Supplementary material 1: Estimated mortalities on whiting when all research vessel survey data is used as input

When the stock assessment models are fitted to all the empirical data, for the years 2004 and 2005 spikes in seal predation mortality (model A) and misreported fishing mortality (model B) are estimated (Figure S1.1).

Figure S1.1: Estimated mortalities (reported and misreported fishing $F$, natural $M$ and seal predation mortality $P$) on whiting when all abundance indices from research vessel surveys are considered in the model A (a) and the model B (b).

A similar spike is observed in average fishing mortality for some runs in (ICES 2013, 2014) but these runs are not kept as final outputs in the reports. As the ICES assessment uses a different model but also shows this effect, it suggests the anomaly is related to the input data rather than to the modelling assumptions alone, i.e. there is something in the empirical data which induces a high total mortality estimate on whiting for these two years. Because the empirical data does not show high levels of landings for these years, when the predation rate is fixed, the stock assessment model allocates the mortality to misreported catch and when it is variable, the model allocates the increase in mortality to an increase in grey seal predation.
Extensive work on different test simulations for whiting indicates signals of large mortality in the survey data from 2001 to 2005 may be responsible for this spike. Indeed, the same simulation but treating the survey data as missing values from 2001 to 2005 gives results for which the spike is absent or considerably reduced (Figures 1 and 3). Similar runs treating the catch data for these years as missing values instead of the survey data still present a spike showing the surveys to be responsible for this spike. Further investigating runs, considering certain surveys only, showed that the two Scottish surveys and the Irish quarter 4 survey are responsible for this spike, with the quarter 4 surveys having the largest impact.

If retained, the spike in mortality in turn leads to consumption by seals or misreported fishing mortality with high values inconsistent with the rest of their respective time series. It is evident that the simulations for which the survey data is removed between 2001 and 2005 are more likely to provide the appropriate state-space outputs for whiting.

References
