Hoki and Middle Depths Fisheries

HOK2008-02	Estimation of proportion spawning in hoki and potential demographic factors affecting recruitment
JMA2009-02	Stock assessment of jack mackerels in JMA7
MID2009-01	Characterisation and fishery monitoring of middle depth species (two species to be determined)
SBW2009-01	Stock assessment of southern blue whiting

Project: Estimation of proportion spawning in hoki and potential demographic factors affecting recruitment

Project Code: HOK2008-02

Start Date: 1 September 2009

Completion Date: 31 December 2010

Vessel Use: None

Overall Objectives:

1. To estimate the proportion of hoki that spawn each year and to investigate demographic factors that may be influencing recruitment of hoki (*Macruronus novaezelandiae*)

Specific Objectives:

1. To estimate the proportion of hoki that spawn each year from the western stock.

2. To review research on the importance of factors such as maternal age structure and condition on recruitment success and variability with particular reference to hoki.

Reporting Requirements:

Research Reporting

Objective 1

1. To present the results to the Hoki Fishery Assessment Working Group as required by 30 September 2010.

2. To submit to the Chief Scientist MFish a Final Research Report as specified in Research Reporting form 5 or a draft Fishery Assessment Report as specified in Research Reporting form 7 by 31 December 2010.

Objective 2

1. To submit to the Chief Scientist MFish a Final Research Report as specified in Research Reporting form 5 or a draft Fishery Assessment Report as specified in Research Reporting form 7 by 31 December 2010.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MFish by 31 December 2010.

Rationale:

General

Hoki is one of New Zealand's largest fisheries with a TACC of 90,000 t since 1 October 2007. This is much less than catch levels in recent years and reflects the current poor status of the western stock estimated in recent stock assessments. Although managed as a single stock, in the past hoki have been assessed as two stocks, western and eastern. The current hypothesis is that juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity.

The proportion spawning has been estimated in a number of studies but these have not been consistent through time. The early estimates (Livingston & Bull 2000) were much lower than those from a recent study (Grimes & O'Driscoll 2005). It is thought that the methods used may have influenced the results rather than representing real differences in spawning proportions between years.

The hoki fishery is largely recruitment driven and recruitment to the western stock was below average in the years 1995–2001, and although year class strength from 2002 to 2005 has improved, current estimates suggest they may still be at or below the long term average. The extended period of low recruitment has had a considerable impact on the fishery, yet the cause remains unknown. The role of climate variability in hoki recruitment patterns is almost certainly important, however, the key drivers and mechanisms are equivocal (Francis et al. 2006).

If the environmental conditions are less than optimal for hoki recruitment, it is important for managers to know if there are other factors which may be also affecting recruitment, particularly if fishing practices can be altered in such a way as to optimise the chance of improved recruitment. Reproductive processes in fishes is a rapidly developing field and includes research into the spawning dynamics of fish, links between the age structure, sex ratios and spawning success of fish, recruitment, and other mechanisms linking environmental conditions to reproductive success. This project will review the literature on fish reproductive processes and search existing data for evidence of demographic or energetic effects on recruitment and recruitment variability in the hoki fishery.

Studies with various fishes have found obvious and not-so-obvious relationships between characteristics of female fish and the quantity, quality and viability of their offspring. The age structure of commercially fished stocks is typically truncated with few older classes from the population. Experiments with species such as cod, striped bass, and rockfish, suggest that maternal age can influence the quantity, quality, and timing of eggs produced and can inflate recruitment variability if only small

demographic segments of the population are successful in a given year. Stock-recruitment relationships currently assume that the number of recruits ultimately produced by a population is not influenced by the age structure of that population- i.e. every larva is equal.

The field is evolving rapidly, and the mechanisms for interactions with fisheries are complex. These types of effects are still not commonly incorporated into stock assessment models, largely because the biology is lagging behind the modelling ability. There is a large effort to incorporate this information as the mechanisms are understood for each species. For example, incorporating age diversity into the stock-recruitment relationship improved the fit with Icelandic cod (Marteinsdottir and Thorarinsson 1998). Several new indicators of reproductive potential, (e.g., liver weights, prey availability) have been proposed for Arctic cod, Scotian Shelf haddock, and US striped bass (Marshall et al 2003). A maternal age effect that gives older females even higher production than fecundity alone would suggest has been found in Pacific ocean perch, and has been incorporated into the stock assessment (Spencer and Ianelli 2006).

Objective 1

Samples of female gonads have been taken from the trawl surveys of the Sub-Antarctic in recent years with the intention to determine spawning proportion each year. Once an agreed protocol has been established these samples will be processed and read to identify fish that spawned in the previous winter.

Objective 2

The literature review will focus on exploited teleosts, but will also include relevant research from other taxonomic groups to describe the range of effects known to date and their mechanisms of action. Fisheries management in New Zealand can benefit from the work done elsewhere on parental effects, but much of the specific information must be generated for each species through biological research and sensitivity modelling. This project will apply the appropriate concepts to the long time series of hoki demographics, sex ratios, body condition, and recently collected data of other biological attributes (liver condition and individual gonad development) to identify indices correlated with stock productivity. A synthesis of information available on hoki and current research results on parental effects may also suggest new indices to develop, such as female energy reserves, spawning data by age, age structure of males, or egg atresia rates as indicators of success in a given year.

Weighting of Objectives:

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

Project: Stock assessment of jack mackerels in JMA7

Project Code: JMA2009-02

Start Date: 1 December 2009

Completion Date: 31 December 2010

Vessel Use: None

Overall Objectives:

1. To conduct stock assessments for the two New Zealand species, *Trachurus declivis* and *T. novaezelandiae* in JMA 7, including estimating biomass and sustainable yields.

Specific Objectives:

1. To update the descriptive analysis of the fisheries for jack mackerels in JMA7 with the inclusion of data up to the end of the 2008/09 fishing year.

2. To review and summarise the historical biological and other relevant data (including length frequency, sex ratio, otoliths, and reproductive condition data) for jack mackerel collected from shed sampling, the scientific observers programme and other sources (e.g. historical survey work) and the use of these data as inputs into a stock assessment.

3. To update the standardised and unstandardised CPUE indices with the inclusion of data up to the end of the 2008/09 fishing year.

4. To conduct stock assessments including estimating biomass and sustainable yields for jack mackerel species *Trachurus declivis* and *T. novaezelandiae* (JMA 7).

Reporting Requirements:
Research Reporting

Objectives 1 to 4

1. To present the results to the Middle Depths Working Group at meetings in Wellington in September 2010 as required.

2. To submit to the Chief Scientist MFish a draft Working Group Report as specified in Research Reporting form 8 by 30 September 2010.

3. To submit to the Chief Scientist MFish a Final Research Report as specified in Research Reporting form 5 or a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 September 2010.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MFish by 31 December 2010.

Rationale:

General
The jack mackerel fisheries catch three species, the two New Zealand species, *Trachurus declivis* and *T. novaezelandiae*, and the more recently arrived *T. murphyi*. The non-native *T. murphyi* spread into New Zealand waters in the early 1980s and in some years is the dominant species in some areas.

Jack mackerels were introduced to the QMS as a species assemblage of the three species *T. declivis* (JMD), *T. novaezelandiae* (JMN) and *T. murphyi* (JMM) under a single species code, JMA. Accordingly it is not possible to determine the quantity of each species caught annually from commercial catch landings data.

In the last 6 years the catch of jack mackerel has increased to the level of the TACC in JMA7. The increase in landings has been attributed to market demand and reduction in the availability of quota for other preferred species. Reported landings in 2007-08 were 34 059 t.

A preliminary stock assessment was completed in research project JMA2004/02 and is reported in the 2008 Plenary report:

> "Of the three jack mackerel species taken in JMA 7, recent information on stock status is only available for *T. declivis*. The current TACC is approximately 50% greater than the historical MCY-based yield estimates for *T. declivis* and *T. novaezelandiae* combined. These estimates of yield do not include *T. murphyi* which comprise an important part of the catches from JMA 7 in some years.
>
> The 2007 preliminary assessment for *T. declivis* did not indicate sustainability concerns with this component of JMA 7 at that time though there are uncertainties in the assessment relating to the catch histories and abundance indices. The preliminary stock assessment indicates that current biomass is 53% of B_0, so the stock is probably above B_{MSY}. The historical estimate of B_0 (see MCY section) is similar to that from the 2007 assessment.
>
> The status of *T. novaezelandiae* and *T. murphyi* in JMA 7 is not known, nor is the sustainability of current removals of these species.

> Overall it cannot be determined if the TAC or current removals are sustainable for JMA 7, but it is likely that the removals from one component of the fishery (*T. declivis*) are sustainable at this time. Given increased catches in recent years continued monitoring of the catch composition is strongly recommended as is further work on potential abundance indices."

The recent increase in catches from the JMA7 fishery suggests that stock assessments are required for the two New Zealand species. The medium term research plan for jack mackerels indicates that a stock assessment is scheduled for 2009-10.

Objective 1
A descriptive analysis of the fishery is important to understand the way in which the fishery operates and how it may change over time. Any subsequent changes over time are important for the interpretation of CPUE indices and other fishery dependent data.

Under this objective the previous characterisations should be updated and the spatial and seasonal structure of the fishery be described. Fleet composition should be examined for consistency over time and any potential changes in gear configuration considered.

Objective 2
Relevant information from recent shed sampling or scientific observer programmes should be compiled for inclusion in the stock assessment. Any historical data not previously included in the assessment, but considered useful for inclusion, should be compiled under this objective.

Objective 3
The previous CPUE analysis should be updated taking into account any changes in the fishery identified under Objective 1. Special consideration should be given to the importance of spatial factors.

Objective 4
This will be the first assessment undertaken for this stock and will be strongly reliant on the successful development of a CPUE series under specific objective 3. It is anticipated that an age-structured assessment would be developed to allow incorporation of the catch sampling data.

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

Weighting of Objectives:

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.1, 0.1, 0.3, 0.5

Project: Characterisation and fishery monitoring of middle depth species

Project Code: MID2009-01

Start Date: 01 December 2009

Completion Date: 31 December 2010

Vessel Use: None

Overall Objectives:

1. To review the status of middle depth Fishstocks not routinely assessed. The two species chosen for review this year are ribaldo and lookdown dory.

Specific Objectives:

Ribaldo

1. To characterise the New Zealand ribaldo fisheries by analysis of commercial catch and effort data up to 2008/09 including:
   - To carry our CPUE analyses for the major fisheries (Fishstocks) where appropriate.
   - To review the indices from CPUE analyses, all relevant research trawl surveys and Observer logbooks to determine any trends in biomass estimates, size frequency distributions or catch rates.
   - To review stock structure using data accessed above and any other relevant biological or fishery information.
   - To assess the availability and utility of developing a series of age frequency distributions from trawl survey and Observer collected otoliths.
   - To make recommendations on future data requirements (including recommendations for annual levels of Observer sampling) and methods for monitoring the stocks.

Lookdown dory

2. To characterise the New Zealand lookdown dory fisheries by analysis of commercial catch and effort data up to 2008/09 including:
   - To carry our CPUE analyses for the major fisheries (Fishstocks) where appropriate.
   - To review the indices from CPUE analyses, all relevant research trawl surveys and Observer logbooks to determine any trends in biomass estimates, size frequency distributions or catch rates.
   - To review stock structure using data accessed above and any other relevant biological or fishery information.
   - To assess the availability and utility of developing a series of age frequency distributions from trawl survey and Observer collected otoliths.

- To make recommendations on future data requirements (including recommendations for annual levels of Observer sampling) and methods for monitoring the stocks.

Reporting Requirements:
Research Reporting

Objective 1

1. To present the results to the Middle Depths Working Group at meetings in Wellington in September 2010 as required.

2. To submit to the Chief Scientist MFish a draft Working Group Report as specified in Research Reporting form 8 by 30 September 2010.

3. To submit to the Chief Scientist MFish a Final Research Report as specified in Research Reporting form 5 or a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 September 2010.

Objective 2

1. To present the results to the Middle Depths Working Group at meetings in Wellington in September 2010 as required.

2. To submit to the Chief Scientist MFish a draft Working Group Report as specified in Research Reporting form 8 by 30 September 2010.

3. To submit to the Chief Scientist MFish a Final Research Report as specified in Research Reporting form 5 or a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 September 2010.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MFish by 31 December 2010.

Rationale:

General
Many of the middle depth fisheries are of moderate size or value compared to the hoki, hake, ling and southern blue whiting fisheries and are not routinely monitored or

assessed. This project is designed to ensure that data available for monitoring the moderately important middle depth species are routinely summarised and assessed on a 5 year rotating schedule. This will allow for research needs relevant to current management issues to be appropriately assessed.

The medium term research plan lists the requirements for future research for each species. Updating the fishery characterisations for 2 species each year will ensure that they are all updated at least every 5 years. The most recent reports on characterisations and other stock assessment research for middle depth species are:

Species	Characterisation	Other stock assessment research
Arrow squid	1988,1995 1997 (Japanese) 2008-09 (proposed)	CPUE 2001 *N. sloanii* Age and growth 1992 (Japanese) MID2008-01
Barracouta	1988 BAR1 2002 2008-09 (proposed)	Tagging 1989 BAR 5 CPUE SI stock structure 2002 CPUE BAR1 2002 CPUE BAR5 1999 MID2008-01
Blue warehou	2005	Stock assessment 1999 WAR3 Age methodology 1998
Frostfish	2001	Biology, commercial landings 1998
Gemfish – southern	1998	Climate and recruitment 1999
Ghost shark – dark – pale	2003 2003	Ageing technique 2001
Lookdown dory	None	Ageing (LDO2004/01)
Ribaldo	2006 (Up to 2002-03)	Ageing (RIB2007/01)
Silver warehou	2007-08	MID2007-03 (SWA 3 & 4) Stock structure 2001 Ageing methodology 1996
White warehou	2005	Ageing & stock assessment 1999

Based on the information needs required to manage these fisheries in the short-term, ribaldo and lookdown dory have been chosen for full characterisation in MID2009/01.

Objective 1

In New Zealand ribaldo is caught on bottom longlines and as a bycatch of trawling. Up to 7000 t were reported in 1977 by Japanese and Korean longline vessels target fishing for ling on the Chatham Rise and east coast of the South Island in the 1970s. In recent years (since the early 1990s) most of the New Zealand catch has probably been by longline but most reported catch from about 1978 to 1990 has probably been as a bycatch during target trawling for hoki (*Macruronus novaezelandiae*), orange roughy (*Hoplostethus atlanticus*) and ling (*Genypterus blacodes*) at 500–1000 m. Reported catch has been mainly from the Chatham Rise and east coast South Island (QMAs 3 & 4) and since 1991–92 from east coast North Island (QMAs 1 & 2). Reported catch prior to 1990 was probably less than actual catch because some of the ribaldo caught by trawling was discarded.

Ribaldo was introduced into the QMS from 1 October 1998. The TACCs remained unchanged until the 2000–01 fishing year when quotas were raised for QMAs 1, 2 and 3. TACCs were increased from 1 October 2006 in RIB 6 to 231 t and in RIB 7 to 330 t. In these stocks landings were above the TACC for a number of years and the TACCs have been increased to the average of the previous 7 years plus an additional 10%.

The stock status is unknown for any ribaldo stocks. The objective of this project is to describe the main fisheries for ribaldo and determine by what means the stocks can be monitored in the long term to determine whether the TACCs are appropriate in each area. The working group report should also be updated to reflect the latest information available.

Objective 2

Lookdown dory is generally caught by bottom trawling in depths of 200 to 800 m as a bycatch in a range of fisheries including hoki, barracouta, hake, ling, scampi and jack mackerel. A small amount of target fishing is reported from FMA 7. Most of the catch has come from FMA 3 (east coast South Island), FMA 4 (Chatham Rise), and FMA 7 (west coast South Island) (Table 4). Landings from around the North Island have been restricted mostly to a few tonnes from FMA 1 and FMA 2 in each year, as well as from FMA 9 in the last three fishing years. In FMA 5 (Southland) and FMA 6 (Sub-Antarctic) landings have been in the order of 10–30 t over the past six years. No landings have been reported from outside the New Zealand EEZ.

The greatest proportion of the estimated catch of lookdown dory is taken as bycatch in the hoki fishery. For all fishing years and FMAs combined, 83% of lookdown dory catch has been bycatch in the hoki fishery, with other fisheries (barracouta 4%, hake 3%, ling 2% and scampi 2%) catching a smaller fraction.

There are no known sustainability concerns in the lookdown dory fishery. Trawl surveys indicate stable abundance in the main fishery. However, the stock status is unknown for any lookdown dory stocks. The objective of this project is to describe the main fisheries for lookdown dory and determine by what means the stocks can be monitored in the long term to determine whether the TACCs are appropriate in each area. The working group report should also be updated to reflect the latest information available.

Weighting of Objectives:

Weightings indicate the relative importance of each of the objectives. The weightings for the objectives in this project are (in order): 0.5, 0.5

Project: Stock assessment of southern blue whiting

Project Code: SBW2009-01

Start Date: 01 October 2009

Completion Date: 30 September 2010

Vessel Use: None

Overall Objectives:

1. To carry out stock assessments of southern blue whiting (*Micromesistius australis*) including estimating biomass and sustainable yields.

Specific Objectives:

1. To determine catch at age from the commercial fisheries at Campbell Island, Auckland Island, Bounty Platform, and Pukaki Rise for 2008/09 from samples collected at sea by the Observer Programme and other sources, with a target coefficient of variation (c.v.) of 20 % (mean weighted c.v. across all age classes).

2. To update the stock assessment of the Campbell Island stock, including estimating biomass and sustainable yields.

Reporting Requirements:
Research Reporting

Objectives 1 and 2

1. To present the results to the Middle Depths Working Group at meetings in Wellington in March-April 2010 as required.

2. To submit to the Chief Scientist MFish a draft Working Group Report as specified in Research Reporting form 8 by 20 March 2010.

3. To submit to the Chief Scientist MFish a Final Research Report as specified in Research Reporting form 5 or a draft Fishery Assessment Report as specified in Research Reporting form 7 by 30 September 2010.

Project Update Reports

No Project Update Reporting is required for this project.

Work In Progress Reports

Monthly Work In Progress Reporting is required for this project in accordance with the Conducting Research with the Ministry document.

Data Reporting

To submit any data generated, collected or modified during the course of this project to the Research Data Manager, MFish by 30 September 2010.

Rationale:

General
This fishery was developed in the early 1970's by the Soviet fleet. Landings have fluctuated considerably, peaking at 75,000 t in the 1991/92 fishing year, when almost 60,000 t was taken from the Bounty Platform stock. From 1992/93 to 1995/96 an annual catch limit of 32 000 t applied, but this was increased for the 1996/97 fishing year to 58 000 t, as the stock assessment indicated higher yields were available. Southern blue whiting was introduced into the QMS in 1999 with separate TACs for each of the four main stocks in SBW6. TACCs have been set at the level of the estimated CAY in most stocks each year resulting in fluctuating total catch limits. The TACC was reduced to 20 000 t from 1 April 2006.

There is uncertainty over the estimates of current stock size for all four stocks. This is due to imprecision in the acoustic data and to uncertainty over recent and future recruitment. The fishery is strongly recruitment driven and is currently dependent on less than 5 year classes, compared with up to 15 year classes in the past. The most recent stock status for the Campbell Islands stock was not updated in 2009, and remains as described in the 2007 Plenary report:

> "The 2006 Campbell Island stock assessment was updated by including an additional year of proportion-at-age data and an additional acoustic index. For the base case, B_{2006} was estimated to be 78 000 t (90% credible interval 56 000–106 000 t), corresponding to 30%B_0 (90% credible interval 20–41%).
>
> The catch is dominated numerically by the strong 2001 and 2002 year classes, and the incoming 2004 year class also appears to be above average. The TACC was reduced to 20 000 t in 1 April 2006, and at this level of catch, the biomass is projected to remain stable over the next 2–3 years. At the current TACC level, the probability that the biomass will drop below B_{1991} is projected to rise to 3% over the next three years (Table 10). The assessment is much more optimistic than the equivalent stock assessment presented in 2006, particularly in the projections, as stock size is not predicted to decrease with future catches of 20 000 t (current TACC)".

Objective 1
A time series of catch at age data has been developed for all the fisheries using otolith samples collected by the Observer Programme. Catch at age data provides information on the year class strength of recent recruitment to the fishery. These are important in future predictions of stock biomass and yield.

Objective 2
In 2010, another year of catch at age data will be available from objective 1. For the Campbell Islands Rise stock a new estimate of biomass from the 2009 acoustic survey (SBW2009/02) will also be available to update the assessment.

Weighting of Objectives:

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