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

Impact Assessment Annex D

North Sea haddock

Input Data

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

Stock and recruitment

Figure 1 presents the time series of recruitment at age 1 estimated by the ICES WGNSSK working group. There is no strong linkage between recruitment and stock biomass. Recruitment to the haddock stock is characterized by two features associated with the level at which recruitment is occurring:

a) Strong autocorrelation when recruitment is at a low level, usually following a high recruitment event, during which recruitment remains very low with little variation.
b) Periodic high level recruitment events that are rarely if ever followed by a second high recruitment.

This dynamic is very different from that of e.g. cod which exhibit substantial year to year variation and whiting which has strong autocorrelation with periodic changes in level that remain constant for several years.

Figure 2 presents the approach taken to simulating the recruitment dynamics of haddock in this study. Two stock and recruitment models are used to simulate the two observed levels of recruitment since 2000. Both of the models assume a constant level of recruitment when spawning biomass exceeds a set threshold (the lowest recorded value) and a decline to the origin at lower levels than the threshold.

Recruitment is generated from the low abundance model for the majority of years with interspersed high recruitment events which are then prevented from occurring for a random period. Recruitment is therefore largely independent of spawning stock abundance above the precautionary biomass limit, below which a decline to the origin is assumed.

Historically there has been significantly higher recruitment abundance as shown in Figure 1. However, since 2000 fishing mortality has been at a low level, spawning biomass has been estimated at the levels observed when the recruitment was more abundant (Figure 4) but the recruitment does not appear to have responded. Consequently, the simulations assume that the current regime of lower recruitment is continued, however, there may be the potential for the stock to rebuild to levels which produce more yield if the environment returns to more favourable conditions.

Fishing mortality scenarios

Fishing mortality for haddock is currently (F=0.23) below that which is expected on average to achieve MSY yield from the stock (ICES F_{MSY}=0.3), which is also the EU-Norway target within the North Sea haddock management plan. Consequently fishing mortality can be increased to meet the management objectives.

However, the recent trends in whitefish fishing mortality rates in the North Sea are not independent, in particular the fishing effort that can be exerted on haddock and whiting is largely determined by the effort management used to control the North Sea cod mortality rate. Consequently, four potential fishing mortality scenarios for haddock are explored (Figure 3):

1) No change in the haddock exploitation level – status quo fishing mortality at the current level (the black line in Figure 3).
2) The blue line in Figure 3 assumes that the fishery develops a fishing method or strategy by which it can decouple the realised haddock fishing mortality rate from that of the cod management plan and can achieve the target value in the agreed EU-Norway management plan – haddock mortality can therefore be increased to the target of 0.3.
3) The currently agreed EU-Norway North Sea cod management plan requires that cod fishing mortality is reduced by 10% annually until the management target of F=0.4 is achieved. Within EU waters this is being enacted by effort reductions across the whitefish fleets, consequently the scenario presented in green line of Figure 3 reduces haddock fishing mortality in line with the cod management plan to achieve a target rate of F=0.4.
4) Within its F_{MSY} advice ICES has an extremely optimistic target for cod mortality of F=0.19. Consequently it could be envisaged that at some stage the EU – Norway plan might be revised to reflect this; the effect of the potential reductions on haddock mortality rates is represented by a continuation of the reductions by 10% annually until the cod target is reached (the red line in Figure 3). As can be determined from Figure 3 this results in very low haddock mortality rates F<0.1.

Note that options 1 and 2 assume that a mechanism is found that allows the fishery for haddock can be decoupled from the cod fishery dynamics, options 3 and 4 assume the current linkage is maintained and that the cod plan drives the haddock fishery mortality.

Discarding scenarios

Currently there is substantial discarding of haddock within the European fisheries exploiting the North Sea which reduces yield. The majority of discarding is at the youngest ages and these have low yield potential and value. 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 thereafter presumably 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 (the main drivers for the current selection pattern of the gear), 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.

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

Percentiles of fishing mortality, spawning biomass, recruitment, discards and landings for a run of the model for 30 years are included for the options:

a. Status quo fishing mortality in the future
b. F_{MSY} fishing mortality at F=0.3
c. A 10% annual reduction in effort until cod achieves F=0.4
d. A 10% annual reduction in effort until cod achieves F=0.19

Figures 3 – 6 present realised fishing mortality, spawning stock biomass, discards and landings outcomes for each scenario.

The scenarios in which haddock mortality rates can be decoupled from that of cod result in higher discards and landings and lower levels of spawning biomass. All of the scenarios keep SSB above precautionary biomass levels.

The scenarios in which haddock mortality rates cannot be decoupled from that of cod result in lower discards and landings as the fishing mortality is reduced well below the target levels. The loss of haddock annual landings resulting from fishing the cod at F = 0.19 is 50% and from fishing cod at F= 0.4 is 20%.

Discussion

The recruitment model used in the simulations reflects the current uncertainty as to the future dynamics of the North Sea haddock productivity. Historically, as can be seen from Figure 6, the stock was more productive, recruitment levels were higher and landings also. Consequently there may be the potential for the stock to rebuild to very high levels if the environment returns to more favourable conditions. The simulations have been run forward to reflect the current conditions and consequently the estimated proportional losses from the haddock production as a result of the cod management at the two levels of F_{MSY}, are likely to be reasonably well determined but the absolute values uncertain.

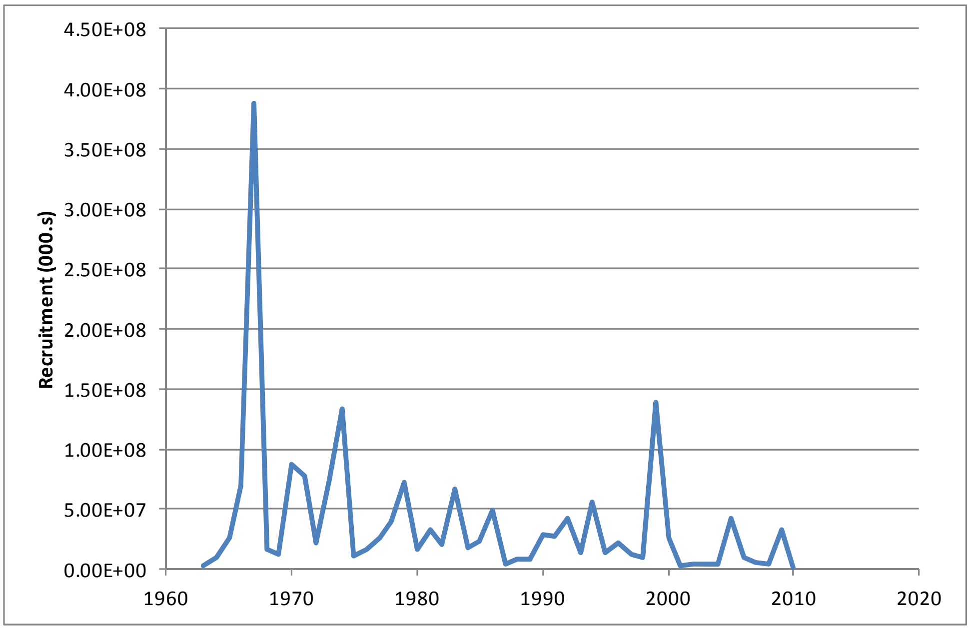


Figure 1. The time series of North Sea haddock recruitment at age 0, illustrating the current low relatively constant background level with periodic very strong year classes considered to be an environmentally driven process.

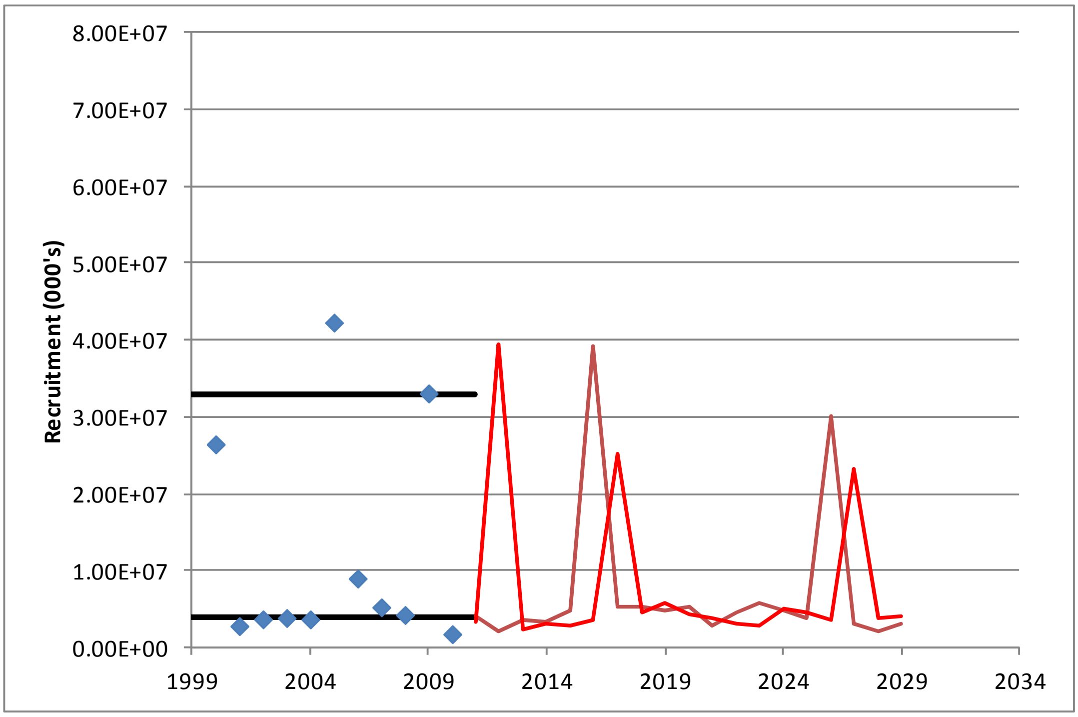


Figure 2. The fit to recent recruitment data (diamonds) of two models (black lines) that assume constant recruitment at two levels. Within the simulation model random draws are used to generate the low level of background recruitment with episodic high recruitment events at the higher level. Two example forward projections are illustrated.

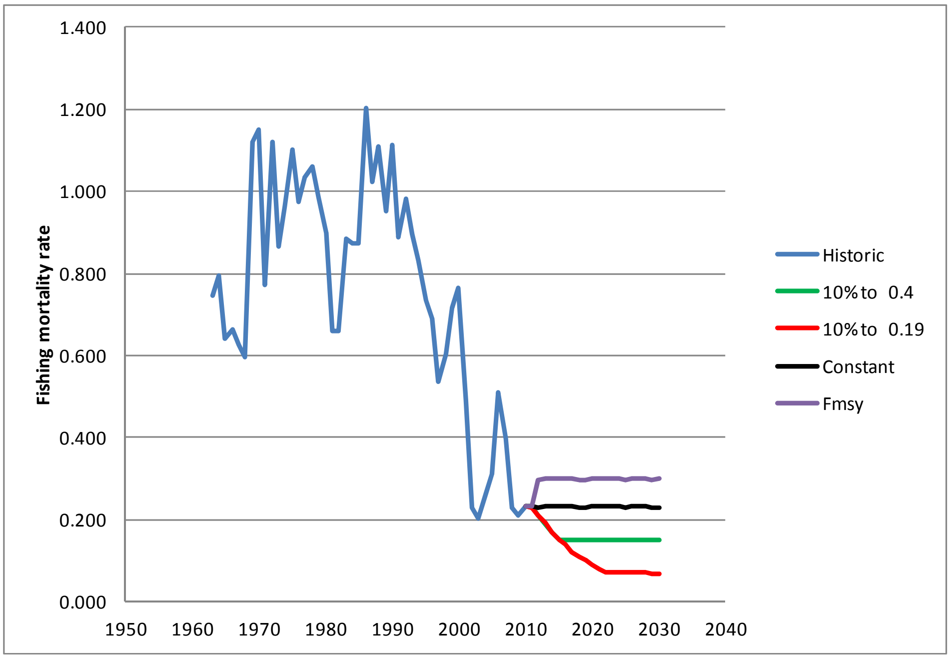


Figure 3. North Sea haddock historic and representative future fishing mortality scenarios; black – continued exploitation at the current level, purple an increase to the agreed management plan target, green – 10% reductions following the cod plan requirement to reach an F of 0.4; red - 10% reductions following the cod plan requirement to reach an F of 0.19.

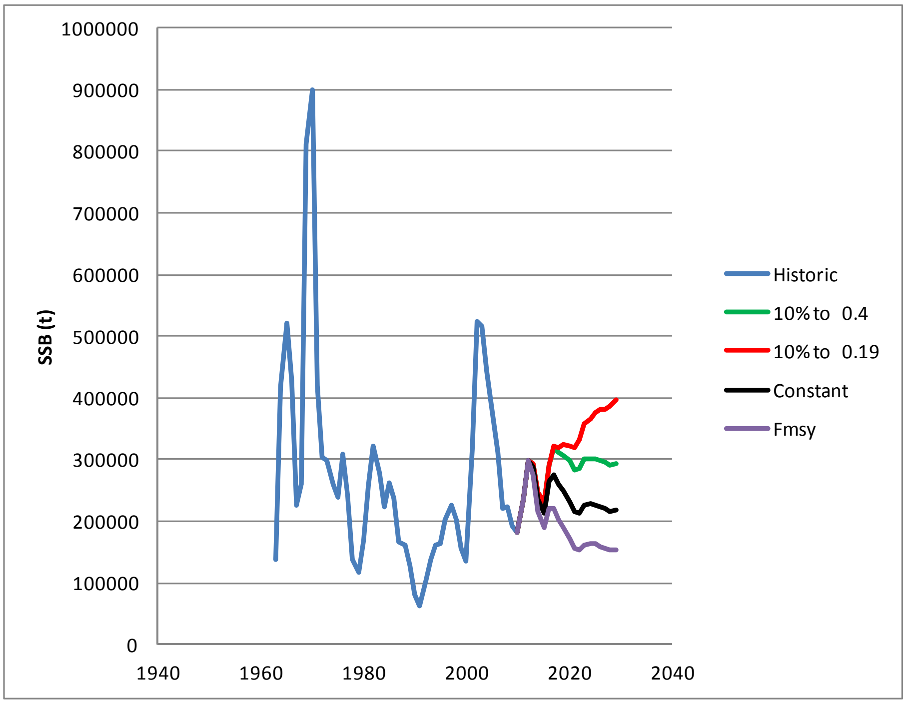
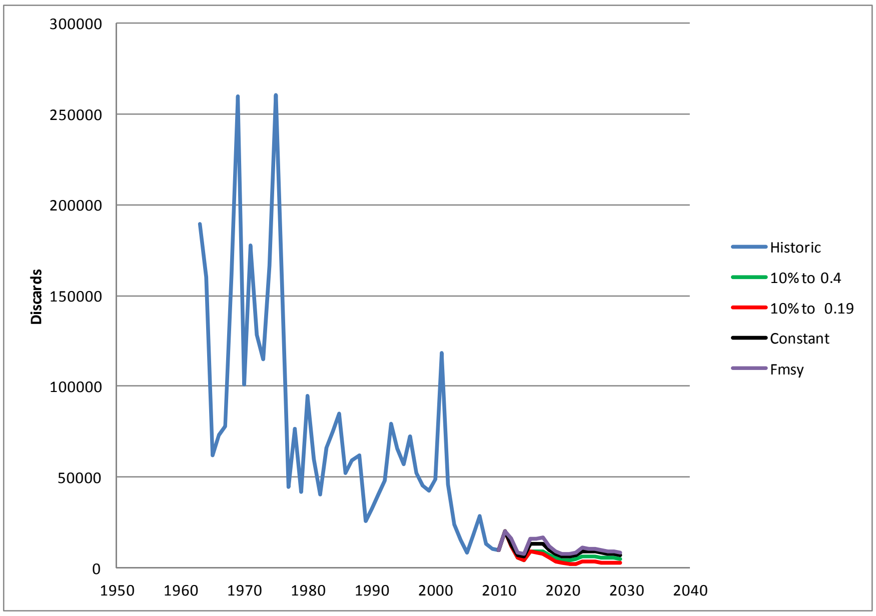


Figure 4. North Sea haddock historic and projected spawning stock biomass; black - continued exploitation at the current level, purple - an increase to the agreed management plan target, green - 10% reductions following the cod plan requirement to reach an F of 0.4; red - 10% reductions following the cod plan requirement to reach an F of 0.19.



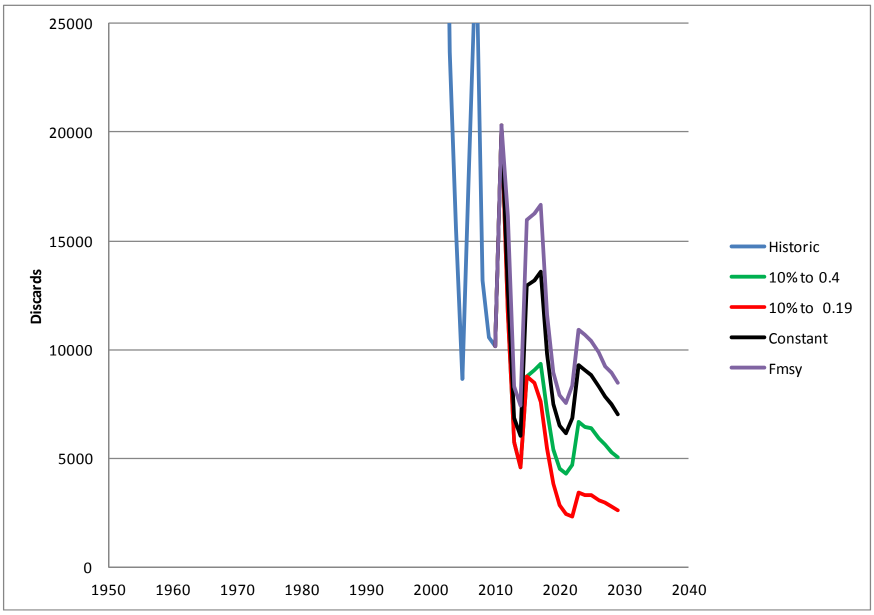
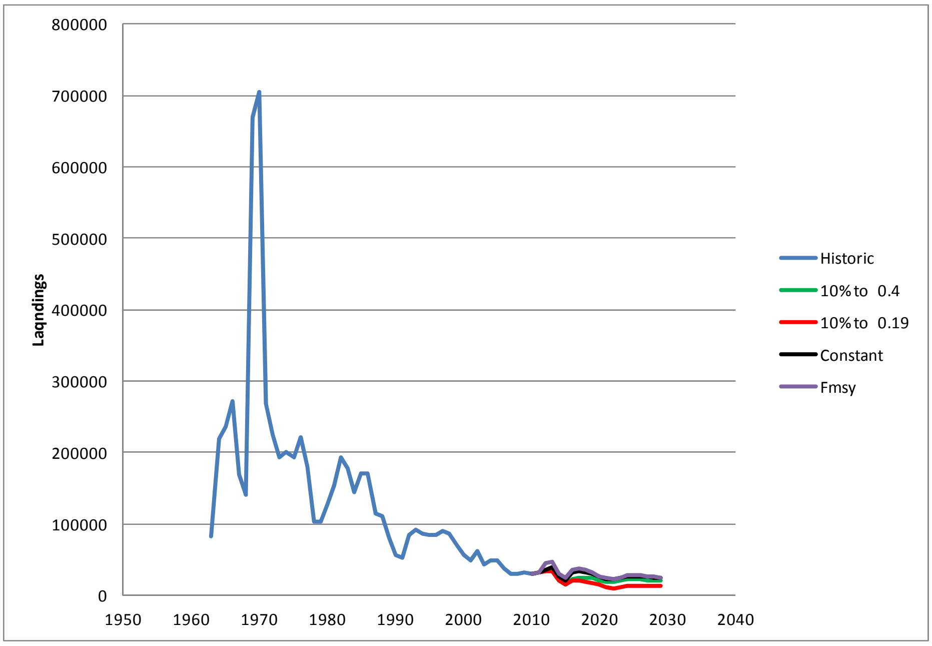


Figure 5. North Sea haddock historic and projected discards assuming no discard ban; black - continued exploitation at the current level, purple - an increase to the agreed management plan target, green - 10% reductions following the cod plan requirement to reach an F of 0.4; red - 10% reductions following the cod plan requirement to reach an F of 0.19.



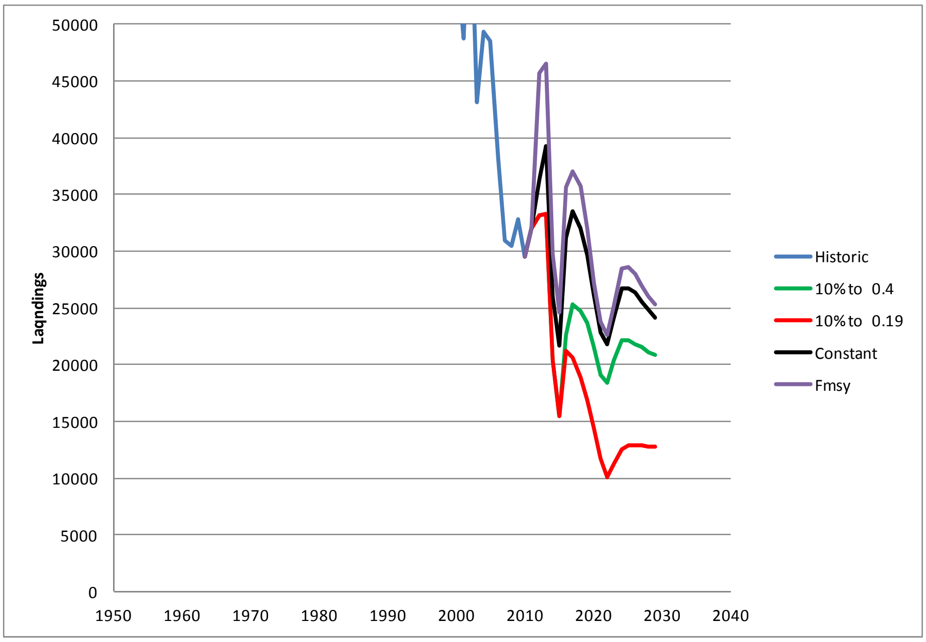


Figure 6. North Sea haddock historic and projected landings assuming no discard ban; black - continued exploitation at the current level, purple - an increase to the agreed management plan target, green - 10% reductions following the cod plan requirement to reach an F of 0.4; red - 10% reductions following the cod plan requirement to reach an F of 0.19.