



European
Commission

JRC SCIENTIFIC AND POLICY REPORTS

Scientific, Technical and Economic Committee for Fisheries (STECF)

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Management measures for sole in area VIIa (STECF-16-04)

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This report was reviewed by the STECF by written procedure in March 2016

Report EUR 27758 EN

European Commission
Joint Research Centre (JRC)
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JRC 100857
EUR 27758 EN
ISBN 978-92-79-56781-0
EUR – Scientific and Technical Research series – ISSN 1831-9424
ISSN 2467-0715
doi:10.2788/780937
Luxembourg: Publications Office of the European Union, 2016
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How to cite this report: Reports of the Scientific, Technical and Economic Committee for Fisheries (STECF) Management measures for sole in area VIIa (STECF-16-04). 2016. Publications Office of the European Union, Luxembourg, EUR 27758 EN, JRC 100857, 12 pp.

Abstract

The European Commission may consult the STECF on any matter relating to marine and fisheries biology, fishing gear technology, fisheries economics, fisheries governance, ecosystem effects of fisheries, aquaculture or similar disciplines. This report deals with management measures for sole in area VIIa. The STECF issues its advice by written procedure in March 2016.

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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

MANAGEMENT MEASURES FOR SOLE IN AREA VIIA (STECF-16-04)

The STECF review was undertaken during March 2016.

Background

The landings of sole in VIIa decreased from an average of about 1,200 t over the period 1987-2006 to just below 100 t in 2014 and ICES advised that *'when the MSY approach is applied, there should be no directed fisheries and all catches should be minimized in 2016'*.

Although the fishing mortality is now inferior to F_{MSY} , the recruitment has been well below average since the beginning of the 2000s. The SSB has shown a clear declining trend in the last 10 years and is now well below B_{MSY} trigger. This stock is subject to a zero TAC for 2016 but there is a 40 tonnes allowance to cover by-catches only.

ICES indicates that there is *'consistency over the recent years in estimating SSB, fishing mortality, and recruitment. The forecasted wanted catch in 2016 and SSB in 2017 are robust to the assumptions of the incoming recruitment'*. However, according to the Belgian authorities, the UK survey focuses on the Liverpool Bay and may not capture the actual stock abundance, among others because windmills farms might have displaced the nursery areas towards un-surveyed locations. The Belgian sector also claims that their LPUEs in observed trips are stable and relatively high for this stock, with more large fish in the catch than 10 years ago, seemingly indicating a stock in reasonable shape.

The Belgian authorities sent the Commission a report (see 'Documents') supporting their request for the setting of a 'small' commercial quota in order to incite the participation of fishing vessels in a scientific programme. This programme would comprise 5 objectives further detailed in the Belgian report:

- 1: Extend the fishery-independent data collection
- 2: Improve the knowledge of the population behaviour of the sole stock
- 3: Assess the validity of the survey
- 4: Improve the stock assessment
- 5: Strengthen the cooperation and communication between fisheries scientists and fishermen

According to the Belgian authorities:

- it is important to continue feeding the scientific process with input data and a small commercial fishery of 54 tonnes would be beneficial to this effect
- the 54-tonnes TAC would result in a fishing mortality below 0.057 ($F_{msy}=0.16$)

Assuming that the agreed by-catch TAC of 40 t for 2016 is caught and landed, the additional quota of 14 t requested for the May/June and September surveys would lead to landings totalling 54 t in 2016,

Documents

- Report presented by the Belgian authorities (see Annex).

Request to the STECF

The STECF is requested to review the document presented by ILVO and:

1. Comment on the suitability of the proposed survey to achieve the 5 objectives stated above.
2. List the pros and cons of setting a TAC of 54 tonnes in relation to the following:
 - a. Potential benefits in terms of enhancing the knowledge base for the stock
 - b. Potential impacts on conservation status and development of the stock
3. Provide an expert opinion if the benefits (2a) could outweigh the impacts (2b)

STECF Observations

STECF agrees with the most recent (2015) ICES assessment and advice on the Irish Sea sole stock (VIIa). According to ICES, the Irish Sea sole stock (VIIa) is currently in a depleted state, and although fishing mortality in 2014 is estimated to be below F_{MSY} , the spawning stock biomass is estimated to have declined and has remained below B_{lim} for the past decade. The failing recruitment in the last 10 years is the major reason for the very low biomass and the resultant ICES advice for 'no directed fisheries and that all catches should be minimised'. STECF notes however, that the assessment is heavily reliant on a survey index (i.e. UK(E&W)-BTS-Q3), which covers only a part of the distribution area of the stock. STECF is therefore of the opinion that collecting additional and more appropriate fishery-independent information (i.e. conducting a survey with a better area coverage and possibly collecting genetic data) would improve stock assessments and advice in the future.

1. Comment on the suitability of the proposed survey to achieve the 5 objectives stated above.

Aim 1: Extended fishery independent data collection

STECF notes that the UK(E&W)-BTS-Q3 survey is more focused on the eastern part of the Irish Sea while the main commercial fishing grounds are more offshore and in the central part of the Irish Sea. STECF considers that the commencement of a survey with broader spatial coverage may result in a better overall assessment of the Irish Sea sole stock (VIIa) in the future, provided that any additional surveys are conducted on a multi-annual basis (i.e. a rule thumb is a minimum period of 5 years). STECF notes that the Belgian proposal is to undertake two surveys in May and June (during the spawning season) and two surveys in September (simultaneously with the UK (E&W)-BTS-Q3

survey). The proposal indicates that in the 2016 May and June campaign, 80 hauls will be randomly distributed (in a stratified random design) outside the 12 NM area where most commercial sole is caught. The same sampling scheme will be repeated in September/October 2016 plus an additional 80 hauls inside the 12 NM limit will also be carried out. To permit sole caught on the May/June and September surveys to be retained and landed, an additional quota of 14 t is requested over and above the agreed by-catch quota of 40 t.

STECF is unclear of the purpose of restricting the May-June surveys to the area outside 12 NM where the majority of commercial fishing effort of the Belgian beam trawl fleet has historically been deployed. To gain insight into the overall size and age distribution of the stock it requires that the whole potential distribution of the stock is covered by the survey and that the survey is undertaken annually. As recruitment to the fishery is at age 2, knowledge of the distribution and relative abundance of 1-year-old fish at spawning time would be valuable additional scientific information. However, it is noted that the proposed May/June survey is not designed to cover areas inside the 12 NM limit and therefore will not cover the entire stock distribution area. STECF considers that, assuming the September/October survey is appropriately designed, the May/June survey would be of limited use for future assessments of the stock. STECF notes that the intention to undertake 160 hauls during each survey has no statistical basis and in general more details relating to the survey sampling design are required together with the technical specifications of the survey gears in order to assess the potential utility of the survey for stock assessment.

Aim 2: Improved knowledge of the population behaviour of the stock

There is insufficient information on the proposed population genetics project to determine its potential ability to deliver its stated objectives i.e. to quantify the contribution of the Liverpool Bay spawning grounds and possible other spawning grounds in the Irish and Celtic Seas to the sole stock in the Irish Sea. In addition, it is not clear from the information presented by ILVO whether the project is likely to result in better insights of the potential migration of sole inside or outside the different fishing grounds and improve the stock assessment.

Aim 3: Assess validity of the survey

STECF notes that the UK (E&W)-BTS-Q3 Survey has received criticism from fishermen and in particular aspects relating to the rigging arrangements and operation of the beam trawl gear and how this may affect its catching efficiency for demersal fish. The proposal to undertake catch comparison trials in the September/October campaigns could potentially provide information on the relative catchability of the commercial and survey beam trawl gears and potentially identify or dispel operational concerns with the UK (E&W) BTS-Q3 survey. However, in the absence of more specific details on how such trials are to be undertaken e.g. deployment of comparative parallel haul, statistical design etc, STECF is unable to assess the potential utility of the outcome of such.

Aim 4: Improvement of stock assessment

It is unclear to the STECF how the proposed surveys will lead to better catch (potential landings plus discards) estimates from the stock as a whole and how these will lead to an improvement in the stock assessment. Additional surveys may result in an improved stock assessment by providing a new or additional tuning fleet that could be incorporated into the assessment model provided that a time series of at least 5 years is built up.

STECF observes that the ILVO report notes that better catch estimates from the VIIa sole stock requires that catch data from the *Nephrops* fishery be made available. However, STECF notes that these data are already provided to the ICES stock coordinator through the ICES InterCatch database and that these data are publically available via the STECF Fishery Dependent Information online data portal.

Aim 5: Strengthen the cooperation and communication between fisheries scientists and fishermen

STECF agrees that stakeholders may frequently challenge the validity or interpretation of scientific advice because of the negative impact policy decisions can have on their individual business. This 'tension' between society, policy and science is plainly evident when environmental sustainability concerns appear in conflict with maintaining livelihoods. STECF is also aware that in many countries the industry has committed themselves in taking actions in the context of preservation and sustainability. In 2015, the Belgian fishing industry has signed a contract with the Flemish government, the scientific institute ILVO and the NGO Natuurpunt to reach a more sustainable fishery. STECF agrees that the proposed commercial survey as such would facilitate learning between fishermen and scientist, increase the transparency of scientific assessments and foster cooperation between scientists and the industry.

2. List the pros and cons of setting a TAC of 54 tonnes in relation to the following:
 - a. Potential benefits in terms of enhancing the knowledge base for the stock
 - b. Potential impacts on conservation status and development of the stock

The potential impact of permitting the additional quota of 14 t to account for landings arising from the proposed survey of the fishing grounds outside 12 NM in the Irish Sea, means that potential landings in 2016 will be 54 t which is expected to result in a fishing mortality rate of less than $F=0.057$ in 2016 (i.e. about 50% of the estimated F_{MSY}). The ICES short term forecast estimates that a zero TAC (implying zero catches) is predicted to result in a 22% increase in SSB in 2017, whilst landings of 58t is predicted to result in an increase in SSB in 2017 of 17%. Therefore, any additional catches due to the proposed surveys will reduce the predicted rate of recovery of the stock but that this impact is likely to be marginal i.e. five percentage points below a zero TAC (catch) option.

STECF notes that the additional quota proposed (14t) would be well in excess of the provisions laid out in article 33.6 of the control regulation (Council Regulation (EC) No 1224/2009) which allows for up to 2% of additional catch for the purpose of scientific research. The 2% rule would equate to 800kg in the case of VIIa sole.

STECF notes that the proposal is to inflate the current TAC by 14t and to add this to the national quota of Belgium to accommodate additional landings from the proposed Belgian May/June and September surveys. This elevates their national fishing opportunities to 24t which is 2.4 times the current quota of 10t. However, if the relative stability share of fishing opportunities between Member States is to be maintained, then an additional 56t over and above the agreed 2016 by-catch TAC of 40 t would need to be allocated implying a by-catch TAC for 2016 of 96 t.

3. Provide an expert opinion if the benefits (2a) could outweigh the impacts (2b)

STECF notes that while the commencement of an additional survey with a broader geographic scale would potentially be advantageous, there is insufficient information presented to determine whether the surveys as currently designed are statistically appropriate. STECF observes that the proposed "number of hauls per statistical rectangle" is substantially biased towards the main commercial fishing areas and that the expected commercial CPUE is then used as the basis for calculating the volume of additional fishing opportunities necessary to undertake the surveys. STECF considers that such overemphasis in commercially exploited areas may potentially bias the outcome of the surveys.

STECF considers that one additional multi-annual survey should prove sufficient provided the survey is appropriately designed. However, if managers wish to facilitate both surveys, the May/June survey should also incorporate stations within the 12 NM limit. If managers chose to support only one survey, then STECF considers that the proposed September/October survey is likely to provide more useful data and information.

STECF notes that the requested additional quota of 14 t is to permit catches of sole also taken during the spawning season to be retained and landed i.e. such catches will mainly represent removals from the spawning stock which is currently severely depleted and the chances of stock recovery will be enhanced if removals from the spawning population are kept to a minimum. STECF therefore considers that if the chances of recovery are to be maximised, it would not be appropriate to permit any further increase in removals from the spawning population.

STECF Conclusions

There are potential scientific and cooperative benefits in undertaking the work programme as proposed in the ILVO report, however there are limitations with regard to the information presented and the overall justifications in the report from ILVO.

STECF makes the following conclusions.

Because the UK (E&W)-BTS-Q3 survey does not cover the entire distribution of the stock, STECF concludes that it would be desirable to undertake an additional survey which covers the full distribution of the stock. STECF concludes that while the proposed surveys can potentially provide information on the distribution and age composition of the catches encountered during the survey, undertaking the surveys for one year only will have very limited value for future stock assessments. The proposed survey for September/October may provide useful additional information provided it is conducted on a multi-annual basis. A time series of at least 5-years is needed in order to provide a useful tuning series for stock assessment.

STECF notes that the proposed survey in May/June only covers the area outside the 12 NM limit and will therefore have limited value from a stock assessment perspective. Furthermore, even with an expansion in geographic coverage, the data gathered from the May/June survey is potentially of more limited scientific benefit than that of the September/October survey. However, if the May/June survey is to be facilitated, STECF concludes that it should be expanded to include the area within the 12 NM zone.

STECF concludes that more specific details on the survey design is required in order to determine whether its design is statistically robust and therefore useful for future assessments of VIIa sole.

Contact details of STECF members

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ANNEX I - REPORT PRESENTED BY THE BELGIAN AUTHORITIES

Information on sole (*Solea solea*) in the Irish Sea (VIIa)

Prepared by ILVO, Belgium

Background

Current Irish Sea sole stock status and fishermen's perception

The sole stock in the Irish Sea (VIIa) is currently in a depleted state. According to ICES, SSB has continuously declined in the period 2001-2009 and has been below B_{lim} since 2005. Recent recruitment has been the lowest of the time series. For these reasons, ICES advises there should be no directed fisheries and all catches should be minimized in 2016. A bycatch TAC of 40 tonnes for sole in the Irish Sea (VIIa) was set for 2016. With the application of the Hague Preferences, Belgium has a bycatch quota of 10 tonnes.

Since no directed fisheries are allowed, there will be little opportunity to collect commercial catch data (length, age and weight). This means no qualitative commercial catch at age data will be available for future stock assessments. The assessment will evolve from a category 1 (*stocks with quantitative assessments*) to a lower (*data poor*) category with further automatic reductions in the current TAC as the inevitable outcome.

The rapid change from stability ($TAC \geq 800$ tonnes until 2007) to the current 40 tonnes TAC has been a shock to the Belgian fishermen involved in the Irish Sea sole fisheries. There is a mismatch between the perception of the Belgian fishermen and the stock assessment results. The fishermen argue that their catch efficiency remains stable and relatively high. Figure 1 shows the LPUE (landings per unit of effort) for the past 10 years and the three main fishing areas in the Irish Sea (areas shown in fig 2). The catch efficiency (based on scientific observer at sea data) indeed rises in the central part of the Irish Sea (this area is referred to as "Horse shoe area" in fig. 2) and remains stable and high in the eastern Irish Sea (Liverpool Bay, fig 2). The spatial distribution of the commercial fishery also remains relatively stable (fig. 3a and 3b, VMS data), until TACs became restrictive the last few year and fishing effort declined, especially in the eastern part of the Irish Sea where sole catches are the highest. The fishermen also argue that the length distributions of the landed sole remain stable and that they are catching larger sole than 10 years ago. This anecdotal information can be confirmed by length measurements performed by scientific observers at sea (fig. 4) showing an increase of sole larger than 30 cm in the Liverpool Bay area. Therefore the fishermen claim that the information of what the fisheries is seeing, isn't captured in the current scientific stock assessment outcome.

Sole stock in a changing environment

Fisheries have been proposed to have altered ecosystems over the course of the 20th century (Rogers & Ellis, 2000). The Irish Sea fisheries have evolved from a cod, whiting, sole and herring dominated fishery in the 1960s to one that is dominated by *Nephrops* and other shellfish stocks today (ICES 2015). The overall Irish Sea fishing effort has been reduced by > 40%, while the large mesh otter trawl and flatfish beam trawl effort has reduced by almost a factor 10. These reductions in effort and other measures to recover the declining cod, whiting, and sole stocks have resulted in little evidence of any stock response. This may

suggest that ecosystem changes may be playing a role by modifying levels of natural mortality. The (apparent) failure of these stocks to recover despite a massive reduction in fishing effort is in contrast to the North Sea where effort reductions have been successful in restoring stocks and is currently unexplained (ICES 2015).

The Irish Sea ecosystem has undergone considerable changes since 1960. The general increase in sea surface temperature (SST) is linked to increased northwards flow of warmer Atlantic waters, a positive phase of the Atlantic Multidecadal Oscillation (AMO) and the increasing influence of global climate change. These changes in atmospheric and hydrographic forcing in the Irish Sea causes changes in the strength and timing of stratification and sea currents (e.g. the western Irish Sea gyre, Olbert et al 2011) that have the potential to alter dispersal and survival of eggs and larvae (Phelps et al 2015). The Irish Sea winter SST shows a significant increase during the last 40 year and this is correlated with a significant long-term trend towards earlier spawning of sole at a rate of 1.5 weeks per decade (Fincham et al 2013). In addition, increased precipitation and river flow are likely to result in changing nutrient supplies that influence phytoplankton structure. Reductions in zooplankton, which is important for fish recruitment, have also been observed (ICES 2015).

Another physical change in the Irish Sea is the introduction of extensive wind farms. Liverpool Bay harbours several wind farms (Gwynt y Môr, Rhyl Flats, North Hoyle, Burbo Bank) with one of the largest operating offshore windfarms in the world (Gwynt y Môr). Several other wind farms are located north of Liverpool Bay close to the Isle of Walney (Barrow, West of Duddon Sands, Walney, Walney extension) and in Solway Firth (Robin Rigg). These windfarms are located in the main spawning and nursery grounds for sole (fig. 5, Ellis et al. 2012). These offshore wind turbines may impact the fauna closely around them by introducing an artificial hard substrate, but may also have effects on greater distances by altering the hydrodynamics in the area (OSPAR 2008). This may influence the recruitment success of sole in the Irish Sea.

One of the important requirements of a successful spawning ground is the presence of suitable hydrographic conditions to transport eggs and larvae to nursery areas (Symonds and Roger 1995). The optimal habitat for spawning grounds depend on a combination of optimal temperature conditions, food availability, competitive interactions and predation risk (Van Keeken et al 2004). The main nursery ground in the Irish Sea is supposed to be the Liverpool Bay area in the Eastern-Irish Sea (Rogers 1992, Symonds and Rogers 1995) providing the greatest contribution to the stocks of adult sole in the Irish Sea. There are other spawning and nursery grounds in the Irish Sea (fig. 5, Ellis et al 2012), but their contribution is supposed to be much lower. Yet, given the current ecosystem changes, changing hydrographic and atmospheric forcing, changing spawning phenology and the introduction of extensive wind farms, it might be that the relative contribution of the different nursery areas has changed or that the nursery areas have been partially displaced.

Scientific survey gear and sampling locations

The assessment for sole in the Irish Sea is primarily driven by the output of a single scientific survey, the UK(E&W)-BTS-Q3. This survey focuses on flatfish species, particularly juvenile plaice and sole (ICES Stock Annex: Sole VIIa) and to a lesser extent on adult flatfish. This survey mainly samples locations in the Liverpool Bay in the eastern part of the Irish Sea, which is supposed to be the main flatfish nursery area in the Irish Sea. The survey indices used in stock assessment of sole are even more focused on the eastern Irish Sea (shown in red in fig. 6).

Recent Belgian scientific observer-at-sea data indicate an increase of juvenile sole in commercial catches in the Horse shoe area, suggesting juvenile sole no longer exclusively occurs in the Liverpool Bay, but have a broader distribution than previously expected (see length distributions in fig. 4 and discard per unit of effort, DPUE, in fig. 7). This perceived change in distribution may have some repercussions on the recruitment estimates of the scientific survey, which may now overlook part of the juvenile sole stock because of its restricted spatial coverage.

In addition to this, Belgium has concerns about the efficiency of the current survey. In 2014, a Belgian fishery scientist and a Belgian skipper joined the UK(E&W)-BTS-Q3 Survey. During this survey only negligible numbers of adult (and juvenile) sole in the Mid-Irish Sea fishing ground were observed. However, Belgian observer-at-sea data recorded much higher catches of both juvenile and adult sole from this area (fig. 1, 4 and 7). The Belgian skipper who took part in the survey observed that the trawl shoes of the survey gear had a limited contact with the seabed and therefore he claims the rigging of the trawl gear and its efficiency to catch demersal fish were questionably. This was acknowledged during the meeting of WKIRISH¹ (ICES WKIrish1 Report 2015).

Given these uncertainties and the lack of opportunities to collect additional commercial fishery data in 2016, Belgium proposes a work plan to allow a broader data collection and in particular to document the spatial and temporal distribution of adult and juvenile sole in the Irish Sea and to document the genetic population structure of the adult sole stock.

Research questions we want to answer based on the outcome from this project are:

- Is there a potential spatial shift of the nursery grounds of sole?
- Is there a potential spatial shift of the adult sole stock?
- What is the current importance of the Liverpool Bay nursery grounds for the commercial Irish Sea sole stock and what is the contribution of potential other nursery grounds?
- Is information from the industry which is often disregarded as being anecdotal or tainted, a valuable source of scientific information if approached in a systemic way?

¹ WKIrish process is a 2-year project that includes a series of workshops and intercessional work that focuses on improving single-species stock assessments, incorporating a mixed fisheries model, and developing the integration of ecosystem aspects and working towards an integrated assessment and advice.

Belgium's improved and extended data collection will lead to an improved single stock assessment for sole in the Irish Sea, one of the objectives of WKIrish3 and will feed into WKIrish4 where an integrated ecosystem assessment will be developed. Furthermore, the genetic profiling of the Irish sole stock will ascertain any changes in migration patterns to inform the WKIrish modelling effort on migration patterns.

Aims

Aim 1: Extended fishery independent data collection

Aim 2: Improved knowledge of the population behavior of the sole stock

Aim 3: Assess validity of the survey

Aim 4: Improvement of stock assessment

Aim 5: Strengthen the cooperation and communication between fisheries scientists and fishermen

Work plan

Aim 1: Extended fishery independent data collection

The UK(E&W)-BTS-Q3 Survey largely focuses on the eastern part of the Irish Sea while the main commercial fishing grounds of sole are more offshore and in the central part of the Irish Sea. This survey was originally designed to monitor the juvenile stocks of flatfish, but now it is also used as the main data source for adult sole. Therefore we propose an industry survey with a broader spatial and temporal coverage of the Irish Sea between 53 and 55°N (excluding the Cardigan Bay (fig 2), which is of minor importance for sole).

We plan two fishing trips in May and June (during the spawning season), and two trips in September (simultaneous with the UK(E&W)-BTS-Q3 Survey). In the May and June campaign we propose to sample 80 hauls randomly distributed (in a stratified random sampling design) outside the 12NM area, this is also where most commercial sole is caught (fig. 8 for preliminary spatial design). Stratification will be based on seabed characteristics and bathymetry. Exact locations within these subzones will be determined later on in the project based on bathymetry, seabed characteristics, location of windmills, shipwrecks and closed areas, and experience of fishermen. This would give us a better view on the age and length distribution of sole in the Irish Sea and also its densities and spatial distribution. The same sampling scheme will be repeated in September-October. In addition, we plan to sample 80 hauls within the 12NM area to better characterize the sole nursery grounds in the Irish Sea (fig. 8). These sampling campaigns will have a much wider spatial coverage than the current survey (fig. 6) and is aimed at detecting a potential spatial shift of the current nursery grounds and at detecting potential other nursery grounds.

This aim is similar to the current Dutch flatfish industry survey in the North Sea in close cooperation with Wageningen IMARES. For this a scientific sole quota of 14 tonnes will be necessary (See Annex 1 for estimation of scientific quota). Initially, a higher quota was estimated, however, as Belgium is aware of the unsure situation of the stock, we've looked at calculating the minimum of quota needed for this survey.

Deliverables: September 2016: distribution data of densities and ages of the spring campaign.

End of October 2016: distribution data of densities and ages of the spring and autumn campaigns and commercial age distribution data from the running year.

Aim 2: Improved knowledge of the population behaviour of the sole stock

From aim 1 we will already get a better view on age and length distribution of sole in the Irish Sea. In addition we will analyse the sole population genetic structure to quantify the contribution of the Liverpool Bay spawning grounds and possible other spawning grounds in the Irish and Celtic Seas for the commercial sole stock in the Irish Sea. This will give us better insights in potential migration of sole inside or outside the VIIa area, which is one of the aims in WKIRISH. We will conduct genetic fingerprinting analyses on sole from the different fishing grounds. The population genetic structure will be determined by neutral molecular markers (microsatellite loci) which are already developed in the Laboratory of Biodiversity and Evolutionary Genomics at KU LEUVEN University in cooperation with ILVO.

Deliverables: better knowledge and insight in the importance of the Liverpool Bay spawning grounds (and potentially other spawning grounds) for the recruitment of the Irish Sea sole stock.

Aim 3: Assess validity of the survey

The UK(E&W)-BTS-Q3 Survey in the Irish Sea has received criticism from the fishermen on the application and the rigging of the trawl gear and its efficiency to catch demersal fish were questioned. We propose to compare the catch compositions of the UK(E&W)-BTS-Q3 Survey with catches from a commercial vessel and gear. A commercial beam trawl vessel and the RV Cefas Endeavour could fish side by side for a selected set of hauls to provide a catch comparison of the survey and a commercial vessel. Of course the catching efficiency of the survey gear and the commercial gear will be different, but the objective is to mainly collect data on the relative importance of the different length/age classes and develop a catch comparison key with the survey. This is similar to the comparative fishing carried out by the Dutch flatfish industry during the Dutch Beam Trawl Survey (BTS) in the North Sea in 2009-2010 in close cooperation with Wageningen IMARES.

The agreement and cooperation of CEFAS would be needed for this task. Previous cooperation during the survey in 2014 has been successful and can be a good basis for further cooperation.

Deliverables: Comparison of age and length composition of the catches in commercial and scientific survey data (in case the relative importance of the different length classes are different)

Aim 4: Improvement of stock assessment

Over the last 10 years, the TAC has been systematically and substantially reduced to a bycatch quatum of 40 tonnes in 2016. Those management considerations were supposed to lead to a significant increase in spawning stock biomass (SSB) of 5 to 20 % yearly (according to the yearly the ICES advice, ICES 2015b). Yet, the SSB has further declined and is now estimated to be at the lowest value of the time series. Therefore it is possible that the stock assessment does not truly grasp what is driving the population dynamics of this stock, and this argues for a revision of the assessment. Although the discard rates of sole are still estimated to be relatively low (average discarding by weight is 7% of the catch), the last years there is an increasing trend. Moreover, the much more intense Irish Sea *Nephrops* fisheries yearly land > 10.000 tonnes *Nephrops* and are supposed to have a considerable sole bycatch (Hepples 1994), but to date, no recent data on sole bycatch are publicly available, not in the ICES InterCatch database, nor in the CEFAS " Discard Atlas of the

North Western Waters Demersal Fisheries”. A better estimation of the discarding of sole and the inclusion of those discards in the assessment, will lead to better catch and mortality estimates.

As the survivor estimates and fishing mortality estimates are almost entirely determined by the UK(E&W)-BTS-Q3 survey, the outcome of aim 3 and aim 2 might propose to review the current assessment results.

Aim 5: Strengthen the cooperation and communication between fisheries scientists and fishermen

Stakeholders may frequently challenge the validity or interpretation of scientific advice because of the negative impact policy decisions can have on their lives. This ‘tension’ between society, policy and science is plainly evident when environmental sustainability concerns appear in conflict with maintaining livelihoods.

In 2015 the Belgian fishing industry signed a contract with the Flemish government, ILVO and the NGO Natuurpunt. Linked to this contract is an improvement trajectory, written by the NGO and accepted by the industry. This involves a list of specific actions to be taken by the industry to reach a more sustainable fishery. Together with the effort by the industry comes the obligation of science to be more active in its communication and be more open regarding the scientific methods used. Observations of fishermen should be taken seriously and this project reflects the efforts of ILVO to resolve disagreements by involving fishermen in the scientific process and by improving the scientific advice.

As such, in addition to generating data to improve fisheries decision-making, this project is a collaborative research project² and is expected to facilitate learning between fishermen and scientists and increase the transparency of scientific assessments. The experience of this industry survey should improve the understanding of how scientific fishery surveys are used to estimate the population status. A state of mind of cooperation with science instead of opposition towards science is anticipated, whilst scientists should become more open to the ideas of fishers and their knowledge of the marine environment.

As well as generating useful data and insights, this Fisheries Science Partnership established with this project, could help to improve the working relationships between fishermen and scientists in Belgium and develop a model to use in the future.

Since the last CFP-reform process, longer term, strategic objectives have become more apparent in industry thinking, e.g. “we need better information on the state of the stock and the best way to fish it in the longer term”. This is particularly evident in this project as this is about the development of long-term vision about the fisheries in the Irish Sea. The results of this project could demonstrate that information from the industry which is often disregarded as being anecdotal or tainted, in fact can be a valuable source of scientific information if approached in a systemic way.

The project will also be vital in developing a set of methodologies for how to engage with fishers as stakeholders in the Belgian policy process. What sorts of data do they esteem, what types of evidence do

² Participatory or Collaborative research is about processes as well as scientific outcomes. It involves stakeholders and scientists working and learning together through the planning and delivery of research. The common aim is to improve the knowledge base and quality of scientific information for management advice and legislation. Two compelling reasons for doing participatory research are that it facilitates solving problems using a more extensive knowledge set, and that greater compliance can be expected when stakeholders themselves have contributed to scientific advice and can see clearly the links from this to policy decisions (<http://nffo.org.uk/responsible-fishing/fisheries-science-partnerships>)

they offer and consider important? How (un)scientific are fishers' discourses? Can their folk and tacit knowledge generate valuable insights, which are meaningful for marine science?

Figures

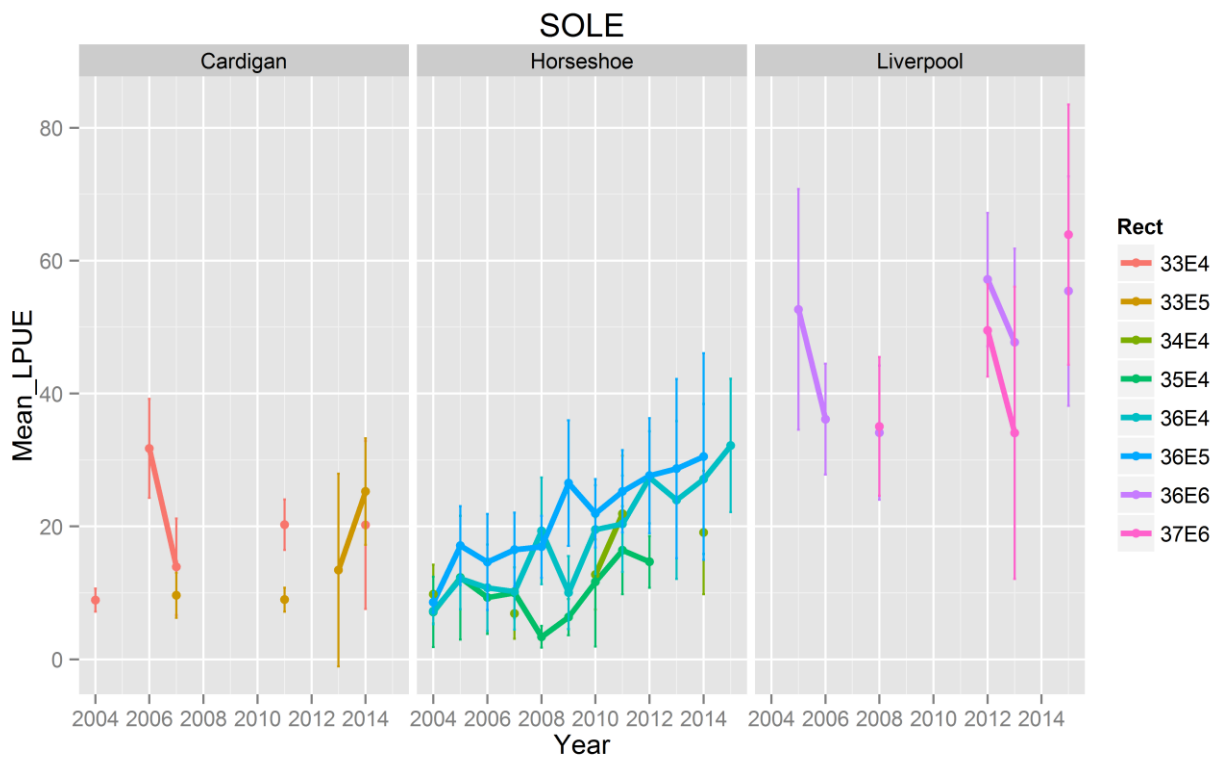


Figure 1: Landings per unit of effort (LPUE, kg/hr fishing) of sole caught by the Belgian beam trawl fisheries. Values are calculated based on the observer-at-sea data on board commercial vessels. The Irish Sea is divided in 3 areas, the Cardigan Bay, the central area SW of the Isle of Man ("Horse shoe") and the Liverpool Bay. Fishing activities in each ICES rectangle are presented by different colours.

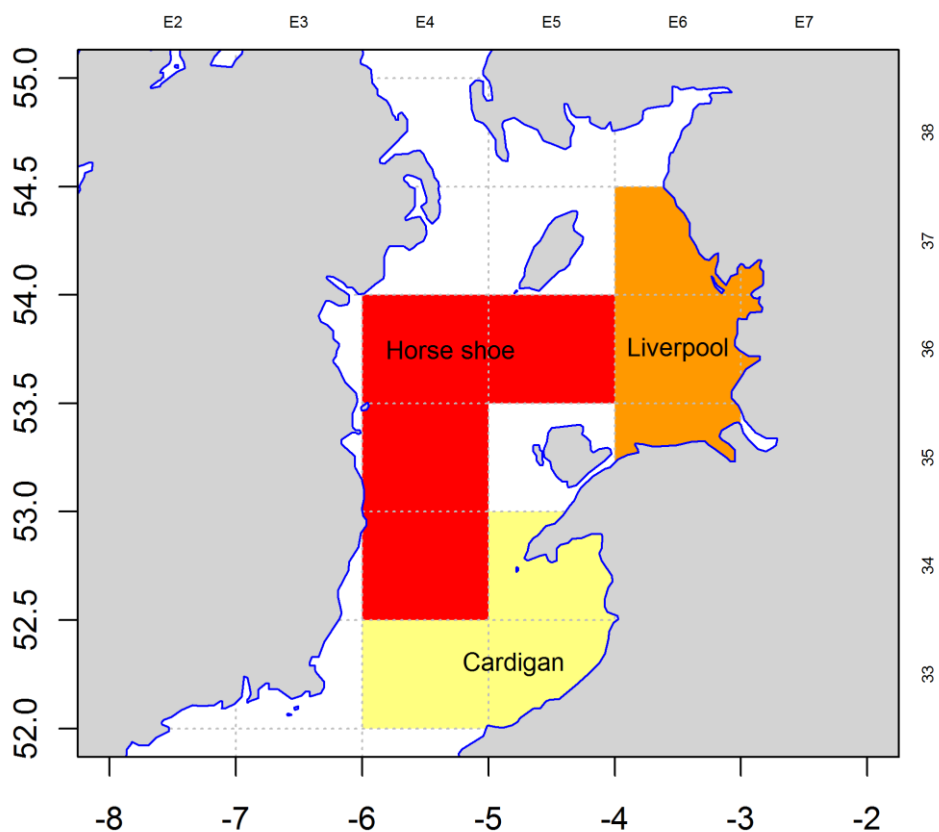


Figure 2: Map of the Irish Sea showing the different fishing grounds used by Belgian beam trawlers. The codes on the top side (E2:E7) and right side (33:38) refer to the ICES Statistical Rectangles, e.g. The rectangle where “Liverpool” is written is rectangle 36E6. “Liverpool” refers to the Liverpool Bay, “Cardigan” to the Cardigan Bay and “Horse shoe” to the central and western part of the Irish Sea.

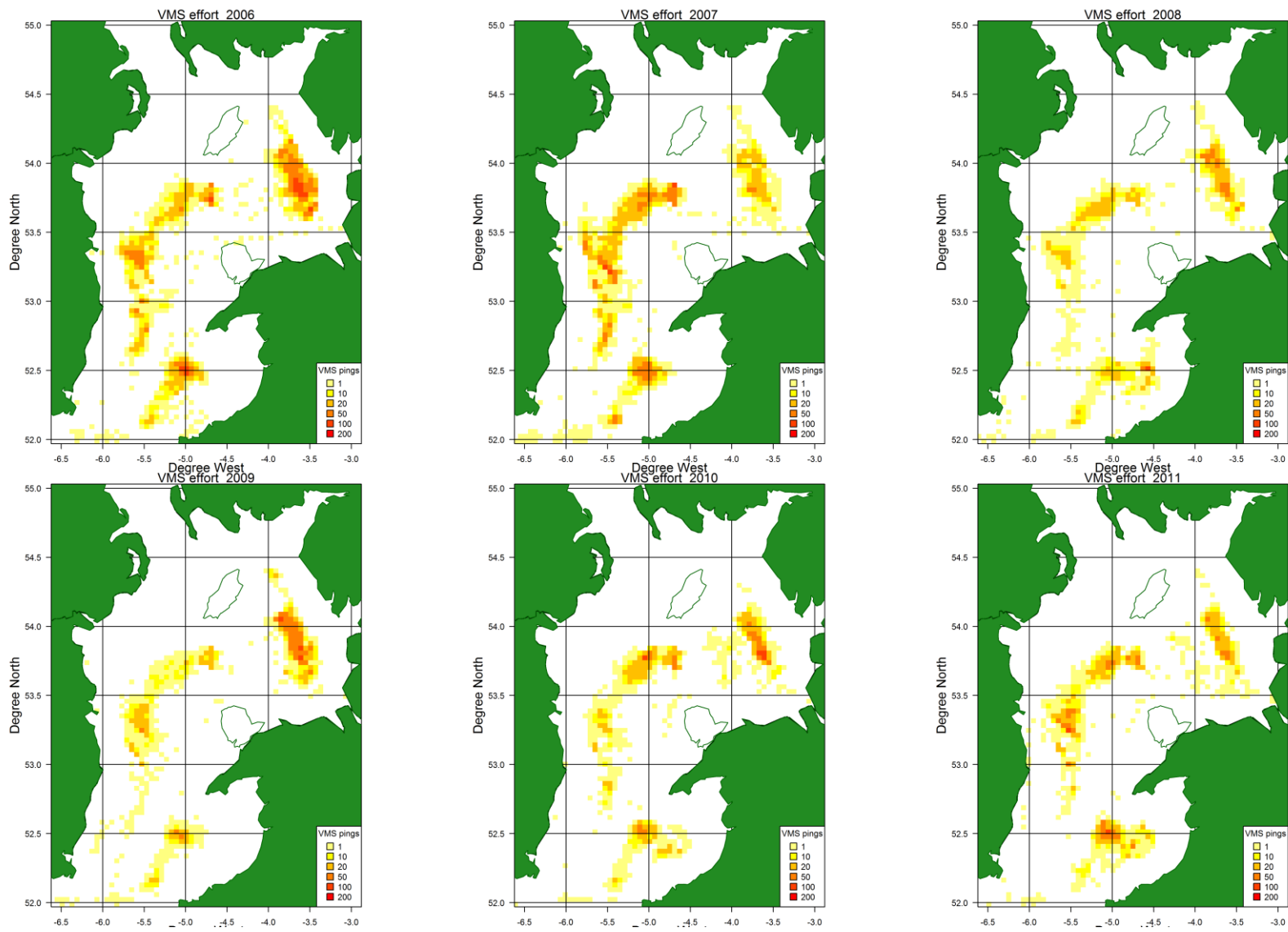


Figure 3a: VMS fishing effort distribution of Belgian beam trawl fisheries (2006-2011) in the Irish Sea.

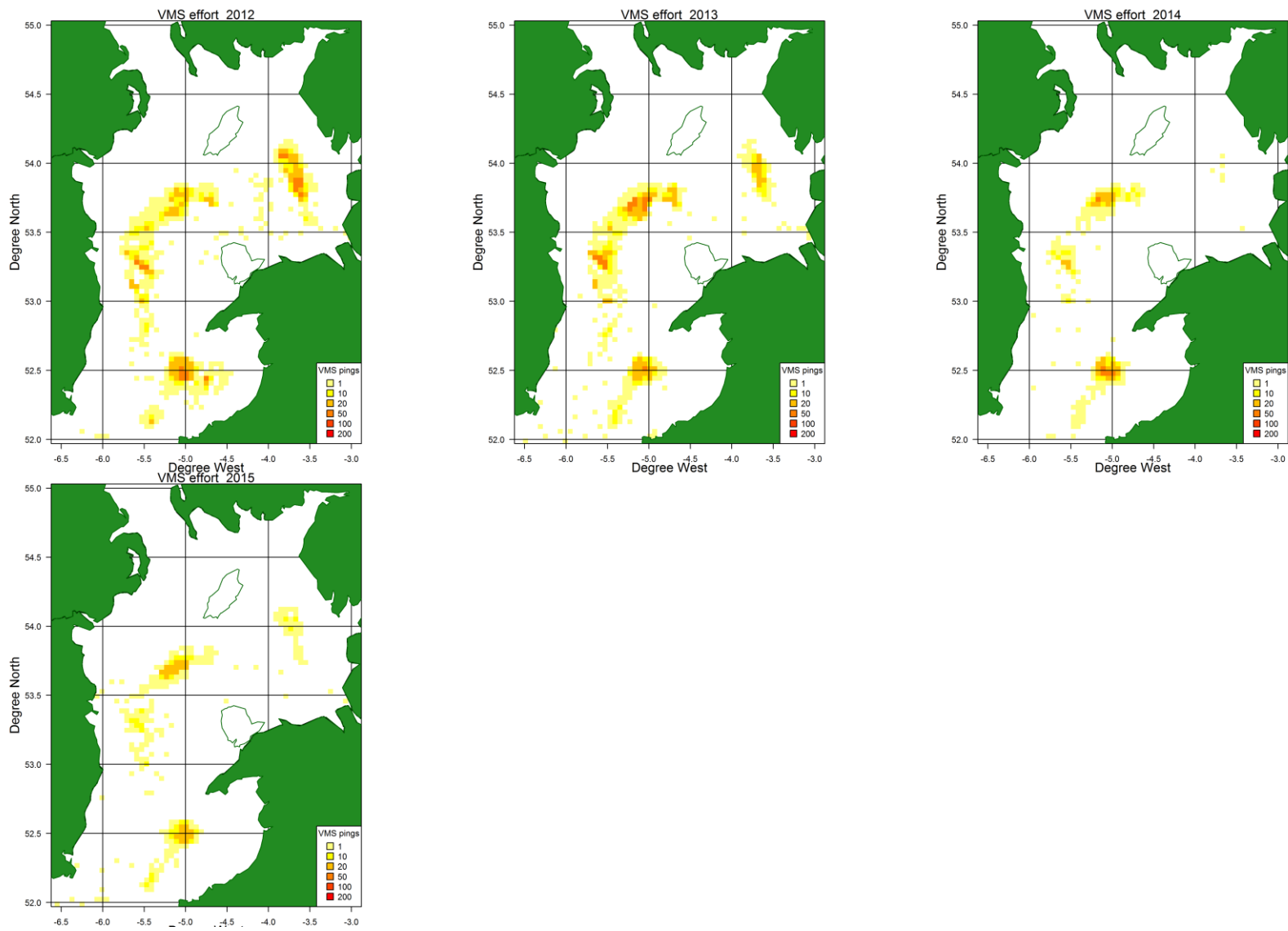


Figure 3b: VMS fishing effort distribution of Belgian beam trawl fisheries (2012-2015) in the Irish Sea.

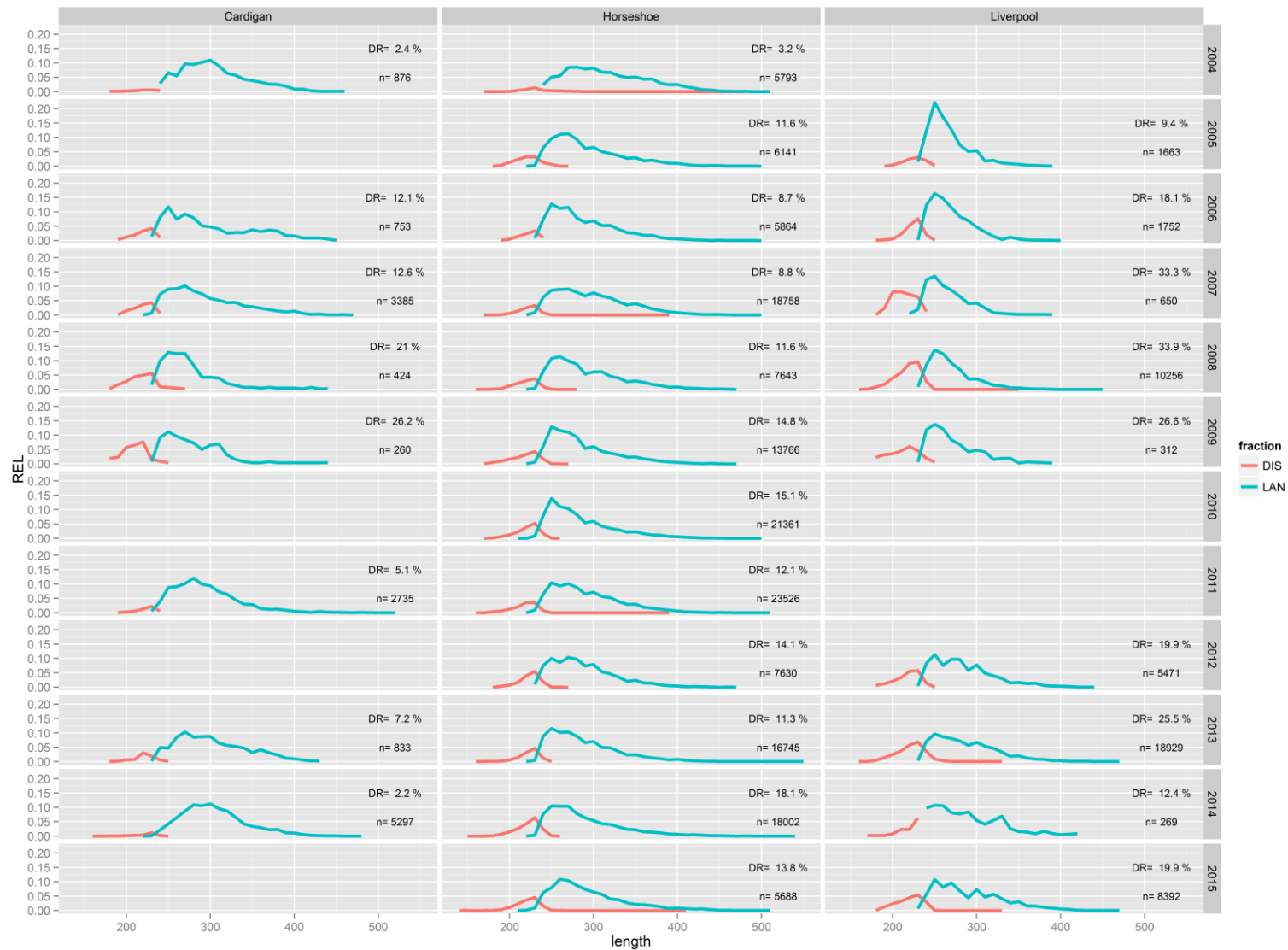


Figure 4: Relative length distribution (%) of discarded and landed sole in the 3 different areas in Irish Sea for 2004-2015 based on observer-at-sea data. “DR” = discard rate based on number of fish. Red lines present the discarded fraction and turquoise the landed fraction. “n” denotes the number of sole measured in a specific year in a specific area. Length in mm.

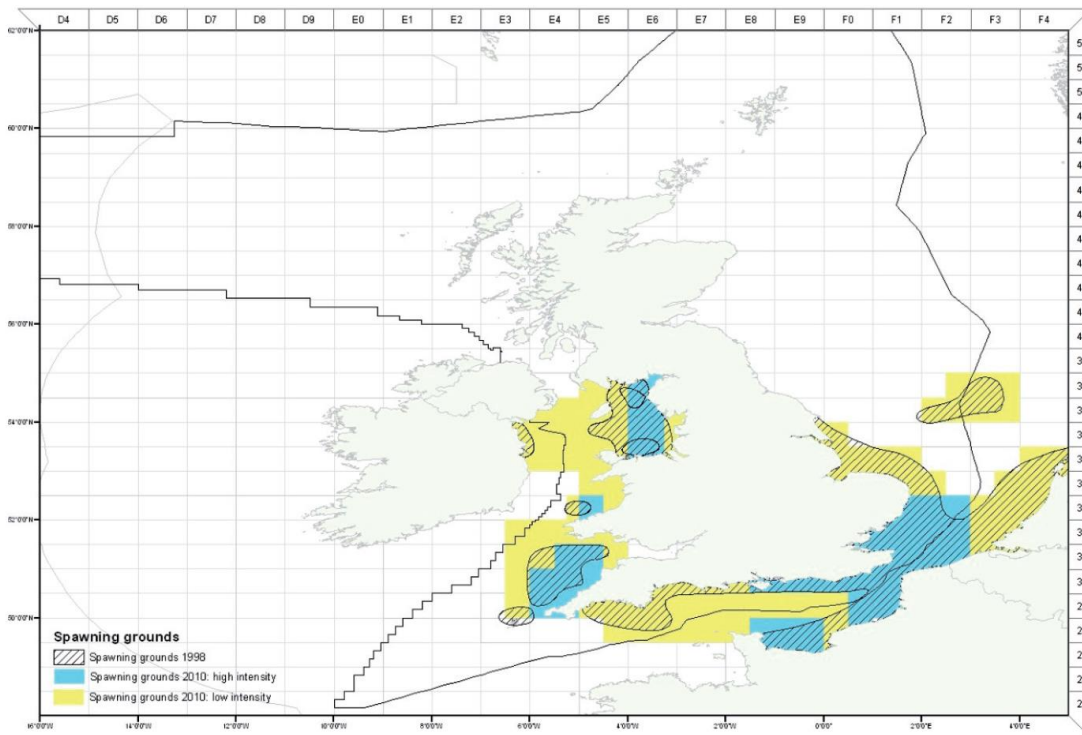


Figure 5: spawning grounds of sole (Ellis et al 2012).

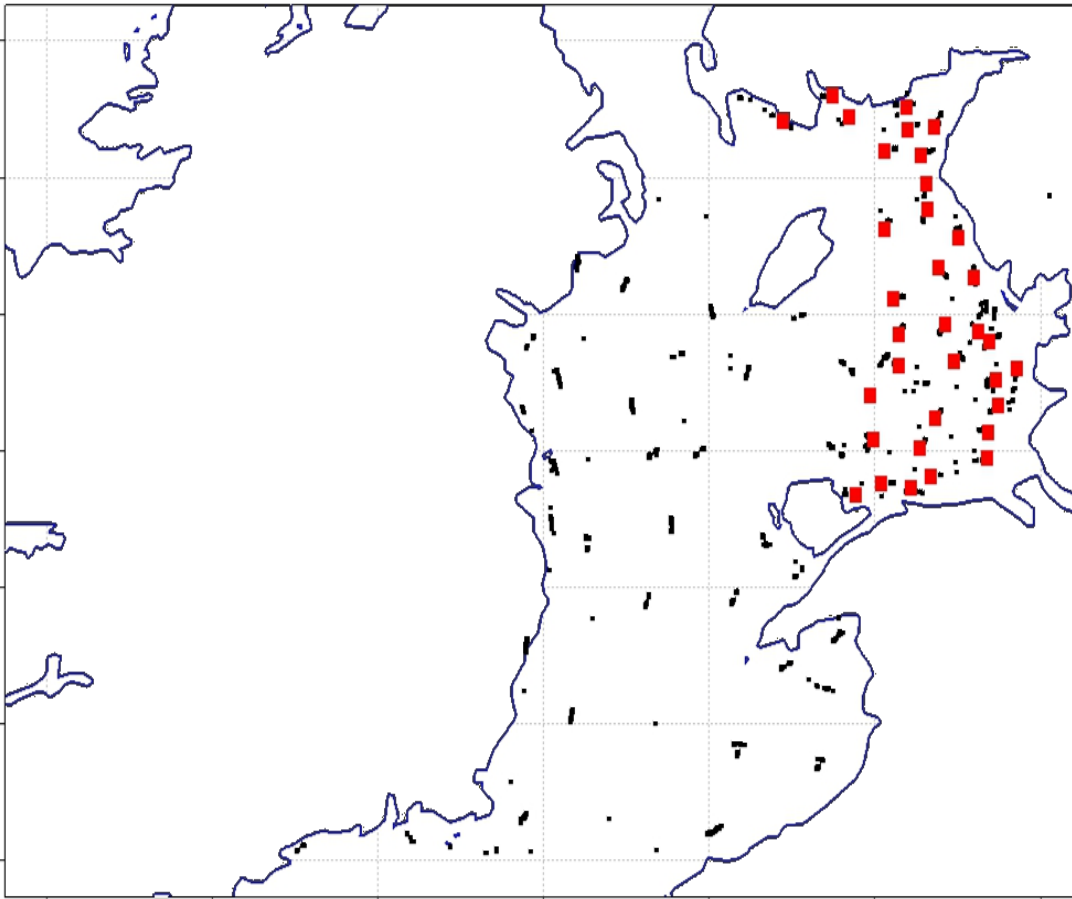


Figure 6: Sampling locations of the UK(E&W)-BTS-Q3 scientific survey in the Irish Sea. Locations in red are the hauls that are used to calculate the survey indices used in stock assessment of sole.

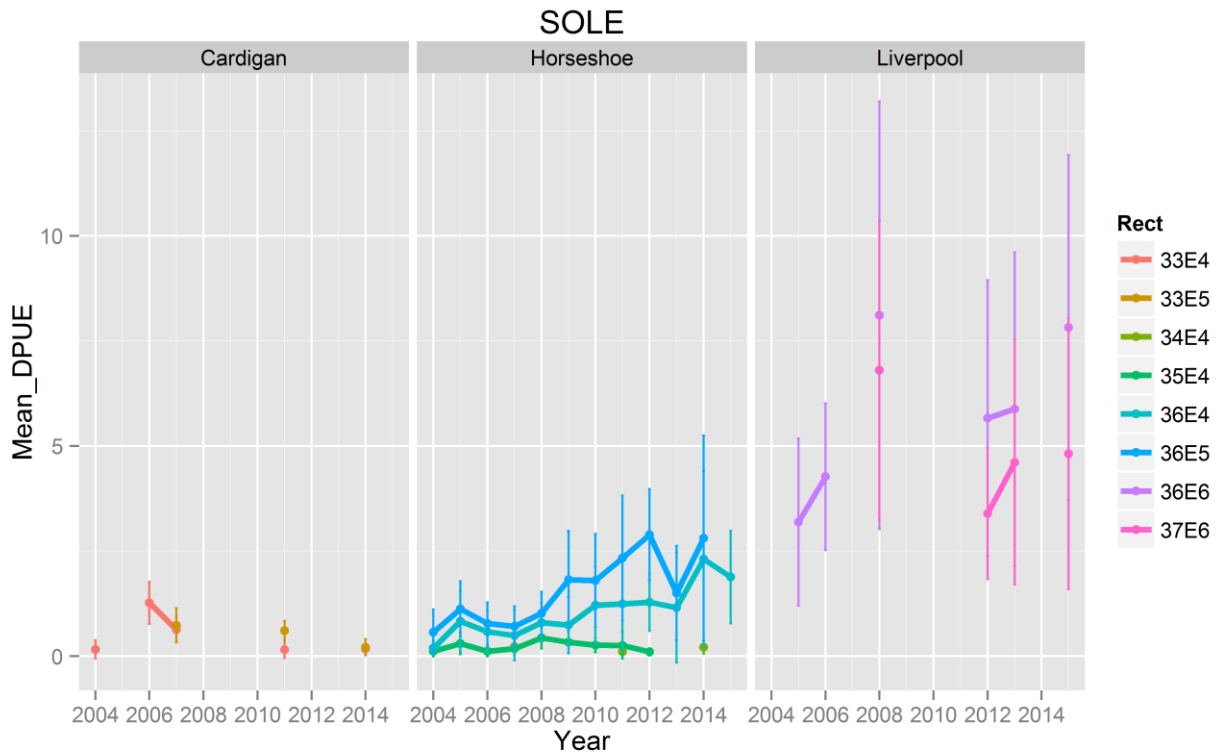


Figure 7: Discards per unit of effort (DPUE, kg/hr fishing) of sole caught by the Belgian beam trawl fisheries. Values are calculated based on the observer-at-sea data on board commercial vessels. The Irish Sea is divided in 3 areas, the Cardigan Bay, the central area SW of the Isle of Man (“Horse shoe”) and the Liverpool Bay. Fishing activities in each ICES rectangle are presented by different colours.

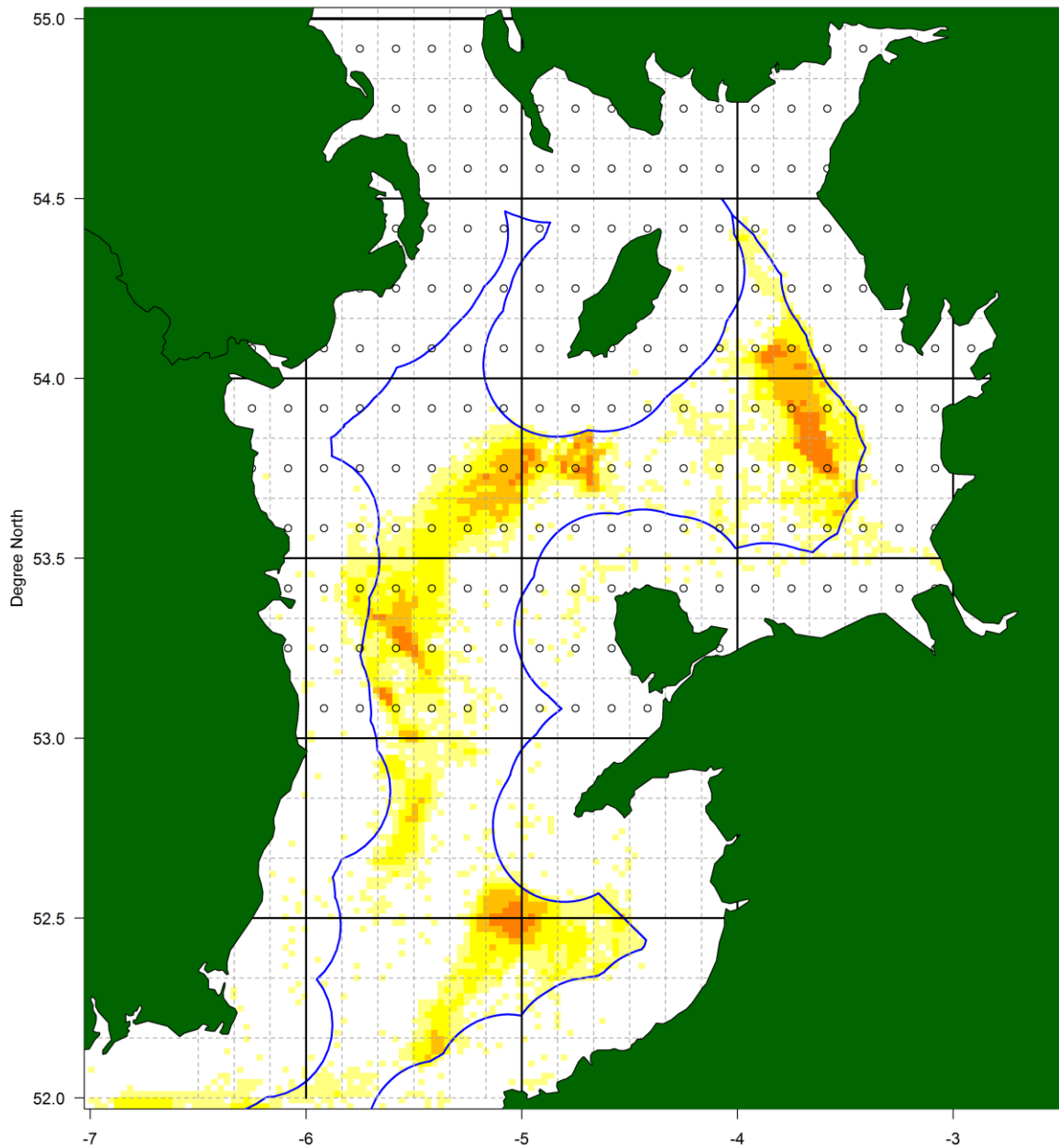


Figure 8: Industry survey sampling locations and VMS fishing effort distribution of Belgian beam trawl fisheries (2006-2015) in the Irish Sea. Blue lines show the 12 nautical mile territorial sea limits. ICES rectangles are plotted and divided in 18 subzones where hauls will be sampled during the industry surveys.

Annex 1: Estimation of scientific sole quota

Table 1: Hauls to sample outside the 12 NM border. Number of hauls per rectangle, the observed LPUE (by observers at sea) and the estimated kg sole that will be caught. The estimated catch per haul was calculated as the mean LPUE +2*standard deviation.

Number of hauls	ICES rectangle	Observed mean LPUE + 2*standard deviation (kg/h)	Expected sole catch (kg)
15	35E4	29.7	446
16	36E4	52.3	837
6	37E4	No data available, estimate taken from 36E4 = 52.3	314
2	35E5	No data available, estimate taken from 36E5 = 61.6	123
18	36E5	61.6	1109
4	37E5	No data available, estimate taken from 36E6 = 103.3	413
13	36E6	103.3	1240
6	37E6	91.8	551
			Total= 5.03 tonnes

Surveys outside 12NM limits

May 2016: 80 hauls outside 12NM area: quota needed of 5.03 tonnes.

September 2016: 80 hauls inside 12NM area: quota needed of 5.03 tonnes.

The scientific sole quota must be utilized within the time frame of the two proposed surveys. Fishing operations are restricted to the pre-defined survey schedule and protocols. Fishing operations will be on pre-designated scientific survey locations. Any sole caught and retained on board in the course of the scientific survey shall be counted against the scientific quota allocation made to the vessel. The catch will be monitored and documented by an ILVO scientific observer at sea.

Survey within 12NM limits

September 2016: 80 hauls inside 12NM area.

No quota is needed as this would be performed as a scientific survey chartering a commercial vessel. Catches will not be retained on board.

Total scientific quota needed

The estimations made in table 1 are based on the observer-at-sea data which are relatively accurate, but based on only a few percent of the actual fishing activity. There may be potentially higher catches than we observed in specific rectangles during months that were not sampled by observers. To be on the safe side, we would request a scientific sole quota of 14 tonnes for the Irish Sea. This would increase the catch to 54 tonnes, which is still below the $F_{MSY} \times (SSB_{2016}/MSY B_{trigger})$ approach followed last year and this corresponds to a mortality lower than 0.057.

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EUR 27758 EN – Joint Research Centre – Institute for the Protection and Security of the Citizen
Title: Reports of the Scientific, Technical and Economic Committee for Fisheries - Monitoring the Performance of the
Common Fisheries Policy (STECF-16-03).

Authors:

STECF members:

Graham, N., J., Abella, J. A., Andersen, J., Bailey, N., Bertignac, M., Cardinale, M., Curtis, H., Daskalov, G., Delaney, A., Döring,
R., Garcia Rodriguez, M., Gascuel, D., Gustavsson, T., Jennings, S., Kenny, A., Kraak, S., Kuikka, S., Malvarosa, L., Martin, P.,
Murua, H., Nord, J., Nowakowski, P., Prellezo, R., Sala, A., Scarcella, G., Somarakis, S., Stransky, C., Theret, F., Ulrich, C.,
Vanhee, W. & Van Oostenbrugge, H.

Luxembourg: Publications Office of the European Union

2016 – 12 pp. – 21 x 29.7 cm

EUR – Scientific and Technical Research series – 1831-9424

ISSN 2467-0715

ISBN 978-92-79-56781-0

doi:10.2788/780937

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