

Marine Strategy Framework Directive Consultation: UK Initial Assessment and proposals for Good Environmental Status

Impact Assessment Annex D

North Sea cod

Input Data

The information required for the stock projections is taken from the ICES 2011 assessment and forecast for the North Sea cod stock.

Stock and recruitment

Along with the future fishing mortality strategy, the major factor determining the trajectory of future biomass and yield is the linkage between the adult spawning biomass and the recruitment that it produces. Figure 1 presents the time series of recruitment at age 1. During the 1970's and 80's recruitment and spawning biomass were both high, during the 1990's and 2000's over-exploitation reduced spawning biomass and recruitment levels declined with it. In recent years, despite a reduction in fishing mortality rate recruitment levels have remained low since 2000 which may result from the low stock abundance or alternatively the poorer environmental conditions in recent years.

Figure 2 presents the fit of two alternative models for the future response of recruitment to increased spawning biomass; both models assume a constant level of recruitment after spawning biomass exceeds a set threshold. An "optimistic" model represents recovery of recruitment abundance to the historic levels recorded in the 1970's and 80's. A pessimistic model assumes that recruitment does not recover at high biomass abundance. Following warming of the North Sea waters there has been a debate as to whether the environment is less favorable for cod; the productivity of the North Sea may have changed and the historic dynamics cannot be recaptured. Additionally, some observers have commented that the high abundance of cod during the 1970's and 1980's was due to conditions prevalent at that time that resulted in a gadoid (cod whiting and haddock) outburst which supported uncharacteristically high populations.

The models reflect the current uncertainty as to the future dynamics of the North Sea cod and are used to evaluate management plans; both models are used in the North Sea cod scenarios.

Fishing mortality scenarios

Fishing mortality for cod in 2010 was $F=0.68$, well above that which is expected on average to achieve MSY yield from the stock. ICES advice states that F_{msy} for the North Sea cod is expected to lie in the range 0.16 – 0.42. ICES has suggested a target of 0.19 at the lower end of the scale. The current agreed EU Norway plan

uses 0.4 as its target for long term exploitation. Consequently North Sea cod fishing mortality has to be reduced to meet management objectives, and four potential scenarios are explored:

- 1) No change in the exploitation level – status quo fishing mortality at the current level.
- 2) The currently agreed EU-Norway North Sea cod management plan requires that fishing mortality is reduced by 10% annually until the management target of $F=0.4$ is reached. Consequently the scenario presented in green line of Figure 3 would apply for future fishing mortality.
- 3) ICES has an extremely optimistic target of $F=0.19$ for its Fmsy advice. Consequently it could be envisaged that at some stage the EU – Norway plan might be revised to reflect this; which is represented by a continuation of the reductions by 10% to 0.19 (the red line in Figure 3).
- 4) The final fishing mortality trajectory explored is that which STECF have said the current cod management plan has achieved a 1.5% reduction on fishing mortality per annum (the black line in Figure 3). Since the EU – Norway North Sea cod management was established the fishing mortality rate has shown only a minor decline as a result of increased levels of discarding (discussed below).

Note that due to the range within which Fmsy is considered to lie (model dependent from 0.16 – 0.42) both options (2) and (3) would be considered as achieving Fmsy in the long term. The potential difficulty with option (3) is that the Johannesburg Agreement requires achievement of Fmsy by 2015 “where possible”. If this is regarded as the Fmsy target, the rate of decline required will need to be much faster. (Norway do not recognise Fmsy as a target – due to its theoretical basis and therefore it is unlikely that they would agree to a sudden switch of the plan to the lower target).

Fishing mortality scenario (4) an annual reduction of 1.5% as noted by STECF for recent years was used as the current status for the evaluation. Scenario (2) the EU Norway long-term fishing mortality target of 0.4 was taken as the MSFD scenario as this target is consistent with the range of F_{MSY} estimated by ICES.

Discarding scenarios

Currently there is substantial discarding of cod within the European fisheries exploiting the North Sea cod (~25%) which reduces yield considerably by killing fish at a young age before they have had a chance to grow and throwing back marketable fish. The discarded fish are assumed dead in the model which is reasonable. A discard ban is being discussed with the aim of introducing it by 2018 and therefore undersized fish caught in a mixed fishery will be landed. Assuming that the industry does not change its selectivity for cod, to avoid discarding small fish, due to the potential loss of haddock and whiting, two potential scenarios could be envisaged:

- 1) Business as usual; discarding continues unchanged
- 2) A total discard ban is effective and yields are increased by landing the small fish that would have been discarded.

In the target MSY scenario, it is assumed that a discard ban becomes operational in 2018 and is 100% effective. Independent fishery selection patterns are used for the larger landed fish and smaller discards consequently the discard tonnage can be transferred to landings in the year that any discard ban is required without the need for further simulations runs.

Output

Figures 3 – 6 present realised fishing mortality, spawning stock biomass, discards and landings outcomes for each scenario. Both Fmsy scenarios of 0.19 and 0.4 with the low and high recruitment regimes lead to recovery of the stock to above the current Bpa level at which the stock is considered to be within safe biological limits.

Obviously, lower mortality rates lead to faster recovery and to higher levels of biomass and higher long term levels of catch. The main driver of the level of landings and discards is the future recruitment abundance at high stock abundance. At the lower recruitment level landings only show a moderate increase above those which are being taken currently from the stock at the lower fishing mortality rates.

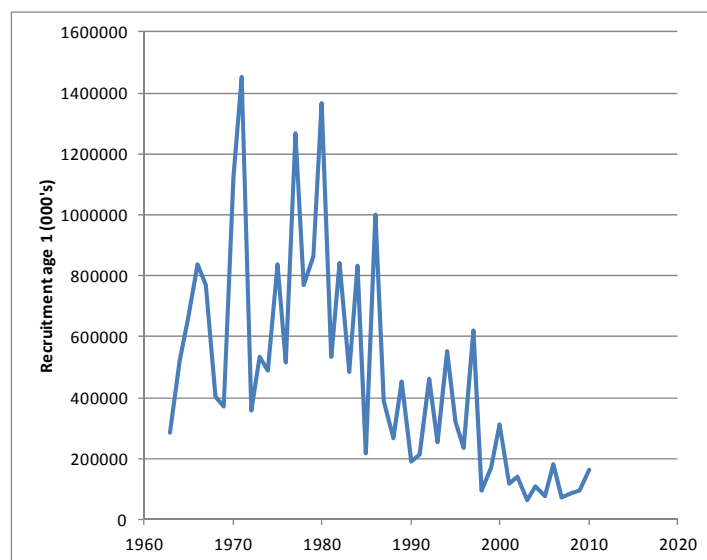


Figure 1. The time series of North Sea cod recruitment at age 1, illustrating the lower level of recruitment recorded since 2000 which may result from the low stock abundance or alternatively the poorer environmental conditions in recent years.

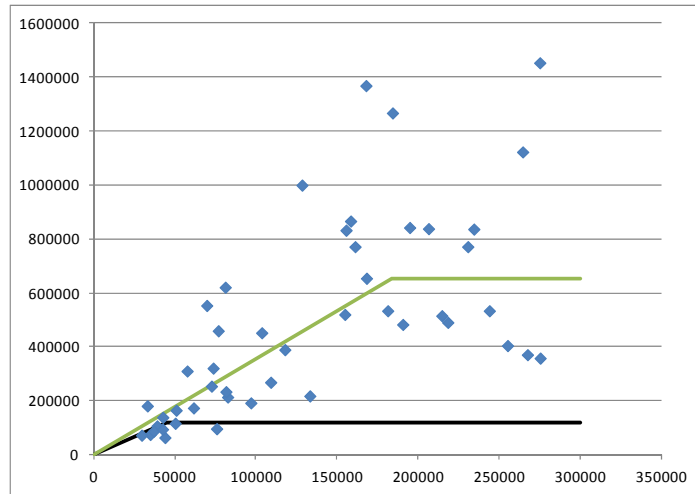


Figure 2. The fit of a model that assumes constant recruitment after spawning biomass exceeds a set threshold for a pessimistic model that assumes recruitment does not recover at higher biomass abundance (black) and a second more optimistic model that allows for recover of recruitment abundance to the historic levels.

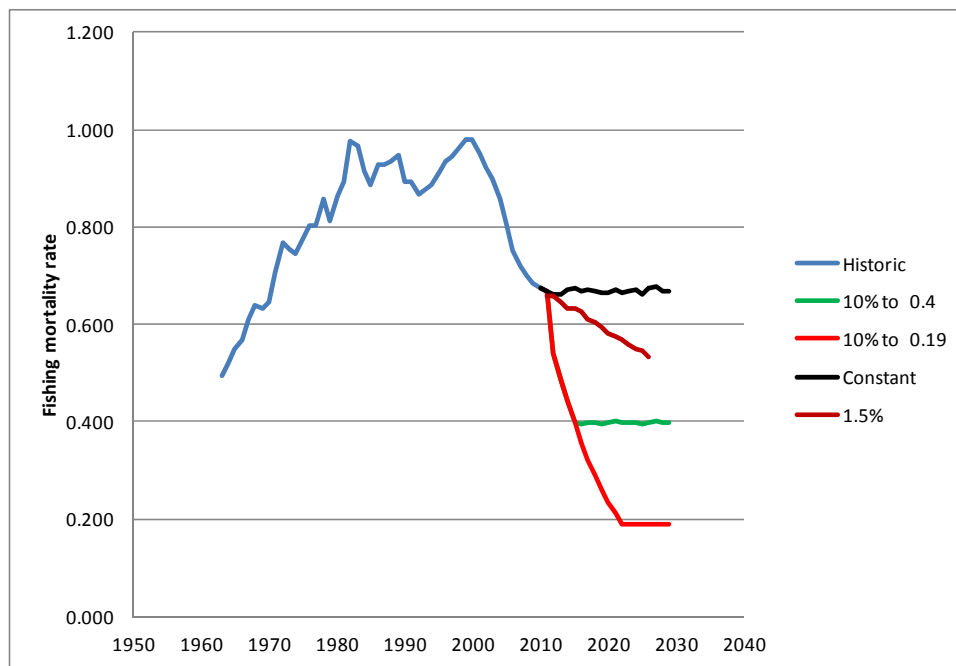


Figure 3. North Sea cod historic and representative future fishing mortality scenarios; green – 10% reductions to the current management target of 0.4; red - 10% reductions to the current management target of 0.19; brown a 1.5% reduction per annum; black – no change a pessimistic option.

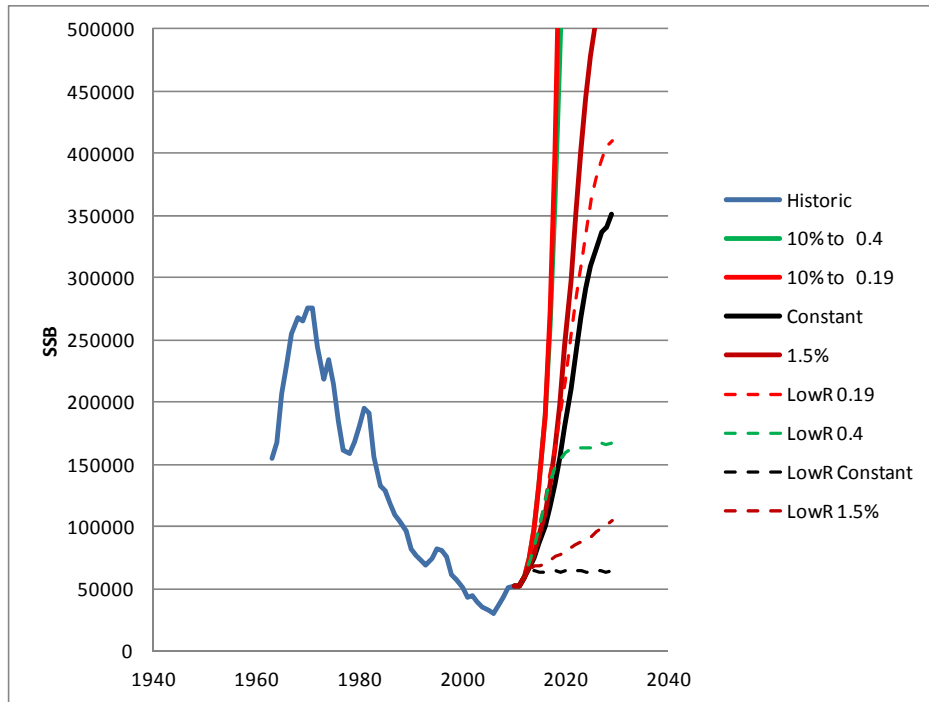


Figure 4. North Sea cod historic and projected spawning stock biomass. Solid lines represent the high recruitment scenario hashed lines the low recruitment scenario; green – 10% reductions to the current management target of 0.4; red - 10% reductions to the current management target of 0.19; brown a 1.5% reduction per annum; black – no change a pessimistic option.

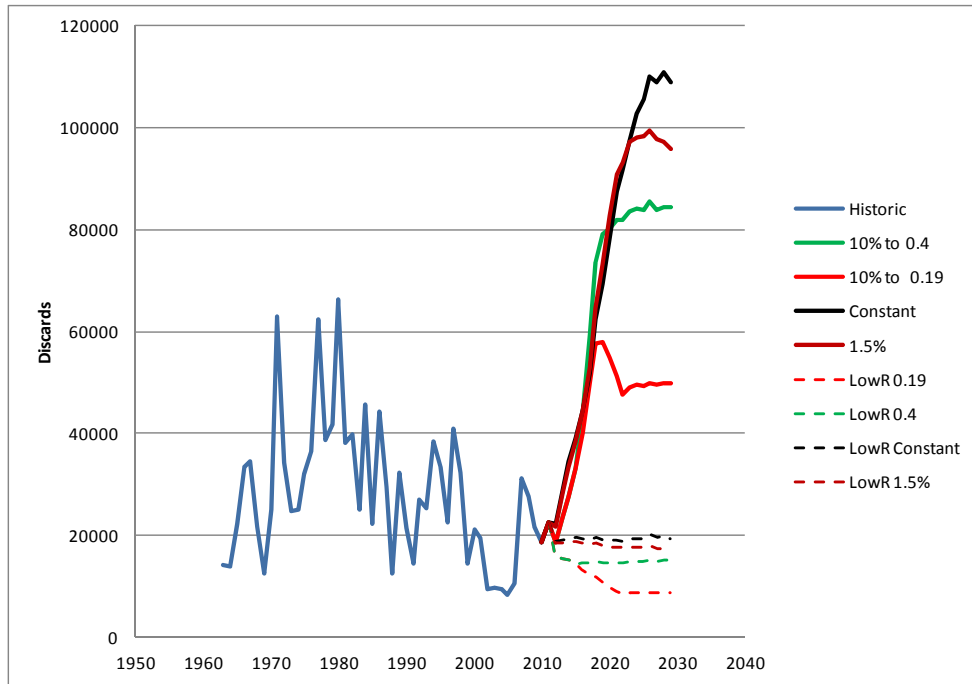


Figure 5. North Sea cod historic and projected discards assuming no discard ban. Solid lines represent the high recruitment scenario hashed lines the low recruitment scenario; green – 10% reductions to the current management target of 0.4; red - 10% reductions to the current management target of 0.19; brown a 1.5% reduction per annum; black – no change a pessimistic option.

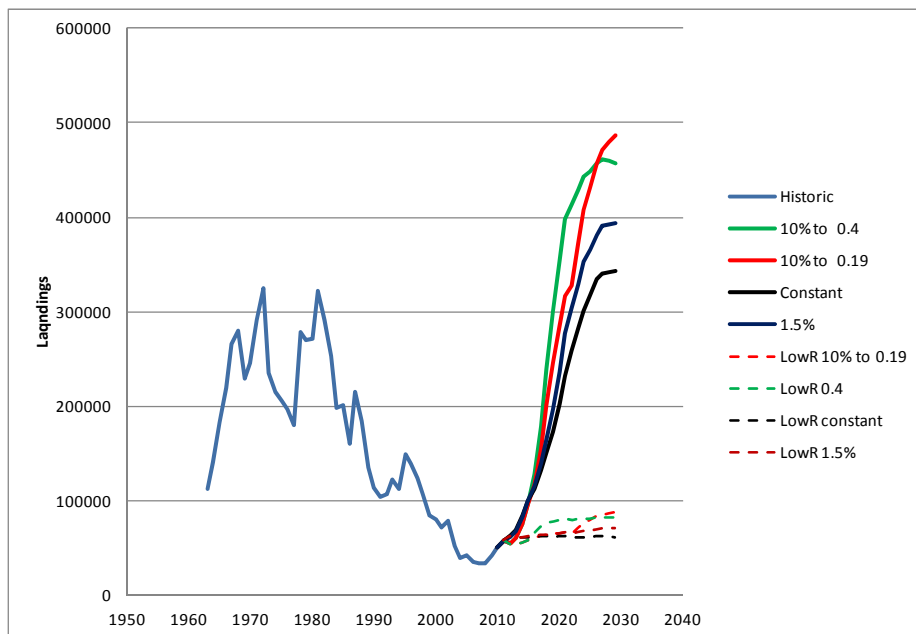


Figure 6. North Sea cod historic and projected landings assuming no discard ban. Solid lines represent the high recruitment scenario hashed lines the low recruitment scenario; green – 10% reductions to the current management target of 0.4; red - 10% reductions to the current management target of 0.19; brown a 1.5% reduction per annum; black – no change a pessimistic option.