A preliminary simulation study of the implications of possible changes in growth on the assessment of Northern stock of European hake (*Merluccius merluccius*) and management advice

CM 2004/K:51

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Background

In June 2002, a pilot tagging experiment has been conducted by Ifremer on the "Grande Vasière", a nursery area situated in the northern part of the Bay of Biscay. 1307 hakes in the size range 13-58 cm (with a mode at 28 cm) have been tagged and released (de Pontual et al., 2003). To date, 40 have been recovered with a time at liberty from 1 to 440 days. Preliminary results from this experiment indicate that growth could be under-estimated (see poster CM 2004/K:66).
In this poster, we look at the potential effects changes in growth rates may have on the northern stock assessments of hake and management conducted by ICES. This is carried out by a simulation approach.

Simulation

An age-length key was generated assuming new von-Bertalanffy growth parameters. To get growth rates in the ball-park of what was observed from the tagging experiment, growth was modelled using the following parameter values : L_∞ = 120cm ; K = 0.2 ; t0 = 0. (figure 1).

This simulated age-length key was then used to rebuild the age-structured data files used by the Extended Survivors Analysis (XSA; Darby and Flatman, 1994) during the WGHMM 2003 stock assessment (Catch at age matrix and indices of abundance of the tuning fleets). An assessment (referred as "simulation" in this document) was then conducted with this new data set and compared with the 2003 assessment (referred as "WGHMM 2003").

Not surprisingly, the catch at age matrix (figure 2) is distorted with much less catches above age 3. For survey abundance indices, the new age group distributions among the observed quarterly length distributions are more consistent than in the original data as they fit better the observed two first modes (figure 3).

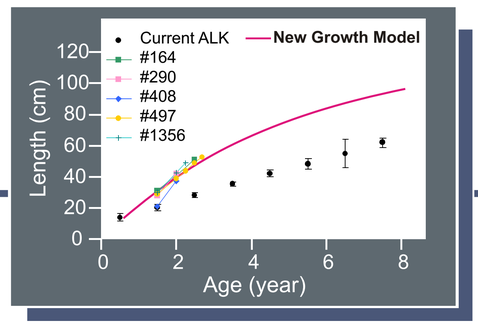

Fig.1 : New growth model, average lengths at age from the current ALK (1992 to 2002) and observed growth from release to recapture for 5 hakes having spent one summer and one winter at liberty

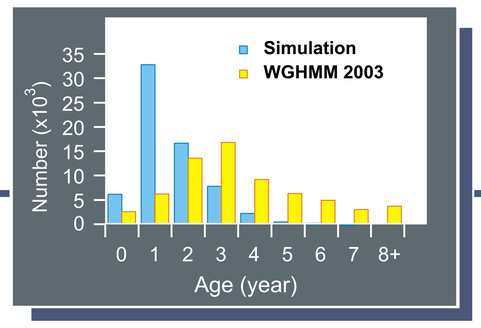

Fig.2: Average number at age 1998-2002 from two catch at age matrices (simulation and WGHMM 2003)

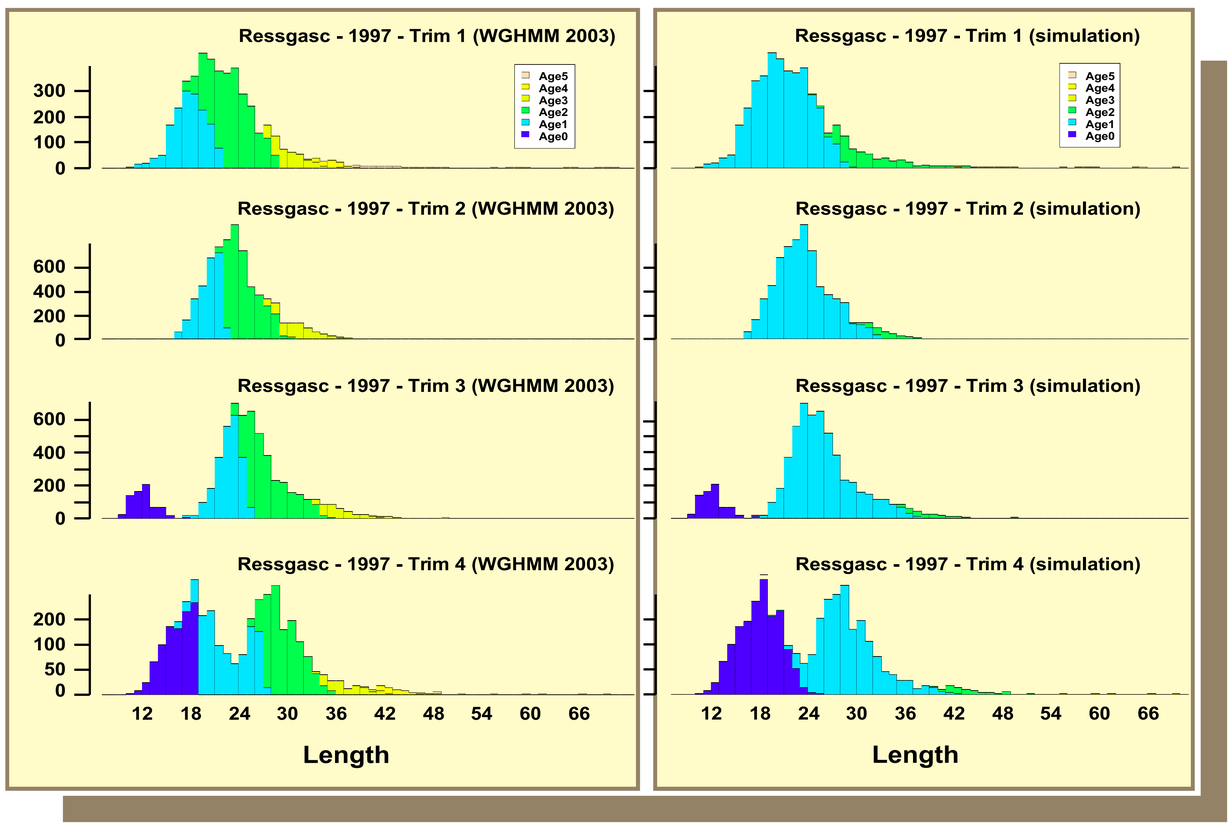

Fig.3 : Length distributions with age group repartition for 1997 RESSGASC tuning indices WGHMM 2003 (Left) and simulation (Right).

Assessment results

Trends in key variables (F, R and SSB) of the stock dynamics are presented in figures 4, 5 & 6. They do not exhibit drastic changes except at the beginning of the series where the SSB increases and F decreases.
It is important to note also that the absolute values are different with a much higher F (around 0.8 instead of 0.3) and lower biomass.
Using the same approach as ACFM 2003 to define the PA reference points, B_{lim} would be set at B_{loss} the lowest observed biomass in the assessment, i.e. 44 000 t. in 1998 and B_{PA} at 62000t.

Medium term projections were then made for a period of 10 years assuming status-quo F. A random recruitment was used for the period 1992-2001 corresponding to low values of SSB (fig.7a & 7b). The results indicate that SSB (and landings) should increase sharply as the strong 2002 cohort enters the SSB (and landing). This is probably an over-optimistic prediction as the 2002 cohort is probably over-estimated and would be down-revised as in previous year. Then, SSB would decrease to the level, higher than B_{PA}, corresponding to average recruitment value. SSB and catch trends show the impact of growth rate changes, resulting in a much more dynamic stock.
On the yield per recruit curve (figure 8), Fmax (0.18) and F0.1 (0.11) are respectively estimated to be 22% and 14% of reference F (respectively 61% and 36% in WGHMM 2003).

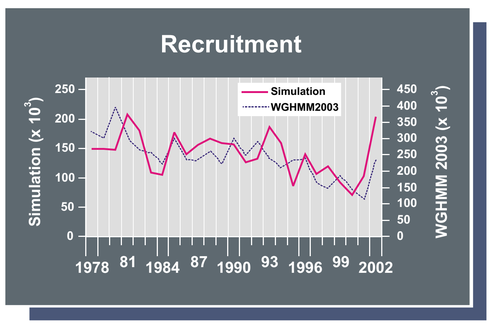

Fig.4 : Comparison of recruitment trends obtained in the simulation and in the WGHMM 2003.

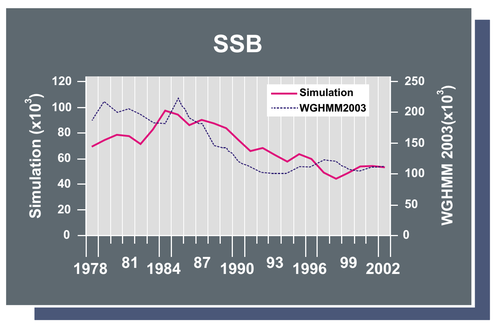

Fig.5 : Comparison of SSB trends obtained in the simulation and in the WGHMM 2003.

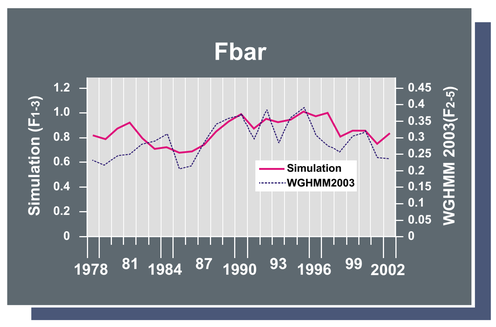

Fig.6 : Comparison of F trends obtained in the simulation and in the WGHMM 2003.

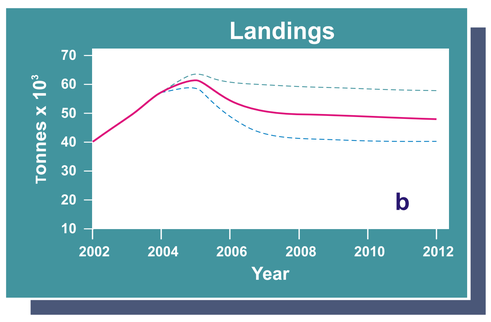

Fig.7a & b : Medium terms predictions. 500 simulations with random recruitment (1992-2001).

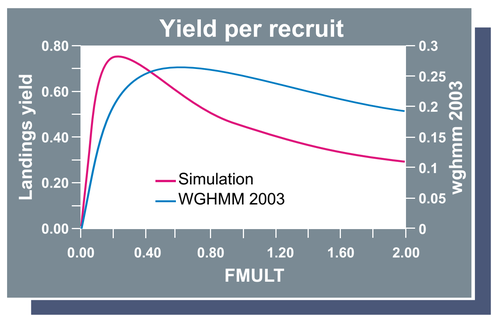

Fig.8 : Yield per recruit analysis.

This analysis should be taken with caution and considered for the moment as a simple illustration of what could be the impact of faster growth on our perception of the stock as :

1. it is based on very few fish and we need to continue the tagging in order to improve our knowledge on the hake growth.
2. we need to do more sensitivity analysis, on the value of M which we have kept at 0.2 while this should probably be increased, on the choice of tuning fleets which need to be reduced, on the settings of XSA, etc.

Despite this limitation, this study shows that change in growth will probably affects the absolute levels of estimates of fishing mortality and stock biomass from stock assessment but might not impact drastically the overall trends. This means that our perception of the stock will be roughly the same. However, the simulation also shows that a stock with such growth rates would be more reactive to changes in fishing levels, which would affect catch forecasts and advice.