CCAMLR

COMM CIRC 08/135
SC CIRC 08/63

Vendredi, 10 Octobre 2008

Notification de projets de recherche scientifique pour 2008/09 - Nouvelle-Zélande

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COMMISSION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES
COMMISSION POUR LA CONSERVATION DE LA FAUNE ET LA FLORE MARINES DE L'ANTARCTIQUE
КОМИССИЯ ПО СОХРАНЕНИЮ МОРСКИХ ЖИВЫХ РЕСУРСОВ АНТАРКТИКИ
COMISIÓN PARA LA CONSERVACIÓN DE LOS RECURSOS VIVOS MARINOS ANTÁRTICOS

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À TOUS LES MEMBRES DE LA COMMISSION ET DU COMITE SCIENTIFIQUE

COMM CIRC 08/135
SC CIRC 08/63

Hobart, le 10 octobre 2008

Notification de projets de recherche scientifique pour 2008/09 – Nouvelle-Zélande

Conformément à la mesure de conservation 24-01, les Membres sont avisés que la Nouvelle-Zélande a soumis une notification relative à un projet de recherche scientifique dans la sous-zone 88.1 (SSRU 88.1B, 88.1C et, à moins que les glaces n'y fassent obstacle, 88.1G) sur une période de trois ans à compter de 2008/09, réévaluée chaque année (voir pièce jointe). La campagne d'évaluation a pour objectif de combler les lacunes critiques dans la connaissance du cycle vital de *Dissostichus mawsoni* en mer de Ross ; elle ne cherche pas à déterminer l'abondance de légine. Elle se déroulera sur un navire de pêche commerciale d'où seront déployés des palangres, des chaluts et d'autres engins d'échantillonnage. Il est prévu que la capture annuelle s'élève à un maximum de 150 tonnes de *Dissostichus* spp. La notification, qui a été reçue le 7 octobre 2008, a été soumise au WG-FSA (WG-FSA-08/62).

Cette notification relève de la mesure de conservation 24-01, paragraphe 3 dont l'alinéa a) est porté à l'attention des Membres. Les observations sur cette proposition, y compris celles exigeant que le plan de recherche soit examiné par le Comité scientifique, devront parvenir au secrétariat avant la XXVII^{e} session du SC-CAMLR ou être présentées directement au Comité scientifique.

D.G.M. Miller
Secrétaire exécutif

P.J.

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7 October 2008

Dr D G M Miller
Executive Secretary
CCAMLR
P O Box 213
North Hobart
Tasmania
AUSTRALIA

Dear Denzil

In accordance with Conservation Measure 24-01, New Zealand would like to notify the Commission of its intention to conduct a mid-winter research voyage to CCAMLR Subarea 88.1, starting in the winter of 2008/09.

New Zealand wishes to draw to the Commission's attention that we have submitted this proposal to WG-FSA for review. Dependent on that that review, New Zealand may submit a revised notification. This research has been notified ahead of the six month deadline (14 November 2008) to ensure an opportunity for scientific review of the proposed survey prior to it being conducted.

New Zealand also notes that in addition to the current requirements in Conservation Measure 24-01, it is also able to comply with those proposed in CCAMLR-XXVII/34 relating to reporting and the use of VMS.

Yours sincerely

Trevor Hughes
New Zealand CCAMLR Commissioner

NOTIFICATION FOR FINFISH SURVEY IN ACCORDANCE WITH PARAGRAPH 3 OF CONSERVATION MEASURE 24-01

CCAMLR MEMBER

New Zealand

SURVEY DETAILS

It is proposed that a scientific research survey be carried out in the austral winter in CCAMLR SSRUs 88.1B, 88.1C and, ice permitting, 88.1G over a three year time series starting in 2008/09, reviewed each year. The survey is designed to cover critical gaps in our knowledge of D. mawsoni life cycle in the Ross Sea; it is not aimed at determining toothfish abundance and is therefore not a random stratified survey. The specific research objectives are:

1. *Primary objectives*
    a. *To investigate the spawning time and location of D. mawsoni in SSRUs 88.1B, 88.1C and 88.1G*
    b. *To investigate the maturity status, histological characteristics of D. mawsoni in SSRUs 88.1B and 88.1C in winter (expected spawning season); to further refine the developmental cycle of D. mawsoni*
    c. *To investigate movement to / from the spawning grounds and its timescale in winter, which is expected to be spawning season*
2. *Secondary objectives:*
    a. *To investigate the potential dispersion areas of eggs and larvae by studying the characteristics of D. mawsoni eggs with regards to buoyancy*
    b. *To determine trophic status and diet of toothfish and other species in the winter*
    c. *To determine winter surface plankton assemblages south of New Zealand using a Continuous Plankton Recorder (CPR)*
    d. *To further inform Southern Oceans ecosystem models by collecting winter water samples for nutrient analysis*
    e. *To characterise acoustic backscatter of the area in winter*
    f. *To gather further biological information on D. eleginoides in the Ross Sea area*

See additional details in Appendix I.

SURVEY AREA/SUBAREA/DIVISION

88.1B, 88.1C, 88.1G (ice permitting)
Geographical Boundaries:
Latitude *from 60°S to 70°S*
Longitude *from 170°E to 170°W*
Is a map of area surveyed (preferably including bathymetry and positions of sampling stations/hauls) appended to the format? *Yes (see Appendix I Figure 2)*

PROPOSED DATES OF SURVEY

between 2009 / 05 / 15 (Y/M/D)
and 2009 / 08 / 31 (Y/M/D)

And same proposed timing in 2010 and 2011

CONTACTS

Name(s) and address of the chief scientist(s) responsible for planning and coordinating the research

Mr Neville Smith
New Zealand Ministry of Fisheries
105 The Terrace
Wellington
New Zealand

And

Dr Stuart Hanchet
NIWA
PO Box 893
Nelson
New Zealand

SCIENCE STAFF

Number of scientists *4 (one CCAMLR observer, one NZ observer and two scientists)* and crew *22* to be aboard the vessel

Is there opportunity for inviting scientists from other Members? *Yes*

If so, indicate a number of such scientists *1 (part of the 4 scientists onboard)*

DESCRIPTION OF VESSEL

Name of vessel *San Aotea II*
Name and address of vessel owner *Sanford Limited*
22 Jelico Street, Auckland, New Zealand
Vessel type (dedicated research or chartered commercial vessel) *Commercial vessel*
Port of registration *Auckland* Registration number *63631*
Radio call sign *ZM2534* Overall length *46.5* (m)
Tonnage *1079 GRT*
Equipment used for determining position *2 independent GPS systems (1 Furno and 1 JRC)*
Fishing capacity (limited to scientific sampling activities only or commercial capacity) *NA*
Fish processing capacity (if vessel type is commercial) *20-25 tons GWT* (tonnes/day)
Fish storage capacity (if vessel type is commercial) *565 m^3 frozen and 100 m^3 meal*

DESCRIPTION OF FISHING GEAR TO BE USED

Trawl type (i.e. bottom, midwater) *NA*
Mesh shape (i.e. diamond, square) and mesh size in codend (mm) *NA*
Longline *Mustad Autoline system using 11.5mm Integrated Weight (IW) longline with 15/O hooks*
Other sampling gear as plankton nets, CTD probes, water samplers, etc. (specify) *Continuous Plankton Recorder, plankton nets*

DESCRIPTION OF ACOUSTIC GEAR TO BE USED

Type *Simrad ES60* Frequency *38kHz*

SURVEY DESIGN AND METHODS OF DATA ANALYSES

Survey design (random, semi-random) *Detailed in the appended application to conduct scientific research (Appendix I)*

Target species *Dissostichus mawsoni*
Stratification (if any) according to:
Depth zones (list) *NA*
Fish density (list) *NA*
Other (specify) *Expected potential locations of spawning*
Duration of standard sampling stations/hauls (preferably 30 min) *Minimum soak time 20 hours subject to environmental conditions (ice, weather etc.,)*
Proposed number of hauls *Minimum of three strata would be surveyed with a minimum of 5 hauls per stratum (subject to ice conditions, weather, catch limits etc.,)*
Proposed sample size (total): *maximum 150 tonnes per year (about 4600 fish), see the appended application to conduct scientific research for details*
Proposed methods of survey data analyses (i.e. swept area method, acoustic survey): *see attached research proposal*

DATA TO BE COLLECTED
Haul-by-haul catch and effort data in accordance with CCAMLR Form C4 for reporting results of fishing for research purposes: *Dissostichus spp.*
Fine-scale biological data in accordance with CCAMLR Forms B1, B2 and B3: *B2*
Other data (as applicable):

- *Between 50 and 100 Dissostichus spp. per set analysed for length, weight, gonad weight and maturity status, proportional to the species catches.*
- *Gonad samples of up to 100 female and 100 male Dissostichus spp. per stratum will be collected for histology work, 6 individuals of each sex per 5cm bin (additional samples if opportunity arises).*
- *The entire gonad of up to 50 female and 25 male D. mawsoni from throughout the range of fish weights will be collected for fecundity work (expected range 15–55 kg).*
- *Samples of liver, muscle and cartilage tissue of up to 50 representative fish of the key species encountered will be collected for trophic studies (stable isotope work).*
- *The stomach contents of up to 200 representative Dissostichus spp. and 50 of every other key fish species will be retained (including those fish sampled for trophic studies to allow for cross-comparison).*
- *All squid beaks retained for further analysis.*
- *Minimum deployment of the plankton net every two sets throughout the voyage.*
- *Minimum 10 egg buoyancy experiments throughout the voyage if running ripe fish available or eggs caught in plankton net sets.*
- *Bycatch sampling as per Conservation Measure 24-01, including skates and macrourids.*
- *Continuous Plankton Recorder en route to and back from the fishing grounds.*
- *Water samples collected for nutrient analysis to be included in ecosystem models.*
- *Acoustics data collected during the entire duration of the trip.*
- *3 Dissostichus spp. tagged per tonne (pro rata per species)*
- *1 in 4 skates caught tagged*

APPENDIX I – Detailed Research Proposal

Application to undertake winter scientific research in CCAMLR Subarea 88.1 (SSRUs 88.1B, 88.1C, and 88.1G) in the 2008/09 season

New Zealand

Abstract

New Zealand proposes to conduct a scientific research survey during the austral winter in CCAMLR SSRUs 88.1B, 88.1C and, ice permitting, 88.1G in 2008/09, as the first in a three year time series. The proposal is for a targeted longline survey designed to cover critical gaps in the knowledge of the life cycle of *D. mawsoni* in the Ross Sea by collecting biological samples from a broad spread of locations across the northern Ross Sea during the austral winter. The survey is designed to collect information that should assist in the understanding of the early life history and reproduction of *Dissostichus mawsoni* in the Ross Sea region. In addition, tag data collected will give additional information on the spawning movements of mature *D. mawsoni*. The results of the research will lead to improved estimates of length/age of maturity, proportion mature that spawn, and contribute to an improved understanding of the Ross Sea *D. mawsoni* stock structure. Data collected during the survey will provide information that is likely to directly influence future assessments of *D. mawsoni*. The proposed research is in accordance with Conservation Measures 24-01, 33-03, 41-01 and 41-09.

1. Introduction

The exploratory toothfish longline fishery in CCAMLR SSRUs 88.1 and 88.2 was initiated by a single New Zealand vessel in 1997/98. The fishery developed slowly until 2003/04 with the full catch limit taken from 2004/05 (Hanchet et al. 2007b). Catch limits have been set for *D. mawsoni* in the Ross Sea since 1997. Since 2005 this limit has been based on a single area homogenous stock assessment model (Dunn & Hanchet 2007) implemented in CASAL (Bull et al. 2005)

Although we have a reasonable understanding of the fishery, knowledge of the spawning behaviour and early life history are still incomplete (Hanchet et al. 2007a and references within). Information on the stock structure of toothfish and the length/age at maturity remains highly uncertain. Changes in assumptions of the nature of the stock structure, age/length of maturation, and spawning proportion will impact on the estimates of yield from the current assessment model (Dunn & Hanchet 2007). The proposed survey will allow collection of data to test current hypotheses about the stock structure, age/length at maturity, and spawning of *D. mawsoni*, by accessing areas during the periods that are not covered by the exploratory fishery. This type of research is supported by the Scientific Committee (SC-CCAMLR XXVI, 2007, paragraph 4.48).

We propose to collect information to allow the testing of the following scientific hypotheses:

- Antarctic toothfish in the Ross Sea spawn in the northern areas between May and August, and that all fish present in that area at that time are mature;
- At the time of spawning, Antarctic toothfish present elevated gonadosomatic indexes (GSI) of between 30-40%. Females still present eggs at two stages of development, with one batch being prepared for a subsequent spawning. Spent females have low residual GSI levels; and

- The Antarctic toothfish population in the northern area of the Ross Sea is a resident population, i.e. those fish spawning in the winter are also present in the summer fishery and both are vulnerable to fishing to a similar degree. The tag recovery rate will be similar to the recovery rate in the summer fishery, and no tags from fish tagged on the slope or shelf will be recovered.

2. Research rationale

Hanchet et al (2007a) reviewed existing knowledge on *D. mawsoni* biology. They coupled that knowledge with ocean circulation to predict where larvae and juvenile *D. mawsoni* might be distributed. The current hypothesis suggests spawning occurs on ridges and banks to the north of the Ross Sea during the austral winter (June to October). Depending on the buoyancy of the eggs and the exact spawning location, models show eggs might be retained within the Ross Sea region through entrainment in one of the two main gyres. One gyre would entrain eggs and larvae onto the Antarctic coast in SSRU 88.2, whilst the other would entrain eggs and larvae on to the Antarctic coast to the west of the Ross Sea in SSRUs 881D and 88.1F (Hanchet et al. 2007a). We note that no *D. mawsoni* eggs or larvae have ever been captured in the Ross Sea.

The precise timing and location of spawning is not known, but it is expected to occur during the austral winter, some months after the fishery has ended. Only two running ripe female *D. mawsoni* have been caught to date (Fenaughty 2006) and there is considerable uncertainty in the maturity status of toothfish, both macroscopically (e.g. Patchell 2001) and histologically (Livingston & Grimes 2005). The present survey proposes to sample at a period when *D. mawsoni* are expected to be spawning, and collect information on spawning time and location, maturity status, and the histological characteristics of mature/spawning toothfish.

The buoyancy of *D. mawsoni* eggs is also unknown (Hanchet et al. 2007a). This is an important consideration in the egg and larval circulation model, as the depth in the water column affects the resulting entrainment and subsequent distribution of the eggs and larvae. Information gathered by samples would allow improved understanding of *D. mawsoni* stock structure in the area. We propose to conduct buoyancy experiments by fertilising running ripe females at sea and from naturally fertilised *D. mawsoni* eggs and larvae caught in plankton nets.

Information on the proportion of fish spawning each year and their length/age at maturity is poor. Changes in assumptions of proportion spawning and/or age/length of maturation will impact on the estimates of yield from the current assessment model (Dunn & Hanchet 2007). The current tag recapture programme shows that most toothfish are recaptured in locations near where they were tagged, with a small number of fish carrying out long distance movements. We propose to tag fish at a time and location when they are spawning, so-as movements from the spawning grounds can be monitored in future years by the commercial fishery. In addition, all fish captured will be scanned for tags and the collection of information that may assist in developing movement hypotheses of mature toothfish to and from the spawning grounds.

Some indirect data on toothfish movements have come from stable isotope data (Bury et al. 2008). They suggested that *D. mawsoni* caught on the slope and in the north had similar carbon isotope signatures. This was in contrast to their typical prey that had a higher isotopic carbon signature in the north. The authors concluded that *D. mawsoni* were probably feeding on the slope, and were unlikely to spend long periods of time in the north. This conclusion would also explain the emaciated state of toothfish in the north compared to that of fish caught further south (Fenaughty 2006).

We propose to collect samples of *D. mawsoni* muscle, liver, and cartilage so-as to further the isotopic work carried out by Bury et al. (2008). Bycatch species will also be sampled to collect information to improve knowledge of trophic feeding at this time of year. In addition, stomachs containing food from toothfish and other key fish species will be retained for later analysis.

We propose to use a Continuous Plankton Recorder (CPR), deployed en route to and from the fishing grounds, with acoustic backscatter be recorded at all times. The CPR will allow the investigation of winter surface plankton assemblages south of New Zealand and will provide a complement to such deployments that have already occurred in the summer on the NZ research vessel Tangaroa (e.g. Hanchet et al. 2008). Acoustic data will also be recorded during the sampling and the results compared to summer acoustics recorded by New Zealand vessels during the usual commercial fishery (e.g. O'Driscoll 2006). Water samples will be collected for nutrient analysis.

This research is also an ideal opportunity to gather critical information on *D. eleginoides* in the Ross Sea area, of which not much is known. It is proposed data be collected in proportion to the *Dissostichus* species caught.

Therefore, the specific research objectives are:

1. Primary objectives
    a. To investigate the spawning time and location of *D. mawsoni* in SSRUs 88.1B, 88.1C and 88.1G
    b. To investigate the maturity status, histological characteristics of *D. mawsoni* in SSRUs 88.1B and 88.1C in winter (expected spawning season); to further refine the developmental cycle of *D. mawsoni*
    c. To investigate movement to / from the spawning grounds and its timescale in winter, which is expected to be spawning season
2. Secondary objectives:
    a. To investigate the potential dispersion areas of eggs and larvae by studying the characteristics of *D. mawsoni* eggs with regards to buoyancy
    b. To determine trophic status and diet of toothfish and other species in the winter
    c. To determine winter surface plankton assemblages south of New Zealand using a Continuous Plankton Recorder (CPR)
    d. To further inform Southern Oceans ecosystem models by collecting winter water samples for nutrient analysis
    e. To characterise acoustic backscatter of the area in winter
    f. To gather further biological information on *D. eleginoides* in the Ross Sea area

3. Research proposal

3.1 Timing of the research

The timing and location of *D. mawsoni* spawning in the Ross Sea is not known, but it is likely to be sometime between May and August, most probably between June and July, on the northern hills (Hanchet et al. 2007a). To date, the exploratory fishery has not sampled those areas of the Ross Sea at times when spawning may be happening. Current commercial constraints on catches and timing of the commercial fishing season mean that such sampling is highly unlikely to happen without a dedicated research voyage.

We propose to sample the northern areas of the Ross Sea during the period between mid-May and mid-September. Further, we recommend that this survey be the first of a three year time series as the exact timing of spawning might not be determined precisely in the first year. A

three-year series is also recommended so-as to allow coverage of all areas where spawning might occur, and to allow for different ice conditions in the three years. It will also allow for an investigation of the potential changes in spawning behaviour between years, estimation of the proportion spawning in the north, and to recapture adequate numbers of tagged fish for quantitative analyses.

3.2 Location of sampling

The exact sampling locations in SSRU 88.1 will depend on the ice conditions at the time, but we propose to begin sampling as far south as possible and then work back to more northerly regions as ice coverage permits.

The research is aimed at obtaining information to address critical gaps in the knowledge of *D. mawsoni* life cycle in the Ross Sea. Set locations will be targeted at areas and features that might be locations of spawning for *D mawsoni*. The study area is split into seven strata (Figure 1) in order to both spread the research effort and tagging, and to cover as wide an area as plausible to locate areas where spawning might take place. These strata are based on topographic features and locations of historic fishing success, and consist of two strata in 88.1B, three in 88.1C and two in 88.1G (Figure 2).

A key area of interest is Long Ridge, which is a 110km long underwater feature at about 66–67ºS in SSRU 88.1C. This feature has been fished by both New Zealand and other vessels in previous years between December and March. We also intend to sample adjacent features in SSRUs 88.1B and 88.1C, as well as in SSRU 88.1G (ice permitting), to collect information to improve the understanding of the spawning dynamics across the northern area. Distribution of catches in those areas, over the entire fleet and the history of the fishery, are shown in Figure 1. It is plausible that the majority of fish in these areas will be spawning at this time of year (Mormede et al. 2008, in press).

However, it likely that the ice will hinder access to at least some of these areas during the sampling period. Past ice coverage is depicted in Figure 3. It shows accessing the areas of interest during the months between June and August will be a challenge because not all areas are free from ice in any year. However, we expect that the survey will be able to sample at least three of those seven strata, and further, each stratum will be sampled with a minimum of 5 sets.

Fishing will be subject to conditions at the time such as ice and weather. However, in order for this survey catch and effort data to be compared with commercial fishery data-sets the fishing will be conducted in a manner as similar as possible to the typical fishery practice in that area. We propose to set longlines with between 4000 – 5000 hooks, with a typical soak time of 20 hours and use gear deployment, recovery and use that is as close to that which is typical of the fishery in that area. New Zealand vessels have so far contributed to about 30% of the total effort in SSRU 88.1B, and just over 50% of the total effort in SSRUs 88.1C and 88.1G, and these data provide a good basis for comparison with the proposed winter research survey.

3.3 Catch allowances

We propose that an allowance of 150 tonnes of *Dissostichus* spp. be allocated for the research, corresponding to approximately 4600 fish. (Note that median weight of *Dissostichus* spp. in the northern SSRUs is about 32.7 kg). This allowance was based on the following requirements:

- Investigation of spawning timing and location: One aim of this research is to find spawning aggregations of large toothfish. If these aggregations are found then large catches might be achieved per set. Previous fishing experience in the area has shown that most areas produce a median catch of 1.2 tonne per set, but some areas have produced median catch per set of up to 10 tonnes (Figure 4). A small catch allowance would potentially only allow for a single set if located within a spawning aggregation or area of dense fish.

- Investigation of spawning characteristics and maturity cycle: An appropriate target sample size for length at maturity is 6 fish per length bin for each stratum sampled. Five-cm length bins will be sufficient to generate resolution in the length at maturity curve, giving 18 length bins between 90 and 175 cm. A sample size of 6 fish per bin is an appropriate number so-as to provide suitable estimates of the proportions mature within each size-bin. It will also be important to determine if smaller fish in the north are also mature, so the sampling will need to obtain samples from all small fish. Further, because fish sampled at the tails of the length distribution are less common, obtaining 6 fish from each length bin will be constrained by the smallest proportion of fish in the length bins to be sampled. Analysis of the Scientific Observer data from 2008 showed that the 90-95 cm bin contained 1% of the observed catch. Hence collecting 6 fish of this size will require about 600 fish to be sampled. Because the 90-95 cm length bin is 54% female, the total estimated number needed is ~1100 fish per stratum. For large fish, 1% of the catch was between 175 and 180cm, but the sex ratio for these fish was 100% female, so the upper end of the size distribution is less constrained by the sample size. Sampling the minimum of three strata would require ~3300 fish. At 32.7 kg average weight, the catch for this segment of sample collection would be ~110 t, and five strata would be ~180 t.

- Investigation of movement: The hypothesis tested is that the population of *Dissostichus* spp. present in the north in winter is the same as the population present in the summer. Tag recaptures and numbers of fish scanned in 2007 and 2008 in SSRUs 88.1B and 88.1C were used to calculate the required number of fish scanned in the research to allow a reasonable estimation of movement. Only 3 tags were recovered in 2008 in SSRU 88.1B and therefore it is expected that only a couple will be recovered during winter sampling. In SSRU 88.1C, we estimate that about 3000 *Dissostichus* spp. would need to be scanned in order to recover about 9 tags (90% confidence interval 4–15), a lower bound on the number of tags that may provide useful information.

- Logistical constraints for carrying out the proposed research: No other fishing grounds are open in the vicinity of the research area during the sampling period. The survey will require seven days steaming to get to the research grounds and another seven days steaming back to port. A minimum of five sets will be carried out per stratum in an area at a time that has not been fished before, and will probably entail one set per day to reduce the risk of gear loss or unexpectedly high catches. The minimum expected sea time required for the survey will thus be between 30 and 45 days in order to cover between three to five strata. Due to the winter conditions, probable ice cover and difficult fishery conditions, it is also expected that the fishing operation will be slower and more difficult than the equivalent summer fishing in the area. We also note that the survey would not be independently funded.

We will attempt to sample a minimum of three out of the seven proposed strata during the research, with at least five sets per stratum (weather and ice permitting). To ensure good coverage of the grounds the vessel will leave a stratum once a catch of 60 t has been reached from that stratum. We note that as the proposed survey is scheduled for between May and August (i.e., after the usual commercial fishery has finished), it will be necessary to set aside

an appropriate *Dissostichus* ssp. catch allocation and appropriate bycatch allocations, as per CM 24-01.

3.4 Biological data collected

Because a key focus of this research is to determine the spawning condition of toothfish, we propose to increase the number of toothfish measured per set from the current 35 fish per set to a minimum of 50 and an ideal of 100 fish per set. Note that it may be logistically difficult to always sample 100 fish per set given the large size and weight of *D. mawsoni* encountered in these SSRUs. All fish will be randomly selected, measured, weighed, sexed, maturity status collected and gonad weighed. Following Conservation Measure 24-01 paragraph 4, these data will be reported to CCAMLR on a set by set basis.

Samples of *Dissostichus* spp. gonads will be collected for histological analyses; entire gonads will be collected for fecundity analyses; and samples of liver, muscle, and cartilage tissue for trophic work will be collected. Samples of tissue of other key fish and squid species caught will also be collected for trophic work (specifically *D. mawsoni, D. eleginoides, Antimora rostrata, Chionbathyscus deweitti, Muraneolepis microps, Macrorus whitsoni*). Stomach contents of toothfish and other key fish species caught will be sampled, and included as a subset of the trophic work samples in order to link trophic level with stomach contents. All squid beaks will be retained. It is possible that different squid species might be caught in that area in winter compared with the summer Ross Sea fishery. Two of the onboard scientists will be dedicated to fish measurement and sampling in addition to the Scientific Observers.

It is intended that vertical tows will be made using plankton nets in an attempt to capture *D. mawsoni* eggs and larvae. The net will be attached to the longline down line and deployed on at least every other set in an attempt to capture any available spawned eggs and possibly larvae. If eggs are caught buoyancy experiments will be carried out prior to preserving the sample for further identification and analyses (see below).

When gravid females and ripe males are caught, fertilised egg buoyancy experiments will be conducted. This will involve fertilising eggs from running ripe female with milt from running ripe males. Once fertilised the eggs would be placed in cylinders for measuring buoyancy following the methods of Robertson (1981) and Stenevik (2008). Successful buoyancy experiments should be carried on for as long as possible to investigate potential changes in egg buoyancy through egg development.

It is also planned to deploy a Continuous Plankton Recorder (CPR) in transit to and from the Ross Sea. This would be the first time that a CPR had been deployed in the winter months in the Ross Sea region and would provide the first data on winter plankton assemblages in the area (G. Hosie, AAD, pers. comm.). Water samples will also be collected for nutrient analysis.

All appropriate Conservation Measures will be observed, and in particular with regards to VME and “Year of the Skate” protocols.

The specific data collected will be as follows:

- At least 50 *Dissostichus* spp. per set analysed for length, weight, gonad weight and maturity status, proportional to the species catches (with more sampled where possible)
- Gonad samples of up to 100 female and 100 male *Dissostichus* spp. per stratum will be collected for histology work, 6 individuals of each sex per 5cm bin (additional samples if opportunity arises).

- The entire gonad of up to 50 female and 25 male *D. mawsoni* from throughout the range of fish weights will be collected for fecundity work (expected range 15–55 kg).
- Samples of liver, muscle and cartilage tissue of up to 50 representative fish of the key species encountered will be collected for trophic studies (stable isotope work).
- The stomach contents of up to 200 representative *Dissostichus* spp. and 50 of every other key fish species will be retained (including those fish sampled for trophic studies to allow for cross-comparison).
- All squid beaks retained for further analysis.
- Minimum deployment of the plankton net every two sets throughout the voyage.
- Minimum 10 egg buoyancy experiments throughout the voyage if running ripe fish available or eggs caught in plankton net sets.
- Bycatch sampling as per Conservation Measure 24-01, including skates and macrourids.
- Continuous Plankton Recorder en route to and back from the fishing grounds.
- Water samples collected for nutrient analysis to be included in ecosystem models.
- Acoustics data collected during the entire duration of the trip.

3.5 Tagging

Particular attention will be given to scanning for tagged toothfish. The number of tags recovered will help determining the nature of the *Dissostichus* spp. population in the northern Ross Sea, including the proportion that may be resident, and the nature of any winter spawning migrations. Based on the number of recaptured tags for *D. mawsoni* in SSRUs 88.1B and 88.1C in 2008, the expected numbers of tags for given numbers scanned were calculated assuming a simple binomial sampling distribution (Figure 5). Tag recovery rates for 2007 yielded similar results. These calculations suggest that about 3000 *D. mawsoni* would need to be scanned in SSRU 88.1C alone in order to recover 9 tags (90% C.I.s 4–15).

Because this research is a unique opportunity to access *Dissostichus* spp. during spawning season, we propose to tag a minimum of three fish per tonne caught, and to tag *Dissostichus* spp. proportional to the species caught. Further, if total *Dissostichus* spp. catch is above 70 tonnes, then the rate will be increased to a minimum of four fish per tonne. In addition, if funding is available, we propose to deploy archival tags on selected toothfish to investigate movements of fish in relation to temperature and depth.

Starry skates will be tagged at a rate of one in four.

3.6 Review

We propose that this research be carried out every year for a period of three years. A full research report will be provided to WG-FSA in October 2009, where the research programme will be thoroughly reviewed. Subsequent surveys will be revised accordingly, with the potential for further development in the second and third years based on the results of the previous years sampling and the review.

4. References

Bull, B.; Francis, R.I.C.C.; Dunn, A.; McKenzie, A.; Gilbert, D.J.; Smith, M.H. (2005). CASAL (C++ algorithmic stock assessment laboratory): CASAL User Manual v2.07-2005/08/21 WG-FSA-05/P3. 272 p. National Institute of Water and Atmospheric Research. Unpublished manuscript presented to the Fish Stock Assessment Working Group of CCAMLR

Bury, S.J.; Pinkerton, M.H.; Thompson, D.R.; Hanchet, S.; Brown, J.; Vorster, L. (2008). Trophic study of Ross Sea Antarctic toothfish (*Dissostichus mawsoni*) using carbon and nitrogen stable isotopes WG-EMM-08/27. 41 p. CCAMLR. (Unpublished manuscript presented to the Ecosystem Monitoring and Management working group of CCAMLR)

Dunn, A.; Hanchet, S.M. (2007). Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea including data from the 2006–07 season WG-FSA-07/37. 26 p. National Institute of Water and Atmospheric Research. Unpublished manuscript presented to the Fish Stock Assessment Working Group of CCAMLR

Fenaughty, J.M. (2006). Geographical differences in the condition, reproductive development, sex ratio, and length distribution of Antarctic Toothfish (*Dissostichus Mawsoni*) from the Ross Sea, Antarctica (CCAMLR Statistical Subarea 88.1). *CCAMLR Science 13*: 27–45.

Hanchet, S.M.; Mitchell, J.; Bowden, D.; Clark, M.; Hall, J.; O'Driscoll, R.; M. Pinkerton; Robertson, D. (2008). Preliminary report of the New Zealand RV Tangaroa IPY-CAML survey of the Ross Sea region, Antarctica in February-March 2008 WG-EMM-08/18. 15 p. National Institute of Water and Atmospheric Research. Unpublished report presented at the EMM working group of CCAMLR

Hanchet, S.M.; Rickard, G.; Fenaughty, J.M.; Dunn, A.; Williams, M. (2007a). A hypothetical life cycle for Antarctic toothfish *Dissostichus mawsoni* in Antarctic waters of CCAMLR Statistical Area 88 WG-FSA-07/35. 25 p. National Institute of Water and Atmospheric Research. Unpublished manuscript presented to the Fish Stock Assessment Working Group of CCAMLR

Hanchet, S.M.; Stevenson, M.L.; Dunn, A. (2007b). A characterisation of the toothfish fishery in Subareas 88.1 & 88.2 from 1997–98 to 2006–2007 WG-FSA-07/28. 20 p. National Institute of Water and Atmospheric Research. Unpublished manuscript presented to the Fish Stock Assessment Working Group of CCAMLR

Livingston, M.E.; Grimes, P.J. (2005). Size at maturity and histological procedures explored to determine spawning activity of female *Dissostichus mawsoni* from samples collected from the Ross Sea in January 2004, December 2004, and January 2005 WG-FSA-05/63. 20 p. National Institute of Water and Atmospheric Research. Unpublished manuscript presented to the Fish Stock Assessment Working Group of CCAMLR

Mormede, S.; Parker, S.J.; Grimes, P. (2008). Investigating length at maturity of Antarctic toothfish (*Dissostichus mawsoni*) based on scientific observers' data. WG-FSA-08/xx. National Institute of Water and Atmospheric Research. Unpublished report presented at the FSA working group of CCAMLR

O'Driscoll, R.L. (2006). Descriptive analysis of mesopelagic backscatter from acoustic data collected in the Ross Sea WG-EMM-06/11. National Institute of Water and Atmospheric Research. Unpublished report presented at the EMM working group of CCAMLR

Patchell, G.J. (2001). Information on the spawning season and size of maturity of Dissostichus mawsoni from Sub-area 88.1 in the 2000-2001 season. WG-FSA-01/51. 10 p. Sealord Group Ltd. Unpublished manuscript presented to the Fish Stock Assessment Working Group of CCAMLR

Robertson, D.A. (1981). Possible functions of surface structure and size in some planktonic eggs of marine fishes. *New Zealand Journal of Marine and Freshwater Research 15*: 147:153.

Stenevik, E.R.; Sundby, S.; Agnalt, A.L. (2008). Buoyancy and vertical distribution of Norwegian coastal cod (*Gadus morhua*) eggs from different areas along the coast. *ICES Journal of Marine Science 65*: 1198:1202.

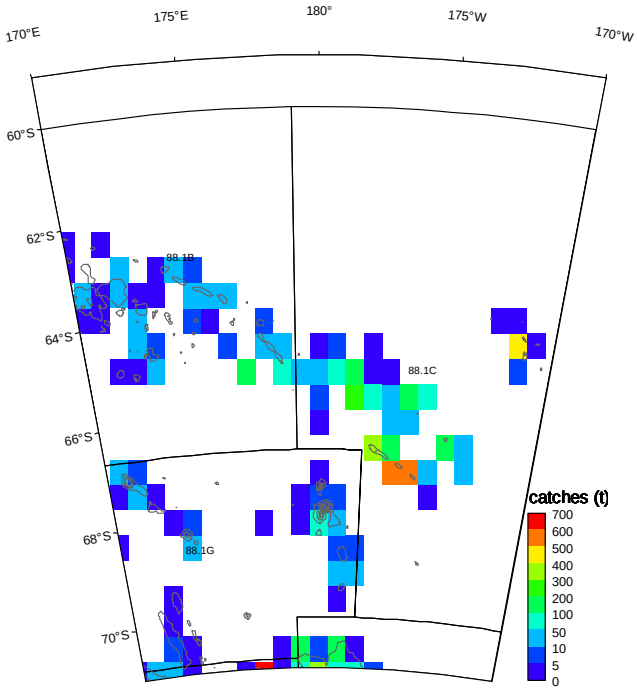


Figure 1: *D. mawsoni* catches in SSRUs 88.1B, C and G in tonnes summed over the entire fishery (1999–2008)

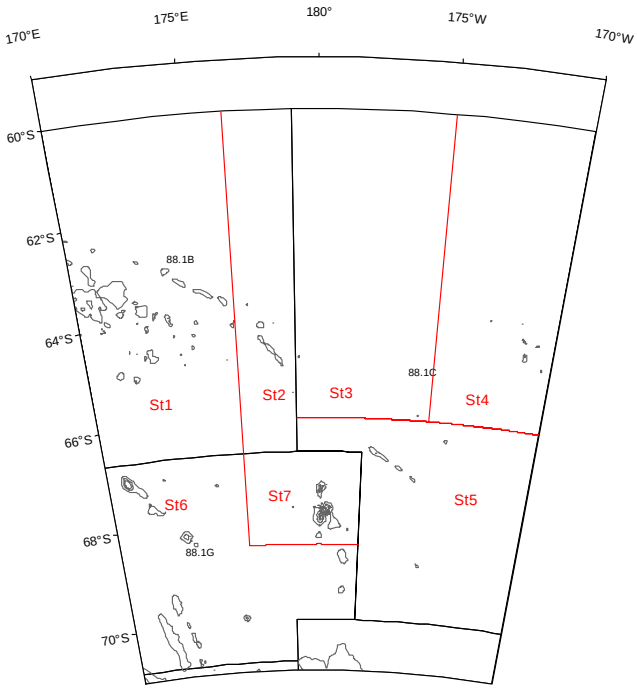
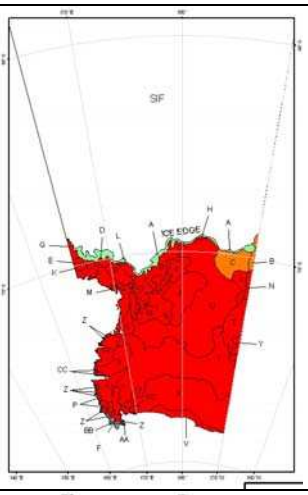
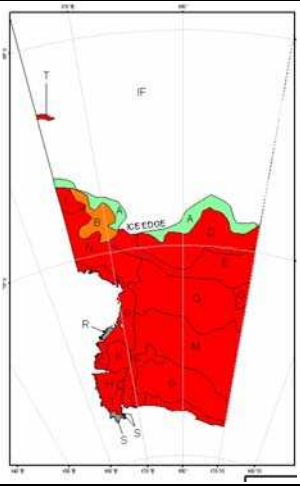
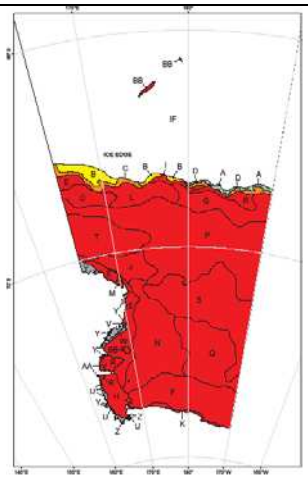
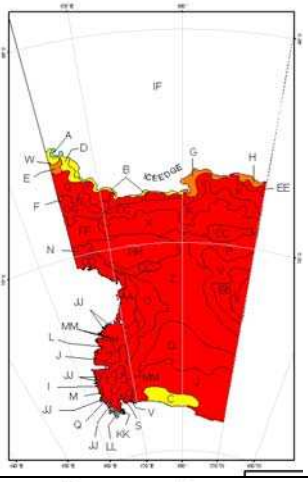
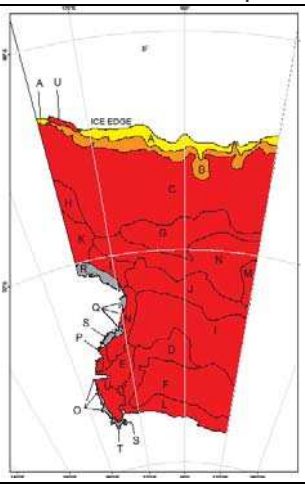
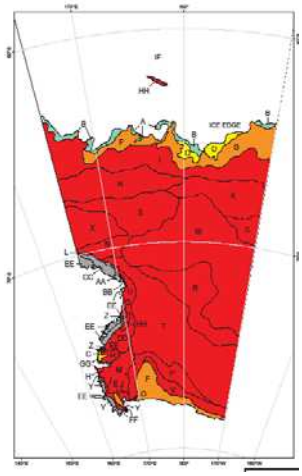
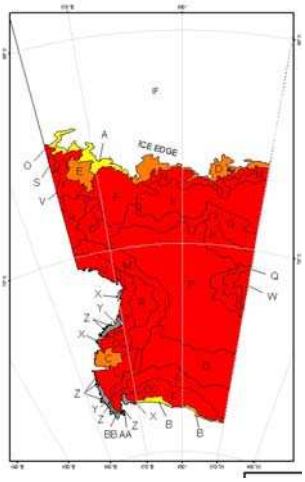
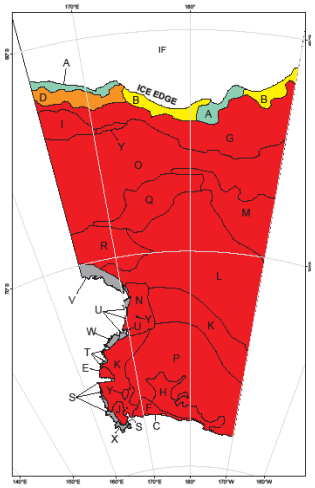
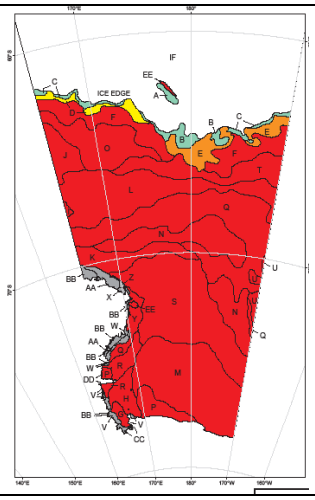


Figure 2: Proposed strata for the research experiment: 2 in 88.1B, 3 in 88.1C and 2 in 88.1G, strata numbered from St1 to St7.

Month	2006	2007	2008
April			
May			
June			

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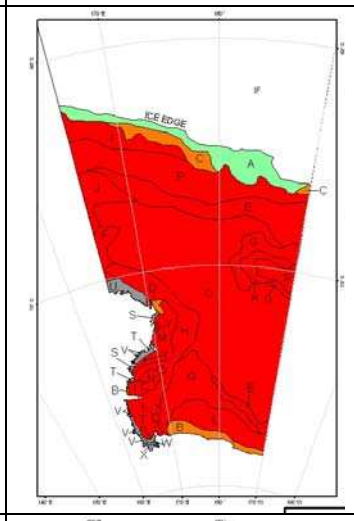
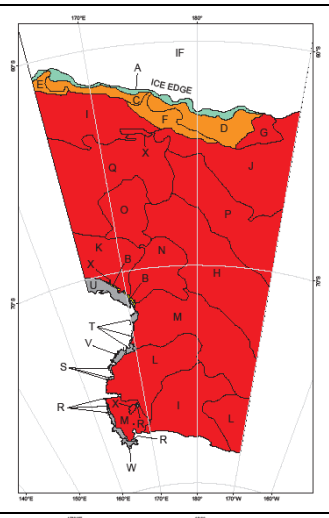
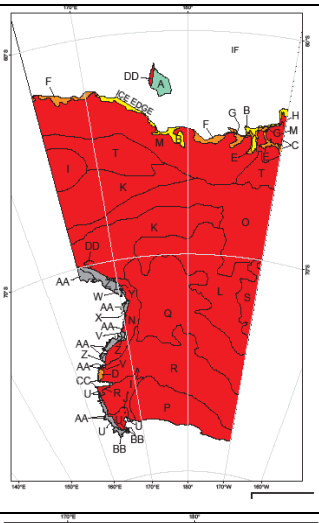
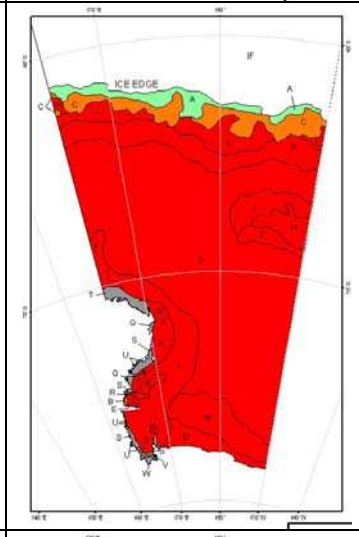
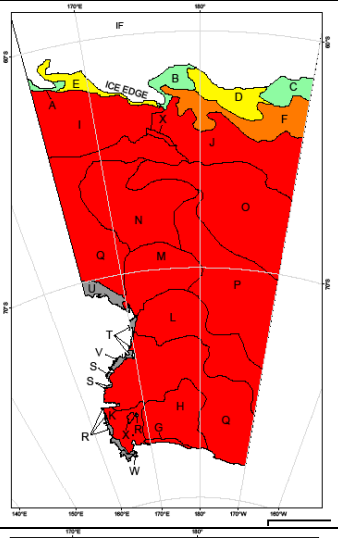
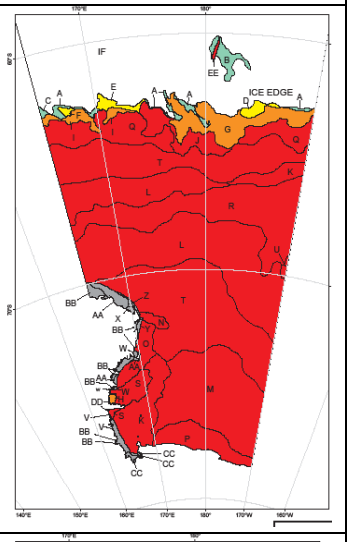
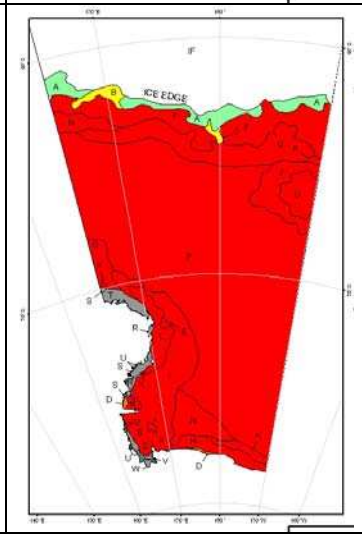
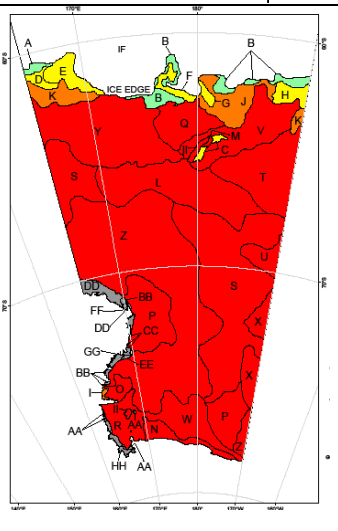
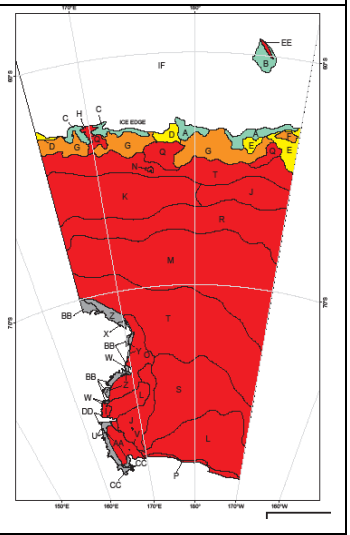
July			
August			
September			

Figure 3: Ice coverage in the Ross Sea in the first week of each month of interest from 2006 to 2008 (courtesy of NOAA National Ice Centre). White: ice free, blue: < 1/10, green: 1–2 tenth, yellow: 4–6 tenth, orange 7–8 tenth, red: 9–10 tenth, dark grey: fast ice, light grey: ice shelf.

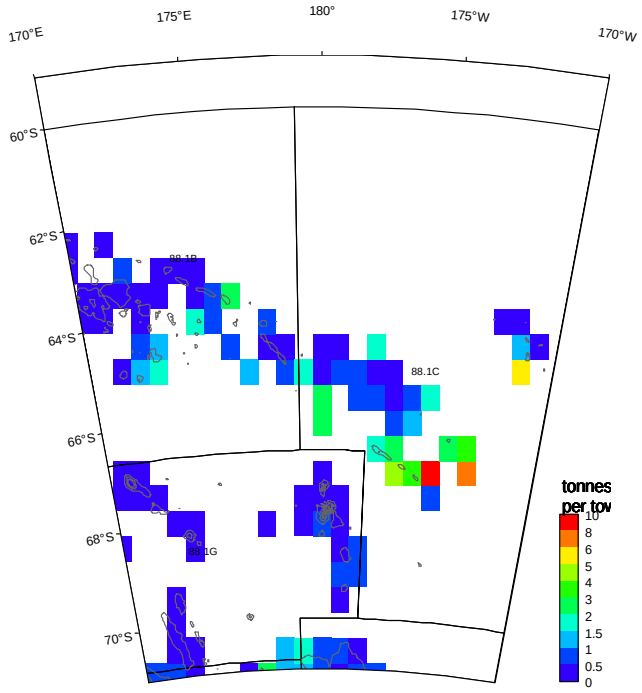


Figure 4: Median catch of *D. mawsoni* per set over the life of the fishery in tonnes in the proposed sampling areas.

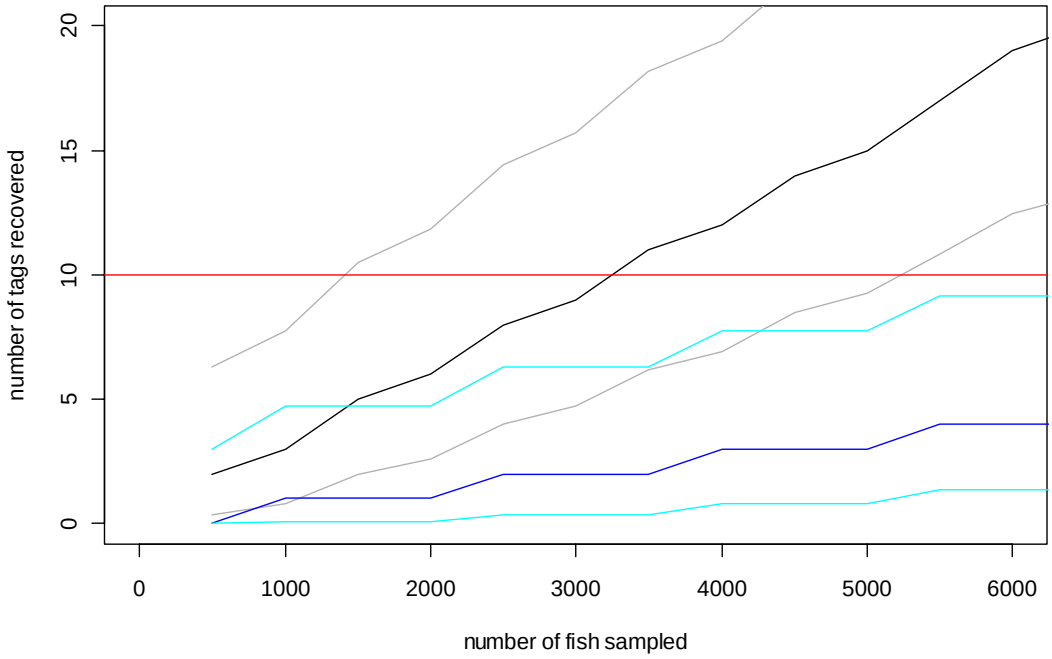


Figure 5: Expected numbers of tags recovered based on the number of *Dissostichus mawsoni* scanned based on the 2008 tag data, with 90% confidence interval. Blue is for 88.1B and black/grey for 88.1C. The red line is the target number of tags recovered for meaningful results.