

# Revision of RMP - Status of ongoing work at the Norwegian Computing Center

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30th May 2005

## 1 Introduction

At the IWC meeting in 2004 (IWC/56/22) the Norwegian Government notified that Norway would like to revise the RMP for North Atlantic minke whales in light of new knowledge and improved computer capacities the last ten years. This involves using  $MSYR^{1+}$  instead of  $MSYR^{mature}$ , and estimating  $MSYR^{1+}$  from available survey and catch/effort data. Further, the current version of RMP are based on simulation trials with depletion level calculated after 100 years of simulation. We intend to run relevant trials for 300 years or until equilibrium is reached.

The Norwegian Computing Center will carry out the scientific work in cooperation with Tore Schweder. Magne Aldrin is head of the project at the Norwegian Computing Center.

The project started in February 2005, and is intended to be completed by the IWC meeting in spring 2006. In the following we will present the content and status of the project.

## 2 Project content and current status

The project can be divided into four main tasks:

1. Estimation of relative abundance series
2. Re-tuning of the catch limit algorithm (CLA)
3. Estimation of  $MSYR^{1+}$
4. Performance and robustness trials for the re-tuned CLA

Tasks 2, 3 and 4 involves simulating from the BALEEN II population model (Punt 1999), using the IWC programs MANTST and MANNA for single stock and multiple stocks simulation trials. As a part of the project, these programs have recently been modified by to allow for  $MSYR$  defined relative to the 1+ population and to run the trials for more than 100 years (up to 2000).

### 2.1 Estimation of relative abundance series

Relative abundance series from 1952 until today will be estimated from catch per unit effort data for E medium area, in the spirit of the work by Cooke (1993) and Schweder and Volden (1994). A central element of the modelling will be the use of boat-specific efficiencies to adjust for the trend towards larger and more efficient boats. Further, the locations of the catches will be taken into account, to adjust for the movement of the catch towards more efficient areas over time. However, substantial changes in catch procedures took place after 1983, including a break in commercial catch from 1988 to 1992. Therefore we will possibly estimate one relative series from 1952 to 1983, and another from 1993 to 2004, without linking these together.

This work will lead to an unsmoothed relative abundance series, possibly broken into two pieces, accompanied by a likelihood function representing information and variability in the catch and effort data.

The work on this task has started, and will probably be finished within the end of 2005.

### 2.2 Re-tuning of the catch limit algorithm (CLA)

The CLA currently in use is tuned with  $MSYR^{mature} = 1\%$ . We will tune it with  $MSYR^{1+} = 1\%$ . Re-tuning with other values may be done as well, based on the

new estimate of  $MSYR^{1+}$  (see task 3).

### **2.3 Estimation of $MSYR^{1+}$**

$MSYR^{1+}$  will be estimated from the relative abundance series estimated in task 1, together with absolute abundance estimates from 1989, 1995 and 1996-2001 (yearly, but less extensive surveys). This will be done by maximizing an integrated likelihood representing both the catch/effort data and the survey data, and using the deterministic BALEEN II model with historical catches. The approach is similar to the so called Hitter-Fitter method, see for instance Cooke (1993) and Schweder, Hagen and Hatlebakk (1997). It involves simulating population trajectories from the BALEEN II model (using MANTST or MANNA) for various values of  $MSYR^{1+}$  and fit them to the abundance estimates, taking into account the uncertainty of the abundance estimates.

Fitting a population dynamics model to the unsmoothed relative abundance data and the other relevant data leads to a smoothed abundance series in addition to estimates of productivity parameters. Cooke (1993) points out the need to account for extra variability caused by a changing migratory pattern, variability in weather, and variability in other factors influencing catch efficiency when abundance series are estimated. Such extra variability could also influence survey response. Our intention is to introduce random components to the likelihood of unsmoothed relative abundance series, and also to the likelihood representing the survey series, to account for such extra variability.

### **2.4 Performance and robustness trials for the re-tuned CLA**

Finally, the efficiency and the robustness of the re-tuned CLA will be tested by simulation trials from the BALEEN II model, again using MANTST and/or MANNA, in similar way as was done in the RMP work in the early nineties. The aim of the robustness trials is to ensure that the probability for the abundance to be threatened is minimal, even for rather unlikely and unfavourable values of the model parameters.

## References

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