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Scientific, Technical and Economic Committee for Fisheries (STECF)

Evaluation/scoping of management plans

Evaluation of the multi-annual management plan for the North Sea stocks of plaice and sole

(STECF-14-03)

Edited by Ernesto Jardim and Finlay Scott

This report was reviewed by the STECF during its' 45th plenary meeting held from 24 to 28 March 2014 in Brussels, Belgium

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TABLE OF CONTENTS

SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

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(STECF-14-03)

THIS REPORT WAS REVIEWED DURING THE PLENARY MEETING HELD IN BRUSSELS, BELGIUM, 24-28MARCH 2014

Background

The multi-annual management plan for North Sea plaice and sole; Council Regulation (EC) No. 676/2007, has been in place since June 2007. Under the reformed CFP it is likely that this management plan will be superseded by a regional management plan for all North Sea demersal stocks caught in mixed fisheries. As a result, it is appropriate to review the past performance of the management plan in order that this retrospective review can form part of the impact assessment for the anticipated mixed-fishery plan.

The evaluation should review the performance of the management plan in achieving its objectives. It should take account of the most recent scientific information on developments in the relevant fish stocks and fishing fleets, and also the any existing studies of the management plan. Where possible, it should consider the individual elements of the plan and summarise how they have contributed to the plan's performance – see STECF SGMOS-10-06a, Annexe C.

Request to the STECF

STECF is requested to review the three reports of the STECF Expert Working Group, evaluate the findings and make any appropriate comments and recommendations.

Observations of the STECF

The objective of the plan (LTMP) to bring both sole and plaice stocks to a status within safe biological limits has been met.

When the plan became operational in 2008, plaice was already within safe biological limits as defined in the plan (Article 2) and below the level for fishing mortality as defined by Article 7 (F=0.3). The proportion of older (and more valuable) plaice in the stock and in the catches has been increasing since the introduction of the plan.

For sole, when the plan became operational in 2008, the stock was outside safe biological limits as defined in the plan (Article 2) and above the level for fishing mortality as defined by Article 8 (F=0.2), but since that time, fishing mortality has been steadily decreasing towards the target value of F=0.2.

STECF notes that in general, the provisions of the LTMP have not restricted fishing opportunities and that the observed fishing patterns have largely been driven by other factors such as decommissioning schemes, high fuel prices and low prices for plaice. Because of such influences, direct effects on catches and effort that may be attributable to the LTMP cannot be fully evaluated. Nevertheless, STECF notes that the most obvious effect of the LTMP has been to bring stability in the annual TAC for both stocks.

In the absence of the LTMP, the move from ICES Precautionary Approach framework to MSY framework (including MSY transition approach) would have potentially resulted in large variations in annual TACs between 2008 and 2012. Also, it is likely that TAC advice for both stocks would have followed largely opposite trends, potentially creating larger mismatches between fishing opportunities for the plaice and sole stocks, and hence, between the amount of fishing effort required to catch the respective TACs. The LTMP may thus have contributed to better governance schemes and more possibilities for long-term planning in the fishery.

Fishing effort in the North Sea flatfish fisheries is regulated both by the cod management plan and by the sole and plaice management plan. Effort ceilings defined by the cod management plan have in most cases not been constraining for the beam trawl fishery (BT1 and BT2), but they may now become more limiting as fishing opportunities for sole and plaice increase. The Dutch BT1 fishery has already reached the ceiling imposed by the cod plan in 2012. According to EWG 13-21, effort in the BT1 fishery is low and results in less than 3% of the total cod catches from the North Sea, so its impact on the cod stock is currently limited. STECF notes that if the Dutch industry wanted to allocate more effort to BT1 to operate in the central North Sea, where sole is not caught and where the discarding of plaice is reduced, the interaction with the cod plan would need to be addressed first.

Considering the provisions of Art.2 both stocks are now within safe biological limits and, according to Art.5, the plan should be amended regarding its objectives, HCRs and effort limitations, on the basis of scientific advice by STECF and the opinion of the NSRAC. STECF notes that until such a revision is implemented the current provisions of the plan remain in force. Since the current harvest rules (targets of F = 0.2 for sole and F= 0.3 for plaice) are performing as intended, and are within the estimated F_{MSY} range for both stocks, they are thus compatible with the stage-two objective of exploiting both stocks at rates consistent with MSY.

STECF concurs with the conclusions from EWG 14-03 which relate to a number of additional design issues in the current LTMP that should be considered in a future revision. These issues include (i) revising the formulation of F_{MSY} such that it is either a target or an upper limit instead of the lower limit as currently defined in Art.4; (ii) specification of socio-economic objectives for the second stage of the plan, (iii) potential interactions with the cod management plan regarding effort restrictions and which could be considered in the context of a mixed fisheries plan.

Conclusions of the STECF

STECF considers that the suite of scientific analyses that have been performed over recent years provides a comprehensive overview of the mechanisms of the LTMP for North Sea plaice and sole, and the outcomes provide the basis for the revision of the plan required by Art.5.

STECF notes that until the revision of the plan required in Art.5 is carried out, the current provisions remain in force and the harvest rules laid out in Art.7 and 8 to set fishing opportunities, have delivered Fs that are within the estimated F_{MSY} range for both stocks, and are thus compatible with the stage-two objective of exploiting both stocks at rates consistent with MSY.

REPORT TO THE STECF

EXPERT WORKING GROUP ON
Evaluation/scoping of Management plans
Evaluation of the multi-annual management plan for the North Sea stocks of plaice and sole
(EWG-14-03)

Varese, Italy, 10-14 March 2014

This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area

1 EXECUTIVE SUMMARY

STECF was asked to carry out the evaluation of the management plan of sole and plaice in the North Sea. The EWG evaluation was carried out following the protocol laid out by SGMOS-10-06a as much as possible. The evaluation reviewed the performance of the management plan in achieving its objectives, taking into account the most recent scientific information on developments in the relevant fish stocks and fishing fleets, and also any existing studies of the management plan. Quantitative analysis was updated from previous evaluations and new analysis were included whenever needed to clarify or support the evaluation.

The multi-annual management plan for North Sea plaice and sole; Council Regulation (EC) No. 676/2007, has been in place since June 2007. Under the reformed CFP it is likely that this management plan will be superseded by a regional management plan for all North Sea demersal stocks caught in mixed fisheries. As a result, it is appropriate to review the past performance of the management plan in order that this retrospective review can form part of the impact assessment for the anticipated mixed-fishery plan.

The EWG identified a number of design issues that need further attention during a revision of the regulation.

The main conclusions of the EWG were:

- The objective of the plan to bring both stocks to a status within safe biological limits has been met.
- The plan is now in stage 2, but management targets and measures must be defined.
- Overall effort has decreased during the period that the management plan was in place at approximately the same rate as effort limitations based on the plan have decreased.
- Neither TAC nor effort turned out to be a limiting factor for most of the time it is unlikely that these components of the plan exerted any major impact on the fisheries. In accordance with statements from the industry the following external factors had substantial influence on the fisheries: decommissioning of vessels, high fuel prices and low plaice prices.
- The large year class of sole in 2009 has contributed to bringing sole inside safe biological limits. This phenomenon can be observed in certain years, and it was also the case for the phase under consideration.
- The fishery has changed considerably in the past few years due to various factors, which led the fishery to use new gears, with the aim of reducing its dependency to fuel. Electric fishing (so-called pulse trawls) are being used since 2009 with 42 active licenses in 2013 and more being granted for 2014. Sumwings have also been used since 2008. These techniques make the vessels more profitable and less sensitive to fuel price increase. Pulse trawls are also believed to have lower catch rates for fish below the marketable size (Marlen et al, 2014) and thus might have the potential to reduce discards. However, the long term impacts on the stocks and also potential impacts on other marine organisms are still unknown. The potential shift in the selectivity of the fleet towards older individuals may affect the implementation of the plan and should be evaluated.
- By definition, the principle of limited quota changes between years stabilized the levels of TACs for both species, which is a major request from the industry.

- In the absence of a plan large peaks in plaice TAC would not have been fully utilized because of a low sole TAC or capacity limitations.
- Effort limits set based on the plan have not been restrictive for any of the national BT2 fleets, the main gear categories catching plaice and sole. But effort limits have recently become restrictive (in 2012) for the Dutch BT1 fleet (not set based on the plan). As stated in Section 4.6 there is scope for a spatial management component in the plan to allow for the possibility of a 'clean' plaice fishery in the North to address a possible imbalance in TAC between plaice and sole. However, the setting of effort limits for the BT1 fleet needs to be addressed.
- Also, following the start of the landings obligation the quality of catch data will change a lot, since all catch will (supposedly) be landed (i.e. no need to estimate discards). If discard estimation in the past has been biased or if discarding continues illegally, there will be a step-change in the quality of the data used in the assessment. In the short term at least this could cause stock size estimation problems and with potentially greater retrospectives. Furthermore, it may lead to a new perception of the stock dynamics and the consequent revision of the reference points.

2 INTRODUCTION

The multi-annual management plan for North Sea plaice and sole; Council Regulation (EC) No. 676/2007, has been in place since June 2007. Under the reformed CFP it is likely that this management plan will be superseded by a regional management plan for all North Sea demersal stocks caught in mixed fisheries. As a result, it is appropriate to review the past performance of the management plan in order that this retrospective review can form part of the impact assessment for the anticipated mixed-fishery plan.

The evaluation should review the performance of the management plan in achieving its objectives. It should take account of the most recent scientific information on developments in the relevant fish stocks and fishing fleets, and also any existing studies of the management plan. Where possible, it should consider the individual elements of the plan and summarise how they have contributed to the plan's performance – see STECF SGMOS-10-06a, Annexe C.

2.1 Terms of Reference

Plan and initiate the work necessary for a retrospective evaluation of the multi-annual management plan for the North Sea stocks of plaice and sole.

2.2 Addressing the Terms of Reference

The evaluation was carried out following the protocol laid out by SGMOS-10-06a as much as possible. Quantitative analyses were updated from previous evaluations and new analyses were included whenever needed to clarify or support the evaluation.

3 DESIGN ISSUES

The first objective of the long term management plan was to rebuild the biomass of the two stocks to safe biological limits. The second phase of the plan should include social and economic objectives, thus requiring the definition of social and economic indicators and targets. At this stage the plan can be described with some employment, income and profitability indicators but the lack of specific objectives limits the assessment in social and economic terms.

3.1 Changes to the design of the plan since its first implementation

It was envisaged that the plan would be revised once both stocks had been brought within precautionary limits for two consecutive years (see EC regulation No 676/2007), but because of pending consultations with Norway for an agreed EU-Norway management plan for plaice, or for a jointly agreed mixed fisheries plan for the North Sea, the process for doing this has not yet commenced. As an interim measure, it was decided to maintain the existing harvest control rules for setting the TACs. In addition, ICES was requested to explore a number of possible options for changes to the existing plan, which have recently been implemented in EU legislation as well. Although, these changes have been implemented outside of the regulation which defines the plan itself, this means de facto that some changes have been made to the design of the plan.

Though the Long Term Management Plan (LTMP) specifies two distinct phases, the definition of actions to be taken in the second phase is limited. Article 5 (Transitional arrangements) of the plan states:

"When the stocks of plaice and sole have been found for two years in succession to have returned to within safe biological limits the Council shall decide on the basis of a proposal from the Commission on the ***amendment of Articles 4(2) and 4(3)*** *and the* ***amendment of Articles 7, 8 and 9*** *that will, in the light of the latest scientific advice from the STECF, permit the exploitation of the stocks at a fishing mortality rate compatible with maximum sustainable yield. "*

Articles 4(2) and 4(3) refer to the values of the F targets for plaice and sole, respectively. Articles 7 and 8 refer to the procedure for setting the TAC for sole and plaice and Article 9 refers to the fishing effort limitation. Hence this article essentially calls for a complete revision of the process used to decide both input and output controls.

TAC setting procedure may need to be revised for stage two to include actions to be taken should the stocks fall out of safe biological limits again (e.g. an HCR that reduces the target F below Bpa or another appropriate biomass trigger point. At present the plan only includes an Article stating that if either stock is suffering reduced reproductive capacity that TACs lower than those derived from Articles 7 and 8 could be set (Article 18, Special Circumstances).

3.1.1 Effort restrictions

In 2011, the latest ICES assessments of the stocks indicated that both the North Sea plaice and sole stocks had been within safe biological limits (see Figure 5-7 and Figure 5-8) for the last two consecutive years, signalling the end of stage one. This lead to the Netherlands submitting a special request for advice to ICES in April 2012 to evaluate whether a number of proposed amendments to the plan were in accordance with the precautionary approach and consistent with MSY. An ad hoc group consisting of scientists from IMARES (the Netherlands) worked to address the issues and produced a report (Coers*et al*, 2012). ICES reviewed this work and concluded that the methods applied were appropriate. The resulting ICES advice indicated that the proposed changes to the LTMP were consistent with the precautionary approach and the principle of maximum sustainable yield (MSY).

In April 2012, ICES was requested to evaluate the impact of two proposed amendments to the plan being in accordance with the precautionary principle and MSY approach. In summary, the proposed amendments comprised (1) a change in the target fishing mortality for sole from 0.20 to 0.25 and (2) ceasing reductions of the Maximum Allowable Effort. A number of management strategies were tested under various scenarios, including differing assumptions on biology and fleet behaviour (Coers*et al*, 2012). ICES concluded that the proposed changes do not affect the plan's consistency with the precautionary approach and the principle of maximum sustainable yield (MSY). In line with this ICES advice, reductions in Maximum Allowable Effort for the BT1 and BT2 fleets have been ceased since 2013 and were maintained at the 2012 level. The proposed change on a target fishing mortality for sole was not implemented.

3.1.2 The assessment basis for the stocks

The LTMP refers often to 'spawning biomass' and 'fishing mortality rate' without specifying how these are to be determined for each stock. This in itself is not unusual for an LTMP since it is assumed that such technical details will be accounted for by STECF in its provision of scientific advice. However, stock assessments evolve through time with the addition of new data and the application of new models.

Significant changes in stock assessments can have a big impact on the perception of the current size of stock biomass and fishing mortality rate, as well as the reference point values and the position of the stocks in relation to these. Since the implementation of the plan, both the sole and plaice stocks have undergone benchmark assessments where both input data and assessment settings were changed For example, though ICES concluded in June 2011 that the North Sea plaice and sole stocks had both been within safe biological limits for two consecutive years, retrospective changes in the assessment conducted in 2012 showed that in 2011 the stock had not yet been within safe biological limits for two consecutive years since the estimate of sole SSB in 2010 was revised down in the latest assessment.

Furthermore, the sole assessment will in the near future be changed to include estimated discards in the assessment model. This could alter the perception of the status of the stock in relation to safe biological limits and/or significantly affect the appropriateness of biological reference points and fishing mortality target reference point values defined in the plan. The LTMP contains no articles specifying actions to be taken should such a change in the perception of either stock occurs.

3.1.3 Banking and borrowing of plaice quota

For sole, flexibility for the fishing fleets to use 10% of their national quota (which they would have 'banked') from the previous year, or 'borrow' 10% of the quota from the next year has been in place since before the management plan was implemented. Early 2013, ICES was requested to evaluate the impact of such an inter-annual quota flexibility of +/-10% for plaice on the performance of the plan with respect to long term yield and risk. For the purpose of the exercise, ICES assumed that the fishing effort ceiling for the sole and plaice fisheries was maintained at its 2012 level. ICES concluded that the multiannual management plan is robust to inclusion of inter-annual quota flexibility in terms of the probability of the stock biomass falling below Blim, and without substantial changes in average yield (Brunel and Miller, 2013). This conclusion was conditional on the inter-annual quota flexibility being suspended when the stock is estimated to be outside safe biological limits. In line with this ICES advice, flexibility for the fleet to use 10% of national quota banked in the previous year, or borrow 10% of the quota from the next year was implemented from the 1st of January 2014.

3.2 TAC and effort setting procedures in stage 2

It was unclear to ICES as to how to proceed with this LTMP once stage one had been completed. Ultimately it was decided that Articles 7 and 8 should be applied independent of which stage the LTMP was in (i.e. while revisions were being made, the same reductions in F towards the targets defined in Article 4 and the same TAC change limits applied).

3.3 Fmsy as a limit

Article 4, objectives of the multiannual plan in the second stage, of the LTMP states:

"1. The multiannual plan shall, in its second stage, ensure the exploitation of the stocks of plaice and sole on the basis of maximum sustainable yield.

2. The objective specified in paragraph 1 shall be attained while maintaining the fishing mortality on plaice at a rate equal to or ***no lower than*** *0.3 on ages two to six years.*

3. The objective specified in paragraph 1 shall be attained while maintaining the fishing mortality on sole at a rate equal to or ***no lower than*** *0.2 on ages two to six years."*

It is unusual for LTMPs to specify minimum fishing mortality values. In recent years there is a growing perception of the fishing mortality associated with MSY (F_{MSY}) as an *upper* limit rather than a target (e.g. Mace, 2001). This is reflected in several United Nations Food and Agriculture Organization (FAO) agreements and guidelines, as well as the Magnuson–Stevens Fishery Conservation and Management Act in the USA. As it currently stands the LTMP considers the target fishing mortality values to be *lower* limits. This is likely inappropriate and should be revised in the establishment of procedures for the second stage of the LTMP.

3.4 Lack of socio-economic objectives for the second stage

While Article 4 specifies that the stocks should be exploited on the basis of MSY, no socio-economic objectives are specified. A lack of such objectives could make the future evaluation of the socio-economic performance of the LTMP difficult to do.

3.5 Possibility to request extra effort when it may become restrictive to the fishery

According to article 9 of the management plan (EC 676/2007) member states can apply for additional effort to be able to take catches of plaice and sole in line with the agreed TACs for both species. As the plaice stock abundance has increased significantly in the last few years TACs increased and therefore increasing effort possibilities could have been requested. Although this extra effort has never been requested by any member state so far, it could potentially lead to overshoot the agreed TAC for one species, e.g. in 2014 that would lead to a possible overshoot of 12% of the agreed sole TAC (STECF 13-02). It might be prudent to take into account the above mentioned issue when defining the details of the second phase of the management plan.

3.6 Scope for spatial management

In order to deal with the possible imbalance in effort arising from article 9 of the management plan, STECF noted that there is a potential for spatial management to balance the mixed fishery TACs of both species under some circumstances. In more northerly areas of the North Sea, concentrations of plaice are much higher compared to sole. This would give parts of the beam trawl fleet the opportunity to fish for plaice north of 56°N (EC Council Regulation 2056/2001) with the mandatory 120mm codend mesh nets (BT1) which would result in negligible sole catches. Taken into account this spatial management scenario could be an option in defining new specifications for the second phase of the management plan. However, it should be noted that this would only be feasible for member states with sufficient effort for the BT1 gear category. From the STECF effort data base (STECF 13-21) it could be concluded that this would not have been possible without effort exchange between other regulated gears for the Dutch fleet in 2012 as the BT1 effort was already fully utilized (Figure 4-6).

3.7 Balancing TACs in a mixed fisheries context

It is generally acknowledged that in a mixed fishery it is often not possible for fishers' to exactly match their catch composition to their catch allocation (quota of different species), even if regulated by an ITQ system like in the Netherlands. One species' quota may be underfished or exceeded, leading to overquota discards and/or unreported landings. Previous work has addressed this issue for the mixed sole and plaice fishery in the North Sea. We consider the two possible 'imbalanced TAC situations' separately and discuss each in the context of its specific issues.

3.7.1 Early exhaustion of the sole TAC

Having a too low sole TAC to fully utilise the plaice TAC should in theory not have to happen because plaice can be caught cleanly in the central and Northern North Sea without 'bycatching' sole, since the distribution area of plaice reaches further North than that of sole. Also, in the area extending from 55°North to 56° North, east of 5°East longitude, the minimum mesh size allowed is 100 mm, while above 56°North the minimum mesh size allowed is 120 mm (EC Council Regulation 2056/2001). With these mesh sizes, very little sole is selected. Miller et al (2010) showed that despite the high value of sole relative to plaice which skews the economic importance in favour of sole, individual vessels in the

Dutch beam trawl fleet indeed differ broadly in terms of the proportion of plaice landings in their overall landings (Figure 3-1). This supports the idea that the fleet should indeed have the potential to be able to cope with a relatively high plaice TAC.

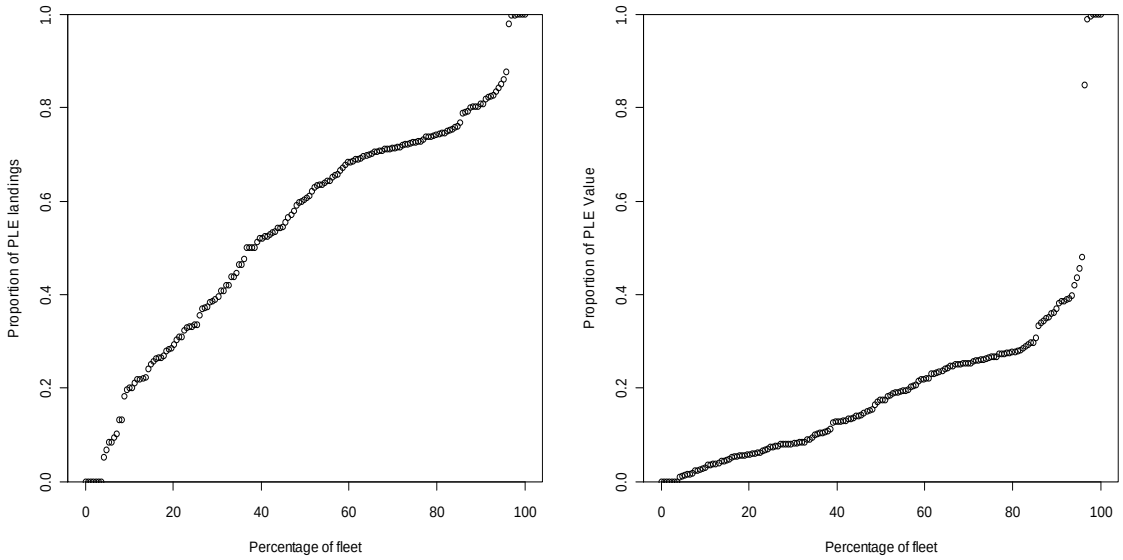


Figure 3-1. Proportion of plaice (out of the total for plaice and sole) landings (left) and value (right) by vessels of the Dutch beam trawl fleet in 2009 (Miller *et al*, 2010).

Considering that the plaice TAC has been relatively high in comparison to the sole TAC and the apparent flexibility of the fleet, a previous Management Strategy Evaluation (MSE) of the flatfish plan in 2010 was based on the assumption that the fleet would be able to fully utilise both TACs and no overquota catches would occur.

It was subsequently recognized however that the variability in landings composition by vessel may not necessarily translate into flexibility for the fleet in its entirety, because of spatial management restrictions. Days-at-see limitations inhibit fishermen that might want to pursue a 'clean' targeted plaice fishery North of 56°North. In that case, plaice quotas may remain unutilised after sole quotas have been finished.

3.7.2 Early exhaustion of the plaice TAC

Since the distribution area of sole (in the Southern North Sea) is 100% overlapped by the distribution area of plaice, catches of sole by definition go hand in hand with plaice bycatch. So when a vessel catches its entire plaice quota before it fills its sole quota, fishing exclusively for sole is not possible. Considering the relatively high value for sole (note that more than 95% of the vessels derive more income from sole than plaice)there is a strong incentive for most vessels in the fishery to carry on fishing until they have fully exhausted their sole quota, which would lead to overquota plaice discards.

3.7.3 Expecting an imbalance?

To establish whether an imbalance in TACs has occurred one could investigate the uptake of the TACs of both species. In recent years, the TACs have not been fully used for either species however (Figure 4-1). Instead, one could also consider the ratio in landing or catch rates for the two species and compare these with the ratio in TACs. Data from the Dutch catch sampling programme provides mean landings and discard rates per hour per species. Comparing the ratio between plaice and sole landings and catch rates with the ratio in the TACs over the past decade provides some insight in whether or not one of the TACs has been restraining the fishery. Figure 3-2 shows that landing rates (in kg/hour) of plaice have on average been four times the landing rates of sole. The TAC of plaice however has been on average a five-fold of the sole TAC. This suggests that generally, by the time that the sole TAC was

fully exhausted, there would be plaice TAC left, which the fleet could fish in the central and Northern North Sea (if not restricted by spatial effort management restrictions).

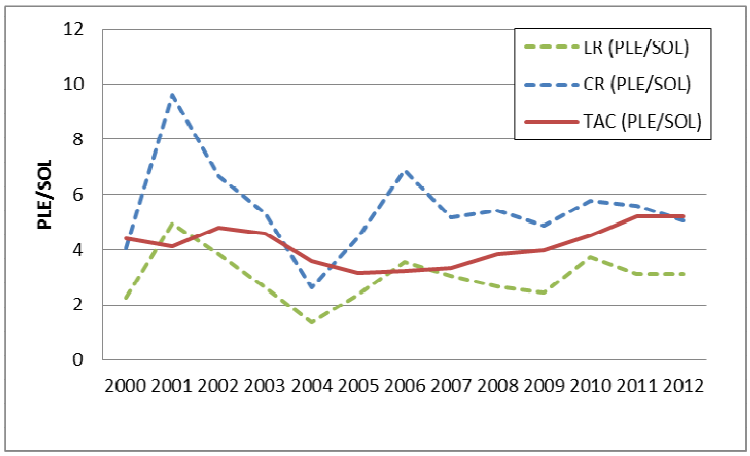


Figure 3-2. Landing, catch and TAC ratios of plaice and sole.

Comparing catch rate ratios with TAC ratios provide a different picture. When discards are included in the equation, Figure 3-2 shows that catch rates of plaice have generally been around 5.5 times the catch rates of sole. This means, in terms of the upcoming landings obligation, that when catch limits (rather than landing limits) are established, the ratio between the limits of PLE/SOL should be generally over 5.5, if a situation where plaice quota restricts the sole fishery is to be avoided.

3.7.4 Conclusion

'Imbalances' in TAC levels can be addressed by:

- Changing the relative levels of TAC for the two stocks
- Changing the effort allowed for different gear types
- Changing the effort allowed in different areas (i.e. spatial management). The fishery in the northern regions is constrained by gear restrictions (i.e. above a certain mesh size above a certain latitude) and by effort restrictions if bycatch of cod is large (following the cod MP – below). There is ongoing work to improve the monitoring of cod bycatch.

3.8 Overlap with other plans

The plan applies to fisheries exploiting the stocks of plaice and sole in the North Sea, i.e. ICES Sub-area IV (as defined in article 1 of the Council Regulation). The only potential overlap with another management plan is that with the long-term plan for cod stocks and the fisheries exploiting those stocks (EC regulation 1342/2008) in setting fishing effort limitations for fleets in the North Sea. For the purpose of setting effort limits, the fleet in the North Sea is divided into effort groups (see Annex IIa of the TAC & quota regulations). For those effort groups that account for 80% of cod catches in the North Sea, annual adjustments of fishing effort limits apply based on the cod plan. The adjustment in the effort limits will be the same percentage adjustment as the adjustment of the fishing mortality of cod (or the percentage reduction of the TAC in the case of data poor conditions, where fishing mortality cannot be estimated). For those effort groups that account for 80% of plaice or sole catches in the North Sea, annual adjustments of fishing effort limits apply based on the plaice and sole plan, which is specified in the plan to be in line with reductions in fishing mortality. The effort reductions for each member state are subsequently determined in relation to their respective quota shares. Generally, applicability of the effort adjustments from both plans has been as shown inTable 3-1. It shows that the overlap of the plans thus transpires in how effort limitations are set for the TR1 group. In practice, application of the cod plan has had precedence over the plaice and sole plan, and so, effort limitations for this group were set based on the cod plan, which affected the plaice fishery of the TR1 group.

Table 3-1. Overlap of the cod and flatfish management plans.

Regulated gear (effort group)	Cod long-term plan	Plaice and sole plan
TR1	**Applicable**	**Applicable**
TR2	**Applicable**	Not applicable
TR3	Not applicable	Not applicable
BT1	Not applicable	Not applicable
BT2	Not applicable[1]	**Applicable**
GN	Not applicable	Not applicable
GT	Not applicable	Not applicable[2]
LL	Not applicable	Not applicable

[1] In 2010, the cod plan's effort reduction applied to the BT2 group as well. In all other years, it did not.

[2] In 2010, the plaice and sole plan's effort reduction applied to the GT group. In all other years, it did not.

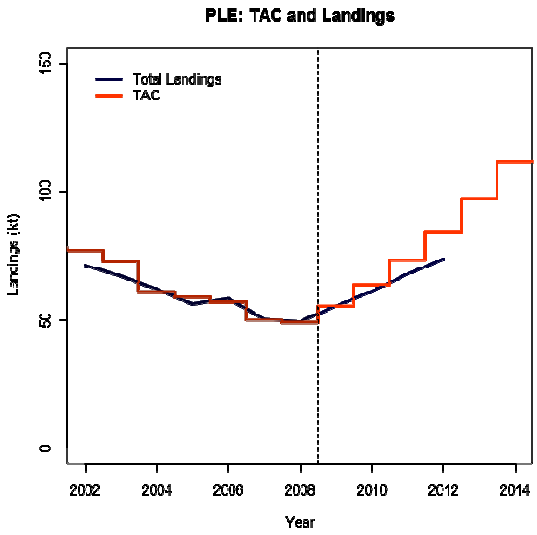
4 ENFORCEMENT AND COMPLIANCE

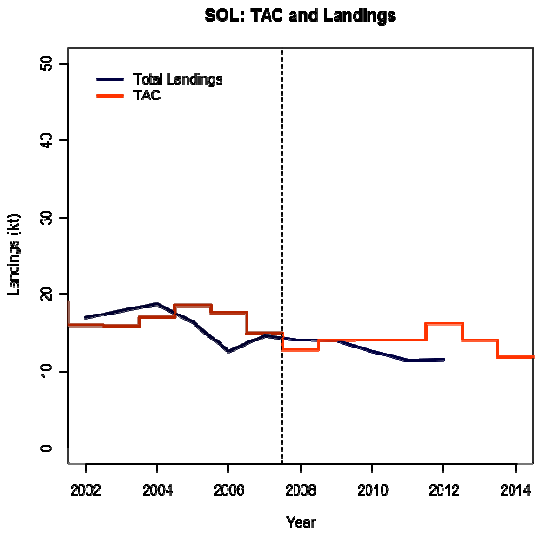
4.1 Trends in landings

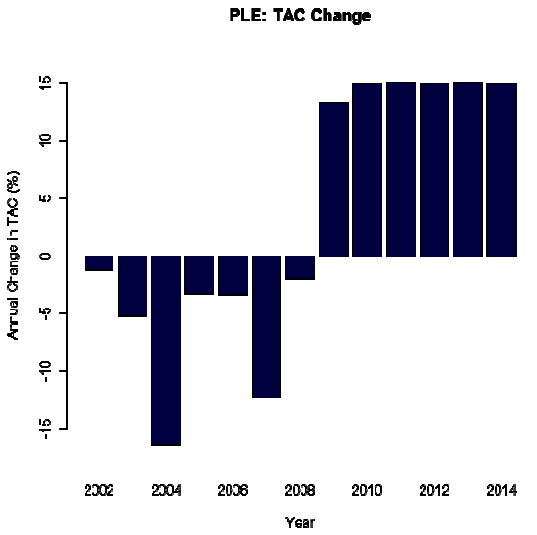
The LTMP has been used to set the TAC for plaice since 2008 (i.e. the TAC for 2009 was the first TAC set according to the plan) and since 2007 for sole (i.e. the TAC in 2008 was the first TAC set according to the plan). Figure 4-1 shows the TAC and associated landings for each of the two stocks. TACs of plaice have increased steadily since the implementation of the LTMP, increasing by the maximum allowed 15% every year except between 2008 for 2009. Sole TAC has been more variable, in one case a 15% increase in TAC being followed directly by a 14% decrease.

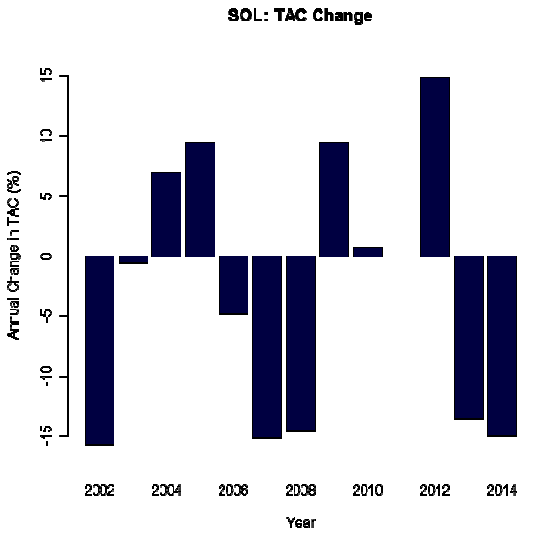
The level of TAC uptake has been more consistent for plaice than for sole. For the plaice stock, annual catch far exceeds the TAC every year, but high levels of discarding (see Section 5.3) ensure that the TAC is not often exceeded. For the sole stock, a system of 'banking and borrowing' has been in place since before the start of the management plan allowing more flexibility in the amount of landings in relation to the TAC in any year. Such a system was evaluated for plaice in 2013 and has been in place for this stock since then.

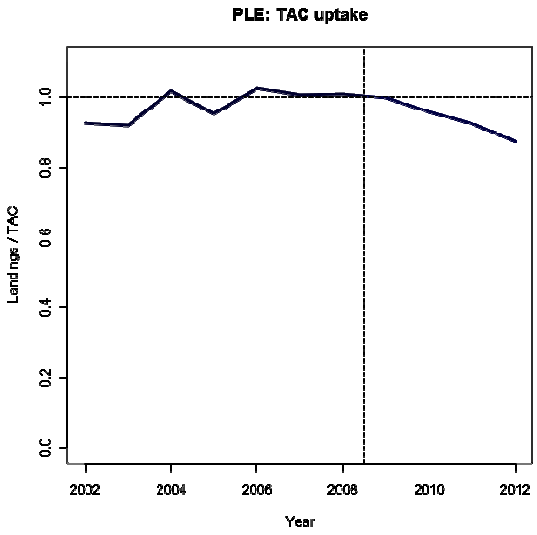
Following the implementation of the management plan both stocks have seen a reduction in the level of TAC uptake. As a result TACs have only been limiting for one year for plaice and two years for sole at the start of implementation. This situation may be due to the impact of external factors and/or effort regulations.


PLE: TAC and Landings
Total Landings
TAC
Landings (kt)
Year


SOL: TAC and Landings
Total Landings
TAC
Landings (kt)
Year


PLE: TAC Change
Annual Change in TAC (%)
Year


SOL: TAC Change
Annual Change in TAC (%)
Year


PLE: TAC uptake
Landings / TAC
Year

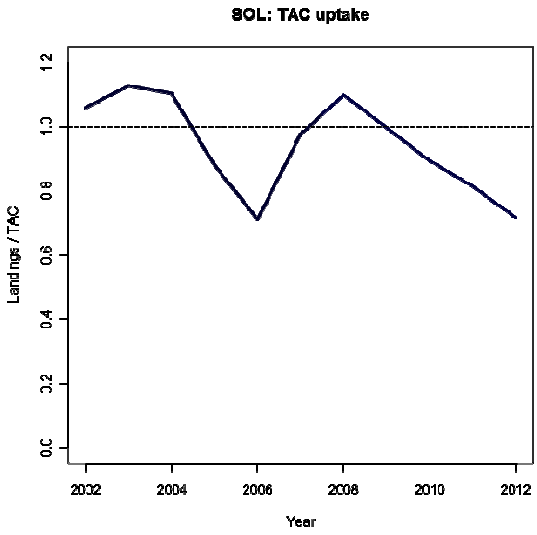

SOL: TAC uptake
Landings / TAC
Year

Figure 4-1. Total allowable catch and total reported landings (top), inter-annual (year *y* /year *y-1*) TAC change (middle) and TAC uptake (bottom) for North Sea plaice (left) and sole (right). The shaded gray area represents the period before the implementation of the plan for setting the TAC for each species.

4.2 Trends in effort

The most important gear categories, as defined in the cod management plan (EC regulation 1342/2008), in terms of total fishing effort in the North Sea are beam trawls with a mesh size of 80 to 120 mm (BT2), otter trawls with a mesh size >100 mm (TR1), and otter trawls with a mesh size of 70 – 100 mm (TR2). The overall effort has shown a sharp reduction of 57% since 2000 in the North Sea (STECF-13-21). The gear categories BT2 and TR1 showed the largest reduction in effort of 63% and 65%, respectively (Figure 4-2). BT2 takes by far the largest landings of plaice and sole (Figure 4-3). The huge decline in BT2 effort between 2007 and 2008 was due to a decommissioning of 23 Dutch beam trawl vessels (Taal *et al*, 2009) before the full implementation of the management plan in 2009. As the effort decline started since 2000 and continued at about the same ratio since the enforcement of the plan it is unlikely that the effort decline since 2008 can be contributed solely to the management plan.

It should also be noted that TR1 is also responsible for a substantial part of plaice landings (Figure 4-4) while sole is not caught with the bigger mesh size otter trawls. Figure 4-4 shows that the proportion of plaice landings in BT2 declined steadily and coincide with an increase in TR1 plaice landings, whereas the sole proportion in BT2 is rather stable. The change in proportions of plaice landed by BT2 and TR1 might be due to a change in spatial distribution of BT2 effort and an increasing plaice stock more exploited by the TR1 gear category. Information from the industry (Gert Meun, pers. comm.) suggests that high fuel prices and low plaice prices resulted in a more southerly operation of BT2 gear since 2007 where marketable size plaice is less abundant whereas sole is more abundant.

However, with the data available it is not possible to directly link the trends in effort to the enforcement of the management plan. To evaluate in detail a possible impact of the management plan on fishing effort and changes in fleet behaviour, a direct link between effort and economic data is needed, which is not the case in the current data calls.

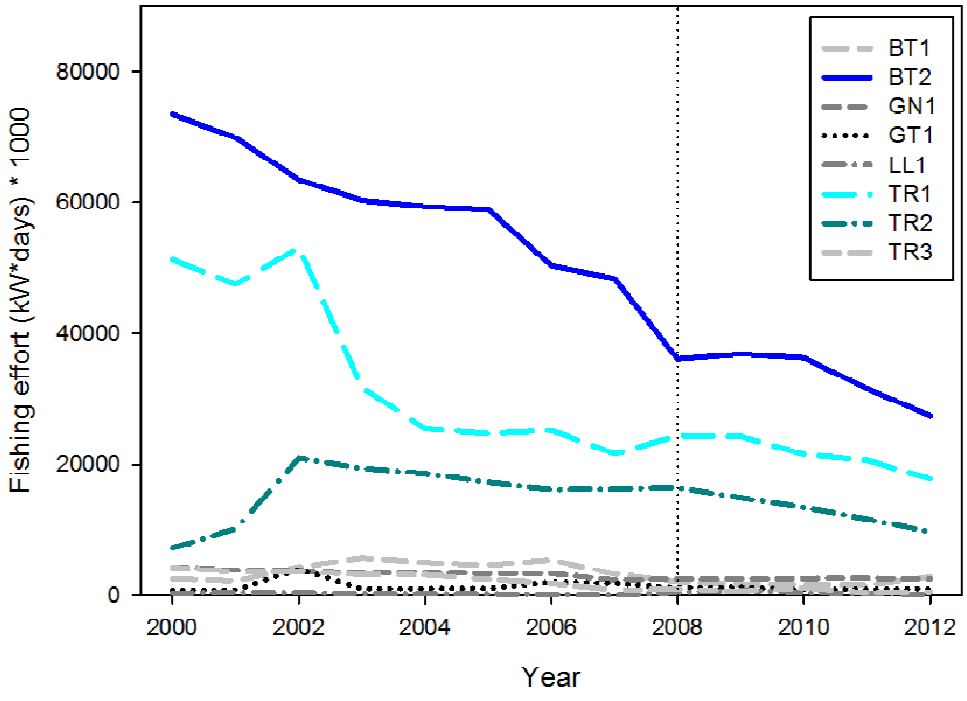


Figure 4-2. Effort by gear category as defined by the cod management plan in the North Sea.

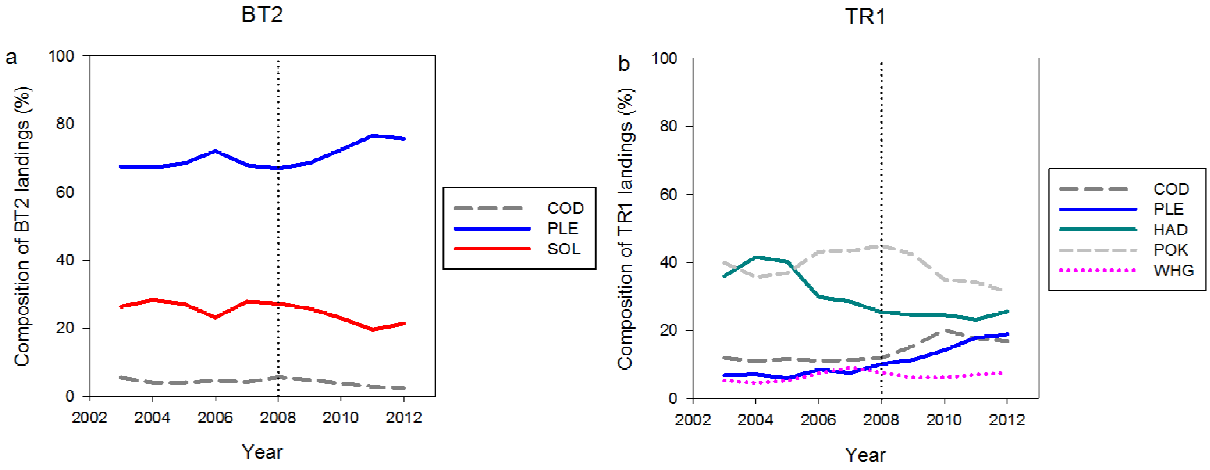


Figure 4-3. Species composition in landings of BT2 (left panel) and TR1 (right panel) gear category.

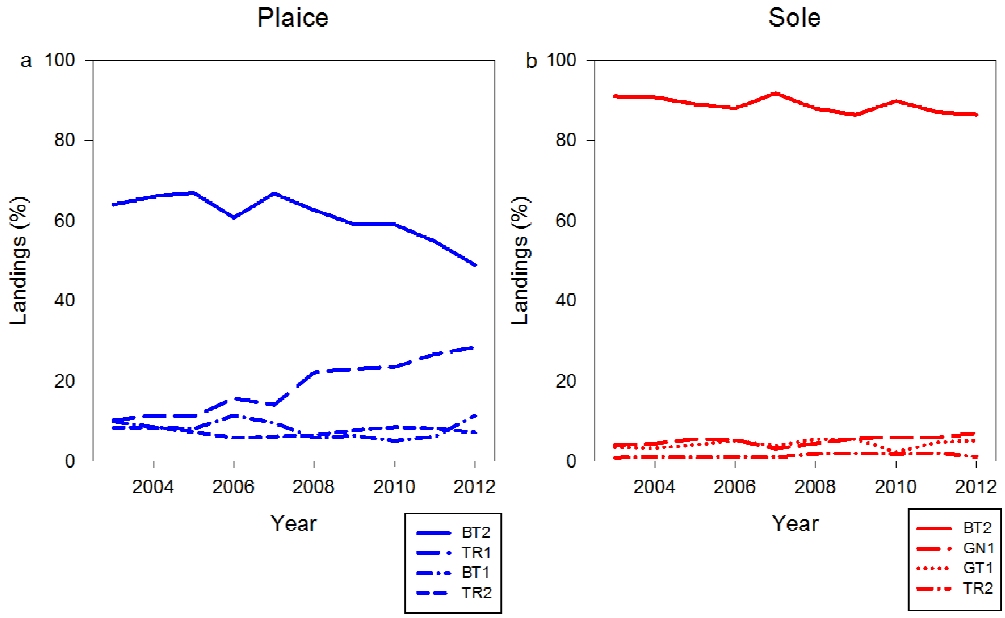


Figure 4-4. The share of plaice (left panel) and sole (right panel) landings for regulated gear categories. Only the four most important gear categories for each species is displayed.

4.2.1 Allowable effort and realized effort

Figure 4-5 shows effort ceilings and realized effort of the BT2 gear category in the Greater North Sea (IIIa, IV, VIId) and the realized effort for the BT2 gear category in the North Sea (IV). Data on effort ceilings displayed here is extracted from the TAC and quotas regulations nr 43/2009, 53/2010, 57/2011, 44/2012 and 40/2013. However, the EWG 13-13 (STECF 13-21) noted that these data do not take into account the effort buyback performed by Member states as part of Article 13 and/or other agreements. This is particularly important for the demersal trawls/seines fishery, as 49% and 36% of the regulated effort (i.e. excluding article 11) by TR1 and TR2 respectively is operated under article 13, and the actual effort is therefore much higher than the official baseline. Therefore, the present analysis was restricted to BT1 and BT2.

Overall, the effort ceiling since 2009 was not limiting for the BT2 gear category. With the exception of Germany in 2009 this was also the case on a member state level (Figure 4-6). However, if a vessel would like to target plaice in the northern part of the North Sea (north of 54°N) it would have to switch to BT1 gear (EC No. 40/2013). This may be limiting for some member states with their current allowed effort ceiling for BT1, e.g. The Netherlands in 2012 (Figure 4-6).

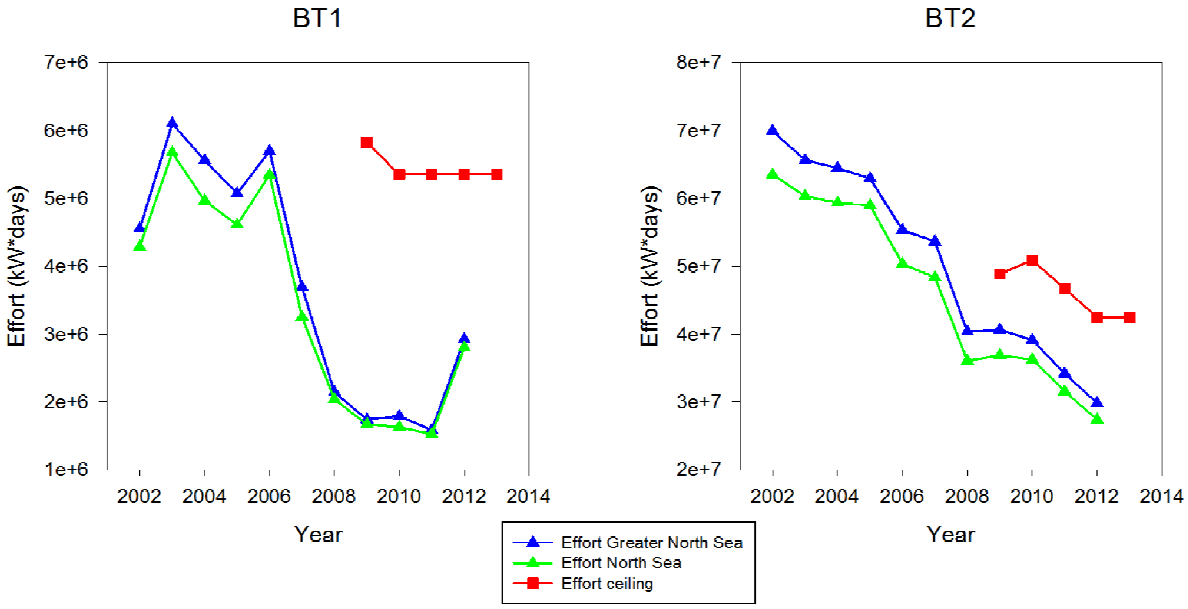


Figure 4-5. Effort ceiling and realized effort of the BT1 (left panel) and BT2 (right panel) gear category. Red squares: effort ceiling BT2 Greater North Sea (IIIa, IV, VIId); blue squares: realized effort BT2 Greater North Sea; green triangles: realized effort BT2 North Sea (IV).

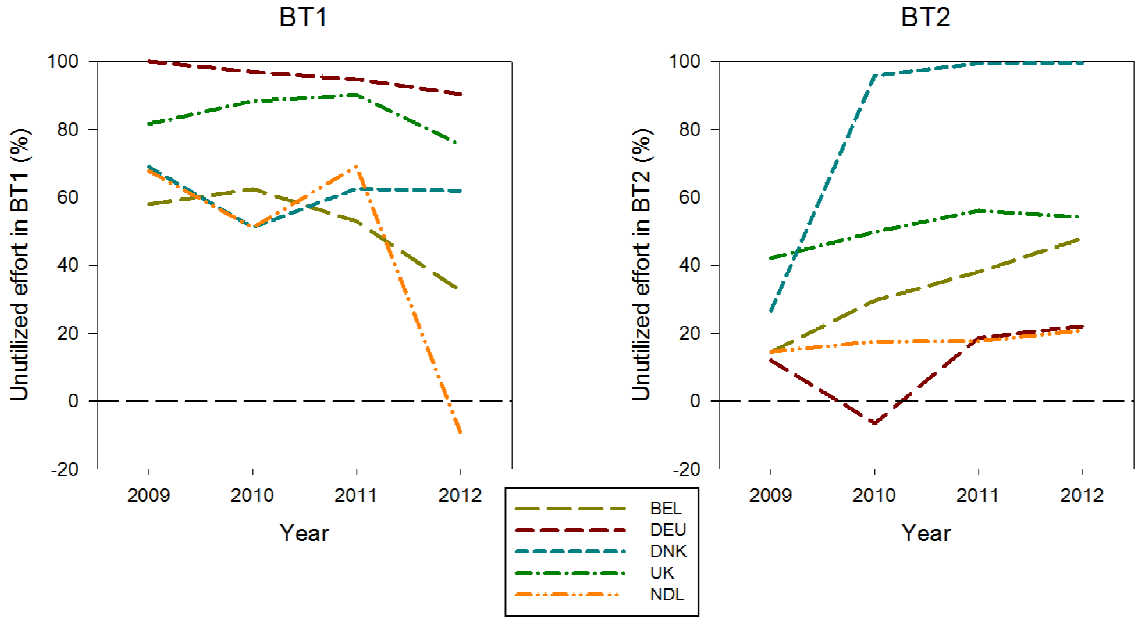


Figure 4-6. Unutilized effort per member state for gear category BT1 (left panel) and BT2 (right panel).

5 ENVIRONMENTAL EFFECTS OF THE PLAN

5.1 Evaluation of the effects of the management plan on the fishery

5.1.1 Trends in catches and landings of plaice and sole

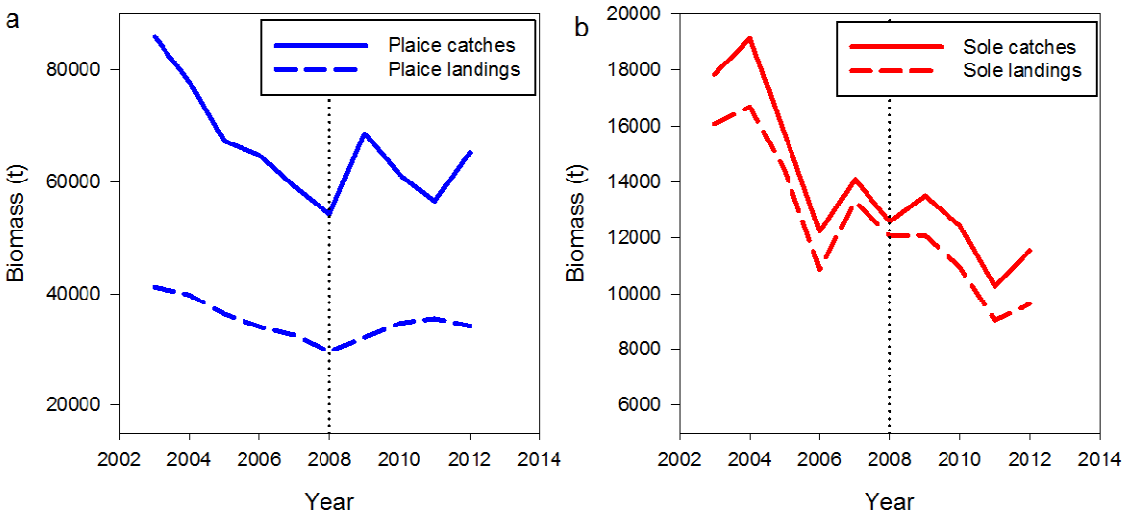


Figure 5-1.Landings and total catches for plaice (panel a) and sole (panel b).

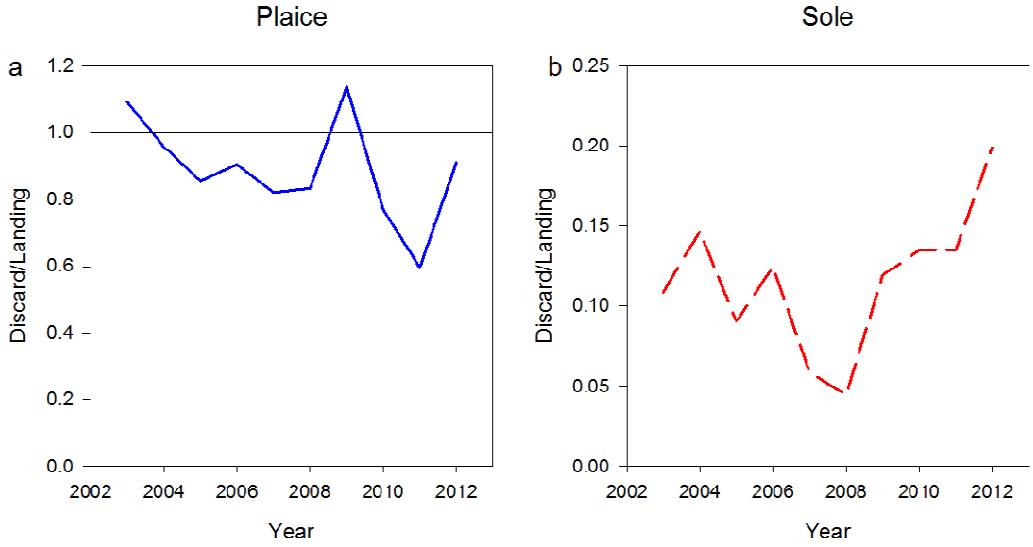


Figure 5-2.Ratio between discards and landings for plaice (panel a) and sole (panel b).

Taking into account discard data of the STECF effort data base (13-21) allowed the estimation of landings and total catches of plaice and sole. This analysis was restricted to the gear category BT2 since for the other gear categories the data seem not reliable enough for the whole time series. However, the BT2 takes the largest part of plaice and sole (Figure 4-4). The catches for plaice showed a decreasing trend since 2003 followed by a sharp increase between 2008 and 2009 (Figure 5-1). Between 2009 and 2012 catches fluctuated with no clear trend. The landings of plaice also decreased since 2003 but increased since 2008 to a maximum of about 35kt in 2011. Sole catches and landings between 2003 and 2012 showed an overall decreasing trend (Figure 5-1). Discards are considerably higher for plaice than for sole. The ratio between discards and landings for plaice fluctuated around 1 between 2003 and 2009 (Figure 5-2) with a peak in 2009 followed considerably lower values in 2010 and 2011. For sole this ratio decreased from 0.15 to 0.05 between 2004 and 2008 but increased since then to about 0.2 in 2012 (Figure 5-2).

The landings per unit effort (LPUE) of plaice showed an increasing trend for the most important gear categories especially since 2008 (Figure 5-3). This is in line with the increasing trend in plaice landings although the overall effort was reduced. A similar increasing trend could also be observed for sole, but only for BT2 and GN1and this trend is not as pronounced as in the case of plaice. This increase in LPUE might be due to increasing stock sizes. The plaice stock increased sharply since 2007 (Figure 5-4). Further, the observed spatial shift of BT2 effort to more southerly areas (see Section 4.2) could also partly explain the increasing LPUE in TR1 and BT1.

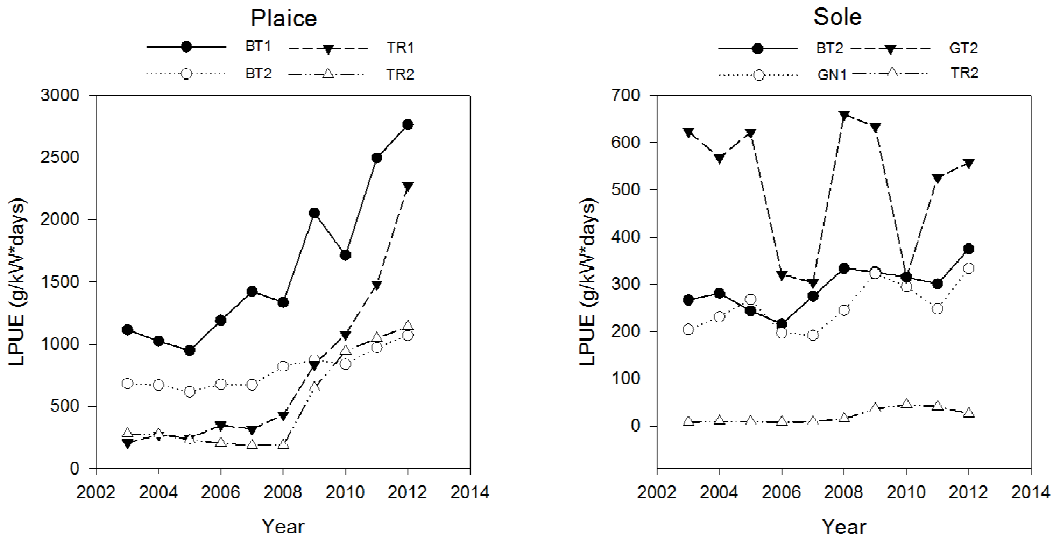


Figure 5-3.Landing per unit effort (LPUE) of plaice (left panel) and sole (right panel) displayed for the four main gear categories for each species.

5.2 Evaluation of the effects of the management plan on the stock

5.2.1 Evaluating the stock response to the changes in the fisheries resulting from the plan - is the plan delivering its own internal objectives with respect to the stock?

Data obtained from the latest ICES assessments of the stocks (ICES, 2013) has been used to evaluate the development of the stocks since the implementation of the plan.

Since the implementation of the management plan the plaice stock has increased steadily and is currently estimated to be at the highest observed level since 1957 (Figure 5-4). This increase does not appear to be driven by exceptional large year classes but rather by a steep reduction in fishing mortality since the 1990s. Fishing mortality has been below the target (and the management intended F) in all years of implementation due to a combination of the 15% TAC increase limit preventing fishing mortality from increasing to the target level and underutilisation of the TAC. Discard levels have been relatively stable in recent years despite the increase in landings. Estimated discards used in the ICES assessment of plaice do not correspond directly with STECF discard estimates due to different raising procedures. The reduction in fishing mortality has led to an increase in older fish in the stock and to a lesser degree in the catch (Figure 5-6).

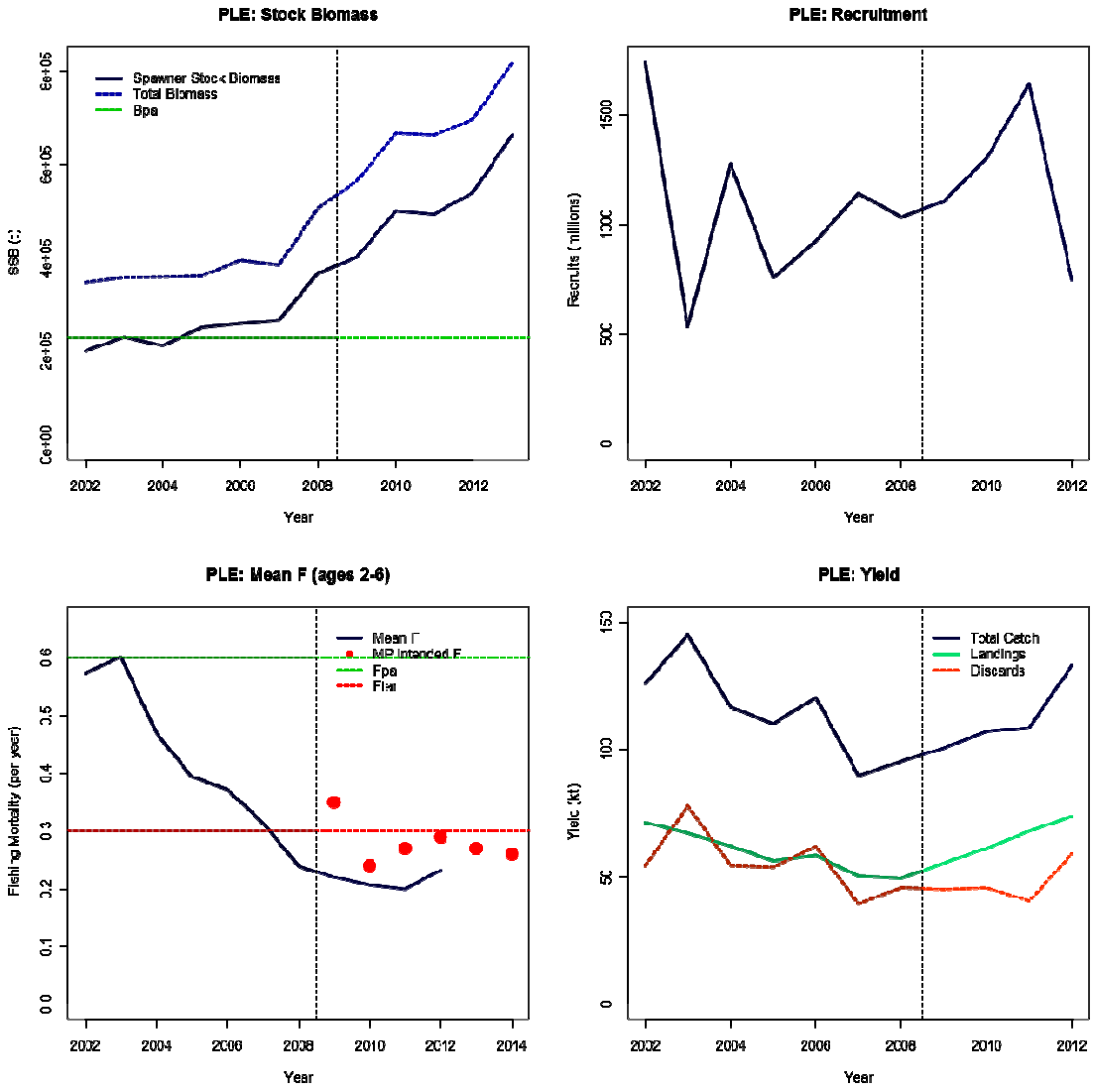


Figure 5-4. North Sea plaice: Stock biomass (top left), recruitment (top right), fishing mortality (bottom left) and yield (bottom right). The shaded gray area represents the period before the implementation of the plan for setting the TAC for each species.

The SSB of sole increased sharply to Bpa at the first year of implementation of the plan as the large 2005 year class (age 1 in 2006) matured (Figure 5-5). After that SSB remained slightly below Bpa eventually increasing above it in 2012. The high recruitment in 2010 should sustain growth of the stock, maintaining it above Bpa at least in the short term. Fishing mortality for sole has been above the target but below Fpa in all years of implementation of the plan. The intended 10% reduction in fishing morality each year did not occur initially due to a combination of retrospective errors in the assessment (revising F up from year to year), forecast assumptions (i.e. assumed intermediate year catch and recruitment) and variable TAC uptake. There appears to be some relationship between BT2 effort (Section 4.2) and fishing mortality, both showing a decrease over time. Landings have decreased slightly since the implementation of the plan and the last two years (2011 and 2012) are the lowest on record with the exception of 1964. The ICES assessment of sole does not consider discards, this will be changed at the next sole benchmark assessment in 2015 or 2016. The age structure of the sole stock (Figure 5-6) is variable over years, apparently driven mainly occasional occurrence of large year classes (e.g. in 2007 and 2008 half the total stock biomass is estimated to come from the 2005 year class alone).

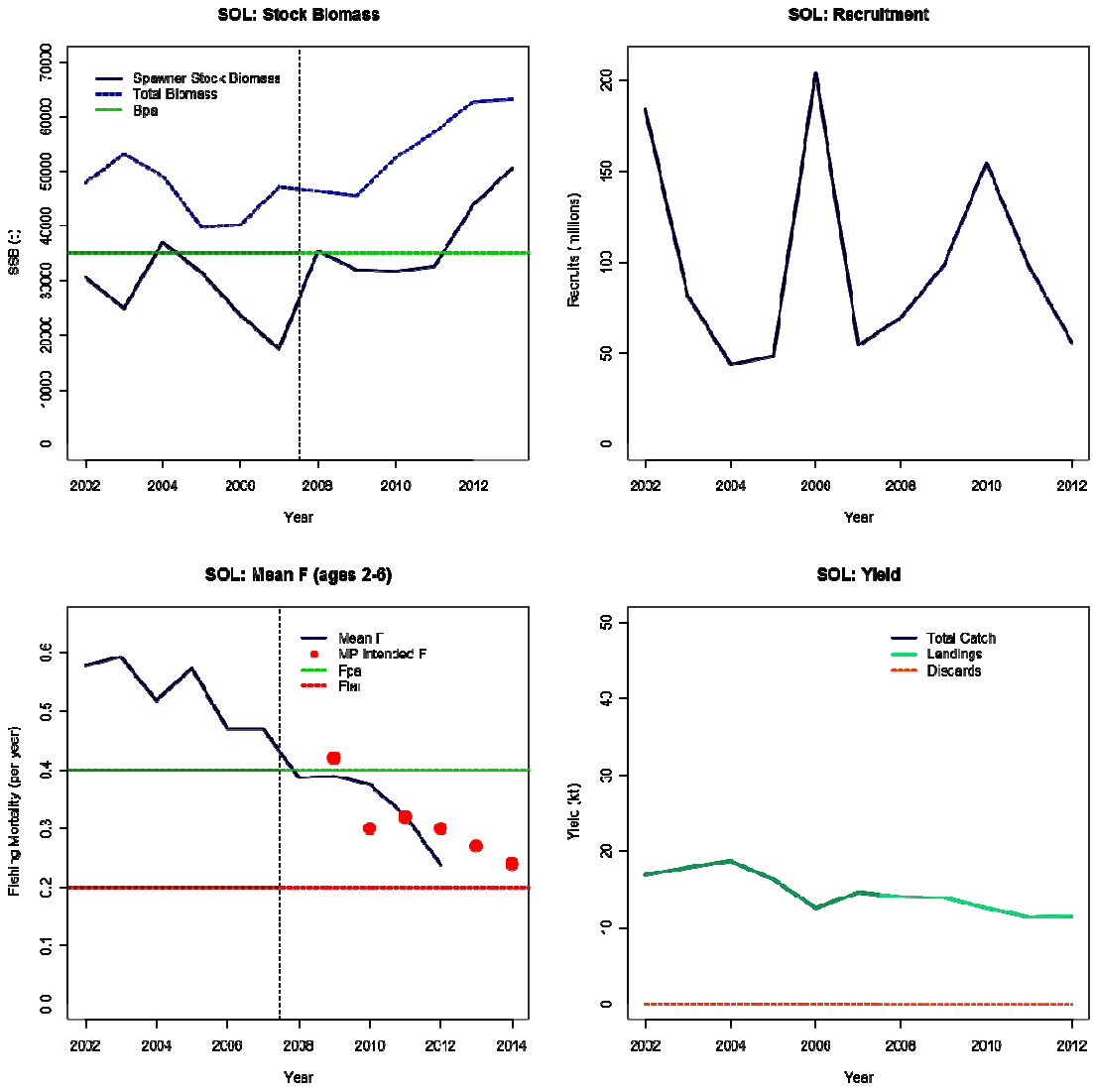


Figure 5-5. North Sea sole: Stock biomass (top left), recruitment (top right), fishing mortality (bottom left) and yield (bottom right). The shaded gray area represents the period before the implementation of the plan for setting the TAC for each species.

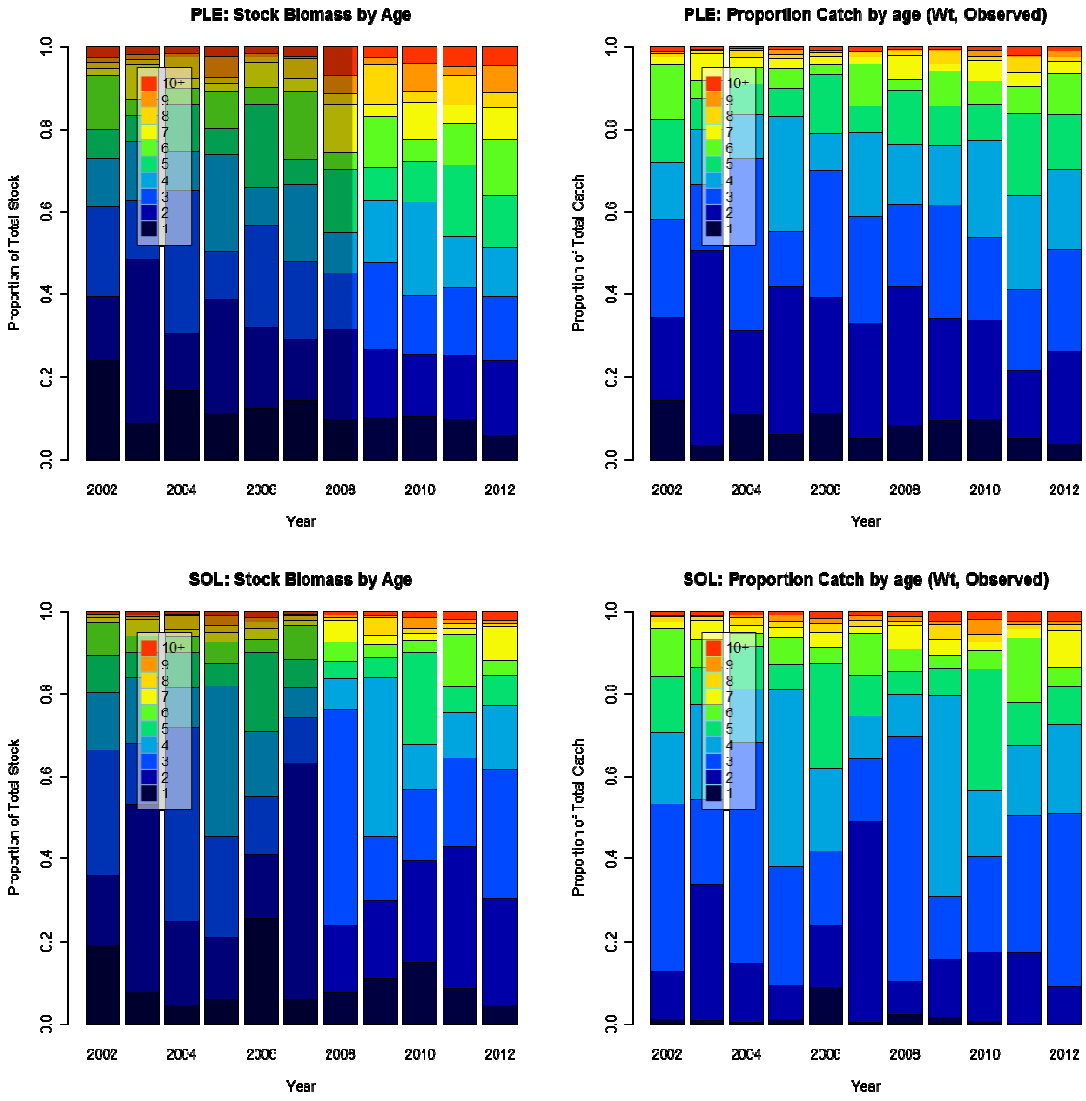


Figure 5-6. Biomass proportion by age in the stock (left) and the catch (right) for North Sea plaice (top) and sole (bottom).

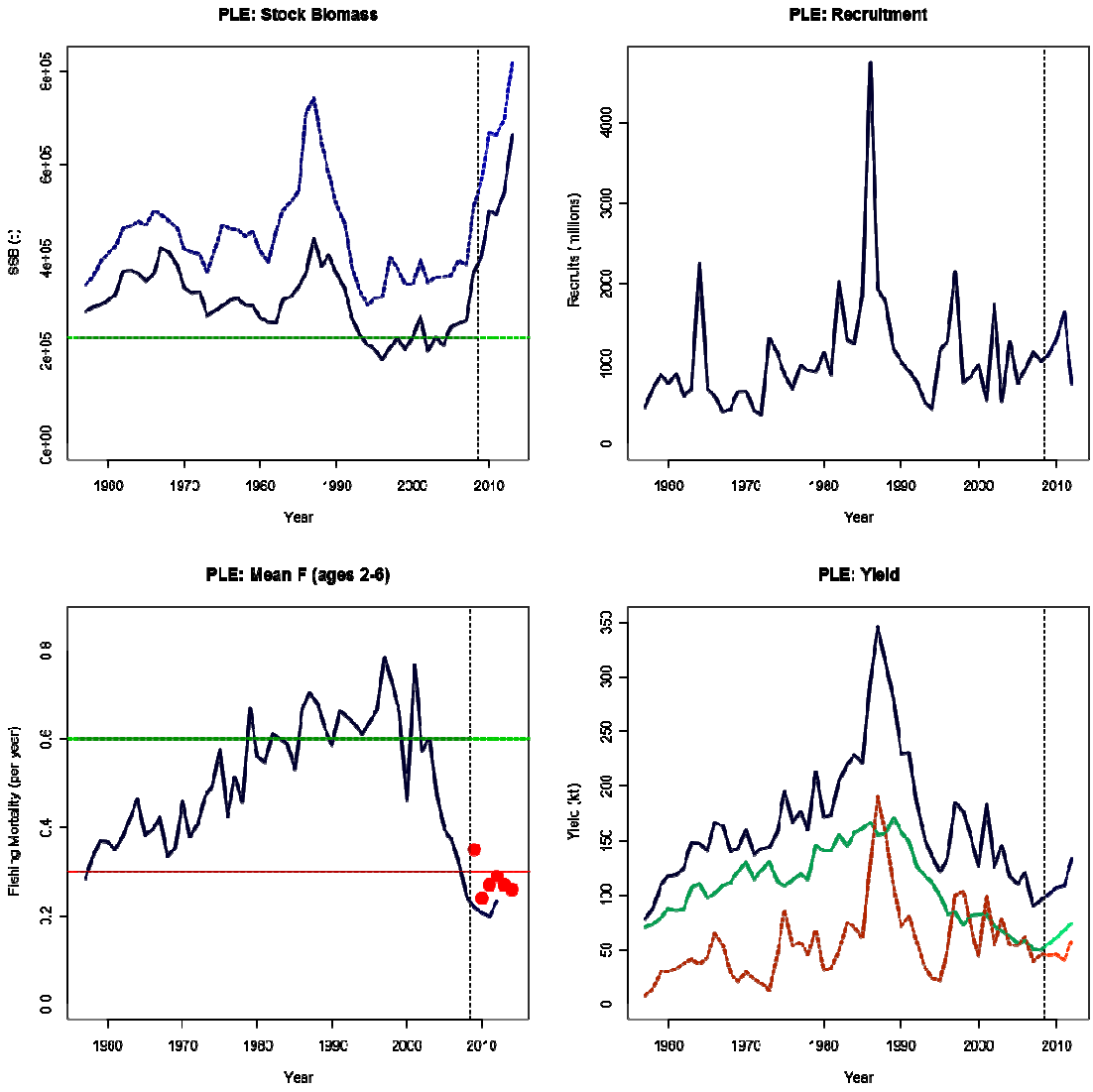


Figure 5-7. Results of the most recent stock assessment for plaice. The stock is currently at record high levels and F at its lowest level. Yield, though increasing, is still low relative to the past. There have been no massive recruitments recently but the general level has been slightly above the geometric mean.

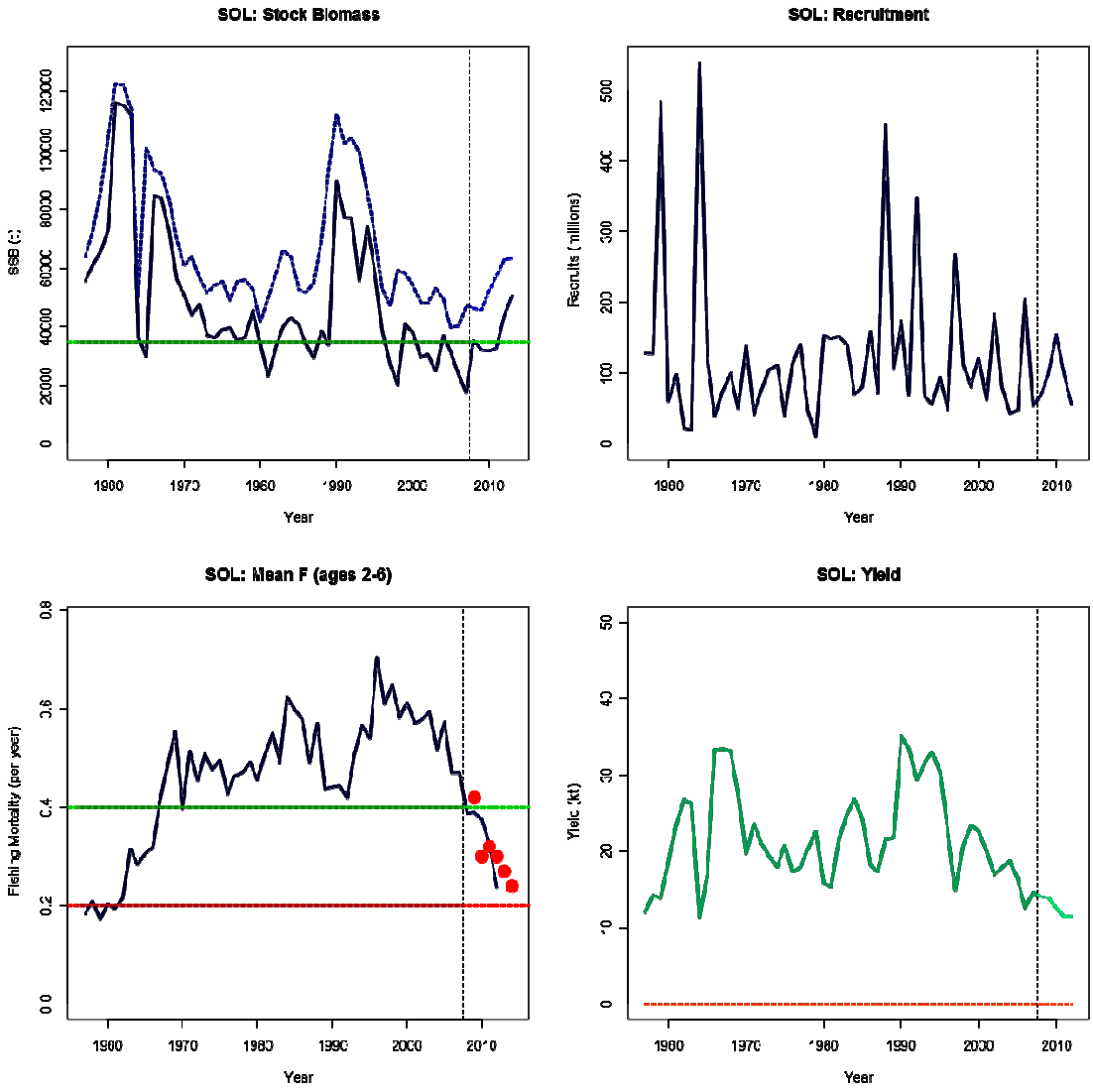


Figure 5-8. Results of the most recent stock assessment for sole.At the start of the plan SSB was at the lowest observed level. Yield is also near the lowest level observed. F has decreased sharply since the 90s. Recent recruitment is variable with no massive peaks.

5.2.2 Evaluating whether the values of target and other reference points referred to in the plan are consistent with current knowledge and the objective of achieving MSY by 2015.

The target values specified in the LTMP are intended to represent fishing mortality rates that are likely to achieve MSY objectives. However, both values differ for the Fmsy values used by ICES (0.2 vs 0.22 for sole and 0.3 vs 0.25 for plaice). In addition, the EU is discussing Fmsy in the context of mixed fisheries management plans, which may subsequently lead to a revision in its views on Fmsy. There are discussions about a potential usage of Fmsy ranges, instead of point estimates, to deal with inconsistencies between TACs in a mixed fisheries context. At present the technical basis for defining these ranges and policy objectives for these are unclear.

Given the current reference points it appears likely that both stocks should achieve MSY objectives by 2015 (plaice below Fmsy, but within range and sole at or above Fmsy but within the range of values – see below). Since the LTMP target for plaice is at the upper bound of what could be considered an appropriate range of values for Fmsy and the sole target is at the lower bound of the acceptable range, it seems likely that target values will need to be revised in the second stage of the plan. In addition, it

may be appropriate to add a revision clause to revisit these values should assessments of the stocks change or a landings obligation is implemented.

5.2.2.1 Exploration of Fmsy for plaice and sole

In 2010 ICES implemented the MSY framework for providing advice on the exploitation of stocks. The aim is to manage all stocks at an exploitation rate (F) that is consistent with maximum (high)long-term yield while providing a low risk to the stock.

In 2011 the Workshop on Implementing the ICES Fmsy Framework (WKFRAME2) refined the procedure for how advice would be made on the basis of this framework (ICES, 2011). The recommendation by WKFRAME2 that simulation tested management plans supersede alternatively estimated Fmsy management was, in part, an acknowledgement that Fmsy is often poorly estimated, particularly for stocks with ill-defined stock recruitment relationships. Both sole and plaice show poor fits for most stock-recruit functional relationships (Figure 5-9) and as a result it is difficult to calculate Fmsy reference points for these stocks.

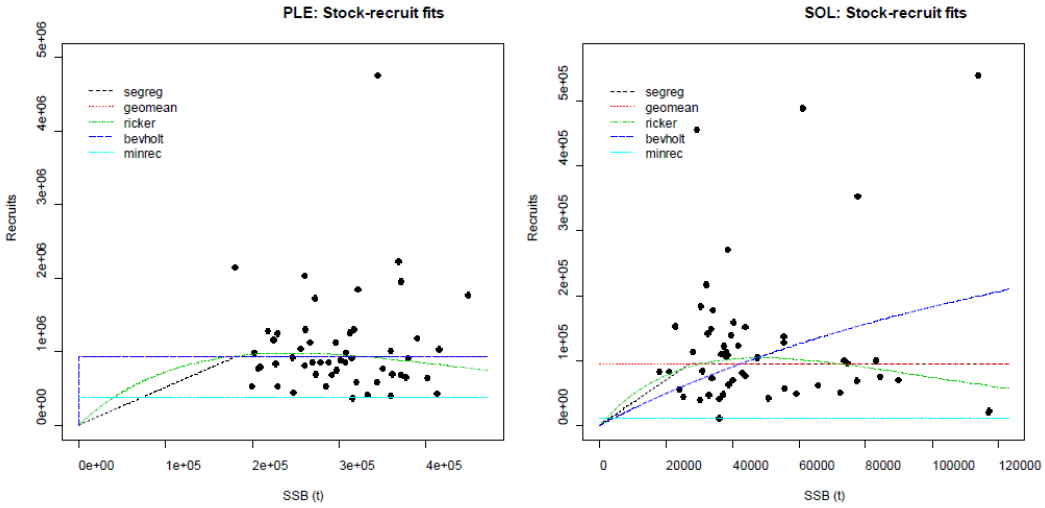


Figure 5-9. Stock-recruit scatters for the North Sea plaice (left) and sole (right) stocks. Data is from the 2010 assessments of the stocks (ICES 2010). The geometric mean (red) and minimum recruitment level (light blue) are plotted as well as segmented regression (black), Ricker (green), Beverton and Holt (dark blue) function fits.

In addition to the MSE simulation studies,the2010 STECF impact assessment of the North Sea flatfish LTMP (Simmonds *et al*, 2010) also included an equilibrium analysis approach to determining Fmsy, taking into account uncertainty in stock recruitment relationships (following the approach used by Simmonds *et al*, 2011). These analyses compliment the CEFAS ADMB approach used at the ICES WGNSSK 2010 meeting in the setting of the initial Fmsy reference points for these stocks (ICES, 2010). It is considered sufficient to briefly describe the approaches and document the main conclusion here, detailed results of the various analyses are available in the published reports (ICES, 2010, Miller and Poos, 2010 and Simmonds *et al*, 2010).

The CEFAS ADMB approach takes into account uncertainty in the input parameters, such as weights at age, maturity and stock numbers at age. The MSE simulations performed by Miller and Poos (2010) consisted of a detailed age-structured population model, including a range of different stock dynamics around the base case model. This incorporated uncertainty in stock recruitment function, measurement error and variability in the fishery. Several alternative stock dynamics and mixed fishery scenarios were tested. A range of management scenarios examined the likely impacts of varying aspects of the multi-annual plan on the stocks and the fishery, including different candidate F targets for each stock. The Simmonds equilibrium analysis (Simmonds *et al*, 2010, 2011) models recruitment stochastically

based on multiple stock recruitment models for the populations. The set of models are based on Bayesian analysis to give a joint distribution of model coefficients (A, Bandσ) for each functional type. The proportion of functional types is chosen based on probability estimates given the quality of the fit. The procedure is documented in Simmonds *et al* (2011) for the example of NE Atlantic mackerel. For the North Sea flatfish stocks the stock recruitment functions chosen were the Hockey-Stick (segmented regression) and the Ricker model.

5.2.2.2 Fmsy reference points for North Sea plaice

The current management plan target for plaice is 0.3. On the basis of the CEFAS ADMB analyses (Table 5-1), an F range of 0.2-0.3 was considered appropriate as a basis for Fmsy. The MSE simulations conducted by IMARES (Table 5-2) indicated that alternative F targets in the 0.15 to 0.3 range lead to the stock stabilising at different levels of SSB, all above Bpa and precautionary with regards to the limit reference points in the short and long-term. In addition, long-term yields for Fs over the range 0.2-0.3 showed negligible differences. The equilibrium analyses taking into account uncertainty in stock recruitment relationships (Figure 5-10) indicated that alternative F targets over the range 0.2-0.3 all lead to similar long-term TAC values (because these values lie on a flat-topped Fmsy distribution). The estimates of Fmsy from the long-term equilibrium analysis method using 2010 assessment values, gives a value for North Sea plaice of F=0.25 (latest calculations; Simmonds *et al*,2010).

On the basis of these analyses the ICES WGNSSK working group has concluded that F=0.25 is an appropriate value for Fmsy for North Sea plaice as it results in a high long-term yield, with low risk to stock. This finding is supported by all analyses including simulation tests, uncertainty in input parameters and uncertainty in stock recruit relationships. In addition, it seems that any F value on the range 0.2-0.3 produces similarly high yields without increasing the risk to the stock.

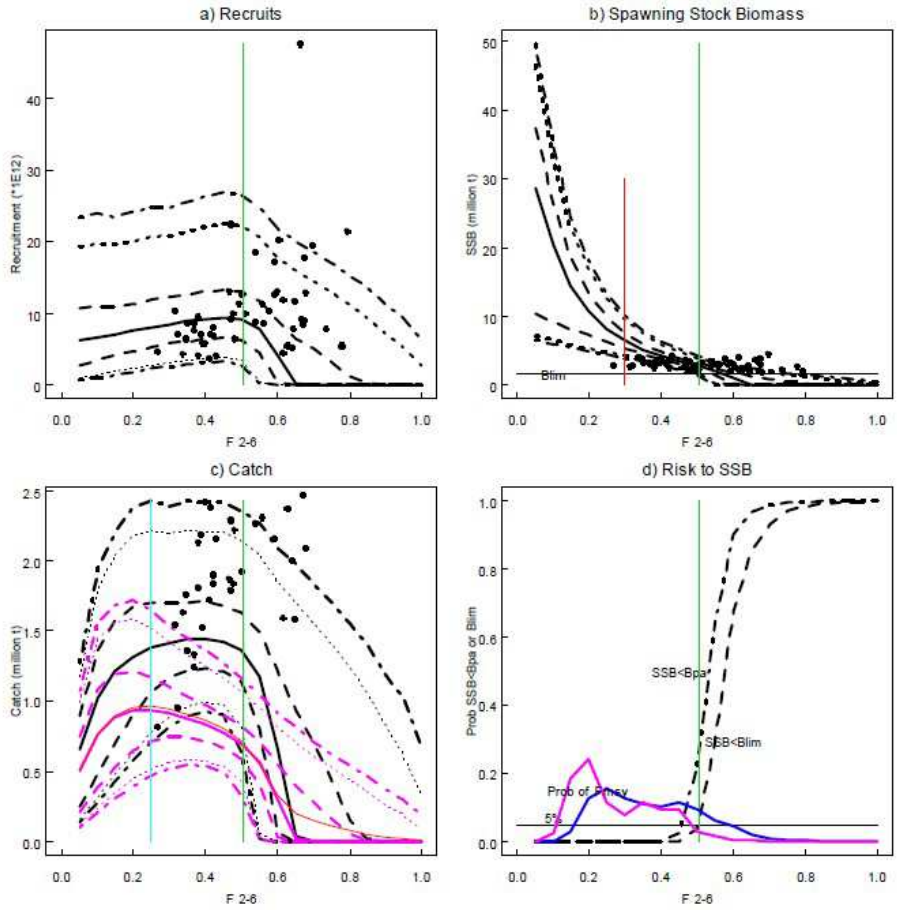


Figure 5-10. Equilibrium exploitation of NS plaice against target F from F=0.05 to 1.0. Quantiles (0.025, 0.5, 0.25, 0.5, 0.75, 0.95, 0.975) of simulated a) Recruits, b) SSB and c) Catch: black lines and Landings pink lines. Historic Recruits, SSB and Catch: black dots. c) mean landings: red line. d) probability of SSB below Blim and Bpa: black lines and 5% probability of SSB below Blim green line in all panels. d) distribution of F for maximum catch, blue line, and maximum landings, pink line. F for maximum Landings: cyan line, based on 50% point on the distribution of F panel (d) and maximum mean Landings panel (c). The red line in panel b shows the current management plan target F. From Simmonds *et al* (2010).

5.2.2.3 Fmsy reference points for North Sea sole

The current management plan target for sole is 0.2. On the basis of the CEFAS ADMB analyses (Table 5-1), an F target of 0.22, within the range 0.13-0.39, was considered appropriate as a basis for Fmsy. The MSE simulations conductedby IMARES (Table 5-2) indicated that alternative F target values in the range 0.15 to 0.35 result in both short-term and long-term differences in TAC. An F target of 0.15 produces lower TAC in both the short- and long-term, while an F target of 0.3 provides higher short-term TACs, slowly becoming more similar to the long-term TACs from F targets in the 0.2-0.25 range. There is a short-term difference between 0.2 and 0.25, though in the long-term this is less substantial. However, for F values above 0.25 there was an increasing risk of driving the stock out of safe biological limits and exploitation levels greater than this were not considered to be precautionary. The equilibrium analyses taking into account uncertainty in stock recruitment relationships (Figure 5-11) using 2010 assessment values gives an Fmsy value for North Sea sole of F=0.32. However, it is considered that it is important to take the risk into account when setting the target F for sole. An increase in F target might lead to higher catches, but the risks associated with increase in target F above 0.3 are considered to be not precautionary.

On the basis of these analyses the ICES WGNSSK working group has concluded that F=0.22 is an appropriate value for Fmsy for North Sea sole as it results in a high long-term yield, with low risk to

stock. This finding is supported by all analyses including simulation tests, uncertainty in input parameters and uncertainty in stock recruit relationships. In addition, it seems that any F value on the range 0.2-0.25 produces high yields while maintaining low risk to the stock.

The sole assessment is due to be benchmarked by ICES in 2015 or 2016 (new independent index, changes to/exclusion of the LPUE index (pulse trawlers removed), inclusion of discards). At the same time reference points will be re-evaluated and may differ from those described above.

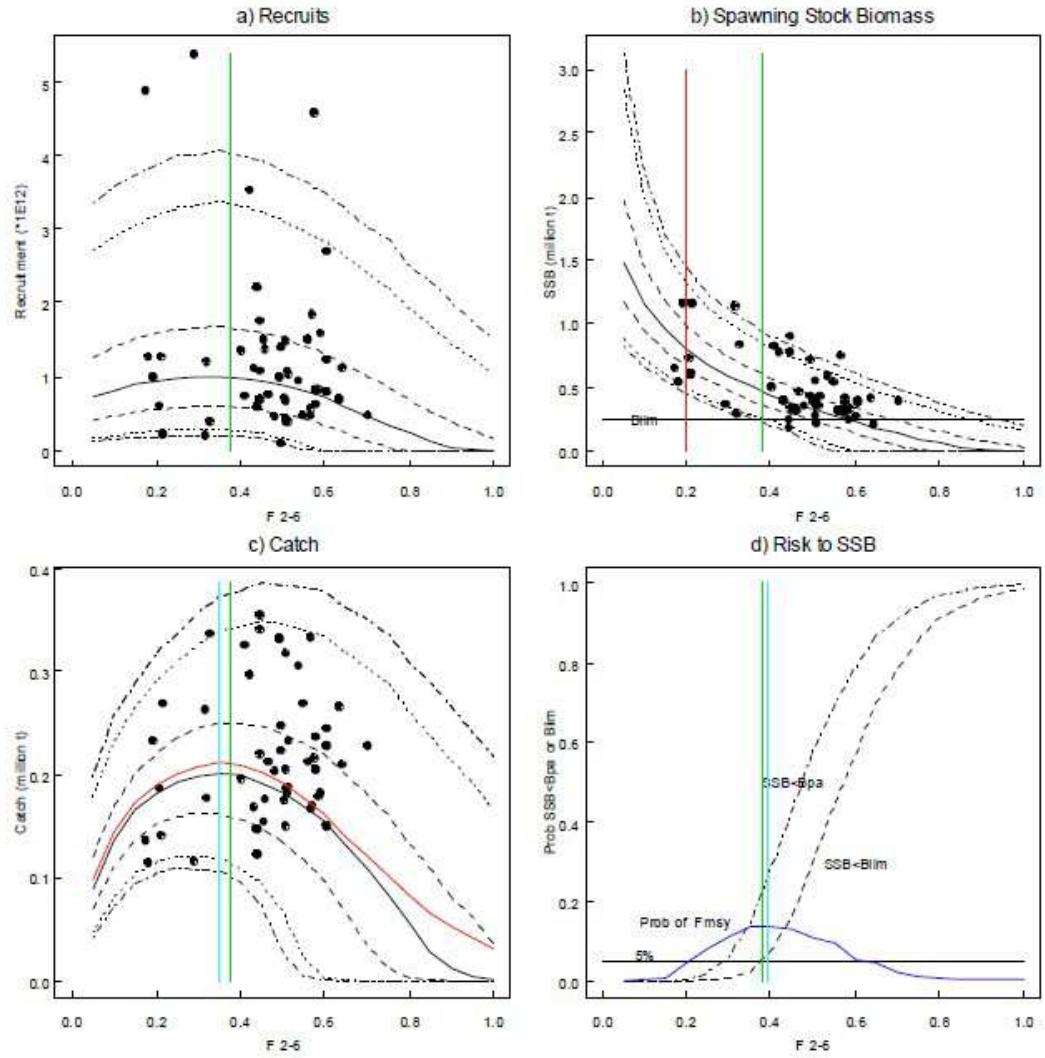


Figure 5-11. Equilibrium exploitation of NS sole against target F from F=0.05 to 1.0. Quantiles (0.025, 0.5, 0.25, 0.5, 0.75, 0.95, 0.975) of simulated a) Recruits, b) SSB and c) Catch/Landings: black lines. Historic Recruits, SSB and Catch/Landings black dots. c) mean catch/landings: red line. d) probability of SSB below Blim and Bpa: black lines and 5% probability of SSB below Blim green line in all panels. d) distribution of F for maximum catch/landings blue line. F for maximum catch/landings: cyan line, based on 50% point on distribution of F panel (d) and maximum mean catch/landings panel (c) The red line in panel b shows the current management plan target F. From Simmonds *et al* (2010).

Table 5-1. Stochastic and deterministic Fmsy estimates for the plaice and sole stocks in the North Sea given three different stock-recruit functions. Fmax estimates are also included. Data come from the WGNSSK 2010 assessments for the stocks (ICES, 2010).

Stochasticpercentiles	5%	50%	95	Deterministic
PLE				
Hockey Stick	0.02	0.19	0.	0.2
Bevertonand	0.02	0.16	0.2	0.2
Ricker	0.19	0.32	0.	0.36
Fmax	0.02	0.17	0.2	0.2
SOL				
Hockey Stick	0.1	0.29	0.5	0.49
Bevertonand	0.02	0.16	0.3	0.58
Ricker	0.13	0.22	0.3	0.31
Fmax	*	*	*	0.58

***Not Examined**

Table 5-2. Management strategy evaluation simulation results for alternative F target values in the North Sea flatfish long term management plan. Medium term (MT; 2015-2024) average annual yield and long term (LT) risk to the stock (chance of falling below precautionary limit reference points) for plaice and sole in the North Sea are shown. Data come from Miller and Poos (2010).

	PLE		**SOL**	
F	MTYield (t)	Risk_Blim (%)	MTYield (t)	Risk_Blim (%)
0.15	101979	0	15904	0
0.2	111468	0	17687	2
0.22	*	*	18215	2
0.23	113152	0	*	*
0.25	112885	0	19151	6
0.3	111376	0	20236	19

***NotExamined**

5.3 Evaluation of the effects of the management plan on the ecosystem.

Discards of undersized plaice in the sole fishery are substantial due to the fact that it is not possible to fish sole clean from bycatch of plaice. Plaice is selected with 80 mm mesh sizes from smaller lengths (due to its shape) than sole, but its minimum landing size is larger than that of sole (27 versus 24 cm respectively). The overall ratio of discards versus landings has shown a decrease in the total fleet fishing for plaice (seeFigure 5-12). This decreasing trend is not clearly present in the Dutch fleet. Since the Dutch fleet holds 75% of the sole quota, this may be explained by the fact that the Dutch fleet operates its fishery predominantly ‘closer to home’ targeting sole. This has in recent years been even more so to avoid high fuel costs when steaming further to fishing grounds further North where they could have cleaner plaice fisheries and low plaice prices.

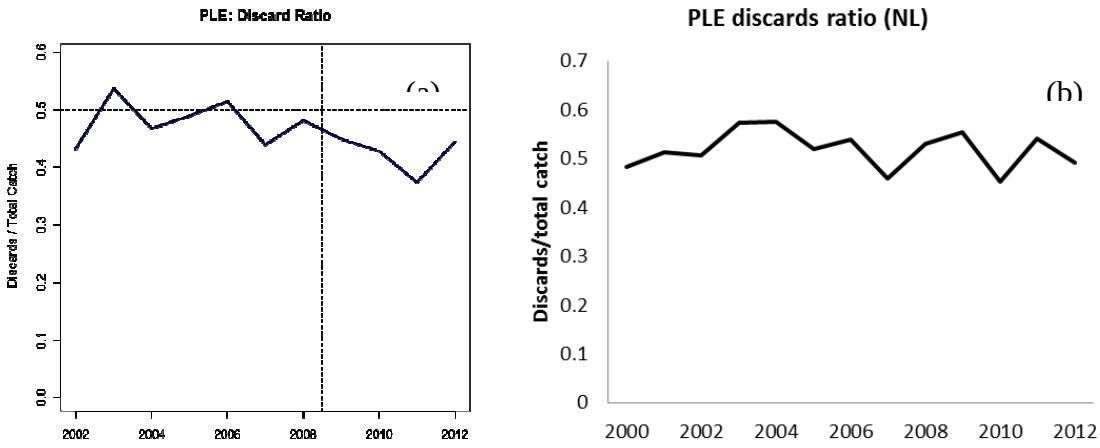


Figure 5-12. (a) Proportion discards out of total catch for the total fleet (from 2013 WGNSSK assessment results) and (b) proportion discards of total catch for the Dutch fleet.

The generally decreasing trend in effort deployed by the fleets fishing on plaice and sole, which may or may not be (partly) a result of the management plan, has the consequence that the fleet as a total has had a decrease in bycatch of organisms related to effort. These may include associated flatfish species and benthic organisms.

6 SOCIAL AND ECONOMIC EFFECTS IF THE PLAN

6.1 Data and Calculation of Indicators

The overarching observation in the evaluation is that in most years neither TAC nor effort, as set through the North Sea flatfish LTMP, was fully exploited (see Section 0). External effects, from outside the management, had a significant impact on the performance of the NS flatfish fisheries.

The focus of the evaluation of the plan was on Dutch, Belgian, British and German beam trawlers >24m. Dutch vessels are displayed in two length classes (24-40m and >40m). British and German beam trawlers are displayed as clusters (> 24m). Belgian vessels are represented through one length class (24-40m).

The fleet segments to be considered have been selected by importance for the stock exploitation and by relevance to the related fishery for the segments.

The selected fleet segments account for the majority of catches. Moreover, the fishery on sole and plaice is the predominant activity of the fleet segments under consideration. Therefore, data provided for these fleet segments in the DCF Annual Economic Report (AER) are regarded suitable for the analysis.

As stated before, the NS flatfish LTMP was not a limiting factor for the fisheries and other factors had a major influence on the economic performance of the fleets. Therefore the time series of economic indicators will more likely reflect the consequences of these external effects.

In the following figures (Figure 6-1, Figure 6-2, Figure 6-3 and Figure 6-4) some numbers and indicators are displayed as time series for the period from the beginning of the plan until the latest year for which data are available from the AER.

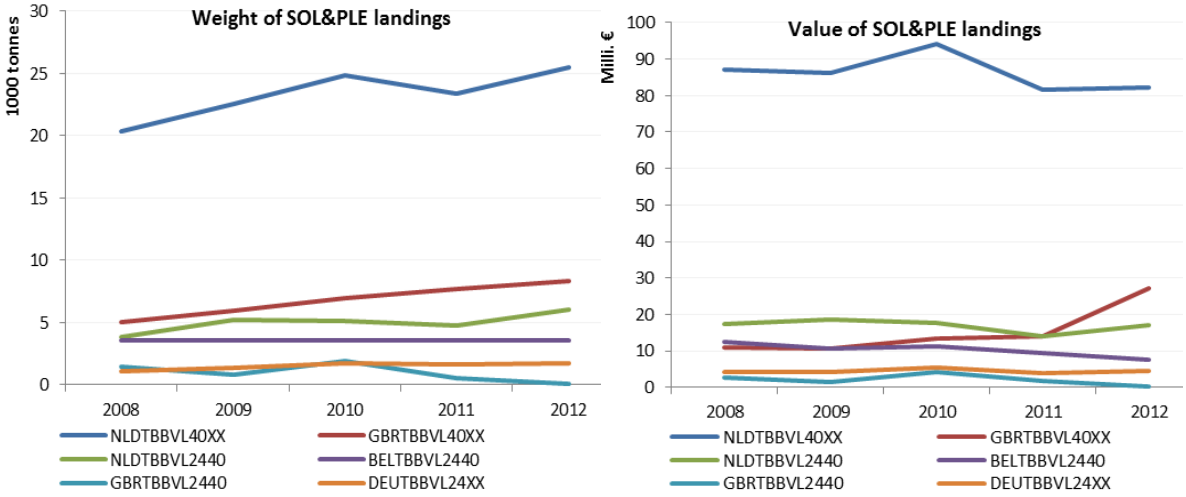


Figure 6-1. Weight and volume of NS sole and plaice landed by relevant segments.

Weight and volume of catches indicate a slight increase, but no abrupt changes in the trend throughout the period of the plan (Figure 6-1).

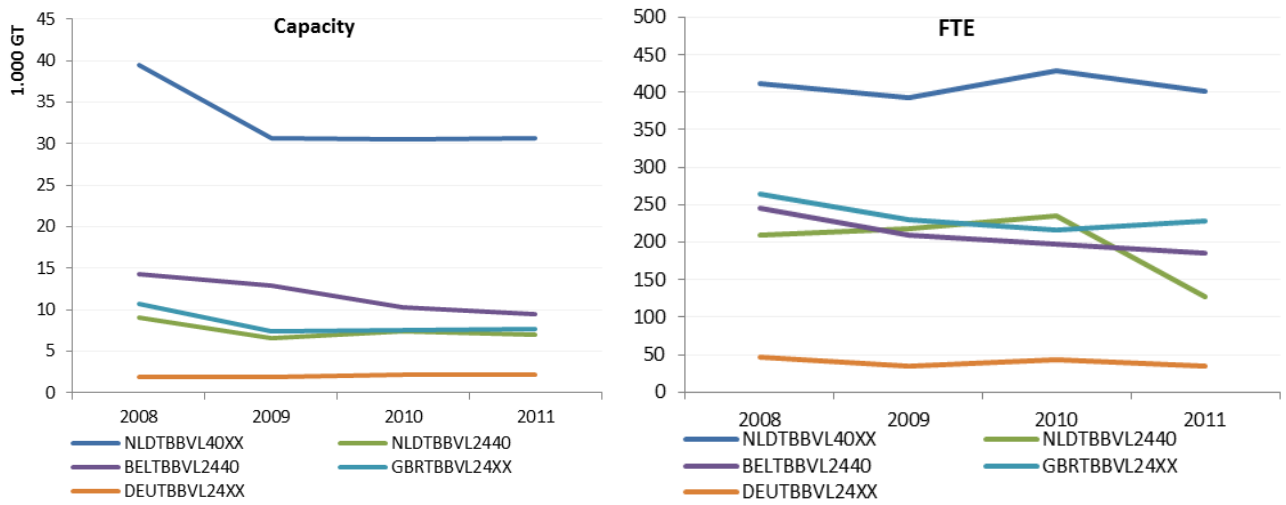


Figure 6-2. Capacity and employment (full-time equivalent) of fleet segments relevant for NS sole and plaice.

Figure 6-2 indicates a considerable decommissioning in the Dutch large beam trawler segment in 2009, initiated by a national decommissioning scheme. In most of the other fleet a decrease in capacity can be observed as well, but not as extreme as in the Dutch fleet. Employment figures show a by and large stable trend.

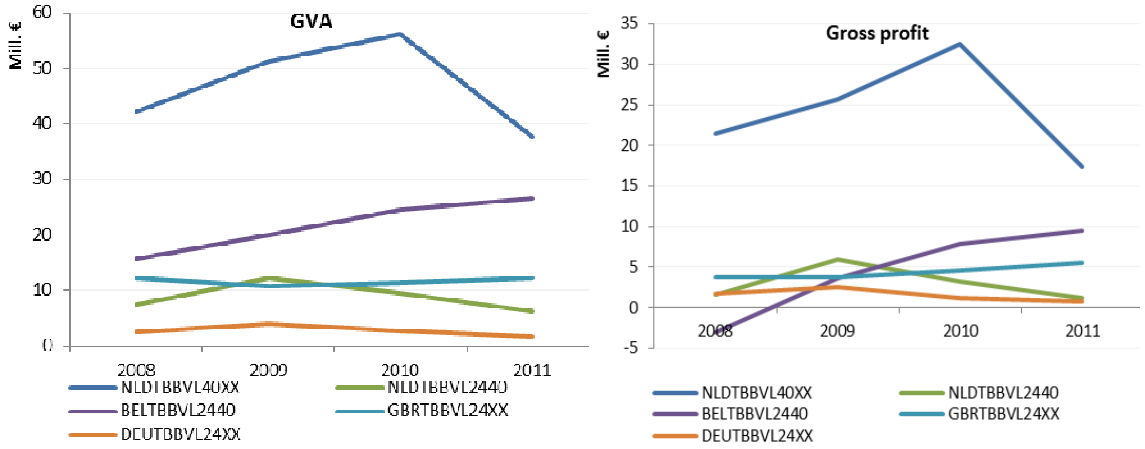


Figure 6-3. Gross value added and gross profit of fleet segments relevant for NS sole and plaice.

GVA and gross profit increased in most cases (Figure 6-3) benefiting mainly from the reduction of the overcapacity in the fleets (mainly due to the decommissioning scheme for the Dutch fleets), the decrease of fuel costs in 2009 (Figure 6-4) but despite a large decrease of the price of plaice in 2009 (-30% of 2008 price) which remained at low level.

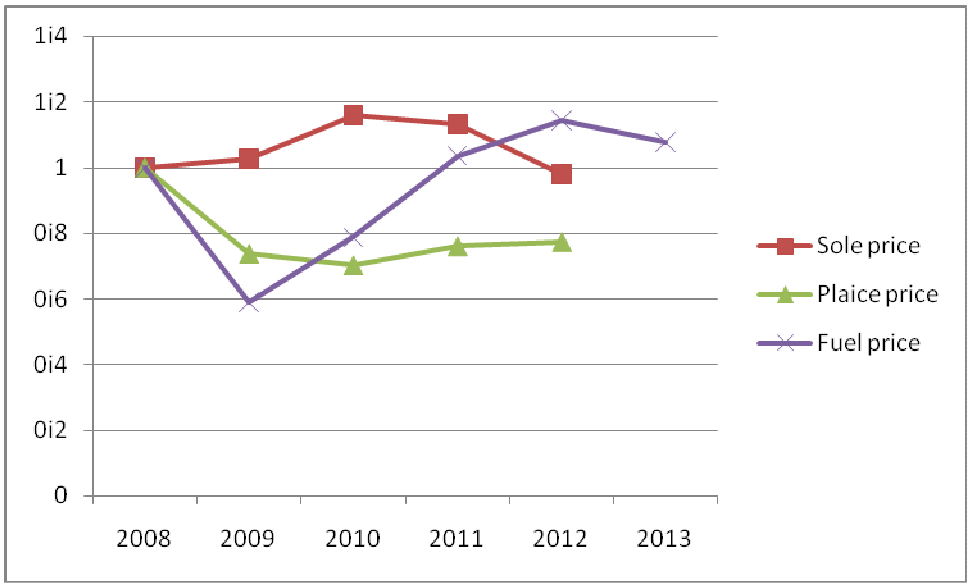


Figure 6-4. North Sea sole and plaice and fuel price evolution relative to 2008 levels.

There is a lack of data on the costs of management and enforcement so they cannot be quantified but the management plan relied on TACs and effort limitations. Those two management measures were already used previously and therefore the costs of implementing these are not believed to have increased with the management plan. It may be argued that the long term management plan rather simplified the decision process of TAC setting as the TACs have followed advice since 2009.

The enforcement costs are not believed to have changed either especially because the TAC and efforts haven't always been constraining.

7 What Has Been the Added Value of the Management Plan

7.1 Developing a "no management plan" scenario

As an exercise to evaluate the added value of the implementation of the LTMP, a scenario of what management could have been applied in the absence of the LTMP was created. The relative performance with and without the management plan was examined under the two management scenarios, starting at the beginning of the LTMP.

A number of assumptions are required to predict what would have happened in the absence of a LTMP for these stocks. In these simulations it is assumed that managers would have followed the ICES advice. For the TACs in 2009 and 2010 the basis for advice would have been the precautionary approach (PA), while for the following years the basis would have been the ICES Fmsy approach (Table 7-1).

For the PA approach, the TAC is either the landings corresponding to F=Fpa or the landings that ensure that the stock remains above Bpa, following the catching of the TAC, whichever is lower. For the Fmsy approach it was used the transition rule. Following this rule the F used gradually steps down towards Fmsy from F_{2010} such that in 2015 F=Fmsy.

In the simulations, for both stocks the first TAC year is 2009 (i.e. from advice given in 2008 using data up to 2007). This was the first year for which the TACs adopted for both stocks came from the LTMP. The LTMP was used for sole for the TAC in 2008, but no agreement was in place at that time over using the LTMP for the plaice stock shared with Norway. Since 2009 there have been changes to both the data and assessment procedure for both plaice and sole. These include changes to weight at age data, merging of abundance indices, different length time series used and other minor technical details. These changes make it difficult to perfectly recreate the assessments of each stock in each year. For simplicity, the first assessment on which advice is based is the 2008 retrospective assessment, using the most recent data and assessment model settings (i.e. the same assessment settings as the 2013 ICES assessment, but with only data up to 2007 used).

For each subsequent year of the simulation and for each stock, the following procedure is followed:

1. The TAC set in the previous year is taken from the stock. In these biological simulations it is assumed that the TAC is landed completely (i.e. there are no limitations on the fleet, and no exceeding of the TAC). In the case of plaice, the observed discard rates and discard selectivity are used to estimate the discard portion of the total catch.

2. Recruitment is estimated from a segmented regression stock-recruit relationship and adjusted according to the observed recruitment residual (segmented regression and recruitment residuals from the 2013 assessment data).

3. Observed abundance index values are calculated from the true stock using the catchability and residuals estimated from the 2013 assessment model.

4. An XSA assessment is fit to the observed data up to year *y*-1 to create a perceived view of the stock in year *y*.

5. A short term forecast (STF) is conducted assuming F=Fsq (rescaled) in the intermediate year and perceived geometric mean recruitment.

5a. In the case of the “no MP’ scenario, the appropriate management rule is applied (before 2010: precautionary approach, thereafter the ICES Fmsy transition rule).

5b. In the case of the “LTMP” scenario, the observed landings are taken from the stock.

6. The STF produces the appropriate TAC, and the loop starts again for the next year.

Since the TAC is set based on the perceived (XSA) view of the stock and assumptions need to be made in the intermediate year of the forecast, the actual Fs that result from the TACs may differ from the management intended Fs according to the applied HCR. The management basis and the TACs set for each year according to the management plan scenario (“LTMP”) and the no management plan scenario (“no MP”) are shown inTable 7-1. The TACs, landings and SSB for each stock are shown inFigure 7-1.

Under the “LTMP” scenario, plaice TACs increased by the maximum allowed 15% almost every year. However, these TACs were not always taken. When the PA approach is followed (2009 and 2010 TACs, “no MP”) a sharp rise in TAC is seen. Bpa for plaice is twice as high as the management plan

target and the growing stock was already well above Bpa in these years. As a result of the high TACs, less growth in SSB is observed compared to the "LTMP" scenario. This leads to a subsequent reduction is TACs under the Fmsy approach in the "no MP" scenario. The "no MP" scenario resulted in higher catches over the time period with significantly less stock growth (though the stock remained above Bpa in both cases). The massive growth experienced by the plaice stock over the last decade means that most bases for management would have been precautionary (in terms of stock biomass) over the period examined.

The first year of the "no MP" scenario for sole sees a sharp reduction in TAC under the PA approach. This is because a reduced F was needed to ensure that the stock remained above Bpa the following year. The next year the SSB of sole increased substantially following the recruitment to the fishery of a large year class and management advice followed F=Fpa. Fpa for sole is also twice the F target used in the management plan and hence the subsequent TAC was a significant increase from the previous year. Overall, both scenarios lead to a similar development in SSB but the "no MP" scenario show much higher inter-annual variation in TACs.

These simple simulations are merely intended for comparison purposes and not to perfectly replicate what would have actually happened. Predicting what managers would have done following negotiations over advice is not possible, but the "no MP" scenario presented provides a plausible basis for how management may have been (though perhaps large inter-annual variations would have been avoided in practice). The assumption of full TAC uptake is also questionable. Following the decommissioning of a number of vessels in the Dutch beam trawl fleet in 2008, it is not certain that the high plaice TACs seen under the "no MP' scenario would have be landed completely. However, the broad conclusions that the plaice TACs would have been higher and the sole TACs more variable in the absence of a management plan are probably valid.

Table 7-1. The two management scenarios, and associated TACs, simulated for plaice and sole in the North Sea. Plaice: 2008 (advice 2009) F=0.39 ; TAC=49 kt. Sole: 2008 (advice 2009) F=0.47 ; TAC=12.8 kt.

	TAC Year[1]	**"LTMP"** Management plan		**"no MP"** PA and MSY transition	
		Rational	TAC (kt)	Rational	TAC (kt)
PLE	2009	EU plan (TAC agreed with Norway)	55.5	Fpa and SSB>Bpa	112,1
	2010	EU plan (TAC agreed with Norway)	63.8[2]	Fpa and SSB>Bpa	150.4
	2011	EU plan (TAC agreed with Norway)	73.4[2]	Fmsy transition (F2010*0.8+Fmsy*0.2) Fmsy = 0.20[4]	96.3
	2012	EU plan (TAC agreed with Norway)	84.4[2]	Fmsy transition (F2010*0.6+Fmsy*0.4) Fmsy = 0.25	71.8
	2013	EU plan (TAC agreed with Norway)	97.1[2]	Fmsy transition (F2010*0.4+ Fmsy*0.6) Fmsy = 0.25	120.5

	2014	EU plan (TAC agreed with Norway)	111.6[2]	Fmsy transition (F2010*0.2+ Fmsy*0.8) Fmsy = 0.25	164.7
SOL	2009	EU plan	14.0	Fpa and SSB>Bpa	8.4
	2010	EU plan	14.1	Fpa and SSB>Bpa	19.9
	2011	EU plan	14.1	Fmsy transition (F2010*0.8+0.22*0.2)	13.9
	2012	EU plan	16.2[2]	Fmsy transition (F2010*0.6+0.22*0.4)	11.8
	2013	EU plan	14.0[3]	Fmsy transition (F2010*0.4+0.22*0.6)	10.6
	2014	EU plan	11.9[3]	Fmsy transition (F2010*0.2+0.22*0.8)	? 7.6

[1]The TAC for year *y* comes from the advice st in year *y*-1

[2] Setting of the TAC based on the plan's target-F would have led to a greater than 15% TAC change. This TAC was thus +15%

[3] -15% change, but not constrained by the 15% rule

[4] In the simulations, Fmsy=0.25 was used for all years (despite the change from 2011 to 2012)

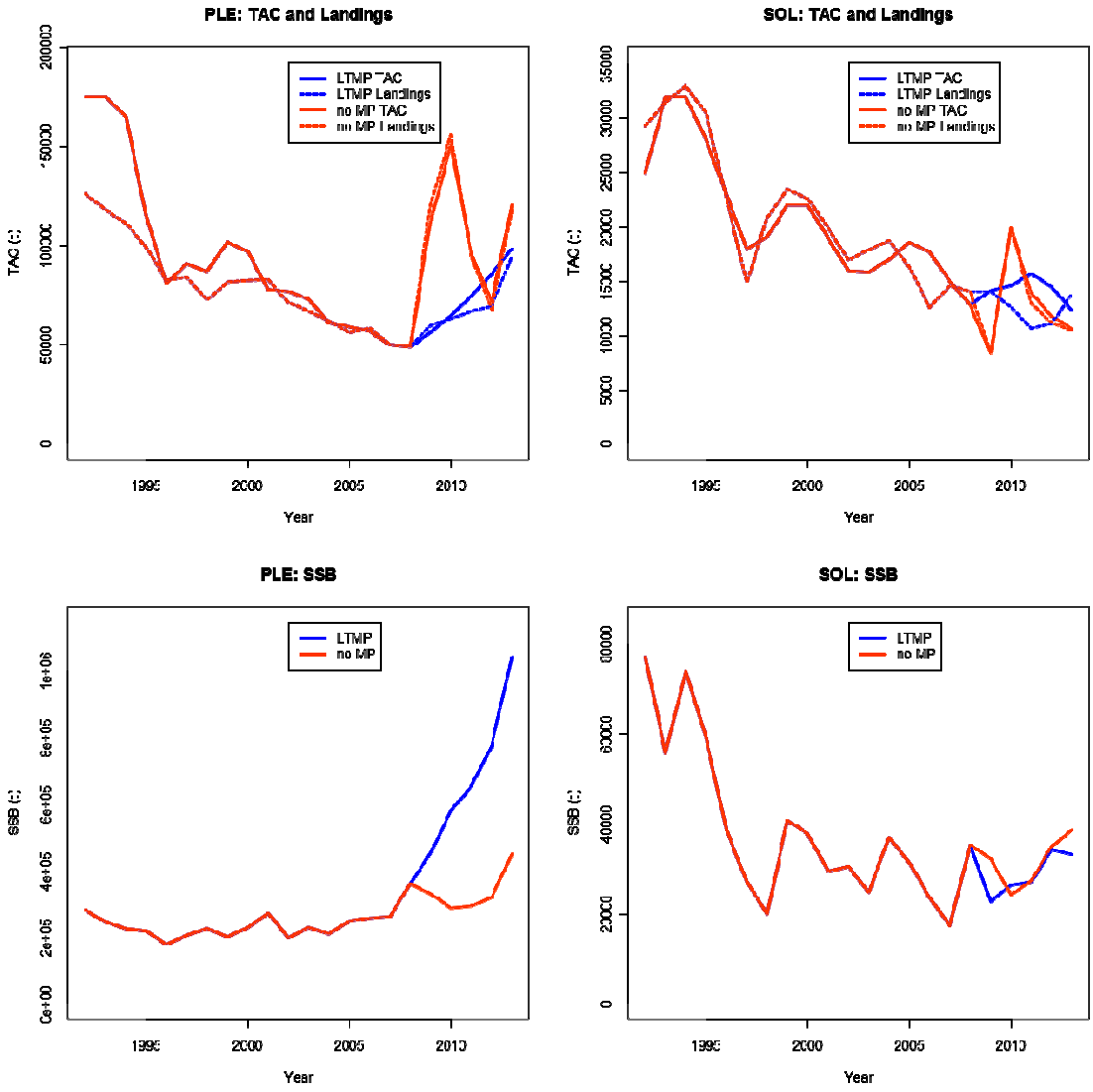


Figure 7-1. Simulated TAC and landings (top) and spawner stock biomass (SSB, bottom) for plaice (left) and sole (right).

7.2 Evaluating the added value of the plan with FishRent bioeconomic analysis

The FishRent model was run for the North Sea flatfish fishery (Salz *et al*, 2010). The selection of the fleet segments included in the simulations is based on the dependency and significance parameters. Five beam trawler fleets are included in the model: Dutch TBB 24-40m, Dutch TBB >40m, German TBB >24m*, Belgian TBB 24-40m and British TBB >24m* (* the German and British fleets TBB 24-40m and >40m are clustered in the DCF data and the entire cluster was included in the model). Sole and plaice North Sea stocks are included in the model and the fleets capture the two species in a mixed fishery. Because of data limitation, the stock was simulated with a production function and no spatial dimension was added to the model (see introduction for discussion on the data).

The fleets are dependent on the two species included in the management plan. Figure 7-2 shows the share of the North Sea sole and plaice in the total revenue of each fleet. The two Dutch fleets and the German fleet have more than 50% of their revenue from the two stocks while the British and Belgian fleets are slightly less dependent with respectively 38% and 24% of their revenue from North Sea plaice and sole. For those two stocks the five fleets cover a large proportion of the landings (Figure 7-3), amounting to 56% for plaice and 76% for sole.

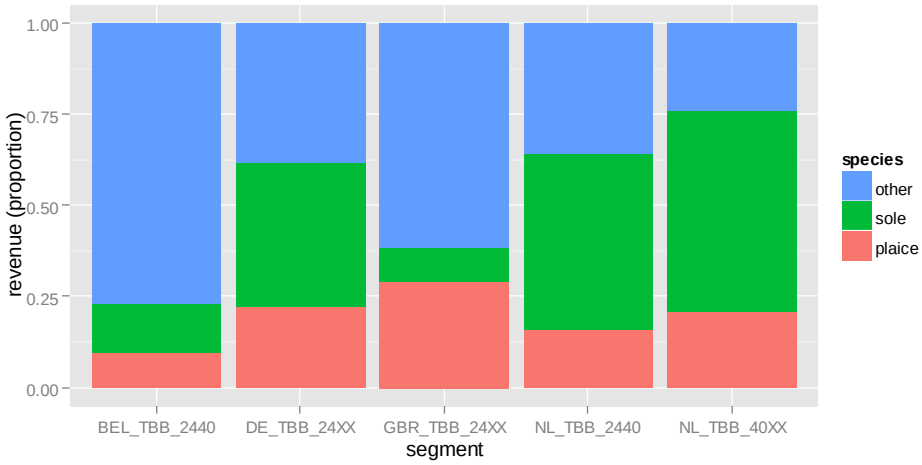


Figure 7-2. Revenue composition of the fleet from North Sea sole, North Sea plaice and other (includes other species and other stocks of sole and plaice) for 2008.

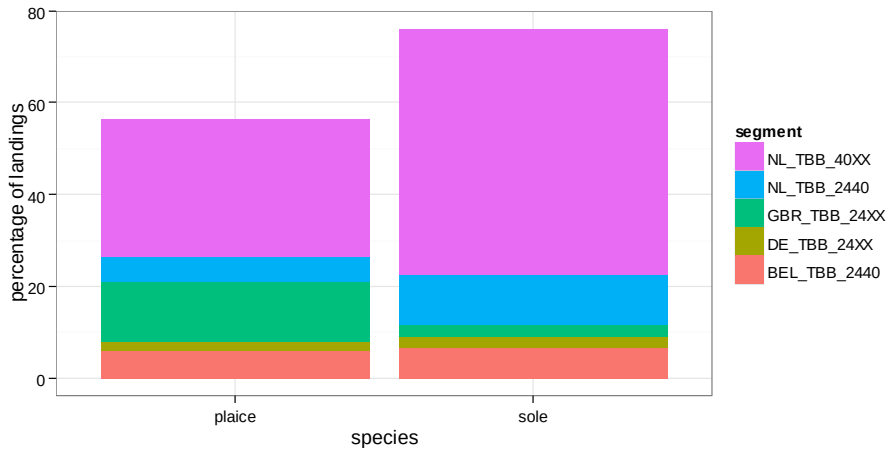


Figure 7-3. Coverage of landings of North Sea sole and plaice by the fleets(as a proportion of the total landings) for 2008.

To investigate the impact of the management plan the following scenarios were simulated. In addition to the TAC scenarios defined in the biological model (see above, Section 7.1), the inclusion of external factors affecting directly the fishery were simulated. Fuel prices, fish prices and decommissioning were regarded as potential relevant external effects. For further insight into the impact of those external factors in comparison with management plan measures simulations for four scenarios have been run:

- "no MP": No LTMP, no external effects
- "no MP + ext. factors": No LTMP, external effects
- "LTMP": LTMP, no external effects
- "LTMP + ext. factors": LTMP, external effects

The prices of fish and fuel were set at the observed values for 2009 to 2012 using a relative factor to mimic their evolution since 2008and were kept constant after 2013. In addition a large decommissioning scheme happened in 2008 in the Netherlands and 23 vessels left the Dutch TBB >40m fleet. The exit of those vessels was forced in the model with no option for those to re-enter.

The TACs associated with the "no MP" and "LTMP" scenarios are taken from the biological model (Figure 7-1). Currently there is no feedback loop between the FishRent simulations and the biological model.

7.2.1 Effect of the management plan:

By comparing the 'LTMP' and 'no MP' scenarios we see that the initial drop in sole TAC in the 'no MP' scenario (Figure 7-1) would have led to lower effort deployed, especially for the large trawlers (Figure 7-4) and resulted in falling profitability (Figure 7-5) and vessels exiting the fishery (Figure 7-6). Without the management plan, there would have been large under-utilized quota because of a mismatch of sole and plaice quota and limited flexibility for the fleet to go fish solely for plaice in the North due to lack of spatial dimension in the model[1].

In the "no MP" scenarios the biological model assumes a full uptake of the TAC of both species while the mismatch between the TAC levels and the limited fishing capacity meant that the landings (Figure 7-7) were lower than the TAC for a number of years and the quota uptake was lower than 100% (Figure 7-8). This lower exploitation of the stocks in the FishRent model explains the differences in SSB compared to the biological model (Figure 7-9).

The large inter-annual variations of TAC in the 'no MP' scenarios lead to changes in the fleets that adapt their capacity to follow the sole TAC. The years when the sole quota is limiting mean sharp decrease of profit and exit out of the fishery especially for the Dutch fleets, highly dependent on sole (Figure 7-6). The subsequent increase of TAC slowly leads to the re-entry of vessels after 2 years and to the rebuilding of the sole-dependent fleets by 2014. Then the "no MP" quota of sole becomes limiting again (Figure 7-8) leading to drop in profitability (Figure 7-5) and vessels would exit again the following year. The oscillations of quota are theoretically followed by fleet size adjustments decreasing and increasing, in reality it would probably be more difficult to re-enter the fishery once the vessel has left, with permanent impact on employment.

7.2.2 Effect of the external factors:

The external factors included in the model are change in fish and fuel price using observed values (Figure 6-4) and the forced exit of 23 vessels out of the Dutch fleet >40m through a decommissioning scheme between 2008 and 2009. The effects of the external factors are assessed by comparing the "LTMP" and the "LTMP + ext. factors" scenarios. The impact of the decommissioning scheme was an immediate decrease of effort in 2008 for the largest fleet (Figure 7-4), this resulted in lower landings and quota uptakes (Figure 7-7 and Figure 7-8) and higher fish stocks (Figure 7-9). The profitability of the Dutch beam trawlers was higher than without external factors as fewer vessels shared the same amount of quota (Figure 7-5). The profitability of the other fleet segments was lower with the actual fuel and fish prices than with the prices fixed at 2008 level. The lower profitability expected when the external factors are effective meant that the British fleet did not start rebuilding when plaice price increased again.

7.2.3 Benefits of the management plans during the implementation period

The actual benefits of the management plan on the fishery are derived from the scenarios including the relevant external factors with and without plan ("no MP + ext. factors" and "LTMP +ext. factors"). The profitability of the fleets is more stable with the plan and is higher in 2014 for most fleets (profitability is slightly higher for Dutch 24-40m fleet as the "no MP + ext. factors" predicts exit of vessels from that fleet segment, Figure 7-5). The employment is also higher for the scenario with the plan as the number of vessels is the same for most fleets except for the Dutch 24-40m beam-trawlers

[1]If space was included we would have expected differences with the introduction of external factors as the low price of plaice and the high prices of fuel would still not have guaranteed that fishers could and would go North to fish plaice

which is lower without management plans (Figure 7-6). The annual landings of both species are slightly higher with the plan (Figure 7-7).

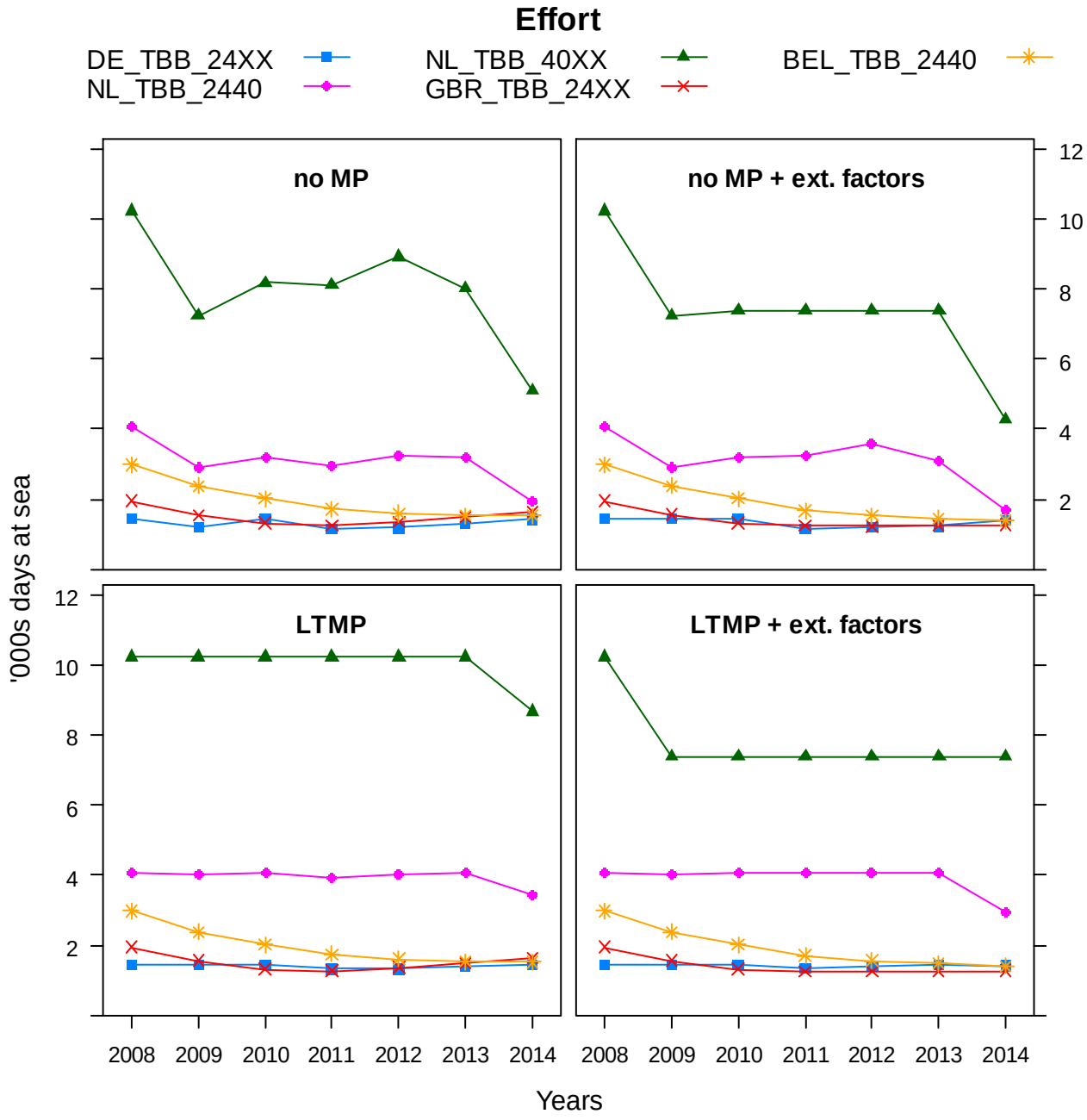


Figure 7-4. Fleet effort in thousands days at sea.

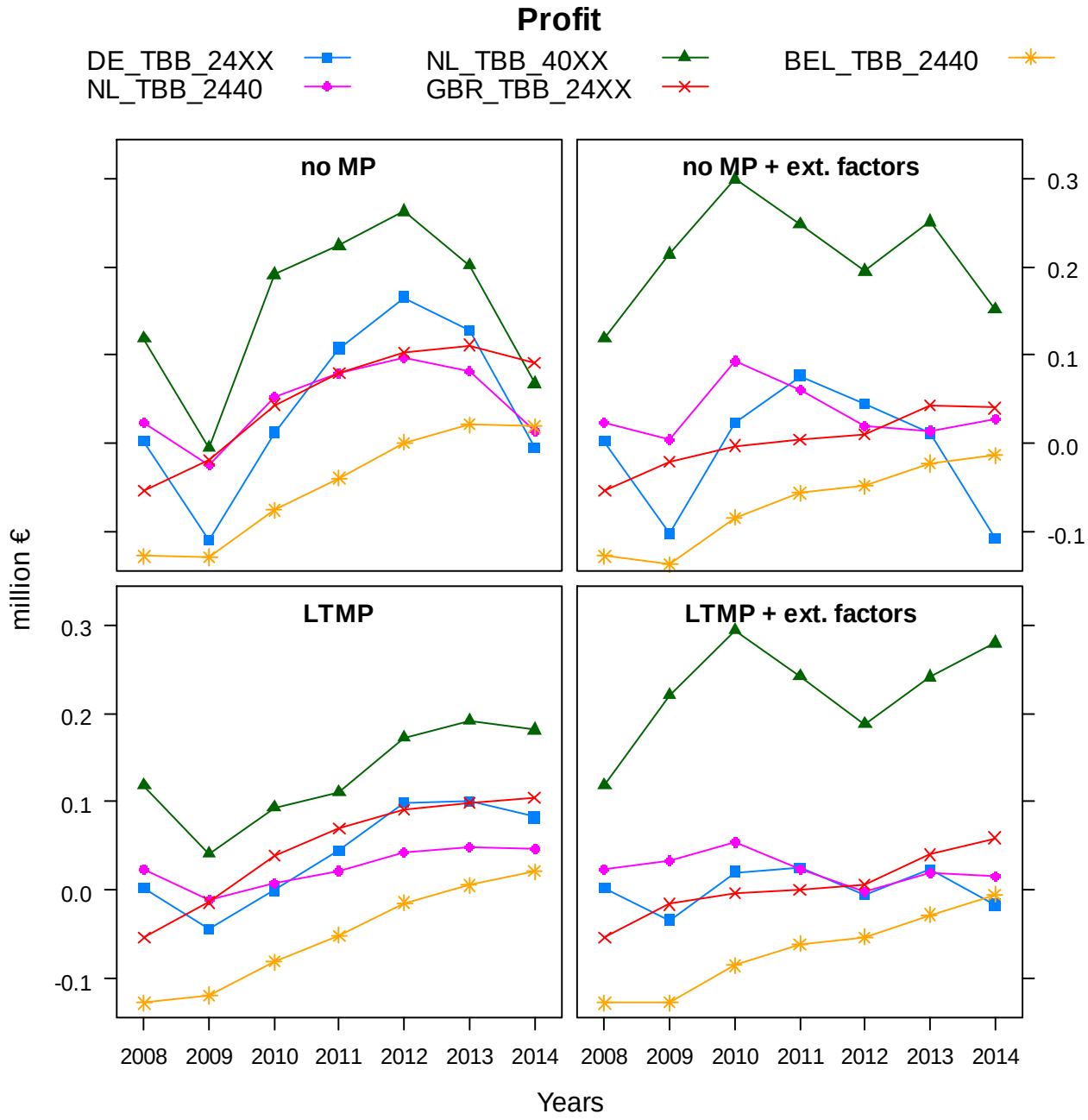


Figure 7-5. Average profit per vessel for the five fleets in million euros.

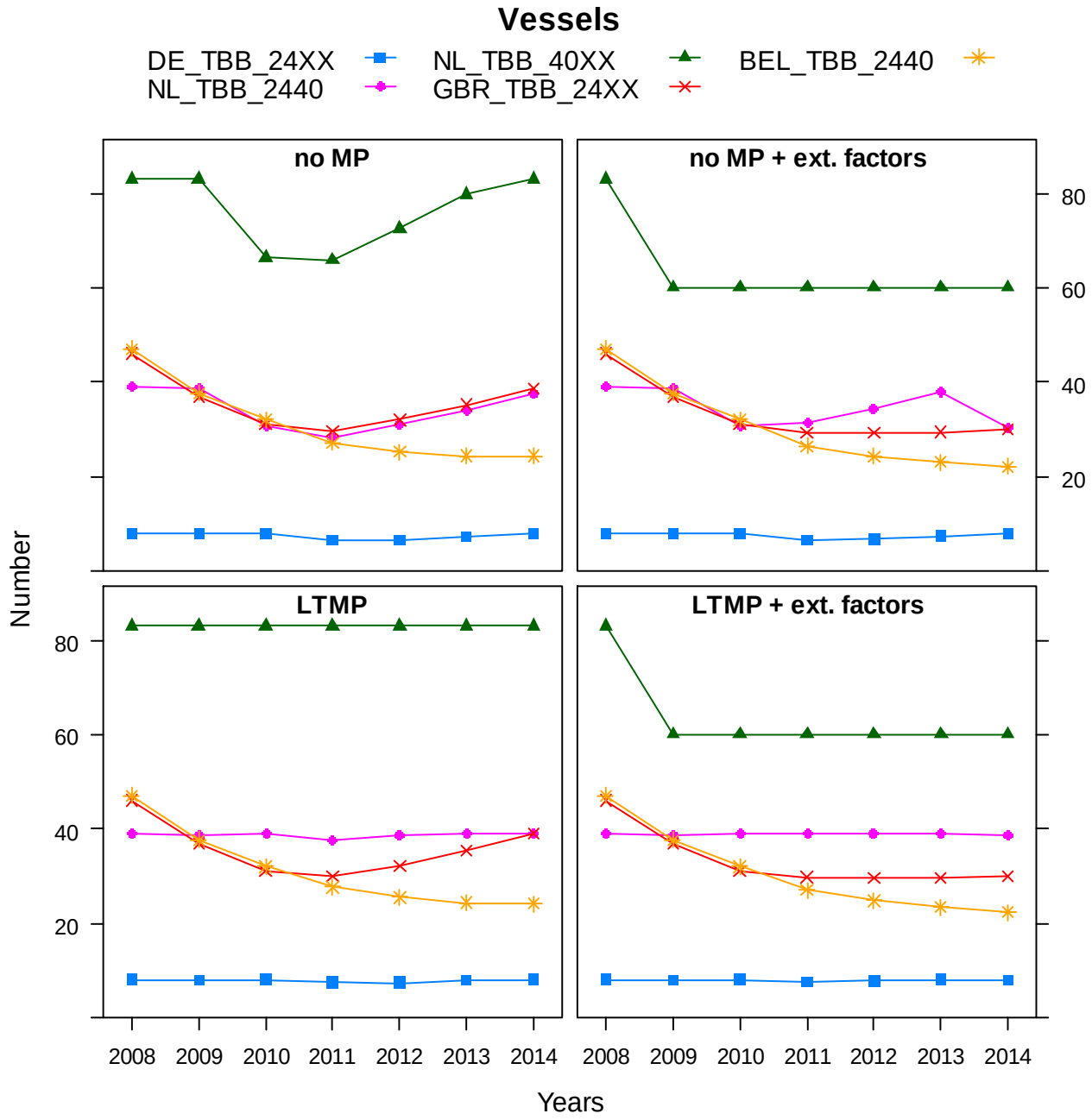


Figure 7-6. Evolution of the size of the fleets.

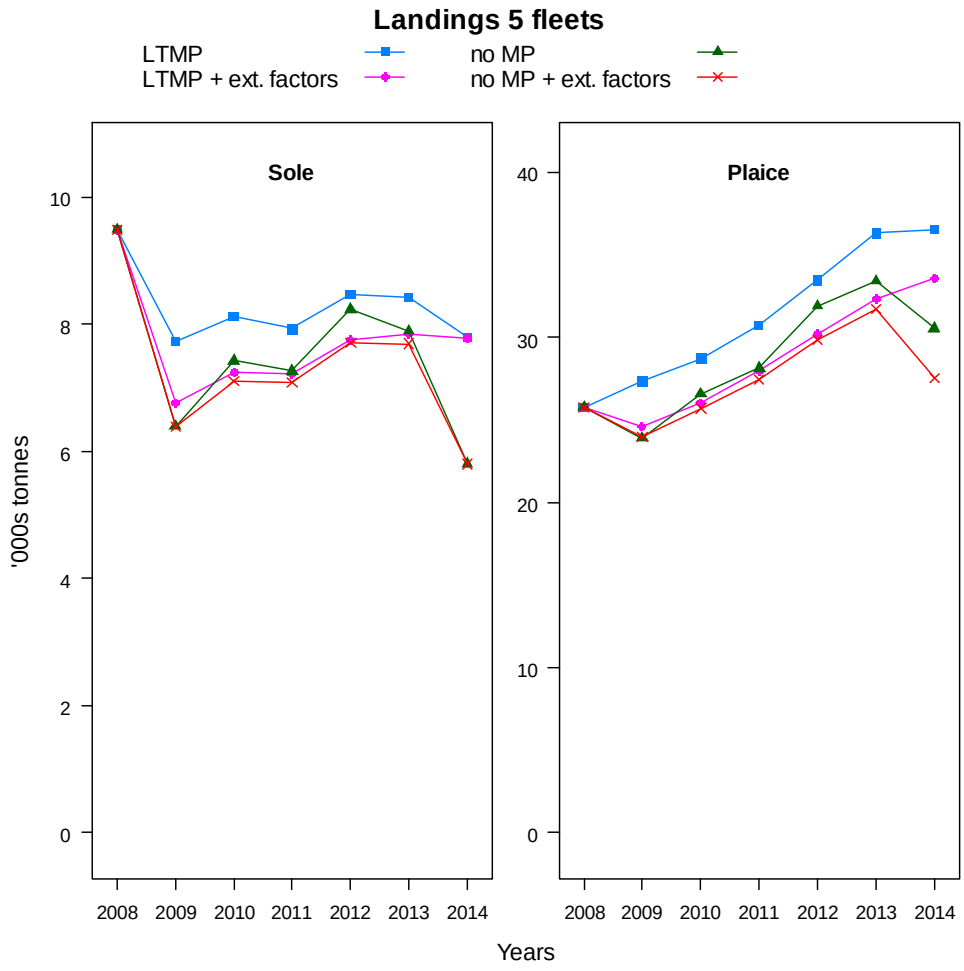


Figure 7-7. Cumulated landings of North Sea sole and plaice by the five fleets.

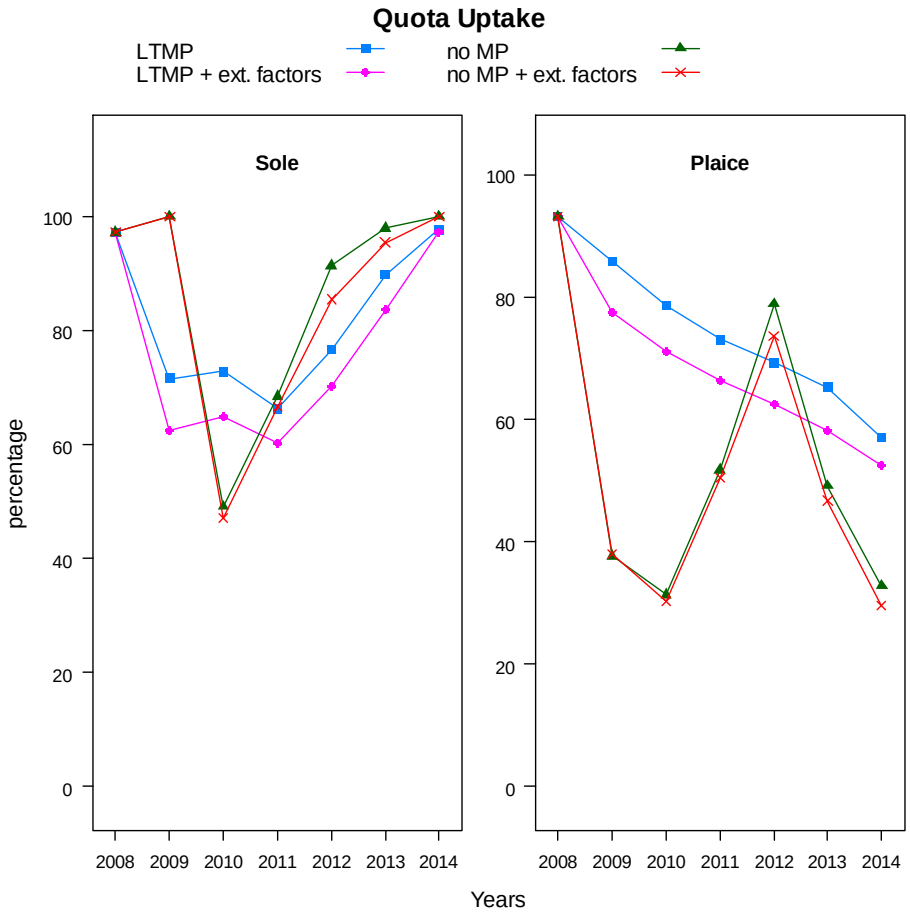


Figure 7-8. Quota uptake as a percentage of the TAC, values are scaled up to the total fleet using the 2008 coverage ratio of the fleets in the model.

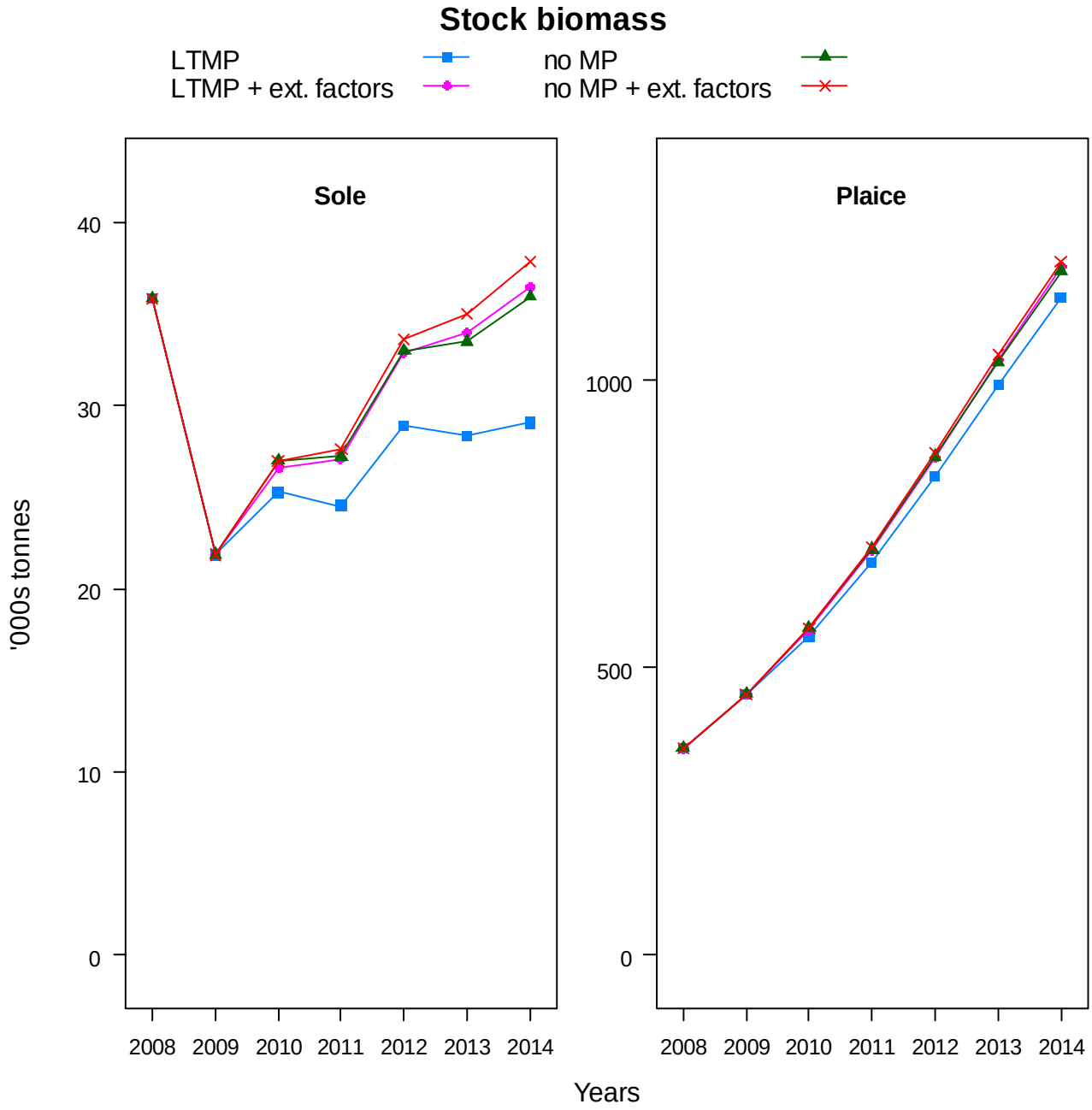


Figure 7-9. SSB for North Sea sole and plaice in thousand tonnes.

8 Performance Evaluation of the Plan

8.1 Effectiveness

• Have there been any side effects resulting from the plan? (for example, changes in behaviour that affect other fisheries, or environmental consequences, changes in the market).

The increase proportion of the large older plaice in the stock has led to an increase in the proportion of the large more valuable plaice in the landings.

• Has the implementation been affected by external factors such as global change, ecosystems effects, or other fisheries?

Change in fuel price, plaice price and the decommissioning scheme have had a major impact on the fishery and while the first two factors led to overall lower profitability of the fleets, and especially the

ones strongly dependent on plaice, the decommissioning scheme allowed the remaining vessels of the Dutch fleets to be more profitable.

It is unsure what is affecting the price of plaice but the increase in import of low value aquaculture fish such as tilapia and pangasius on the EU markets is believed to have led to the long-term drop of plaice price.

8.2 Utility

Based on the simulations, the Belgian and British fleets were expected to decrease in the first period because they were unprofitable at the beginning of the period but the British fleet which is more dependent on plaice was supposed to rebuild after a few years, the low plaice prices prevented the fleet from rebuilding once the stock had rebuilt. The largest change in fleet capacity observed came from the decommissioning of vessels from the Dutch fleet.

Simulations show that the fleets' entry and exit behaviour is largely driven by the level of TACs of the sole stock which is more restrictive. With the rebuilding of the stocks the capacity of the fleets was too low to catch the full quota. The plan guarantees a stability of the TAC and prevents sudden change which would lead to negative profits and exit of the fishery in case of quota decrease or to the quota being underutilized if TAC increased sharply.

The plan didn't lead to large changes in the capacity itself. The decommissioning scheme in 2008 and the unfavourable economic environment for plaice fleets did.

8.3 Efficiency (cost-effectiveness)

The economic and social situation of the fishery was more impacted by external factors than by the plan itself. What the plan provided was stability in the TACs and transparency in the management process. The economic benefits of the plan are limited as it seems that most of what happened to the fleets was mainly driven by the external factors. There are benefits to cap the inter-annual change in TAC as it allows the fleets to adapt to the changes while limiting the overcapacity of the fleets to the available quota or the under-utilization of the TAC.

We cannot assess the effect of other sectors of the industry (processing, transporting, etc) due to lack of information.

8.4 Indicators

The lack of objectives limits the assessment in social and economic terms. Due to the aforementioned reasons the changes in the time series of capacity, employment, landings and profitability indicators cannot be solely assigned to LTMP measures.

8.5 Sustainability

8.6 Data issues

Scenario 2 and choke species: Fishing quotas are equivalent in size to the current landing quotas. As the total catches are considerably higher than the current landings (and quotas), for the species whichland their full quotas it is not possible to land all current catches. When the quota of species that cannot be avoided has been used (choke species), and escape clauses such as the 9% rule are utilized, fisheries should be stopped. This means that quota of the other species may not be landed.

9 CONCLUSIONS

9.1 Impacts for the stock

The objective of the plan to bring both stocks to a status within safe biological limits has been met. Although, given the circumstances during the effective duration of the plan, it is likely that quota and effort limits were not the only factors affecting stock development.

The plan is now in stage 2. The HCRs in stage 2 are not clearly specified. The plan foresees a re-evaluation of the biological objectives and introduction of economic and social objectives. New HCRs (TACs and effort) need to be established.

9.2 Impacts of the plan on the environment and the ecosystem

Overall effort has decreased during the period that the management plan was in place at approximately the same rate as effort limitations based on the plan have decreased.

It is likely that this overall reduction in effort led to an overall decrease in bottom contact and ecosystem impact in terms of bycatch of fish and other benthic marine organisms. Decommissioning of Dutch vessels before the implementation of the management plan contributed to this decrease in effort substantially and probably also other external factors. Therefore, it is neither possible to directly link the decreasing trends in effort to the implementation of the management plan nor possible impacts on the environment and the ecosystem associated with these.

9.3 Side effects resulting from the plan

Keeping the TAC for plaice relatively low (in comparison to what they could have been without the plan) has allowed the 'maturation' of the stock, which has led to relatively older (and thus larger) individuals in the catches, which receive better prices on the market.

9.4 External factors

As neither TAC nor effort turned out to be a limiting factor for most of the time it is unlikely that these components of the plan exerted any major impact on the fisheries. In accordance with statements from the industry the following external factors had substantial influence on the fisheries: decommissioning of vessels, high fuel prices and low plaice prices.

The large year class of sole in 2009 has contributed to bringing sole inside safe biological limits. This phenomenon can be observed in certain years, and it was also the case for the phase under consideration.

The fishery has changed considerably in the past few years due to various factors, which led the fishery to use new gears, with the aim of reducing its dependency to fuel. Electric fishing (so-called pulse trawls) are being used since 2009 with 42 active licences in 2013 and more being granted for 2014. Sum wings have also been used since 2008. These techniques make the vessels more profitable and less sensitive to fuel price increase. Pulse trawls are also believed to have lower catch rates for fish below the marketable size (Marlen*et al*, 2014) and thus might have the potential to reduce discards. However, the long term impacts on the stocks and also potential impacts on other marine organisms are still unknown. The potential shift in the selectivity of the fleet towards older individuals may affect the implementation of the plan and should be evaluated.

9.5 Added value of the plan

By definition, the principle of limited quota changes between years stabilised the levels of TACs for both species, which is a major request from the industry.

In the absence of a plan large peaks in plaice TAC would not have been fully utilised because of a low sole TAC or capacity limitations.

The economic model (FishRent) shows that low sole TACs (in the first year of the simulation, to bring the SSB>Bpa), would likely have resulted in exits of vessels from the fishery.

9.6 Enforcement and compliance

Effort limits set based on the plan have not been restrictive for any of the national BT2 fleets, the main gear categories catching plaice and sole. But effort limits have recently become restrictive (in 2012) for the Dutch BT1 fleet (not set based on the plan). As stated in Section 3.6there is scope for a spatial management component in the plan to allow for the possibility of a 'clean' plaice fishery in the North

to address a possible imbalance in TAC between plaice and sole. However, the setting of effort limits for the BT1 fleet needs to be addressed.

9.7 Landings obligations

Also, following the start of the landings obligation the quality of catch data will change a lot, since all catch will (supposedly) be landed (i.e. no need to estimate discards). If discard estimation in the past has been biased or if discarding continues illegally, there will be a step-change in the quality of the data used in the assessment. In the short term at least this could cause stock size estimation problems and with potentially greater retrospectives. Furthermore, it may lead to a new perception of the stock dynamics and the consequent revision of the reference points.

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12 LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on:
http://stecf.jrc.ec.europa.eu/web/stecf/ewg1403

List of background documents:

1. EWG-14-03 – Doc 1 - Declarations of invited and JRC experts (see also section 11 of this report – List of participants)

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Abstract

The Expert Working Group meeting of the Scientific, Technical and Economic Committee for Fisheries EWG-14-03 on Evaluation/scoping of Management plans. Evaluation of the multi-annual management plan for the North Sea stocks of plaice and sole was held from 10-14 March 2014 in Varese, Italy. The report was reviewed and endorsed by the STECF during its plenary meeting held from 24 to 28 March 2014 in Brussels (Belgium).

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The Scientific, Technical and Economic Committee for Fisheries (STECF) has been established by the European Commission. The STECF is being consulted at regular intervals on matters pertaining to the conservation and management of living aquatic resources, including biological, economic, environmental, social and technical considerations.

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