Analyses of benthic invertebrate incidental catch data have been shown to be useful for the determination of species distributions and of possible changes in biodiversity in areas where benthic communities are affected by trawl fisheries. In order for this kind of analysis to proceed, the identification of benthic invertebrate species must improve. Impeded species identification also hinders the development of accurate ecological risk assessments of fisheries impacts on the relevant bycatch species or on related ecological processes.

In the past it has been common practice (funded by MFish) on inshore and deepwater trawl surveys to collect samples of benthic invertebrates from incidental catches and return them to shore (i.e. freezer storage at NIWA) for subsequent identification. However collecting and preserving large volumes of material for identification ashore is not feasible, especially at the scale of entire fisheries. Accordingly, most invertebrates are identified and discarded at sea, with priority given to retention of previously unidentified material. Preparation of an identification manual for benthic invertebrates from all depths is currently in progress under the Ministry of Fisheries project ENV2004/02. This manual is intended to increase the capabilities of seagoing researchers and Ministry of Fisheries observers, and therefore increase the reliability with which most organisms are identified at sea. As noted in the project guidelines, a comprehensive guide could not be completed in a single year. Instead the project proposed that additional taxa would be added to the existing manual over the course of several years. A selection of 100 abundant species and 10 higher taxonomic groups was made for project ENV2004/02.

An illustrated guide is currently in preparation, comprising a glossary describing the main taxonomic groups, general keys for selected higher groups such as corals, and identification sheets for the 100 selected species. A Research Progress Report on the Benthic Invertebrate Guide has been prepared (Tracey et al. 2004)<sup>1</sup> and a presentation was made to the Aquatic Environment Working Group in August 2004. Completion of this first version of the identification guide is expected by 30 November 2004. The next steps in preparing the identification manual are to expand the guide by a further 100 species and to improve images used in the identification sheets already in preparation.

After the guide has been developed and is in active use, advice from other programmes (e.g. the Ministry of Fisheries Biodiversity programme) can be used to update the guide as appropriate. Future research will quantify and map the incidental catches of benthic invertebrate species in commercial and research trawling throughout the New Zealand EEZ. This information will help researchers to determine the nature and extent of the effects of trawl fisheries on associated and dependent benthic invertebrate species.

This research project is rated high priority because our present lack of capacity to reliably identify benthic invertebrate bycatch species seriously undermines our ability to carry out further research. In the absence of an effective identification guide it is impossible to determine the impacts of trawl fisheries on associated and dependent invertebrate species, or to assess the sustainability of fishing practices with respect to the benthic environment. It is necessary to provide a continuing development of the existing research programme, to ensure that use of the

---

<sup>1</sup> Tracey, D.M., Clark, M. R., Oliver, M., Anderson, O. F. 2004: Benthic invertebrate sampling and species identification in trawl fisheries. *Progress Report Ministry of Fisheries Research Project ENV200204, Objective 1*. 10 p

competencies and experience derived during the development of the initial programme is maximized. Delaying the commencement of this programme would engender a risk of a loss of expertise to continue the research in the most efficient manner. For this reason, the research is a high priority.

### *Objective 1*

Under this objective the project will produce at-sea identification guides for benthic invertebrate species, using desk-top analysis and shore-based research and also at-sea research. Project ENV2004/02, already in progress, has identified a priority list of species likely to be encountered as incidental catch in research and commercial trawl fishing. Further research is required to expand the taxonomic coverage of the existing guide and to produce simple and clearly-illustrated guide sheets for use by non-expert staff at sea.

The 100 species and 10 higher taxa included in the initial version of the guide (produced under project ENV2002/04) were chosen such that the most commonly encountered fauna (irrespective of taxa) would be included in the first year, the next most common in the following year, and so on. This approach ensures that common bycatch species can be accurately identified and recorded as early as possible, rather than some common species being included only in a later version of the guide. Species included in the first year of the project and in the proposed updated version include invertebrates recently introduced to the QMS and species identified for introduction to the QMS in the near future.

The guide is a “living” document that will develop flexibly over time. Images will be improved, species descriptions expanded and species added. The initial version of the guide has focussed on deepwater species, making it more useful for Ministry of Fisheries observers and some major offshore research trawl surveys, and enabling better descriptions of faunal composition in areas least affected by fishing. The guide will extend to inshore species in future years.

Version one of the guide has been prepared in both ‘paper’ and electronic formats. Access to the internet-based guide, and to the database produced as part of this project, will be considered as part of the project costings. Open internet-based access will ensure that research supported by funding from the Ministry of Fisheries is accessible to as wide a user-group as possible.

### *Objective 2*

The purpose of any guide is to ensure that identification is as accurate as possible to enable confidence in describing faunal composition and monitoring changes over time. Most benthic bycatch organisms treated in this project are reasonably large (i.e. caught primarily with nets with a mesh size of 100 mm) and identification is often relatively straightforward. For some benthic invertebrates, accurate identification to species level can be carried out confidently; for others at-sea identification is only possible to genus level.

In order to check the accuracy of at-sea identifications using the guide, and to determine the appropriate level of taxonomic resolution for various taxa, at-sea identification will be verified by comparison with identifications made by taxonomic experts on-shore, consistent with the recommendations of the August 2004 AEWG meeting. The results of this assessment will be used to improve the guide and to ensure that it provides a robust and suitable manual for benthic invertebrate identification at sea.

**Cost Recovery Information:**

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 7 (1) (c) schedule 4 of the Fisheries (Cost Recovery) Rules 2001:

- all fishstocks.

This project is estimated to cost between \$125,000 - \$150,000.

**Project:** Threat status of associated and dependent species

**Project Code:** ENV2005/21

**Start Date:** 1 October 2005

**Completion Date:** 30 September 2006

**Vessel Use:** None

**Overall Objectives:**

1. To review the current threat status of selected associated or dependent species

**Specific Objectives:**

1. To assess the current threat status of selected associated or dependent species in selected fishery areas

**Rationale:**

*General*

Non-target catches are generally either managed fisheries (inside or outside the QMS), or, associated or dependent species. Most of the associated or dependent species that are caught incidentally in fisheries, assessments of threat status have not been undertaken. Exceptions include most protected species, and other species whose threat status has been researched under project ENV2003/05.

Under ENV2003/05 — *To review the current threat status of selected associated or dependent species* — the threat status of a group of commercial target and associated bycatch fish and invertebrate species is currently being assessed. Criteria for assessing the threat status are being examined as part of the project, and include an examination of several alternative threat classification systems for marine species. These criteria have been specifically designed for marine fishes to “identify [distinct population segments] at risk at a sufficiently early stage of decline to avoid listing as threatened or endangered”.

Such threat status information is a level of complexity missing at present in the consideration of the potential environmental effects of changes in TACCs across a range of fisheries, and when assessing the adequacy of Fisheries Plans proposed by stakeholders, or in developing Stock Strategies. Information from this project will be useful to fisheries managers when addressing the effects of fishing on associated or dependent species, and especially when considering alterations in management regimes that may alter the threat status of associated or dependent species.

The research will provide an assessment of the threat status of non-target fish and invertebrate species from selected marine ecosystems, to be determined in consultation with the Ministry of Fisheries. Suggestions include inshore Hauraki Gulf and deepwater species on the Campbell and Bounty Plateau.

This research is considered a medium priority as it is necessary to assist fishery managers in identifying high risk stocks that are associated or dependent on commercial fisheries, and thus take these factors into account in determining harvest strategies while remedying, mitigating or avoiding the adverse effects of fishing.

#### *Objective 1*

A list of species to be assessed will be developed in consultation with Fisheries Managers. Accordingly, the list will include associated or dependent teleosts and marine invertebrates identified in previous research into non-target catches in various New Zealand fisheries (e.g. see NZ FAR 2001/16).

Building on work undertaken in project ENV2003/05, the research will extend the risk classification to further groups, targeting those which are most commonly encountered in non-target species catch. The research will recommend threat classification for a selected group of species.

Validation of the recommended threat classifications will be undertaken by seeking expert opinion on the classifications.

#### **Cost Recovery Information:**

The percentage allocation for this project will be attributed to the following Fishstocks according to rule 7 (1) (c) schedule 4 of the Fisheries (Cost Recovery) Rules 2001:

- all fishstocks.

This project is estimated to cost between \$30,000 - \$50,000.

**Project:** Relative effects of fishing and environmental degradation on northern harbour fisheries

**Project Code:** ENV2005/22

**Start Date:** 1 October 2005

**Completion Date:** 30 September 2007

**Vessel Use:** None

**Overall Objectives:**

1. To assess the relative impacts of fishing and environmental degradation on northern harbour (finfish) fisheries.

**Specific Objectives:**

1. To collate available information on fisheries catch and effort across all sectors, harbour usage by fishers, and environmental change in large northern New Zealand harbours.
2. To design a detailed monitoring scheme of fisheries catch and effort from these large harbours, in order to track changes in CPUE and distribution of fishing effort through time, relative to environmental changes at these sites.

**Rationale:**

*General*

Northern New Zealand has several large harbours that support regionally important finfish fisheries and have been shown to be important nursery areas for fish. Examples are the Kaipara and Manukau Harbours on the west coast, and Whangarei, Waitemata, and Tauranga Harbours on the east coast. Unfortunately, these harbours are coming under increasing pressure directly from human activities and indirectly as a result of land based anthropogenic changes to the environment. While there is widespread concern that the abundance of some harvested fish species has declined, at present it is unclear to what extent observed declines have been caused by fishing, by large-scale habitat and/or environmental degradation, by natural environmental variability, or by a combination of fishing and environmental factors.

Local communities may rely heavily on harbours for food, and reductions in sought-after fish species will have negative impacts on such activities. Recreational fishing is also a major pastime for many New Zealanders, and estuarine waters receive particularly heavy usage due to their sheltered nature and easy access.

Commercial fisheries for flatfish and mullets are common in harbours, and there are lesser fisheries for snapper, trevally and school shark. Juveniles of many fish species use harbours as “nursery areas”, especially on the west coast where juvenile snapper, trevally and kahawai

are scarce on the open coast. Estuaries and harbours may fill a crucial functional role in the recruitment of fished stocks.

Many habitats in large harbours are likely to have been substantially modified in recent times. The watersheds that drain into them have been heavily modified, and substantial human settlement has occurred around them. Deforestation and urbanisation has significant effects on water quality and run-off regimes. Probably the greatest impact on them has been an increase in the rate of sedimentation from changed catchment use (forest clearance, farming, and urbanisation). Other impacts may come from industrial waste, fertilizers, reclamation, sewage, and storm-water (especially from roads).

The proposed research programme will provide an experimental design aimed at examining the relative impacts of fishing and of environmental/habitat degradation on the distribution and abundance of fish in large harbours. Work is already underway (funded by FRST) to examine the role of estuaries as nursery areas for estuarine and coastal fish species. The research proposed here will build upon and complement that research. The proposed project will design a study to address the potential impacts of fishing and environmental degradation on the adult component of estuarine fish stocks, by seeking to understand how these adult fish utilise harbour habitats both spatially and temporally.

One likely methodological approach to this research will be to assess current and historical patterns of fish abundance as a function of variation along key environmental gradients (such as depth, turbidity, current, bottom type, freshwater input, and distance from harbour mouth) in these large harbours. Quantified relationships between environmental variables and the composition of fish assemblages will be used to examine to what extent fish assemblages are determined by site-specific environmental factors, and to determine which environmental variables exert the greatest influence on fish abundance and assemblage structure. Where strong relationships are evident, they will be used to predict the identity and distributions of fish in northern harbour environments, and to predict the likely impacts on fish assemblages of (past and future) large-scale environmental changes (e.g. sedimentation).

Within the context of this framework for understanding the 'natural' (i.e. environmental) drivers of fish distribution and abundance, researchers can then examine areas within northern harbours in which fish abundances are thought to have declined and assess the extent to which fishing and/or environmental drivers may be responsible for observed fish assemblages and for apparent past abundance trajectories. By disentangling the effects of fishing vs. environmental change on fish assemblages, scientists can begin to understand the actual mechanisms responsible for observed changes in fish abundance, and to identify effective indicators of fish assemblage dynamism. This type of research may ultimately lead to the development of predictive understanding of fish assemblage dynamics under various management regimes comprising particular combinations of fishing and terrestrial/environmental impacts. This kind of predictive understanding is crucial for proper management of northern harbour environments, which are important at a national level as fisheries, but also have high recreation and customary significance.

This research project is rated medium priority because of concerns about the sustainability of current fisheries impacts in northern harbours, because information critical for the effective management of these harbours (i.e. the relative impacts of fishery vs. environmental impacts on fish stocks) remains largely unknown, and because northern harbours support both commercial and recreational fisheries of considerable value. It would be desirable for the research to be

undertaken within the next 2 years to make most effective use of FRST funded research opportunities.

### *Objective 1*

Most northern harbours have had a long history of fishing and of other terrestrial-derived environmental impacts associated with increasing population pressures and changing land use. It is likely that considerable data already exist that may reveal possible relationships between fishing effort, other environmental changes, and changing patterns of fish abundance. Information on current fish distributions, whether from commercial catch statistics, recreational fishing surveys or other scientific surveys, may reveal environmental/habitat affinities of different fish assemblages when compared with current data describing variation in environmental conditions in northern harbour environments. Data revealing changes in fish catch and effort over time may suggest environmental drivers of fish distribution or abundance when analysed relative to the timing of episodic environmental perturbations, such as sedimentation events. Researchers will explore all available data for evidence of relationships between fishing effort, environmental variation, and the structure and abundance of fish assemblages. Future research may involve targeted surveys to test these relationships and to reveal the ecological mechanisms responsible for them.

### *Objective 2*

Detailed understanding of the causal mechanisms responsible for changing fish abundance and identity will likely require detailed analyses of changing catch and effort at finer spatial and temporal scales than is commonly available. Researchers will design a research programme designed to monitor catch and effort by both commercial and recreational fisheries for a range of finfish species at scales sufficiently small to permit detailed assessment of changing spatial and temporal catch and effort dynamics. The monitoring programme will be designed to run over several years, as it is hoped that future changes in finfish abundance or type can be interpreted with sufficient resolution to reveal potential causal mechanism for observed changes.

### **Cost Recovery Information:**

This project is 100% Crown funded.

This project is estimated to cost between \$30,000 - \$50,000.

**Project:** Monitoring recovery of the benthic community between North Cape and Cape Reinga

**Project Code:** ENV2005/23

**Start Date:** 1 October 2005

**Completion Date:** 30 September 2007

**Vessel Use:** According to tender

**Overall Objectives:**

1. To design a monitoring programme that will allow a quantitative examination of the recovery of the benthic community from the effects of fishing between North Cape and Cape Reinga.

**Specific Objectives:**

1. To design a monitoring programme that will provide the following quantitative estimates:
  - i) estimates of the nature and extent of past fishing impacts on the benthic community between North Cape and Cape Reinga;
  - ii) estimates of change over time in areas previously fished but subsequently closed to fishing. Estimated parameters will include indices representing biodiversity, community composition, and biogenic structure;
  - iii) Estimates of change over time in areas environmentally comparable to those assessed in (ii), above, but subject to ongoing fishing impacts; and
  - iv) Estimates of change over time in areas comparable to those above, but not impacted by fishing (if any such areas can be found).

**Rationale:**

*General*

The Ministry of Fisheries has responsibility to determine the nature and extent of the effects of fishing on the aquatic environment, including on associated or dependent species and on biodiversity. A survey of marine invertebrate fauna was carried out in this location in January 1999, and highlighted the unique and highly diverse fauna of colonial and non-colonial invertebrates present (Cryer et al. 2000). The research also indicated that rapid changes in species composition and community structure had occurred, most likely a consequence of dredging for scallops. This existing survey provides baseline data, with acoustic, photographic and dredge sampling at a range of sites within the region. On the basis of the preliminary findings of this research, an area closure for mobile bottom fishing methods was implemented to prevent ongoing effects of fishing on the important local benthic

communities. An ongoing sampling and experimental design is required to provide some indication as to the nature and extent of the impacts of scallop dredging in the past, and to monitor the recovery of areas that were previously dredged but subsequently closed to fishing.

This project will design an appropriate sampling programme that will provide the data necessary to address the following issues. The proposed design will need to provide some means of assessing the cumulative impacts of past scallop dredging on the benthic fauna of the area. Ideally this will involve direct comparison between historically fished areas with un-fished refugia on similar substrates. Because the area now protected from fishing had been uniformly dredged prior to closure in 2001, the closed area does not constitute an un-fished treatment. However it may be possible to examine un-fished areas in close proximity to rocky outcrops that constitute an obstacle to dredging. If an un-fished area on comparable substrate cannot be found, then some indication of past fishing effects may be achieved by re-analysing the results of the initial (circa 1996 (?)) survey in which high biodiversity was evident and comparing these results with the biodiversity now present.

The sampling design will also provide the means of monitoring ongoing changes in the biodiversity of areas that are subject to ongoing fishing impacts and comparing these areas with comparable areas that were previously fished but have been subsequently closed to fishing. In this way the sampling programme will provide some indication of re-colonisation and/or recovery of benthic faunal assemblages that have been affected by dredging.

This project will also propose analytical methods by which data resulting from the monitoring programme will be interpreted to improve our understanding of the response of benthic communities to disturbance by bottom-contacting fishing methods. The project will identify alternative approaches, outlining the limitations of each, and will suggest ways in which the outcomes of the research may be utilised to improve the management of other areas in which similar fishing methods are used. Finally, the project will suggest the means by which biological indicators of benthic impacts might be developed and applied in dredge fisheries elsewhere.

This research project is rated high priority because of concerns about the sustainability of current fisheries impacts on benthic communities, many of which may provide essential structural habitat for other taxa, and because of the current lack of knowledge regarding the ability of benthic communities to recover from the impacts of bottom-contacting fishing gear.

### *Objective 1*

One method for measuring the effects of fishing on biodiversity over time is to monitor changes in indicators of biodiversity over time in areas subjected to different past or ongoing fishing treatments. This kind of research requires a robust experimental design in order to avoid as much as possible the confounding effects of natural environmental or habitat variability. The products of this research should provide a detailed outline of the necessary sampling regime to reproducible standard, with explicit estimates of (and justification for) vessel time and other resources required. The research design should explicitly consider existing natural gradients in community structure, the influence of natural environmental variability, and other factors affecting benthic community composition, and should detail how these factors are to be dealt with in the sampling design. Researchers should outline how the

data from the proposed monitoring programme will ultimately allow scientists to distinguish between multiple drivers affecting benthic communities in the area.

This proposal is also consistent with the directions signalled in the Ministry's Draft Strategy for Managing the Effects of Fishing on the Aquatic Environment and the Ministry of Fisheries / Department of Conservation Draft Marine Protected Areas Strategy. Key changes proposed to the former include regular assessing and reporting on the status of species and habitats affected by fishing activities, and implementing a proactive approach to the management and protection of species and habitats affected by fishing activities. An assessment of changes in the benthic community structure resulting from fishing and the cessation of fishing will help us determine how much of a habitat type needs to be protected from the effects of fishing. It will also contribute to our understanding of the effectiveness of fishing method closures in remedying the effects of fishing. All the objectives in this project are consistent with the *Strategic Framework and Directions for Fisheries Research Contracted by the Ministry of Fisheries* document.

**Cost Recovery Information:**

This project is 100% Crown funded.

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

