Cod monitoring

Results 2015, Quarter 4

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IMARES report C053/16

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Contents

1 Introduction

The Cod monitoring program is part of the Dutch cod avoidance plan developed by the Dutch Government together with the Dutch fishing sector. The aim of this cod monitoring program is to provide information on the Catch per Unit Effort (CpUE) in the TR fleet (bottom trawls and seines). This is needed in order to calculate a conversion factor between the CpUE of the TR and the BT (beam trawl) gears. The transition of kW-days between gears is regulated by the European cod recovery plan (EC 2008 and EC 2004) and depends on the yearly CpUE-ratio of cod between the respective gear groups.

In the Dutch cod avoidance plan, the Dutch government distinguishes between otter/pair trawlers that are directed to cod (TR1AB[1]) and those for which cod is bycatch (i.e. TR1C and TR2) (see table 1). The kW-days transition only applies to the second group, fisheries for which cod is bycatch. For the kW-days transition between the BT and the TR gears for which cod is bycatch (TR1C and TR2) a conversion factor of 3:1 is used in the Netherlands. This is different than stated in the European Cod Recovery Plan and therefore the ratio should be substantiated for.

Table 1. Definitions of the fleet segments used in this report.

Fleet definition	Geartype	Meshsize (mm)	Target species
TR1AB	Otter/pair trawlers and seines	>120	Cod
TR1C	Otter/pair trawlers and seines	100-119	Plaice
TR2	Otter/pair trawlers and seines	70-99	Plaice/Nephrops
BT2	Beam trawlers	70-119	Plaice/Sole

A yearly analysis of the EU-logbook (hereafter logbook) data in combination with VMS-data is provided to the Ministry of Economic Affairs. However, to remain updated, an overview of fishing activity, cod catches and cod Landings per Unit Effort (LpUE) of all four gear types per quarter is requested by the Ministry of Economic Affairs. This report presents the results of the fourth quarter in 2015.

Monthly cod LpUE estimates are used by MMO, Marine Management Organisation (UK) to determine RTC, Real Time Closures. The Dutch LpUE averages, mapped per 1/16 ICES squares, of the months of quarter 4 and years 2014 and 2015 are presented in Appendix B, Figures 7-9. These figures present the information required by MMO to estimate LpUE and select monthly RTCs.

[1]Some fishermen fishing with TR gear, 120+ mesh size are targeting plaice with cod as minor by-catch.

2 Materials and Methods

In this section, the data sources and the final output are described. See " Appendix A. Extended Material and Methods " for a detailed description of the method to link VMS and logbook data. The method used in this report is consistent with the method described in Hintzen, et al 2013.

2.1 Logbook data

All fishermen are obliged to report their activities on a daily basis. This includes location, gear used, vessel characteristics and estimated landing quantities (in kg). These quantities are an estimation and therefore deviate from auction data. Moreover, fishermen do not have to report catches for species with a trip-total quantity below 50 kg. As cod is a by-catch species, trips with cod landings lower than 50 kg can be expected. Therefore, the cod catches in this report are an (under)estimation of the total catches. Second, fishermen report all landings and vessel characteristics online and the data are immediately imported in the database of the Dutch Government. The logbook data cannot be validated or checked by IMARES on correctness of the information. Therefore, records with a type-error in the gear description will not be recognised as "wrong ", but will erroneously be taken into consideration.

2.2 VMS data

All ships over 12 meters are obliged to participate in the Vessel Monitoring System (VMS). This system sends regular updates to a satellite, containing time and date, position, speed and vessel ID. All these records are registered by the Dutch government. IMARES has permission to work with these data.

2.3 Value maps

All value maps show data for quarter 4 of 2015, summed for all gears together and for each gears separately. To facilitate the visual comparison between quarterly and yearly spatial distribution, values of fishing activity and landings in quarter 4 are multiplied by 4. By doing so, fishing activity and landings per quarter have similar value ranges as yearly fishing activity and landings value ranges. To supply actual quarterly fishing activity and cod landings, each map includes a legend underneath with the absolute quarterly value for that gear.

2.4 Calculate LpUE ratio

A quarterly indicator of the conversion factor between the TR and the BT gears is given. This indicator is based on the ratio between LpUE of the TR gears for which cod is bycatch (TR1C and TR2) and the BT2 gears (LpUE estimates: Cod landings/Fishing activity of the gears [kg/kWday], see formula 1). As this analysis is based on logbook data, in which cod landings are reported in kg (with a minimum of 50 kg), the calculated ratio in LpUE has a large uncertainty range not accounted for in this quarterly report. A more detailed yearly ratio in LpUE between BT and TR will be given in the extensive year report, that will be published later this year.

Formula 1:

$$\left(\frac{(Cod\ landings\ TR1C + TR2)}{(Fishing\ activity\ TR1C + TR2)}\right) \Bigg/ \left(\frac{Cod\ landings\ BT2}{Fishing\ activity\ BT2}\right)$$

3 Results

3.1 Fishing activity

Fishing activity was calculated for all gears together (figure 1) and for each gear separately (figure 2, table 2). Fishing activity is displayed in kW-days, which represents days at sea multiplied by the engines power, as the day-transition is applied to kW-days. Most fisheries are concentrated in the southern- and central North Sea. Also in the English Channel activity takes place.

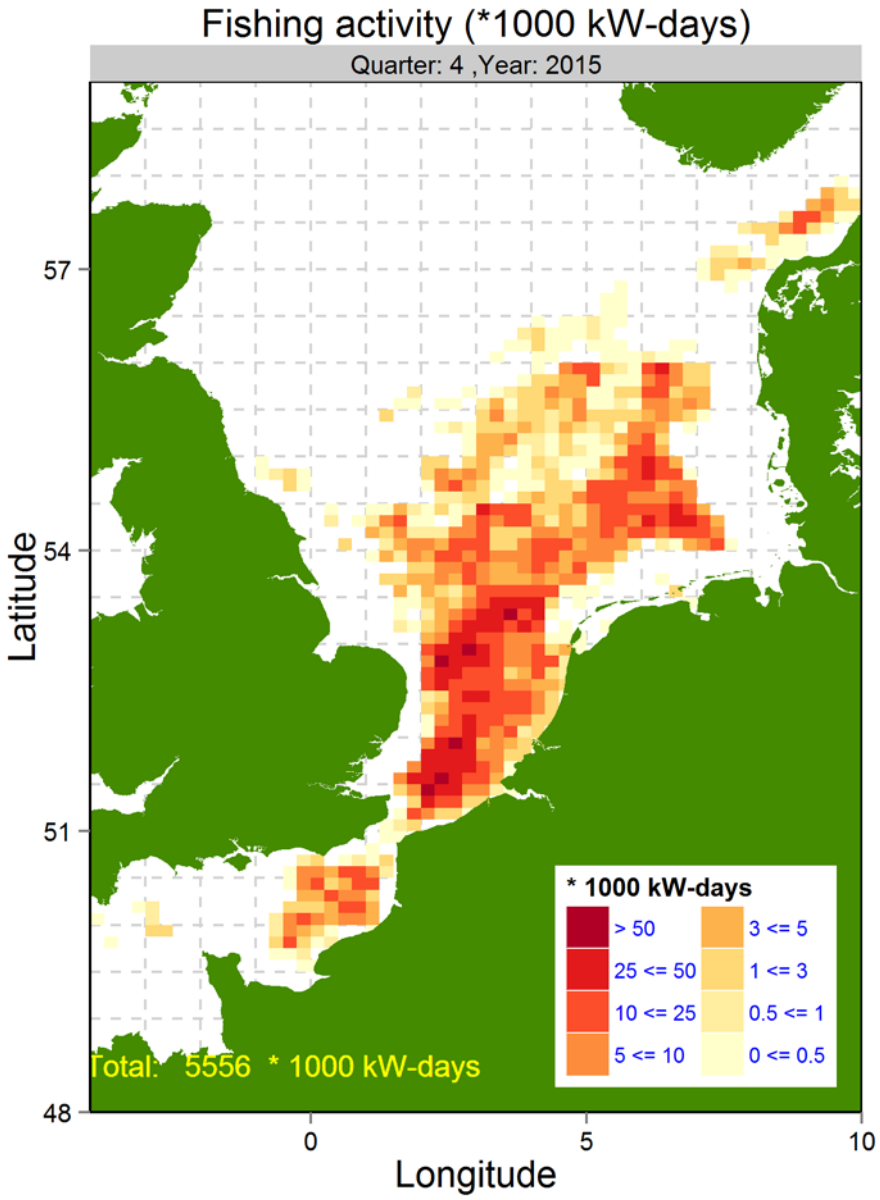

Figure 1. Fishing activity (in *1000 kW-days) map for all TR and BT2 gears together in quarter 4 in 2015 . The text bottom-left on the map shows the estimate of total fishing activity for all gears combined in this quarter.

Fishing activity is dominated by BT2 gears, with only a small contribution of TR gears (figure 2, table 2). The TR2 fleet is the most active fleet within all TR gears, with an effort of 406 000 kW-days. From figure 2 and table 2 we can see that TR vessels hardly use a mesh size of 120< mm (TR1AB) in the

4th quarter of the year, this is consistent with Kraan, et al 2013 and Kraan, et al 2014 , who also recognised that TR1AB are mainly active in summer.

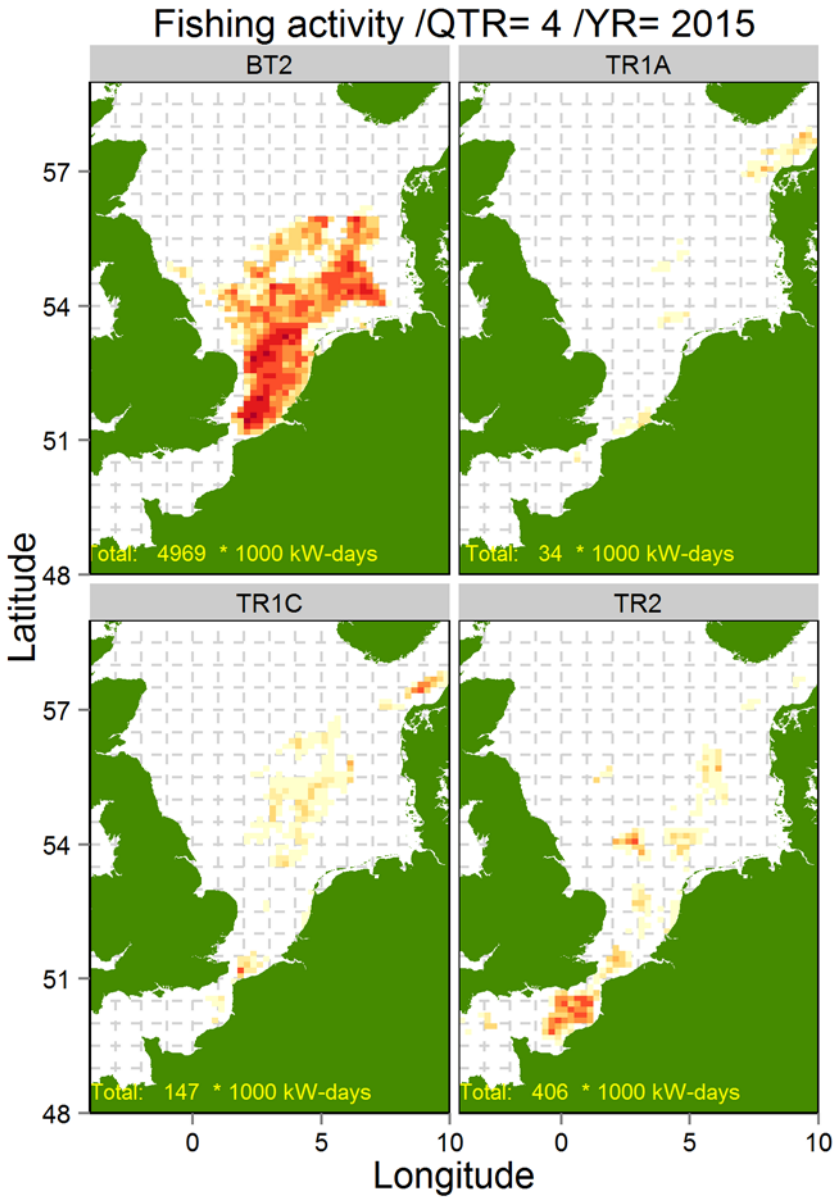

Figure 2. Fishing activity (in *1000 kW-days) for the BT2, TR1AB, TR1C and TR2 gear types separately. Colour index is similar to figure 1. The bottom text on the maps shows the estimate of total fishing activity (in kW-days) per gear for this quarter.

3.2 Cod landings

Most landed cod was caught at the entrance of the Skagerrak and in the south, off the Belgian coast(figure 3). Total landings were lower than in the third quarter of 2015 (514 Ton)

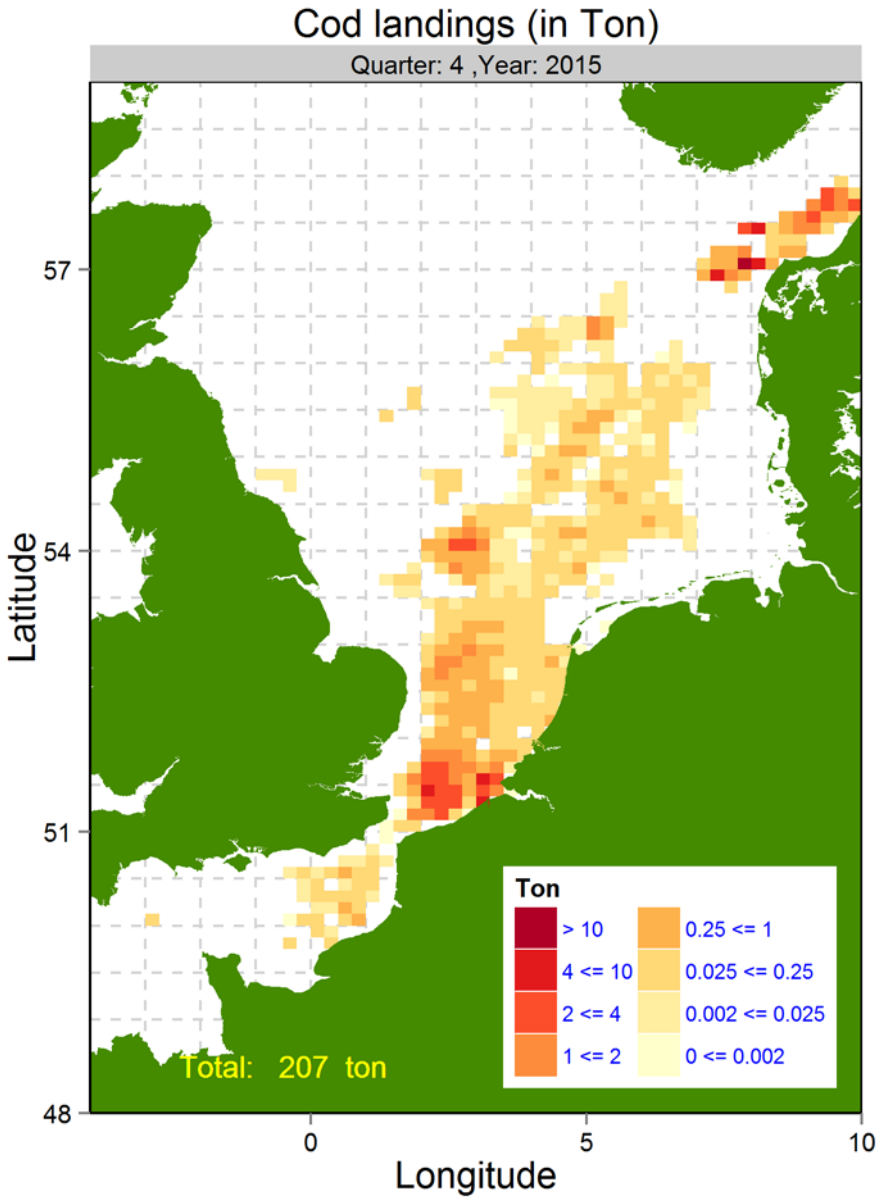

Figure 3. Cod landings (in Ton) for all TR and BT2 gears together in quarter 4 in 2015 . The text bottom-left on the map shows the estimate of total Cod landings for all gears combined in this quarter.

In the fourth quarter, most landed cod was caught by BT2 gears and secondly by the TRIAB fleet (figure 4, table 2).

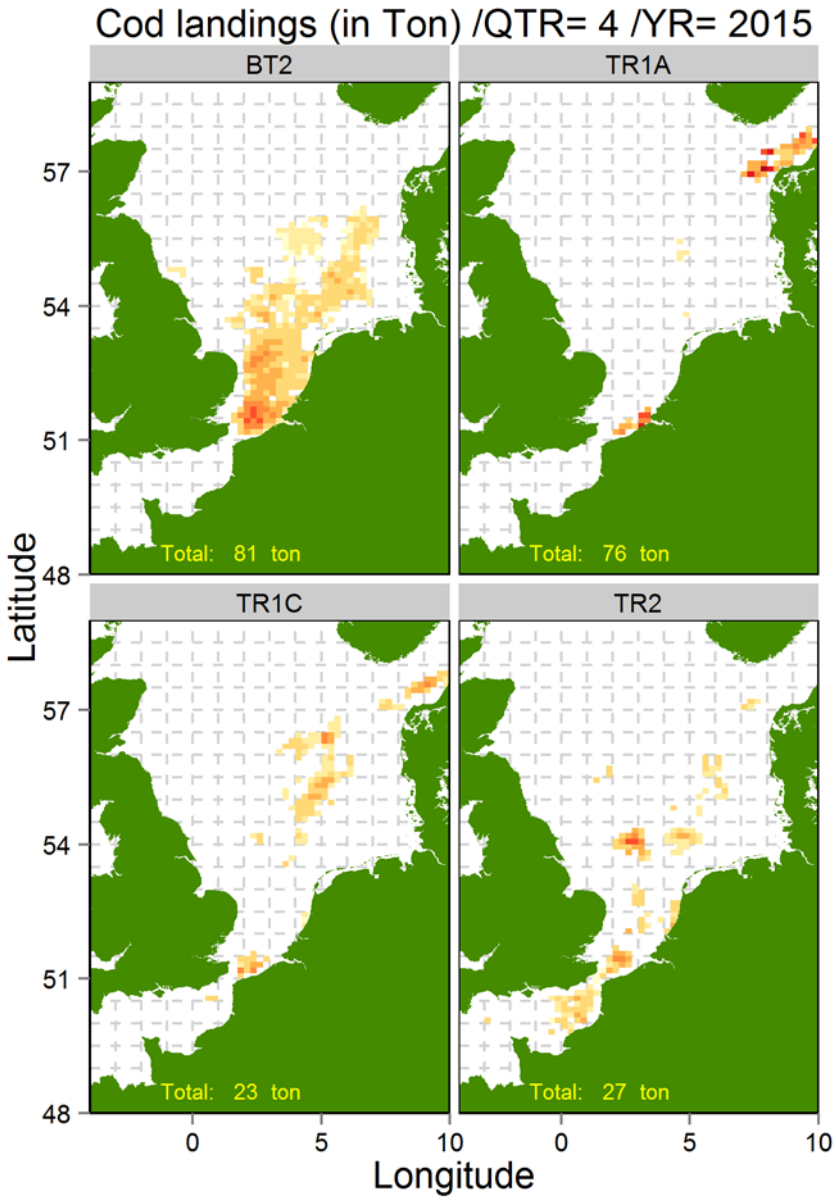

Figure 4. Cod landings (in Ton) for the BT2, TR1AB, TR1C and TR2 gear types separately. Colour index is similar to figure 3. The bottom text on the maps shows the estimate of the total cod landings (in Ton) per gear for this quarter.

3.3 Cod LpUE

Per 1/16th ICES rectangle, the cod landings per unit effort (LpUE) can be calculated by dividing the cod catch (in kg) by the fishing effort (in kW-days) (figure 5).

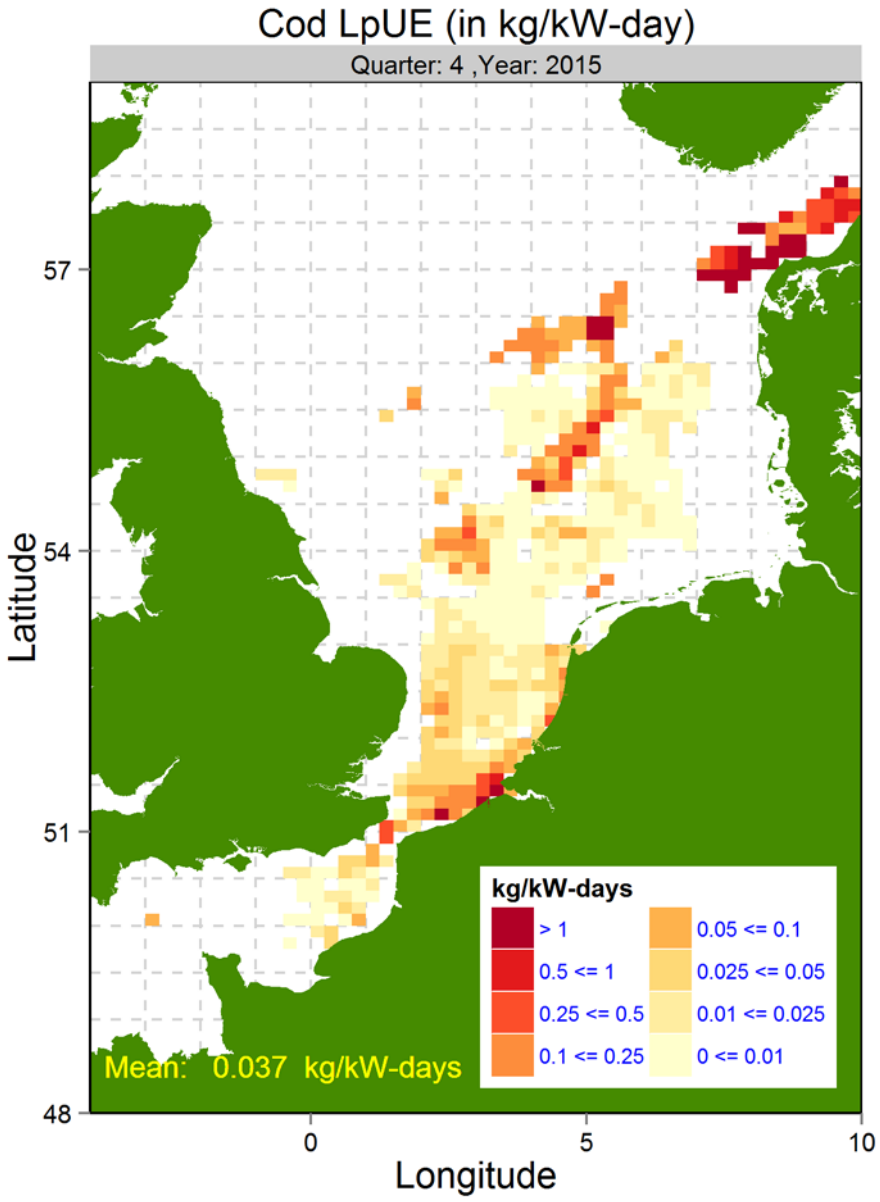

Figure 5. Cod LpUE (in kg/kW-days) for all TR and BT2 gears together in quarter 4 in 2015. The text bottom-left on the map shows the estimate of Cod LpUE for all gears combined in this quarter.

The TR1AB gear had the highest cod LpUE on average (2.24kg/kW-days) (figure 6, table 2), followed by the TR1C fleet (0.15 kg/kW-days).

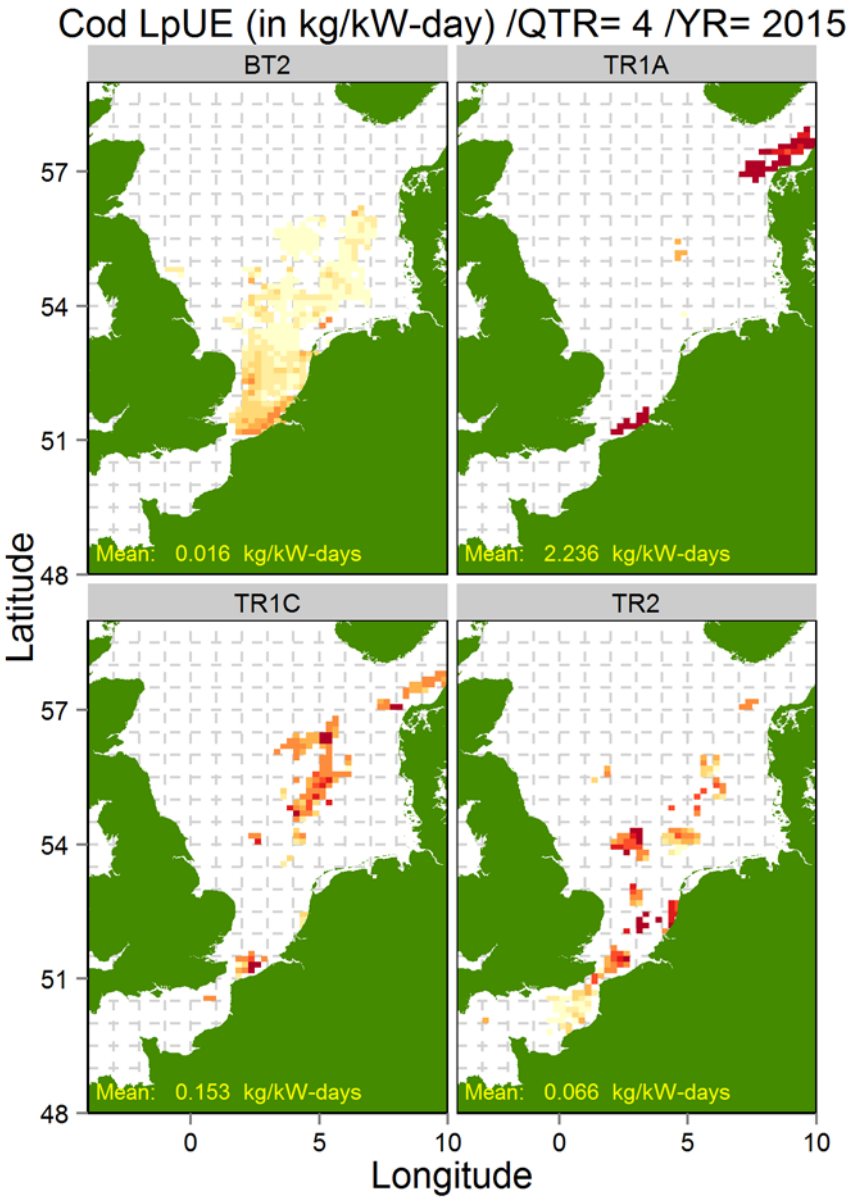

Figure 6. Cod LpUE (in kg/kW-days) for the BT2, TR1AB, TR1C and TR2 gear types separately. Colour index is similar to figure 5. The bottom text on the maps shows the estimate of the mean LpUE (in kg per kW-days) per gear for this quarter.

4 Summary

In quarter 4 the fishing effort of the fleet is dominated by the BT2 fleet with 89.4% of the total fishing activity. This fleet is located widespread over the central and southern North Sea (figure 2). The fishing activity of the TR fleet is much lower, with the TR1AB fleet hardly active in quarter 4 (0.6 % of total fishing activity, table 2). This pattern is congruent with previous cod monitoring project reports (Kraan, et al 2013; Kraan, et al 2014; Reijden, et al 2015a). The TR2 fleet is most active in the English Channel.

The BT2 fleet lands most of the Cod, with 81 tonnes of the 207 tonnes in total, representing 39.1% of the total cod landings (figure 4, table 2).

Fishing activity of the TR1AB fleet is similar to quarter 1 (Reijden, et al 2015a) or 2 but smaller than quarter 3(Reijden, et al 2015b). The average cod LpUE per quarter in 2015 has been 2.118 kg/KW-days (quarter 1); 0.944 kg/KW-days (quarter 2); 2.369 kg/KW-days (quarter 3) and 2.24 kg/KW-days.[2]

For facilitating comparisons between quarters, the quarterly totals of fishing activity and cod landings and the quarterly average LpUE are shown in Table 2. If the kW-days transition was determined based on the LpUE in quarter 4, the conversion factor would be 5.5 :1.

This is higher than the conversion factors calculated based on quarter 1 in 2015 (2.8:1; Reijden, et al 2015d) and lower than the conversion factor based on quarter 2 (18:1; Teal, et al 2015) in 2015 and slightly higher than the currently used conversion factor of 5:1. However, as the conversion factor is determined on yearly LpUE, the calculated factor in this report is only an indicator.

Table 2. Activity (*1000 kW-days), Cod landings(ton) & LpUE (kg/kW day) of the various fleets.

Fleet_definition	Fishing_Activity	_%	Cod_landings	_%	LpUE
BT2	4969	89.4	81	39.1	0.02
TR1A	34	0.6	76	36.7	2.24
TR1C	147	2.6	23	11.1	0.15
TR2	407	7.3	27	13	0.07
Total	5557		207		0.04

[2]The average LpUEs per quarter mentioned here may deviate from the LpUE's mentioned in the quarterly reports that were published during 2015 (Reijden, et al 2015b; Teal et al, 2015; Reijden, et al 2015c). The reason for this is that the numbers in the quarterly reports are preliminary figures. The numbers become more accurate over time when for instance also cod landings and fishing effort of Dutch vessels that land their catch abroad become available.

Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 124296-2012-AQ-NLD-RvA). This certificate is valid until 15 December 2018. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Fish Division has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 1th of April 2017 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

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6 Justification

Report C053/16
Project number: 4318100034

The scientific quality of this report has been peer reviewed by a colleague scientist and a member of the MT of IMARES.

Approved: Ralf van Hall, Fisheries researcher

Signature:

Date: 18 May 2016

Approved: Jacob Asjes, Member of the MT

Signature:

Date: 18 May 2016

7 Appendix A. Extended Materials and Methods

7.1 Data pre-processing

VMS and logbook data were received from the Ministry of Economic Affairs and stored in a local database at IMARES.

VMS records are considered invalid and are therefore removed from the analyses if they :

- o Are duplicates or pseudo-duplicates (indication of malfunctioning of VMS device)
- o Identify an invalid geographical position
- o Are located in a harbour
- o Are located on land
- o Are associated with vessel speeds > 20 knots

Logbook records are removed from the analyses when they:

- o Are duplicates
- o Have arrival date-times before departure date-times
- o Overlap with other trips of that vessel

7.2 Link VMS and logbook data

VMS and logbook datasets are linked using the unique vessel identifier and date-time stamp in both datasets available. In other words, records in the VMS dataset that fall within the departure-arrival timeframe of a trip described in the logbook are assigned the unique trip number from the logbook record which allows matching both datasets. The following gear types were selected as TR gear: OTB (Otter bottom trawls), OTT (Otter Twin Trawls), PTB (Pair Bottom Trawls), SDN (Danish Seine), SSC (Scottish Seines), SPR (Pair Seine). All TR gears are further divided based on their mesh size, following TR1AB: >=120mm, TR1C: 100 ? 119mm, TR2: <100mm. The BT gear is defined as TBB (Beam Trawls) gear type. This consists not only of the traditional beam trawl; all innovative sub-gears like sumwing, pulse and pulswing are included in the BT gear. Next, the BT gear is further classified into categories, based on mesh size. The used geartype BT2 includes all BT vessels operating with a mesh size of 70-99mm.

7.3 Define fishing activity

Speed recordings obtained from VMS data are used to create frequency plots of these speeds, where along the horizontal axis the speed in knots is given and the vertical axis denotes the number of times that speed was recorded. In general, 3 peaks can be distinguished in such a frequency plot. A peak near 0 knots, associated with harbour/floating, a peak around the average fishing speed and a peak around the average steaming speed. Using the frequency plots, activity is determined for each VMS-point based on the speed recorded. Activity analyses are performed separately for each gear category.

7.4 Spatial distribution

The fishing activity determined from the logbooks (kW-days) and the cod landings recorded in the logbooks (kg), are assigned to those (fishing) VMS records that have vessel id, fishing date and fishing position in common. At the spatial scale of 1/4 degree longitude* an 1/8 degree latitude (1/16 ICES rectangle), the total landings of cod (kg) and fishing activity (kW-days) are calculated. Subsequently LpUE (landings per unit effort) can be calculated for each 1/16 ICES rectangle by dividing the landings by the activity.

8 Appendix B. Monthly LPUE cod

In this section the average LpUE for cod are presented by month for quarter 2 for this 2014 and 2015 combined. This is representative for the data used by the MMO to determine RTC?s.

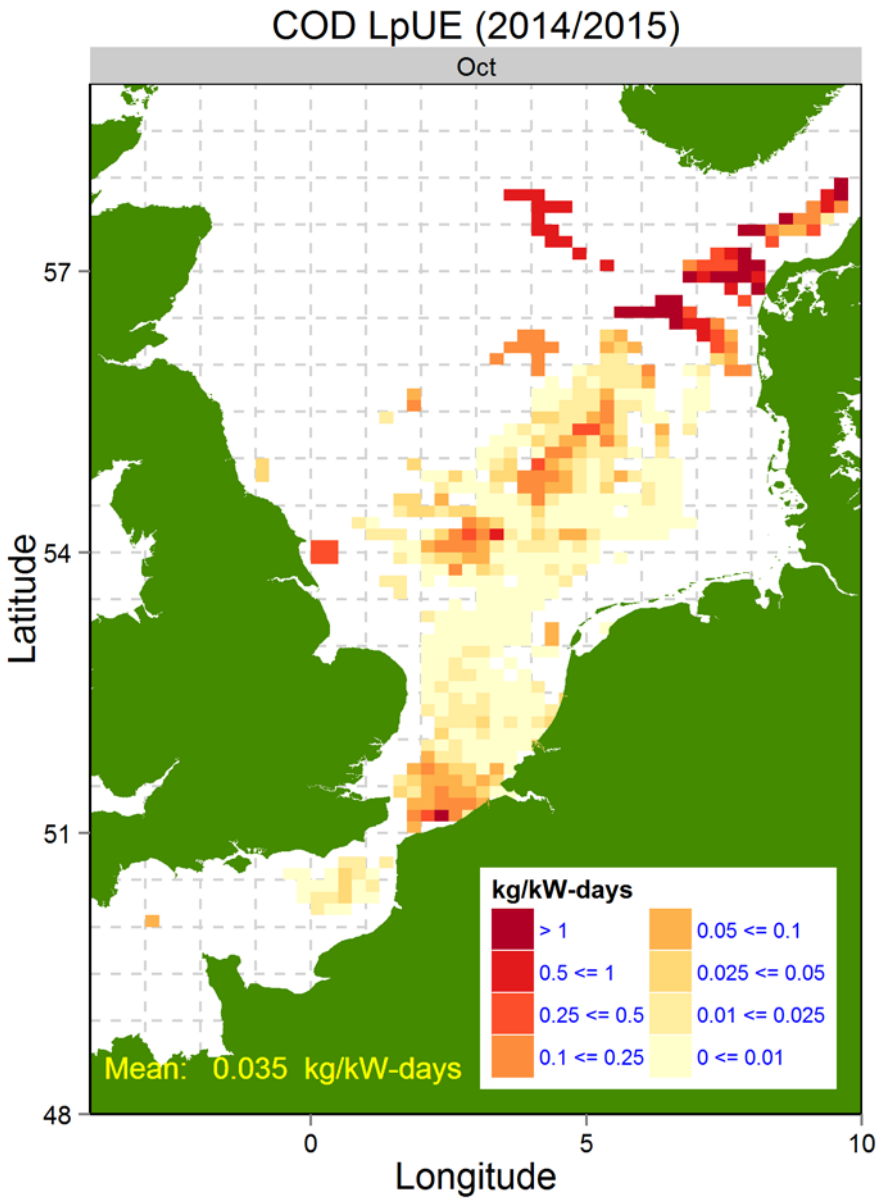

Figure 7. Average Cod LpUE (kg/kW-days) of all gears in Oct of 2014 and 2015. Colour index is shown in the legend. The box underneath each map shows the average LpUE for this month.

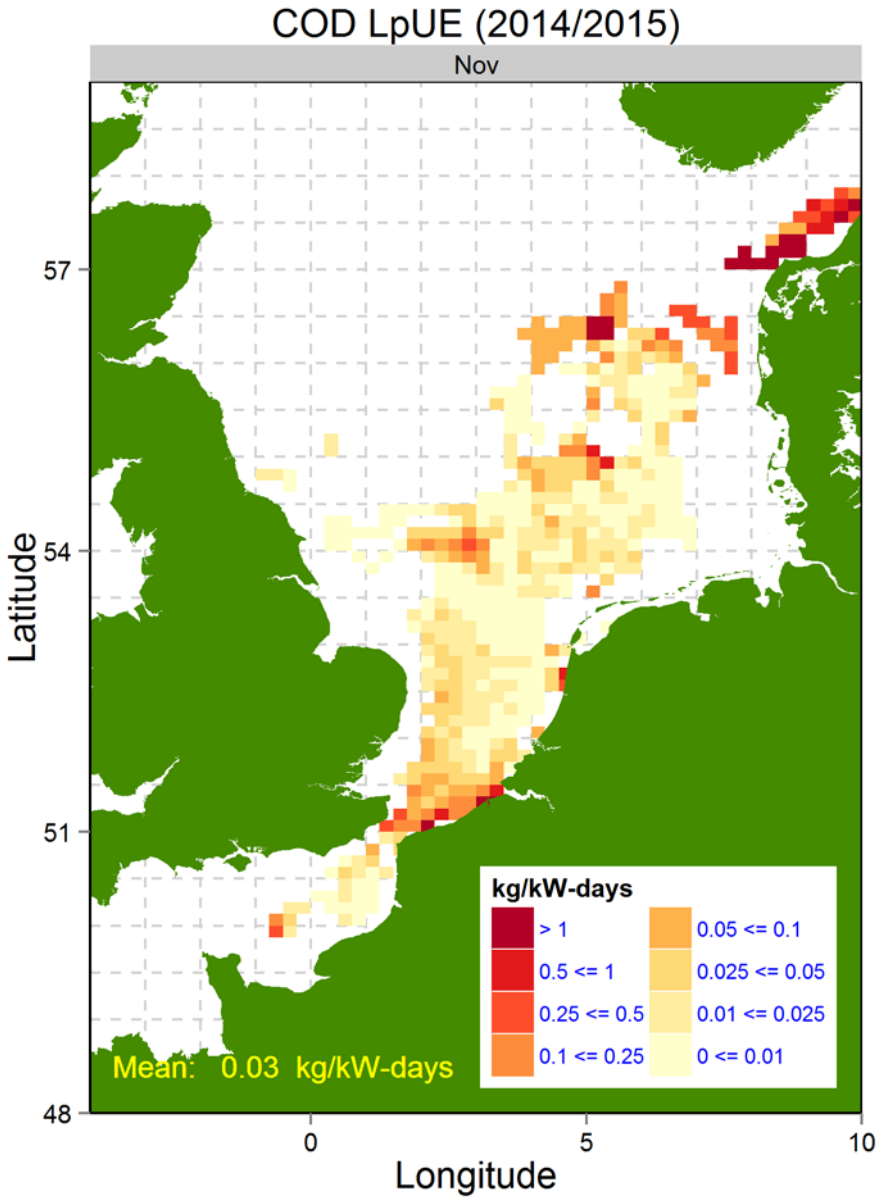

Figure 8. Average Cod LpUE (kg/kW-days) of all gears in Nov of 2014 and 2015. Colour index is shown in the legend. The box underneath each map shows the average LpUE for this month.

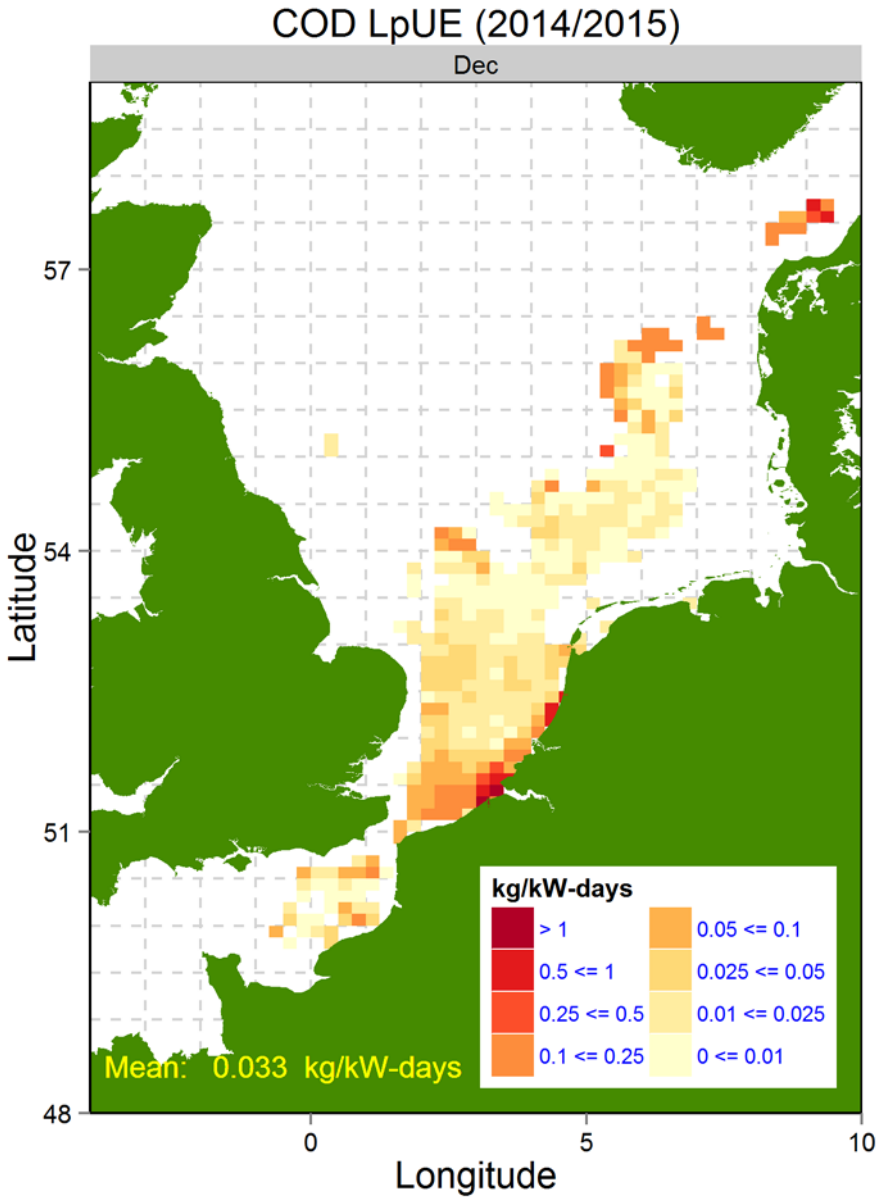

Figure 9 . Average Cod LpUE (kg/kW-days) of all gears in Dec of 2014 and 2015. Colour index is shown in the legend. The box underneath each map shows the average LpUE for this month.

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IMARES (Institute for Marine Resources and Ecosystem Studies) is the Netherlands research institute established to provide the scientific support that is essential for developing policies and innovation in respect of the marine environment, fishery activities, aquaculture and the maritime sector.

The IMARES vision

'To explore the potential of marine nature to improve the quality of life'

The IMARES mission

- To conduct research with the aim of acquiring knowledge and offering advice on the sustainable management and use of marine and coastal areas.
- IMARES is an independent, leading scientific research institute

IMARES Wageningen UR is part of the international knowledge organisation Wageningen UR (University & Research centre). Within Wageningen UR, nine specialised research institutes of the DLO Foundation have joined forces with Wageningen University to help answer the most important questions in the domain of healthy food and living environment.