

2.1.8.5 Norwegian request for advice on the effects of technical management measures

Norway has requested ICES as follows:

Given the uncertainty regarding the present state of the stock of sandeel in the North Sea, and the concern that incoming year class may be poor, ICES is requested to outline likely effects of possible protective measures, notably minimum landing size, closed areas and closed seasons.

ICES Comments

The Norwegian request asks for advice on the effects of three possible technical measures; minimum landing sizes, closed areas, or closed seasons. Clearly, devising any such measure should take account of information on the seasonal availability and population structure of North Sea sandeels. At present, there is insufficient information to quantify the possible effect of such measures. Therefore, the following sections will review the potential benefits of each measure in relation to the current understanding of the stock.

The status of the sandeel stock in the North Sea and advice for 2005 is reported on in Section 4.4.14.b.

Summary

While several sandeel (*Ammodytes* spp) species occur in the North Sea, sandeel landings from the North Sea consist almost entirely of the lesser sandeel (*Ammodytes marinus*).

Seasonal closures can have a protective effect in two ways:

- 1-group sandeel have a rapid increase in weight and oil content from April until June. It is therefore possible to achieve the same value in weight and oil by postponing the season and then catching fewer specimens.
- The 0-group is only fished in the autumn. Hence, to protect the 0-group, a closure of the fishery in the second half of the year may be considered as a precautionary measure. It is unknown to what extent preventing fishery on the 0-group will benefit the stock.

The implementation of a *minimum landing size* would be aimed at decreasing fishing mortality on 0-group sandeels. The nature of the fishery – fishing with small-mesh trawls and landing for reduction purposes – suggests that the effective implementation of a minimum landing size may only be possible through implementation of closed areas and seasons.

Area closures: The distribution of sandeel is patchy, and the sandeel is quite sedentary once it has settled to the bottom. Hence, there is a risk of local depletion in areas with intense fishing. At the larval stage there is an exchange between areas, which is dependent on the hydrographical conditions. The present knowledge is insufficient to outline specific areas that might be candidates for regional management. Also, cannibalism might mitigate any long-term positive effects on the production in a closed area.

All these measures need to be considered further in the broader context of a management strategy. In this years advice, ICES suggests a further development of such a management strategy.

Background, biology, and fishery

While several sandeel (*Ammodytes* spp) species occur in the North Sea, sandeel landings from the North Sea consist almost entirely of the lesser sandeel (*Ammodytes marinus*) and only this species is described below.

Sandeels have bank-affiliated resident juvenile and adult life stages coupled to specific areas of sediment. The patchy distribution of this sediment is a key constraint on the distributional extent of sandeels, following settlement. The eggs are also demersal and are spawned directly onto the sandy areas they inhabit. Consequently, dispersal between patches of suitable sediment is confined to the pelagic larval stage, which lasts between 1 and 3 months. Estimates of passive transport during this phase indicate varying levels of exchange between spawning grounds. As a result inter-mixing across sandeel aggregations within the North Sea stock is limited. Furthermore, the relative geographic and hydrographic isolation of some sandeel aggregations, such as near the Firth of Forth, make them dependent on local spawning. Given the potential for differences in recruitment and mortality between local populations, the present management of the stock by a single TAC covering the whole North Sea potentially makes these populations vulnerable to regional-specific overexploitation.

There is considerable variation in size and maturity-at-age between regions and banks within the North Sea. Sandeels in coastal areas off Shetland, Norway, and off the Firth of Forth have much lower growth rates than those living offshore. These regional differences have implications for the maximum fishing mortality an area will support and for the recovery time from a local collapse, but little specific information is available. For example, although sandeels occur

very patchy and densities can be very high, density-dependent effects on growth and mortality have not been demonstrated for sandeels in the North Sea.

Growth rates within the North Sea stock vary substantially between regions and between years, and the patterns of emergence and thus the availability of sandeels to the fishery is also highly variable. This has strong implications for the effect of management actions on the sandeel stock dynamics.

Cannibalism of immature sandeels on the early life stages of sandeels has been demonstrated for other sandeel species with a similar life cycle and behaviour as that of *A. marinus* in the North Sea, and cannibalism has a major impact on the recruitment pattern.

Minimum landing sizes

The nature of the fishery – fishing with small-mesh trawls and landing for reduction purposes – suggests that the effective implementation of a minimum landing size may only be possible through implementation of closed areas and seasons. Avoiding catch of small sandeel could increase the yield over a fishing season due to the rapid growth of sandeel during the fishing season. Also it is possible to decrease fishing mortality on 0-group sandeels as these only occur in the catches from late in the summer and may dominate the catches towards the end of the fishing season.

Very small sandeels are low in oil content and their economic value is low, this is already a practical limiting factor for a directed fishery on small sandeels. Because of this quality constraint almost all fishing on 0-group takes place late in the year and is mostly limited to areas where 0-group growth rates are very high, such as Fisher banks. The directed fishery for 0-group sandeels is carried out by a small number of vessels and targets a small part of the sandeel areas. A minimum landing size restriction late in the season could reduce mortality on 0-group sandeels in the areas where this fishery occurs. This may reduce fishing mortality per landed tonnes provided that fishing effort is displaced to areas where larger sandeels are taken, rather than catches of undersized fish being discarded or slipped. A real-time control rule of the type that “fishing should cease in an area if catches are composed of x% sandeels < y cm in z hauls” would be required.

Closed seasons

In the Shetland assessment area a closed season approach has been applied in the past to reduce fishing pressure on 0-group sandeels at times when they are important to local seabird predators. In this area the protection of 0-group sandeels was considered important since historically the fishery took a large proportion of that age-group.

In contrast to Shetland, 0-group sandeels only comprise a small proportion of the North Sea landings. However, given the small size of the 2002 year class and the less-than-average size of the 2003 year class, reducing 0-group mortality on the 2004 and 2005 year classes may help in stock recovery. The quantification of the effect on the sandeel stock by decreasing the mortality of 0-group sandeels is not possible at the present time due to the lack of knowledge on cannibalism and other sources of natural mortality.

1-group sandeel have a rapid increase in weight and oil content from April until June. Postponing the start of the fishery has the potential of increasing the yield (in weight) and yield in the form of oil even more.

Closed areas

Closing an area to a fishery will potentially help to conserve fish stocks, particularly if the area encompasses a large spawning congregation that provides a source of recruits for many surrounding areas, or if it contains a resident and reproductively isolated population. There is evidence of a resident and reproductively isolated sandeel population off the northeast UK (Firth of Forth). This information, together with a decline in the breeding success of sandeel-dependent seabirds and particularly kittiwakes in this region following the development of a fishery in the 1990s, led to a closure of the area in 2000. The concern was that any reduction of the local sandeel population below a level where it affected breeding success of sandeel-dependent seabirds could potentially affect other top predators. The direct impact of the closure is still uncertain and the decision rules for re-opening have yet to be agreed.

The closed area approach has also been applied to the small Shetland sandeel assessment area in the early 1990s, and since the re-opening in 1995 there has been a precautionary TAC and limit on the size of vessels operating. The initial total closure in 1991 was in response to a succession of poor year classes in the managed region, which was associated with almost complete breeding failure in local seabird colonies. The stock did recover during the closure, but the primary reason for this appeared to be due to immigration of 0-group from outside the assessed region. In spite of the low fishing pressure, the stock has suffered poor recruitment in recent years.

These two examples of closed areas highlight the importance of understanding how different patches of sandeels are linked by larval dispersal. Identifying and protecting source populations and small reproductively-isolated resident populations could help in achieving sustainable management of the North Sea stock.

Regional area TACs

In light of the changed perception of the geographical status of the North Sea sandeel stock it might be more appropriate to set separate TACs to cover identified separate sandeel populations. In the first instance, such TACs would be intended to ensure the persistence of the sandeel populations and support a viable fishery in the identified regions. This proposal requires that assessments are disaggregated accordingly. Initial work has been done on assessing three units separately, but more work is required to be confident that regional assessments can be done adequately. It is essential that appropriate fishery data on catch and effort are collected. It is also important that at least one abundance survey is initiated for stock assessment purposes. Further, it is essential that the population units to be assessed separately can be defined based upon knowledge on sandeel biology and distribution pattern.

Sources of information

Bell, E. Response to sandeel request – 2005 Sandeel assessment. Working Paper 14 to the Working Group on Demersal Stocks in the North Sea and Skagerrak (ICES 2004).

ICES 2004. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 7–16 September 2004 (ICES CM 2005/ACFM:07).

Johannessen, T., E. Johnsen, K. Korsbrekke, and D. Skagen. Yield and sustainability in the sandeel fishery in the North Sea. Working Paper 13 to the Working Group on Demersal Stocks in the North Sea and Skagerrak (ICES 2004).

Wright, P. and H. Jensen. Potential effects of technical management measures for the sandeel stock in the North Sea. Working Paper 9 to the Working Group on Demersal Stocks in the North Sea and Skagerrak (ICES 2004).