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**COMMISSION STAFF WORKING DOCUMENT**

**EVALUATION OF CLOSED AREA SCHEMES (SGMOS-07-03)**

**SUBGROUP ON MANAGEMENT OF STOCKS (SGMOS), OF THE SCIENTIFIC,  
TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)**

**STECF OPINION EXPRESSED DURING THE PLENARY MEETING**

**OF 5-9 NOVEMBER 2007 IN ISPRA**

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

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**1. BACKGROUND**

**Closed areas for conservation of stocks as implemented so far in the North East Atlantic and North Sea**

The Commission is in the process of revising the technical measures for the Atlantic, the North Sea, The Skagerrak and the Kattegat (Regulation 850/98 and associated subsequent Regulations). As a part of this exercise, the Commission has requested STECF to evaluate the utility and effectiveness of existing measures limiting fishing activity in an area (closed areas).

A two step approach has been followed. First, an overview was made of existing closed areas within EU waters and of any existing material that could be used to evaluate their effectiveness. This first meeting of the STECF subgroup on Management of Stocks (SGMOS-07-02) was held in March 2007; it prepared an inventory of closed areas and identified a process and the data requirements for an evaluation of the closed areas in the inventory, considering maximum use of existing evaluations and information.

Second, most of the closed areas in the North Sea and Atlantic identified at the first meeting were evaluated during a second meeting of SGMOS-07-03 held in October 2007. This working paper contains the STECF opinion on the report of the SGMOS-07-03.

**2. FINDINGS OF THE SUBGROUP ON MANAGEMENT OF STOCKS (SGMOS-07-03)**

In summary, the terms of reference of the subgroup were to: evaluate the efficiency of the closed areas on conservation of marine organisms; propose, as appropriate, modifications of the closed areas in order to improve their positive effect on the conservation of marine organisms and when an assessment was not possible, identify the data requirements for an evaluation of the closed areas in a short term.

Overall SGMOS-07-03 found that most closures had been established without clear objectives. This made it difficult for the subgroup to evaluate the effectiveness, regardless of the amount of evidence that might be available. SGMOS-07-03's first task was thus to devise, on the basis of knowledge and logic, some objectives for each closure. The effectiveness of each closure was then evaluated against those objectives. It is important to note that if the objectives were not correctly devised, then it is likely that the evaluation of effectiveness will also not be fully correct. Another feature of all closures that needs to be borne in mind is that most were usually established as part of a package of measures to achieve a wider objective,

for instance, recovery of a fish stock. The measure of ‘success’ in this case would be the recovery of the stock, but it is usually very difficult to evaluate the role that a part of the overall package has played in the achievement (or otherwise) of the objective. If the stock has recovered, just how much was due to the closed area and how much was due to other measures?

Despite these difficulties, SGMOS-07-03 made an evaluation of most of the areas under consideration, although some of these evaluations were made on a small base of evidence. The results of the evaluations are summarised below. In general the results did not allow SGMOS-07-03 to draw firm conclusions on the efficiency of most of the closures.

To facilitate future evaluation of closed areas SGMOS-07-03 recommended that when a closed area is established, explicit consideration be given to its objectives and ways of measuring whether or not those objectives have been met. If possible, these measures should be based on pre-existing data series. This will minimise extra costs of monitoring and place any future changes in environmental or other conditions in context.

SGMOS-07-03 also recommended that closures be reviewed on at least a 3-5 year cycle, both for effectiveness and for appropriateness.

#### **i) Closure of an area for sandeel fisheries in ICES zone IV (Point 5 from Annex III of CR 41/2007)**

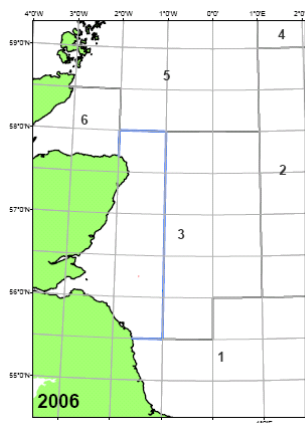


Chart showing the closed area (blue line)

The closure was established in 1999 and there appears to have been an improvement in the age 1+ sandeel abundance until around 2003. Environmental changes have since caused dramatic declines in sandeel size and seabird breeding productivity in 2004, 2006 and 2007.

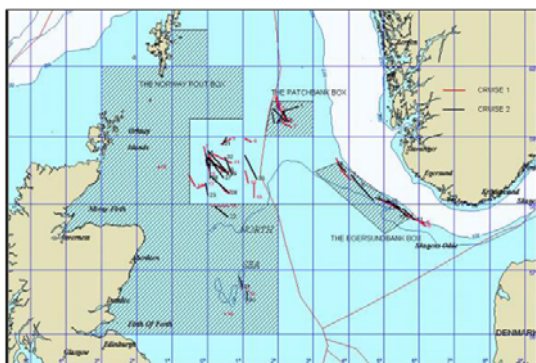
A number of studies have attempted to evaluate the impact of the closure on seabirds, sandeels and fish predators. Breeding productivity of kittiwakes (that feed at the sea surface) was significantly depressed in the closure zone when the fishery was active, whereas no effect was found in a control zone, which was open to the fishery. Furthermore, kittiwake breeding productivity was negatively correlated with fishery effort during the fishery period in the closure zone, but not in the control zone. The lack of any discernable effect on diving seabirds could result from their comparatively low sensitivity to reduced prey availability.

The indicator suggested by ICES of kittiwake breeding success has returned to a low level recently, and other seabirds are suffering from a poor food supply.

SGMOS-07-03 considers that the current poor state of sandeels in the closed area would not be helped with re-opening at this time.

SGMOS-07-03 does not propose modifications to the closed area.

**ii) Closure of an area for Norway pout to protect other roundfish (Article 27 of CR 850/89)**



*Map of the Norway pout box and two additional areas closed to Norway pout fishery by the Norwegian authorities: Patch Bank and Egersund Bank.*

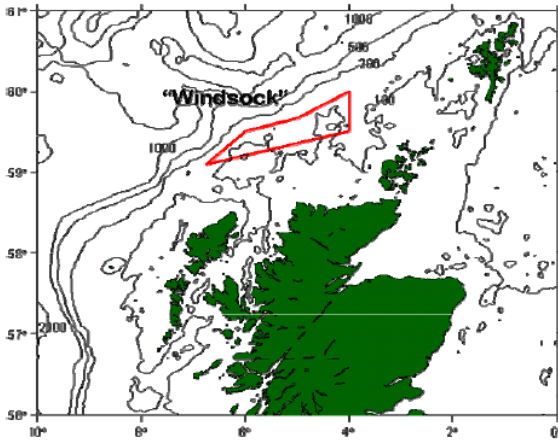
There was not enough high resolution disaggregated data to conduct an evaluation of the effects of the Norway pout box. The EU data collection regime is of too low resolution to be used for this purpose, i.e. there is no data from individual hauls and positions.

It was not possible for the SGMOS-07-03, on the basis of the evidence available, to make any recommendation on changes to the Norway pout closure.

SGMOS-07-03 advises that an evaluation of the effects of the Norway pout box requires that experimental surveys be initiated to determine CPUE inside and outside the Norway pout closure.

There is currently (2007) no Norway pout industrial fishery in the North Sea. This, however, may not be the case in future and the subgroup therefore considers that an evaluation of the Norway pout closure is still relevant.

**iii) Closed area for the conservation of cod in ICES zone VIa (Point 7 from Annex III of CR 41/2007)**



**iv) Area closed for cod fishing in ICES zone VIa (the “windsock”).**

SGMOS-07-03 finds that it would have been very difficult to have detected any direct effect of the closure on the primary objective of allowing as many cod to spawn as possible in 2001, even with a dedicated sampling programme. The available information on stock status was too poorly spatially resolved to disentangle any closure effects from other causes of change.

The STECF Mixed Fisheries Group suggested in 2004 that for any beneficial effects of area closures to be observed in cod and other mobile stocks, larger area closures continued over several years are likely to be required. The STECF Mixed Fisheries Group recognised that this closure would not be sufficient by itself to protect cod, but that its removal would not help to improve cod recovery measures.

SGMOS-07-03 suggests that an expansion of the closure may be more effective.

**v) Closed area for the conservation of cod in ICES zone VIIf and g (Point 7 from Annex III of CR 41/2007)**



*Extent of the Celtic Sea cod closure in 2005. (Area within 6 miles of baseline was not included in closure in 2006 and 2007.) Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*



SGMOS-07-03 based its evaluation of the closed area on an evaluation carried out by ICES in 2007. The main conclusions of ICES evaluation are:

There are different responses from the fisheries to the closure of ICES rectangles 30E4, 31E4, and 32E3. French trawlers account for the majority of the cod catches (on average three quarters of the international cod landings). The French fishing effort (time fishing in VIIfg) has been dramatically reduced over the 1999–2006 period by around 65% for the gadoids métiers. This reduction is mostly due to a decrease in the number of vessels involved rather than to a reduction in the mean fishing time per vessel. Although this effort reduction was already initiated before the first year of the closure, the closure has probably been an incentive to a further reduction in effort. There has been some displacement of vessels away from spawning aggregations of cod (e.g. a number of UK vessels), but also some displacement in time (e.g. a number of Belgian vessels).

Potential effects of the Celtic Sea cod closure can be summarised as follows:

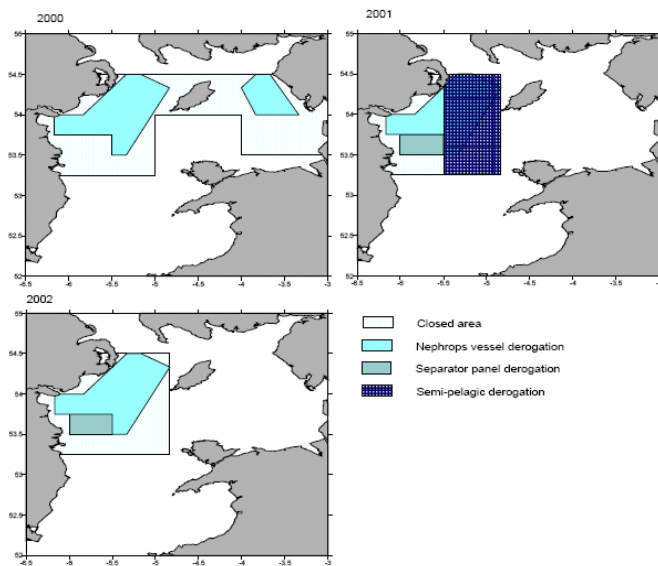
- The displacement of fishing activities away from spawning aggregations is therefore expected to have reduced fishing mortality on mature cod during the spawning season, but the effects on other parts of the cod stock in the area are unknown.
- The closure of the spawning areas to all forms of cod fishing will largely reduce the disturbance on spawning aggregation of cod. While the effect of this is expected to be positive, it is unquantifiable at present. However, the spawning ground in the western Celtic Sea is not covered by the closure. In addition, no measures are currently in place to protect recruitment.
- It is unlikely that the closure will have beneficial effects for the stocks of *Nephrops*, anglerfish, hake, and megrim. Landings from the closed rectangles have always been low compared to the total landings of these stocks. The closure overlaps with the main fishing grounds for sole and plaice, but the effect on these stocks is currently unclear.

It was also concluded that it was prerequisite to have an adequate assessment of the discarding and highgrading practices in order to get better information on the changes in selectivity and recruitment estimates.

Many vessels (particularly beam trawlers) fished close to the borders of the closed rectangles during the closure, and fished intensively inside the rectangles when they were re-opened.

The existing evaluations of the closure have been unable to disentangle the effects of the closure from other factors influencing fishermen's tactical decisions. A more comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required, based on accurate fleet definitions and fishing activity data collected at an appropriate spatial and temporal resolution.

**vi) Closed area for conservation of cod in the Irish Sea Point 8 from Annex III of CR 41/2007**



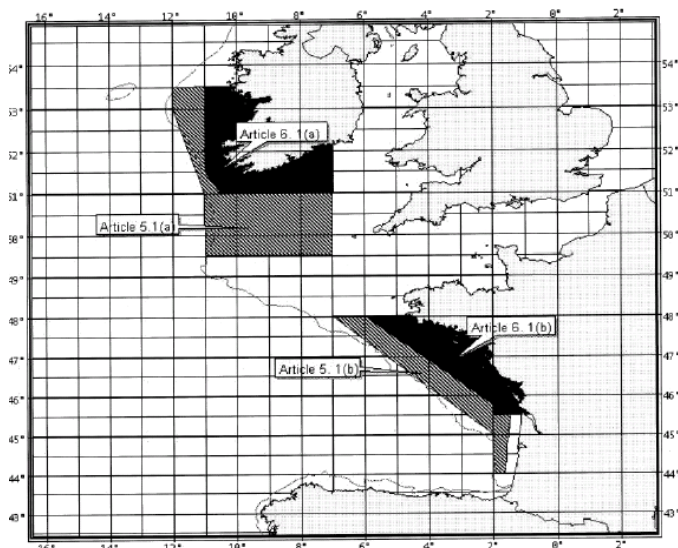
*Extent of the Irish Sea cod closure in 2000, 2001 and 2002 and onwards. The darker area in 2002 indicates the area within which derogated Nephrops trawlers are permitted to fish. The rectangle at the south-western end of the Nephrops derogation area is open only to Nephrops trawlers using an inclined separator panel.*

SGMOS-07-03 concludes that the Irish Sea cod closure in 2000 was of appropriate extent and duration to encompass the majority of the spawning stock throughout the spawning season. The closure from 2001 onwards encompasses the majority of the western Irish Sea spawning population of cod for most of the spawning season but excludes the eastern Irish Sea spawning population.

On the basis of the information available, SGMOS-07-03 was unable to determine the extent to which the Irish Sea cod closure since 2000 has reduced fishing mortality to a lower value than would otherwise have occurred, through protection of adult cod during spawning or influencing changes in fishing effort in the different fleets. A comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required to evaluate the cod closure.

SGMOS-07-03 indicates that a modification of the areas closed would be possible, but SGMOS-07-03 had insufficient evidence to make any firm suggestions.

**vii) Closed areas for conservation of hake (Article 28 of CR 850/98 and Articles 5 & 6 of Com. Reg. 494/2002)**



*Delimited areas according to Article 5.1a and 5.1b and Article 6 of the CE Regulation N° 1162/2001.*

Since the implementation of the technical measures and the adoption of a recovery plan for northern hake in 2004, the stock situation has improved, the northern hake stock has met (or is very close to) the SSB target defined in the recovery plan. Article 3 of the recovery plan indicates that, in such situation, a management plan should now be implemented.

SGMOS-07-03 believes the closure has been effective in its contribution to improve the selection pattern.

SGMOS-07-03 considers that the probable transition from a recovery plan to a management plan for the northern hake stock that should take place in the near future may be a good opportunity to improve further the selection pattern and examine the boundaries of the technical measures in place.

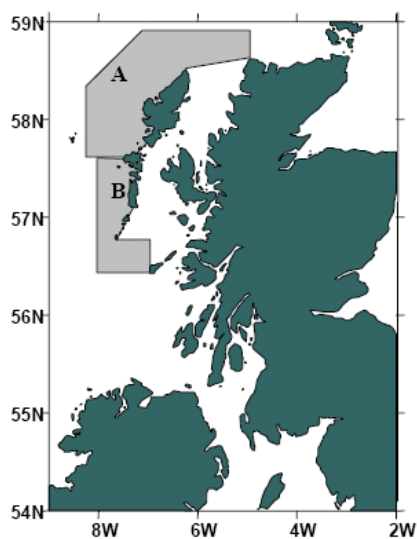
**viii) Closed areas for conservation of herring under Council Reg. 850/98 (Article 20 of CR 850/98 (spawning grounds))**

Some of the 12 closures evaluated are shown below.

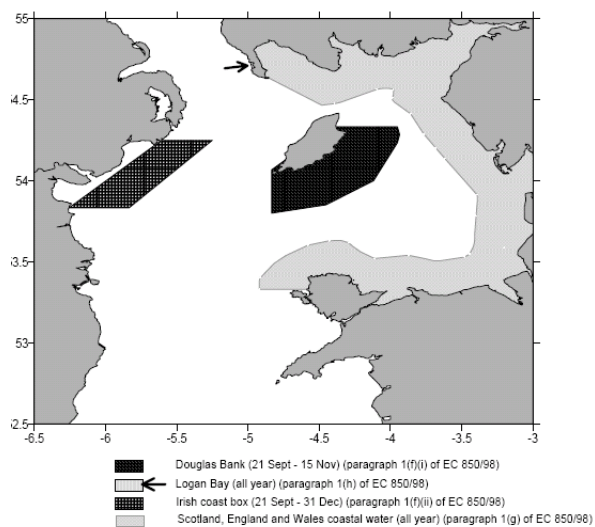


*Area closed for herring fishing in the Firth of Clyde. Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries*

and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.



Location of Butt of Lewis closed area (A) and closed area under UK in force until 1986 (A+B).



Position and geographical area of herring closures within the Irish Sea as defined by Council Regulation (EC) No 850/98, amended by EC 2723/1999.



*Location of three closures for herring off southern Irish coast. Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*

The closures were put in place to prevent excessive fishing mortality during spawning periods when there is dense aggregation and very high catchability. Except for the closures in the Irish Sea SGMOS-07-03 was not in the position to evaluate the effects of the closure. For the Irish Sea closures the SGMOS-07-03 considers it unlikely that the closures are particularly important in overall stock management.

Since the closures were introduced, more effective control systems have been implemented (e.g. VMS and Buyers and Sellers documentation). SGMOS-07-03 concludes that provided stocks are not overfished as defined by ICES, that fisheries managers set TACs in line with management plans for sustainable stocks and are confident that there are effective controls on fishing mortality the closures can be removed.

**ix) Closed areas for conservation of herring (Articles 20 and 21 of CR 850/98 (nursery areas))**

Closures for herring nursery grounds are detailed under Article 20 of Council Regulation 850/98. These include closure off Jutland (this is covered in Section 2.9) and closures g) and h) in the Irish Sea off the coasts of Scotland, England and Wales (see 2.6). Under Article 21 of Council Regulation 850/98, closures a) off the east coast of England and closures b) the inner Firth of Forth and the inner Moray Firth are closed to sprat fishing to protect juvenile herring.



*Areas closed for sprat fishing off eastern Scotland to protect juvenile herring. Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever*

*for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*

SGMOS-07-03 was not in the position to evaluate the possible effects of the closures. SGMOS notes that at the time when the arrangement of closures for herring fishing in the Irish Sea was first introduced, there was both a fishery for adult fish and an industrial fishery for young fish. Currently, the conservation basis to maintain the juvenile herring closures is notional in the absence of an industrial fishery.

In the past high by-catches of herring were taken in in the sprat fisheries in the western North Sea. As a potential fishery for sprat still exists in these areas protection of the herring may still be required.

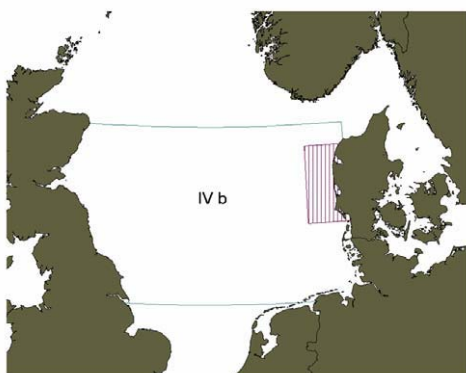
**x) Closed area for protection of herring in ICES zone IIa (Point 2 from Annex III of CR 41/2007)**



*Closure for herring in ICES division IIa. Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*

It was unclear to SGMOS-07-03 as to why this closure was established. The most likely explanation given was that it was established to reduce the level of area misreporting in the Norwegian spring-spawning herring fishery. SGMOS-07-03 was not in the position to evaluate the possible effects of the closure.

**xi) Closed area to sprat and herring fisheries to protect herring (off Jutland) (Article 20 and 21 of CR 850/98 and Article 20 of CR 850/98)**



*Location of the area closed to sprat and herring fishing off Jutland*

New analyses of juvenile herring catch rates gathered through IBTS-surveys were presented to SGMOS-07-03. The analyses did not allow the group to draw clear conclusions on the impact of the closures on catches of juvenile herring. However, the analyses led SGMOS-07-03 to conclude that the sprat closed area is currently performing sub-optimally in the fulfilment of its objectives and SGMOS-07-03 recommends that further analyses be carried out to determine if the sprat closed area boundaries might perform better in an alternative configuration.

**xii) Closed area for conservation of mackerel (Article 22 of CR 850/98)**



*Extent of the mackerel box in 2007. Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*

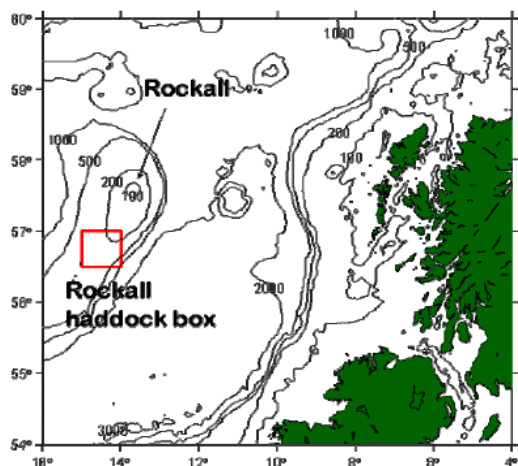
SGMOS-07-03 considers the 2002 ICES advice provides a strong indication that the mackerel box was beneficial for conservation of Northeast Atlantic mackerel. However, SGMOS-07-03 had no information available to carry out an evaluation of any potential changes in the boundaries of the mackerel closure.

In view of possible shifts in distribution of mackerel, SGMOS-07-03 recommends that a further evaluation using up-to-date fishery and survey data should be carried out by ICES to



determine if the current Mackerel Box arrangement remains appropriate for conservation of the stock.

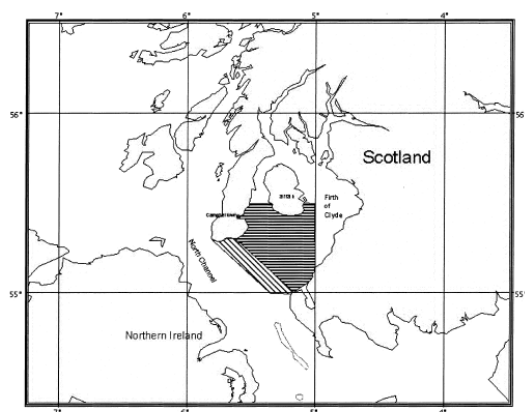
**xiii) Rockall Haddock box in ICES zone VI (Point 5 from Annex III of CR 41/2007)**



*Location of Rockall haddock closure.*

Some changes in exploitation pattern of haddock were observed in the area but they are uncertain due to unreliable discard estimates. Also some decrease in total UK fishing effort was observed at the time of the closure but it is not known what proportion was applied directly to the haddock fishery.

**xiv) Firth of Clyde cod closure - Closed area for the conservation of cod in ICES zone VIa (Originally Council Reg. (EC) No 456/2001 Now under Scottish Government legislation SSI 2007/63)**



*Chart showing the area closed to fishing. All bottom trawling is prohibited in the stippled areas except for trawling for Norway lobster in the inner area*

The Clyde closure includes the main cod spawning area of an aggregation of cod that is reproductively isolated from the major spawning aggregation of VIa. Although the effect of the closure on this sub-stock is unclear, based on the high densities of mature cod within the



closed area at spawning time, it is likely to be having some positive impact on an aggregation that is susceptible to local depletion.

### **3. STECF COMMENTS AND CONCLUSIONS**

STECF notes that although SGMOS-07-03 conducted comprehensive analyses of available relevant information the subgroup was not in position to draw full conclusions on the efficiency of any of the closures evaluated. The available data and information did in general not allow a separation of possible effects of the closures from effects of other management measures affecting the stocks and fisheries concerned. STECF further notes that the lack of clear objectives for most of the closures added to the difficulties in assessing the impacts of the closures.

STECF concludes on the basis of the analyses conducted by SGMOS-07-03 that it will be very difficult if at all possible to establish the necessary database and information required to give quantitative evaluations of the conservation effect of the closures. It will be very difficult to separate the effects of the closures from effects of other management measures in place. Except for the sandeel closure (section 2.1) all the closures evaluated were originally established as part management measures aiming at ensuring sustainable exploitation of the stocks concerned or as part of control measures. These closures contribution to ensuring sustainable exploitation should be seen in relation to other measures in place and it may therefore be more useful to conduct any future analysis of these closures as part of general analyses of management plans and measures in place. Such analyses may provide the basis for determining the importance of a certain closure in achieving the management objectives.

As a general point, STECF notes that providing that the stocks concerned are exploited sustainable and that fisheries managers are confident that fishing mortality on the stocks can be effectively controlled by other measures than closed areas, the use of closed areas as a tool to regulate fishing mortality at the stock level might be unnecessary. However, closed areas may be an efficient management tools to achieve objectives other than regulating fishing mortality at stock level.

STECF therefore recommends that any closed areas or other technical measures aiming at ensuring sustainable exploitation be developed and implemented as integrated parts of recovery or management plans. This will ensure that the importance of the closures are evaluated in conjunction with general evaluation of the plans and seen in relation to the effect of other measures introduced as part of the plans. For closures falling outside recovery or management plan areas, STECF recommends that managers set objectives for closures (both current and in the future) and establish a formal review process. The suggestions of “objectives” in the SGMOS-07-03 may prove a useful starting point.

From an economic point of view individual management measures have different consequences in the sense of revenues and costs. In the case of many of the stocks for which closed areas are established many other management measures are additionally in place. As already noted there is no general analysis of the measures in the sense of their success and influence on each other. STECF recommends therefore a pilot study for one of the cases. The aim should be to make a combined biological and economic analysis on the usefulness of relevant management measures, including existing measures, in terms of their contribution to achieving the management objectives and the costs they put on the fishing operations and control. STECF suggests that such an evaluation of the anticipated hake management plan

would provide a useful case study. The outcome could be a recommendation for simple cost-effective management approach with a limited number of measures to achieve the desired objectives.

Based on the findings of the SGMOS-07-03, STECF draws the following conclusions and recommendations concerning the different closures evaluated:

**Closure of an area for sandeel fisheries in ICES zone IV (Point 5 from Annex III of CR 41/2007)**

Noting the following:

- the poor state of the sandeel (sub) stock in the closed area;
- the overall objectives of ensuring sustainable exploitation of sandeel stocks while avoiding local depletion of sandeel aggregations
- the objective of achieving for the management of the fisheries on sandeel that ensure sustainable fisheries, allow the maximum sustainable yields to be obtained and prevent local depletion of sandeel aggregations

STECF recommends that current closure should be maintained until a management plan has been established that provides the necessary protection of the sandeel in the area taking into account the role of sandeel in the ecosystem. In order to inform the management plan, STECF recommends that the current monitoring effort on both the sandeel stock and dependent predators should continue.

**Closure of an area for Norway pout fishing to protect other roundfish**

STECF notes that SGMOS-07-03 was unable to assess the effects of the Norway pout box. STECF furthermore notes that the results of the IBTS survey indicates that around 30 % of the Norway pout are found inside the box and that the area covered by the Norway pout box is an important nursery ground for juvenile haddock and whiting. STECF therefore recommends that the Norway pout box is maintained in its present form until a management plan for the Norway pout fisheries that ensures low by catches of juvenile gadoids has been implemented.

**Closed area for the conservation of cod in ICES zone VIa**

STECF notes that SGMOS-07-03 was not in the position to assess the effect of the closure on the cod stock in ICES zone VIa. However, the subgroup concludes that the extent and location of the closure is unlikely to be suitable to greatly reduce fishing mortality on the stock but states that removal of the closure would not help to improve VIa cod recovery

STECF notes that the closed area is set up to help recovery of the cod stock in ICES zone VIa. STECF is not in the position to advise if the closure would help in achieving this objective. It is therefore important that the closure is evaluated in relation to all management measures in place to promote the recovery of cod in VIa. STECF recommends that the closed area is maintained in its present form until this overall evaluation has been completed.

### **Closed area for the conservation of cod in ICES zone VII f and g**

STECF concludes that the closure is likely to have resulted in a positive benefit for cod, displacing fishing activities away from spawning aggregations off north Cornwall and reducing fishing mortality on adult individuals during spawning. Also since CPUE are much larger in the closure area during spawning season than anywhere else, the closure had the effect of making vessels less efficient at catching cod. However, it is difficult to quantify and disentangle the benefits from other factors affecting trends in the fisheries throughout VII e–k.

STECF suggests that the closure should remain in place but also that modification of the areas closed should be considered, for example to include the spawning grounds in the western Celtic Sea. However, STECF had insufficient evidence to make any firm suggestions for modifications at the moment.

### **Closed area for conservation of cod in the Irish Sea**

STECF notes that the Irish Sea closed area was to reduce fishing mortality and to allow cod a better opportunity to spawn. STECF furthermore notes that SGMOS-07-03 was not in the position to determine the extent to which the closure has led to reduction in fishing mortality. However, recent trends in fishing mortality suggest that the closure has been of limited benefit, although it is difficult to disentangle the effectiveness of this particular measure in isolation. However, it is likely that the effectiveness of the area closure has been diluted because of several derogations, the alteration of the closure limits and evidence of effort displacement to the outside of the closed area.

STECF is, on the basis of the findings of the subgroup, not in the position to advise if the closure is important in rebuilding the cod stock in the Irish Sea. STECF suggests that the closure is evaluated in relation to all management measures in place to promote the recovery of cod and that possible closed areas in the Irish Sea for conservation of cod is integrated into the recovery plan for cod.

### **Closed areas for conservation of hake**

STECF notes that SGMOS-07-03 believes the closure has been effective in contributing to the improvement in selection pattern for northern hake.

Noting that the recovery plan for northern hake is likely to be replaced by a management plan for this stock, STECF suggests that this will provide a good opportunity to examine the use of closed areas as means to further improve exploitation pattern and recommends that possible closed areas for conservation of hake be integrated in the management plan. Until the management plan has been implemented, STECF recommends that the closures remain in place.

STECF notes that SGMOS-07-03 has not evaluated the areas in VIII c and IX a closed for trawl, Danish seine and similar gears (appendix 2.5 of the report of SGMOS-07-03). STECF recommends that if an evaluation of these areas is required the evaluation should be in the context of the recovery plan for southern hake and Norway lobster stocks in the Cantabrian Sea and Western Iberian Peninsula.

### **Closed areas for conservation of spawning herring under Council Reg. 850/98**

STECF notes that with the exception of the closures in the Irish Sea SGMOS-07-03 was not in the position to evaluate the effects of the closures.

STECF concurs with the conclusions of SGMOS-07-03 and notes that providing stocks are not overfished, and that fisheries managers set TACs in line with management plans for sustainable stocks and are confident that fishing mortality on the stocks concerned is effectively controlled, the existing closures may be unnecessary.

### **Closed areas for conservation of herring nursery areas under Council Reg. 850/98**

STECF notes that SGMOS-07-03 was not in the position to evaluate the effectiveness of the closures. The closures in the Irish Sea were set up to limit catches of juvenile herring in small meshed trawl fisheries. As these fisheries are no longer in operation STECF suggests that the existing closures may be unnecessary.

The closed area in the Firth of Forth covers an area that appears to contain juvenile herring throughout most of the year. Furthermore it is located inshore to the sandeel closure off the east coast of Scotland. It is considered advisable to restrict activities with small mesh gears in this area. The closed area in the Moray Firth covers an area that appears to contain juvenile herring throughout most of the year. This area also coincides with a Special Area of Conservation (SAC) designated by UK for the protection of bottle-nosed dolphins. STECF therefore recommends that the closures in the inner Firth of Forth and the inner Moray Firth be maintained.

### **Closed area to sprat and herring fisheries to protect herring (off Jutland)**

STECF notes that despite the introduction of the sprat box in 1984, catches of juvenile herring remained at very high level until 1996 where a new monitoring and control system for small meshed trawl fisheries were implemented and by-catch limits were enforced. Since then, additional measures to limit catches of herring in small-meshed trawl fisheries have been introduced including a separate TAC for herring taken in trawl fisheries using mesh sizes of less than 32 mm. When a Member State has taken its by-catch quota it is not allowed to land unsorted catches containing herring. STECF notes that this in practise this means that herring taken by the member States small-meshed trawlers can not be landed if the member States by-catch quota has been taken.

Noting that these by-catch rules have effectively limited the catches of juvenile herring to levels well below the upper levels agreed by the Community and Norway, STECF advises that under the present management regime the sprat box is not required to limit catches of juvenile herring.

### **Closed area for protection of herring in ICES zone IIa**

To prevent area- misreporting of North Sea herring catches to Division IIa STECF recommends the closure be maintained in its present form.

### **Closed area for conservation of mackerel**

STECF notes that the available information indicates that the closure has been beneficial for conservation of Northeast Atlantic mackerel and recommends that this closure be maintained.

### **Rockall Haddock box in ICES zone VI**

STECF considers that the available information indicates that the haddock box has had a positive conservation impact and recommends the closure be maintained.

### **Clyde cod box**

STECF considers that the available information indicates that the cod box in the Clyde has had a positive conservation impact and recommends the closure be maintained.

### ***Proposed closed areas south-western of Ireland for environment conservation***

a) STECF is requested to review the ICES advice on Western Irish Natura Sites, to evaluate the findings and make any appropriate comments and recommendations (refs: ICES advice 2007, AGWINS report 2007 of the ad-hoc group for Western Irish Natura Sites).

ICES was specifically asked to:

- Review and evaluate all relevant information on fishing activities in the proposed areas to assess possible impact to these fisheries of closure and other potential management measures;
- Evaluate whether the boundary of the proposed area is appropriate for delimiting the fisheries management measures needed to protect the habitats for which the area has been proposed;
- On the basis of known impacts of fishing gears active in the vicinity, evaluate whether it will be necessary to close all fisheries to achieve the conservation objectives of the proposed protected areas, and if not, what management measures would be suitable.

STECF notes that there was an incomplete data set for the ICES WG to access the distribution of different fishing activities in the area. Therefore it was not possible to provide a quantitative assessment of the potential impacts of closure or other potential management measures. Taking into account the size and location of the sites together with the limited information on the distribution of fishing effort, it appears that a relatively small amount of fishing effort is likely to be affected even if the sites are completely closed to fishing activity. STECF agrees that the boundaries of the proposed sites encompass the main areas where coral beds are known to occur and are appropriate for delimiting the fisheries management measures needed to protect the habitats within. Such habitats comprise not only the coral itself but also the geological structures and associated biological communities.

In relation to fisheries closures or other management measures for the designated Natura 2000 sites, ICES conclusions were as follows:

## **NW Porcupine Bank**

At the NW Porcupine site the southeastern boundary is up to 3.5 km from the conservation feature of the site. Spanish longline vessels currently fish for hake within this zone as well as outside it. Although longlines are not considered the most damaging fishing gear used in the region, the effect on reef ecosystems of exploitation of the target species is not fully understood, but it is likely to affect achievement of the conservation objectives. ICES advises restricting access to the site to the longline fleet until the implications to the habitat of exploitation of the hake stock are better understood. When such understanding becomes available a further evaluation might occur.

### *SW Porcupine Bank*

The main fishing activity within the SW Porcupine site appears to be from pelagic trawlers targeting blue whiting. The VMS data available do not allow distinction between pelagic and demersal fleets. ICES considers that the pelagic trawl fishery will not adversely affect the conservation objectives of the site, thus it should not be necessary to restrict access to the site by this fishery. However because of a current inability to distinguish the type of fishing ICES advises that the site be closed to all fisheries. Blue whiting is widely distributed in deepwater to the west of UK, and is not considered to be exclusively associated with reefs.

### *Belgica Mound*

At Belgica Mound there is an active French and Spanish bottom trawl and longline fishery in the southern and eastern part of the site, targeting hake and deepwater species, which also takes place beyond the site boundary to the east. Exploitation of demersal reef-associated stocks, and the potential for damage to the physical structure of the reefs by towed gears, suggests that these activities are not compatible with the conservation objectives for the site. ICES therefore advises full closure of the site.

### *Hovland Mound*

At Hovland Mound there is a Spanish deepwater bottom trawl fishery within the northwestern part of the proposed site, which appears to form part of a larger fishery. Fishing within the site boundary to the northwest has the potential to impact the physical structure of the reef and the reef-associated fish community, and is not compatible with the conservation objectives for the site. ICES therefore advise full closure of the site.

### Further STECF comments and recommendations

With the exception of its advice regarding pelagic trawling for blue whiting, STECF agrees with ICES. STECF considers that the impact of pelagic trawling for blue whiting on the habitats that the sites are designed to protect, is likely to be negligible, and advises that this activity need not be restricted within the designated areas.

b) The Commission has received the following comments and request from Spain and would like STECF to advise and comment as appropriate:

- Deep water corals we want to protect with these closures live at depths greater than 500 m. The areas include depths between 400 and 1.500 m. Areas with bathymetry of less than 500m should be excluded from the closed areas.

The obligation of the member states is not only to protect a certain species but a certain habitat type, supporting biological communities and geological structures. Furthermore, STECF notes that the NW Porcupine Bank SAC is the only site of the four designated sites that includes an area shallower than 500 m. This area is well selected from a coral habitat perspective and corals are observed in waters shallower than 500m within the area.

- Assess the possible effect on fish populations of displacement of fishing activities to shallower waters, following the closures. In the case of hake, juveniles are fished in areas that are not so deep. Could this have a negative effect on fishing mortality of target species?

STECF did not have access to the data and information required to assess the potential effects of a displacement of fishing activities from within the Natura 2000 sites to areas of shallower water and as a result, is unable to determine the effect of such displacement on fishing mortality.

- Assess the impact of fishing effort displacement to other areas; increased fishing effort in the new areas and possible conflict between different fishing gear in such areas.

STECF did not have access to the data and information required to assess the impact of fishing effort displacement to other areas or to advise on any potential conflict between different fishing gears in such areas.

- Assess compatibility between existing vulnerable ecosystems in the proposed MPAs and recent and continuous fishing with bottom gear in such areas.

STECF considers that continuous fishing with bottom trawls is incompatible with the objective to protect sensitive ecosystems within the Natura 2000 sites.

- Assess possible socioeconomic impact of setting up the four proposed MPAs.

STECF did not have access to any appropriate data and information to assess the potential socioeconomic impacts of a possible removal of fishing effort from the proposed sites. Even basic information on the catches by relevant fleets was unavailable. If there are future requests to STECF to assess possible socioeconomic impacts, the relevant Member States must as a minimum, provide catch and effort data pertaining to the fleets and fisheries likely to be affected.

### ***References***

ICES. 2007a. Report of the Ad hoc Group for Western Irish Natura Sites (AGWINS), 21 June 2007, Dublin, Ireland. ICES CM 2007/ACE:06. 26 pp.

ICES 2007b. Answer to special request from European Commission on Western Irish Natura 2000 Sites. Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems, 2007. ICES Advice. Volumes 1 - 10. Copenhagen, Denmark. Available at: <http://www.ices.dk/committe/Acfm/comwork/report/2007/special%20requests/Western%20Iri sh%20N2K%20Sites%20Advice.pdf>

**ANNEX STECF/SGMOS-07-03 WORKING GROUP REPORT ON EVALUATION OF  
CLOSED AREA SCHEMES**

**Ispra, 15-19 OCTOBER 2007**

This report is the opinion of the expert working group on evaluation of closed area schemes (STECF/SGMOS-07-03) and not of the Scientific, Technical and Economic Committee for Fisheries (STECF)

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



#### 4. SUMMARY

SGMOS-07-03 met in Ispra, Italy in October 2007 in order to evaluate a set of areas closed to fisheries in the eastern North Atlantic and North Sea. The objective was to determine, for each closed area, its value for conservation and to make recommendations on the future of the closure (renewed, modified or deleted). In cases where there was insufficient evidence, SGMOS-07-03 was asked to identify what further studies might be required.

Overall SGMOS-07-03 found that most closures had been established without clear objectives. This made it difficult to evaluate their effectiveness, regardless of the amount of evidence that might be available. SGMOS-07-03's first task was thus to devise, on the basis of knowledge and logic, some objectives for each closure. The effectiveness of each closure was then evaluated against those objectives. It is important to note that if the objectives were not correctly devised, then it is likely that the evaluation of effectiveness will also not be fully correct. Another feature of all closures that needs to be borne in mind is that most were established as part of a package of measures to achieve a wider objective, for instance, recovery of a fish stock. The measure of 'success' in this case would be the recovery of the stock, but it is usually very difficult to evaluate the role that a part of the overall package has played in the achievement (or otherwise) of the objective. If the stock has recovered, just how much was due to the closed area and how much was due to other measures?

Despite these difficulties, SGMOS-07-03 made an evaluation of most of the areas under consideration, although some of these evaluations were made on a small base of evidence. These evaluations are summarised in the following table. Further details on each evaluation can be found in the relevant chapter of the report.

SGMOS-07-03 noted that in several cases current fisheries advice appears to be based solely on TAC with occasional notes on technical measures. In many cases, closed areas received little or no mention in the years after their establishment. For none of the closures considered here was its effect explicitly addressed in the respective stock assessment.

Based on the above points SGMOS-07-03 therefore recommends that when a closed area is established, explicit consideration be given to its objectives and ways of measuring whether or not those objectives have been met. If possible, these measures should be based on pre-existing data series, the spatial scale of which should be taken into account when designing closed areas. This will minimise extra costs of monitoring and place any future changes in conditions in context. Furthermore SGMOS-07-03 recommends that closures be reviewed on at least a 3-5 year cycle, both for effectiveness and for appropriateness. Chapter 17 of this report makes recommendations for the monitoring of existing and future closures.

<b>Closure and most recent regulation</b>	<b>Effectiveness of closure</b>	<b>Recommendations on closure</b>
<p>Closure of an area for sandeel fisheries in ICES zone IV</p> <p><i>Point 5 from Annex III of CR 41/2007</i></p>	<p>Appears to have been an improvement in the age 1+ sandeel abundance until around 2003. Environmental changes have since caused dramatic declines in sandeel size and seabird breeding productivity in 2004 and 2006-07.</p> <p>A number of studies have attempted to evaluate the impact of the closure on seabirds, sandeels and fish predators. Breeding productivity of kittiwakes was significantly depressed in the closure zone when the fishery was active, whereas no effect was found in the control zone, which was open to the fishery. Furthermore, kittiwake breeding productivity was negatively correlated with fishery effort during the fishery period in the closure zone, but not in the control zone. The lack of any discernable effect on diving seabirds could result from their comparatively low sensitivity to reduced prey availability.</p>	<p><b>SGMOS-07-03 recommends that this closure remains in place.</b></p> <p>The indicator suggested by ICES of kittiwake breeding success has returned to a low level recently, and other seabirds are suffering from a poor food supply.</p> <p>SGMOS-07-03 considers that the current poor state of sandeels in the closed area would not be helped with re-opening at this time.</p>
<p>Closure of an area for Norway pout to protect other roundfish</p> <p><i>Article 27 of CR 850/89</i></p>	<p>There is not enough high resolution disaggregated data to conduct an evaluation of the effects. The EU data collection regime works on too low resolution to be used for this purpose, i.e. there is no data from individual hauls and positions.</p>	<p><b>SGMOS-07-03 recommends that this closure remains in place and that studies of its effectiveness are initiated.</b></p> <p>It is not possible, on the basis of the evidence available to the SGMOS-07-03, to make any recommendation for change to the Norway pout closure.</p> <p>An evaluation of the effects of the Norway pout box requires that we initiate experimental surveys to determine CPUE inside and outside the Norway pout closure.</p> <p>There is currently no Norway pout industrial fishery in the North Sea. This, however, may not be the case in future and an evaluation of the Norway pout closure is therefore still relevant.</p>

Closure and most recent regulation	Effectiveness of closure	Recommendations on closure
<p>Closed area for the conservation of cod in ICES zone VIa</p> <p><i>Point 7 from Annex III of CR 41/2007</i></p>	<p>It would have been very difficult to have detected any direct effect of the closure on the primary objective of allowing as many cod to spawn in 2001, even with a dedicated sampling programme. The available information on stock status is too poorly spatially resolved to disentangle any closure effects from other causes of change.</p> <p>The statistical power of the spatio-temporal evaluation needs to be assessed before we have any certainty in the results.</p>	<p><b>SGMOS-07-03 recommends that this closure remains in place, but the location and extent of the closure should be re-considered alongside other measures of the recovery plan for this stock.</b> The STECF Mixed Fisheries Group suggested in 2004 that for any beneficial effects of area closures to be observed in cod and other mobile stocks, larger area closures continued over several years are likely to be required. The STECF Mixed Fisheries Group recognised that this closure would not be sufficient by itself to protect cod, but that its removal would not help to improve cod recovery measures. An expansion of the closure may be more effective.</p>
<p>Closed area for the conservation of cod in ICES zone VIIf and g</p> <p><i>Point 7 from Annex III of CR 41/2007</i></p>	<p>SGMOS-07-03 is confident that the cod closure has played a role in the reduction in the fishing effort of French gadoid trawlers in the Celtic Sea. The reduction in effort of this fleet is probably the main factor in the apparent reduction in fishing mortality in recent years.</p> <p>The closure is potentially effective for displacing fishing activities away from spawning aggregations off north Cornwall and hence making vessels less efficient at catching cod. The effectiveness of the closed rectangle off the Irish Coast is less evident due to its lesser importance as a fishing ground for the EU whitefish fleets and poorer knowledge of spawning distribution off the Irish Coast.</p>	<p><b>SGMOS-07-03 recommends that this closure remains in place. It may be that modification of the areas closed would be possible, but SGMOS-07-03 had insufficient evidence to make any such recommendation. Further collaboration between fishermen and scientists in interpreting the fishery data is recommended.</b></p> <p>The existing evaluations of the closure have been unable to disentangle the effects of the closure from other factors influencing fishermen's tactical decisions. A more comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required, based on accurate fleet definitions and fishing activity data collected at an appropriate spatial and temporal resolution.</p>

Closure and most recent regulation	Effectiveness of closure	Recommendations on closure
<p>Closed area for conservation of cod in the Irish Sea</p> <p><i>Point 8 from Annex III of CR 41/2007</i></p>	<p>SGMOS-07-03 concludes that the Irish Sea cod closure in 2000 was of appropriate extent and duration to encompass the majority of the spawning stock throughout the spawning season. The closure from 2001 onwards encompasses the majority of the western Irish Sea spawning population of cod for most of the spawning season but excludes the eastern Irish Sea spawning population.</p> <p>On the basis of the information available, SGMOS-07-03 was unable to determine the extent to which the Irish Sea cod closure since 2000 has reduced fishing mortality to a lower value than would otherwise have occurred, through protection of adult cod during spawning or influencing changes in fishing effort in the different fleets.</p>	<p><b>SGMOS-07-03 recommends that this closure remains in place. It may be that modification of the areas closed would be possible, but SGMOS-07-03 had insufficient evidence to make any such recommendation.</b></p> <p>A comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required to evaluate the cod closure.</p>
<p>Closed areas for conservation of hake</p> <p><i>Article 28 of CR 850/98 and Articles 5 &amp; 6 of Com. Reg. 494/2002</i></p>	<p>Since the implementation of the technical measures and the adoption of a recovery plan for northern hake in 2004, the stock situation has improved, the northern hake stock has met (or is very close to) the SSB target defined in the recovery plan. Article 3 of the recovery plan indicates that, in such situation, a management plan should now be implemented.</p> <p>SGMOS-07-03 believes the closure has been effective in its contribution to improve the selection pattern.</p>	<p><b>SGMOS-07-03 recommends that this closure remains in place.</b></p> <p>The probable transition from a recovery plan to a management plan for the northern hake stock that should take place in the near future may be a good opportunity to improve further the selection pattern and examine the boundaries of the technical measures in place.</p> <p>SGMOS-07-03 apologises for overlooking two closures off Iberia and failing therefore to review them.</p>

Closure and most recent regulation	Effectiveness of closure	Recommendations on closure
<p>Closed areas for conservation of herring under Council Reg. 850/98</p> <p><i>Article 20 of CR 850/98 (spawning grounds)</i></p>	<p>The closures were put in place to prevent excessive fishing mortality during spawning periods when there is dense aggregation and very high catchability. It was thus a measure to aid management rather than having a stock biology basis. It is impossible to quantify the contribution of the closures to controlling fishing mortality independently from other measures in place.</p> <p>Since the closures were introduced, more effective control systems have been implemented (e.g. VMS and Buyers and Sellers documentation). However, the effectiveness of such measures in controlling exploitation needs to be demonstrated. In the North Sea, ICES has advised that enforcement and management issues have resulted in exploitation well above the recommended harvest rate during 2005-2007. With continued poor recruitment, this could bring the stock to <math>B_{lim}</math> by 2009, potentially leading to further reduced recruitment and stock collapse.</p>	<p><b>SGMOS-07-03 recommends that closed areas for spawning herring could potentially be removed, but only if there are accurate assessments and forecasts indicating the relevant stocks are in a healthy state, that fisheries managers set TACs in line with management plans for sustainable stocks, and that there are proven effective controls on fishing mortality minimising the risk of F exceeding agreed targets.</b></p> <p>This recommendation leaves a residual risk of loss of a population using a specific local spawning ground. This risk exists in many areas already as fishing occurs on pre-spawning herring in the weeks before closures. SGMOS-07-03 suggest that before any removal or alteration of a spawning closure could be considered, the fishing industry, scientists and managers should collaborate in drawing up effective plans for minimising the risks of overharvesting of individual spawning populations.</p>
<p>Closed areas for conservation of herring</p> <p><i>Article 20 of CR 850/98 (nursery areas)</i></p>	<p>It is impossible to evaluate the effectiveness of these Irish Sea closures as there are no longer any industrial fisheries for herring in the Irish Sea.</p> <p>No information was available to review the effectiveness of herring nursery closures in the western North Sea.</p>	<p><b>SGMOS-07-03 recommends the removal of the closures in the Irish Sea as there are no longer industrial fisheries for herring there.</b></p> <p><b>SGMOS-07-03 recommends the retention of closures in the North Sea in areas where a fishery for sprat is present.</b></p>
<p>Closed area for protection of herring in ICES zone IIa</p> <p><i>Point 2 from Annex III of CR 41/2007</i></p>	<p>It was unclear to SGMOS-07-03 as to why this closure was established. The most likely explanation given was that it was established to reduce the level of area misreporting in the Norwegian spring-spawning herring fishery.</p>	<p>If the reason for establishment was as suggested, <b>SGMOS-07-02 recommends removal of the closure if relevant management authorities are confident that modern control systems can minimise area misreporting</b></p>

<b>Closure and most recent regulation</b>	<b>Effectiveness of closure</b>	<b>Recommendations on closure</b>
<p>Closed area to sprat and herring fisheries to protect herring (off Jutland)</p> <p><i>Articles 20 and 21 of CR 850/98</i></p>	<p>New analyses of juvenile herring catch rates gathered through IBTS-surveys led SGMOS-07-03 to conclude that the sprat closed area is currently performing sub-optimally in the fulfilment of its objectives.</p> <p>Substantial differences were found between analyses of the IBTS data and the acoustic surveys data, most likely due to differences in the timing of the surveys.</p>	<p><b>SGMOS-07-03 recommends that a closure be maintained and that further analyses be carried out to determine if the sprat closed area boundaries might perform better in an alternative configuration.</b></p> <p>Further analyses are required to fully understand the effectiveness of the current closure and/or any re-configuration of the closure.</p>
<p>Closed area for conservation of mackerel</p> <p><i>Article 22 of CR 850/98</i></p>	<p>SGMOS-07-03 considers the 2002 ICES advice provides a strong indication that the mackerel box was beneficial for conservation of Northeast Atlantic mackerel.</p>	<p><b>SGMOS-07-03 recommends that this closure be maintained.</b></p> <p>However, SGMOS-07-03 had no information available to carry out an evaluation of any potential changes in the boundaries of the mackerel closure.</p> <p>In view of possible shifts in distribution of mackerel, SGMOS-07-03 recommends that a further evaluation using up-to-date fishery and survey data should be carried out by ICES to determine if the current Mackerel Box arrangement remains appropriate for conservation of the stock.</p>
<p>Rockall Haddock box in ICES zone VI</p> <p><i>Point 5 from Annex III of CR 41/2007</i></p>	<p>Some changes in exploitation pattern of haddock were observed in the area but they are uncertain due to unreliable discard estimates. Also some decrease in total UK fishing effort was observed at the time of the closure but it is not known what proportion was applied directly to the haddock fishery.</p>	<p><b>SGMOS-07-03 recommends that the closure be maintained.</b></p>
<p>Firth of Clyde cod closure</p> <p>Originally Council Reg. (EC) No 456/2001</p> <p>Now under Scottish Government legislation SSI 2007/63</p>	<p>The Clyde closure includes the main cod spawning area of an aggregation of cod that is reproductively isolated from the major spawning aggregation of VIa. Although the effect of the closure on this sub-stock is unclear, based on the high densities of mature cod within the closed area at spawning time, it is likely to be having some positive impact on an aggregation that is susceptible to local depletion.</p>	<p><b>SGMOS-07-03 recommends that the seasonal closure remains in place.</b></p>

## 5. INTRODUCTION

### 5.1. Background to the meeting

The Commission is in the process of revising the technical measures for the Atlantic and the North Sea (Regulation 850/98 and associated subsequent Regulations). As a part of this exercise, an evaluation of closed areas laid down in this regulation is required. A considerable body of material and evaluations has been compiled through a number of research projects and study groups. A two step approach has been followed: first, an overview was made of existing closed areas within EU waters and of any existing material that could be used to evaluate their effectiveness. This first STECF meeting was held in March 2007; it prepared an inventory of closed areas and identified a process and the data requirements for an evaluation of the closed areas in the inventory, considering maximum use of existing evaluations and information.

This report is of the meeting that undertook the second step in this process and is an evaluation of a specific list of closed areas in the Atlantic and the North Sea. The report attempts to determine, for each of the closed areas, its value for conservation. The objective is to help the Commission to decide if the closed areas should be renewed, modified or deleted in the new regulation. When no advice was possible due to a lack of data, the report identifies the material required to evaluate the closed area. It is expected that any such evaluation would be supported through the Data Collection Regulation or a specific research project.

### 5.2. Terms of Reference

SGMOS-07-03 was requested to:

- Evaluate the efficiency of the following closed areas for the conservation of marine organisms:
  - Closure of an area for sandeel fisheries in ICES zone IV<sup>1</sup>
  - Closure of an area for Norway pout to protect other roundfish<sup>2</sup>
  - Closed area for the conservation of cod in ICES zone VIa, VIIIf and g<sup>3</sup>
  - Closed area for the conservation of cod in Irish Sea<sup>4</sup>
  - Closed areas for the conservation of hake<sup>5</sup>
  - Closed areas for the conservation of herring in west of Scotland<sup>6</sup>
  - Closed area for the protection of herring in ICES zone IIa<sup>7</sup>
  - Closed area for sprat to protect herring<sup>8</sup>
  - Closed area for the conservation of mackerel<sup>9</sup>
  - Rockall haddock box in ICES zone VI<sup>10</sup>

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<sup>1</sup> point 5 from Annex III of Council Regulation (EC) No 41/2007

<sup>2</sup> Article 27 of Council Regulation (EC) No 850/98

<sup>3</sup> point 7 from Annex III of Council Regulation (EC) No 41/2007

<sup>4</sup> point 8 from Annex III of Council Regulation (EC) No 41/2007

<sup>5</sup> Article 28 of Council Regulation (EC) No 850/98 and Articles 5 and 6 of Commission Regulation (EC) No 494/2002

<sup>6</sup> Article 20 of Council Regulation (EC) No 850/98 [Note that this Regulation covers more geographical areas than west of Scotland – all closures were examined by SGMOS-07-03]

<sup>7</sup> point 2 from Annex III of Council Regulation (EC) No 41/2007

<sup>8</sup> Article 21 of Council Regulation (EC) No 850/98

<sup>9</sup> Article 22 of Council Regulation (EC) No 850/98

<sup>10</sup> point 5 from Annex III of Council Regulation (EC) No 41/2007

- For each of the closed areas, list existing information on the effects and evaluate if the closed areas have had a positive impact on the conservation of marine organisms, have had no impact or if the impact is not known. If possible also identify adverse impacts of the closed areas on conservation [of any marine organism or habitat].
- Propose, as appropriate, modifications of the closed areas in order to improve their positive effect on the conservation of marine organisms.
- When an assessment is not possible, identify the data requirements for an evaluation of the closed areas in a short term.

### Notes on Terms of Reference

During discussion on the first day of the meeting, the representative from the Commission clarified that the request on closed areas for the conservation of herring in west of Scotland should, if time in the meeting permitted include all other herring closures listed in Article 20 of Council Regulation No 850/98. SGMOS-07-03 also examined a closed area in the Firth of Clyde, Scotland that was originally established under European Regulations, but is now maintained under UK legislation only.

### 5.3. Participants



**SGMOS-07-03.** Left to right; Back row: Andrzej Jaworski, Sarunas Zableckis, Thomas K. Sørensen, Peter Jones, Michel Bertignac, Mark Tasker, Mike Armstrong. Front row: Floriana Folisi, George Petrakis, Pieter-Jan Schön, Peter Wright, Hendrik Doerner, Anne Sell



## **Experts**

Mike Armstrong (CEFAS, UK)  
Michel Bertignac (IFREMER, France)  
Andrzej Jaworski (FRS, UK)  
Peter Jones (University College London, UK)  
George Petrakis (HCMR, Greece)  
Pieter-Jan Schön (AFBI, UK)  
Anne Sell (BFAFi, Germany)  
Thomas K. Sørensen (Difres, Denmark)  
Mark Tasker (chair; JNCC, UK)  
Peter Wright (FRS, UK)

## **European Commission:**

Hendrik Doerner (DG JRC, STECF secretariat)  
Sarunas Zableckis (DG JRC, STECF secretariat)  
François Theret (DG FISHERIES AND MARITIME AFFAIRS)

### **5.4. Acknowledgements**

SGMOS-07-03 thanks Francois-Xavier Thoorens and Floriana Folisi of DG JRC for their help during the meeting.

SGMOS-07-03 thank the many colleagues helped SGMOS-07-03 by email and in discussions, including Emma Hatfield, Mark Dickey-Collas, Mark Payne, Henrik Mosegaard, Ole Vestergaard, Roddy Mavor, Phil Kunzlik, Christopher Zimmermann, Joachim Gröger and Chris Darby. Rasmus Nielsen helped in particular with the Norway pout box analyses and text.

### **5.5. Structure of report**

The report that follows is structured by each of the closures that SGMOS-07-03 was requested to evaluate, with the addition of a chapter covering the closure for cod on the Clyde. The closures of herring fishing over spawning grounds under Article 20 of Council Regulation (EC) No 850/98 are considered as a group in one chapter.

Each chapter is structured in a similar fashion with sections as follows:

- a summary the advice given;
- the legislation (when the legislation is brief it is included verbatim, when lengthy it is summarised with the actual text included in Appendix 2);
- an illustrative map of the closure (not to be used in legal circumstances);
- a table providing goals, objectives, indices of success, success criteria and monitoring method. In some cases these items could be drawn from the legislation, in other cases SGMOS-07-03 inferred them from the legislation – in these latter cases the relevant text is italicised;
- a background to the closure;

- any amendments to the closure or to management of nearby areas or of the stock concerned that might affect the success of the closure;
- a summary of previous evaluations of the closure;
- an inventory of the information available at the SGMOS-07-03 meeting;
- an evaluation of the effectiveness of the closure;
- a statement of SGMOS-07-03’s confidence in the evaluation;
- any known adverse biological effects of the closure, e.g. displacement of effort;
- a recommendation on the closure;
- a recommendation on information requirements – this being divided between information known to exist (but not available at the SGMOS-07-03 meeting) and new data/information that should be gathered;
- any references cited in the text.

A section providing recommendations for needs if any existing or further closure is to be evaluated in future completes this report. SGMOS-07-03 hopes that these recommendations will ensure that closures might be reviewed in a timely and efficient manner in the future.

## **5.6. Fisheries Closures**

The closure of certain grounds to fishers is a management tool that has been used ever since fisheries management started. Closures may be introduced for many reasons, including biological, social and economic. In modern fisheries management, closures are usually part of a package of measures taken to achieve sustainable fisheries, expressed in terms such as ensuring that a stock is kept “within safe biological limits” or ensuring that some aspect of the ecosystem is protected. These terms are usually rather vague, and when coupled with other measures, it becomes very difficult to work out what precisely was intended by an individual closure. In addition to this, some closures (or the precise details of the closures), have been filtered through a political negotiation process, so although a closure proposal may have started out as a biologically-based recommendation, the addition of the political process may have changed the actual closure to something very different that no longer has a firm basis in biology. This lack of clarity in decision-making (and recording of decisions) has meant that it has only been possible in a few cases in this review to determine the precise objectives of a closure. In only one case was there ever a proposal as to how the effects of the closure should be monitored and guidance given for subsequent management action should the closure be shown to achieve its objective. In this case the suggestion was not adopted in the management Regulation. In this review, SGMOS-07-03 has tried to suggest presumed management objectives for each of the closures in order that subsequent success could be evaluated.

A second difficulty encountered by SGMOS-07-03 is that many decisions, and the advice leading to those decisions, were taken in the era before electronic documentation. It has proved challenging in these cases to find any information on these closures in the absence of an expert on those closures.

## 6. CLOSURE OF AN AREA FOR SANDEEL FISHERIES IN ICES ZONE IV

### Summary

The closure partially met the goal to improve sandeel availability for a dependent predator (kittiwakes). Following the closure there appears to have been an improvement in the age one and older sandeel abundance until around 2003. Environmental changes have since caused dramatic declines in sandeel size and seabird breeding productivity in 2004 and 2006-07. SGMOS-07-03 recommends that the current poor state of sandeels in the closed area would not be helped with re-opening at this time. Catches did increase immediately outside the closed area beyond the level recommended by ICES in some years. However, there is virtually no fishery now in the area adjacent to the closed area due to the low abundance of sandeel.

### Legislation

The sandeel closure was intended to benefit predators dependent on sandeels by avoiding a localised depletion. Article 29a from Council Regulation (EC) No 850/98 Annex defines the restriction for sandeel fishery and included a requirement for Commission evaluations to be provided to the Council by March 2001 and 2002 in order that any appropriate amendments could be made by the end of 2002. The current regulation is given in Point 5 from Annex III of Council Regulation (EC) No 41/2007 (see Appendix 2.1). Fisheries for scientific investigation were allowed in the regulation in order to monitor the sandeel stock in the area and the effects of the closure. The legislation only prohibits fishing for sandeels in the area (Figure 6.1).

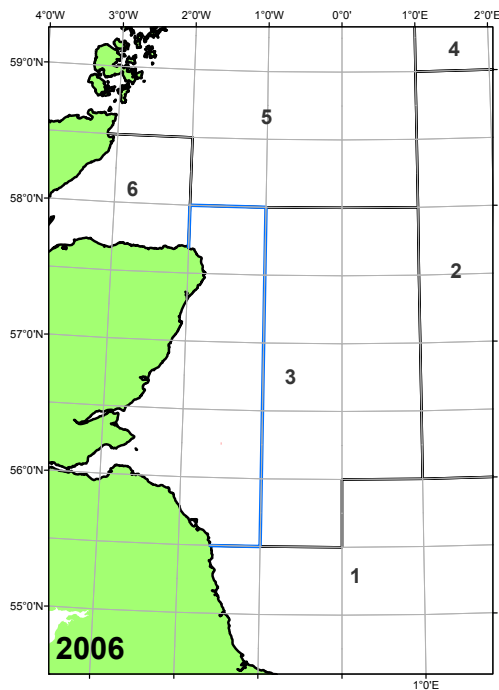


Figure 6.1. Chart showing the closed area (blue line) and the sub-stock areas defined in Wright *et al.* (1998). Area 3 = north west North Sea sub-stock (NWNS).

Table 6.1 Goals and objectives - North Sea sandeel closure

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Avoid adverse changes in the north west North Sea food web	Local sandeel abundance remains high enough to provide food for a variety of predator species.  <i>Seabird populations</i>	None explicit.  <i>but ICES proposed threshold levels of the number of fledged chicks per kittiwake nest; <math>\leq 0.5</math> closure <math>\geq 0.7</math> for re-opening<sup>1</sup>.</i>	None explicit  <i>Breeding success of kittiwake is <math>&gt; 0.7</math> chicks per nest per year for 3 years.</i>	<i>UK Seabird Monitoring Programme and CEH Isle of May monitoring programme.</i>
Sustainable fish stocks	Avoid localised depletion of sandeel aggregation	Legislation exists for a commercial monitoring fishery  <i>Scottish executive also supported scientific surveys</i>	Local abundance increase above pre-closure level	Danish commercial monitoring CPUE  FRS acoustic, dredge and grab survey
Avoid negative ecosystem effects of fisheries displacement	Minimise displacement of sandeel fishery to previously low and unfished areas	<i>No legislation but ICES proposed monitoring fishery landings and effort inside and outside the closed area</i>	<i>No legislation but ICES proposed that harvest in area 3/NWNS (Wright et al., 1998), east of 1° W, should not exceed 30,000 t (= average 1994-99)</i>	<i>Landings and Danish monitoring vessel VMS data</i>

1. Simulations using plausible values for population parameters of kittiwakes in the North Sea indicate that kittiwake populations will decline with a breeding success of 0.5 fledged chicks per well-built nest, and increase with breeding success greater than 0.7 fledged chicks per well-built nest (Thompson *et al.* 1999).

### Background to the closure

Due to their importance in North Sea food webs, ICES has advised that management should ensure that sandeel abundance be maintained high enough to provide food for a variety of predator species. During the early 1990s a substantial sandeel fishery developed in the north-west North Sea, off the Firth of Forth. The landings from this fishery peaked at over 100,000t in 1993 and then subsequently fell. The Firth of Forth area is important for breeding seabirds and the removal of such large quantities of sandeels within their foraging range soon became a matter of concern. The UK called for a moratorium on sandeel fishing adjacent to seabird

colonies along the UK coast and in response the EU requested advice from ICES. An ICES Study Group was convened in 1999 in response to an EU request for advice on the impact of sandeel fisheries on dependent predators and the potential for closed areas to ameliorate any effects.

The study group noted that there was suggestion of a negative effect of the Firth of Forth fishery on the sandeel stock in 1993 (subsequently published in Rindorf *et al.*, 2000), which coincided with a particularly low breeding success of seabirds, especially kittiwakes. The study group concluded that there were two reasons for continued concern about this area. First, sandeels supported a number of potentially sensitive seabird colonies off the north east UK coast (Lloyd *et al.*, 1991). Second, work on population structure indicated that sandeels in this area are reproductively isolated from the main fished aggregations in the north west North Sea (area 3 in Wright *et al.* 1998). Consequently, as sandeel assessments are only conducted for the North Sea there was no reliable means of evaluating the state of the sandeel aggregation near the Firth of Forth to ensure local depletion was not occurring. For these reasons the ICES study group recommended that the sandeel fishery west of 1° W in NWNS be closed to sandeel fishing, because breeding success of kittiwakes was less than that needed to maintain viable colonies (<0.5 fledged chicks per well-built nest) and that such a closure should stay in force until kittiwake breeding success exceeded 0.7 fledged chicks per well-built nest. The intention was that kittiwake breeding success would provide a sensitive indicator of sandeel availability to other sandeel-reliant predators.

The EU agreed with ICES advice to close the fishery from 2000 to 2002 whilst maintaining a small commercial monitoring. However, the Commission did not accept the use of kittiwake breeding success as a suitable index for re-opening and no alternative criteria have been put in place despite an intention to do so.

The ICES study group did consider the issue of effort displacement and proposed that the fishery in the remainder of NWNS, east of 1° W, should not be allowed to exceed the recent average harvest in NWNS of approximately 30,000 t. However, this advice was never translated into a management objective.

### **Subsequent amendments affecting the closure**

The fishery closure was continued for a further 3 years following the second evaluation report. The area also remained closed in 2007 because of the generally poor state of the North Sea sandeel stocks.

### **Summary of previous evaluations**

An annual evaluation was conducted for the first two years of the fishery closure (Wright *et al.*, 2002). The 2002 report highlighted that there had been an increase in sandeel abundance and breeding success of kittiwakes. However, the cause of the 2000 sandeel increase was unclear as it preceded any increase in the local spawning stock.

### **Inventory of data available for evaluating the effectiveness of the closure**

Detailed long-term data on demography and foraging ecology of five seabird species, including kittiwake, have been collected since the early 1980s on the Isle of May by the UK's Centre for Ecology and Hydrology, using highly standardized methods (Harris *et al.* 2005). Breeding seabirds are also monitored at a large number of colonies along the UK North Sea

coast as part of the UK Seabird Monitoring Programme coordinated by the Joint Nature Conservation Committee.

A monitoring fishery with a limited total catch was allowed in the closed area in order to continue the time series on CPUE (catch per unit effort) and to collect biological data on sandeel in the area (Wright *et al.*, 2002; Jensen *et al.*, 2007). This monitoring fishery only involved vessels with a track record in the area prior to the closure. Assessing local sandeel population biomass is difficult because of the species' capacity to move freely between the seabed sediments and the overlying water column. Other research based indices involving acoustics, dredge and grab sampling have also been used since 1997. Greenstreet *et al.* (2006) summarises the results of this monitoring between 1997 and 2003. Due to differences in emergence from the sand and survey timing there is no single reliable time series of sandeel abundance. However, using a combination of data sources Greenstreet *et al.* (2006) provides estimates of 0-group and 1+ abundance for the period 1997 to 2003.

Commercial CPUE in the Firth of Forth region declined from 1997 to 1999 and then increased following the closure between 2000 and 2002. However, CPUE has subsequently declined with exceptionally low CPUE in 2007 (Jensen *et al.*, 2007). Using a combination of survey based indices and the timing of the spring bloom Greenstreet *et al.* (2006) provided biomass estimates for both buried and emerged sandeels between 1997 and 2003. According to these estimates 0-group abundance appeared higher in 2000, 2002 and 2003 than in the pre-closure period, although due to uncertainty in the estimates, the difference was not significant. Age 1+ abundance was significantly higher in the years 2000-03 than during the period 1997-99. Greenstreet *et al.* (2006) suggested that the large increase in 1+ group sandeel abundance in 2000 was likely to be due to the combined effects of a substantial decline in fishing mortality of this age group in 1999, and recruitment of a stronger 1999 year-class relative to that of 1998. An analysis of age 1 densities in dredge surveys also indicated that within year total mortality was far lower in 2000 than in 1999 (Jensen *et al.*, 2001).

Average kittiwake breeding success within the closed area exceeded 0.7 chicks per well built nest in 2000, 2003 and 2005 (JNCC Seabird Monitoring Programme). Consumption rates of age 0, but not age 1+ sandeels, were higher after the fishery closure (Daunt *et al.*, in press). In contrast to the surface feeding kittiwakes there was no detectable effect on diving seabird species. The closure also did not have a positive impact on the consumption rate of age 0 sandeels by fish predators (Greenstreet 2006).

### **Effectiveness of closure**

Whilst the causes of the increase in age 1 abundance in 2000 are still not clear there does appear to have been an improvement in the age 1+ sandeel abundance until around 2003. Environmental changes have since caused dramatic declines in sandeel size and seabird breeding productivity in 2004 (Wanless *et al.*, 2005; Frederiksen *et al.*, in prep.) and 2006-07 (S. Wanless and F. Daunt, unpublished data),

A number of studies have attempted to evaluate the impact of the closure on seabirds, sandeels and fish predators. Frederiksen *et al.* (in prep.) used a replicated before-after control-impact design comparing two coastal zones off the east UK. They found that breeding productivity of kittiwakes was significantly depressed in the closure zone when the fishery was active, whereas no effect was found in the control zone, which was open to the fishery. Furthermore, kittiwake breeding productivity was negatively correlated with fishery effort during the fishery period in the closure zone, but not in the control zone. The lack of any

discernable effect on diving seabirds could result from their comparatively low sensitivity to reduced prey availability (Furness and Tasker, 2000).

### **Confidence in the evaluation**

Research since the closure has strengthened the justification for separate sub-populations given in the original proposal (Gallego *et al.*, 2004; Frederiksen *et al.*, 2005). Further research has shown that sandeels are slow growing and mature comparatively later in the closed area (Boulcott *et al.*, 2007) and that the size at age differences between the closed and major fished areas have become more pronounced (Wanless *et al.*, 2004; Wanless *et al.*, 2005). Time series of age 1 CPUE for NWNS does not show the elevated recruitment in 2001 that was seen in other parts of the North Sea (ICES, 2006; Jensen *et al.*, 2007). Analyses of seabird breeding productivity are currently in press or review in peer reviewed publications. The estimates of sandeel abundance by the monitoring fishery and research vessel indices are subject to greater uncertainty which has led to questions about the cause of the initial increase in age 1 abundance in 2000. Nevertheless, the closure does appear to have played a part in the initial post-closure recovery of the local sandeel aggregation.

### **Adverse effects of closure**

Concerns about effort displacement were justified since catches in NWNS, east of 1° W did increase above 30,000 tonnes suggested by the ICES study group. In the ICES rectangle 41E9, adjacent to the closed area the catch in 2003 was around 40,000 tonnes. Nevertheless, landings in the open area never approached the high levels observed off the Firth of Forth in the early 1990s.

### **Recommendation on the closure**

As originally proposed in the ICES study group in 1999 the sandeels in the closed area do exhibit population traits that make them more vulnerable to recruitment overfishing than the aggregations from the main fished areas.. Whilst the current poor state of sandeels in the closed area would probably deter fishermen from fishing there if the area was open, this could not be assured. Therefore it would be prudent to wait for enhanced recruitment and productivity in the area before any re-opening is considered. Legislation to limit harvest in the rest of NWNS, as originally proposed by the ICES study group, could reduce the potential for over-exploitation in the ICES statistical rectangles 41E9 and 40E9 adjacent to the closed area.

### **Recommendation on further evaluation**

The lack of an age specific abundance time-series limits the evaluation of the closure impact on the local sub-stock and so further analyses of the monitoring catch data are needed. This could include an estimate of total mortality between the closed and open part of north west North Sea sub-stock for a before-after control-impact analysis.

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## **7. CLOSURE OF AN AREA FOR NORWAY POUT TO PROTECT OTHER ROUND FISH**

### **Summary**

During the 1960s a significant small-mesh fishery developed for Norway pout in the northern North Sea. This fishery was characterised by relatively large bycatches, especially of haddock and whiting.

In order to reduce bycatches of juvenile roundfish, the 'Norway pout box' was introduced in which fisheries with small-mesh trawls were banned. The Norway pout box has been closed for industrial fishing for Norway pout since 1977. The box includes roughly the area north of 56° N and west of 1° W (Figure 7.1). Furthermore, in the Norwegian economic zone, the Patch Bank has been closed since 2002 as well as the Egersund Bank since 2005 (Figure 7.1).

Before the Norway pout box closure, the Danish and Faroese industrial bottom trawl fisheries using small mesh sizes (16-31 mm) took place in the northwestern North Sea and the Norwegian fishery in the Norwegian Trench (ICES 1977), and the industrial fleets were fishing in the Norway pout box area targeting mainly Norway pout.

Based on IBTS samples for the period 1991-2004 (Figure 7.3), 30.0% and 27.5% of Norway pout numbers were estimated to be inside the Norway pout box for the first and third quarter, respectively (Anon. 2005). It should be noted that the IBTS survey does not cover depths >200 m along the Norwegian Trench. The area covered by the Norway pout box is an important nursery ground for juvenile haddock and whiting, and the distribution of the juvenile and adult Norway pout is overlapping the distribution of these species.

Bycatches of other gadoid species in the Norway pout fishery outside the Norway pout box have been reduced significantly over the last 30 years. Additionally, scientific evaluation has shown that the selectivity in the Norway pout fishery can be significantly further improved. A thorough evaluation of the effect of the closure, including investigation of whether the closure is necessary given the developments in more selective Norway pout fishing methods, demands further and more disaggregated information than available today.

Existing documentation does not allow for a full quantification of the effects of the closure of the small meshed fishery inside the Norway pout box.

## **Legislation**

The UK Government set up the closure in 1977, prohibiting the fishery of the small mesh size bottom trawl in the area, in order to protect the juveniles of haddock, whiting and other roundfish and to increase the recruitment. The UK Government ratified the statutory instrument setting up an area closure of the Norway pout fishery in Feb 1977. In 1986 the closure was included in EC legislation (Regulation 3094/86, Article 27) and further consolidated in Council Regulation (EC) 850/98.

Within the Norway pout box as defined in Article 27 of Regulation (EC) 850/98 (see Appendix 2.2) it is prohibited throughout the year to retain more than 5% of the catch as Norway pout if they are caught within a large area in the northwestern North Sea (Figure 7.1). The purpose has been protection of juvenile gadoids (mainly cod, haddock, and whiting) caught in mixtures with Norway pout.

Additional legislation by Norway of closed areas for Norway pout fishery covers the Patch and Egersund Banks: Norway pout may only be fished as bycatch in the mixed industrial fishery in all areas under Norwegian fisheries jurisdiction. Two areas in the Norwegian economic zone have been closed for fishing on Norway pout, sandeel and blue whiting (Figure 7.1). The approach has been to close areas where the probability of bycatches of juveniles and not-targeted species, such as cod, saithe, haddock, are considered unacceptably high. This measure could therefore also be mentioned as a measure to protect juveniles of other species than Norway pout and sandeel. As of 1 January 2002 the Patch Bank was permanently closed. Before the closure of the Patch Bank an annual average of approximately 2.000 tonnes of Norway pout were fished in this area by Norwegian vessels. As from 1 May 2005 a seasonal closure of the Egersund Bank in the period 1 December to 31 May was determined.

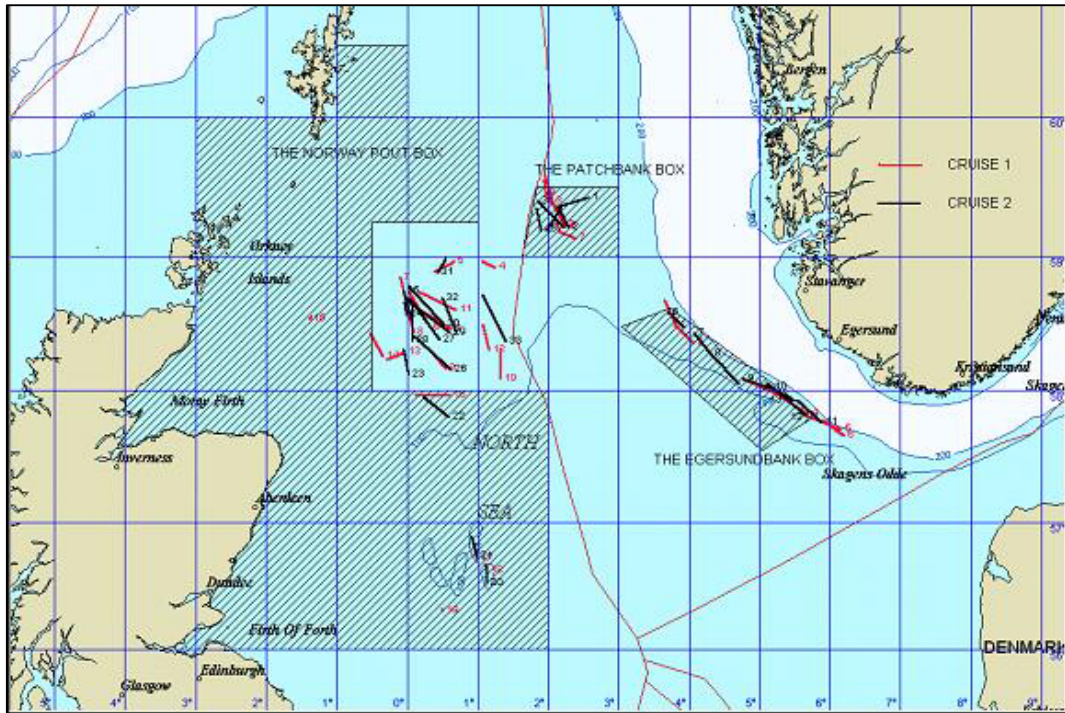


Figure 7.1. Map of the Norway pout closures: Norway pout box, Patch Bank and Egersund Bank.

Table 7.1 Goals and objectives – Norway pout box

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
<p>Establishment of the Norway pout box (1977 by the UK Government, 1986 by the EC Regulation 3094/86)</p> <p>To protect certain roundfish species (EC 3094/86)</p> <p><i>Article 27 of Regulation (EC) 850/98</i></p>	<p>To reduce the fishing mortality on juvenile gadoids such as, haddock, cod and whiting.</p> <p><i>To increase the recruitment of these species to human consumption fishery.</i></p>	<p>None explicit.</p> <p><i>Disaggregated catch rates from IBTS surveys of Norway pout and juveniles of cod, whiting and haddock inside and around the Norway pout box (for preliminary distribution patterns)</i></p> <p><i>Catch rates of the same species from commercial fishery around the box based on further disaggregated catch data and from trial fishery with commercial vessels both inside and outside the box</i></p>	<p>None explicit.</p> <p><i>Reduced fishing mortality of juvenile haddock, cod and whiting.</i></p>	<p>None explicit</p> <p><i>Evaluation of disaggregated CPUE indices from IBTS surveys and commercial fishery inside and outside the Norway pout box, respectively, for Norway pout, cod, whiting and haddock. Provide new data for this.</i></p> <p><i>Possible indications from trends in fishing mortalities in juvenile haddock and whiting before and after the Norway pout box establishment</i></p>

### Background to closure

Norway pout is distributed from the west of Ireland to Kattegat, and from the North Sea to the Barents Sea. In the North Sea shelf area, it is mainly distributed in the northern part (largely to the north of 57°N) and in Skagerrak at depths between 50 and 250 m (Raitt 1968, Sparholt *et al.* 2002a). Figures 7.2, 7.3 and 7.5 show geographical distribution of the stock obtained from the ICES IBTS surveys. The IBTS Surveys only cover areas within the 200 m depth zone. However, very few Norway pout are caught at depths greater than 200 m in the North Sea and Skagerrak on shrimp trawl survey (Sparholt *et al.* 2002b). For the Norwegian Trench, Albert (1994) found Norway pout at depths greater than 200 m, but very few deeper than 300 m.

During the 1960s a significant small-mesh fishery developed for Norway pout in the northern North Sea. This fishery was characterised by relatively large bycatches, especially of haddock

and whiting. In order to reduce bycatches of juvenile roundfish, the ‘Norway pout box’ was introduced where fisheries with small-mesh trawls were banned. The Norway pout box has been closed for industrial fishery for Norway pout since 1977 and onwards. The box includes roughly the area north of 56° N and west of 1° W (see Figure 7.1).

The UK Government set up the closure in 1977, prohibiting the fishery of the small-mesh bottom trawl in the area, in order to protect the juveniles of haddock, whiting and other roundfish and to increase recruitment to the human consumption fishery. Since 1986 the closure is included in EC legislation (Regulation 3094/86 and in Article 27 of Council Regulation (EC) 850/98 (EU 1998; Anon 2004). The box was designed by an expert committee. Before the closure industrial bottom trawls with a small mesh size (16-31 mm) were fishing in the area targeting mainly Norway pout.

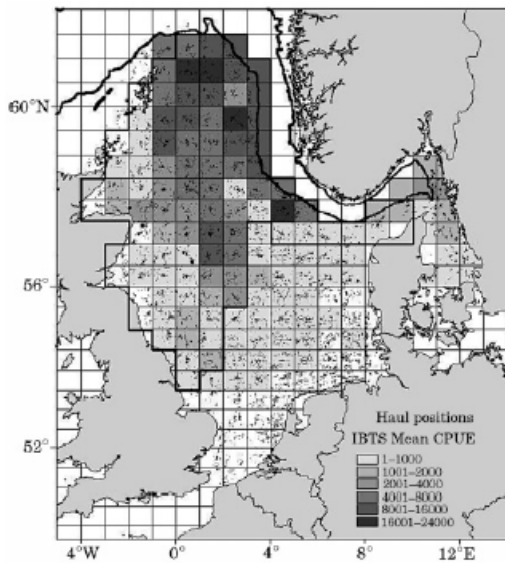


Figure 7.2. Positions fished at the IBTS first quarter and mean CPUE (numbers) of Norway pout by rectangle, 1981–1999. The standard area used to calculate abundance indices and the 200 m depth contour is also shown [from Sparholt *et al.*, 2002b].

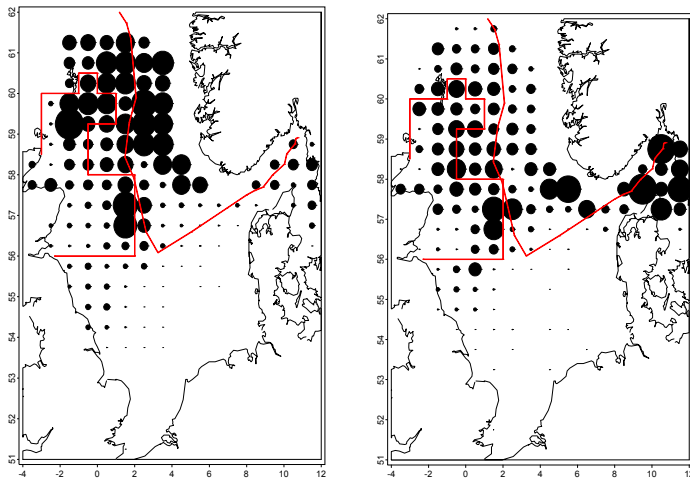


Figure 7.3a and b. IBTS Quarter 1 (a) and quarter 3 (b) mean CPUE (numbers per hour) of Norway pout by quarter during the period 1991-2004. The area of the circles is proportional to CPUE. The IBTS surveys do only cover areas within the 200 m depth zone. The 'Norway pout box' and the boundary between the EU and the Norwegian EEZ are shown. The maps are scaled individually (Anon. 2005).

Based on IBTS (International Bottom Trawl Survey) samples for the period 1991-2004 given in Figure 7.3, 30.0% and 27.5% of Norway pout numbers were estimated to be inside the Norway pout box for the first and third quarter, respectively (estimates based on Figure 7.3 and Anon. 2005).

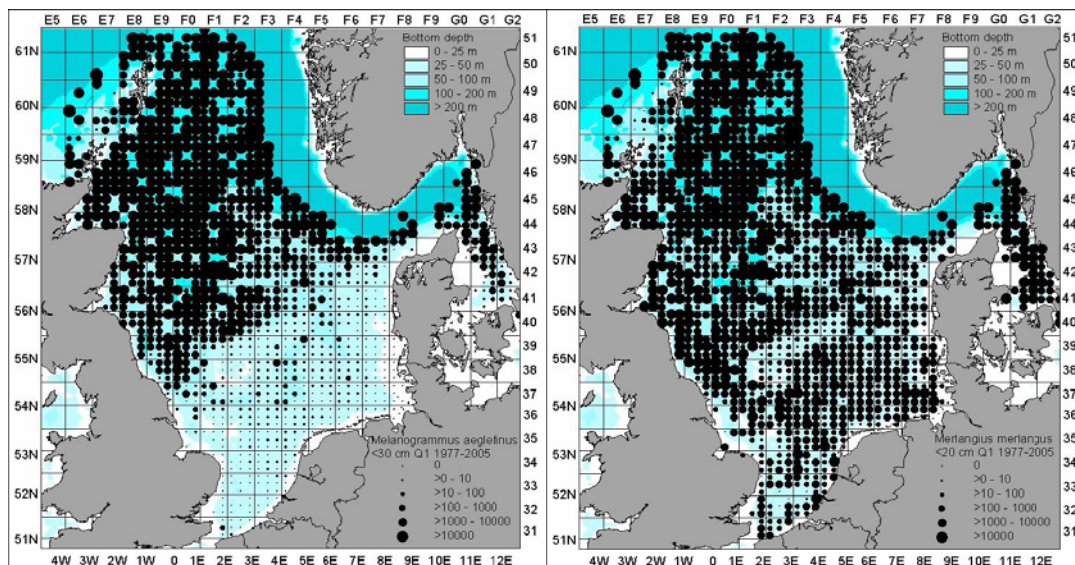


Figure 7.4. Average annual catch rate (number per hour fishing) for juvenile (<30cm), haddock (left) and whiting (right) in the quarter 1 IBTS survey, 1977-2005. Source: ICES FishMap

The area covered by the Norway pout box is an important nursery ground for juvenile haddock and whiting according to ICES data (Figure 7.4). The distribution of the juveniles



and adult Norway pout is overlapping the distribution of (among other) these species (Figures 7.2, 7.3, 7.5).

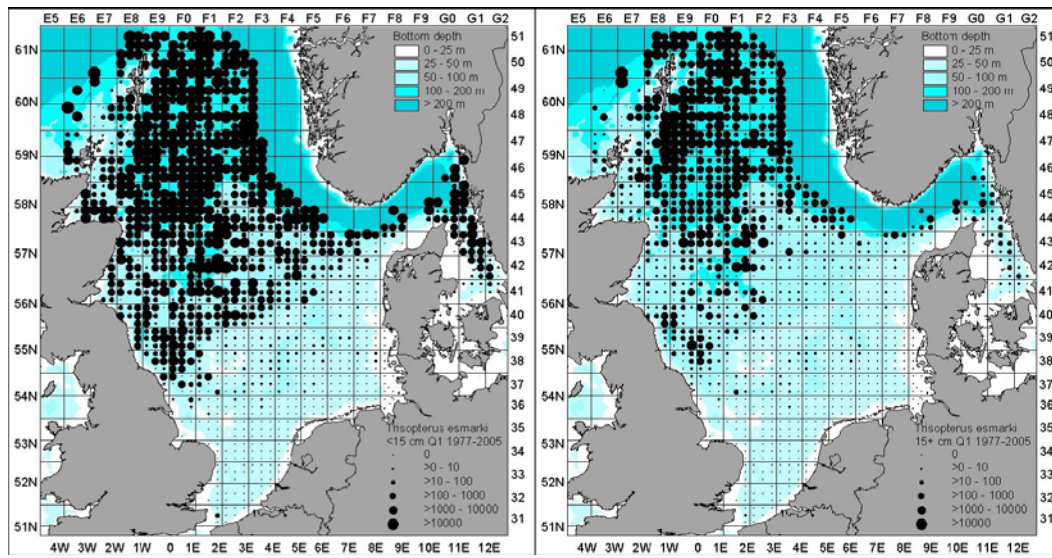


Figure 7.5. Average annual catch rate (number per hour fishing) for juvenile (<15cm, left) and adult (15cm, right) Norway pout in the quarter 1 IBTS survey, 1977-2005. Source: ICES FishMap.

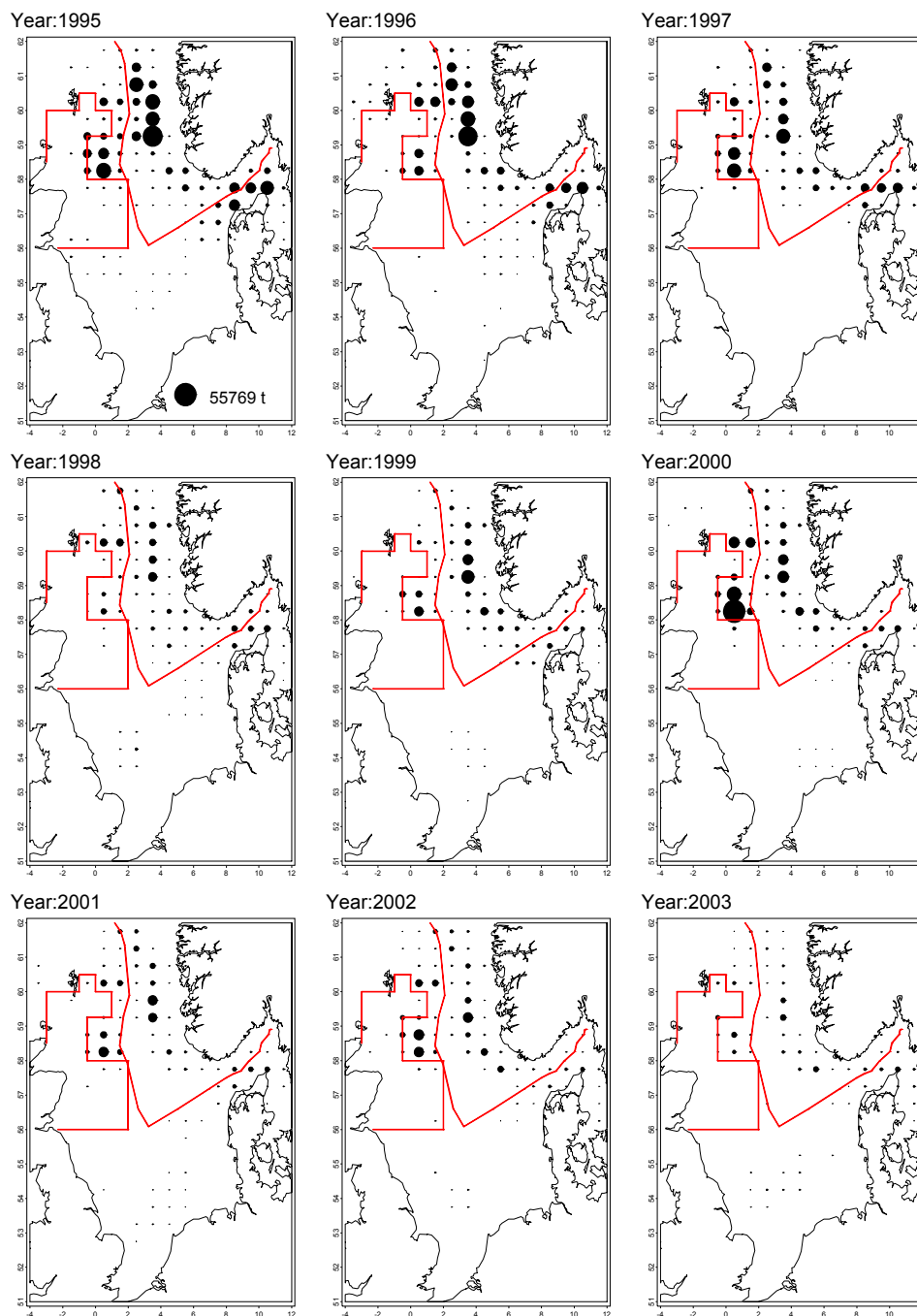


Figure 7.6. Landings of Norway pout by year and ICES rectangles for the period 1995-2003. Landings include Danish and Norwegian landing for the whole period. The area of the circles represents landings by rectangle. All rectangle landings are scaled to the largest rectangle landings shown at the 1995 map. The Norway pout box and the boundary between the EU and the Norwegian EEZ are shown on the map. (Anon. 2005).

The distribution of catches of Norway pout during the period 1994-2003 is shown in Figure 7.6. The Norway pout fishery has been closed in all of 2005, first half of 2006, and for all of 2007 in the entire North Sea because the stock has been on a low level below the precautionary biomass reference points (Bpa 150,000t). ICES advice in October 2007



provides basis for a re-opening of the Norway pout fishery in 2008 again as the stock has increased and recovered to above precautionary limits because of a relatively strong 2007 year class.

### **Subsequent amendments affecting the closure**

The Norway pout box overlaps with the Shetlands Box (Council Regulation (EC) No. 2371/2002). The Shetlands Box (Figure 7.7) was originally established in 1983 and has played an important role in attempts to achieve a balance between the different fleets and fishing communities (NAFC 2004) through a number of regulations of demersal fisheries based on vessel sizes as well as licensing schemes for large, demersal vessels (NAFC 2004).

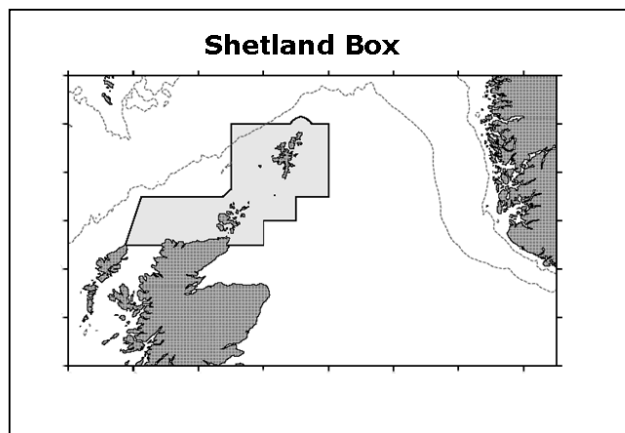


Figure 7.7. The Shetland Box.

### **Summary of previous evaluations**

The effects of the Norway pout box are not yet thoroughly evaluated. Earlier attempts have proven it impossible to differentiate the effects of the box from the effects of e.g. technological advances and selectivity of gear (Anon. 1987). On the basis of analyses of catch and bycatch data in the Danish Norway pout fishery inside and outside the Box 1975-1986, it was concluded that bycatch of each age group of whiting, haddock and herring depends on location, quarter, year class strength and year within the study period (Anon. 1987). According to this study, bycatch of whiting and haddock dominated in the Norway Pout fishery, and bycatch was shown to be correlated with introduced technical measures, including the Norway pout box and the introduction of the Common Fisheries Policy in 1983. However, changes in bycatch were shown to be linked to differences in yearly and seasonal distribution of Norway pout. Thus, it was from this study not possible to separate area and seasonal effects in relation to quantifying the effect on bycatch by the Norway pout box. In addition, technological development in the industrial fisheries in this decade was not evaluated.

### **Information used by SGMOS-07-03 for evaluating the effectiveness of the closure**

*Previous evaluations:*

Information from Anon. 1987 as described above.

*Developments in the selectivity in the fishery since introduction of the Norway pout box:*

1. Historical reduction of bycatches in the commercial fishery

Bycatches on other gadoid species in the Norway pout fishery outside the Norway pout box have been reduced significantly over the last 30 years. This is directly evident from data (Table 7.2, Figure 7.7) submitted in the ICES 2007 AGNOP WG (ICES 2007) where the overall proportion of haddock and whiting in the Danish and Norwegian small mesh size fisheries in the North Sea has been reduced significantly over the period, and also in relation to the Norway pout catches.

Table 7.2. Catch ('000 t) of all species (total) and for selected species of the Danish and Norwegian small-mesh fisheries in the North Sea. (Data from ICES 2007).

Year	Total	Norway pout	Haddock	Whiting	Percentage of Total		
					Norway pout	Haddock	Whiting
1974	1857	736	48	130	39.63	2.58	7.00
1975	1836	560	41	86	30.50	2.23	4.68
1976	1858	435	48	150	23.41	2.58	8.07
1977	1675	390	35	106	23.28	2.09	6.33
1978	1612	270	11	55	16.75	0.68	3.41
1979	1434	320	16	59	22.32	1.12	4.11
1980	1674	471	22	46	28.14	1.31	2.75
1981	1245	236	17	67	18.96	1.37	5.38
1982	1476	360	19	33	24.39	1.29	2.24
1983	1401	423	13	24	30.19	0.93	1.71
1984	1298	355	10	19	27.35	0.77	1.46
1985	1100	197	6	15	17.91	0.55	1.36
1986	1170	174	3	18	14.87	0.26	1.54
1987	1179	147	4	16	12.47	0.34	1.36
1988	1388	102	4	49	7.35	0.29	3.53
1989	1536	162	2	36	10.55	0.13	2.34
1990	1040	140	3	50	13.46	0.29	4.81
1991	1349	155	5	38	11.49	0.37	2.82
1992	1561	252	11	27	16.14	0.70	1.73
1993	1083	174	11	20	16.07	1.02	1.85
1994	1307	172	5	10	13.16	0.38	0.77

1995	1551	181	8	27	11.67	0.52	1.74
1996	1119	122	5	5	10.90	0.45	0.45
1997	1416	126	7	7	8.90	0.49	0.49
1998	1283	72	5	3	5.61	0.39	0.23
1999	1103	97	4	5	8.79	0.36	0.45
2000	1187	176	8	8	14.83	0.67	0.67
2001	1152	59	6	7	5.12	0.52	0.61
2002	1186	73	4	8	6.16	0.34	0.67
2003	681	18	1	3	2.64	0.15	0.44
2004	692	12	1	2	1.73	0.14	0.29
2005	613	1	0	1	0.16	0.00	0.16

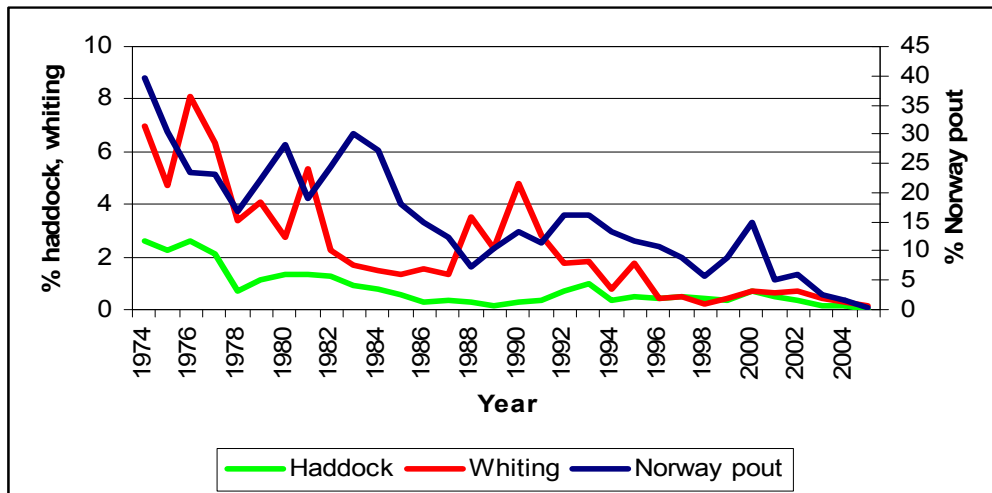


Figure 7.7. Proportion of Norway pout, haddock and whiting in the in the Danish and Norwegian small-meshed fisheries in the North Sea. (Data from ICES 2007).

## 2. Establishment of more selective fishing gears

Since the establishment of the Norway pout box in 1977, there have been a number of studies carried out on the effects of more selective fisheries technology in the Norway pout fishery. Furthermore, additional studies will be carried out during the autumn 2007 by Denmark. Main results of previous investigations have been reviewed and summarized in Nielsen and Madsen (2006).

Early Scottish and Danish attempts to separate haddock, whiting and herring from Norway pout by using separator panels, square mesh windows, and grids were all relatively unsuccessful. More recent Faeroese experiments with grid devices have been more successful. A 74 % reduction of haddock was estimated (Zachariassen and Jákupsstovu, 1997) and 80% overall reduction of the bycatch (ICES 1998).

Eigaard and Holst (2004) found based on sea trials in year 2000 that trawl gears with a sorting grid with a 24 mm bar distance in combination with a 108 mm (nominal) square mesh window improved the selectivity of the trawl with catch weight reductions of haddock and whiting of 37 and 57% but also with a 7 % loss of Norway pout. The study showed that application of these reduction percents to the historical level of industrial bycatch in the North Sea lowered on average the yearly haddock bycatch from 4.3 to 2.7% of the equivalent spawning stock biomass. For whiting the theoretical reduction was from 4.8 to 2.1%. The purpose of the sorting grid was to remedy the bycatch of juvenile gadoids in the industrial fishery for Norway pout by inserting a sorting grid in front of the cod-end, while the purpose of square mesh window was to retain larger marketable consume fish species otherwise sorted out by the grid.

Kvalsvik *et al.* (2006) carried out experimental fishing during 1998-1999 on commercial vessels to evaluate grid systems and two different mesh sizes (10mm or 24mm) in the grid section. A grid with a bar space of 22mm and various bar thicknesses were used. They showed that in the 1998 trials, 95% (weight) of the bycatch species was sorted out with a 33% loss of the industrial target species. The loss of Norway pout was around 10%. With the 1999 trials they found that 62% of the bycatch species were sorted out and the loss of target species was 22% with a loss of Norway pout of 6%. The selectivity parameters for haddock showed a sharp size selection in the grid system.

In conclusion, recent experiments with grid devices indicate a substantial reduction in bycatch of saithe, whiting, cod, ling, hake, mackerel, herring, haddock and tusk. The reduction in haddock bycatch was lowered by the presence of many small individuals of the strong 1999 year class. The loss of Norway pout at around 10% or less when using a grid with a 22-24 mm bar distance. There was also a considerable loss of other industrial species: blue whiting, Argentine and horse mackerel. The Danish experiment indicates that it is possible to retain larger valuable consume fish species by using a square mesh panel in combination with a grid. Selectivity parameters have been estimated for haddock, whiting and Norway pout. These can be used for simulation scenarios including estimates of the effect of changing the bar distance in the grid.

### 3. Increased spatio-temporal selectivity in the fishery

Danish-Norwegian fishing trials and pilot investigations were performed in autumn 2005 in order to explore variation in bycatch levels in the small-mesh industrial trawl fishery in the North Sea targeting Norway pout (Degel *et al.*, 2006).

The trial fishery was performed by two Norwegian commercial trawlers and a Danish commercial trawler traditionally involved in the small-mesh industrial trawl fishery in the North Sea and Skagerrak targeting Norway pout. The fishery was carried out within periods and areas of conducting traditional fishery for Norway pout, and the fishery was conducted with standard trawl gears used in the commercial small-mesh industrial fishery targeting Norway pout.

In general the ratio between the Norway pout target species and the sum of bycatch of certain selected species indicate that the bycatch ratio is high in the commercial Norway pout fishery. However, statistical analyses reveal that the fishermen can significantly minimize the bycatch ratio by targeting in the fishery (spatio-temporal targeting, way of fishing, etc.), i.e. when they determine the fishing stations and the fishery performed. The pilot investigations show no general significant spatio-temporal patterns in the bycatch ratio. However, there are from the

results obvious geographical and diurnal differences in the species composition of the bycatch between areas and between day and night fishery. The length distributions of the catch rates by species indicate spatial patterns between some of the species caught. These fishing trials and pilot investigations are based on only very few observations, and data are obviously rather uncertain, variable and noisy. In general, it can be concluded that relatively high bycatches can be reduced by specific targeting in the fishery, both with respect to allocation of the fishery in time and space but also in relation to fishermen knowledge about the fishery and resource availability. This demands though that the skippers/fishermen act accordingly when fishing, and a proper at-sea control.

In December 2003, a commercial vessel was chartered in a UK Fisheries Science Partnership project (Revill *et al.*, 2004) to examine the bycatch using an industrial Norway pout trawl in four ICES rectangles to the immediate north east of the Pout Box. Norway pout catches were highly variable but averaged only 25% of the total catch weight and exceeded the 60% required by legislation in only two out of the 11 tows. Haddock comprised 38% and whiting 19% of the total catch weight. No tows were carried out inside the box.

### **Effectiveness of closure**

Based on the existing documentation it is not possible to evaluate the effectiveness of the Norway pout box closure on reductions in gadoid bycatch.

### **Confidence in evaluation**

Not evaluated.

### **Adverse effects of closure**

Not evaluated.

### **Recommendation on closure**

A thorough evaluation of the effect of the closure, including investigation of whether the closure is necessary given the developments in more selective Norway pout fishery, demands further and more disaggregated information than available today.

Full documentation of the selectivity of size and species in the fishery in general should be provided from previous and ongoing selectivity studies from fisheries research institutes.

More disaggregated commercial fishery and research survey catch rate data for Norway pout and relevant bycatch species should be provided and analysed covering specific catch rates inside and outside the box. This includes evaluation of disaggregated CPUE indices from IBTS surveys and commercial fishery inside and outside the Norway pout box.

Disaggregated catch rates from IBTS surveys of Norway pout and juveniles of cod, whiting and haddock inside and around the Norway pout box can give preliminary indications of distribution patterns. However, given the development in the selectivity in the fishery both with respect to gear selectivity and the fisherman behaviour on choice of fishing ground and time, it is necessary to make full evaluation of catch rates of these species from commercial fishery conducted partly around the Norway pout box as well as catch rates of the same species from trial fishery with commercial vessels both inside and outside the box.

In general, evaluation of disaggregated commercial fishery data demands provision of more detailed fishery data than available today according to the traditional logbook information from the present data collection regulation system under EU.

### **Recommendations on data requirements**

Information not available to SGMOS-07-03 and therefore not used

### **Further data collection requirements**

The IBTS time series data could be analysed to compare the abundance indices inside and outside the box in order to examine if there are consistent differences in the abundance, in the length distribution of specific species, in the catch composition and in the biodiversity indices.

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## **8. CLOSED AREA FOR THE CONSERVATION OF COD IN ICES ZONE VIa, VIIf AND G**

### **8.1. Closed area for the conservation of cod in ICES zone VIa**

#### **Summary**

The closed area known as the “windsock” was established as an emergency measure for the recovery of the stock of cod in VIa. Whilst the location of the area was based on pre-closure cod landings, the extent of the closure is unlikely to be large enough to greatly reduce F in the VIa stock, given the mobility of cod. Any effect of the closure on spawning cod in 2001 cannot be disentangled from other causes of changes in SSB, recruitment or F. However, F<sub>2-5</sub> decreased and SSB increased in 2001 and 2002. The stock has since declined to very low levels. Evaluations of the long term effect of closed area on cod and other ground fish are currently in progress. Whilst the effect of the closure cannot be fully evaluated at the present time, SGMOS 0703 notes that its removal would not help to improve cod recovery. The boundaries of the closure should be re-considered in relation to other measures of the recovery plan for this stock.

#### **Legislation**

Point 7 from Annex III of Council regulation (EC) No 41/2007 defines a closed area for the conservation of cod in VIa (Appendix 2.3). The legislation prohibits the use of any demersal trawl, seine or similar towed net, any gill net, trammel net, tangle net or similar static net or

any fishing gear incorporating hooks within a defined area of ICES division VIa (Figure 8.1.1). Derogations are provided for purse seines and some categories of trawls fishing for pelagic fish.

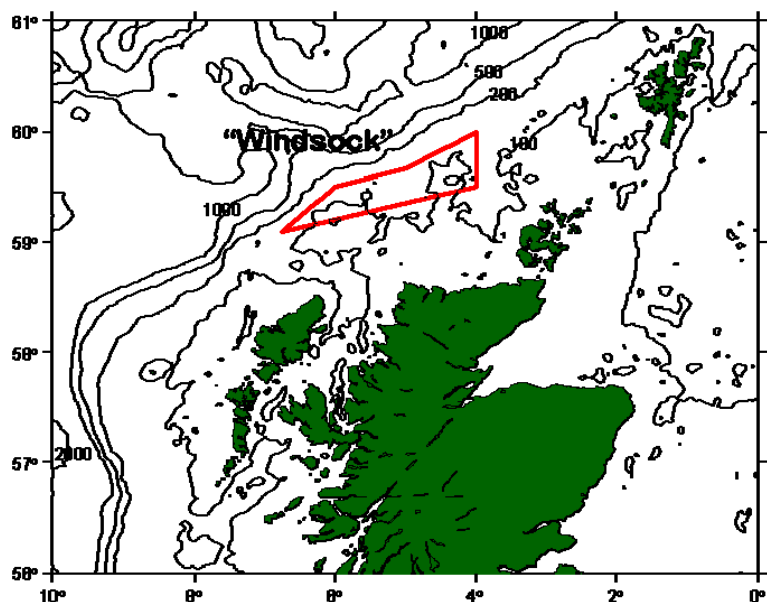


Figure 8.1.1. Area closed for cod fishing in ICES zone VIa (the “windsock”).

Table 8.1.1 Goals and objectives – Area VIa cod closure

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Promote recovery of VIa cod stock	Protect spawning aggregations of cod (in an area where spawning cod used to be caught)	None specified <i>SSB</i> <i>Fishing mortality</i>	Reduced <i>F</i> to allow maximise cod spawning in 2001  <i>Decreased fishing mortality on ages 2–8+</i>	Annual bottom trawl surveys conducted annually, in Quarter 1 and 4, by FRS, Scotland  Landings and discards data
	<i>Potentially reduce F on the ground fish assemblage.</i>	<i>Size structure (abundance by size class)</i>	1) <i>increased abundance inside the protected area relative to adjacent fishing grounds, or</i>  2) <i>increase in both areas (indicating spill-over)</i>	



## **Background to closure**

The closed area known as the “windsock” was established as an emergency measure for the recovery of the stock of cod to the west of Scotland. In November 2000, ICES indicated that the stock of cod to the west of Scotland (ICES Division VIa) was at serious risk of collapse. In December 2001, the Commission and the Council noted the urgent requirement to establish a recovery plan for cod to the west of Scotland. The area to be protected was considered by scientists, the industry and the Commission in January 2001. The closure period was from 6 March–30 April in 2001. Regulations from 2003 (2287/2003) states that the closure is year round. The immediate requirement was to allow as many cod as possible to spawn before the end of April 2001, when the spawning season was expected to finish. Council Regulation (EC) No 456/2001 adopted a regulation that prohibited conducting any fishing activity in the designated area with an exemption given to purse seines and some categories of trawls fishing for pelagic fish. Emergency measures in place for cod since 2001 have been replaced with the cod recovery plan (EC Reg. 423/2004). The closure was maintained by Council Regulations in subsequent years (with no exemptions). No measures were applied to regulate effort displaced during the period of the control.

The regulation targeted areas where high catch rates of cod had recently been experienced during March and April, based on international landings data. The controlled areas were not defined for the purposes of regulating fishing effort on the cod stock in this area (Fisheries Conservation Group 10/1/2001). The closure includes some of the historic areas of high cod egg densities and spawning adults (Wright *et al.*, 2006). Tag-recapture experiments indicate that cod migrate extensively in the northern part of VIa and IVa west of Shetland (Easey, 1987) and so this closure is unlikely to provide year round protection. The offspring of cod in the area are likely to be widely dispersed both in the northern part of VIa and IVa (Heath and Gallego, 1997).

## **Subsequent amendments affecting the closure**

No subsequent amendments have been made since the imposition of the closure.

## **Summary of previous evaluations**

ICES (2003) provided an initial evaluation of the closure in 2001 based on the landings. The ICES Working group noted that assuming the closure comprised the entirety of the ICES rectangles affected by the measure, they contribute on average less than 32% of the cod catch from Division VIa per annum (1995–1999), but were only enacted for one sixth of the year. Assuming no additional catches of cod were taken by vessels displaced from the controlled areas, this amounts to a reduction of <6% of the annual expected catch. The actual effect is likely to be even less as this calculation assumes the area controls affect the ICES rectangles in their entirety, no catches by displaced vessels and no “catch-up” fishing once the period of the closure ended. Therefore, the working group thought it unlikely that the controlled areas in Division VIa did have a significant affect fishing mortality on cod in 2001.

Although it was not a full scale evaluation, the Scottish fishing industry presented a paper to the STECF Mixed Fisheries Working Group in 2004 (STECF 2004) based on an analysis of the spatial distribution of the landings data. From this they suggested that the “windsock” area had been relatively ineffective and that it could be made into a seasonal closure without reducing the benefit to cod significantly. Further, it was suggested that a mesh size increase would be more effective leading to a reduction in effort on cod by 5–10%. The STECF Group

concluded that given the data provided in the fishing industry paper, it was not possible to detect any beneficial effect of either the annual or seasonal “windsock” closure on the cod stock. According to the STECF Group, additional data sources may give more information, but any beneficial effects are likely to be so small that it would be hard to distinguish these from noise in the data. The STECF Group noted that, based on previous experience, increasing the mesh size would not produce the expected benefits.

The STECF mixed fisheries group suggested in 2004 that for any beneficial effects of area closures to be observed in cod and other mobile stocks, a larger area closure continued over several years is likely to be required. The group recognised that this closure would not be sufficient by itself to protect cod, but that its removal would not help to improve cod recovery measures (STECF 2004).

### **Inventory of data for evaluating the effectiveness of the closure**

There is no dedicated monitoring of the closed area. However, there is information available from bottom trawl surveys conducted annually, in Quarter 1 and 4, by FRS, Scotland.

### **Effectiveness of closure**

Any effect on the primary objective of allowing as many cod to spawn in 2001 cannot be disentangled from other causes of changes in SSB, recruitment or F. However, estimates of  $F_{2-5}$  decreased and SSB increased in 2001 and 2002, while recruitment decreased in 2001, but increased in 2002 (ICES 2003). Research vessel indices during the spawning season did indicate an increase in SSB in the northern part of VIa in 2001 relative to previous years (Holmes *et al.*, in review). However, SSB subsequently fell in the following years and is now at very low levels.

Based on the data collected by FRS in Quarter 1 and 4, an evaluation has been recently conducted to consider how the closure affected cod and other main stocks within the closed area. An approach was adopted in which changes were evaluated spatially (inside and outside the protected area) and temporally (before and after the implementation). Depth was incorporated into the model to account for the dependence of abundance on this factor. The analysis is in progress and the results of the evaluation should be treated as provisional. Nevertheless, the closure seems to have little effect on the demersal fish community. No effect was detected for cod or any of the other main commercial stocks. The closure may have affected some non-commercial species since a highly positive effect was observed for some species, e.g. lesser spotted dogfish.

### **Confidence in evaluation**

It would have been very difficult to have detected any direct effect of the closure on the primary objective of allowing as many cod to spawn in 2001, even with a dedicated sampling programme. The available information on stock status is too poorly spatially resolved to disentangle any closure effects from other causes of change. The statistical power of the spatio-temporal evaluation needs to be assessed before we have any certainty in the results.

### **Adverse effects of closure**

Cod are taken as a mixed demersal fishery so any evaluation of the closure needs to consider this. No adverse effect has been found to date based on analyses of changes in fish

community. However, analyses of fishery data (including landings) are needed to properly evaluate the effects of displaced effort.

### **Recommendation on closure**

The extent and location of the closure is unlikely to be suitable to greatly reduce F in the VIa stock, given the mobility of cod and the past contribution of the area to landings. Nevertheless, given the very poor state of the stock removal would not help to improve cod recovery measures. Therefore SGMOS-07-03 recommends that the closure be maintained until such times that the location and extent of the closure can be re-considered in the context of the recovery plan for this stock.

### **Recommendation on data requirements**

Standard data on CPUE from fish surveys, data on landings, preferably at a finer scale than by rectangle, should be required and may be accessible. More analyses on the distribution of fishing effort (logbooks, VMS) are needed to consider the displacement of effort.

The FRS closed area evaluation needs to be continued to consider statistical power and encompass more environmental factors that may be determining community changes. A multivariate methodology may also be considered as an alternative to this approach.

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## **8.2. Closed area for the conservation of cod in ICES zone VIIf and g**

### **Summary**

The Celtic Sea cod closure was proposed by French, Irish and UK fishermen as an alternative to days-at-sea limits for reducing fishing mortality. SGMOS 07-03 is confident that the cod closure has played a role in the reduction in the fishing effort of French gadoid trawlers in the

Celtic Sea. The reduction in effort of this fleet is probably the main factor in the apparent reduction in fishing mortality in recent years.

The existing evaluations of the closure have been unable to disentangle the effects of the closure from other factors influencing fishermen's tactical decisions. A more comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required, based on accurate fleet definitions and fishing activity data collected at an appropriate spatial and temporal resolution. Further collaboration between fishermen and scientists in interpreting the fishery data is strongly recommended.

The closure is potentially effective for displacing fishing activities away from spawning aggregations off the North Cornwall and hence making vessels less efficient at catching cod. The effectiveness of the closed rectangle off the Irish Coast is less evident due to its lesser importance as a fishing ground for the EU whitefish fleets and poorer knowledge of spawning distribution off the Irish Coast.

It is not possible, on the basis of the evidence available to SGMOS07-03, to make any recommendation for further modification of the Celtic Sea cod closure.

### Legislation

Council Regulation (EC) No 41/2007, Annex III, part A 7 prohibits fishing in ICES rectangles 30E4, 31E4 and 32E3 during February and March 2007, with derogations for vessels using pots, creels or vessels using nets with less than 55mm mesh size for pelagic species. The prohibition does not apply within 6 nautical miles from the base line (Appendix 2.3).

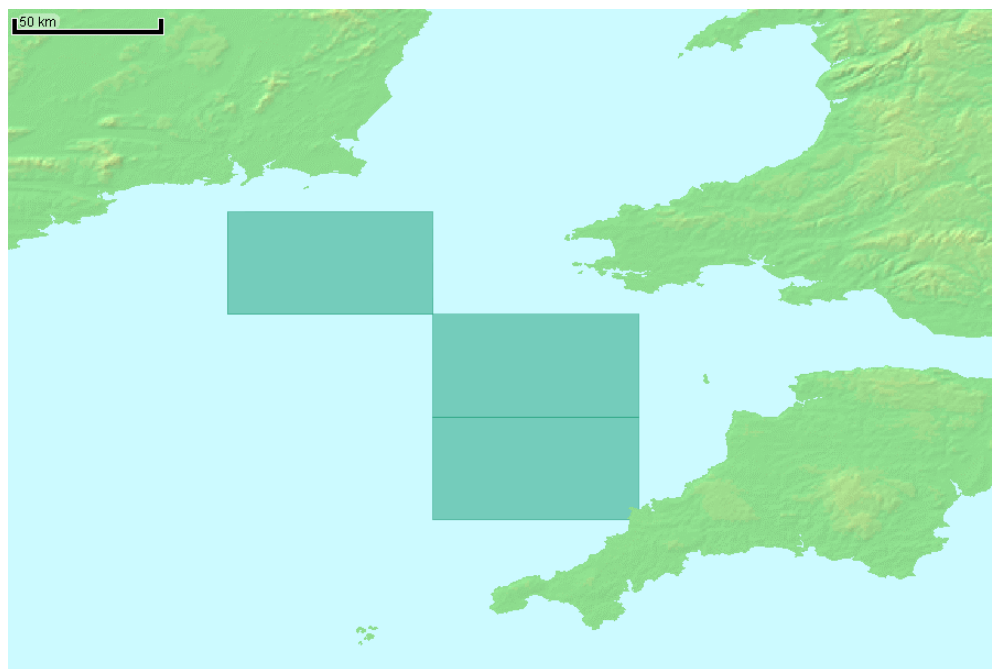


Figure 8.2.1. Extent of the Celtic Sea cod closure in 2005. (Area within 6 miles of baseline was not included in closure in 2006 and 2007.) *Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*

Table 8.2.1. Goals and objectives – cod closure in ICES zone VIIIf and g.

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Conservation of cod in ICES Divisions VIIe-k.	<p>None explicit</p> <p><i>To help manage fishing effort on cod in line with the TAC by preventing fishing on spawning aggregations.</i></p>	<p>None explicit</p> <p><i>Level of compliance</i></p> <p><i>F and SSB estimates relative to target associated with TAC.</i></p> <p><i>Catchability of cod by fleet metier.</i></p> <p><i>Timing and distribution of spawning aggregations relative to closure.</i></p>	<p>None explicit</p> <p><i>Full compliance with Regulation;</i></p> <p><i><math>F \leq F(\text{target})</math></i></p> <p><i><math>SSB \geq B(\text{target})</math></i></p> <p><i>Catchability altered as predicted.</i></p> <p><i>No TAC overshoot</i></p> <p><i>Closure encompasses bulk of spawning aggregations vulnerable to fishing.</i></p>	<p><i>Fishery landings and discards data by age class; survey and fishery CPUE data; analytical assessment.</i></p>

### Background to closure

During 2004, a group of fishermen from fishermen’s organizations in France, Ireland and the UK met to develop a plan for management of VIIe-k cod as an alternative to the cod recovery measures being applied to cod fisheries in the North Sea, West of Scotland and the Irish Sea (Council Regulation (EC) No 423/2004, of 26 February 2004, establishing measures for the recovery of cod stocks). The fishermen’s group considered that a suitable closure of the cod spawning grounds in the Celtic Sea (VIIIf&g) could achieve a sufficient reduction in fishing mortality on VIIe-k cod avoiding the need for days-at-sea limits. The group worked with Ifremer scientists to demonstrate that closure of ICES rectangles 30E4, 31E4 and 32E3 in Quarter 1, with effort diverted and used in the same Quarter elsewhere, should reduce fishing mortality by about 13%. This reduction was expected due to displacement of effort away from spawning aggregations and into areas with historically lower catch rates of cod.

The proposal was accepted by the EU Council of Ministers and included in Council Regulation (EC) No 27/2005, Annex III, part C 12 of 22 December 2004, fixing fishing opportunities for 2005 for Community vessels in Community waters. The closure extended from January 1 to 31 March for all vessels. Derogations were granted for vessels using pots and creels and vessels using nets with mesh size less than 55mm and retaining only specified pelagic species. A derogation was granted for beam trawlers to fish in the closure during March.

## Subsequent amendments affecting the closure

Following a proposal from the North Western Waters RAC that a closure in January had reduced value due to low catch rates prior to the spawning run of cod in February, Council Regulation (EC) No 51/2006, Annex III, part A 4.2 amended the closure in 2006 to cover February and March only, and removed the derogation for beam trawlers in March. The prohibition no longer applied within 6 nautical miles from the baseline to minimise impacts on small inshore vessels with limited ability to travel to other fishing grounds. No further amendments were applied for 2007.

## Summary of previous evaluations

A series of working documents (Anon., 2004; Biseau and Bellail, 2006; Scott *et al.* 2006; Anon. 2007; Armstrong *et al.*, 2007; Bisseau, 2007; Demaré, 2007;) were available to the ICES Working Group on the Assessment of Southern Shelf Demersal Stocks in 2006 and 2007, evaluating the effects of the closure on fishing activities of French, UK, Irish and Belgian vessels.

In June 2007, the North Western Waters Regional Advisory Council submitted a request to ICES via the European Commission to carry out an evaluation of the Celtic Sea cod closure. The request was also for an assessment of the impacts of the closure on other species such as sole, plaice, *Nephrops* and other gadoids, and the effects of effort displacement. The letter from the NWWRAC also recommended that the industry, ICES and the Commission work together to consider the data being used in the assessment, and to develop proposals to improve data collection using all means possible (i.e. fishing vessels and fishermen as well as conventional sources) to ensure that there is an improvement in the assessment of this stock in this area.

SGMOS 07-03 was provided with a draft of the ICES response (draft dated 15 October 2007). The ICES response is based largely on the Working Documents mentioned above and additional text included in the WGSSDS 2007 report. The main conclusions of the ICES response are reproduced below, under three general headings:

### *What is the impact of the Celtic Sea (Trevose) closure on the behaviour of the fishery?*

There are different responses from the fisheries to the closure of ICES rectangles 30E4, 31E4 and 32E3. French fishing effort of vessels targeting gadoids in the Celtic Sea has decreased considerably since 1999. Although this effort reduction was already initiated before the first year of the closure, the closure has probably been an incentive to a further reduction in effort. The closed rectangles did probably only have limited impact on the Irish fishing activity, which is typically more in the western Celtic Sea. In the more eastern Celtic Sea fishing grounds, there has been some displacement of vessels away from spawning aggregations of cod (e.g. a number of UK vessels), but also some displacement in time (e.g. a number of Belgian vessels).

### *What is the impact of the Celtic Sea closure on the status of the demersal stocks affected?*

It is not possible to give a quantitative assessment of the impact of this closure on the demersal stocks in the area. Several years of observations are required before any conclusions can be drawn. But in the event of a changed stock status, it will be difficult to quantitatively disentangle the effect of the closure from other factors. The potential effects of the Trevose closure can be summarized as follows:

- Historically, landings and LPUE of Celtic Sea cod has been highest in rectangle 30E4 during the first quarter (and especially during March). The other two closed rectangles have also high LPUE values, but similar LPUEs are found in surrounding rectangles. The displacement of fishing activities away from spawning aggregations is therefore expected to have reduced fishing mortality on mature cod during the spawning season but the effects on other parts of the cod stock in the area are unknown.
- The closure includes the main cod spawning area in the eastern Celtic Sea. Due to the specific behaviour of cod with large aggregations of adult fish during spawning time (March-April), the closure of the spawning areas to all forms of cod fishing will reduce the disturbance of spawning fish. While the effect of this is expected to be positive, it is unquantifiable at present. However the spawning ground in the western Celtic Sea is not covered by the closure. In addition, no measures are currently in place to protect recruitment.
- Other stocks that might be affected by the closure include, *Nephrops*, anglerfish, hake, haddock, whiting, megrim, plaice and sole. It is unlikely that the closure will have beneficial effects for the stocks of *Nephrops*, anglerfish, hake and megrim. Landings from the closed rectangles have always been low compared to the total landings of these stocks. The closure has also resulted in some displacement of French fishing activity into the anglerfish / megrim fishery in the Celtic Sea. The closure is expected to have less impact on haddock and whiting than on cod, because the catch rates are not consistently higher in the closed rectangles compared to surrounding rectangles. The closure overlaps with the main fishing grounds for sole and plaice, but the effect on these stocks is currently unclear.

*What are the main data deficiencies to evaluate the status of Celtic Sea cod?*

Improved data collection is required to improve the quality of the assessment for cod, and assess the utility of this measure. ICES encourages the fishing industry to assist in this process. A prerequisite is an adequate assessment of the discarding and high-grading practices in order to get better information on the changes in selectivity. Valuable information to serve this purpose could be derived from well designed discard sampling programmes carried out in close collaboration with the fishing industry. Improve survey information is also required.

#### **Information available to SGMOS-07-03 for evaluating the closure**

The Council (EC) Regulations for the Celtic Sea cod closure do not provide for specific monitoring programmes to evaluate the success of the closed area.

Data for evaluation of the closure are available from the fishery, catch sampling and surveys. The data are collected as required by the EU Data Collection Regulation (Council Regulations (EC) 1543/2000 and 1639/2001 and subsequent amendments).

The only information available to SGMOS 07-03 to evaluate the closure was the ICES WGSSDS response to the NWWRAC request (summarised above), the series of Working Documents provided to WGSSDS in 2006 and 2007, and the results of the ICES assessment of the VIIe-k cod stock.

## Effectiveness of closure

SGMOS 07-03 concludes from the available material that the collaboration between professional fishermen and scientists has resulted in a potentially effective measure for displacing fishing activities away from spawning aggregations off the North Cornwall and hence making vessels less efficient at catching cod. The major impact of the closure appears to have been on French trawlers that historically have taken a large fraction of the VIIe-k cod landings.

The effectiveness of the closed rectangle off the Irish Coast is less evident due to its lesser importance as a fishing ground for the EU whitefish fleets and the poorer knowledge of the distribution of cod spawning activity off the SE coast of Ireland.

The current scientific assessment of the stock has not covered enough years of the closure to make any evaluation of effects of the closure on fishing mortality (Figure 8.2.2). The assessment has retrospective bias affecting the fishing mortality estimates for the final few years. Recruitment has been very poor in recent years, and SSB has declined below any values observed prior to the 2000s.

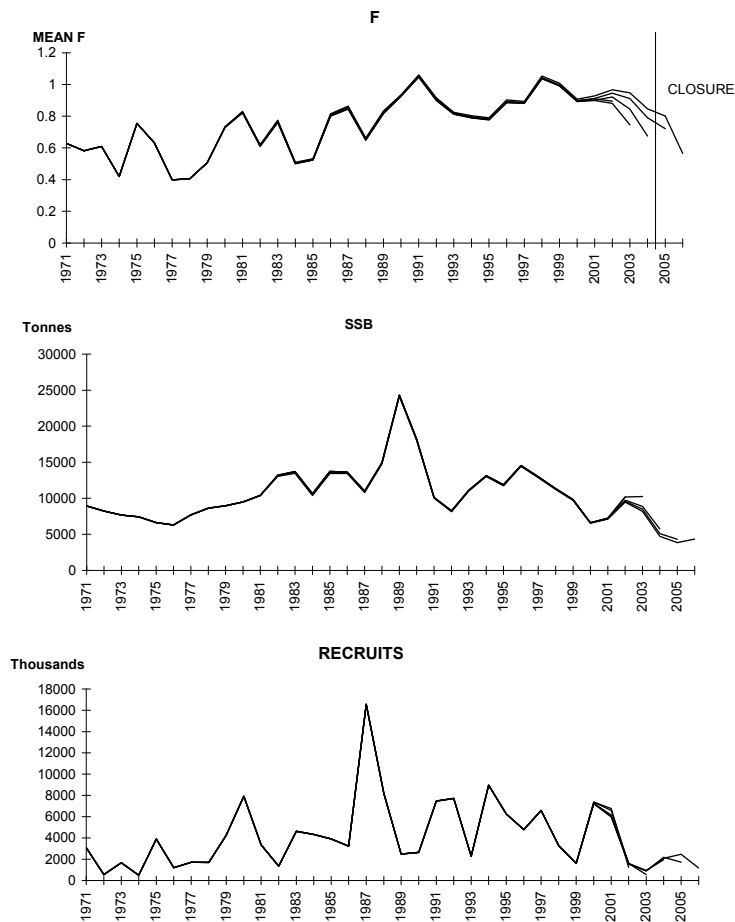


Figure 8.2.2. Results of retrospective analysis of the final assessment of VIIe-k cod given by the ICES Working Group on the Assessment of Southern Shelf Demersal Stocks (ICES, 2007). The Celtic Sea closure commenced in 2005.



### **Confidence in evaluation**

SGMOS 07-03 is confident that the cod closure has played a role in the reduction in the fishing effort of French gadoid trawlers in the Celtic Sea. The reduction in effort of this fleet is probably the main factor in the apparent reduction in fishing mortality in recent years. However, it is not yet possible to quantify the relative effects of the closure and other factors affecting fishing activities in the Celtic Sea.

### **Adverse effects of closure**

SGMOS 07-03 did not have adequate information to evaluate any potential changes in selectivity patterns due to displacement of effort away from areas with elevated densities of mature cod to areas that may have a different population structure. The absence of discards estimates in the current ICES assessment will impede an accurate evaluation of changes in selectivity.

### **Recommendation on closure**

It is not possible, on the basis of the evidence available to SGMOS-07-03, to make any recommendation for further modification of the Celtic Sea cod closure.

### **Recommendation on data requirements**

The existing evaluations of the closure have been unable to disentangle the effects of the closure from other factors influencing fishermen's tactical decisions. A more comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required, based on accurate fleet definitions and fishing activity data collected at an appropriate spatial and temporal resolution. Further collaboration between fishermen and scientists in interpreting the fishery data is strongly recommended.

#### *Data available but not provided to SGMOS-07-03*

The type of information necessary for a full evaluation of the cod closure is listed in Table 8.2.2, together with a brief indication of what is currently (potentially) available. SGMOS-07-03 recommends the compilation of the monitoring and other data listed in Table 8.2.2, to the fullest extent possible, for all fisheries, sampling programmes and surveys, to allow a comprehensive evaluation of the efficiency of the closure as a measure for conserving cod.

Table 8.2.2. Inventory of the type of information necessary for a full evaluation of the closed area (CA) for Celtic Sea cod, together with a brief indication of what is currently available

<b>Information required</b>	<b>Information available</b>
Information on spatial stock structure.	<i>Few data currently available. Linkages between different spawning sites in VIIe-k are poorly understood.</i>
Information on seasonal movements fish of different sizes and ages into and out of the CA.	<i>Limited data available from tagging.</i>

<b>Information required</b>	<b>Information available</b>
Relative densities of populations inside and outside the CA (+ gradients).	<i>Historical fishery log-book CPUE available at trip / ICES rectangle scale. Limited data at haul level from discard sampling. Cefas FSP survey data in spring 2004-006. Other survey data mainly from autumn surveys.</i>
Age/size structure of the population and fishery catches inside and outside the CA (+gradients)	<i>Fishery sampling data including discard sampling trips.</i>
Stock reproductive potential.	<i>Few data available.</i>
Time series of relative or absolute abundance of adult fish and recruits in each population.	<i>Annual ICES stock assessment ( no discards included yet). Tuning data from surveys and fishery CPUE</i>
Time series of fishing mortality estimates by length or age in each population.	<i>ICES stock assessment. No discards data included yet.</i>
Time series of fishing effort and fishery landings and discards for appropriate fleet units, available at the spatial and temporal resolution of the CA. Knowledge of accuracy of data is required.	<i>Landings data potentially available for all fleets at trip and ICES rectangle scale. Processed VMS data potentially available. Discard data available for variable periods.</i>
Knowledge of fishermen's tactical decisions in response to the CA.	<i>Limited information available.</i>
Indirect effects of the CA on fishing mortality (e.g. economic factors leading to vessel decommissioning).	<i>Data on fleet structure and decommissioning available.</i>
Changes in other regulations or processes affecting fishing mortality or spawning success	<i>Details of regulations available; information on environmental and biological processes relatively poor.</i>

*Requirement for further data to evaluate closure*

The availability of international VMS data linked to log-book data, and filtered to include only positions during fishing, would greatly facilitate evaluation of the cod closure.

More comprehensive sampling of fishery catches inside and outside the closure would be beneficial, including discards estimates.

Survey data with sufficient coverage during the spawning period would facilitate an evaluation of distribution and population structure of cod and other co-occurring species.

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Biseau, A. and Bellail, R. 2006. Trends in French Gadoids effort in the Celtic Sea – Impact of the closure of Zones on the fishing strategy of the French vessels? Working Document 2 to the ICES Working Group on the Assessment of Southern Shelf Demersal Stocks 27 June- 5 July 2006, ICES, Copenhagen

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## 9. CLOSED AREA FOR THE CONSERVATION OF COD IN IRISH SEA

### Summary

The Irish Sea cod closure was introduced as an emergency measure in 2000 to protect spawning cod. SGMOS-07-03 concludes that the Irish Sea cod closure has probably played a role, in conjunction with other measures reducing fishing opportunities on cod, in the recent reduction in fishing effort in the Irish Sea. However the relative contribution of the closure to conservation of cod, and the effects of vessels switching to derogated gears or displacing their effort elsewhere could not be evaluated from the available information. A more comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required.

SGMOS-07-03 concludes that the Irish Sea cod closure in 2000 was of appropriate extent and duration to encompass the majority of the spawning stock throughout the spawning season. The reduced closure from 2001 onwards has encompassed the majority of the western Irish Sea spawning population of cod for most of the spawning season but has excluded the eastern Irish Sea spawning population.

A derogation for prawn fishing, and a reduction in spatial extent to cover only the spawning sites in the western Irish Sea since 2001, will have significantly diluted the effectiveness of the closure in reducing fishing mortality on spawning cod at spawning time and in controlling fishing effort on cod in line with the TAC.

ICES stock assessments indicate that fishing mortality (F) increased to a historical high value in 1999 but may have declined slightly during 2000-2005, although the spawning stock remains seriously depleted due to high F and very poor recruitment. Very poor recruitment in recent years is likely due to a combination of low SSB and unfavourable environment reflected in rising sea temperatures. Fishing effort of whitefish vessels has also decreased substantially in recent years. However, on the basis of the information available, SGMOS-07-03 was unable to determine the extent to which the closure may have reduced F to a lower value than would otherwise have occurred in the absence of a closure.

### **Legislation**

Point 8 from Annex III of Council Regulation (EC) No 41/2007 defines a closed area for the conservation of cod in the Irish Sea (Appendix 2.4). The legislation prohibits the use of any demersal trawl, seine or similar towed net, any gill net, trammel net, tangle net or similar static net or any fishing gear incorporating hooks within a defined area of ICES division VIIa from 14 February to 30 April (Figure 9.1). Derogations are provided for *Nephrops* trawls of 70-79mm and 80-89mm mesh bands to fish within a defined area of the closure, and for the same trawls fitted with separator panels to fish in another, smaller area of the closure.

Council Regulation (EC) No 423/2004, of 26 February 2004, established measures for the recovery of cod stocks including in the Irish Sea (recovery is defined as two consecutive years in which SSB is greater than that decided by managers as being within safe biological limits). The regulation includes a harvest control rule, measures for restriction of fishing effort, technical measures, control and enforcement, accompanying structural measures and market measures. The Regulation does not specifically mention the Irish Sea spawning closure. However the closure has a potential role in keeping catches in line with TACs set according to the harvest control rules in Regulation 423/2004, by reducing targeted fishing on spawning aggregations.

The introduction of the Clyde cod closure in spring 2001 was very relevant for the operation of the Irish Sea closure as it prevented access by vessels displaced from the Irish Sea cod closure to a neighbouring area with high cod catch rates.

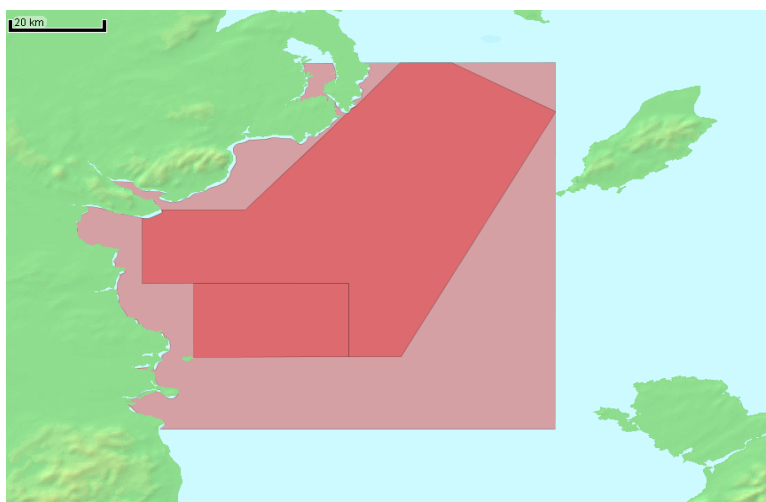


Figure 9.1. Extent of the Irish Sea cod closure in 2007. The darker area indicates the area within which derogated *Nephrops* trawlers are permitted to fish. The rectangle at the south-western end of the *Nephrops* derogation area is open only to *Nephrops* trawlers using an inclined separator panel. Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.

Table 9.1. Goals and objectives – Irish Sea cod closures

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Conservation of Irish Sea cod	<p>None explicit</p> <p><i>Protection of adult cod during the spawning period</i></p>	<p>None explicit</p> <p><i>Level of compliance</i></p> <p><i>F and SSB estimates relative to target associated with TAC.</i></p> <p><i>Catchability of cod by fleet metier.</i></p> <p><i>Timing and distribution of spawning aggregations relative to closure.</i></p>	<p>None explicit</p> <p><i>Full compliance with Regulation;</i></p> <p><i><math>F &lt; F(\text{target})</math></i></p> <p><i><math>SSB &gt; B(\text{target})</math></i></p> <p><i>Catchability altered as predicted.</i></p> <p><i>No TAC overshoot</i></p> <p><i>Closure encompasses bulk of spawning aggregations vulnerable to fishing.</i></p>	<p>Spatial fishery catch, effort and sampling data; surveys; analytical stock assessment.</p>

## Background to closure

### *The closure in 2000*

Following advice from ICES that the stock of cod in the Irish Sea (ICES Division VIIa) was at serious risk of stock collapse, a cod spawning closure was established by Council Regulation (EC) No 304/2000 with the stated objective “to allow as many cod as possible to spawn during the period mid-February to the end of April 2000”. The design of the closure was established during a series of consultations between the Commission and fishery administrators, fishery scientists and fishermen from Member States fishing cod in the Irish Sea (UK, Ireland, Belgium, France and the Netherlands).

The “horseshoe” closure from 15 February to 30 April 2000 (Figure 9.2) was chosen for the EC Regulation 304/2000 as encompassing the bulk of the egg production of cod both in space (Figure 9.3) and time (Figure 9.4). Calculations based on previous fishery data indicated that a closure of this extent, excluding all forms of fishing, would reduce cod landings in line with the reduction in TAC from 5,500t in 1999 to 2,100t in 2000. A smaller closure proposed by the fishing industry was considered by the Commission to be too small to be effective.

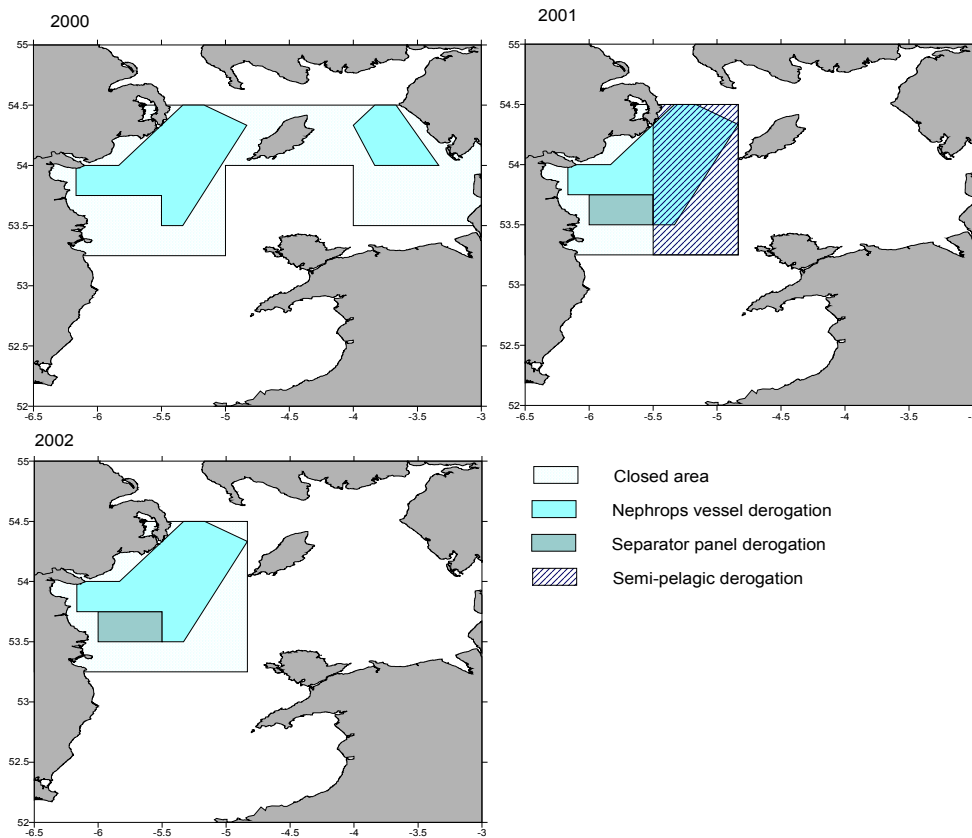


Figure 9.2. Evolution of the Irish Sea (VIIa) cod closed areas in 2000, 2001 and 2002 onwards.

The socio-economic importance of the *Nephrops* fisheries was recognised by permitting a derogation for defined *Nephrops* gears operating in defined *Nephrops* fishing grounds (excluding an area at the southern end of the western Irish Sea mud patch where intensive cod spawning had been recorded) (Figure 9.2). Beam trawling with mesh sizes 16-31mm and

≥80mm was also permitted within the closure to the east of 5° 30'. Based on official UK landings statistics, it was calculated that the derogations in 2000 could roughly halve the expected benefits of the closure in reducing cod catches.

Further requests were made for derogations to catch haddock, rays and plaice on defined fishing grounds for these species within the closed area, and to extend the *Nephrops* derogation to include the area of the western Irish Sea *Nephrops* grounds that remained closed. These were addressed by an authorisation from the Commission for Member States to carry out limited experimental fishing operations in 2000 to demonstrate the potential bycatch of cod. These trips were to be monitored by impartial observers.

#### *The closure in 2001*

In view of the very small catches of cod in the experimental plaice fishery along the English coast in 2000, the Commission decided to exclude this region from the closure in 2001. Regulation 300/2001 allowed for an additional derogation for a further experimental haddock fishery using semi-pelagic trawls in a defined area (Figure 9.1), and for the use of *Nephrops* trawls with an inclined separator panel within the southernmost area of the *Nephrops* grounds closed to all other forms of fishing (Figure 9.2). Both of these derogated gears were subject to catch limits of cod of 18% (separator trawls) and 15% (semi-pelagic trawls), and scientific observers were required for a specified minimum number of trips. The request for a ray fishery derogation was turned down.

A further Council Regulation (EC) 2549/2000 came into force on 1 January 2001, with amendments in Council Regulation (EC) No 1456/2001, of 16 July 2001, to establish some technical measures for the protection of juveniles as part of the Irish Sea cod recovery plan. These were additional to those defined in Regulation (EC) No. 850/98 but deleting footnote 6 of Article 850/98 which relaxed the percentage bycatch conditions prevailing for various fishing gears in 2000. The new technical measures included some proposals made by the fishing industry:

#### *The closure from 2002 onwards*

The haddock experiment in 2001 was deemed unsuccessful by the Commission in meeting the cod bycatch limit, and Council Regulation (EC) No 254/2002 removed the semi-pelagic trawl derogation in 2002. Continued successful results using inclined separator panels resulted in removal of the need for observers on *Nephrops* vessels using the panels, and applied only the catch composition rules contained in Annex 1 of Council regulation (EC) No 850/98 of 30 March 1998. The closure from 2002 onwards is shown in Figures 9.1 and 9.2.

### **Subsequent amendments affecting the closure**

The closure details in Council Regulation (EC) No 254/2002 have remained unchanged for subsequent years.

### **Summary of previous evaluations**

The 2001 meeting of the ICES Working Group on the Assessment of Northern Shelf Demersal Stocks (ICES, 2002) examined changes in fleet fishing activities for UK and Belgian vessels following the introduction of the closure in 2000. The main changes noted were a displacement of whitefish trawl effort to the North Channel and Clyde, and a switch from semi-pelagic trawling to twin-rigging by some Northern Ireland vessels to take

advantage of the derogation for *Nephrops* fishing in the closed area. The Belgian beam trawl fleet did not operate in the Irish Sea during the closure period in Quarter 1 2000. The UK (England and Wales) beam trawl and whitefish otter trawl effort was also reduced in 2000 due to the closure.

The STECF SGRST 07-01 meeting report (STECF, 2007) provides some comments on the effectiveness of the Irish Sea cod recovery plan. The report states that “The Irish Sea closed area has been in place since 2000, however the objective of this closure is not clear – to reduce fishing mortality or to allow cod to spawn. Recent trends in fishing mortality suggest that the closure has been of limited benefit, although it is difficult to disentangle the effectiveness of this particular measure in isolation. However, it is likely that the effectiveness of the area closure has been diluted because of several derogations, the alteration of the closure limits and evidence of effort displacement to the outside of the closed area.

A paper by Kelly *et al.* (2006) provides some background to the closure, but focuses mainly on an evaluation of the harvest control rules specified by Council Regulation (EC) No 423/2004, of 26 February 2004, establishing measures for the recovery of cod stocks.

### **Information available to SGMOS-07-03 for evaluating the closure**

None of the Irish Sea cod regulations provided for specific monitoring programmes to evaluate the success of the closed area in meeting its objectives of protecting adult cod during the spawning season.

Data for evaluation of the closure are available from the fishery, catch sampling and surveys. The data are collected as required by the EU Data Collection Regulation (Council regulations (EC) 1543/2000 and 1639/2001 and subsequent amendments).

The only information available to SGMOS-07-03 to evaluate the closure was distribution data from surveys, the results from ICES assessments of the stock, and the results of recent STECF/SGRST evaluations of effort trends by fleet.

### **Effectiveness of closure**

#### *Appropriateness of the spatial and temporal coverage of the closure*

The cod closure in 2000 was accurately designed and encompassed the bulk of the egg production of cod and species with similar eggs during 1995 (Figures 9.3 and 9.4). A series of egg surveys in 2000 showed a very similar distribution of gadoid eggs (Armstrong *et al.* 2002), although spawning was slightly earlier in time (Figure 9.4) and some spawning had started prior to the commencement of the closure on 14 February.

A current programme of biennial egg production surveys in the Irish Sea (Defra contract MF0160) showed that the location of cod spawning in 2006 remained similar to the pattern observed in 1995 and 2000.

The annual egg production surveys in 1995 and 2000 provided separate estimates of spawning stock biomass for cod on the western and eastern Irish Sea spawning grounds. Biomass estimates for mature females (tonnes; relative standard errors in parenthesis) are given below (from Anon. 2002):



	Western Irish Sea	Eastern Irish Sea
1995	2,060 (0.19)	1,610 (0.23)
2000	1,553 (0.16)	1,407 (0.11)

The surveys indicated a similar biomass of mature female cod on each spawning site in the two years, although the cod closure covers only the western spawning site.

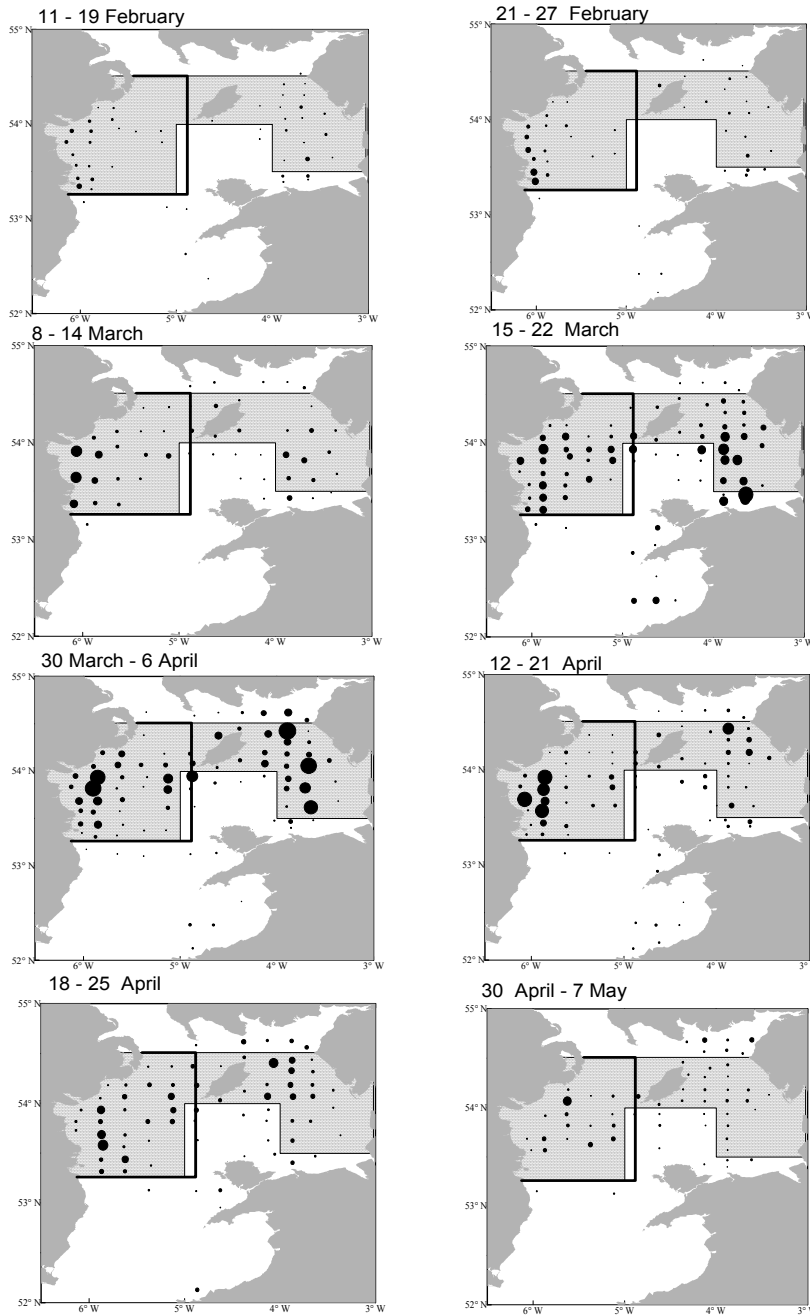


Figure 9.3. Distribution of early-stage (stage 1) eggs of appearance and size expected for cod, during a series of ichthyoplankton surveys in 1995. Shaded area is the cod closure in 2000. The heavy line delineates the closure from 2001 onwards.

### Seasonal production of stage 1 cod-like eggs

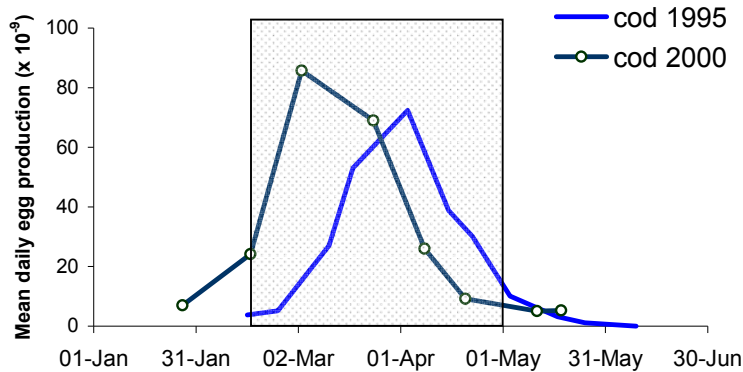


Figure 9.4. Seasonal production of “cod-like” eggs in the Irish Sea in 1995 and 2000 in relation to closure period (shaded area).

SGMOS-07-03 therefore concludes that the Irish Sea cod closure in 2000 was of appropriate extent and duration to encompass the majority of the spawning stock throughout the spawning season. The closure from 2001 onwards encompasses the majority of the western Irish Sea spawning population of cod for most of the spawning season but excludes the eastern Irish Sea spawning population.

#### *Effectiveness for reducing fishing mortality on adult cod*

The permitted derogations and the reduction of the area of the closure in 2001 diluted the potential for the closure for managing fishing effort on cod in line with the desired reductions in fishing mortality and catch. Evidence for under-reporting of cod catches persisted from 2000 onwards, indicating that fishing vessels displaced from the closure or using derogated gears were still able to fish in areas with relatively high catch rates of adult cod. There is some evidence that a combination of a scarcity of cod and the introduction of the Buyers and Sellers Scheme reduced any under-reporting in 2006 (ICES, 2007).

The current ICES assessment of the Irish Sea cod stock (ICES, 2007) uses a method (B-Adapt) that provides model-based estimation of additional, unrecorded cod removals from 2000 onwards. Landings data prior to 2000 include estimates made using a sampling scheme at several major ports and are treated as being accurate.

The spawning stock of cod in the Irish Sea comprises variable proportion of 2-year-olds and almost all 3-year-old and older fish. The ICES assessment shows that fishing mortality at ages 2-4 increased progressively during the 1980s and 1990s, reaching an extremely high value by 1999 (Figure 9.5). Some reduction in mortality estimates is apparent during 2000 – 2005. The estimates for the most recent years (particularly 2006) are highly sensitive to assumptions regarding the accuracy of official landings data in 2006. All data available to ICES (ICES, 2007) indicate a continued very steep age profile of cod indicating continued very high mortality rate. The spawning stock biomass remains seriously depleted, and very poor recruitment in recent years is likely due to a combination of low SSB and unfavourable environment reflected in rising sea temperatures.

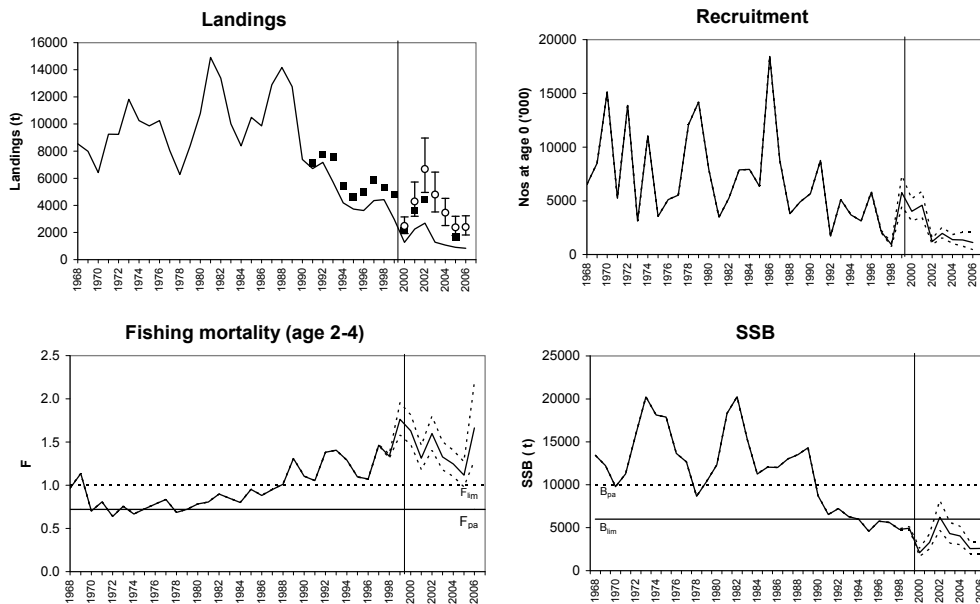


Figure 9.5. Landings and stock trends for Irish Sea cod from ICES assessment in 2007 (ICES, 2007). Continuous line on landings plot is the reported landings; filled squares are landings in 1991-2002 and 2005 including sample-based estimates at three ports; open circles with 90% confidence intervals are total removals estimates (in excess of assumed natural mortality) from B-Adapt. Dotted lines on plots are 5<sup>th</sup> and 95<sup>th</sup> bootstrap percentiles. Recruitment is at age 0. The vertical line on each plot indicates the start of the cod closure in 2000. Fishing mortality in the final years is poorly estimated and highly dependent on assumptions regarding the accuracy of recent official landings data.

STECF (2007) shows a slow decline in total nominal effort of demersal gear types in the Irish Sea since 2003. This is the combined result of stable effort of towed gears with 70-89 mm mesh (predominantly *Nephrops* trawlers) and a substantial decline in effort of trawlers using 100mm+ mesh. The effort of 100mm+ vessels with track records showing >5% cod in their landings was 60% lower in 2006 than in 2003. It is likely that the combination of the cod closure and other cod recovery measures since 2004 has played a role in this reduction in the whitefish fleet. Effort has remained high in the valuable *Nephrops* fishery despite decommissioning of vessels, due to vessels switching from whitefish trawling.

On the basis of the information available, SGMOS-07-03 was unable to determine the extent to which the Irish Sea cod closure since 2000 has reduced fishing mortality to a lower value than would otherwise have occurred, through protection of adult cod during spawning or influencing changes in fishing effort in the different fleets.

A more comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required.

### Confidence in evaluation

SGMOS-07-03 concludes that the Irish Sea cod closure has probably played a role, in conjunction with other measures reducing fishing opportunities on cod, in the recent reduction in fishing effort in the Irish Sea. However the relative contribution of the closure to the conservation of cod, and the effects of vessels switching to derogated gears or displacing their

effort elsewhere could not be evaluated from the available information. A more comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required. SGMOS-07-03 did not have sufficient information available to carry out a sufficiently accurate evaluation of the success of the Irish Sea cod closure for conservation of the stock.

### **Adverse effects of closure**

Switching of whitefish trawlers to derogated *Nephrops* trawls, or displacement of effort to other areas with different population structure of cod, could potentially cause an undesirable shift in exploitation pattern towards younger cod. The current ICES assessment does not include discarded cod, and it is therefore difficult to evaluate shifts in exploitation pattern.

### **Recommendation on closure**

It is not possible, on the basis of the evidence available to SGMOS-07-03, to make any recommendation on changes to the Irish Sea cod closure.

The extent and timing of the closure appears appropriate for the western Irish Sea spawning population. The eastern Irish Sea spawning population was of similar biomass to the western spawning population in 1995 and 2000 but has not been covered by a spawning closure since 2001. Any decision to alter the area of the closure should take into account knowledge of stock structure in the Irish Sea, movements of cod within the Irish Sea and between the Irish Sea and surrounding management areas, and spatial differences in fishing effort on the stock components. There is some evidence from tagging studies for spawning site fidelity, characteristic seasonal patterns of migration onto and away from the spawning grounds, and for limited movements of fish between the Irish Sea and neighbouring management and assessment areas (Brander, 1975; Anon, 2000; Ó Cuaig and Officer, 2007). This information needs to be more fully evaluated in the context of the cod closures, and further studies put in place.

### **Recommendation on data requirements**

#### *Data available but not provided to SGMOS-07-03*

The type of information necessary for a full evaluation of the cod closure is listed in Table 9.2, together with a brief indication of what is currently (potentially) available. SGMOS-07-03 recommends the compilation of the monitoring and other data listed in Table 1, to the fullest extent possible, for all fisheries, sampling programmes and surveys, to allow a comprehensive evaluation of the efficiency of the Irish Sea cod closure as a measure for conserving cod.

Table 9.2. Inventory of the type of information necessary for a full evaluation of the Irish Sea cod closure, together with a brief indication of what is currently available

<b>Information required</b>	<b>Information available</b>
Information on spatial stock structure.	<i>Limited information is available from tagging studies and spawning distribution.</i>
Information on seasonal movements fish of different sizes and ages into and out of the CA	<i>Limited data is available from tagging.</i>

Relative densities of populations inside and outside the CA (+ gradients).	<i>CPUE from surveys and derogated fishing gears available, but fishery log book data not at sub-rectangle scale of the closure boundaries. Only limited historical discard data available.</i>
Age/size structure of the population and fishery catches inside and outside the CA (+gradients)	<i>Survey data and fishery sampling data available – fishery data at rectangle level. Only limited historical discard data available.</i>
Stock reproductive potential.	<i>Size and age related fecundity data available for 1995, 2000 and 2006.</i>
Time series of relative or absolute abundance of adult fish and recruits in each population.	<i>Survey data and annual ICES stock assessment. No discards currently in assessment.</i>
Time series of fishing mortality estimates by length or age in each population.	<i>ICES stock assessment. No discards data currently included.</i>
Time series of fishing effort and fishery landings and discards for appropriate fleet units, available at the spatial and temporal resolution of the CA. Knowledge of accuracy of data is required.	<i>Landings data potentially available for all fleets, but at trip and ICES rectangle scale. Processed VMS data potentially available. Only very limited observer data available.</i>
Knowledge of fishermen’s tactical decisions in response to the CA.	<i>Limited information available.</i>
Indirect effects of the CA on fishing mortality (e.g. economic factors leading to vessel decommissioning).	<i>Data on fleet structure and decommissioning available.</i>
Changes in other regulations or processes affecting fishing mortality or spawning success	<i>Details of regulations available; information on environmental and biological processes relatively poor.</i>

#### *Requirement for further data*

The availability of international VMS data linked to log-book data, and filtered to include only positions during fishing, would greatly facilitate evaluation of the Irish Sea cod closure.

More comprehensive data on discarding is required to fully evaluate the selectivity of the different derogated and excluded fishing gears. (The Irish Sea Pilot discarding project introduced in 2007 should provide enhanced data).

More comprehensive sampling of fishery catches inside and outside the closure is required.

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## **10. CLOSED AREAS FOR THE CONSERVATION OF HAKE**

### **Summary**

The hake boxes were introduced to improve the selection pattern and protect juveniles. Although somewhat limited in scope, these closures were a step in the right direction and may have contributed to an unquantifiable extent to the recent recovery of the stock. SGMOS-07-03 recommends that this area closure be maintained.

Even if the stock is now in a “safer” situation in terms of precautionary approach, one of the major issue which persists is “growth over-fishing”. The probable transition, in the short term, from a recovery plan to a management plan may be a good opportunity to revise the current technical measures. If a redefinition of the closed areas regulation takes place, SGMOS-07-03 recommends that :

1. other area-based regulations to improve selectivity also be investigated, such as the use of alternative gears and/or fishing practices in specific areas.
2. the geographical limits of the area should encompass a larger part of the areas where the higher concentrations of juvenile hake are observed and where discarding occurs.

3. Between current areas, a standardization of gillnet mesh size limits at 100 or 120mm should be envisaged. This should be based on sound selectivity studies.
4. If possible, the impact of any proposed measures on the stock dynamics and on the fishery should be tested by simulations.

SGMOS-07-03 accidentally overlooked two closures off Iberia for the conservation of the southern hake stock (Appendix 2.5), and therefore failed to review them.

### **Legislation**

A range of technical measures were introduced by Article 28 of Council Regulation No 850/98. These were amended and prolonged by Council Regulations No. 1162/2001, No. 2602/2001 and No. 494/2002 (Appendix 2.5).

First, a 100 mm minimum mesh size was introduced for otter-trawlers when hake comprises more than 20% of the total amount of marine organisms retained onboard, with a dispensation for vessels less than 12 m in length and which return to port within 24 hours of their most recent departure. Such derogation, introduced in article 2(2) of Regulation (EC) No 1162/2001, was justified by the fact that the limit on the catches of hake would cause “serious economic problems for small fishing vessels working on a daily basis”. Furthermore, such derogation was expecting to have negligible consequences regarding the conservation and recovery of the hake stock.

Second, two areas (Area 5.1a and b, Figure 10.1) were defined, one in Sub area VII (SW of Ireland) and the other in Sub area VIII (Bay of Biscay), where a 100 mm minimum mesh size was required for all otter-trawlers, irrespective of the proportion of hake caught. For gillnets, a mesh size of 100 mm or greater is required in area 5.1b and a mesh size of 120 mm or greater is required in area 5.1a.

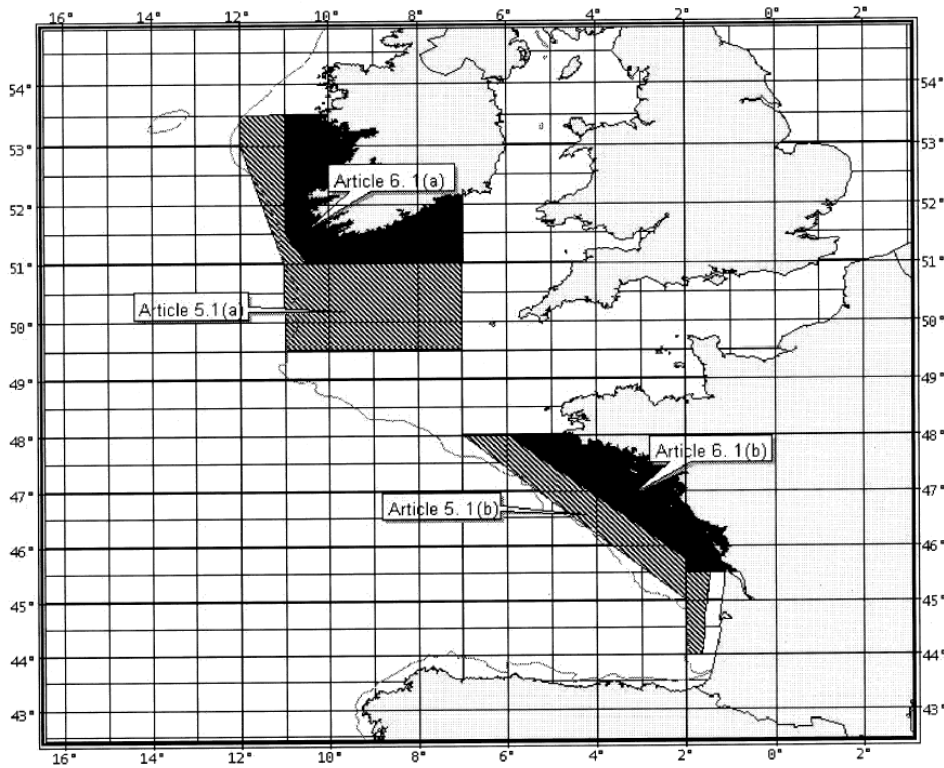


Figure 10.1. Delimited areas according to Article 5.1a and 5.1b and Article 6 of the CE Regulation N° 1162/2001.

Table 10.1. Goals and objectives – Closures for hake stock

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Recovery of the stock of hake in ICES sub-areas III, IV, V, VI and VII and ICES divisions VIII a, b, d, e	None explicit <i>Improving the selection pattern and protecting juveniles, and eventually to contribute to the rebuilding the SSB in the long term</i>	None explicit. <i>F at age</i> <i>Length distribution of the catch.</i>	None explicit <i>Achievement of desired selectivity pattern</i>	Stock assessment based on surveys and landings

### Background to closure

Following concerns in the late 1990s about the low level of the stock biomass and the possibility of recruitment failure as indicated by ICES stock assessments, a range of technical measures were introduced (Council Regulations N°1162/2001, 2602/2001 and 494/2002) with the aim of improving the selection pattern and protecting juveniles.



The geographical limits of the areas resulted from a compromise between reducing as much as possible catches of age 0 hakes without impacting too much on the *Nephrops* fishing activity.

No evaluation of the measure was carried out by simulation before the closure was introduced.

### **Subsequent amendments affecting the closure**

A subsequent temporary derogation was implemented in 2006 and 2007. It allows, in Sub area VIII, otter-trawlers owning a licence for *Nephrops* and using a squared mesh panel to use a 70-mm mesh size in the area defined in Council Regulations No 1162/2001, 2602/2001 and 494/2002, where 100-mm minimum mesh size is required for all otter-trawlers.

Furthermore, a ban on gillnets was implemented in Subareas VIa,b and VIIb,c,j,k for fishing at depths of more than 200 m (EC Reg. No 51/2006) during the first semester of 2006.

### **Summary of previous evaluations**

An STECF ‘Hake Technical Measures meeting’ met in Lisbon 2003 (STECF 2004) and was requested to evaluate the impact of the technical measures. No simulations were conducted during that meeting and that group concluded that, with the information available, it was not in a position to measure any impact. Its main conclusions were the following:

- Given that the technical measures were in force for about 2 years only and that hake matures late, it was not possible for the measures to have yet had much impact on the spawning biomass.
- After reviewing all available information on the selectivity of the relevant fishing gears, the working group considered that the technical measures adopted could be expected, in themselves, to improve selectivity and therefore contribute to the recovery of spawning biomass in the long term.
- Furthermore, since other factors such as the environment may also affect the stock dynamics, the working group considered that even if a positive effect on the stock status could be observed in the future, it would be difficult to attribute these effects specifically to any of the adopted measures.

The relevant ICES Working Group (WGHMM) has also been routinely asked to evaluate the measures, but considered that the scarcity of detailed spatially structured information and natural variations in the system preclude attributing improvements in the stock situation as the direct consequence of the technical measures.

### **Inventory of data used by SGMOS-07-03 for evaluating the effectiveness of the closure**

None of the northern hake regulations suggested any specific monitoring programmes to evaluate the success of the closed area in meeting its objectives.

Thus, SGMOS-07-03 used current historical information available on the fishery, together with the results from the latest stock assessments (ICES, 2007). This includes:

- Age structure of the population and fishery landings by métier

- Partial discards data.
- F at age as estimated from the stock assessment.
- SSB level as estimated from the stock assessment.

### **Effectiveness of closure**

Since the implementation of the technical measures presented above and the adoption of a recovery plan for northern hake in 2004 (EC Reg. No 811/2004), the stock situation has improved. The fishing mortality of juvenile hake (in the landings) is estimated to have decreased between 1997 and 2001 and has remained low since (ICES, 2007). This does not include discards and thus limits the interpretation which can be made. The northern hake stock has met (or is very close to) the SSB target defined in the recovery plan of 140 000 t for two years (2006, 2007). Article 3 of the recovery plan indicates that, in such situation, a management plan should now be implemented.

However, if the northern hake situation has improved, our capacity to attribute such improvement to any measures has not evolved much since the STECF subgroup meeting held in Lisbon in 2003. SGMOS-07-03 was therefore unable to quantify the extent that the measures, which were expected by themselves to reduce fishing mortality and discarding, may have contributed to the recovery of the stock.

### **Confidence in evaluation**

SGMOS-07-03 did not have sufficient information available to carry out an accurate evaluation of the closure. Recent stock assessments do not include discards which makes difficult any precise quantification of the potential impact of any improvement in the selection pattern for this fishery. Furthermore there are concerns over the accuracy of aging data and the calculation of historic catch-at-age data.

### **Adverse effects of closure**

The effects of the mesh size restrictions in Regulation 494/2002 must also be considered in the context of the other restrictions that apply. Vessels must use a 100mm mesh in the areas defined in Article 5.1 of the Regulation, but mesh sizes less than 100 mm may be used in the areas closer inshore that are defined in Article 6 provided that an observer programme is implemented. It is possible that some vessels, rather than changing to a 100 mm mesh in order to operate in the area referred to in Article 5.1 diverted their effort to the area referred to in Article 6. SGMOS-07-03 did not have adequate information to quantify the extent to which such a diversion might have occurred.

### **Recommendation on closure**

The probable transition from a recovery plan to a management plan for the Northern Hake stock that should take place in the near future may be a good opportunity to revise the current technical measures in place. Once it has reached a “safer status” in terms of precautionary approach, one of the major issue that still remain for this stock is “growth over-fishing”, which is not limited to the catch of under-sized fish and spans a larger spectrum of the length classes. As said above, the technical measures in place have for main objectives the improvement of the selection pattern, they thus go in the right direction and SGMOS-07-03

recommends retaining the area closures regulation for this stock. They may not be sufficient however and it may be worthwhile to envisage some changes in the following directions.

1. The problem of discards needs to be tackled more explicitly even though, at present, discards information are still insufficient to quantify thoroughly and precisely the potential impact of any improvement in the selection pattern. This could be done by defining areas for the use of more selective gears encompassing a larger part of the areas where the higher concentrations of juvenile hake are observed and where discarding occurs. In this context, an area-based regulation may be a way to improve the selection pattern not only through gear selectivity as it is done at present but also, for instance, by the use of alternative gears and/or fishing practice.
2. The use of closed area for the improvement of the selection pattern should not be limited to under-sized fish but should involve larger length classes as this would also potentially reduce “growth over fishing”.
3. Between areas, a standardization of gillnet mesh size limits at 100 or 120mm should be envisaged. This should be based on sound selectivity studies.
4. If possible, the impact of any proposed measures on the stock dynamics and on the fishery should be tested by simulations.

### **Recommendation on data requirements**

#### *Further data requirement for an evaluation*

The availability of international VMS data coupled with logbook data would greatly facilitate evaluation.

An adequate assessment of the discarding in the fishery components is required in order to get better information on the changes in selectivity. This can be obtained from discard sampling programmes carried out in close collaboration with the fishing industry.

More spatially detailed sampling of fishery catches inside and outside the closure is required.

### **References**

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## **11. CLOSED AREAS FOR THE CONSERVATION OF HERRING**

### **11.1. General background to closed areas for conservation of herring**

Closed areas for the conservation of herring were mostly introduced during periods when herring stocks were declining under heavy exploitation. Two types of closure may be perceived: a) those on spawning grounds and b) those on nursery grounds. Related to the latter type are closures of sprat fisheries in areas of high juvenile herring concentration. The

sprat are frequently mixed with juvenile herring, thus a small mesh fishery for sprat can have a high bycatch of juvenile herring. Spawning ground closures appear primarily to have been introduced to avoid the risk of overfishing during a period of the year when herring are in dense spawning aggregations, and thus vulnerable to a high rate of fishing mortality over a short period of time. These closures thus make sense in the absence of other ways of effectively controlling overall fishing mortality. From other perspectives, such closures limit the efficiency (catch per unit effort) of the fishery and, if herring roe has a high value, can reduce the overall value of the catch.

SGMOS-07-03 considered the two types of closure separately and brought together these groups of closures into two sections in order to reduce repetition.

## **11.2. Herring spawning ground closures**

### **Summary**

SGMOS-07-03 found little evidence to evaluate spawning ground closures, but noted that these were introduced during years when herring stocks were under particular pressure, and were intended primarily to limit the risk of overfishing during the period of the year when herring are densely aggregated and thus vulnerable to a high rate of fishing mortality over a short period of time. SGMOS-07-03 noted that many other herring spawning grounds were not closed at this time, and could find no record of the logic behind which grounds remained open, while others were closed. Given that most herring stocks are now in a better condition than when the closures were implemented, and that most of this stock improvement seems to be due to controls on overall fishing pressure, SGMOS-07-03 recommends that these fishery closures could be removed. This recommendation would be conditional on managers being confident that control of overall fishing mortality is effective. It is noted that current ICES advice indicates that for North Sea stocks, fishing mortality (F) is being set above that dictated by the management plan. In this case fishing mortality control is not effective. Should managers continue to set such levels of F, then rather than open grounds, further grounds should be closed. Closures should also be reconsidered should herring stocks suffer a severe downturn. Managers and fishers need also to avoid depleting individual spawning grounds. A diversity of spawning areas used by site-faithful will lead to a more robust herring population overall that should be better able to survive poorer environmental conditions.

### **Legislation**

Closures for spawning herring are detailed under Article 20 of Council Regulation 850/98. These include closure a) the Firth of Clyde, closures c) and e) off the north-east coast of England, closure d) off the Butt of Lewis in north-west Scotland, closures f) off the east coast of the Isle of Man and off the east coast of Northern Ireland and closures i), j) and k) off southern Ireland (Appendix 2.6). Each of these closures has specific time limits and has derogations to allow low levels of retained bycatch. Illustrative maps (Figures 11.2.1 – 11.2.4) are provided below, with the exception of the closures off the east coast of England, where SGMOS-07-03 could not source a map.

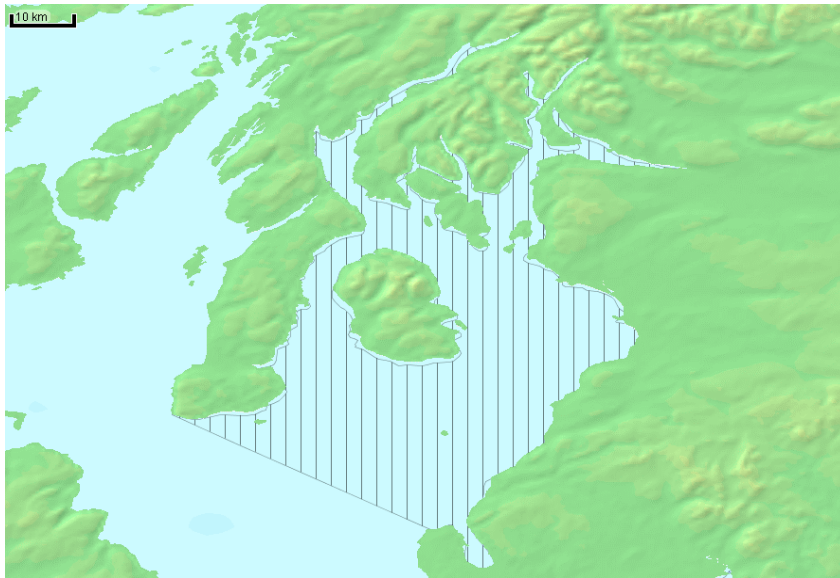


Figure 11.2.1. Area closed for herring fishing in the Firth of Clyde. *Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*

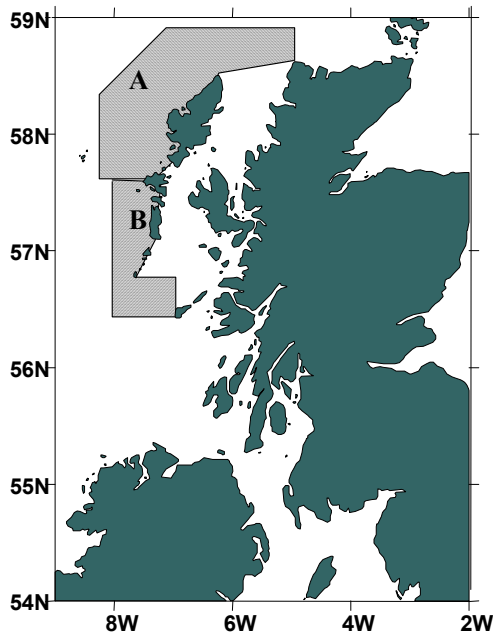


Figure 11.2.2. Location of Butt of Lewis closed area (A) and closed area under UK in force until 1986 (A+B).

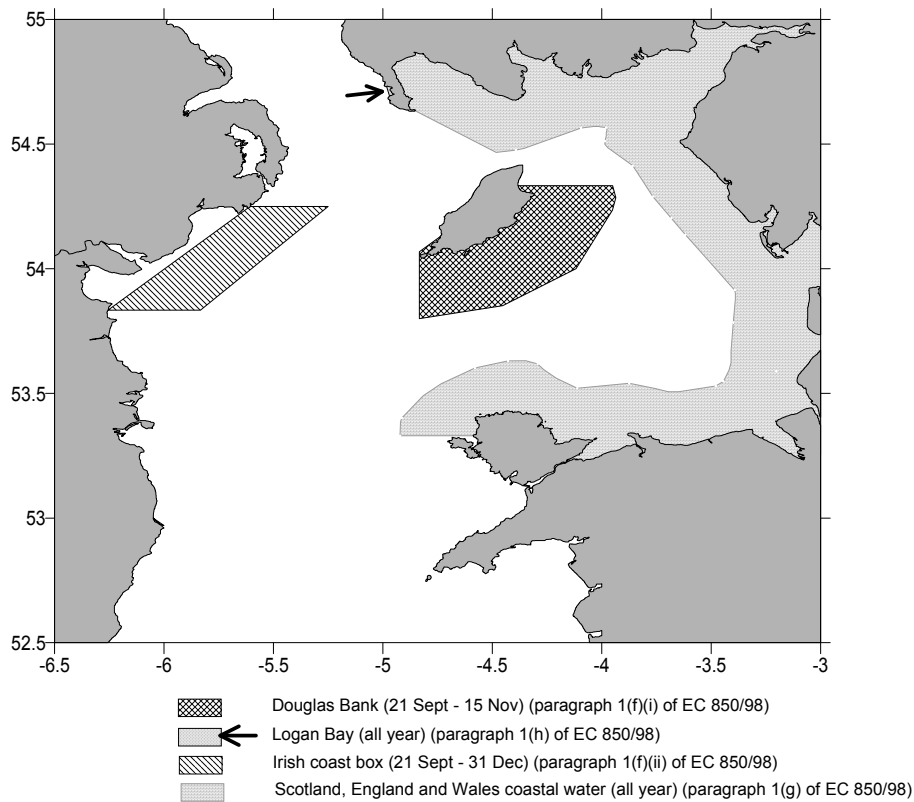


Figure 11.2.3 Position and geographical area of herring closures within the Irish Sea as defined by Council Regulation (EC) No 850/98, amended by EC 2723/1999.

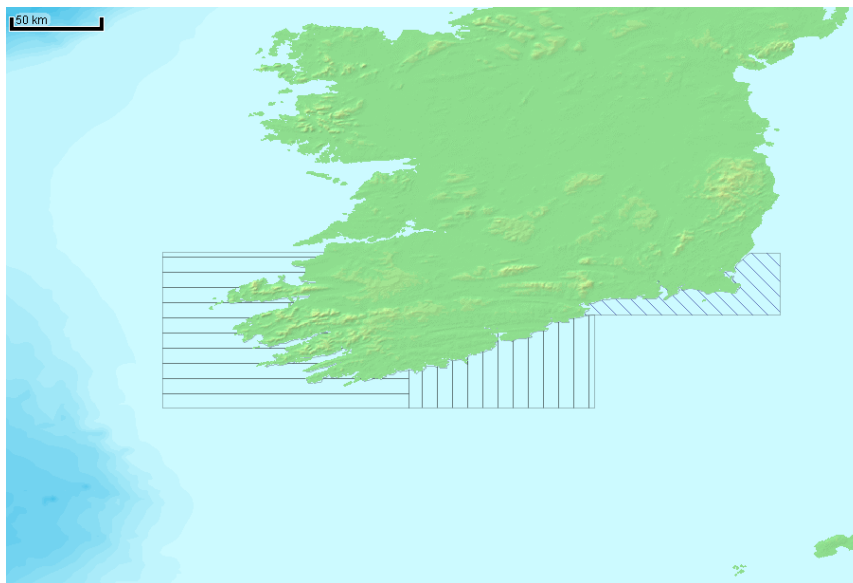


Figure 11.2.4 Location of three closures for herring off southern Irish coast. *Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*

Table 11.2.1. Goals and objectives – herring spawning closures

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
None explicit Protection of herring stock	Prevention of fishing on herring on the spawning aggregations during specified period of time	None explicit  <i>Compliance</i>  <i>F and SSB estimates relative to target associated with TAC.</i>  <i>Timing and distribution of spawning aggregations relative to closure.</i>	None explicit  <i>Full compliance with Regulation</i>  <i><math>F &lt; F(target)</math></i>  <i><math>SSB &gt; B(target)</math></i>  <i>No TAC overshoot</i>  <i>Closure encompasses bulk of spawning aggregations.</i>	Fishery monitoring  Stock assessment    Acoustic and early-stage larva surveys

1. Regulation EC 850/98 has a general statement of its goal being the conservation of fishery resources through technical measures for the protection of juveniles. However, these closures appear to be for spawning aggregations of adult fish.

### Background to closures

#### *Firth of Clyde*

This closure was established to give protection to the spring-spawning stock in the Clyde (STECF, 1992). No background information on this closure was available to SGMOS-07-03.

#### *Butt of Lewis*

In 1974, the closure proposed by the UK was accepted by NEAFC and implemented in UK national legislation as the West Coast Herring (Licensing and Prohibition of Fishing) Order 1974 (SI 2208/1974). In this legislation, the closure covered a larger area reaching as far as south as 56° 30' N (Figure 11.2.2). In 1982, the European Commission adopted the recommendation from ICES (ICES 1982) that the area VIa North would be treated as a separate management unit because the ongoing or then recent fisheries activities were distinct from those in neighbouring areas. The northern part of the NEAFC closure, “The Butt of Lewis Box”, was then designed as a measure to protect spawning fish (Hatfield *et al.*, 2007) and was in 1986 adopted in EC regulation 3094/86 article 7.

#### *East coast of England*

The recommendation for the area of the north east England was given in the 1984 ACFM report (ICES 1984). No further information was available to SGMOS-07-03 on the reasons for the broad spatial choice of closures. There are many herring spawning grounds in the

North Sea, as well as considerable sub-division of the stocks; given that some stocks (e.g. the southern Downs stock) suffered particularly during the herring collapse, it seems odd that closures only to help protect the central North Sea stock were chosen. At a fine scale, SGMOS-07-03 did not have information on choice of the boundaries of the closures, although herring spawning grounds are very specific in terms of sediment size and water (oxygen) flow. If the habitat has not changed, it is likely that the ground will remain suitable. No information was available on whether positive or negative outcomes were expected or considered.

### *Irish Sea*

There have been three types of fishery on herring in the Irish Sea in the last 40 years:

- i. Isle of Man- aimed at adult fish that spawn around the Isle of Man.
- ii. Mourne- aimed at adult fish that spawn off the Northern Irish eastern coast.
- iii. Mornington- a mixed industrial fishery that caught juveniles in the western Irish Sea. (ICES 2007).

In the 1970s the catch of fish from the Mourne fishery made up over a third of the total Irish Sea catch. The fishery was carried out by UK and Republic of Ireland vessels using trawls, seines and drift nets in the autumn. The fishery, however, declined and in recent years has been sporadically prosecuted by a small fleet of Northern Ireland drift-netters with a small seasonal quota (ICES, 1994). The fishery on the Manx (Isle of Man) herring stock has been the main fishery in the Irish Sea, generally occurring during June to November. There is a seasonal pattern of fishing usually commencing on fish of mixed sizes to the west of the Isle of Man and in the North Channel, and then moving onto the spawning grounds off the east coast of the Isle of Man, making the fishery dependent on the migratory behaviour of herring.

Landings in the Irish Sea increased substantially in the late 1960s due to the collapse of the North Sea herring fishery and subsequent interest in the Irish Sea fisheries. It was during this time that ICES first considered the Irish Sea (Division VIIa) for stock assessment (ICES 1994). Catches increased in excess of 20,000t by the early 1970s and there was concern at the level of fishing mortality. In 1972, in an effort to reduce the fishing effort and catch, a study group (ICES 1972) recommended a prohibition of herring fishing within 12 nautical mile of the Isle of Man between 1st October and 30th April. The closure enforced in 1973 by the UK Government, was from 1 October to 17 November each year.

In 1975, it was thought that the closure, although initially effective, did not reduce fishing effort sufficiently due to the influxes of new vessels into the Irish Sea (Bowers 1980). It was recommended to either lengthen the closure by two weeks (starting on 14 September) or to impose a TAC of 12,000 t on the fishery. The latter recommendation was taken on by ICES and TAC constraints were adopted by the European Union for the 1977 fishing season onwards. Reported landings from the Irish Sea declined rapidly over the following years (most noticeably up to 1984), mainly due to TAC constraints on the fishery.

In 1978, the Mornington fishery was closed due to management concerns (ICES, 1994). The fishery started in 1969, took place throughout the year and at its peak caught 10,000 tonnes per year. The Irish Sea spawning stock biomass, however, still declined in the later part of the 1970s and was thought to be at an extremely low level. In an attempt to reduce overall fishing mortality, further closures were introduced in 1980.



Between 1980 and 1985 the fishery in the Irish Sea was closed: (a) north of 53° 30'N from 20 September to 15 November each year, (b) closed throughout the year on the west coast of Scotland, England and Wales out to 12 nautical miles from the baselines of the coasts, (c) and within Logan Bay on the Mull of Galloway, and (d) all year on the east coast of Ireland (except for the Mourne fishery using vessels <40 feet using drift nets (>54 mm stretched mesh)) (ICES 1994).

During this period of the 1980s there were fisheries for adult Manx and Mourne herring and an industrial fishery for young fish. The arrangement of closed areas was established to protect juvenile herring at a time when an industrial fishery had been operating in the area, and to reduce overall fishing effort on adult herring when a large fleet of herring vessels was operating in the Irish Sea. Boats from the Republic of Ireland were not permitted to fish east of the Isle of Man.

Following advice from ICES in 1985, based on results from a trawl survey, the closures were altered (ICES 1996). The areas closed in September in the north Irish Sea were reduced to two smaller areas, one off the east coast of the Isle of Man and the second along the east coast of Ireland. These essentially covered the main spawning grounds for the Manx (Isle of Man, Douglas Bank) and Mourne (off Northern Ireland) stocks of herring in the Irish Sea (ICES 1994) and the first indirect indication of a change in the objective of the closure to specifically protect the spawning components. During spawning herring are slow moving and form dense aggregations, making them particularly vulnerable to high fishing mortality in a relatively short time. The other two closed areas (to protect juveniles) remained in place.

In 1986, the timings of the closure of the spawning areas were changed to 1 September to 16 November and then again in 1987 to 21 September to 31 December each year (ICES 1994). In 1999 there was a reduction in the closure area to the east of the Isle of Man (Douglas Bank spawning ground) and change in time of the closure from 21st September- 31st December to 21st September - 15th November (ICES 2000)

#### *South coast of Ireland*

No background information on this closure was available to SGMOS-07-03.

#### **Subsequent amendments affecting the closure**

##### *Firth of Clyde*

No history of these closures was available to SGMOS-07-03.

##### *Butt of Lewis*

See history in previous section

##### *East coast of England*

No history of these closures was available to SGMOS-07-03.

##### *Irish Sea*

Council Regulation (EC) No 850/98 Article 20, amended by Council Regulation (EC) No 2723/1999, that defined the area and period of the herring closures in the Irish Sea have remained unchanged in subsequent years.

#### *South coast of Ireland*

No history of these closures was available to SGMOS-07-03.

### **Summary of previous evaluations**

#### *Firth of Clyde*

No previous evaluation of this closure was available to SGMOS-07-03. STECF (1992) proposed that the closure should be retained. However, they gave no rationale for this although Clyde herring are spring spawners whilst the main herring group in VIa are autumn spawners. ICES no longer gives advice on this stock as there is no landings-independent research data.

#### *Butt of Lewis*

No previous evaluation of this closure was available to SGMOS-07-03. STECF (1992) commented that the closure is intended to protect the most important spawning ground in VIa but noted that there had been no discussion of the closure since the ICES Herring Working Group in the mid-seventies. ICES advice has not referred to this closure in recent years.

#### *East coast of England*

No previous evaluations are known to have occurred.

#### *Irish Sea*

There have been several evaluations of the closed areas in the Irish Sea, in terms of location and timing, prior or subsequent to changes in the legislation. These evaluations are not well documented and were done under the auspices of ICES or as a request from local administrations. The following is not a definitive list of these evaluations.

More extensive survey data were gathered since the late 1980s, which provided more detailed and refined information on herring distribution and the duration of the spawning period on the Douglas Bank spawning grounds in particular. The 1994 and 1995 studies of the Douglas Bank spawning grounds (ICES 1994, 1996) using a combination of trawl survey, larval survey and acoustic survey data, indicated that spawning fish are concentrated within a much smaller area than covered by the closure. Spawning is mostly completed by the end of October, whereas the closure at that time remained in force until 31 December. The starting date of 21 September was thought to be appropriate in view of the pattern of spawning in most years. ICES (1996) commented that although the closure is clearly an important management tool, because of the concentration of the stock in such a small area, some modification of the Douglas Bank spawning closure could be acceptable to relax the restrictions on fishing opportunities. This was suggested with caveats, i.e., the size of this stock should be monitored through continuation of the series of acoustic surveys, and that an effective procedure for control of fishing activities should be in place.

No official evaluation has been done for the Mourne spawning stock. The results of surveys have indicated a comparatively low spawning stock size of Mourne herring in the western Irish Sea (ICES 1996). The biomass of Mourne herring was estimated to be 2-4% of the total Irish Sea stock, determined from larval production estimates (Dickey-Collas *et al.*, 2001). The traditional gillnet fishery on the Mourne herring, which has a derogation to fish within the Irish closed box, started operating again in 2005 after many years of absence (ICES 2007). Catches are constrained by a quota that is usually set at around 600t, although this is often not attained. No evaluation of the effect of the seasonal gillnet catch of spawning fish in this area has been conducted. ICES (1996) recommended the continued protection of this spawning stock through a seasonal spawning closure.

UK also carried out an evaluation of the appropriateness of the western and eastern Irish Sea closed boxes in 1997, based on an extended acoustic survey and historic trawl surveys. The closed box serves to protect the spawning grounds of the Mourne herring stock.

#### *South coast of Ireland*

No previous evaluations are known to have occurred.

#### **Information available to SGMOS-07-03 for evaluating the effectiveness of the closure**

##### *Firth of Clyde*

No information was available to SGMOS-07-03.

##### *Butt of Lewis*

As far as can be determined, no specific monitoring of the closure occurs.

Hatfield *et al.* (2007) stated that over the years there had been problems with the assessment of the various stocks to the west of the British Isles. After a series of analytical assessments for VIa North, the 2006 assessment was not accepted due to conflicts between the acoustic survey index and catch data (ICES, 2006). According to the authors, the VIa North fishery operates throughout the year, and is primarily a winter to summer fishery, i.e., not targeting the spawning aggregations.

The Pelagic RAC Working Group stated in June 2006 for herring in Division VIa North that the survey results are unreliable and the stock may be “up or under Bpa” (the exact meaning of this term is not apparent to SGMOS-07-03). The RAC’s Executive Committee supported the group and recommended to the EU Commission in February of 2007 that The Butt of Lewis Closure be removed.

At the same time, the EU project WESTHER investigated the stock structure of herring west of the British Isles and concluded that the different stocks are more linked than previously assumed. Therefore, while the current assessment of herring assumes separate stocks in the ICES areas VIa North, VIaS and VIIbc, Irish Sea, and Celtic Sea and VIIj, results from WESTHER suggest that under the current stock assessment units (ICES, 2007), two basic assumptions of stock assessment (the stock is a closed unit, and the data used in assessments are representative of the entire stock) are violated (Hatfield *et al.*, 2007).

SGMOS-07-03 was not able to evaluate whether any displacement of effort has occurred due to the closure.

### *East coast of England*

As far as can be determined, no monitoring or surveillance of the closures or their potential biological effects is occurring. No mention of the closures in annual North Sea ICES Assessment Group reports has been found. SGMOS-07-03 cannot evaluate whether any displacement of effort occurred.

### *Irish Sea*

No specific monitoring programmes to evaluate the success of the Irish Sea herring closures have been included in the EC Regulations. The only data available to evaluate the closures are those collected by routine sampling and survey data collection programmes by national laboratories.

The only information available to SGMOS-07-03 to evaluate the herring closures, however, was the results of the ICES assessment of the stock and the historic information on the fishery.

### *South coast of Ireland*

No information was available to SGMOS-07-03. It was noted that despite good statistical data, ICES finds it difficult to derive precise estimates of the current SSB and F due to high variability in the data.

## **Effectiveness of closures**

### *Firth of Clyde*

No information was available to SGMOS-07-03.

### *Butt of Lewis*

SGMOS-07-03 was unable to find any information that could distinguish between the closure and other management measures taken for this stock

### *East coast of England*

SGMOS-07-03 was unable to evaluate the effectiveness of the closures. The condition of the North Sea herring stock has improved in recent years, but it is not known the degree to which the closures have contributed to this.

### *Irish Sea*

The stock of herring in the Irish Sea collapsed in the late 1970s following a period of very high fishing mortality, but did not subsequently recover to the same extent as that in the North Sea and no substantial increases in TACs have occurred. Although ICES (2007) considered the stock assessment not accurate with respect to recent F and SSB, the overall stock biomass has been relatively stable over the last number of years fluctuating around Bpa.

Considering the time span of the closures (30+ years) and the reduction in the herring fishing fleet to primarily one pair trawl team currently prosecuting the Manx herring fishery, it seems unlikely that the closures are particularly important in overall stock management.

*South coast of Ireland*

No information was available to SGMOS-07-03.

**Confidence in evaluation**

*Firth of Clyde*

It may be that information exists that was not available to SGMOS-07-03.

*Butt of Lewis*

SGMOS-07-03 is confident that a detailed evaluation of the effects of closure, and especially one which simultaneously considers all closures on herring in the wider area has not been performed.

*East coast of England*

It may be that information exists that was not available to SGMOS-07-03.

*Irish Sea*

It may be that information exists that was not available to SGMOS-07-03.

*South coast of Ireland*

It may be that information exists that was not available to SGMOS-07-03.

**Adverse effects of closure**

*Firth of Clyde*

No information was available to SGMOS-07-03.

*Butt of Lewis*

Based on the information available to SGMOS-07-03, potential adverse effects of the closure on marine organisms have not been investigated.

*East coast of England*

No information was available to SGMOS-07-03.

*Irish Sea*

The closure of the more productive fishing grounds for adult herring during the main autumn fishing season, particularly in relation to the Douglas Bank closure, force the herring fishermen to operate in other areas (e.g. west coast of the Isle of Man) where adult and juvenile herring are found in proximity. Highest concentrations of 1-ring herring are often found off the west coast of the Isle of Man, where there is no closed box. In general, fishermen are experienced at locating adult fish and minimising catches of small fish. There is a strong incentive to avoid catching juveniles as there is no market for them and fishing in areas dominated by juveniles would waste fishing time and hence reduce income. Smaller 1

and 2-ring herring are nevertheless taken in the present commercial fishery, especially from strong year classes, but the fishing mortality on the landed component of these remain small (no estimates of slippage are available). During the period of the autumn fishery, these 1-ring fish are about two years old and some are mature. The displacement of effort to less productive fishing areas results in an extended fishing season and an increased mortality on smaller fish.

Studies have shown that fish of Celtic Sea origin are present in the western Irish Sea (e.g., Brophy and Danilowicz 2002), and then return south as 1- and 2-ringers (Molloy *et al.* 1993). The displacement of effort to the west coast of the Isle of Man may thus have an impact on the Celtic Sea herring stock.

#### *South coast of Ireland*

No information was available to SGMOS-07-03.

#### **Recommendation on closures**

All of these closures were bought in during periods of high fishing mortality and declining herring stocks, primarily to avoid catching herring when they occur in dense spawning aggregations and vulnerable to high rates of fishing mortality over a short period of the year. This was probably appropriate given the difficulties of enforcement of overall catch levels and the easy monitoring of the location of fishing vessels. These enforcement difficulties have persisted until recent years (judging by the reports by certain Member States). Modern enforcement tools, such as the use of tracking fish reaching the market ('Buyers and Sellers' Regulation) and VMS, coupled with a substantially reduced fleet should be more effective. If fisheries managers are confident that TACs can now be effectively enforced then there would be no need to retain herring spawning closures under current stock levels. This recommendation may not remain suitable should herring stocks fall to low levels again in future. It is also important that Managers set fishing mortality (F) levels in line with management plans for stocks. It is noted that current ICES advice indicates that for North Sea stocks, fishing mortality (F) is being set above that dictated by the management plan. In this case fishing mortality control is not effective. Should managers continue to set such levels of F, then rather than open grounds, further grounds should be closed.

SGMOS-07-03 notes that this recommendation leaves the risk of depletion of individual spawning grounds. Herring are broadly faithful to their natal grounds and this has led to some sub-structuring of the stocks. Such sub-structuring will theoretically make stocks more robust to local environmental change (if one ground suffers poor spawning success due to a local environmental variability, the overall stock may not necessarily suffer). This risk is present in many areas of herring distribution at present, for instance the Downs stock in the southern North Sea has no closed areas, and many spawning grounds in the central North Sea are not closed. In addition, several herring fisheries target pre-spawning aggregations adjacent to closed areas in the period immediately prior to spawning. SGMOS-07-03 notes that the herring fleets will benefit most from a robust herring stock and thus suggests that fisheries managers might ask the industry to bring forward suggestions as to how to avoid local over-depletion of grounds if no closures are in place.

#### **Recommendation on data requirements**

If further evaluation should prove necessary, the following data might be analysed or collected.

*Data in existence but not evaluated by SGMOS-07-03*

Finely resolved information on fisheries effort before and after the installation of the closures is not available, but VMS and logbook data should exist for an inside-outside comparison for the most recent years.

Data from acoustic surveys in the months June/July are available for the North Sea and west of Scotland stocks and show the pre-spawning distribution and abundance of adult herring. However, there are no acoustic surveys within the closed areas that cover the time of closure / spawning aggregation. Acoustic surveys take place in the Irish Sea in September immediately prior to spawning. From 2007, additional surveys of herring around the Isle of Man are being carried out by AFBI (Northern Ireland) at intervals during the spawning season to examine the movements of herring onto the spawning grounds. Herring larva surveys in the North Sea and Irish Sea provide information on relative production of early-stage larvae in the vicinity of known spawning sites.

*Impacts of derogated fishing gears and other human activities*

The benefits of any closure for herring fishing on these spawning grounds may be reduced if the grounds are also open and demersal trawling occurs on them (for other species). Towed demersal gears could disrupt the areas of spawn, or create sediment clouds nearby that could drift onto the spawning beds and smother the eggs and reduce oxygen supply. Gravel extraction on or near spawning sites could also have negative impacts.

SGMOS-07-03 was unable to evaluate whether such effects may be occurring. An evaluation of VMS data during these closures would allow an evaluation of the activities of VMS-equipped vessels on spawning grounds.

*Implications of possible revisions to western stock units*

The EU project WESTHER proposed new units for assessments of herring stocks to the west of the British Isles, based on the distribution and the interchange of herring in those areas. Therefore, the benefits from the Butt of Lewis closure would need to be re-evaluated in conjunction with other spawning grounds and closures within the group of inter-connected areas (termed “Malin Shelf” by WESTHER, Hatfield *et al.*, 2007) in order to determine whether the closure does contribute significantly by lowering fishing mortality and securing the stock. To address this, the existing acoustic surveys for adults, as well as larval surveys, may need to be adapted to provide a sufficient spatial and temporal coverage of the individual spawning grounds.

*East coast of England closures*

If the effects of these closures are to be determined, then there would be a need to evaluate the proportion of the central North Sea herring spawning stock using grounds within the closures. This is a difficult undertaking due to the problems of surveying herring when they are forming into dense spawning aggregations. The feasibility and potential accuracy of surveys of individual spawning grounds using acoustics and larval production surveys should be evaluated.

Table 11.2.2. Inventory of the type of information necessary for a full evaluation of the Irish Sea herring closures, together with a brief indication of what is currently available

<b>Information required</b>	<b>Information available</b>
Information on spatial stock structure.	Information available from distribution of spawning fish and previous stock discrimination studies including recent WESTHER project.
Information on seasonal movements fish of different sizes and ages into and out of the closed area	Seasonal patterns of fishery are well defined; only limited information available on actual migration patterns for all stock components.
Relative densities of populations inside and outside the CA (+ gradients).	Acoustic and early-stage larva surveys
Age/size structure of the population and fishery catches inside and outside the CA (+gradients)	Survey data and fishery sampling data available – fishery data at rectangle level.
Time series of relative or absolute abundance of adult fish and recruits in each population.	Survey data and annual ICES stock assessment. No discards in assessment.
Time series of fishing mortality estimates by length or age in each population.	ICES stock assessment. No discards data included.
Time series of fishing effort and fishery landings and discards for appropriate fleet units, available at the spatial and temporal resolution of the closure. Knowledge of accuracy of data is required.	Fleets currently very small. Landings data potentially available for all fleets, but at trip and ICES rectangle scale. Processed VMS data potentially available. Only very limited observer data available.
Indirect effects of the closed area on fishing mortality (e.g. economic factors leading to vessel decommissioning).	Data on fleet structure and decommissioning available.
Changes in other regulations or processes affecting fishing mortality or spawning success	Details of regulations available; information on environmental and biological processes relatively poor.

### References

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### **11.3. Herring nursery ground closures**

#### **Summary**

SGMOS-07-03 was able to review information on herring nursery ground closures in the Irish Sea, but had no information on closures in the western North Sea (see Section 13 for the closure in the eastern North Sea). SGMOS-07-03 recommends that where a fishery for sprat is present, then closures should be retained. There is no longer any fishing for juvenile herring in the Irish Sea, so the closure could be removed there.

#### **Legislation**

Closures for herring nursery grounds are detailed under Article 20 of Council Regulation 850/98. These include closure b) off Jutland (this is covered in Section 13 as the closure is contiguous with that for sprat fishing in the area) and closures g) and h) in the Irish Sea off the coasts of Scotland, England and Wales (Appendix 2.6). Under Article 21 of Council

Regulation 850/98, closures a) off the east coast of England and closures b) the inner Firth of Forth and the inner Moray Firth are closed to sprat fishing to protect juvenile herring (Appendix 2.8). Each of these closures has specific time limits and has derogations to allow low levels of retained bycatch. An illustrative map of the Firth of Forth and Moray Firth is provided below (Figure 11.3.1). Figure 11.2.3 covers the Irish Sea. A map of the closure off the east coast of England was not available to SGMOS-07-03.



Figure 11.3.1. Areas closed for sprat fishing off eastern Scotland to protect juvenile herring. *Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*

Table 11.3.1. Goals and objectives – herring nursery closures

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Conserve herring stocks in the North and Irish Seas (juveniles)	None explicit <i>Reduce fishing effort; protect juveniles</i>	None explicit <i>Compliance</i> <i>Selectivity pattern</i>  <i>Distribution of juveniles relative to closure</i>	None explicit <i>Full compliance</i>  <i>Desired selectivity pattern achieved; reduced discarding/slippage</i>  <i>Higher abundance inside closure than outside</i>	None explicit <i>Fishery monitoring</i>  <i>Sampling of fishery catch and discards; stock assessment</i>  <i>Trawl/ acoustic surveys</i>

### Background to closures

#### *Irish Sea*

Since the collapse of the northern Irish Sea herring stock and fishery in the late 1970s, management of the fishery has included closures of nursery grounds. The closed areas consist of all-year closures along part of the east coast of Ireland, and off the coasts of southwest Scotland, off northwest England and off north Wales.

### *East coast of England and Scottish Firths*

Apart from these areas being known to have had sprat fisheries in the past, sometimes with a high bycatch of juvenile herring, no background information on these closures was available to SGMOS-07-03.

### **Subsequent amendments affecting the closure**

The history of the Irish Sea closures is given in Section 11.2. No history of the east coast of England and Scottish Firths closures was available to SGMOS-07-03.

### **Summary of previous evaluations**

#### *Irish Sea*

There have been several evaluations of the closed areas in the Irish Sea, in terms of location and timing, prior or subsequent to changes in the legislations. These evaluations are not well documented and were done under the auspices of ICES or as a request from local administrations.

ICES (1996) also commented on the all year juvenile closures along part of the east coast of Ireland, and the west coast of Scotland, England and Wales. The series of acoustic and trawling surveys of VIIa(N) showed that juvenile herring were widespread throughout the year in areas beyond the closed boxes. The necessity for the juvenile closures was questioned, as there is no longer an industrial fishery, and the present herring fleet is small. In view of the apparently low level of fishing mortality and the absence of an industrial fishery, the ICES Working Group suggested that the present juvenile closures could be relaxed. A system was suggested that allows temporary closures if catches of juvenile herring become excessive and considered to be more appropriate than the present system. This advice was not adopted within EC regulations.

The UK also carried out an evaluation of the appropriateness of the western and eastern Irish Sea closed boxes in 1997, based on an extended acoustic survey and historic trawl surveys. The closed box in the western Irish Sea covers an area with high concentrations of juvenile herring, although significant quantities of juveniles also occur outside the closure. In comparison, the eastern Irish Sea closed box covers the majority of juvenile herring in the eastern Irish Sea but extends farther south than the main concentrations off Cumbria and the Solway Firth. The study concluded that there was no conservation basis for extending the eastern Irish Sea closure farther south than Morecambe Bay (Armstrong 1997).

No information could be obtained detailing any specific evaluation that has been carried out for the Logan Bay closure.

### *East coast of England and Scottish Firths*

No previous evaluations are known to have occurred.

### **Information available to SGMOS-07-03 for evaluating the effectiveness of the closure**

#### *Irish Sea*

The references used in the previous section were available to SGMOS-07-03.

*East coast of England and Scottish Firths*

No information was available to SGMOS-07-03.

**Effectiveness of closures**

*Irish Sea*

At the time when the arrangement of closures for herring fishing in the Irish Sea was first introduced, there was both a fishery for adult fish and an industrial fishery for young fish. Currently, the conservation basis to maintain the juvenile herring closures is notional in the absence of an industrial fishery. Due to the limited information available, SGMOS-07-03 was unable to evaluate the effectiveness of the herring closures in the Irish Sea.

*East coast of England and Scottish Firths*

No information was available to SGMOS-07-03.

**Confidence in evaluation**

SGMOS-07-03 did not have sufficient information available to carry out a full evaluation of the success of these closures.

**Adverse effects of closures**

SGMOS-07-03 did not have any information on whether or not an adverse effect arose from the closures.

**Recommendation on closure**

*Irish Sea*

Based on the information available to SGMOS-07-03, the conservation basis of maintaining the juvenile herring closures in the Irish Sea is notional in the absence of an industrial fishery. SGMOS-07-03 recommends that the closures relating to juvenile herring in the Irish Sea could be removed, providing that overall fishing effort is still controlled in line with the TAC. The role of using juvenile closures as a management tool should be re-examined if an industrial fishery using small meshes is re-established.

*East coast of England and Scottish Firths*

A potential fishery for sprat exists in the western North Sea, so in the light of past high bycatches of herring in fisheries in these areas, SGMOS-07-03 recommends that these closures be maintained.

**Recommendation on data requirements**

*Irish Sea*

The level of discarding of juvenile and adult herring in trawl catches of non-targeted herring fisheries operating in the closed areas in the Irish Sea is poorly estimated.

## *East coast of England and Scottish Firths*

The best data to evaluate the potential impact is acoustic surveys and sufficient trawling on targets to estimate species compositions.

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## **12. CLOSED AREA FOR THE PROTECTION OF HERRING IN ICES ZONE IIa**

### **Summary**

SGMOS-07-03 was unable to determine why this closure was put in place originally – it is neither a spawning, juvenile or adult aggregation ground. A senior herring biologist told SGMOS-07-03 that in the past Norwegian Spring Spawning herring did not occupy this area in the months of the closure (mid May to end of February). Thus anybody landing from this area at this time was catching some other population or area misreporting. If this was the case then SGMOS-07-02 recommends removal of the closure if relevant management authorities are confident that modern control systems can minimise area misreporting.

### **Legislation**

Herring may not be caught or landed in the far north of the EU fishing zone in the North Sea/North Atlantic from 16 May to 28 February (Appendix 2.7)

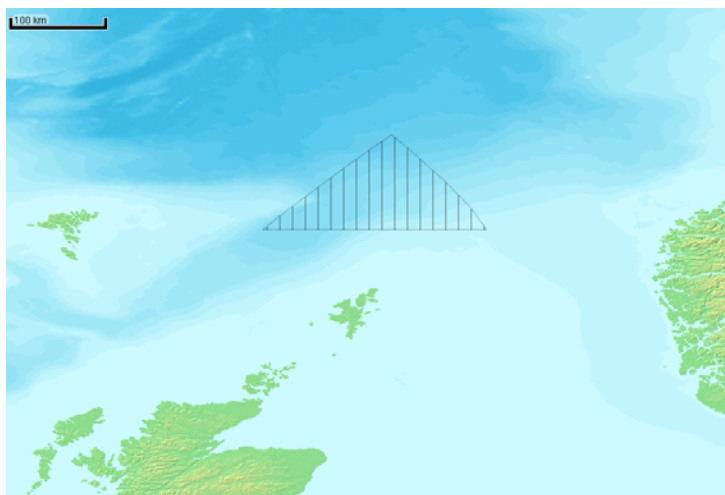


Figure 12.1. Closure for herring in ICES division IIa. *Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*

Table 12.1. Goals and objectives – herring closure in ICES zone IIa

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Conservation of herring stock	None explicit	None explicit.	None explicit	

**Background to closure**

SGMOS-07-03 could not find a reason for this closure in any documentation. However, SGMOS-07-03 heard from a senior herring biologist that in the past Norwegian spring spawning herring did not occupy this area in these months. Thus anybody landing from this area at this time was catching some other population or area misreporting. If preventing this was or is the primary objective of the closure then its success should be evaluated accordingly.

**Subsequent amendments affecting the closure**

SGMOS-07-03 is unaware of any amendments affecting this closure.

**Summary of previous evaluations**

Reports of the ICES Assessment Group in the recent years have not given specific reference to the closure’s success. Earlier systematic evaluations, if they were carried out, were also not available.

**Information used by SGMOS-07-03 to evaluate the effectiveness of the closure**

No specific information was available to SGMOS-07-03. The ICES WGNPBW 2006 report indicates that herring are not in these waters during the winter, but may pass through on their migrations in May. There were no reported catches of Norwegian spring-spawning herring in 2006 in the area (ICES 2006).

Overall, the herring stock in IIa is among the stocks in best condition: ICES (2006) stated: “Based on the most recent estimates of SSB and fishing mortality, ICES classifies the stock as having full reproductive capacity and being harvested sustainable” and in 2007: “The stock is considered to be within safe biological limits. Fishing mortality is lower than the defined limit and target reference points. SSB is well above all reference points and is estimated near the highest in the time-series. The stock contains a number of good year classes. The productivity of the stock presently is high.” (ICES 2007)

**Effectiveness of closure**

SGMOS-07-03 found no information to evaluate the effectiveness of this closure. Nevertheless, if judged by the current fishing activities in the closed area and the present overall status of the Atlanto-Scandian herring stock in IIa, the closure should not be needed to support the management goals.

**Confidence in evaluation**

Information may exist that SGMOS-07-03 was unable to locate.

### **Adverse effects of closure**

SGMOS-07-03 found no information to indicate whether or not there were adverse effects of this closure.

### **Recommendation on closure**

SGMOS-07-03 recommends removal of the closure if relevant management authorities are confident that modern control systems can minimise area misreporting.

### **Recommendation on data requirements**

No recommendations are made.

### **References**

ICES 2006. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group (WGNPBW). ICES CM 2006/ACFM:34.

ICES 2007. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group (WGNPBW). ICES CM 2007/ACFM:29

## **13. CLOSED AREA FOR SPRAT TO PROTECT HERRING, WITH CONTIGUOUS CLOSED AREA FOR HERRING**

This review covers Article 21 of Council Regulation (EC) no 850/98 and Article 20 (b) of that Regulation as the boundaries of the ‘two’ closures are the same.

### **Summary**

An expected decrease in bycatches of age 0 herring in the industrial sprat fishery was observed shortly after the implementation of the closed area in 1984. However, throughout the 1990s, age 0 catches increased to values almost as high as the ones observed before 1984. It was not until a TAC bycatch limit was set in 1996 that bycatches of juvenile herring in the North Sea have been consistently lowered.

New analyses of juvenile herring catch rates gathered through IBTS-surveys (3rd Quarter 1991-2006) led SGMOS-07-03 to conclude that the sprat closed area is currently performing sub-optimally in the fulfilment of its objectives, i.e. to protect juvenile nursery areas and to protect juvenile herring. However, an important caveat must be applied to these results, in that the question of how representative the fishing gear used in the IBTS survey is for sprat and herring, and how its results relate to catch data from targeted industrial sprat-fisheries, is unclear. It was therefore deemed necessary to conduct additional analyses to examine how representative the IBTS data is by comparison with acoustic surveys. Poor availability of the data limited the extent of the analysis, but substantial differences between these two surveys were found, most likely due to differences in the timing of the surveys.

SGMOS-07-03 recommends that a closure be maintained and that further analyses be carried to further understand the effectiveness of the current closure and determine if it might perform better in an alternative configuration.

## Legislation

Two articles (20 and 21) of Council Regulation (EC) 850/98 close an area off Jutland (Figure 13.1) to both sprat and herring fisheries (Appendix 2.6 and 2.8). Both restrictions were put in place to protect juvenile herring concentrations.

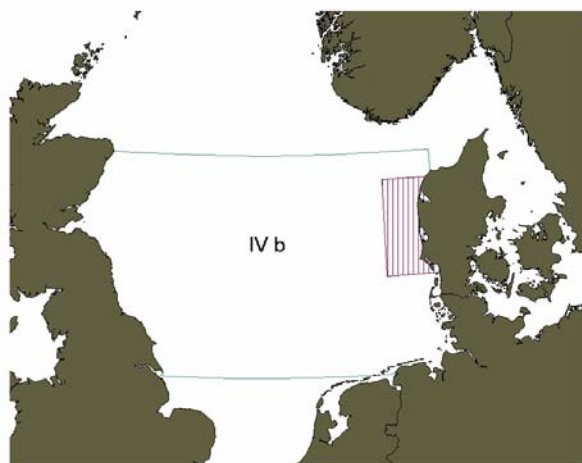


Figure 13.1. Location of the area closed to sprat and herring fishing off Jutland

Table 13.1. Goals and objectives – sprat and herring closure off Jutland

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Protect herring stock  <i>Council Regulation 850/98</i>  <i>Article 20 and 21 of Council Regulation (EC) No 850/98</i>	None explicit  <i>Protection of juvenile herring from bycatch in sprat fishery and from a directed herring fishery</i>	None explicit  <i>Bycatch of juvenile herring (0-group, 1-group especially) within closed area</i>	None explicit  Bycatch of juvenile herring in closed area limited to 5%  <i>Discard of juvenile herring in industrial sprat fisheries in nearby areas not exceeding averages for North Sea.</i>	IBTS  Acoustic survey  Bycatch  High-resolution spatial fisheries data (VMS)

### Background to closure

North Sea autumn-spawning herring spawn off the east of Great Britain during late autumn, and the eggs and larvae drift west across the North Sea during winter and spring to the nursery areas off the west coast of the Jutland peninsula. Excessive fishing mortality on these juveniles is recognised as one of the major contributions to the late-1970s herring stock



collapse (Simmonds 2007). Industrial sprat-fisheries have been associated with high herring bycatches, especially in certain nursery areas, e.g. near the coast of Jutland.

In 1978, due to decreased herring stocks, a maximum bycatch limit of 10% was implemented for industrial fisheries landing sprat. In 1984 herring stocks had increased substantially and it became impossible to keep the bycatch of herring below the 10% limit. Random sampling showed that 90% of the herring bycatch took place within the current sprat closed area (Baron, 2002). As a result, the ‘Sprat Closed Area’, or ‘Sprat box’, was established. The area lies off the west-coast of Denmark, covering the rectangle defined by 7° E, 55° 30' N, 57° N and the Danish coastline and is closed to industrial sprat fishing from 1st of July to the 31st of October.

The establishment of the sprat closed area was expected to result in a significant decline in the catches of juvenile herring for the entire ICES division IVb, mainly age 0 individuals. This decline was expected as more than 90% of age 0 herring caught in the entire division IVb came from the sprat fishery bycatches during the 3rd and 4th quarters within the current location of the closure.

The dynamics of North Sea herring have changed. For five years (2002-2006) herring recruitment has been unusually low, most likely due to environmental effects (Figure 13.2). This poor recruitment has reduced catch potential to 40% of the average and will reduce it further. Management must account for the reduced catch potential. In addition, due to a combination of various enforcement and management issues, exploitation is well above the recommended harvest rate for the last three years (2005 - 2007). Failure to comply with the harvest rule for a fourth year combined with the poor recruitment will bring the stock to Blim by 2009. Potentially this could lead to further reduced recruitment and stock collapse (ICES 2007).

This stock has recently produced five poor year classes in a row, which has never been observed before. Larval surveys show a large abundance of larvae in recent years. However, survival of these larvae seems to be very poor. The specific reasons for this are not known (ICES 2007).

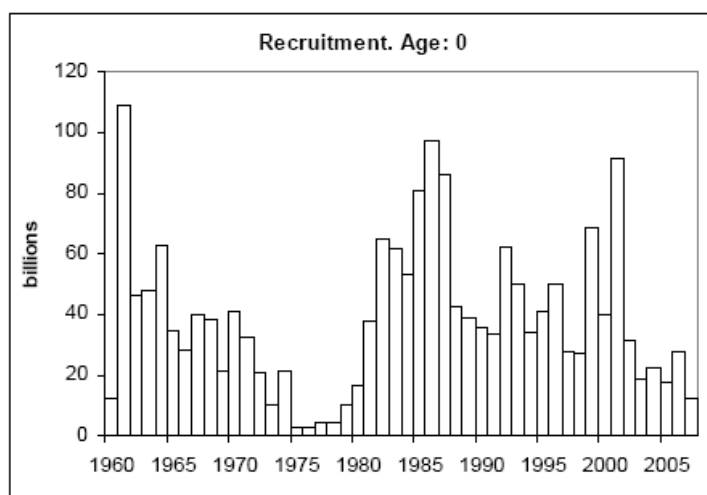


Figure 13.2 Herring in Subarea IV, Divisions VIIId & IIIa (autumn spawners), stock summary (ICES 2007).

## **Subsequent amendments affecting the closure**

Until 1996, the only control on the bycatch of herring in industrial, small meshed fisheries was a sprat TAC, with the 10% bycatch limit of herring applying to individual trips. From 1987 to 1995 there was a very high mortality on immature herring, mainly in the small meshed fisheries. As a result, a herring bycatch ceiling for the small meshed fisheries in the North Sea has been enforced since 1996.

## **Summary of previous evaluations**

The sprat closed area has been evaluated as a desktop study in 2001-2002 by Baron (2002) in an internal, unpublished review. The conclusion from this review was as follows:

- No clear evidence that the closed area resulted in decrease of annual mortality of age 0 herring in division IVb consistently over time, even if more than 90% of the catches were considered to be due to the bycatch in the coastal area by this fishery.
- In contrast, there was a nearly constant decrease in the catches and mortality of age 0-1 herring over years after 1996 coinciding with the introduction of a bycatch ceiling for herring for the small meshed fishery in the North Sea. The observed increase in the age 0 catches during the 1990's after the establishment of the closed area could not be explained by variations in herring recruitment or sprat biomass.
- Although it is known that juvenile herring is in general located in the eastern part of the North Sea, there is a lack of detailed knowledge of the exact spatial distribution of juvenile herring.
- Similarly, data on the bycatch species-age composition over time would allow a better analysis of the trend in the industrial catches.

## **Information used by SGMOS-07-03 to evaluate effects of closure**

No closure-specific monitoring has been or is currently carried out.

The Sprat box and the areas surrounding it are covered regularly during the 3rd quarter by the IBTS Q3 bottom trawl survey, and at least partially by the North Sea Acoustic survey. Both surveys record age-resolved density distributions of herring and sprat in this area and are therefore suitable for use in monitoring applications.

## **Effectiveness of closure**

The expected decrease in age 0 catches was in fact observed shortly after the implementation of the closed area in 1984. However, throughout the 1990's, age 0 catches increased to values almost as high as the ones observed before 1984. This increase occurred especially during the 3rd quarter, corresponding to the time when the fishing activity in the closed area was forbidden, suggesting that age 0 bycatches may come from surrounding zones within the IVb division, where the sprat fishery is permitted. In 1996, TAC limitations were imposed to the herring bycatches, and as a result catches decreased again keeping nearly constant over time. The same trend is observed for the annual fishing mortality of age 0-1 herring from division IVb mostly due to catches in the 3rd and 4th quarters as in the other quarters catches were almost zero. In relation to age 1 herring, there was a general increase in the annual mortality

after the effective implementation of the closed area until 1996 (implementation of herring bycatch ceiling) when values decreased to the similar values recently observed (Baron, 2002).

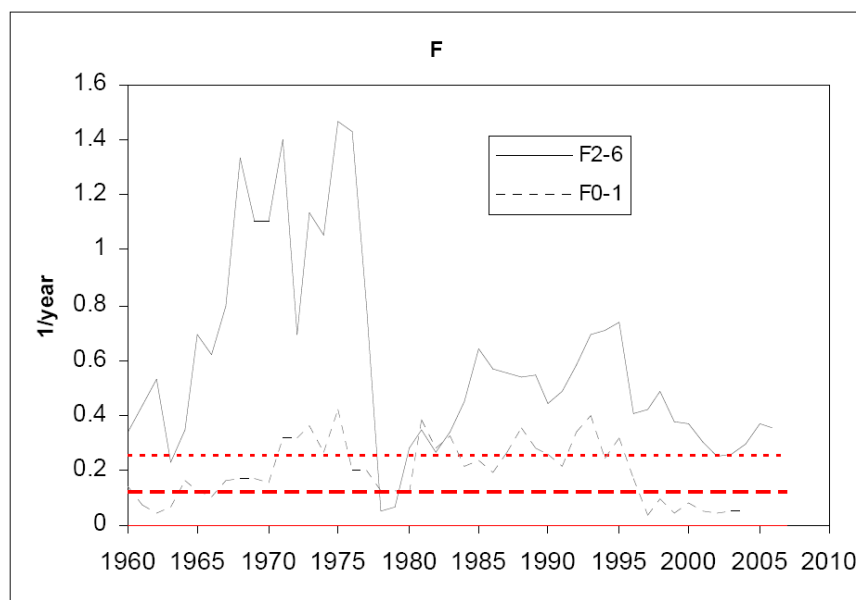


Figure 13.3. Herring in Subarea IV, Divisions VIIId & IIIa (autumn spawners), stock summary. Fishing mortality is expressed as averages over ages 2-6 (dots) and 0-1 (line) (ICES 2007).

Annual fishing mortality (F) for herring in Subarea IV, Divisions VIIId & IIIa (autumn spawners) can be seen in Figure 13.3 (F0-1). It is apparent that a sharp and consistent decrease in F coincides with TAC limitations on herring bycatch, imposed in 1996.

In order to re-evaluate the performance of the sprat closed area, a new desktop study was performed prior to the meeting (Payne, 2007). In this work survey data from the IBTS 3rd quarter (3Q) survey was used to assess the spatial appropriateness of this restriction for use in protecting 0-wr herring. Follow-up work, utilising data from the North Sea acoustic survey and addressing questions arising from the meeting, is also presented here.

#### *Materials and Methods*

Standardised catch rates of sprat and herring from the third quarter International Bottom Trawl Survey (IBTS), disaggregated by age and on an individual haul-basis, were obtained from the ICES DATRAS database for the years 1991-2006. The age-resolved sprat data was aggregated into a total sprat catch-rate by summing over all ages. Age 0 herring data was analysed without further aggregation. The arithmetic mean of the catch-rates observed in the individual hauls (including those where sprat/herring were not observed) was calculated for each square in each year. The mean CPUE for a square could then be calculated by averaging across all years, thereby giving equal weight to each year, independent of inter-annual variations in survey-coverage. The probability of a given event was calculated in a frequentist manner by looking at the fraction of hauls in a stat-square and year in which it occurs. An estimate of the long-term probability was then determined by averaging this fraction over all years, again eliminating the effect of survey variability.

Additional analysis was performed after the meeting using data from the North Sea acoustic survey. Estimates of the number of individuals in a statistical square were obtained from the FishFrame database. Whilst this survey has been performed since at least 1998, the data is currently not readily available in the public domain. The FishFrame database attempts to resolve this issue, but is currently not fully populated. Data was thus only available for herring from 2003-2006 and for sprat for 2006. In addition, the lack of a central approval mechanism means that permission to use this data is required from the individual institutions, which proved to be time-consuming. The analysis was therefore severely limited by these hurdles.

### Results

The temporally-averaged density distribution of sprat (Figure 13.4) and 0-wr herring (Figure 13.5) in the third quarter (i.e. during the time of the Sprat Box closure) was calculated. The distributions show a high degree of correspondence, especially in the areas immediately off the west coast of Denmark, and extending out into the central, southern and south-western North Sea. Sprat also appear along the east coast of UK, whereas 0-wr herring are generally limited to the eastern half of the North Sea. High catch rates of both groups are also observed in the Kattegat and Skagerrak.

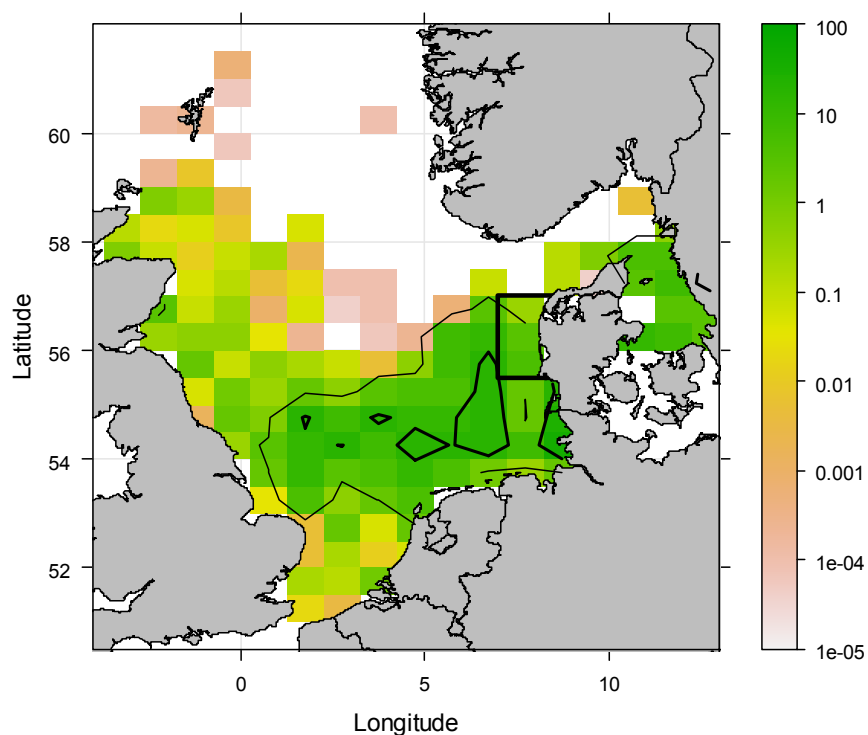


Figure 13.4. North Sea sprat. Mean CPUE from IBTS Q3, 1991-2006. Sprat Box outline (heavy black line). The medium-weight black contour line contains 50% of the population, whilst the lighter contour line contains 95%.

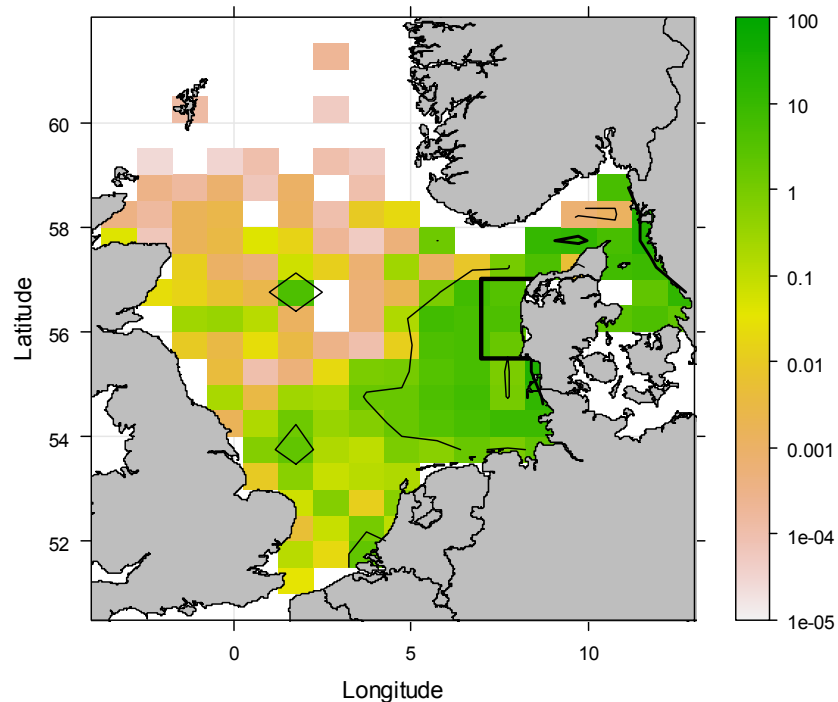


Figure 13.5. North Sea 0-wr herring. Mean CPUE from IBTS Q3, 1991-2006. Sprat Box (heavy black line). The medium-weight black contour line contains 50% of the population, whilst the lighter contour line contains 95%.

It is apparent from the CPUE spatial distributions that the ranges of sprat and 0-wr herring overlap significantly during the time in which the IBTS Q3 survey is carried out. Interpretation of these distributions can be aided by considering the ratio of the catch rates of the two species (Figure 13.6): the resulting value can be thought of as the number of 0-wr herring caught for every sprat caught. The catch-rate ratio shows a significant variation throughout the closed-area, varying from 0.25 in the south to 11.0 in the north. These values are on average higher than those in the areas to the west and south of the area where the largest proportion of the sprat population can be found.

An alternative metric can be derived from a probabilistic analysis of the IBTS haul data. It is well known that sprat and juvenile herring school closely together, especially in the nursery areas where the closed-area is located. Whilst the catch-rate ratio gives a measure of the relative average densities of the population, the frequency with which sprat schools contain herring is also important to consider, and may be more relevant to an actual fishery; indeed, one can envisage a scenario in which sprat and juvenile herring both occur in an area in high densities, but are not necessarily caught together by a specific metier due to different behavioural patterns.

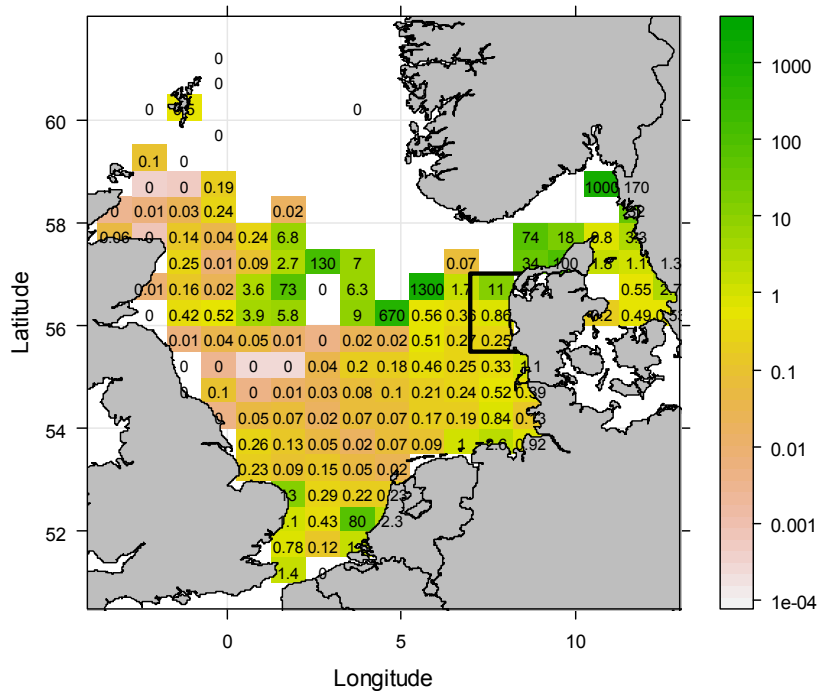


Figure 13.6. Ratio of 0-wr herring CPUE to sprat CPUE in a given stat-square, as estimated from IBTS Q3 data, 1991-2006. The ratio can be thought of as the number of 0-wr herring caught for each individual sprat caught. Numbers show the ratio for given rectangle. Sprat Box outline (heavy black line).

A measure of the co-schooling behaviour of sprat and herring can be obtained from the probability of observing juvenile herring in a haul that contains sprat (Figure 13.7). The probability of this occurrence is seen to be high in the closed-area (around 75% on average). However, even higher probabilities are observed to the west and south of the area, where the probability of herring appearing amongst the sprat approaches 100%. These results suggest that there is a tendency towards strong co-occurrence of the two species which, whilst high in the closed-area, is even higher in regions nearby.

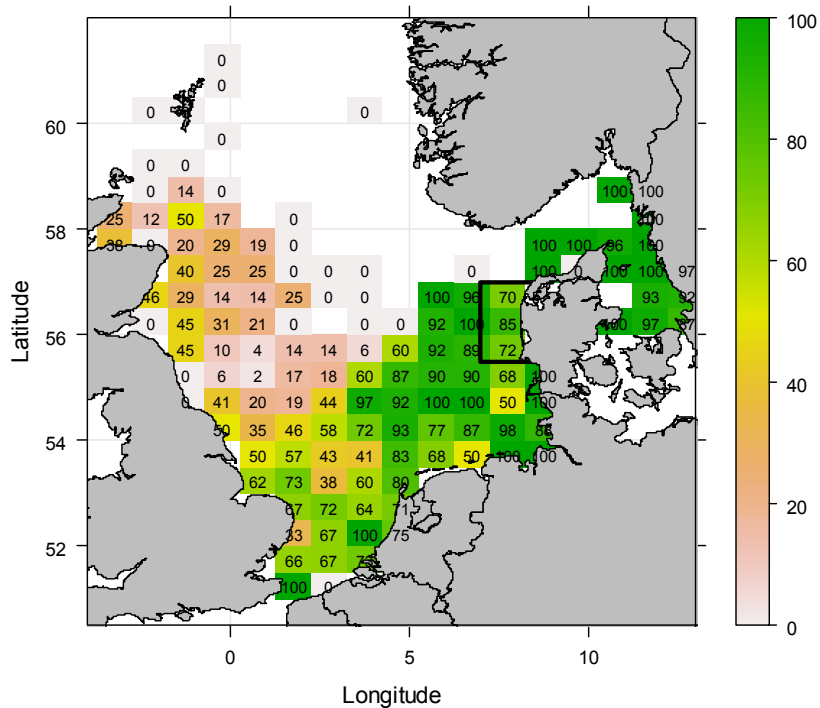


Figure 13.7. Percentage probability of a haul containing 0-wr herring given that it already contains sprat, from IBTS Q3 haul data, 1991-2006. Numbers show the probability for given rectangle. Sprat Box outline (heavy black line).

It should be borne in mind that these results are derived from the IBTS survey and therefore are the catches of a demersal trawl using GOV gear. However, it is not clear whether this method can reliably describe the distribution and abundance of sprat, which is a pelagic species. Furthermore, the question of how the IBTS catches relate to catches in the actual fishery is unclear. As a cross-check on these IBTS results, data from the North Sea acoustic survey was analysed. Unfortunately, the analysis was hampered by the poor availability of the relevant data, and only a limited analysis was possible. The distribution patterns of sprat (Figure 13.8) and 0-wr herring (Figure 13.9) observed show a significantly different pattern from those seen using the IBTS data (Figures 13.4 and 13.5). The distribution patterns of sprat and juvenile herring were observed to show a much more southerly pattern than that seen using IBTS. The sprat population was also quite disjointed and the species was almost absent from the closed area. While it was possible to calculate a relative catch ratio of juvenile herring to sprat (Figure 13.10), the lack of data and patchy nature of the distribution made interpretation of spatial trends difficult.

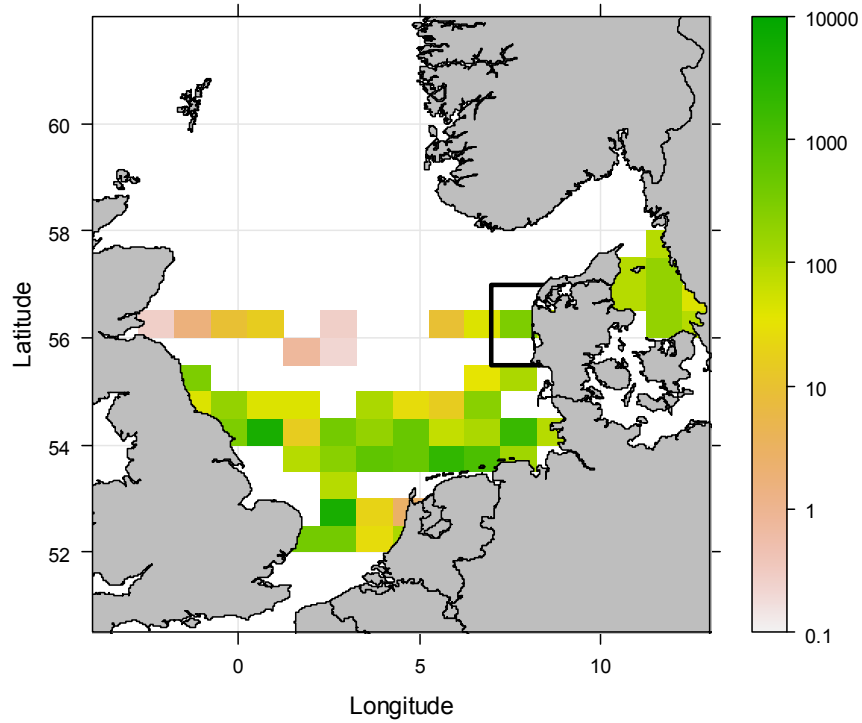


Figure 13.8. North Sea sprat. CPUE from 2006 North Sea acoustic survey. Sprat Box outline (heavy black line).

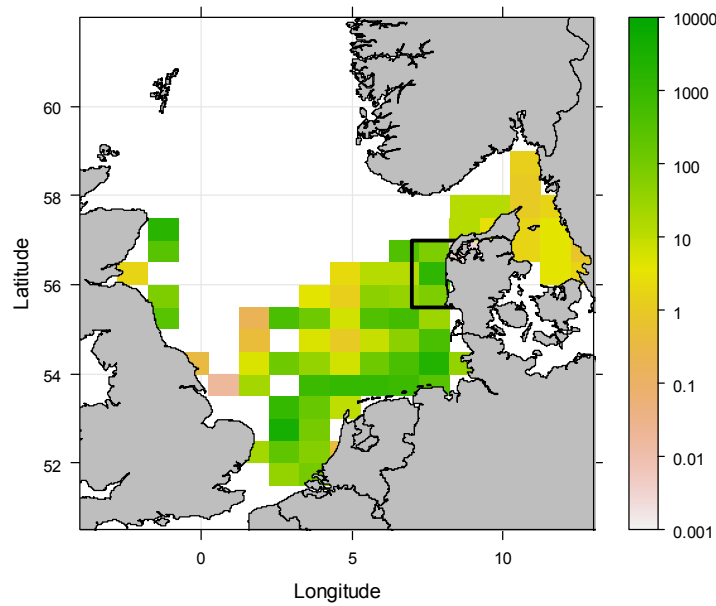


Figure 13.9. North Sea 0-wr herring. Mean CPUE from North Sea acoustic surveys, 2003-2006. Sprat Box outline (heavy black line).



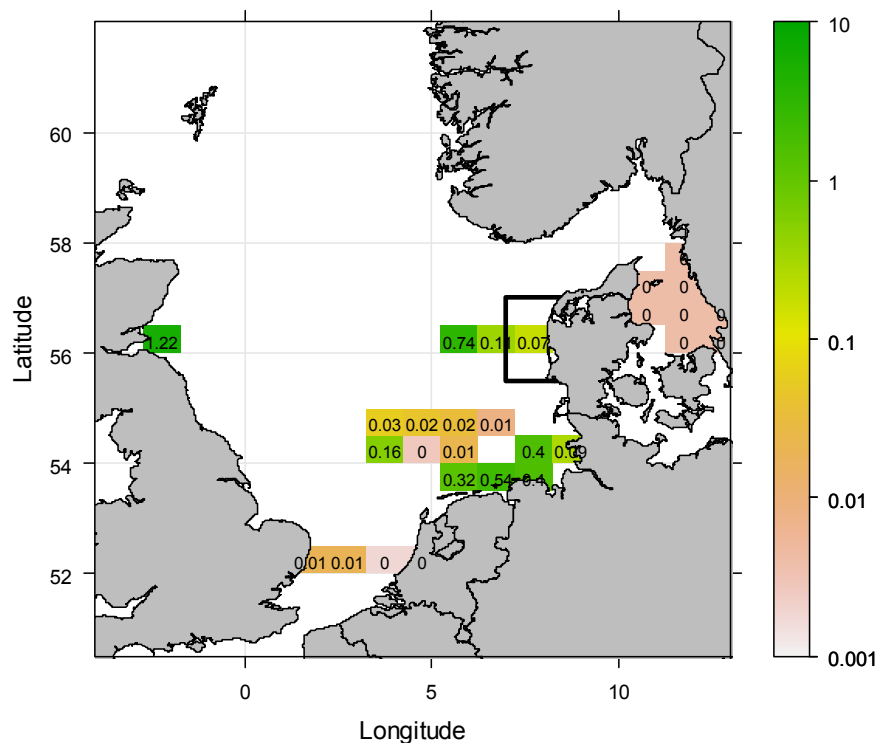


Figure 13.10. Ratio of 0-wr herring CPUE to sprat CPUE in a given stat-square, as estimated from the North Sea acoustic survey, 2006. The ratio can be thought of as the number of 0-wr herring caught for each individual sprat caught. Numbers show the ratio for given rectangle. Sprat Box outline (heavy black line).

The metric of most relevance in terms of bycatch intensity, however, is the mean CPUE of 0-wr herring in hauls that contained sprat (Figure 13.5.). This value can be thought of as the rate at which 0-wr herring are caught when catching sprat and thus it is a proxy for the bycatch intensity expected in an actual sprat fishery. Again, although the rate was high within the sprat box, areas to the west showed significantly higher rates.

*Discussion.*

Great care must be taken in the interpretation of the analysis presented here, and each result should be viewed in its appropriate context. However, the data does provide a qualified insight into the appropriateness of the current location of the closed area.

The results from the IBTS survey suggest that the closed area covers a region where there is potential for an appreciable bycatch rate of 0-wr herring, as seen in the ratio of the catch rates and the high propensity of the two species to occur together. However, these results are not unique to the closed area, and there are regions nearby, especially to the west and south, where both phenomena are stronger. These results therefore suggest that the position of the closed area may be sub-optimal. Moving or extending the Box to encompass these areas may give improved protection to juvenile herring.

An important caveat must be placed upon these results. These results are based on IBTS survey data, which uses a demersal GOV trawl, which is quite different to the gear used in the industrial sprat fishery. Differences in the relative selectivities for sprat and 0-wr herring between the two different sets of gear, as well as differences in the demersal/pelagic

behaviour of the species and how they interact with a demersal trawl, mean that the frequency and severity of juvenile-herring bycatch may be quite different in the fishery to that viewed through the lens of the IBTS.

Attempts to clarify the reliability of the IBTS survey were made by comparing the IBTS results against a similar analysis performed using acoustic-survey data; however, this approach proved to be largely unsuccessful. The limited amount of data readily accessible severely hampered the analysis. Furthermore, detailed comparison of the spatial patterns obtained from the IBTS and acoustic surveys showed no correlation between the values for a square, even though there is a good correlation between the total indices. The most likely explanation is due to differences in the timing of the two surveys; the IBTS Q3 survey occurs in August-September, whereas the acoustic survey is in June-July. The stock may have rearranged itself appreciably during this time, leading to observed changes in the distribution pattern. Further analysis is required to determine whether any useful information can be obtained from the acoustic survey.

It is also possible to analyse this closed area more directly via information from the fishery. However, such an analysis is hampered by many factors, not least of which is the lack of information coming directly from the Sprat Box area (as it is closed to the fishery). Work was performed towards this end, but unfortunately, it was not possible to draw any conclusions within the timeframe available. Further analysis is recommended.

#### *Conclusions.*

Analysis based on IBTS Q3 data suggests that the current placement of the closed area may be sub-optimal. However, the relationship between the IBTS indices and the expected bycatch rates of juvenile herring in the sprat fishery is unclear, as is the reliability of a bottom-trawl survey for assessing sprat abundance. Attempts to resolve this issue using information from acoustic surveys have been hampered by the poor availability of the data. As a consequence, it has not been possible to rigorously assess the effectiveness of closure in its current or alternative configurations. Further analysis is recommended.

#### **Confidence in evaluation**

See above *Conclusions*.

#### **Adverse effects of current closure**

There is a potential risk that fishing effort displaced as a result of the closure may be displaced to areas in which densities of juvenile herring may be relatively higher than within the closed area. The potential result may therefore be an industrial sprat fishery in more important herring nursery areas that is intensified by a factor corresponding to the fisheries effort displaced from the closed area.

#### **Recommendation on closure**

New analyses of juvenile herring catch rates gathered through IBTS-surveys (3rd Quarter 1991-2006) led SGMOS-07-03 to conclude that the sprat closed area is currently performing sub-optimally in the fulfilment of its objectives, i.e. to protect juvenile nursery areas and to protect juvenile herring. However, this result is subject to a crucial caveat regarding the question of how the IBTS survey results relate to actual catches from the targeted industrial sprat-fisheries and how well the IBTS survey describes sprat abundance. It was therefore

deemed necessary to conduct additional analyses to determine how representative the IBTS data is by comparison with acoustic surveys. Substantial differences between these two surveys were found.

It is apparent that further analyses are required to fully understand the effectiveness of the current closure and/or any re-configuration of the closure. Until then, the current closure should remain in place.

### **Recommendations on data requirements**

Information not available to SGMOS-07-03 and therefore not used.

- VMS to determine the location of fisheries effort in general or in relation to displaced fishing effort
- North Sea acoustic survey herring and sprat abundances (data was only partially accessible in the time frame available)

### **Further data collection requirements**

- detailed knowledge of the exact spatial distribution of juvenile herring
- Regarding appropriateness of the timing or duration of the closure (Payne 2007), data with a much higher temporal-resolution than is currently available (and comparable spatial resolution) are required.
- There is also potential for further analysis of this problem directly from the fishery data. However, this would require age- and statistical rectangle- resolved data on the herring bycatch in the commercial sprat fishery.

There is a need for further investigation of the relationship between the IBTS Q3 survey catch rates and those in the actual commercial fishery before conclusions regarding relocation of the Sprat box can be drawn. The following recommendations provide a framework for further investigations (Payne *et al.* 2007):

1) A comparison of IBTS Q3 CPUE with acoustic survey results for both sprat and 0-wr herring across the entire North Sea was attempted in the current analysis, as such a comparison might contribute to knowledge regarding whether or not the IBTS Q3 adequately represents the distribution and catch rates of these two species. However, it was not possible to obtain all data necessary to carry out the entire analysis. It is recommended that all acoustic data sets (sprat & herring) be transferred into the Fishframe database. A simplified and single-pointy-of-entry method for approving the use of this data would also make this system easier to use.

2) Compare IBTS Q3 CPUE and commercial catch rates from logbooks of both sprat and 0-wr herring during the third quarter in the North Sea. Due to the closure of the Sprat Box to the fishery during the third quarter, there is no reliable information available about catch rates in this area. However, if the IBTS can be shown to adequately describe the commercial catch rates outside the Box, then it is reasonable to expect that it will also do so inside the Box.

3) Analysis of 0-wr herring bycatch data in sprat fisheries. Such an analysis, while being the ideal manner in which to approach this problem, is constrained by two factors: firstly, the

absence of commercial catch data in the Sprat Box during the relevant time period, and secondly, the lack of information regarding the age structure of the herring bycatch. It may be possible to resolve this second problem using length-based analysis of the bycatch data, but it is currently unclear whether such an analysis is feasible on a statistical square basis.

4) In the case of significant differences between the results of analyses 1, 2 and 3 it is recommended that field studies be performed. Specifically, it is envisaged that a high-resolution acoustic survey be performed in the Sprat Box area and adjacent areas during the time of closure, examining the distribution of sprat and 0-wr herring, and especially the co-occurrence of these two species in schools. Such work could be performed as part of the standard IBTS Q3 survey or the North Sea acoustic survey, and would require only three to four days of ship time.

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## 14. CLOSED AREA FOR THE CONSERVATION OF MACKEREL

### Summary

The 2002 meeting of the ICES Working Group on the Assessment of Mackerel, Horse mackerel, Sardine and Anchovy (WGMHMSA) carried out a detailed evaluation the mackerel box (ICES, 2003). SGMOS-07-03 considers the WGMHMSA evaluation and the subsequent advice provided by ACFM in October 2002 provides a strong indication that the mackerel box was beneficial for conservation of Northeast Atlantic mackerel at the time of the evaluation.

No subsequent evaluations were available to SGMOS-07-03 to determine if the mackerel box continues to have the same conservation benefits, and SGMOS-07-03 did not have the full data and expertise of the mackerel stocks and fisheries to carry out an evaluation of the current appropriateness of the Mackerel Box or any potential changes in the closure that could be beneficial.

In view of possible shifts in distribution of mackerel, a further evaluation using up-to-date fishery and survey data should be carried out by ICES to determine if the current Mackerel Box arrangement remains appropriate for conservation of the stock. The previous evaluation was in 2002, and SGMOS-07-03 considers that a re-evaluation within five years would have been appropriate. A re-evaluation by mackerel experts is therefore overdue.

### Legislation

Article 22 of Council Regulation (EC) No 850/98 provides restrictions on fishing for mackerel in an area in the western English Channel and the Celtic Sea (Figure 14.1). It prohibits the retention on board of mackerel within the area except where the weight of the mackerel does not exceed 15 % by live weight of the total quantities of mackerel and other marine organisms on board which have been caught in this area (Appendix 2.9).

The regulation does not apply to vessels fishing exclusively with gill nets and/or hand lines. It also does not apply to vessels fishing with demersal trawls, Danish seines or other similar towed nets, provided that they have on board a minimum of 75 % by live weight of marine organisms with the exception of anchovy, herring, horse mackerel, mackerel, pelagic cephalopods and sardine, calculated as a percentage of the total live weight of all the marine organisms on board. Other conditions are given in the Regulation.



Figure 14.1. Extent of the mackerel box in 2007. *Whilst every effort has been made to ensure the accuracy of the information on this map, the Directorate-General for Fisheries and Maritime Affairs takes no responsibility or is not liable whatsoever for any errors or omissions. The boundaries shown on this map are for illustrative purposes only.*

Table 14.1. Goals and objectives – mackerel box

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Conservation of the Northeast Atlantic mackerel stock.	Reduce fishing effort on age 1-3 mackerel in Quarter 1&2 and ages 0-2 in Quarter 3&4.	None explicit. <i>Required indices would be fishing mortality estimates for mackerel, by age.</i>	None explicit <i>Achievement of desired selectivity pattern</i>	<i>Fishery landings and discards data by age class and rectangle; survey and fishery CPUE data; analytical assessment.</i>

### Background to closure

The Mackerel Box was established to reduce the fishing effort on juvenile mackerel in the Northeast Atlantic (ages 1,2 and 3 in Quarters 1 and 2, and ages 0,1 and 2 in Quarters 3 and 4). Juvenile mackerel are considered to be abundant in Divisions VIIe,f,g,h which are covered by the Mackerel Box. A seasonal closure was imposed from 1980 and the area was permanently closed in 1985 to all methods of mackerel fishing except quota-regulated vessels using gill nets or handlines. Mackerel may also be taken legally inside the Box as a 10 or 15% bycatch in the Danish industrial fishery for horse mackerel and pilchards and the Dutch human consumption fisheries targeted at horse mackerel.

The 2002 ICES evaluation of the Mackerel Box noted that the only other area with restrictions on the fishing of juvenile mackerel is in the southern North Sea in which large numbers of juvenile mackerel occur during the third quarter of the year. This area, like the Mackerel Box is closed to a targeted mackerel fishery throughout the year and was a conservation measure introduced after the North Sea stock had been severely over-fished.

### Subsequent amendments affecting the closure

SGMOS-07-03 was not aware of any subsequent changes to the Mackerel Box regulation.

### Summary of previous evaluations

The 2002 meeting of the ICES Working Group on the Assessment of Mackerel, Horse mackerel, Sardine and Anchovy (WGMHMSA) carried out a detailed evaluation the Mackerel Box (ICES, 2003), and this formed the basis for advice given by ACFM in October 2002 in response to a special request. The main outcomes of the review are summarised below:

- The age compositions of the commercial catch in number at age recorded within Divisions VIIefgh (the area covered by the mackerel box) in the years 1988 – 2001 show that juvenile fish constitute the greatest proportion of the catch in numbers, with a range from 70 – 85%. Surveys carried out in the Mackerel Box indicated the proportional number of immature fish within samples taken from the Mackerel Box at 91% in 1990, 60% in 1991, 76% in the winter of 1995/6 and 69% in 1998.
- Catches of mackerel in Division VIIefgh in recent years comprised 38% of the total catches (and hence fishing mortality) of 1-year-olds and 26% of the catches and fishing mortality of 2-year-olds.

- Mackerel caught in Divisions VIIegfh have lower weights at age than other Northeast Atlantic areas.
- The yield-per-recruit calculated using the partial F vector and weights-at-age for catches taken in Divisions VIIegfh is 15% lower than the equivalent value using the F-vector and weights-at-age in the area outside VIIegfh. The loss is due to the low weight of fish taken in divisions VIIegfh and the low modal age of capture. The result is consistent with previous studies.

The WGMHMSA evaluation recommended that the loss of potential yield and the increased risk to the spawning stock of the NEAC mackerel should be avoided, and that the Mackerel Box should remain closed to targeted mackerel fishing.

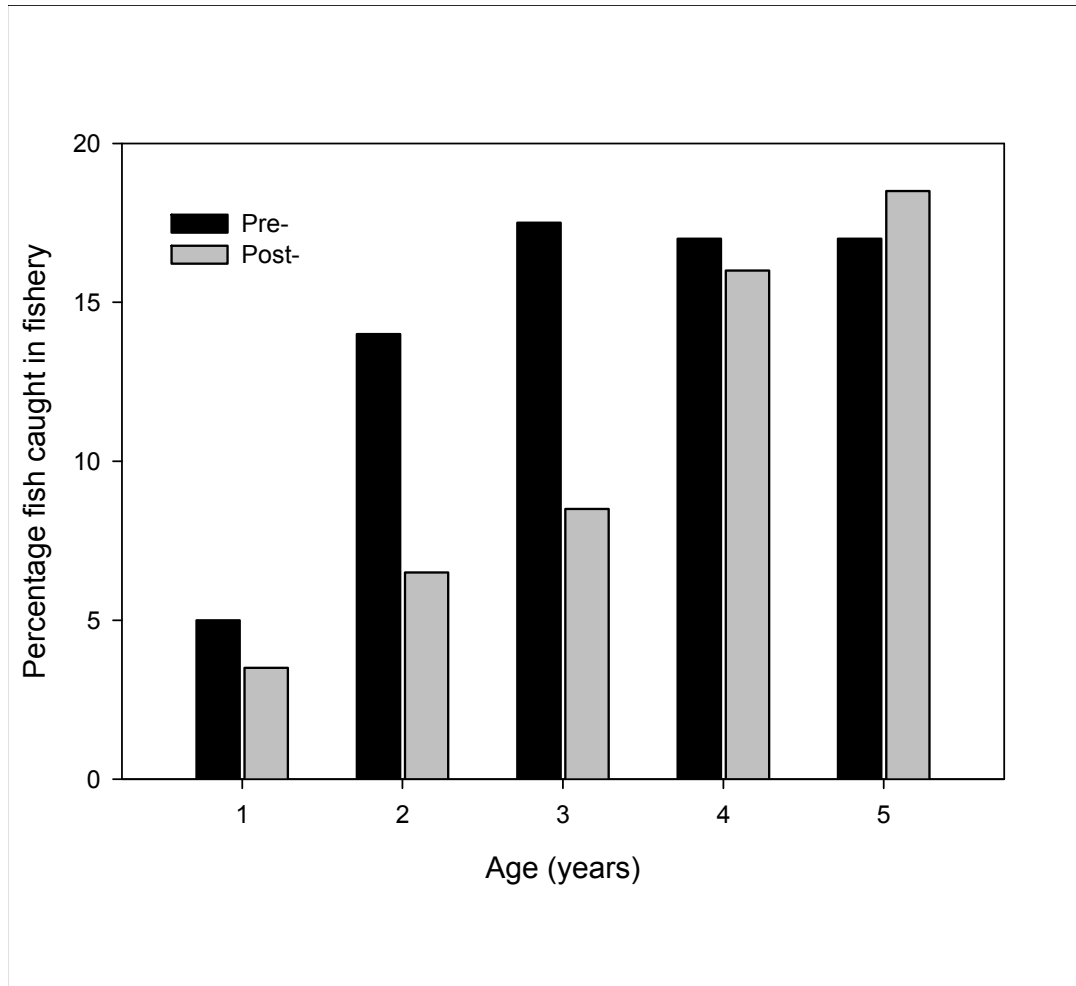


Figure 14.2. Change in fishing mortality by age-class in the mackerel fishery as represented by the percentage change in numbers caught for ages 1 – 5+. Pre-closure years = 1981-83, post-closure years = 1985-86.

**Information available to SGMOS-07-03 for evaluating the closure**

SGMOS-07-03 did not have the full data and expertise of the mackerel stocks and fisheries to carry out an evaluation of the current appropriateness of the Mackerel Box or any potential changes in the closure that could be beneficial.

### **Effectiveness of closure**

SGMOS-07-03 considers the ICES (2003) evaluation provides a strong indication that the Mackerel Box was beneficial for conservation of Northeast Atlantic mackerel at the time of the evaluation.

### **Confidence in evaluation**

No subsequent evaluations were available to SGMOS-07-03 to determine if the Mackerel Box continues to have the same conservation benefits. Historically the Mackerel Box contained a large proportion of juveniles, and continues to do so, but shifts in the distribution of mackerel may have resulted in other areas now also having a high proportion of juveniles.

### **Adverse effects of closure**

SGMOS-07-03 is not aware of any adverse effects of the closure.

### **Recommendation on closure**

In view of possible shifts in distribution of mackerel, a further evaluation using up-to-date fishery and survey data should be carried out by ICES to determine if the current Mackerel Box arrangement remains appropriate for conservation of the stock. The previous evaluation was in 2002, and SGMOS-07-03 considers that a re-evaluation within five years would have been appropriate. A re-evaluation by mackerel experts is therefore overdue.

### **Recommendation on data requirements**

The current data collection appears appropriate for evaluating spatial population structure of mackerel, providing sampling levels are sufficient. The data required for an evaluation include spatial data on fishery catches (landings and discards), age compositions and weights-at-age by fleet metiér, and survey data on population distribution, abundance and size/age structure.

### **References**

ICES, 2003. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, 10-19 September 2002. ICES CM 2003/ACFM:07.

## **15. ROCKALL HADDOCK BOX IN ICES ZONE VI**

### **Summary**

Rockall haddock box, which is formed by one ICES rectangle (42D5), was established in 2001 in the NEAFC area and in 2002 in the EU waters. All fishing activities are prohibited within the box, except with longlines. The goal of this area closure was to protect juvenile haddock by preventing bycatch. Only a very limited evaluation of its effectiveness has been made. Some changes in exploitation pattern were observed in the area following the closure, especially with regard to small haddock, but estimates of fishing mortality at these age groups are very uncertain due to different discarding practices applied by EU and international ICES fleets. This limited evidence suggests that the closure had the desired effect and that it should be maintained.



## Legislation

Point 6 from Annex III of Council Regulation (EC) No 41/2007 defines a closed area for the protection of juvenile haddock in ICES area VIb (Appendix 2.10). The legislation prohibits the use of all fishing, except with longlines within a defined area of ICES division VIb (Figure 15.1).

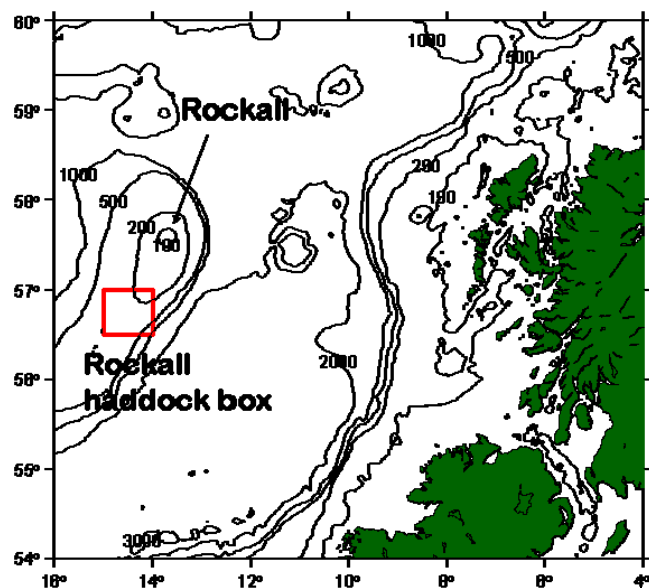


Figure 15.1 Location of Rockall haddock closure.

Table 15.1 Goals and objectives – Rockall haddock closure.

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Conservation of Rockall haddock	None explicit <i>Protect juvenile haddock (by preventing bycatch) and improve the selection pattern</i>	None explicit <i>Fishery selection pattern</i>  <i>Distribution of haddock of different sizes/ages relative to closure.</i>	None explicit <i>Desired selection pattern achieved</i>  <i>Fraction of juvenile haddock population in closure relatively larger than for older fish.</i>	None explicit Fishery landings and discards by size/age class; stock assessment.  Groundfish surveys conducted by FRS, Scotland, in the Rockall area since 2001 (incomplete time series)

## **Background to closure**

The Extraordinary Meeting of NEAFC in March 2001 adopted a recommendation for closing an area to the west of the Rockall Bank (ICES Sub-division VIb) for all trawl fishing as a first step to establish appropriate management measures for Rockall haddock in the Regulatory Area (NEAFC 2001, Annexes). The Rockall haddock box was established in 2001 in the NEAFC area (western part) and in 2002 in the EU waters (eastern part). All fishing, except with longlines, was prohibited in Community and international waters in the box formed by one ICES rectangle (42D5). The closure was maintained in subsequent years, in NEAFC agreements and Council Regulations (ICES 2002).

## **Subsequent amendments affecting the closure**

No subsequent amendments have been made since the imposition of the closure.

## **Summary of previous evaluations**

NEAFC requested ICES in 2001 and 2002 to evaluate the spatial distribution of the fishery, the spawning stock and the juvenile fish of the stock of haddock around Rockall, especially the proportion of the juveniles below 200 m. Based on this, the possibility was considered of changing the limits and/or establishing new limits along the 200 m depth contour. This would allow NEAFC to consider how appropriate the area and seasonal closures were relative to other measures, such as using larger mesh sizes and TACs. NEAFC also requested ICES to provide information on the effect of the Rockall Box in preventing bycatch of juvenile haddock and consider other possible area closures (NEAFC 2001, 2002, Annexes). However, ICES has not been able to quantify the effects of the closed area or suggest other boundaries of the box.

## **Inventory of data for evaluating the effectiveness of the closure**

No closure-specific monitoring has been carried out. Some survey information is available (ICES 2007). FRS has conducted ground fish surveys in the Rockall area since 1997 of alternate years. Due to concerns about the haddock stock at Rockall some extra time was allocated to carry out a partial survey in September 2002. Full surveys were conducted in 2005–2007. The Scottish survey is conducted on 49 standard trawl stations. However, the survey area and number of stations varied in different years and do not cover the full period before and after the closure (ICES 2006). A Russian trawl-acoustic survey was conducted in 2005. Data on discards are available from EU vessels. Some EU and NEAFC data on VMS are available for 2002 and NEAFC VMS data for 2003–2005, but they are of limited value due to incomplete coding of fishing gear and because they do not discriminate between fishing and steaming. No logbook information is available for the total fishery. Some logbook information is available on the UK fleet.

## **Effectiveness of closure**

Some changes in exploitation pattern were observed in the area following the closure, with lower relative exploitation rate on age groups 1 and 2 (ICES 2006). Also some decrease in total UK fishing effort (except longlines) on the Rockall Bank as a whole and an increase in the other VIb rectangles were observed, but it is not known what proportion of that effort was applied directly to the haddock fishery (ICES 2006).

### **Confidence in evaluation**

The estimates of fishing mortality at age groups 1 and 2 are very uncertain, mainly due to different discarding practices applied by EU and international ICES fleets (ICES 2007). The haddock catch by Scottish and Irish vessels is underestimated in young age groups as a result of discarding of small individuals. On Russian vessels, the whole catch of haddock is retained onboard. In some years, haddock discards onboard Scottish and Irish vessels were determined directly, while in other years, indirect discard estimates were calculated. Discard data collected from Scottish vessels in 1999 and 2001 show that only a small proportion of small haddock taken aboard is landed.

### **Adverse effects of closure**

No adverse effect has been found.

### **Recommendation on closure**

The limited evidence from the change in the exploitation pattern before and after the closure does suggest that the closure had the desired benefit. However, the quality of the discard data has been questioned. On the basis of available evidence SG-MOS 0703 recommends that the closure should be maintained.

### **Recommendation on data requirements for further evaluation**

There is a need to continue the sampling programme and monitor changes in fish densities and size structure. Also collection of gear and fishing/non-fishing information for the NEAFC and EU area should be improved before a more complete evaluation of the closure.

### **References**

ICES 2002. Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks (WGNSDS), 14–23 August 2001, ICES Headquarters. ICES CM 2002/ACFM:02. 448 pp.

ICES 2006. Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems, 2006. ICES Advice. Books 1–10. 5, 271 pp.

ICES 2007. Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks (WGNSDS), 8–17 May 2007, Galway, Ireland. ICES CM 2007/ACFM:22. 852 pp.

NEAFC 2001. Report of the 20th Annual Meeting of NEAFC, 5–9 November 2001. Annex R.

NEAFC 2002. Report of the 21st Annual Meeting of the North-East Atlantic Fisheries Commission, 12–15 November 2002. Volume 2 – Annexes, Annex S.

## 16. FIRTH OF CLYDE COD CLOSURE

### Summary

The Clyde seasonal closure was put in place in 2001 and is intended to protect spawning cod. In the past, the majority of landings were made during the spawning season of cod. The Clyde closure includes the main cod spawning area of an aggregation of cod that is reproductively isolated from the major spawning aggregation of VIa. Although the effect of the closure on this sub-stock is unclear, based on the high densities of mature cod within the closed area at spawning time, it is likely to be having some positive impact on an aggregation that is susceptible to local depletion. Therefore SGMOS-07-03 recommends that the seasonal closure remains in place.

### Legislation

Article 1 point b) and c) from Council Regulation (EC) No 456/2001 defines a closed area for the conservation of cod in the Firth of Clyde. The legislation prohibits the use of any demersal trawl, seine or similar towed net, any gill net, trammel net, tangle net or similar static net or any fishing gear incorporating hooks within a defined area of ICES division VIa from 14 February to 30 April (Figure 16.1). Derogations are provided for fishing with gears appropriate for the capture of pelagic fish, molluscs and crustaceans. For *Nephrops*, catches retained on board can only be landed if their percentage composition complies with the conditions laid down with respect to towed gears of mesh size range 70 mm to 79 mm in Annex I of Council Regulation (EC) No 850/98 of 30 March 1998 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms.

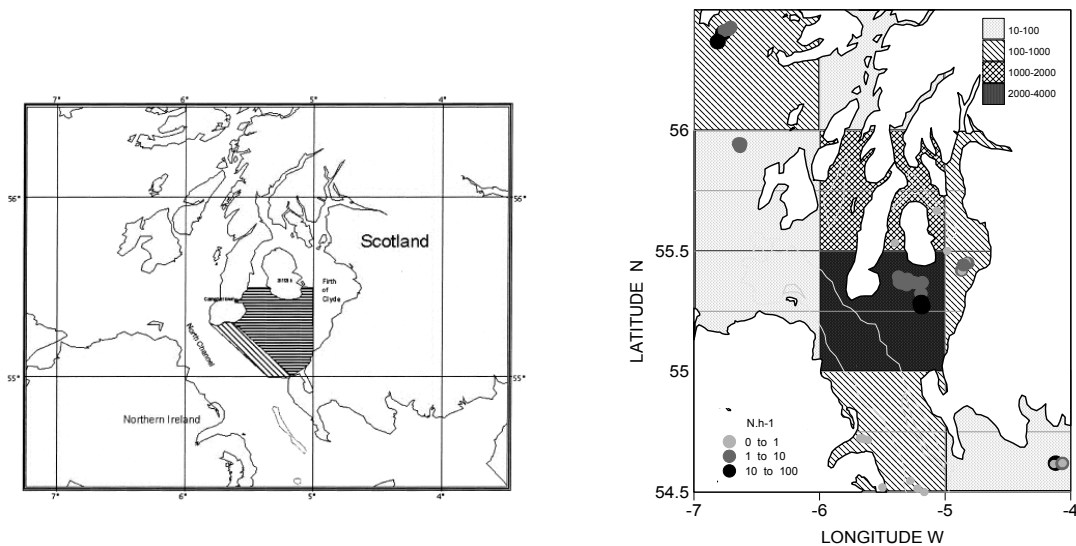


Figure 16.1. a) Chart showing the area closed to fishing. All bottom trawling is prohibited in the stippled areas except for trawling for Norway lobster in the inner area, b) the total UK March and April landings (tonnes) into Scottish ports for the period 1986-2005 by ICES rectangle. Coloured circles refer to number of spawning cod caught per hour research vessel tow in 2002-04.

Table 16.1. Goals and objectives – Clyde cod closure

Goals	Specific objectives	Indices of success	Success criteria	Monitoring
Protection of adult cod during the spawning period	None explicit	None explicit  <i>Required indices would be: fishing mortality on cod associated with catches inside and outside closure.</i>	<i>Extent of reduction in fishing mortality on mature cod attributable to closure.</i>  <i>Local increase in SSB</i>	Research vessel derived indices of local SSB and Z.

### Background to closure

In November 2000, the International Council for the Exploration of the Sea (ICES) reported that the VIa stock was at serious risk of collapse. At the December Council meeting the same year, the Commission noted the urgent requirement to establish a recovery plan for cod to the west of Scotland. The immediate requirement was to allow as many cod as possible to spawn before the end of April 2001 when the spawning season finishes. The Clyde Sea area (see Figure 16.1a) was one of the two areas closed (Anon., 2001). The area closed to fishing comprises part of ICES statistical rectangle 39E4 that excludes the deep North Channel. The closure was intended to cover the spawning period and coincide with a similar Irish Sea closure (14 February to 30 April). This was important since the ICES Working Group on the Assessment of Northern Shelf Demersal Stocks (ICES, 2002) reported a displacement of whitefish trawl effort to the North Channel and Clyde following the Irish Sea closure in 2000.

Whilst the Clyde fishery accounts for < 10% of the VIa landings it one of the two most important spawning areas south of the Minch. Most cod are landed in March and April in the Clyde (64% over the period between 1986 and 2000) and this period coincides with the spawning time of cod in this area (Wright *et al.*, 2006a). Hislop (1986) showed that monthly landings per unit effort (LPUE) over the period 1971-80 varied by 10 fold with the peak in LPUE occurring during this spawning period. The area of spawning cod in the Clyde accounts for the largest proportion of landings in March and April in the southern part of VIa (Figure 16.1b). Therefore, the Clyde closure appears to exclude fishing from a locally important spawning aggregation.

### Subsequent amendments affecting the closure

The Clyde Sea closure has since continued under national UK legislation (Anon., 2002; 2007).

### Summary of previous evaluations

There has not been any EC or ICES review of the closure. FRS prepared a review of the Clyde cod closure in 2006 (Wright *et al.*, 2006a).

## Inventory of data for monitoring the effectiveness of the closure

None of the Clyde cod regulations provided for specific monitoring programmes to evaluate the success of the closed area (CA) in meeting its objectives of protecting adult cod during the spawning season. However, data for evaluation of the closure are available from the fishery, catch sampling and surveys. The type of information necessary for a full evaluation of the cod closure is listed in Table 16.2 and much of the biological information can be found in Wright *et al.* (2006a, b & c).

### Effectiveness of closure

#### *Appropriateness of the spatial and temporal coverage of the closure*

The closed area encompasses an area that has much higher catch rates of cod than in other areas of the North Channel and western Irish Sea during the spawning season (Figure 16.1b; Figure 16.2). FRS surveys have also indicated that most spawning occurs in the closed part of the Firth of Clyde (Figure 16.1b).

Information on adult cod movements is available from tag-recapture experiments using conventional and electronic tags (Wright *et al.*, 2006b, c). These studies do not indicate any significant exchange of adults between the northern and southern part of ICES area VIa. Most cod released in the Clyde during the spawning period were recaptured within 80 km of their release position. Cod may move outside of the closed area after spawning including into the north Channel and Irish Sea (Wright *et al.*, 2006c; Armstrong *et al.*, 2005). Nevertheless, conventional tag-recaptures suggest cod return to the Clyde to spawn (Wright *et al.*, 2006b). In VIa, substantially elevated densities of juvenile cod were only found within the Clyde and isolated sites off Mull and in the Minch (Gibb *et al.*, 2007). Analyses of otolith elemental concentrations of 0-group cod and the 0-group component of the otolith from the same year-class at age 2 indicate that most adults originate from local nursery areas (Wright *et al.*, 2006b). Particle tracking modelling, using fine scale 3-D oceanographic models conducted as part of the EU METACOD project strongly indicate that the Clyde Sea area is quite retentive, with relatively little import from more northerly spawning grounds. Therefore, recovery within the Clyde is likely to be dependent on the intrinsic rate of population growth in this area rather than recruitment from other areas.

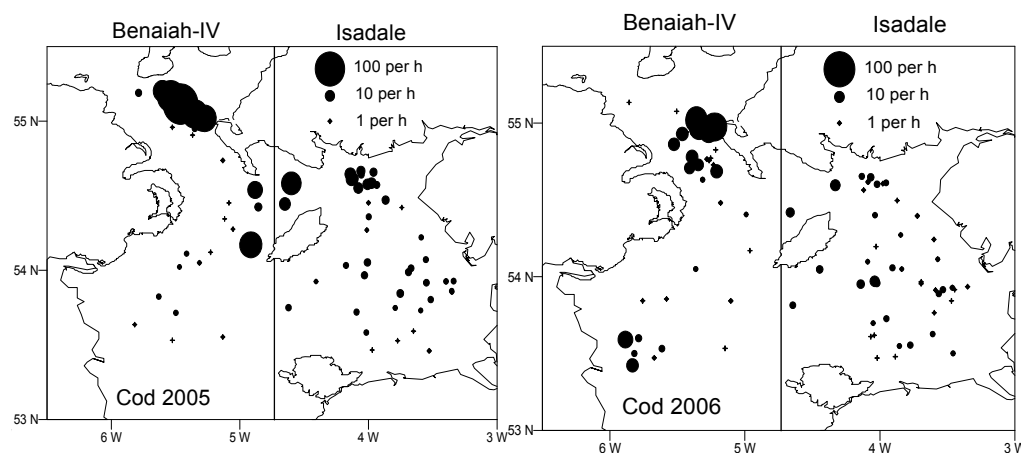


Figure 16.2. Catches of cod per hour of trawling during the spawning season; symbols marked at mid-tow positions with height proportional to catch per hour (Armstrong *et al.*, 2006).

## **Effectiveness for reducing fishing mortality on adult cod**

The spawning stock of cod in the Clyde comprises a high proportion of 2-year-olds and almost all 3-year-old and older fish. Given the relatively minor contribution of the Clyde to VIa landings, stock indicators from the ICES assessment are probably irrelevant to evaluations of the closure.

Whilst SGMOS-07-03 cannot conclude that the cod closure has led to a significant reduction in fishing mortality there are reasons to believe this is probably the case. This is because the closed area protects a relatively high density of spawning cod and past evidence indicates greatly elevated catch rates during the spawning season (Hislop, 1986). Hence the seasonal closure may be expected to have had a disproportionately large restriction on effort and catch of cod.

Estimates of spawning stock biomass (SSB) and recruitment (numbers at age 1) for the Clyde Sea and adjacent areas have been made from 1st quarter research vessel trawl survey data (Holmes *et al.*, in prep.). These indicate that cod SSB in the Firth of Clyde has not declined to the same extent as in the central part of VIa.

A more comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required.

## **Confidence in evaluation**

Research following the closure clearly shows that Clyde cod could be subject to local depletion since they appear largely self-recruiting. Whilst SGMOS-07-03 did not have sufficient information available to carry out a full evaluation of the success of the Clyde cod closure for conservation of this sub-stock SGMOS-07-03 did consider this was highly likely to have had some benefit.

## **Adverse effects of closure**

Switching of whitefish trawlers to derogated *Nephrops* trawls, or displacement of effort to other areas with different population structure of cod, could potentially cause an undesirable shift in exploitation pattern towards younger cod.

## **Recommendation on closure**

Given the displacement of effort from the Irish Sea closure and the importance of the Clyde closure to what appears to be a resident sub-stock, the decision to close the area would appear to have been precautionary. As there is the potential for local depletion of a sub-stock SGMOS-07-03 recommends that the Clyde cod closure is maintained.

## **Recommendation on data requirements**

SGMOS-07-03 recommends a need to estimate local fishing and total mortality the region and surrounding waters for a before-after control-impact analysis.

Table 16.2. Inventory of the type of information necessary for a full evaluation of the Clyde cod closure, together with a brief indication of what is currently available.

<b>Information required</b>	<b>Information available</b>
Information on spatial stock structure.	<i>Information available from tagging studies, otolith microchemistry, otolith shape, juvenile and spawning distribution.</i>
Information on seasonal movements fish of different sizes and ages into and out of the CA	<i>Limited data available from tagging.</i>
Relative densities of populations inside and outside the CA (+ gradients).	<i>CPUE from surveys .</i>
Age/size structure of the population and fishery catches inside and outside the CA (+gradients)	<i>Survey data and fishery sampling data available – fishery data at rectangle level.</i>
Stock reproductive potential.	<i>Size and age related fecundity data available for 1969-70 and 2002-3.</i>
Time series of relative or absolute abundance of adult fish and recruits in each population.	<i>Survey data.</i>
Time series of fishing mortality estimates by length or age in each population.	<i>No data currently available.</i>
Time series of fishing effort and fishery landings and discards for appropriate fleet units, available at the spatial and temporal resolution of the CA. Knowledge of accuracy of data is required.	<i>Landings data potentially available for all fleets, but at trip and ICES rectangle scale. Processed VMS data potentially available.</i>
Knowledge of fishermen's tactical decisions in response to the CA.	<i>Limited information available.</i>
Indirect effects of the CA on fishing mortality (e.g. economic factors leading to vessel decommissioning).	<i>Data on fleet structure and decommissioning available.</i>
Changes in other regulations or processes affecting fishing mortality or spawning success	<i>Details of regulations available; information on environmental and biological processes relatively poor.</i>

## References

Anon. 2001. Commission Regulation (EC) No 456/2001 of 6 March 2001 establishing measures for the recovery of the stock of cod to the west of Scotland (ICES Division VIa) and associated conditions for the control of activities of fishing vessels. Official Journal of the European Communities L65/13



Anon. (2002) The Sea Fish (Prohibited Methods of Fishing) (Firth of Clyde) Order 2002. Scottish Statutory Instrument 2002. HMSO, No. 58

Anon. (2007) The Sea Fish (Prohibited Methods of Fishing) (Firth of Clyde) Order 2007. Scottish Statutory Instrument 2007. HMSO, No. 63

Armstrong, M., Cotter, J., Witthames, P., Bevan, D., and Malone, D. 2005. Final report of Programme 4: Irish Sea roundfish, Fisheries Science Partnership, 41pp.

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Gibb, F., Gibb, I.M., and Wright, P.J. 2007. Isolation of Atlantic cod (*Gadus morhua*) nursery areas. Marine Biology, 151: 1185-1194

Hislop, J.R.G. 1986. The demersal fishery in the Clyde Sea Area. Proceedings of the Royal Society of Edinburgh Section B, 90: 423-437

Holmes, S.J., Wright, P.J., and Fryer, R.J. in prep. Evidence for regional variability in cod dynamics in the North Sea and West of Scotland from survey data. ICES Journal of Marine Science

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## 17. HOW TO MONITOR AND EVALUATE CURRENT AND FUTURE CLOSURES

### Objectives

For stocks the Closed Area (CA) is designed to benefit, *ideally*, the objectives will have been established as part of the design and regulation process. Having clear objectives is a key prerequisite for evaluation. The objectives of CAs are generally focused on the following for specific areas at specific times of the year, if not all year:-

- protect spawning stock/grounds
- protect juveniles/nursery grounds

For some of the older closures, these objectives were not stated in the regulation but can be assumed, whilst for others the objectives remain a mystery. More recently, the regulations have included specific objectives and Table 17.1 shows the objectives of the CAs this meeting was tasked with evaluating:-

Table 17.1 Key objectives of the evaluated CAs

<i>Protect spawning stocks/grounds</i>	<i>Protect juveniles/nursery grounds or improve selectivity</i>	<i>Protect dependent predators</i>
Cod in ICES zone VIa	Norway Pout	North-east UK sandeel
Cod in Irish Sea	Hake	
Herring – East of England	Herring - Clyde	
Herring – Butt of Lewis	Herring – Irish Sea	
Herring – Irish Sea	Sprat to protect herring	
Herring – southern Irish Coast	Conservation of mackerel	
Herring in ICES zone IIa	Rockall Haddock ICES zone VI	

For several of these CAs, the evaluations revealed an emergent secondary objective of reducing fishing mortality of the stock. In the case of Celtic Sea cod (Trevose closure), the closure of the spawning grounds was specifically designed to reduce fishing mortality as an alternative to direct effort control. The key objective of the North-east UK sandeel CA was the protection of diving seabirds and this is considered in the section on species and habitat conservation, but this is a good example of a CA that is now considered to have a fishing mortality reduction objective in the face of recent concerns about the state of this stock.

### **Ideal evaluation approaches**

*Ideally*, for any given CA the following parameters will have been monitored both pre and post-closure (time series data), and both inside and outside the CA (spatial data), *ie* Before-After-Control-Impact experimental design (BACI).

1. Fishing effort and mortality (retained and discarded) for the total area of the stock in question;
2. CPUE: for surrounding open area where stock is exploited and/or in the CA during the open season. This will provide for extrapolations to assess density gradients of the stock(s) in question across the CA boundaries, *ie* the effectiveness of the CA in reducing fishing mortality and increasing stock densities. These should be derived from a combination of experimental trawls and data derived from log books, rather than a reliance on the latter.
3. Population structure inside and outside the CA: gradients. This will provide for assessments of the effectiveness of the CA in increasing the stock reproductive potential. These should similarly be derived from a combination of analyses of experimental and commercial trawls.

If the CA is designed to reduce the bycatch of sympatric stocks, *eg* Norway Pout CA to protect other roundfish, the total bycatch in the fisheries surrounding the CA should be monitored as it is important to determine the bycatch through displaced effort around the CA. If the effort required to take the TAC has increased due to the CA preventing exploitation of the denser target populations, it is possible that the total bycatch may actually have increased if the distribution of the sympatric stocks is not the same as the target stocks.

*Ideally*, for each CA actual assessments of fish movements for the stocks in question would be undertaken through the tagging of fish and studies on propagule/larvae movements (otolith micro-chemistry, particle tracking, population genetics).

### **Confounding factors**

There are several challenges to CA evaluation related to factors such as:-

- Trends in fleet structure through, for example, vessels switching from gears restricted or banned in the CA to gears that target other stocks but can still directly/indirectly affect the stocks on which the CA is focused: creeping technical/effort shifts, particularly those related to the impacts of derogations in the CA, eg smaller, less powerful vessels allowed to fish, vessels from certain member states allowed to fish or gain earlier access;
- Trends in the behaviour of the fleets related to the CA, eg the impacts of ‘fishing the edge’; the impacts of displaced effort on the target stocks of the CA and for other target stocks, recognising that effort displacement arguably applies to any restrictions on fishing;
- Trends in fleet structure and behaviour related to changes in market conditions, technological developments, etc.
- Impacts of illegal fishing in the CA;
- Impacts of wider scale technical regulations, effort reductions, etc;
- Environmental changes due to natural and other anthropogenic factors that affect the status and distribution of stocks.

Some of these factors are under the control of the CFP and could be minimised in order to support CA evaluations. This may, however, be counterproductive as wider scale measures often complement site specific measures such as CAs in improving fish stocks, so a trade-off must be made between designing a rigorous evaluation programme and recognising the necessity for concurrent wider scale regulatory changes, all be they changes that represent confounding factors in CA evaluation. Confounding factors that are not under the control of the CFP such as natural environmental changes and those related to other regulatory frameworks must, as far as is practicably possible, be taken into account in CA evaluations.

### **Key questions**

With regards to confounding factors, a key question is whether it is warranted and feasible to study the patterns and impacts of all these potentially confounding factors for every CA or is this just an unwarranted and unfeasible *ideal*?

With regards to number of CA evaluations, it could be argued that once a sufficient number of satisfactory evaluations have been carried out for a given category of CA, the effectiveness of further similar CAs need not be evaluated as it can be assumed that they will be so. However, given that any marine area to which a CA could be applied can be considered to be unique in terms of the interactions between physical, ecological and human factors, coupled with the related potential for confounding factors such as those discussed above, it could be argued that any given CA requires a specific evaluation programme, *ie* it is not appropriate to assume

the success of a given CA by transferring/extrapolating evaluation results from other CAs. Similarly, with regards to the time frame over which evaluations run, given the potential for emergent confounding factors, it could be argued that it is not appropriate to cease the evaluation programme for a given CA after a certain number of years, though it may be feasible to streamline monitoring to focus on certain key parameters related to spatial and temporal CPUE and population structure trends. A key question in this respect is whether such arguments are valid?

With regards to spatial and temporal resolution, a key finding from the assessments of the CAs at this meeting is that little, if any, data had been gathered with a specific focus on the CA. Instead, the CA assessments must rely on data gathered through other programmes, *eg* the International Bottom Trawl Survey (IBTS) and general stock assessments. This data is generally not *ideal* for evaluating the effectiveness of the CAs in question as it is not at appropriate temporal (before-after CA to establish time series data) and spatial (focused on assessing effects across the CA boundaries) scales. For several CAs, little or no 'baseline' (pre-CA) data could be found and for most of the CAs the data had been collected at a spatial scale relating to ICES rectangles, rather than at a scale specifically focused on evaluating the effects. This represents a significant weakness in the data available to evaluate closed areas. This raises the critical question of whether the expenditure required to put in place an *ideal* approach to evaluating CAs is warranted and feasible?

## Recommendations

On the basis of the discussions related to the evaluations undertaken at this meeting, there was a consensus that the maintenance of the *status quo* was not an option, *ie* no formal requirement for evaluations, poor availability of data to inform such evaluations and an *ad hoc* approach to the few evaluations that have previously taken place. However, it was also agreed that it was not realistic to recommend a requirement for theoretically *ideal* evaluations due to the financial resources they would require relative to the value of the fishery resources in question. This led to discussions on how a balance might be struck between the *status quo* and the *theoretically ideal* approach.

A key recommendation in achieving this balance is that **CAs should be designed so that they can be evaluated using existing data.** In other words, since most stock evaluation data is collected on the basis of ICES rectangles, the **boundaries of CAs should also be designed on the basis of these rectangles where possible. Where not possible, systems for recording fishing activities and catches should be designed to provide data separately for the closed and non-closed areas at the appropriate spatial resolution.**

It was agreed that it was not feasible for dedicated evaluation studies to be undertaken for CAs that have been designed to closely fit the grounds in question, even though such an approach may be more ideal. The previously outlined BACI elements 1-3 could be undertaken for most, if not all, CAs designed on the basis of ICES rectangles, employing data gathered through existing stock evaluation programmes, *eg* ICES stock assessments, IBTS, etc. A slight increase in sampling effort will generally be required for such surveys in and around CAs to increase the confidence and power of the results, but this would entail a small increase in expenditure compared to the cost of surveys dedicated to specifically designed CAs. Such surveys can be complemented by the increasing use of commercial catch data that can be gathered through increased cooperation with the industry, *eg* through Fisheries-Science Partnerships (UK) and Regional Advisory Councils (CFP). The forthcoming requirement for

electronic log books coupled with VMS surveillance will enhance the potential to employ commercial catch data in CA evaluations.

Many CAs have the objective of protecting nursery grounds (see Table 17.1) and the success of CAs in achieving this can be relatively easily evaluated through such studies as this is a readily observable parameter, *ie* more juvenile fish, whilst the benefits of closing spawning grounds and the resulting impacts of both juvenile, spawning and fishing mortality reduction closures on CPUE and stock structure can be evaluated using existing data. Whilst it was agreed that a marginal increase in sampling effort would entail further costs, where improving CA evaluations is concerned it was agreed that ‘the cost of not doing something may be greater than the cost of doing something’, and that designing CAs around ICES rectangles so that we can draw and build on existing data represents an ideal way of improving such evaluations. It was further agreed that much work has been undertaken by various member states and organisations on many commercial species but the data has not been pulled together. Programmes to integrate the collection and integration of such data could greatly assist both general stock assessments and the evaluation of CAs, especially if they were designed on the basis of ICES rectangles.

Several further recommendations were agreed in relation to the need for the following modifications:-

- More specific objectives and success criteria on the basis of which CAs can be judged to be working, in which case they remain, or can be judged to not be working, in which case the regulation should be revoked. The specific objectives should be stated in the regulation whilst the success criteria, evaluation design and the increased survey costs entailed through increasing sampling effort in ICES rectangles in and around CAs should be required through the regulation but delegated to member states. It is also recommended that there be a requirement in CA regulations for annual evaluations linked with relevant TAC assessments and periodic (every 3-5 years) review of annual CA evaluations on the basis of which decisions can be taken as to whether the CA should remain, be modified or be revoked, subject to specific success, modification and revocation criteria. Such periodic assessments could be integrated with relevant recovery plan assessments for the stock in question, where appropriate.
- Risk analyses relating to both designating CAs, eg risk of confounding factors such as fleet behaviour/structure modifications, displacement effects, and revoking CAs, eg risk of adverse consequences for target and non-target stocks.
- Fewer derogations for certain gears, etc as these represent confounding factors and undermine the potential to achieve CA objectives, the potential for fishermen to respect and cooperate with CA restrictions, and the potential to statutorily enforce such restrictions. It is much more expensive to police CAs that are subject to many derogations as remote surveillance monitoring often cannot distinguish between the different gear types that are actually being used, therefore the presence of enforcement vessels is often required. A further consequence is that there is a greater likelihood of illegal fishing in a CA that is subject to several derogations, which again represents a confounding factor, and undermines the potential to achieve CA objectives, as well as undermining fishermen’s respect for and potential to cooperate with CA restrictions. Whilst we are not necessarily recommending complete no-take MPAs, it must be recognised that derogations can represent a major hurdle to the successful operation, enforcement and evaluation of CAs. It was noted that if enforcement costs were

passed to the industry the pressure from industry for derogations is likely to be reduced in the face of the increase in such costs associated with derogations.

- Assessments of the responses of fleets to CAs in terms of their behaviour (changes in fishing patterns) and their structure (changes to the size and number of vessels and the gears they employ). Such changes represent potential confounding factors, eg fishing the edge, effort displacement, etc, and need to be monitored as part of CA evaluations. Such monitoring is feasible employing VMS and log book data, as the research by Steve Murawski (NOAA) demonstrates, and is an important element of CA evaluations.
- Recognition that CA evaluations, coupled with stock assessments, can both provide both a means of monitoring the effects of climate change on stocks and, more importantly, support decisions whether the location of CAs should be modified to reflect related shifts in the location of stocks.

### **Habitat and species conservation objectives**

There is potential for coincidental habitat and species conservation benefits through CAs, *ie* nature or biodiversity conservation objectives. Such benefits are unlikely for temporary CAs, other than for non-target sympatric species whose spatial/temporal dynamics coincide with those of the target species, *ie* they aggregate in the CA at the same time. They are very likely for permanent restrictions for habitats and species that occupy the same compartment of the CA, particularly habitats and species that are impacted by the gears that are banned in the CA, *eg* benthic habitats, and species will benefit where demersal gears that impact them are banned. On the other hand, it is important to recognise that large areas of the seabed arguably remain unfished and CAs may compel fishermen to seek previously unexploited areas, thereby increasing overall damage to the marine environment through displacement (Kaiser 2005). However, again, it could be argued that the potential impacts of effort displacement on habitats and other species arguably apply to any restriction on fishing.

A growing number of CAs are designed to achieve benefits for habitats and species not related to commercial fish stocks, *eg* Darwin Mounds, Rockall (vulnerable habitats), North-east UK sandeel CA (dependent predators). There will be a growing number of such designations following the recent CFP reform that provides for measures to achieve habitat and species conservation objectives and in order to fulfil legal obligations related to MPAs under the Birds/Habitats Directives, OSPAR, etc. The monitoring and evaluation of such CAs is specifically related to the habitat and species conservation objectives of such closures. For instance, there have been many studies on the benefits of the North-east UK sandeel CA for sea birds (see chapter: North-east UK sandeel CA). For the purposes of this report, it is concluded that the evaluation of CAs for specific habitat and species conservation objectives should be designed in specific relation to such objectives and related legal obligations and that a full discussion of the many methods in relation to the many potential objectives is beyond the scope of this report.

### **Reference**

Kaiser, M.J. 2005. Are marine protected areas a red herring or fisheries panacea? Canadian Journal of Fisheries and Aquatic Sciences, 62:1194-1199.

## APPENDIX 1 ADDRESSES OF SGMOS-07-03

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## APPENDIX 2 LEGISLATION

### Appendix 2.1 Point 5 from Annex III of Council Regulation (EC) No 41/2007

#### 5. Closure of an area for sandeel fisheries in ICES zone IV

5.1. It shall be prohibited to land or retain on board sandeels caught within the geographical area bounded by the east coast of England and Scotland, and enclosed by sequentially joining with rhumb lines the following positions, which shall be measured according to the WGS84 coordinate system:

- the east coast of England at latitude 55°30'N,
- latitude 55°30'N, longitude 1°00'W,
- latitude 58°00'N, longitude 1°00'W,
- latitude 58°00'N, longitude 0°00'W,
- the east coast of Scotland at longitude 2°00'W.

5.2. Fisheries for scientific investigation shall be allowed in order to monitor the sandeel stock in the area and the effects of the closure.

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### Appendix 2.2 Article 27 of Council Regulation (EC) No 850/98

#### Restrictions on fishing for Norway pout to protect other roundfish

1. The retention on board of Norway pout which are caught with any towed gear in the area which is bounded by a line joining the following points shall be prohibited:

- a point at 56° N on the east coast of the United Kingdom as far as 2° E,
- the running north to 58° N, west to 0° 309 W, north to 59° 159 N, east to 1° E, north to 60° N, west to longitude 0° 009;
- from there north to 60° 309 N, west to the coast of the Shetland Isles, then west from 60° N on the west coast of the Shetlands to 3° W, south to 58° 309 N,
- and finally west to the coast of the United Kingdom.

2. However, vessels may retain on board quantities of Norway pout from the area and caught with the gear described in paragraph 1, provided they do not exceed 5 % of the total weight of the marine organisms on board which have been caught in the said area with the said gear.

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### Appendix 2.3 Point 7 from Annex III of Council regulation (EC) No 41/2007

#### 7. Restrictions on fishing for cod in ICES zones VI and VII

7.1. ICES zone VIa



Until 31 December 2007, it shall be prohibited to conduct any fishing activity within the areas enclosed by sequentially joining with rhumb lines the following positions, which shall be measured according to the WGS84 coordinate system:

- 59°05'N, 06°45'W
- 59°30'N, 06°00'W
- 59°40'N, 05°00'W
- 60°00'N, 04°00'W
- 59°30'N, 04°00'W
- 59°05'N, 06°45'W.

#### 7.2. ICES zones VII f and g

From 1 February 2007 until 31 March 2007, it shall be prohibited to conduct any fishing activity in the following ICES rectangles: 30E4, 31E4, 32E3. This prohibition shall not apply within 6 nautical miles from the baseline.

7.3. By way of derogation from points 7.1. and 7.2. it shall be permitted to conduct fishing activities using pots and creels within the specified areas and time periods, provided that:

- (i) no fishing gear other than pots and creels are carried on board, and
- (ii) no fish other than shellfish and crustacea are retained on board.

7.4. By way of derogation from points 7.1. and 7.2., it shall be permitted to conduct fishing activities within the areas referred to in those points using nets of mesh size less than 55 mm, provided that:

- (i) no net of mesh size greater than or equal to 55 mm is carried on board, and
- (ii) no fish other than herring, mackerel, pilchard/sardines, sardinelles, horse mackerel, sprat, blue whiting and argentines are retained on board.

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### **Appendix 2.4      Point 8 from Annex III of Council Regulation (EC) No 41/2007**

#### **Closed area for the conservation of cod in the Irish Sea**

#### **8. Technical conservation measures in the Irish Sea**

8.1. In the period from 14 February to 30 April 2007 it shall be prohibited to use any demersal trawl, seine or similar towed net, any gill net, trammel net, tangle net or similar static net or any fishing gear incorporating hooks within that part of ICES division VIIa enclosed by:

- the east coast of Ireland and the east coast of Northern Ireland and
- straight lines sequentially joining the following geographical coordinates:
- a point on the east coast of the Ards peninsula in Northern Ireland at 54° 30'N,

- 54° 30'N, 04° 50'W,
- 54° 15'N, 04° 50'W,
- a point on the east coast of Ireland at 53° 15'N.

8.2. By way of derogation from point 8.1, within the area and time period referred to therein:

(a) the use of demersal otter trawls shall be permitted provided that no other type of fishing gear is retained on board and that such nets:

- (i) are of mesh size either 70 mm to 79 mm or 80 mm to 99 mm, and
- (ii) are of only one of the permitted mesh size ranges, and
- (iii) incorporate no individual mesh, irrespective of its position within the net, of mesh size greater than 300 mm, and
- (iv) are deployed only within an area enclosed by sequentially joining with rhumb lines the following coordinates:

- 53° 30' N, 05° 30' W
- 53° 30' N, 05° 20' W
- 54° 20' N, 04° 50' W
- 54° 30' N, 05° 10' W
- 54° 30' N, 05° 20' W
- 54° 00' N, 05° 50' W
- 54° 00' N, 06° 10' W
- 53° 45' N, 06° 10' W
- 53° 45' N, 05° 30' W
- 53° 30' N, 05° 30' W;

(b) the use of separator trawls shall be permitted provided that no other type of fishing gear is retained on board and that such nets:

- (i) comply with the conditions laid down in subparagraph (a), and
- (ii) are constructed in conformity with the technical details provided in the Annex.

Furthermore, separator trawls may also be used within an area enclosed by rhumb lines sequentially joining the following coordinates:

- 53° 45' N, 06° 00" W
- 53° 45' N, 05° 30' W
- 53° 30' N, 05° 30' W
- 53° 30' N, 06° 00' W
- 53° 45' N, 06° 00' W.

8.3. The technical conservation measures referred to in Articles 3 and 4 of Council Regulation (EC) No 254/2002 of 12 February 2002 establishing measures to be applicable in 2002 for the recovery of the stock of cod in the Irish Sea (zone VIIa) (1) shall apply.

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**Appendix 2.5 Article 28 of Council Regulation (EC) No 850/98 and Articles 5 and 6 of Commission Regulation (EC) No 494/2002**

**Restrictions on fishing for hake**

1. Fishing with any trawl, Danish seine or similar towed net, in the geographical areas and during the periods mentioned below, shall be prohibited:

(a) from 1 September to 31 December, with in the geographical area bounded by a line joining the following coordinates:

- the point on the north coast of Spain called Cabo Prior (latitude 43° 349 N, longitude 8° 199 W),
- latitude 43° 509 N, longitude 8° 199 W,
- latitude 43° 259 N, longitude 9° 129 W,
- the point on the west coast of Spain called Cabo Villano (latitude 43° 109 N, longitude 9° 129W);

(b) from 1 October to 31 December, within the geographical area bounded by a line joining the following coordinates:

- the point on the west coast of Spain called Cabo Corrubedo (latitude 42° 359 N, longitude 9° 059 W),
- latitude 42° 359 N, longitude 9° 259 W,
- latitude 43° 009 N, longitude 9° 309 W,
- the point on the west coast of Spain at latitude 43° 009 N;

(c) from 1 December to the last day of February in the following year, within the geographical area bounded by a line joining the following coordinates:

- a point on the west coast of Portugal at latitude 37° 509 N,
- latitude 37° 509 N, longitude 9° 089 W,
- latitude 37° 009 N, longitude 9° 079 W,
- a point on the west coast of Portugal at latitude 37° 009 N.

2. Within the zones and during the periods referred to in paragraph 1, the carrying on board of any trawl, Danish seine or similar towed net shall be prohibited, unless such gears are lashed and stowed in accordance with the provisions laid down in Article 20(1) of Regulation (EEC) No 2847/93.

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**Article 5 of Commission Regulation (EC) No 494/2002**

1. For the purposes of paragraph 2 [of above], the following geographical areas are defined:

(a) the area enclosed by straight lines sequentially joining the following geographical coordinates and excluding any part of that area situated within the limit of 12 nautical miles calculated from the baselines of Ireland:

53°30'N, 11°00'W  
53°30'N, 12°00'W  
53°00'N, 12°00'W  
51°00'N, 11°00'W  
49°30'N, 11°00'W  
49°30'N, 07°00'W  
51°00'N, 07°00'W  
51°00'N, 10°30'W  
51°30'N, 11°00'W  
53°30'N, 11°00'W;

(b) the area enclosed by straight lines sequentially joining the following geographical coordinates and excluding any part of that area situated within the limit of 12 nautical miles calculated from the baselines of France:

48°00'N, 06°00'W  
48°00'N, 07°00'W  
45°00'N, 02°00'W  
44°00'N, 02°00'W  
a point on the coast of France at 44°00'N  
a point on the coast of France at 45°30'N  
45°30'N, 02°00'W  
45°45'N, 02°00'W  
48°00'N, 06°00'W.

2. Within the areas defined in paragraph 1:

— it is prohibited to conduct any fishing activity using any towed net other than beam trawls of mesh size range 55 to 99 mm,

— it is prohibited to immerse, partially or wholly, or otherwise deploy for any purpose any towed net other than beam trawls which is of mesh size range 55 to 99 mm,

— all towed nets other than beam trawls of mesh size range 55 to 99 mm shall be lashed and stowed in accordance with the provisions laid down in Article 20(1) of Regulation (EEC) No 2847/93 of 1 October 1993 establishing a control system applicable to the common fisheries policy (1).

Within the area defined in paragraph 1(a):

- it is prohibited to conduct any fishing activity using any fixed gear of mesh size less than 120 mm,
- it is prohibited to immerse, partially or wholly or otherwise deploy for any purpose, any fixed gear of mesh size less than 120 mm,
- all fixed gears of mesh size less than 120 mm shall be lashed and stowed in accordance with the provisions laid down in Article 20(1) of Regulation (EEC) No 2847/93.

Within the area defined in paragraph 1(b):

- it is prohibited to conduct any fishing activity using any fixed gear of mesh size less than 100 mm,
- it is prohibited to immerse, partially or wholly or otherwise deploy for any purpose, any fixed gear of mesh size less than 100 mm,
- all fixed gears of mesh size less than 100 mm shall be lashed and stowed in accordance with the provisions laid down in Article 20(1) of Regulation (EEC) No 2847/93.

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**Article 6 of Commission Regulation (EC) No 494/2002**

1. Within the area defined in Article 5(1)(a), beam trawls of mesh size range 55 to 99 mm may be deployed or immersed partially or wholly only in that part of the area to the east of 07°30'W and only in the period April to October.

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**Appendix 2.6 Article 20 of Council Regulation (EC) No 850/98**

**Restrictions on fishing for herring**

1. The retention on board of herring which are caught within the geographical areas and during the periods mentioned below shall be prohibited:

(a) from 1 January to 30 April, within the geographical area situated to the north-east of a line drawn between Mull of Kintyre and Corsewall Point;

(b) from 1 July to 31 October, within the geographical area bounded by the following coordinates:

- the west coast of Denmark at latitude 55° 309 N,
- latitude 55° 309 N, longitude 7° 009 E,
- latitude 57° 009 N, longitude 7° 009 E,
- the west coast of Denmark at latitude 57° 009 N;

(c) from 15 August to 15 September, within the zone extending from six to 12 miles off the east coast of the United Kingdom as measured from the baselines between latitudes 55° 309 N and 55° 459 N;

(d) from 15 August to 30 September, within the geographical area bounded by a line joining the following points:

- the Butt of Lewis,
- Cape Wrath,
- latitude 58° 559 N, longitude 5° 009 W,
- latitude 58° 559 N, longitude 7° 109 W,
- latitude 58° 209 N, longitude 8° 209 W,
- latitude 57° 409 N, longitude 8° 209 W,
- the west coast of North Uist at latitude 57° 409 N, then along the north coast of the island as far as latitude 57° 409 360 N, longitude 7° 209 390 W,
- latitude 57° 509 30 N, longitude 7° 89 60 W,
- north-east along the west coast of Lewis as far as the point of departure (Butt of Lewis);

(e) from 15 August to 30 September, within the zone extending from six to 12 miles off the east coast of the United Kingdom as measured from the baselines between latitudes 54° 109 N and 54° 459 N;

(f) from 21 September to 31 December, within the parts of ICES Division VIIa bounded by the following coordinates:

- (i) — the east coast of the Isle of Man at latitude 54° 209 N,
- latitude 54° 209 N, longitude 3° 409 W,
- latitude 53° 509 N, longitude 3° 509 W,
- latitude 53° 509 N, longitude 4° 509 W,
- the south-west coast of the Isle of Man at longitude 4° 509 W,

and

- (ii) — the east coast of Northern Ireland at latitude 54° 159 N,
- latitude 54° 159 N, longitude 5° 159 W,
- latitude 53° 509 N, longitude 5° 509 W,
- the east coast of Ireland at latitude 53° 509 N;

(g) throughout the year within ICES Division VIIa, in the geographical area between the west coasts of Scotland, England and Wales, and a line drawn 12 miles from the baselines of the coasts bounded to the south by latitude 53° 209 N and to the north-west by a line drawn between the Mull of Galloway (Scotland) and the Point of Ayre (Isle of Man);

(h) throughout the year within Logan Bay, defined as the waters east of a line drawn from the Mull of Logan situated at latitude 54° 449 N and longitude 4° 599 W, to Laggantalluch Head, situated at latitude 54° 419 N and longitude 4° 589 W;

(i) in 1997, and every third year thereafter, from the second Friday in January, for a period of 16

consecutive days within the area bounded by the following coordinates:

- the south-east coast of Ireland at latitude 52° 009 N,

- latitude 52° 009 N, longitude 6° 009 W,
- latitude 52° 309 N, longitude 6° 009 W,
- the south-east coast of Ireland at latitude 52° 309;

(j) in 1997, and every third year thereafter from the first Friday in November for a period of 16 consecutive days within the area bounded by the following coordinates:

- the south coast of Ireland at longitude 9° 009 W,
- latitude 51° 159 N, longitude 9° 009 W,
- latitude 51° 159 N, longitude 11° 009 W,
- latitude 52° 309 N, longitude 11° 009 W,
- the west coast of Ireland at latitude 52° 309 N;

(k) in 1998, and every third year thereafter, from the first Friday in November for a period of 16 consecutive days within the area bounded by the following coordinates:

- the south coast of Ireland at longitude 9° 009 W,
- latitude 51° 159 N, longitude 9° 009 W,
- latitude 51° 159 N, longitude 7° 309 W,
- the south coast of Ireland at latitude 52° 009 N.

2. However, vessels may retain on board quantities of herring from any of the areas described, provided they do not exceed 5 % of the total live weight of the marine organisms on board which have been caught in each separate area during one of the periods specified.

3. Notwithstanding paragraph 1, points (f)(ii) and (h), vessels with a length not exceeding 12,2 metres based in ports situated on the east coast of Ireland and Northern Ireland between latitudes 53° 009 N and 55° 009 N may retain on board quantities of herring from the areas set out in paragraph 1, points (f)(ii) and (h). The only method of fishing authorised shall be drift-netting with nets of a mesh size equal to, or greater than, 54 millimetres.

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**Appendix 2.7            Point 2 from Annex III of Council Regulation (EC) No 41/2007**

**2. Fishing for herring in EC waters of ICES zone IIa**

It shall be prohibited to land or retain on board herring caught in EC waters of zone IIa in the periods 1 January to 28 February and 16 May to 31 December.

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**Appendix 2.8            Article 21 of Council Regulation (EC) No 850/98**

**Restrictions on fishing for sprat to protect herring**

1. The retention on board of sprat which are caught within the geographical areas and during the periods mentioned below shall be prohibited:

(a) from 1 January to 31 March, and from 1 October to 31 December, within ICES statistical area 39E8. For the purpose of this Regulation, this ICES area shall be the area bounded by a line due east from the United Kingdom east coast along latitude 55° 009 N to a point at longitude 1° 009 W, from there due north to a point at latitude 55° 309 N and from there due west to the United Kingdom coast;

(b) from 1 January to 31 March, and from 1 October to 31 December, within the inner waters of the Moray Firth west of longitude 3° 309 W, and in the inner waters of the Firth of Forth west of longitude 3° 009 W,

(c) from 1 July to 31 October, within the geographical area bounded by the following coordinates:

- the west coast of Denmark at latitude 55° 309 N,
- latitude 55° 309 N, longitude 7° 009 E,
- latitude 57° 009 N, longitude 7° 009 E,
- the west coast of Denmark at latitude 57° 009 N.

2. However, vessels may retain on board quantities of sprat from any of the areas described, provided they do not exceed 5 % of the total live weight of the marine organisms on board which have been caught in each separate area during any of the periods specified.

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## **Appendix 2.9      Article 22 of Council Regulation (EC) No 850/98**

### **Restrictions on fishing for mackerel**

1. the retention on board of mackerel which are caught within the geographical area bounded by the following coordinates shall be prohibited:

- a point on the south coast of the United Kingdom at longitude 2° 009 W,
- latitude 49° 309 N, longitude 2° 009 W,
- latitude 49° 309 N, longitude 7° 009 W,
- latitude 52° 009 N, longitude 7° 009 W,
- a point on the west coast of the United Kingdom at latitude 52° 009 N,

except where the weight of the mackerel does not exceed 15 % by live weight of the total quantities of mackerel and other marine organisms on board which have been caught in this area.

2. Paragraph 1 shall not apply:

(a) to vessels fishing exclusively with gill nets and/or hand lines;

(b) to vessels fishing with demersal trawls, Danish seines or other similar towed nets, provided that they have on board a minimum of 75 % by live weight of marine organisms with the exception of anchovy, herring, horse mackerel, mackerel, pelagic cephalopods and sardine, calculated as a percentage of the total live weight of all the marine organisms on board;



(c) to vessels which are not equipped for fishing and to which mackerel are being transhipped.

3. All mackerel which are on board shall be deemed to have been caught within the area provided for by paragraph 1, except those which have been declared to be on board before the vessel enters that area, under the procedure described in the following subparagraphs.

The master of a vessel intending to enter that area in order to fish, and holding mackerel on board, shall notify the control authority of the Member state in whose zone he intends to fish of his estimated time and place of arrival in this area no more than 36 hours and no less than 24 hours before the vessel enters that area.

On entering the area, he shall notify the competent control authority of the quantities of mackerel which he has on board and which are entered in the log-book. The master may be required to submit his log-book and the catches on board for verification at a time and place to be determined by the competent control authority. The time shall be no later than six hours after receipt by the control authority of the message notifying the quantities of mackerel on board and the place shall be as near as possible to the point of entry into the area.

The master of the fishing vessel who intends to enter the area for the purpose of having mackerel transhipped to his vessel shall notify the control authority of the Member State in whose zone transhipment will take place, or the intended time and place of transhipment no more than 36 hours and no less than 24 hours before transhipment begins. Immediately on completion of transhipment, the master shall inform the competent control authority of the quantities of mackerel which have been transhipped to that vessel.

The competent control authorities are:

— for France: Mimer, telex: Paris 25 08 23,

— for Ireland: Department of Marine, telex: Dublin 91798 MRNE,

— for the United Kingdom: Ministry of Agriculture, Fisheries and Food, telex: London 21274.

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**Appendix 2.10 Point 6 from Annex III of Council Regulation (EC) No 41/2007**

**6. Rockall Haddock box in ICES zone VI**

All fishing, except with longlines, shall be prohibited in the areas enclosed by sequentially joining with rhumb lines the following positions, which shall be measured according to the WGS84 coordinate system:

Point No	Latitude	Longitude
1	57°00'N	15°00'W
2	57°00'N	14°00'W
3	56°30'N	14°00'W
4	56°30'N	15°00'W