

# Cod monitoring

*Results 2014, 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)<sup>1</sup> 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 (TR1AB<sup>2</sup>) 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.

<b>Fleet definition</b>	<b>Gear type</b>	<b>Meshsize (mm)</b>	<b>Assumed target species</b>
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 2014.

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<sup>1</sup> And other gears (gillnets, trammel nets and longlines) which are not relevant for this report.

<sup>2</sup> Some fishermen fishing with TR gear, 120<sup>+</sup> 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 underestimation 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, 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

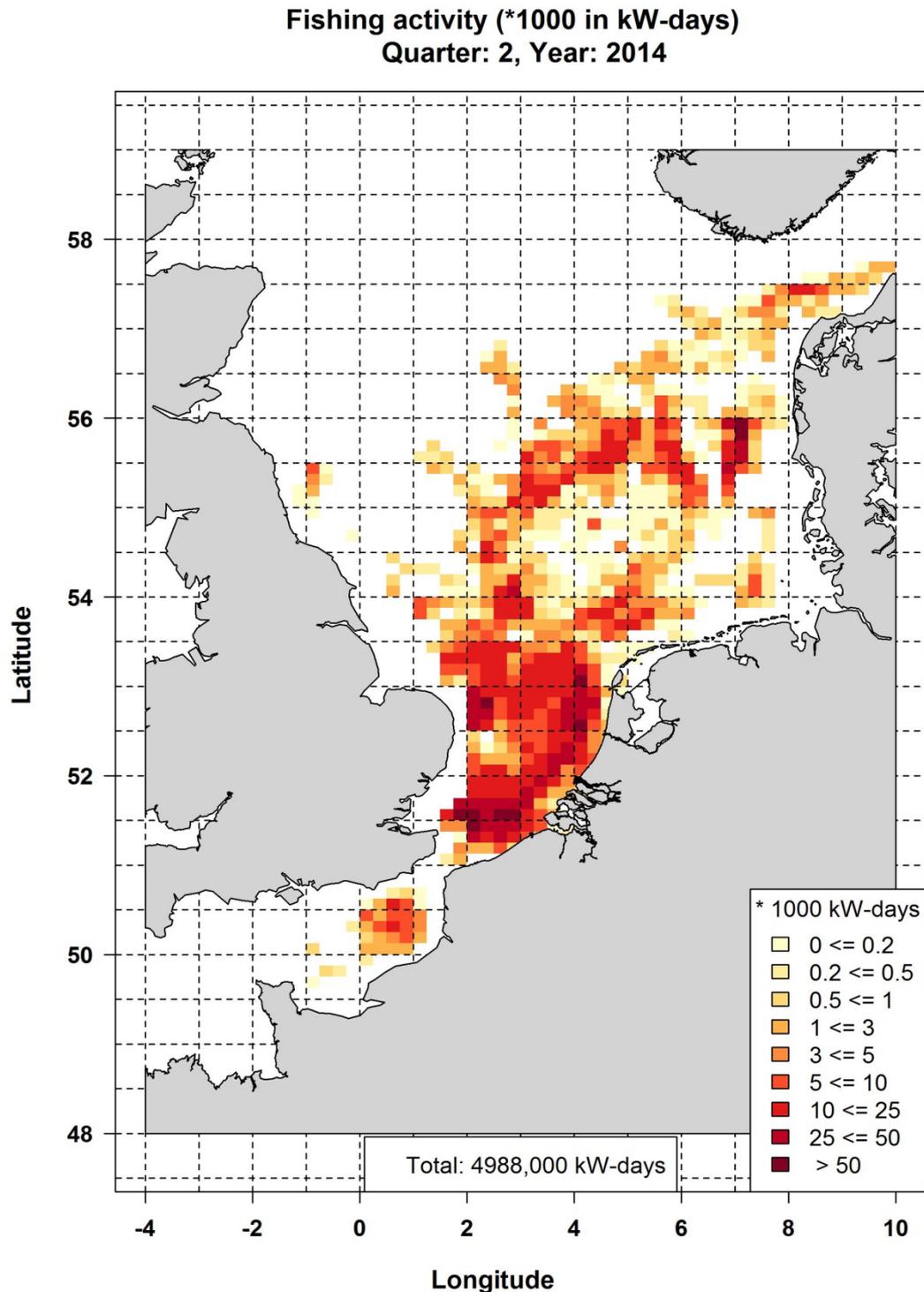
A quarterly indicator of the conversion factor between the TR and the BT gears is given. This indicator is based on the ratio between LpUE of the TR gears for which cod is bycatch (TR1C and TR2) and the BT2 gears (see formula (1)). As this analysis is based on logbook data, in which cod landings are 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

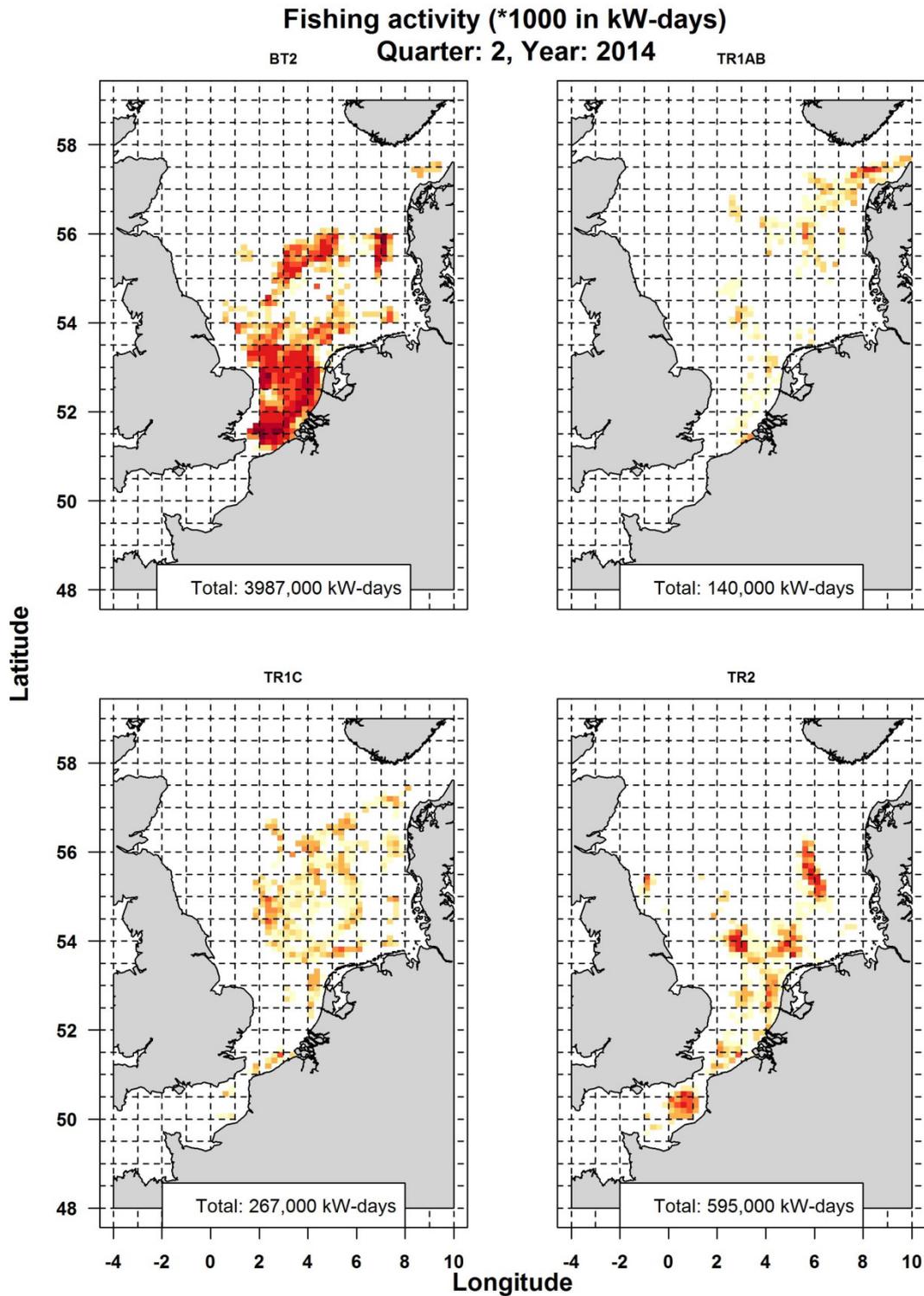
#### 3.1 Fishing activity

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 part of the North Sea, although a concentration of fishing activity can be observed near the coast of Denmark at the Horns Reef around 56° N and 7° E.



**Figure 1.** Fishing activity (in \*1000 kW-days) for all TR and BT2 gears together in quarter 2 in 2014. The box underneath the map shows the total fishing activity for all gears combined in this quarter.

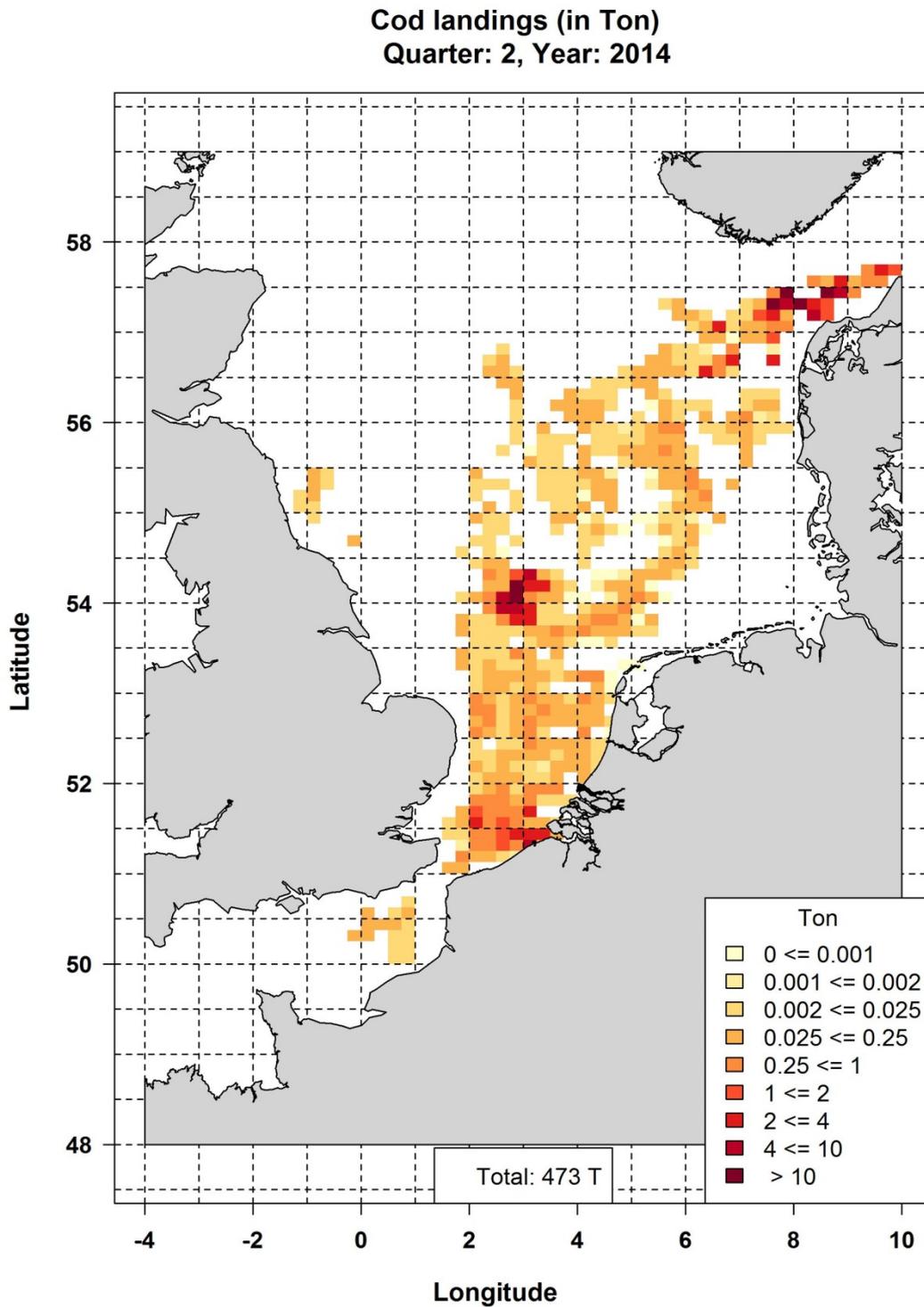
Fishing activity is dominated by BT2 gears, with only a small contribution of TR gears (figure 2, table 2). The TR2 fleet is the most active part of the total TR fleet, with 595000 kW-days at sea in quarter 2. These are mainly concentrated in the English Channel and at two fishing ground for Norway lobster (*Nephrops norvegicus*); the Botney gut/Silver pit (around 54° N, 3°E, near the Cleaverbank), the Oystergrounds (around 54° N, 5°E) and east off Horns Reef, called "Off Horns Reef" (ICES, 2014).



**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.

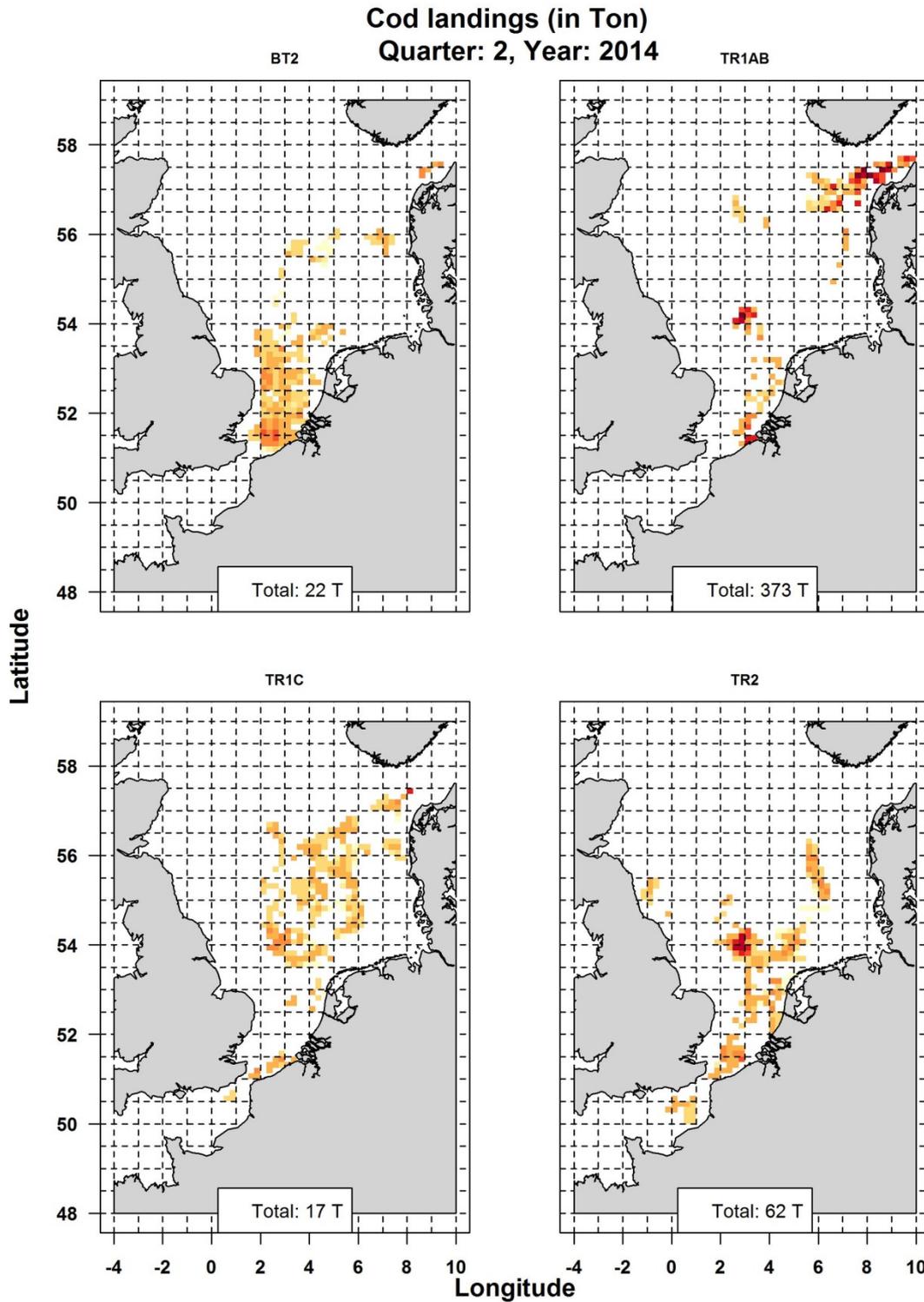
### 3.2 Cod landings

Most landed cod was caught in the entrance of the Skagerrak (57° N, 7-9° E) and at the Botney gut/Silver pit.



**Figure 3.** Cod landings (in Ton) for all TR and BT2 gears together in quarter 2 in 2014. The box underneath the map shows the total cod landings for all gears combined in this quarter.

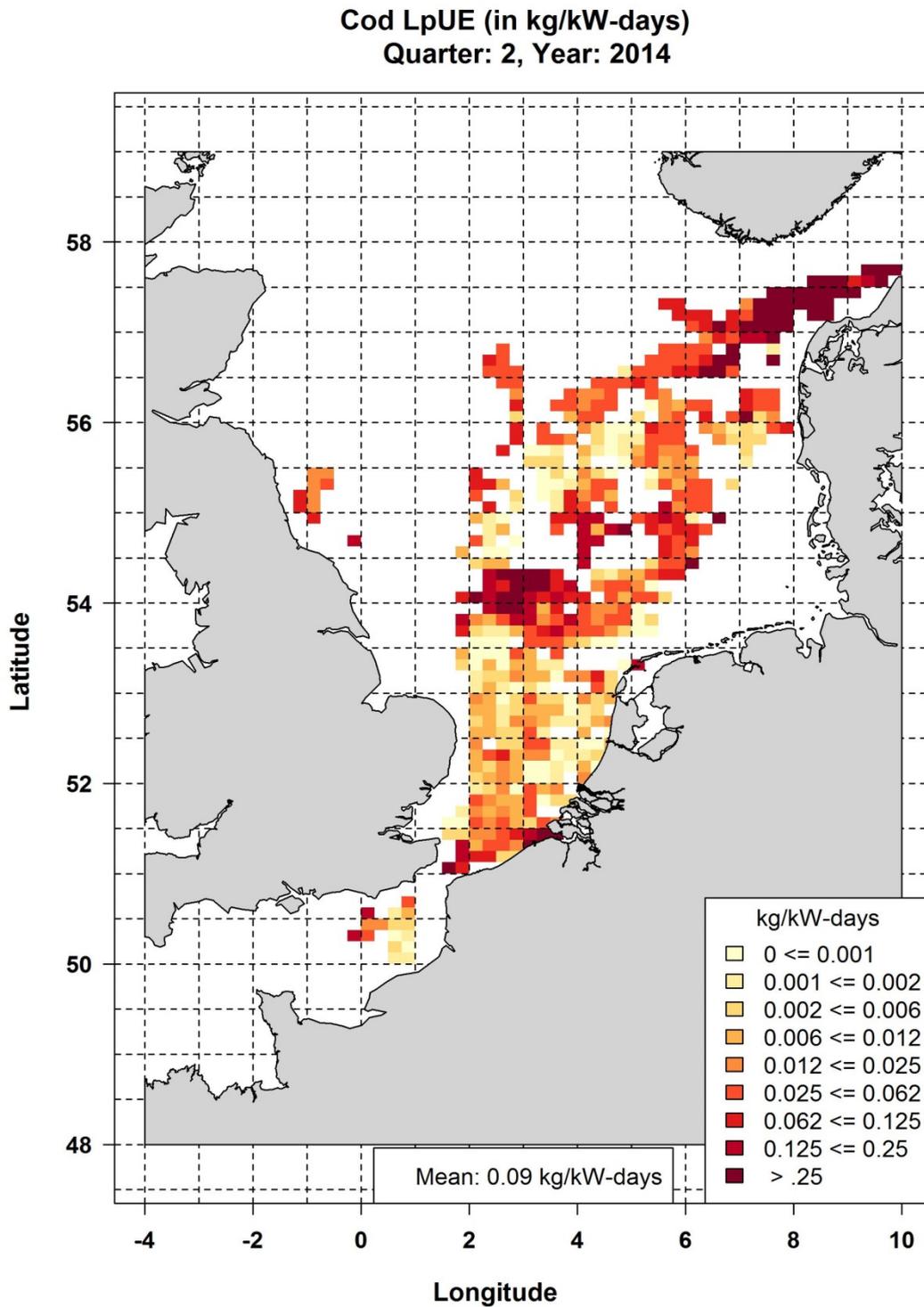
In the second quarter, most landed cod was caught by TR1AB gears (figure 4, table 2). This fleet segment is responsible for the high catches in the opening of the Skagerrak and partly for the catches in the Botney gut/ Silver pit. In the Botney gut/ Silver pit, the catches of TR2 gears are substantial as well. The TR1C gears caught in total the least (table 2), but in comparable amounts as the BT2 fleet.



**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.

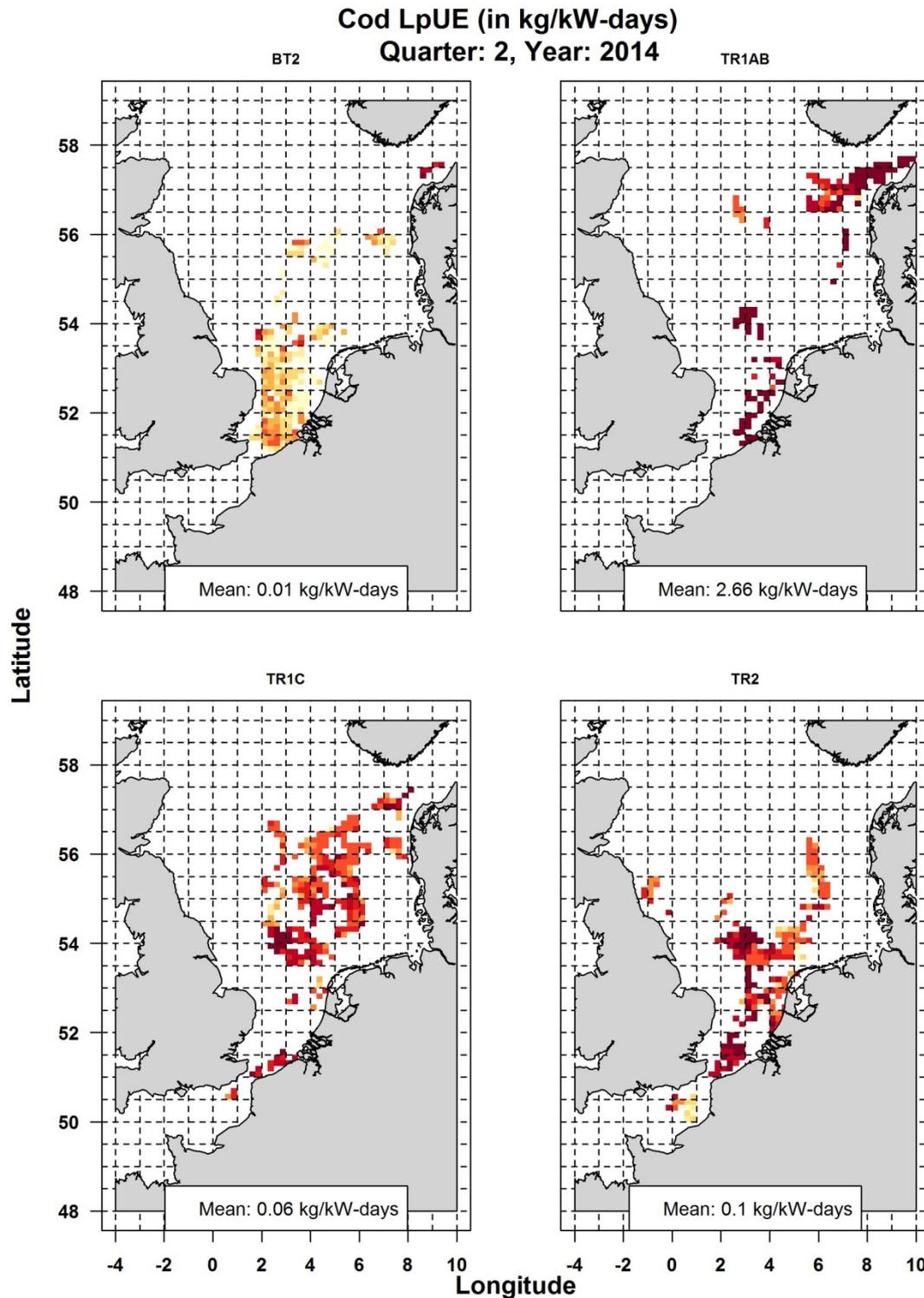
### 3.3 Cod LpUE

Per 1/16<sup>th</sup> 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 2 in 2014. The box underneath the map shows the total LpUE for all gears combined in this quarter.

The TR1AB gear had the highest landings of cod per unit effort on average (2.66 kg/kW-days) (figure 6, table 2), followed by the TR2 fleet (0.1 kg/kW-days). Although the fishing activity of the BT2 fleet is much higher than the TR1C fleet, the lower catches of the TR1C fleet still result in higher LpUE for this fleet compared with the BT2 fleet. Remarkable is the high LpUE of TR1AB and TR2 fleets in The Falls (51°N, 2°E). Due to the high fishing activity of the BT2 fleet in this area and their low catches of cod, this area is not visible as a high cod landings area in figure 3 or figure 5.



**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 TR fleet is dominated by the TR2 fleet. This fleet is located in the English Channel, the Botney gut/ Silver pit and at Off Horns reef (figure 2). The TR1C fleet operates more in the central North Sea, west of Denmark. The TR1AB fleet is the least active segment of all TR fleets, mainly located at the opening of the Skagerrak. The effort of the beam trawl fleet is substantially higher (~80% of total fishing activity), with most of the fishers probably aiming for plaice and sole. This fishery is spread all over the south-eastern North Sea, but is concentrated in the Southern part of the North Sea, the Doggersbank and close to the coast of Denmark around 56°N.

The TR1AB fleet is responsible for the majority of the cod landings, with 373 tonnes of the 657 tonnes in total, representing ~79% of the total cod landings (figure 4, table 2). These cod are mainly caught at the opening of the Skagerrak and the Botney gut/Silver pit. However, figure 6 shows that LpUE in the southern part of the North Sea are similar to the opening of the Skagerrak and at the Botney gut/ Silver pit. Due to low fishing activity of the TR1AB fleet in this area, the absolute cod landing quantities remain low in this area.

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 Norway lobster. 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 6).

In comparison with the first quarter of 2014 (Reijden *et al.* 2015), both the TR1AB and the TR1C fleet showed higher fishing activity, whilst the BT2 fleet showed less activity. In combination with differences in the spatial distribution of the fleet, this led to higher cod landings than observed in quarter 1. In quarter 2, most cod was caught in the opening of the Skagerrak and at the Botney gut/ Silver pit instead of the Falls (comparison of figure 3 in Reijden *et al.* (2015) and figure 3 in this report). Fishing activity in this part of the North Sea was caused by the TR1C and TR1AB fleets, which were not present in quarter 1 in that area.

LpUE have changed compared with quarter 1 as well. Especially the large decrease in LpUE for the BT2 fleet is remarkable. The observed high LpUE in the Falls for the BT2 fleet cannot be observed in quarter 2 anymore. This may suggest a decrease in cod abundance in the Falls.

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 17:1. However, as the conversion factor is determined on yearly LpUE, the calculated factor in this report is only an indicator.

**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 2.

	Fishing activity (*1000 kW-days)		Cod Landings (Ton)		Average LpUE (kg per kW-days)
<b>BT2</b>	3987	(79.9%)	22	(4.6%)	0.01
<b>TR1AB</b>	140	(2.8%)	373	(78.7%)	2.66
<b>TR1C</b>	267	(5.4%)	17	(3.6%)	0.06
<b>TR2</b>	595	(11.9%)	62	(13.1%)	0.10
<b>Total</b>	<b>4989</b>		<b>474</b>		<b>0.10</b>

## 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.

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## Justification

Report C069/15  
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: 29<sup>th</sup> of April 2015

Approved: Nathalie Steins  
Head of department Fisheries

Signature:



Date: 29<sup>th</sup> of April 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 – 119mm, 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.