



Cod monitoring

Results 2015, Quarter 2

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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 423/2004 and EC 1342/2008) 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 (TR1AB¹) 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	Gear type	Meshsize (mm)	Assumed target species
TR1AB	Otter/pair trawlers	>120	Cod
TR1C	Otter/pair trawlers	100-119	Plaice
TR2	Otter/pair trawlers	70-99	Plaice/Nephrops
BT2	Beam trawlers	70-119	Plaice/Sole

Between 2011 and 2013, the monitoring program existed of an extended analysis of self-reported cod catch data (both landings and discards) in combination with the regular DCF discard monitoring program, an extra observer program and the CCTV-project in TR-fisheries (see Kraan *et al.*, 2013 and 2014). Over the years, the ministry of Economic Affairs and IMARES drew the conclusion that monitoring cod discards via the self-reporting scheme asked for disproportionately high effort of the TR-skippers while discards were hardly affecting CpUE rates (Ministry of Economic Affairs, 2014). Therefore, it was agreed upon a yearly analysis of the EU-logbook (hereafter logbook) data in combination with VMS-data, which is readily available. 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 second quarter in 2015.

As monthly maps of LpUE are used by the Marine Management Organisation (MMO) to determine Real Time Closures (RTC), we present the average monthly distribution of LpUE in 2014 and 2015 in appendix B for the months in quarter 2 (Figures B1, B2, B3). These figures are compatible with the data requirements for the MMO, and as such, may be used to forecast future RTC's.

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 data. Therefore, records with a type-error in the gear description will not be recognised as ‘wrong’, but will wrongly 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 an update to a satellite, containing time and date, position, speed and name of the vessel. 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 2 of 2015, summed for all gears together and for all gears separately. To facilitate the visual comparison between quarterly and yearly spatial distribution, values of fishing activity and landings in quarter 2 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 box underneath with the absolute quarterly value for that (those) gear(s).

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 (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.

$$(1) \quad \left(\frac{(\text{Cod landings TR1C+TR2})}{(\text{Fishing activity TR1C+TR2})} \right) / \left(\frac{(\text{Cod landings BT2})}{(\text{Fishing activity BT2})} \right)$$

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 with the engines power, as the day-transition is applied to kW-days. Most fisheries are concentrated in the southern North Sea with a band of higher intensity also stretching across the central North Sea and at the Doggersbank.

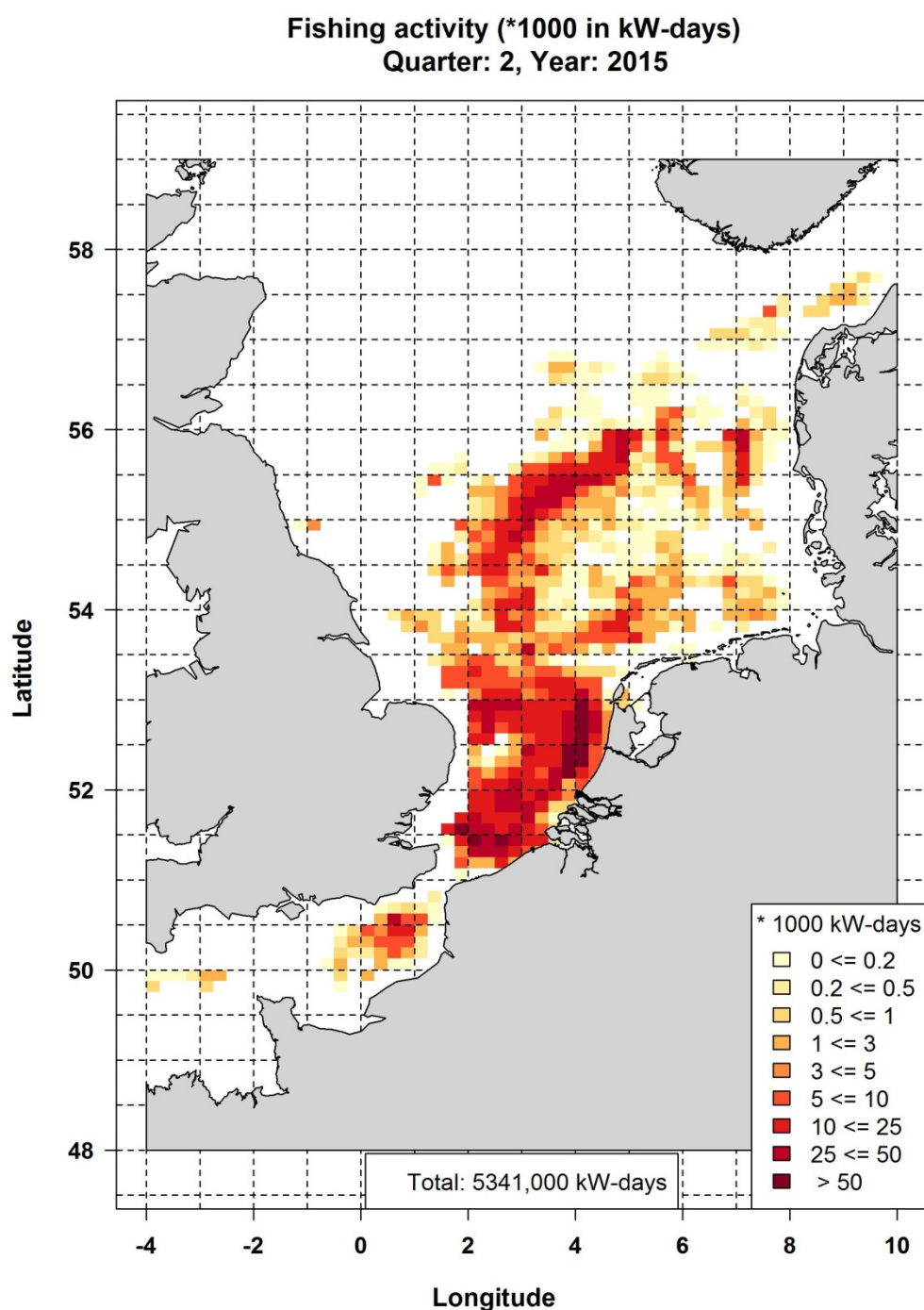


Figure 1. Fishing activity (in *1000 kW-days) for all TR and BT2 gears together in quarter 2 in 2015. The box underneath the map shows the total fishing activity for all gears combined in this quarter.

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 484'000 kW-days. This fleet is mainly active in the English Channel, but also at a number of known Nephrops (*Nephrops norvegicus*) fishing grounds, such as the Botney gut/Silver pit, the Oystergrounds and east off Horns Reef (ICES, 2014). Whilst the activity of BT2 gears is slightly less compared to quarter 1 of this year (Reijden *et al.*, 2015a) the TR gears (particularly TR1AB and TR1C) are considerably more active in quarter 2.

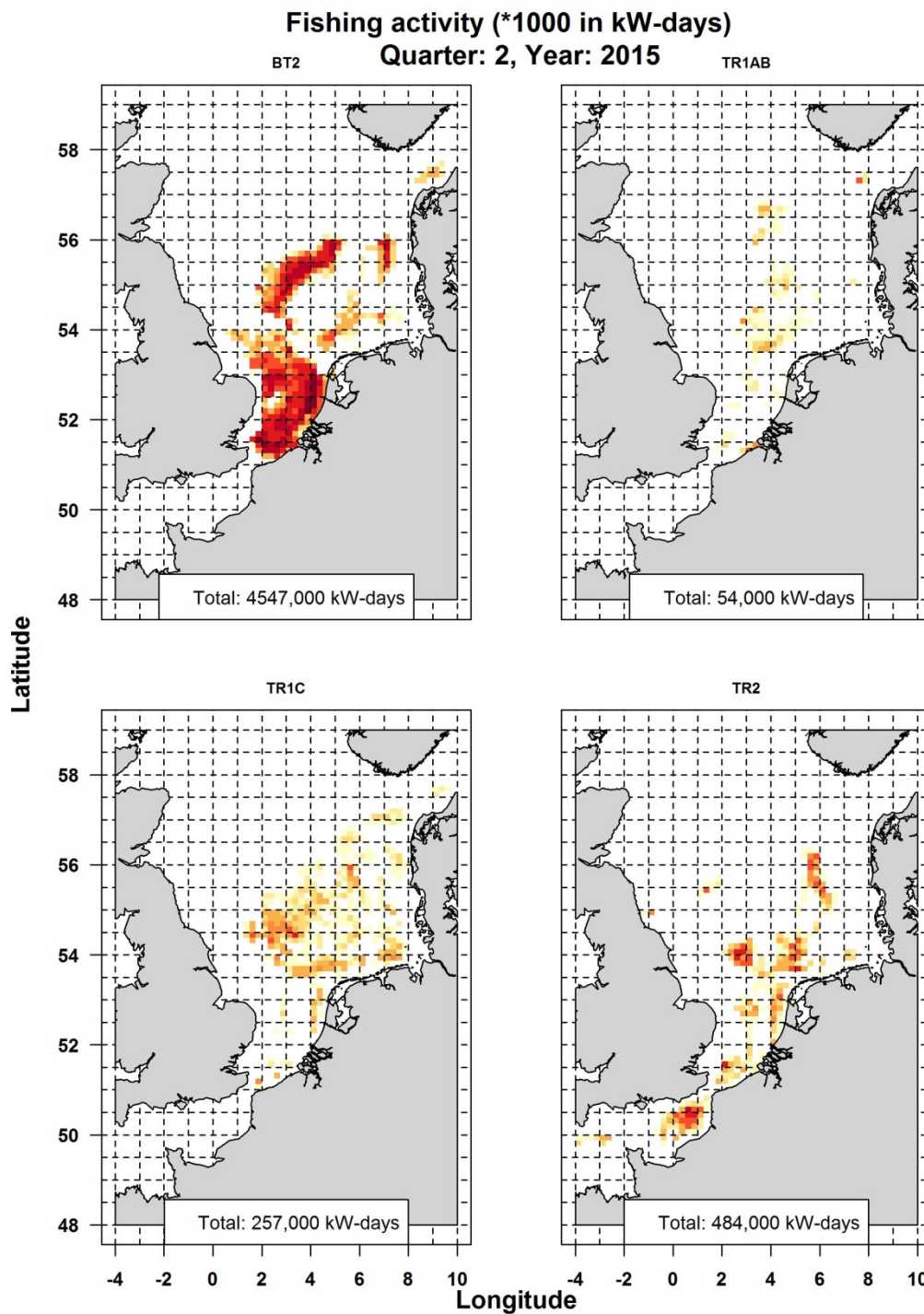


Figure 2. Fishing activity (in kW-days/1000) for the BT2, TR1AB, TR1C and TR2 gear types separately. Colour index is similar to figure 1. The box underneath each map shows the total fishing activity (in kW-days) per gear for this quarter.

3.2 Cod landings

Most landed cod was caught at the Botney Gut/Silver pit with other hotspots at the entrance of the Skagerrak and in the South off the Belgian Coast. Total landings are less compared to quarter 1 (Reijden *et al.*, 2015a)

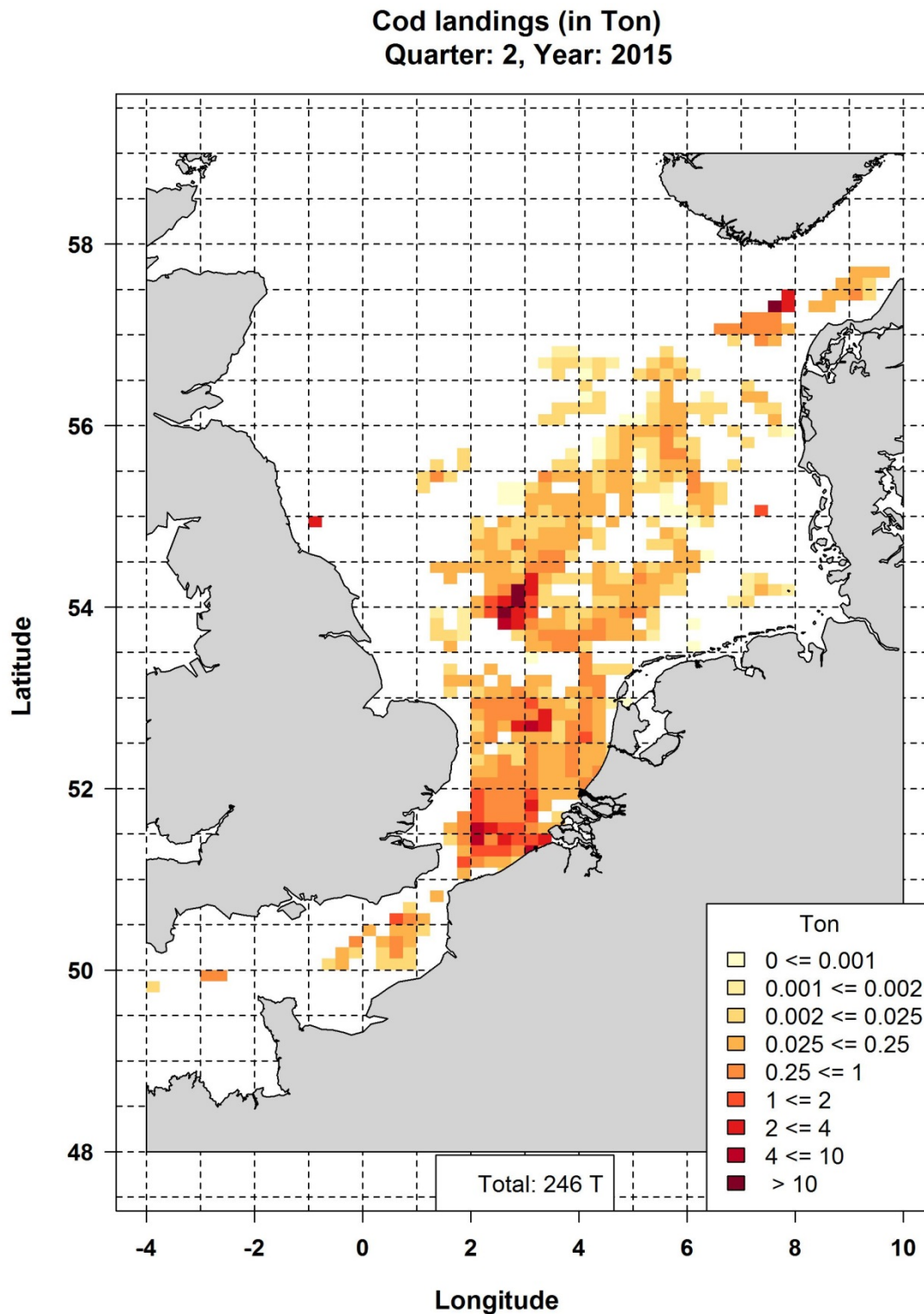


Figure 3. Cod landings (in Ton) for all TR and BT2 gears together in quarter 2 in 2015. The box underneath the map shows the total cod landings for all gears combined in this quarter.

In the second quarter, most landed cod was caught by TR2 gears (figure 4, table 2). This fleet is responsible for the hotspot of landings originating from the Botney gut/Silver pit with some higher catches in the southern North Sea as well.

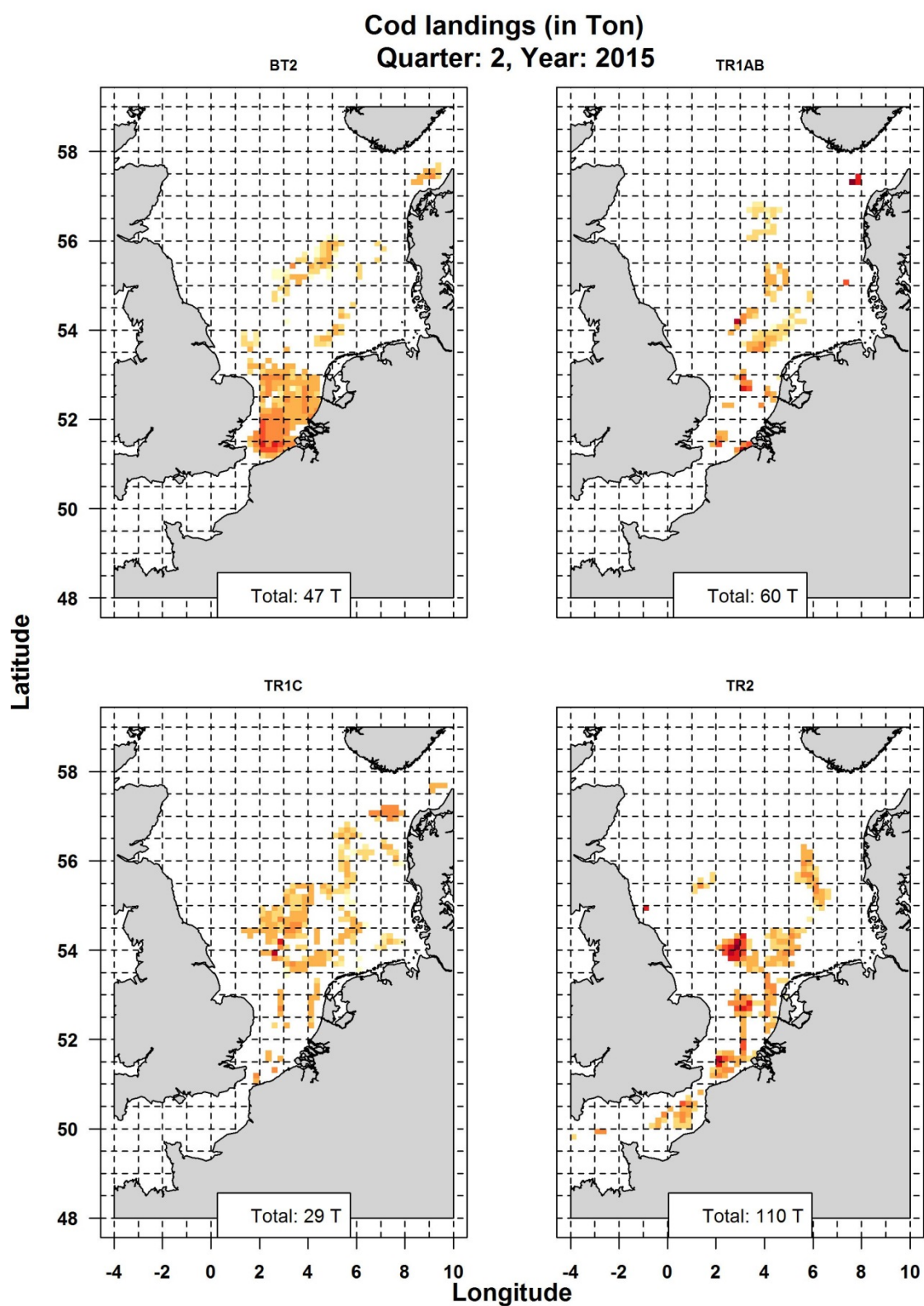


Figure 4. Cod landings (in Ton) for the BT2, TR1AB, TR1C and TR2 gear types separately. Colour index is similar to figure 3. The box underneath each map shows the total cod landings (in Ton) per gear for this quarter.

3.3 Cod LpUE

The cod landings per unit effort (LpUE) can be calculated for each 1/16th ICES rectangle by dividing the cod catch (in kg) by the fishing effort (in kW-days) (figure 5). Highest LpUE are shown around the Botney gut/Silver pit and the entrance to the Skagerrak with some higher patches stretching in-between these two points.

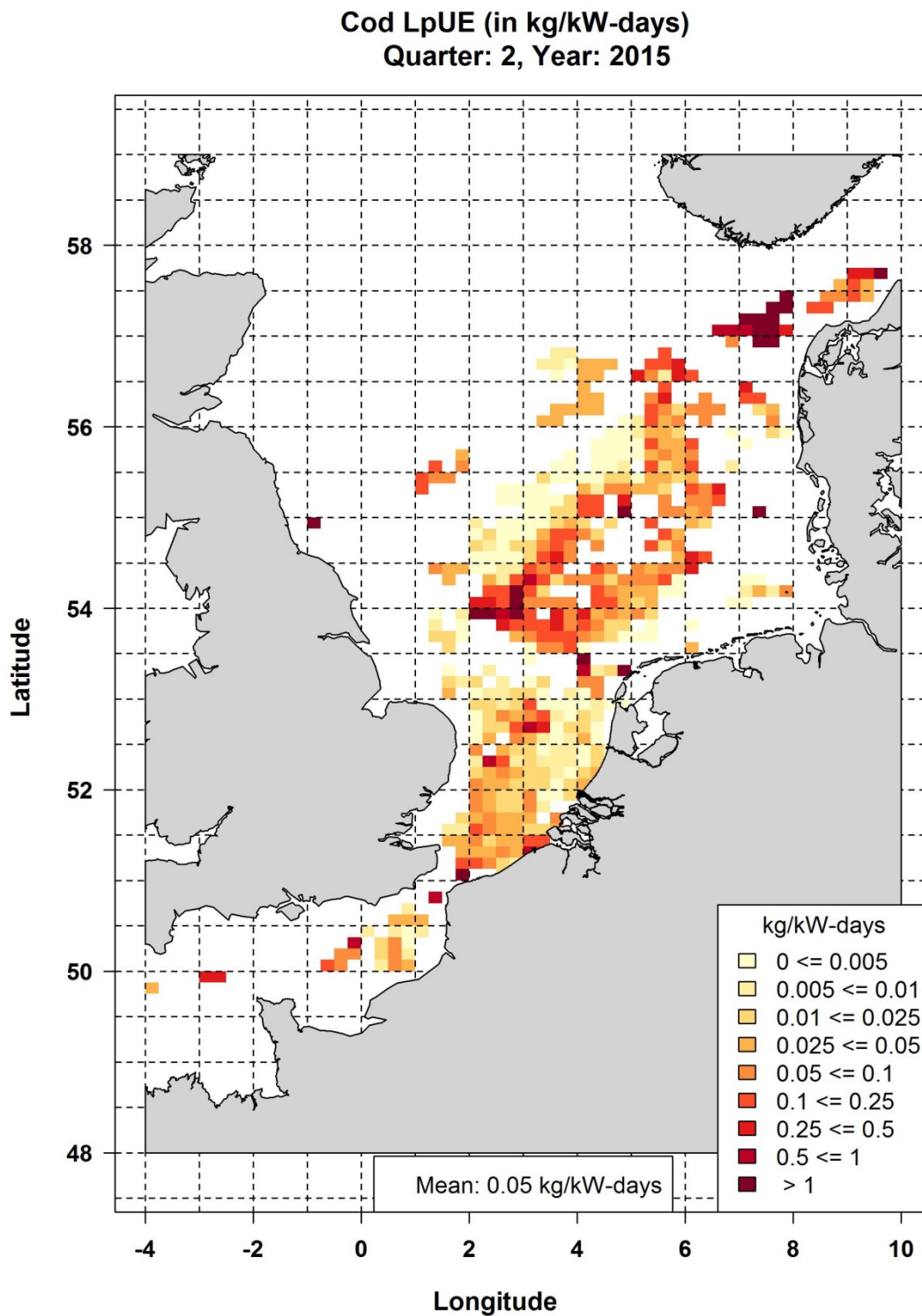


Figure 5. Cod LpUE (in kg/kW-days) for all TR and BT2 gears together in quarter 2 in 2015. The box underneath the map shows the total LpUE for all gears combined in this quarter.

The TR1AB gear had the highest cod LpUE on average (1.12 kg/kW-days) (figure 6, table 2) and high LpUE at almost all areas where fishing was recorded. The LpUE of the BT2 gears was very low despite having by far the highest fishing activity (figure 2, table 2). Highest LpUE of the TR1C are mainly at the entrance of the Skagerrak and the Botney gut/Silver pit. The TR2 gear shows highest LpUE in the Botney gut/Silver pit and spreading down to southern North Sea.

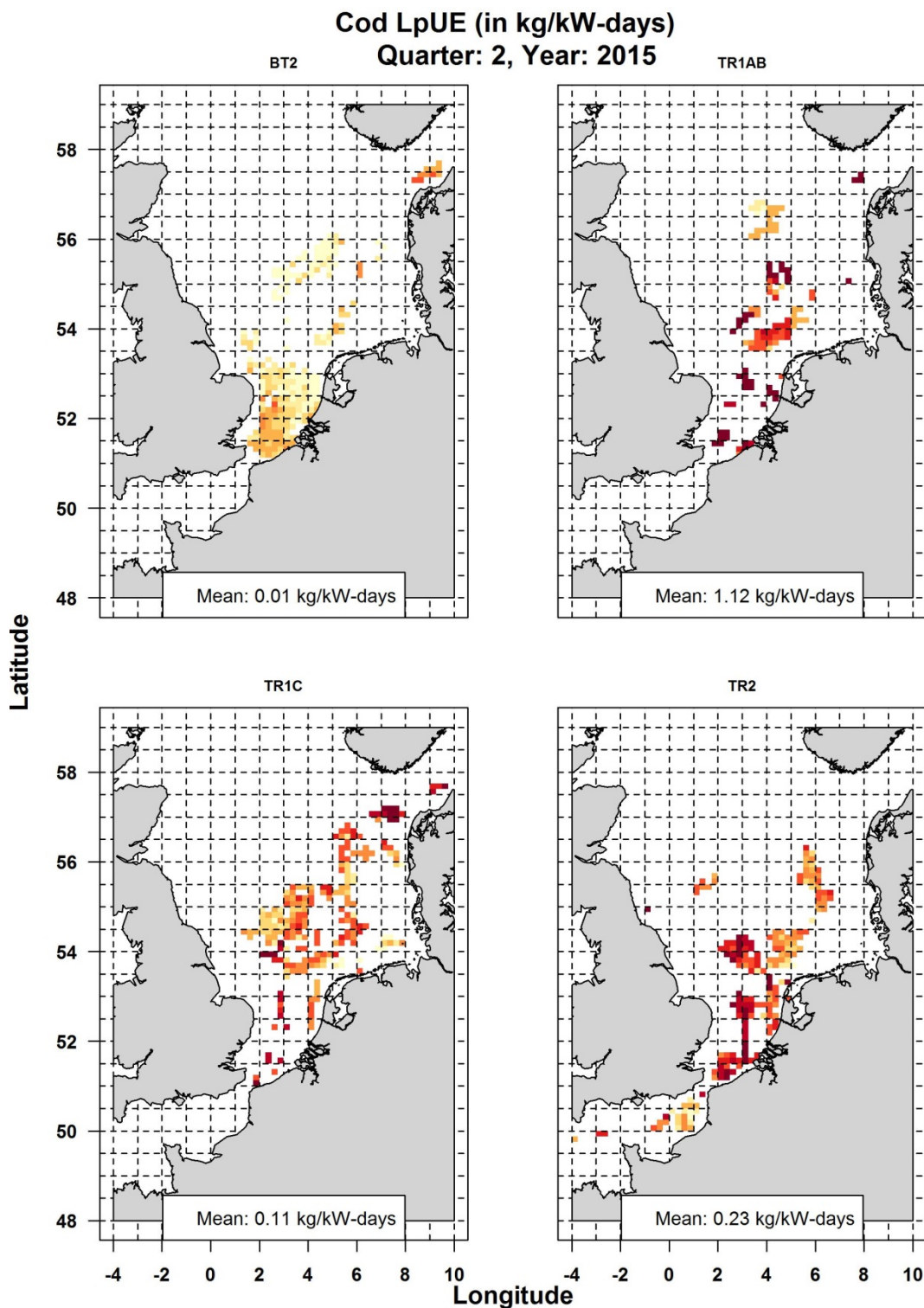


Figure 6. Cod LpUE (in kg/kW-days) for the BT2, TR1AB, TR1C and TR2 gear types separately. Colour index is similar to figure 5. The box underneath each map shows the total LpUE (in kg per kW-days) per gear for this quarter.

4. Summary

In quarter 2 the fishing effort of the fleet is dominated by the BT2 fleet with 85% of the total fishing activity. This fleet is located widespread over the central-east and southern North Sea (figure 2), most likely targeting plaice and sole in these areas. The fishing activity of the TR fleet is much lower, with the TR1AB fleet showing the lowest activity in quarter 2 (1% of total fishing activity, table 2), although higher activity compared to quarter 1 (17'000 kW days, Reijden *et al.*, 2015a). The TR2 fleet is the most active TR fleet with hotspots of activity in the English Channel, Botney gut/Silver pit, Oystergrounds and Horns reef. These patterns are similar to those previously recorded in quarter 2 (Kraan *et al.*, 2013, 2014, Reijden *et al.*, 2015b).

Total cod landings (figure 3) are almost half of the landings recorded in quarter 2 in 2014 (246T and 473T respectively). This can be mainly attributed to the considerably lower landings of the TR1AB fleet (373T in 2014 Q2 compared to 60T in 2015 Q2). This decrease in cod landings in the TR1Ab fleet can partly be explained by the decrease in fishing effort of this fleet (140.000 kWdays in 2014 Q2 compared to 54.000 kWdays in 2015 Q2). Why this fleet segment has decreased its fishing effort is unknown. However, in addition to the effort reduction, fleet spatial distribution is different for both years. Where in 2014 much effort was allocated in the opening of the Skagerrak, with high cod landings (Reijden *et al.*, 2015b), this year the fleet is mainly active in the central North Sea. Average LpUE of the TR1AB fleet has subsequently decreased as well, from 2.66 kg/kWday in 2014 Q2 to 1.11 kg/kWday in 2015 Q2. Most likely, this can be attributed to the fleet spatial distribution.

Compared to Q1 of 2015 the landings are slightly lower in total with a decline in landings mostly seen in the BT2 fleet (216T in Q1 and 47T in Q2). Overall LpUE have remained fairly stable at 0.05-0.06 kg/KW days for quarter 1 and quarter 2, although the highest LpUE are found further northeast in quarter 2 by the entrance of the Skagerrak. The TR2 fleet is responsible for the majority of the cod landings (45%, figure 4, table 2). These cod are mainly caught at the Botney gut/Silver pit but also in the southern North Sea. Although the TR1AB fleet is responsible for less of the total landings (24%, table 2) the LpUE are considerably higher than those of the TR2 fleet (figure 6).

The TR2 fleet can be divided in two separate segments; one operating in the English Channel and one operating in the central part of the North Sea. Most likely, these segments represent different fishing gears, with the segment in the English Channel being flyshooters targeting tub gurnard (*Chelidonichthys lucerna*) and striped red mullet (*Mullus surmuletus*), whilst the segment in the central North Sea being otter trawlers targeting Nephrops. The segment in the English Channel is catching relatively low amounts of cod, while at the Norway lobster fishing grounds the bycatch of cod is larger (figure 4 and 6).

In comparison with the first quarter of 2015 (Reijden *et al.*, 2015a), both the TR1AB and the TR1C fleet showed higher fishing activity with the TR1AB fleet spreading further North and fishing at the entrance of the Skagerrak and the TR1C fleet spreading in the coastal areas around the German Bight. The BT2 and TR2 fleets showed fairly similar activity to quarter 1. The spatial distribution of the BT2 fleet changed slightly in quarter 2 with a band of high fishing intensity stretching across the central part of the North Sea and less into the German Bight as seen in Q1 (Reijden *et al.*, 2015a). This spatial shift may explain in part the lower landings as the LpUE also declined.

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 2, the conversion factor would be 18:1. However, as the conversion factor is determined on yearly LpUE, the calculated factor in this report is only an indicator. This preliminary conversion factor is almost double of the preliminary conversion factor presented for quarter 2 in 2014 (9:1, Reijden *et al.*, 2015b). This doubling is caused by higher LpUE's of the TR2 and TR1C fleet segments, as the LpUE BT2 fleet is approximately equal to 2014 Q2. Based on visual comparison of the spatial distributions of LpUE of both years, the TR1C fleet has lower LpUE in the central part of the North

Sea, but an increased LpUE at the opening of the Skagerrak. This may be caused by little competition in that area, as the TR1AB fleet is not fishing in these grounds. For the TR2 fleet, no obvious changes with respect to previous year can be observed. Therefore, it may suggest that total cod population has increased in 2015, compared with 2014.

Table 2. A summary of fishing activity (% of total), cod landings (% of total) and average LpUE for the 4 gears separately and the overall total for quarter 1.

	Fishing activity (*1000 kW-days)		Cod Landings (Ton)		Average LpUE (kg per kW-days)
BT2	4547	(85.1%)	47	(19.1%)	0.01034
TR1AB	54	(1.0%)	60	(24.4%)	1.11111
TR1C	257	(4.8%)	29	(11.8%)	0.11284
TR2	484	(9.1%)	110	(44.7%)	0.22727
Total	5342		246		0.0461

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 2015. 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.

References

EC 423/2004. Council Regulation (EC) No 423/2004 of 26 February 2004 establishing measures for the recovery of cod stocks. Available at: <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32004R0423>

EC 1342/2008. Council Regulation (EC) No 1342/2008 of 18 December 2008 establishing a long-term plan for cod stocks and the fisheries exploiting those stocks and repealing Regulation (EC) No 423/2004. Available at: <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32008R1342>

ICES (2014) Nephrops in subarea IV (North Sea) (update). ICES Advice November 2014.

Hintzen, NT, A Coers and KG Hamon (2013) A collaborative approach to mapping value of fisheries resources in the North Sea (part 1: Methodology). IMARES report C001/13. (available at: <http://edepot.wur.nl/248628>)

Kraan, ML, SS Uhlmann, MAM Machiels, HMJ van Overzee and ATM van Helmond (2013) Monitoring of cod catches in Dutch otter trawls and seines. IMARES report C077/13.

Kraan, ML, MAM Machiels, KJ van der Reijden and AJ Paijmans (2014) Monitoring of cod catches in Dutch otter trawls and seines. IMARES report C105/14.

Ministry of Economic Affairs (2014). "Brief over nieuwe aanpak kabeljauwmonitoring." Letter. (available at: <http://www.rijksoverheid.nl/documenten-en-publicaties/brieven/2014/11/28/brief-over-nieuwe-aanpak-kabeljauwmonitoring.html>)

Reijden, KJ van der, MAM Machiels and ML Kraan (2015a) Cod monitoring: Results 2015, quarter 1. IMARES report C084/15.

Reijden, KJ van der, MAM Machiels and ML Kraan (2015b) Cod monitoring: Results 2014, quarter 2. IMARES report C069/15.

Justification

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Project Number: 4308101082

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

Approved: Ralf van Hal
Researcher

Signature:



Date: 30th of October 2015

Approved: Nathalie Steins
Head of department Fisheries

Signature:



Date: 30th of October 2015

Appendix A. Extended Materials and Methods

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

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: $\geq 120\text{mm}$, TR1C: $100 - 119\text{mm}$, TR2: $< 100\text{mm}$. 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 gear type BT2 includes all BT vessels operating with a mesh size of 70-99mm.

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.

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.

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.

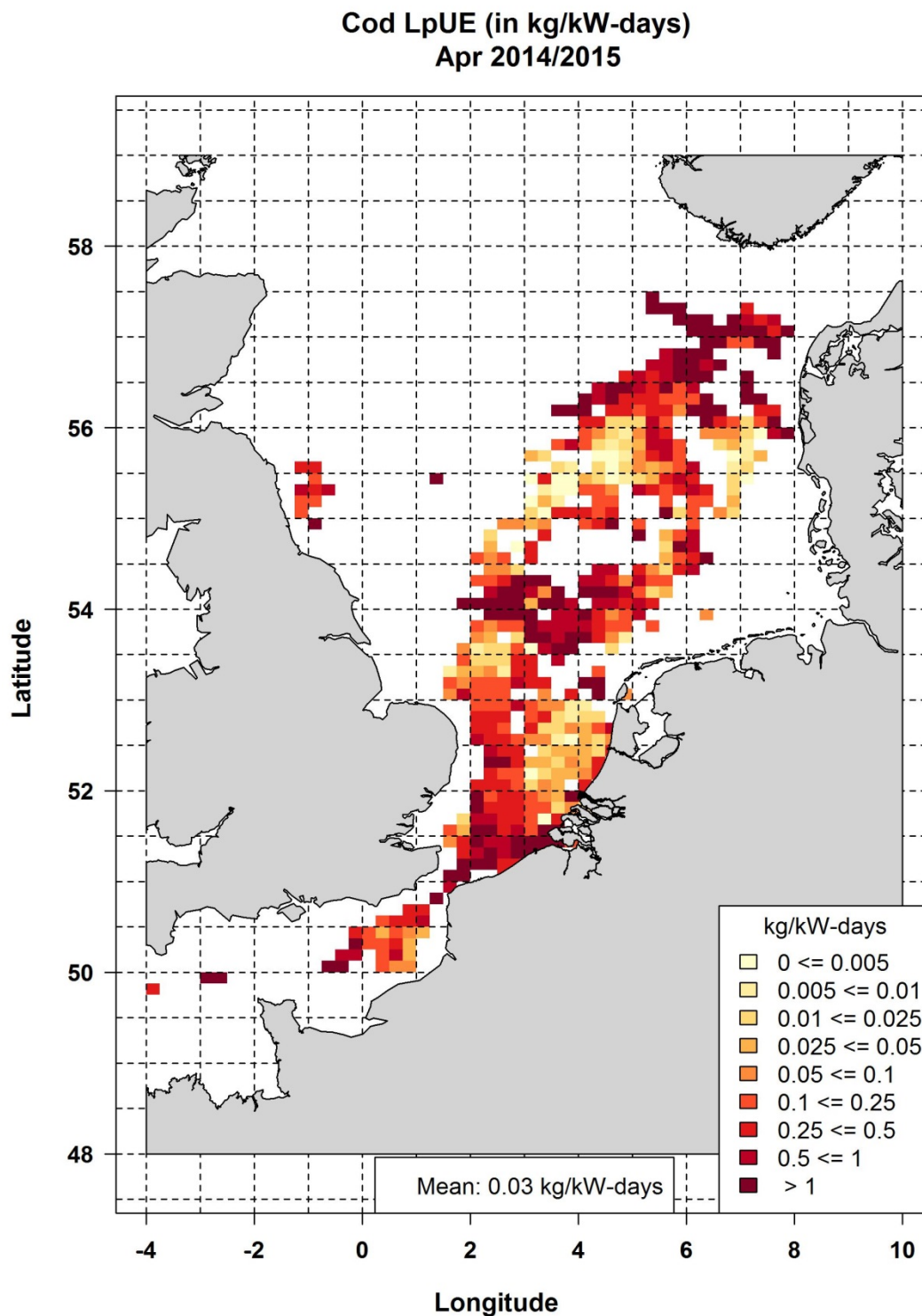


Figure B1 Average cod LpUE (in kg/kW-days) for all TR and BT2 gears together in April 2014 and 2015. The box underneath the map shows the average total LpUE for all gears combined in this month.

**Cod LpUE (in kg/kW-days)
May 2014/2015**

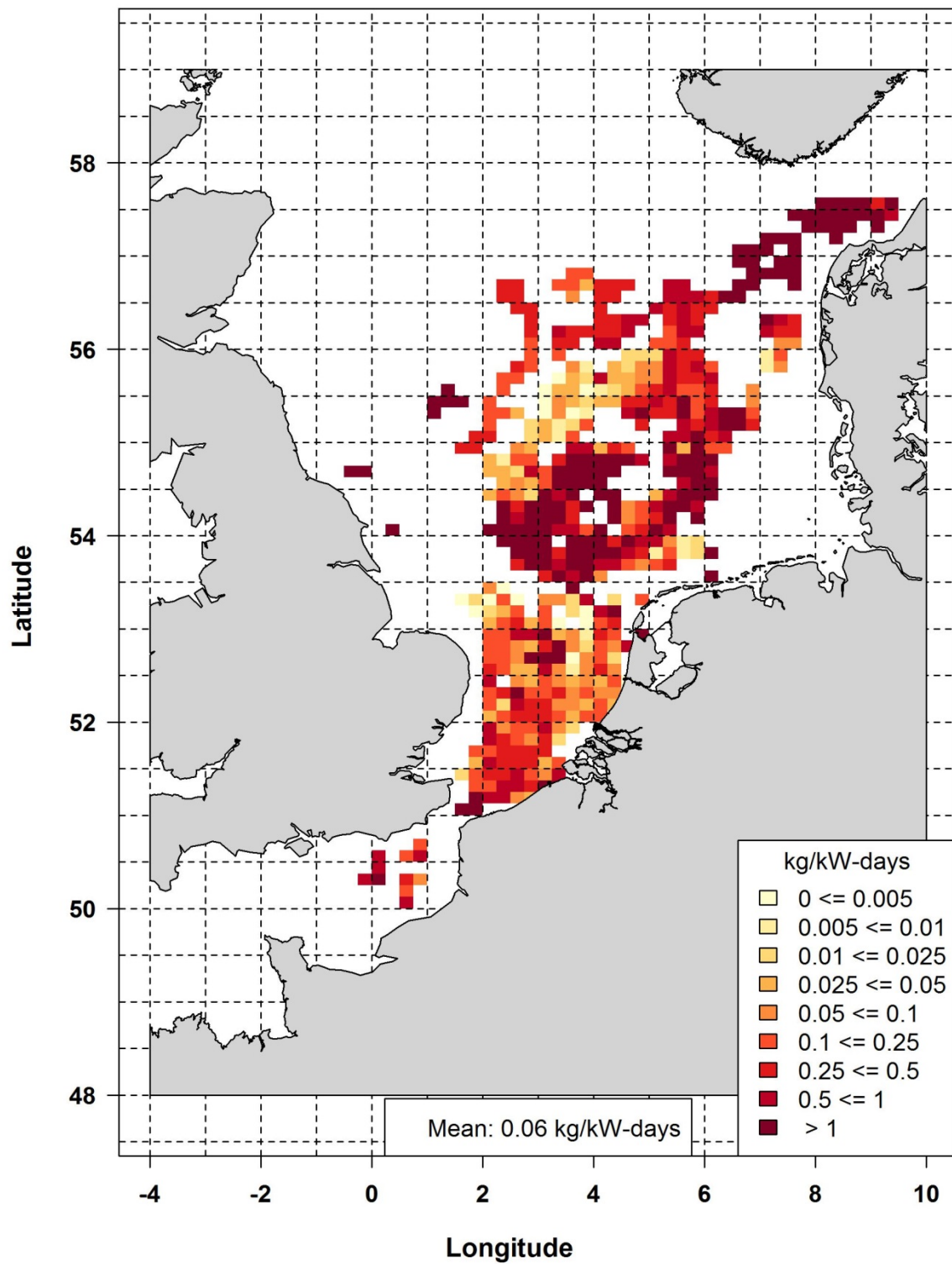


Figure B2 Average cod LpUE (in kg/kW-days) for all TR and BT2 gears together in May 2014 and 2015. The box underneath the map shows the average total LpUE for all gears combined in this month.

Cod LpUE (in kg/kW-days)
Jun 2014/2015

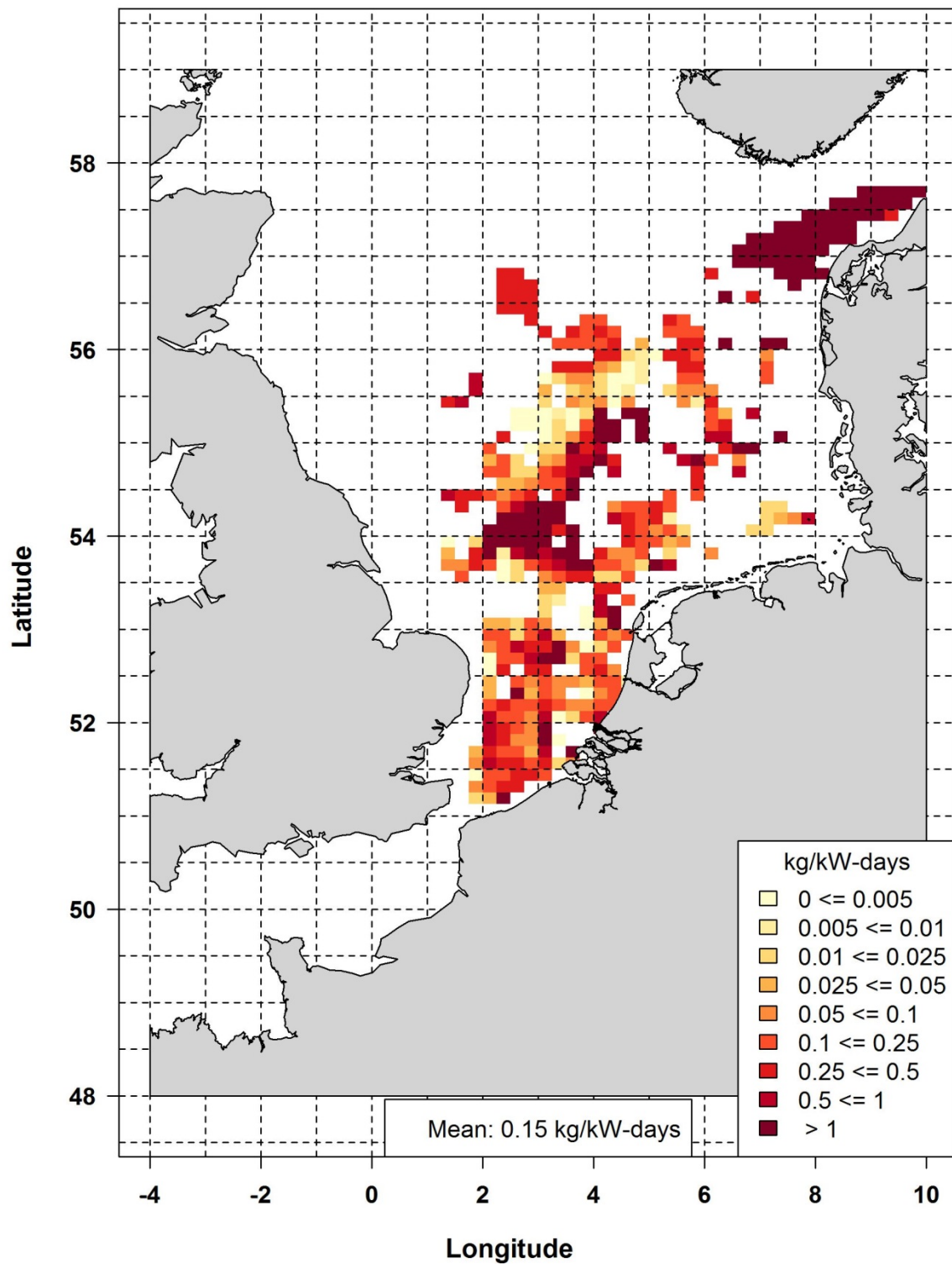


Figure B3 Average cod LpUE (in kg/kW-days) for all TR and BT2 gears together in June 2014 and 2015. The box underneath the map shows the average total LpUE for all gears combined in this month.