Appendix 1

AGENDA

1. INTRODUCTORY ITEMS
    - 1.1 Convenor's opening remarks
    - 1.2 Election of Chair and appointment of rapporteurs
    - 1.3 Adoption of Agenda
    - 1.4 Available documents

2. REVISED MANAGEMENT PROCEDURE (RMP) – GENERAL ISSUES
    - 2.1 Matters related to MSYR and MSYL
        - 2.1.1 Review MSYR Workshop report, if appropriate suggest changes to the plausible range
        - 2.1.2 Modelling MSY-related parameters under stochastic dynamics
    - 2.2 Finalise the process for reviewing proposals to amend the RMP
    - 2.3 Consideration of the Norwegian proposal to amend the RMP
    - 2.4 Work plan

3. RMP – PREPARATIONS FOR IMPLEMENTATION
    - 3.1 Western North Pacific Bryde's whales
        - 3.1.1 Finalise abundance estimates for western North Pacific Bryde's whales
        - 3.1.2 Review of proposed research plan
        - 3.1.3 Work plan
    - 3.2 North Atlantic fin whales
        - 3.2.1 Report of the First Intersessional Workshop
        - 3.2.2 Objectives of the First Annual Meeting
        - 3.2.3 Review results of conditioning
        - 3.2.4 Updates to standard datasets
        - 3.2.5 Final consideration of plausibility (including weighting of trials in terms of overall balance)
            - 3.2.5.1 Stock structure hypotheses
            - 3.2.5.2 Other
        - 3.2.6 Data/research to reduce hypotheses
        - 3.2.7 Specification of operational features and management variants
        - 3.2.8 Specification and classification of final trials
        - 3.2.9 Inputs for actual application of the CLA
        - 3.2.10 Work plan
    - 3.3 North Atlantic common minke whales
        - 3.3.1 Implementation Review
            - 3.3.1.1. History
            - 3.3.1.2. Stock structure
            - 3.3.1.3. Abundance estimates
            - 3.3.1.4. Implementation Simulation Trials
            - 3.3.1.5. Management area*s*
        - 3.3.2. Recommendations
    - 3.4 North Pacific common minke whales (RMP/NPM)
        - 3.4.1 Progress on developing an inventory of the new data available
        - 3.4.2. Recommendations

4. WORK PLAN

5. ADOPTION OF REPORT

Appendix 2

ESTIMATION OF *MSYR* IN THE PRESENCE OF ENVIRONMENTALLY-INDUCED VARIABILITY: FURTHER SPECIFICATION OF MODELS USED IN SC/59/RMP10 AND SC/NO1/MSYR1

Justin Cooke

Model for the true population ("operating model")
The true population is simulated using a bulk, non-age structured model:

$$x_{t+1} = x_t \exp\left(r(x_t, t) - F_t\right)$$

x_t: stock size in year *t*
F_t: fishing mortality rate in year t
$r(x,t)$: net recruitment rate, given by:

$$r(x,t) = r_{\max}\left(1 - e^{-\left(\sigma\eta_t + \frac{1}{2}\sigma^2\right)}\left(1 - q + q\left(x/K\right)\right)^z\right)$$

K : mean carrying capacity (set to 1.0 so that all population sizes are relative to K)
z : density-dependent exponent (set to 2.39)
q : habitat quality ($0 < q \leq 1$) (values used in trials are 0.1, 0.4 and 0.9)
σ : level of environmental variability (values used in trials are 0.0, 0.5 and 1.0)
η_t : standard N(0,1) random variables, not necessarily uncorrelated

Serial correlation in environmental variability is modelled by invoking a sequence v_t of uncorrelated N(0,1) random variables, such that:

$$\eta_0 = \nu_0$$
$$\eta_t = \rho\nu_t + \sqrt{1-\rho^2}\,\nu_{t-1} \quad (t = 1, 2, ...)$$

The serial correlation ρ was set to 0.0, 0.5 or 0.9 in different trials.

MSYR and *MSYL* depend on both q and z and are found by maximisation of the yield $x\,r(x,t)$.

In the simulations, the population is subject to T_0 years of exploitation at a constant fishing mortality rate, followed by T_1 years of protection with annual surveys of population size.

During the monitoring period, an annual population estimate is obtained that is log-normally distributed with a given CV:

$$y_t = x_t \exp\left(\tau\zeta_t\right) \quad (t = T_0 + 1, ..., T_0 + T_1)$$

where $\tau^2 = \ln(1 + CV^2)$ and the ζ_t are standard normal uncorrelated random variables. Values used for CV were 0.0, 0.2, and 0.5.

There are two ways of specifying the depletion of the population at the start of the monitoring period:

Method 1 (used in SC/59/RMP10) defines the depletion level as a fraction of K. The population model is started at $t = T_0$ with $x_t = DK$, where D is the specified depletion level. Using this method, the period of exploitation is not explicitly modelled.

Method 2 is to start the population at $t = 0$ with $x_0 = K$. The level of fishing mortality is found which depletes the population to DK after T_0 years. If the population declines to below DK without catches, the simulation is discarded and a new simulation is run.

Model for the fitted population (assessment model)
The assessment model is deterministic:

$$x_{t+1} = \left(x_t - \tilde{c}_t\right)\exp\left(r(x_t)\right)$$
$$r(x) = r_0\left(1 - \left(x/K\right)^z\right)$$

c_t is the catch in year t. $\tilde{c}_t$ is the capped catch in year t : $\tilde{c}_t = \min\left(c_t, 0.5x_t\right)$. The catch-capping is used to prevent the fitted population becoming negative during the search for the minimum. The capping would not normally be active at the solution.

Parameter estimation
r_0 and K are free parameters to be estimated. The assessment model is fitted in each of two ways:
(i) with the assumption $x_0 = K$;
(ii) with x_0 (the initial population size) as an additional free parameter to be estimated.

When the true population has been simulated using method 2, then it is necessary to treat x_0 as a free parameter, because the period with catches has not been simulated.

The exponent z is kept fixed at the value 2.39, which corresponds to $MSYL = 0.6$. The estimate of *MSYR* is given by $r_0\, z/(1+z)$.

The model fitting is fitted by minimising the following expression for the deviation between observed and predicted abundance:

$$Q = \sum_{t=T_0+1}^{T_0+T_1}\left(\log\left(y_t/x_t\right)/\tau\right)^2$$

The model is fitted by a nested minimisation over K, r_0 and, optionally, x_0. The minimisation over K is performed at the innermost level, the minimisation over x_0, if applicable, at the outermost level. At each level, the function Q is first evaluated over a grid of points, to check for multiple minima, before the minimum is located.

Significance testing
A tally is kept of trials where the assumption $x_0 = K$ would be rejected in favour of $x_0 < K$ is kept by computing for each trial the difference $\Delta = Q\left(x_0 = K\right) - Q\left(\hat{x}_0\right)$. The cases where $\hat{x}_0 < K$ and $\Delta > 1.92$ constitute cases where the assumption $x_0 = K$ would be rejected in favour of a lower value of x_0 at the 2.5% significance level.

Reporting of results
For each trial, the following statistics are saved: best estimates of each of the fitted parameters (r_0, K and x_0), the goodness-of-fit Q, and the time series of true, observed and fitted population sizes by year during the monitoring period. The desired percentiles of each of the saved statistics are computed, separately for each statistic.