

# Cod monitoring

*Results 2015, quarter 1.*

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# IMARES Wageningen UR

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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.

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 first quarter in 2015.

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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 1 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 1 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

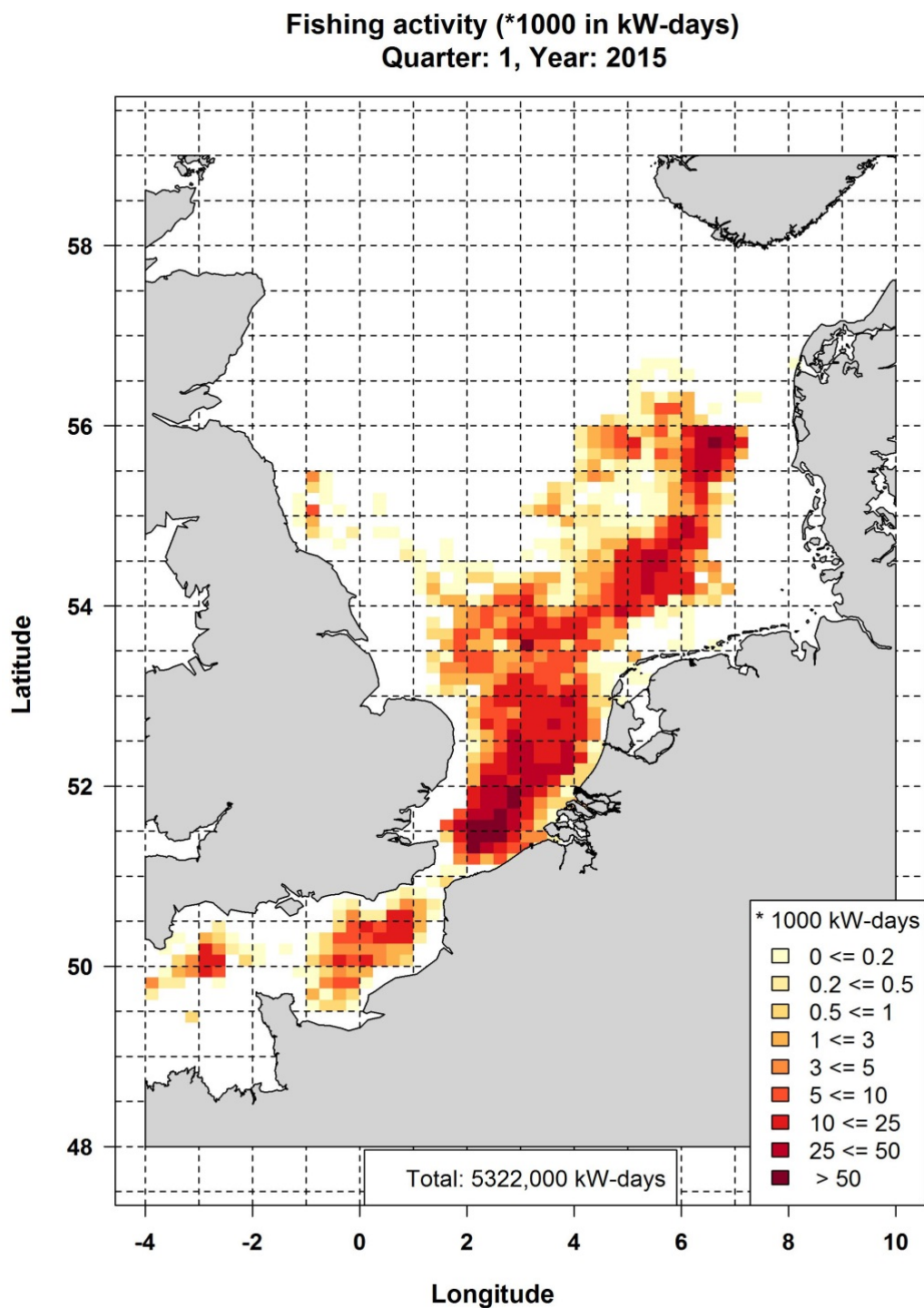
A quarterly indicator of the conversion factor between the TR and the BT gears is given. This indicator is based on the ratio between LpUE of the TR gears for which cod is bycatch (TR1C and TR2) and the BT2 gears (see formula (1)). As this analysis is based on logbook data, in which cod landings are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

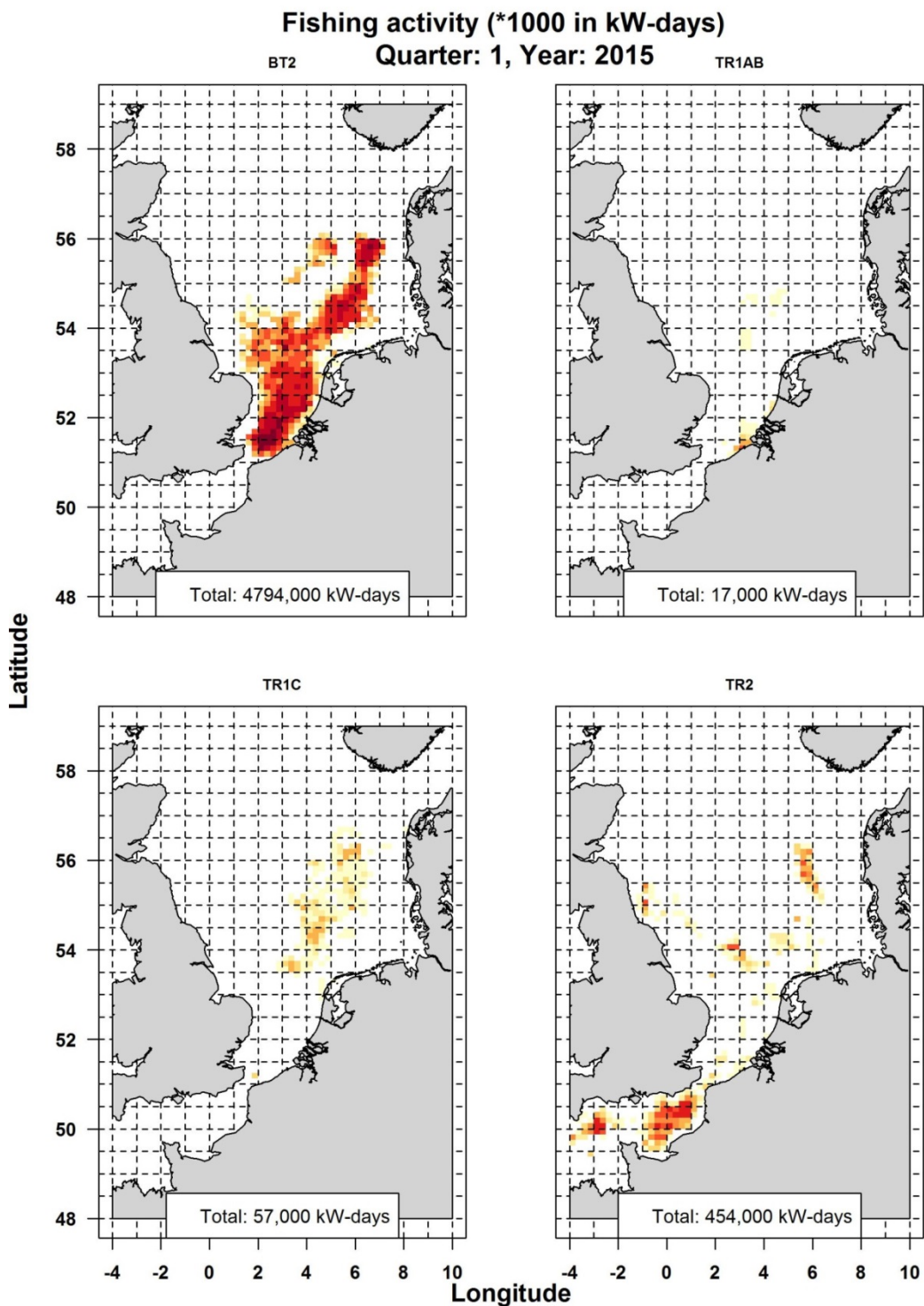
#### 3.1 Fishing activity

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 and central-east part of the North Sea.



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

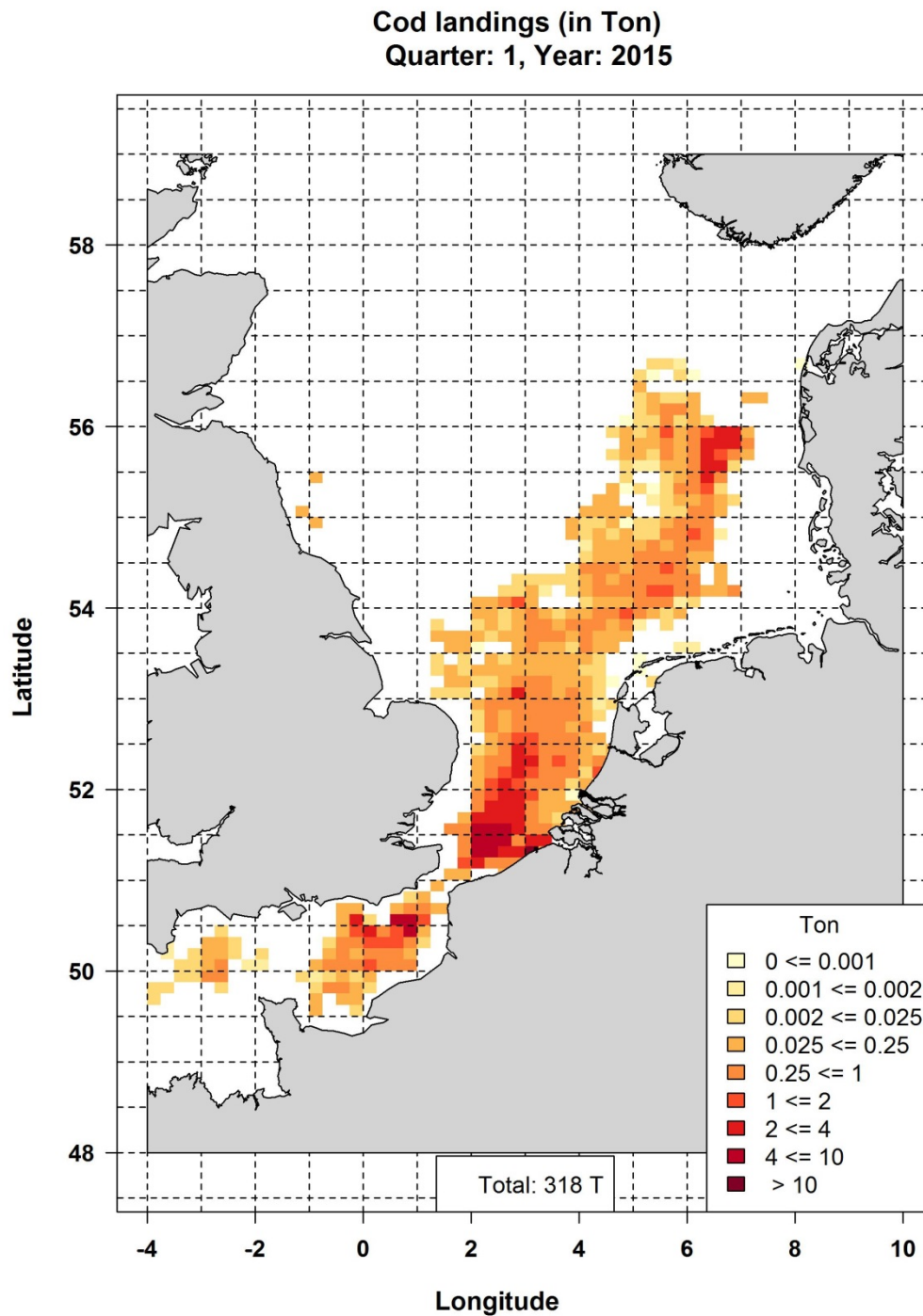
Fishing activity is dominated by BT2 gears, with only a small contribution of TR gears (figure 2, table 2). The TR2 fleet is the most active fleet within all TR gears, with an effort of 454 \* 1000 kW-days. This fleet is mainly active in the English Channel, but is active at the known Nephrops (*Nephrops norvegicus*) fishing grounds as well. From figure 2 and table 2 we can see that TR vessels hardly use a large mesh size (TR1AB) in the 1<sup>st</sup> quarter of the year, this is consistent with Kraan *et al.* (2013 and 2014) and Reijden *et al.* 2015a, which recognised that TR1AB are mainly active in summer.



**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

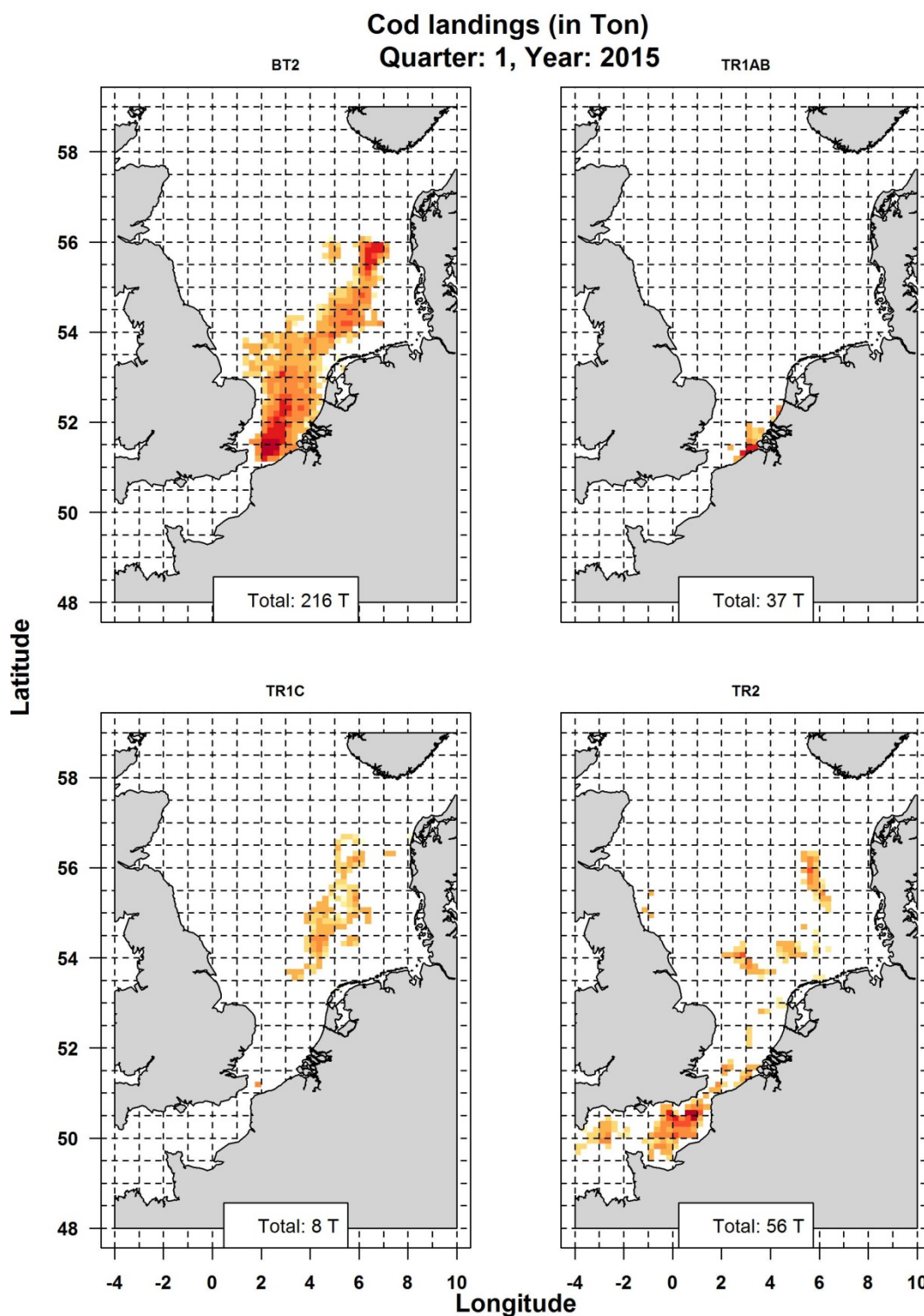
Most landed cod was caught in The Falls (around 51° N, 2° E), at Off Horns Reef (around 55.5° N and 7° E) and in the English Channel (figure 3). In the central part of the North Sea, landings are relatively low.



**Figure 3.** Cod landings (in Ton) for all TR and BT2 gears together in quarter 1 in 2015. The box underneath the map shows the total cod landings for all gears combined in this quarter.



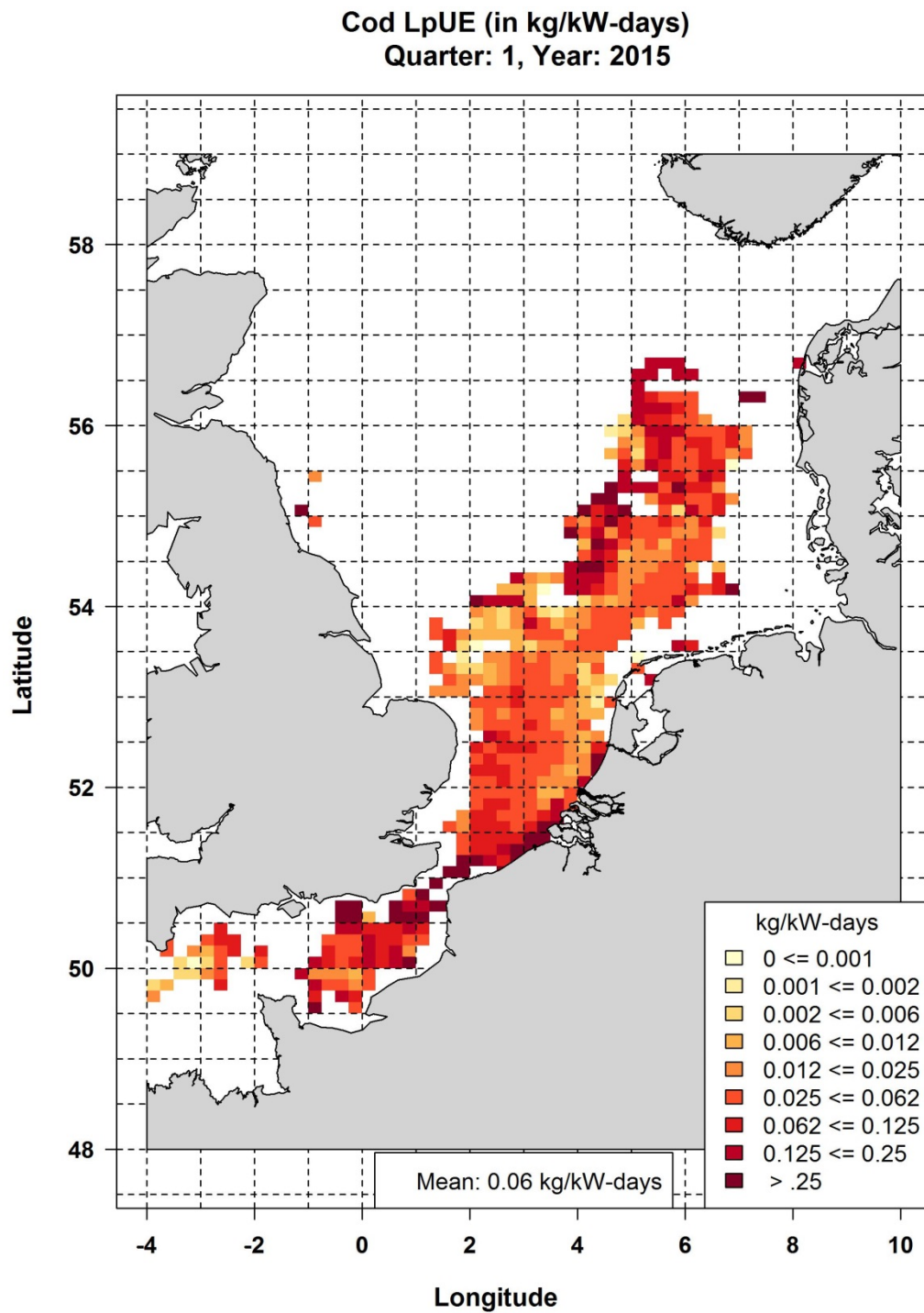
In the first quarter, most landed cod was caught by BT2 gears (figure 4, table 2). Relative high cod catches in the BT2 fleet can be observed in The Falls and Off Horns Reef, however, fishing activity was concentrated in these areas as well. All cod landed in the TR1AB fleet was caught in the Vlake van Raan.



**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.

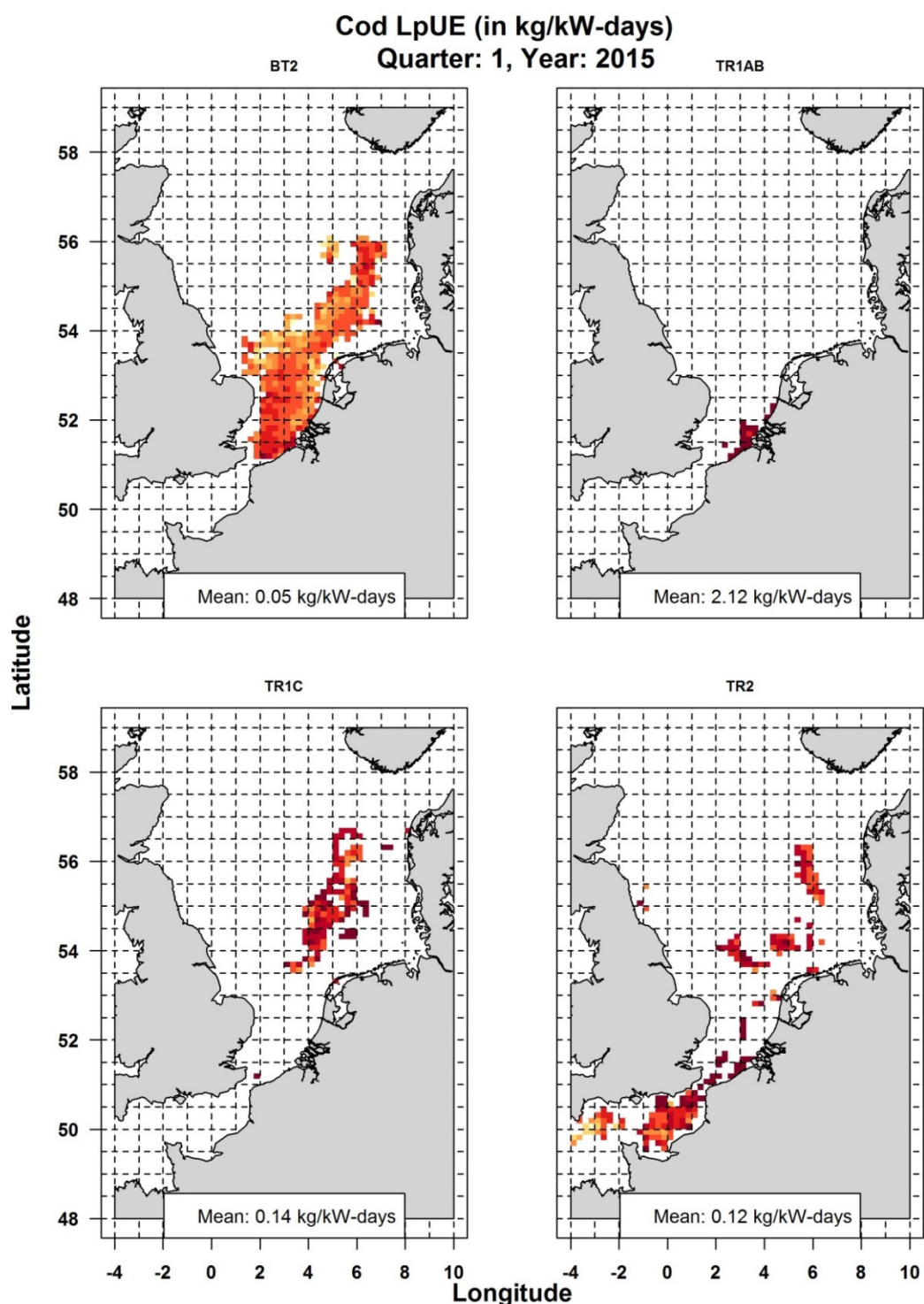
### 3.3 Cod LpUE

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 1 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 (2.12 kg/kW-days) (figure 6, table 2). No remarkable spatial differences are observed in LpUE for the BT2 fleet, except for the relatively low LpUE in the central North Sea. The observed high cod landings at the Falls and at Off Horns Reef of this fleet are caused by the concentrated fishing activity of the fleet in these areas. Highest LpUE in the TR2 fleet are observed in the most southern part of the North Sea, at the opening of the English Channel.



**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 1 the fishing effort of the fleet is dominated by the BT2 fleet with ~90% of the total fishing activity. This fleet is located widespread over the central-east and southern North Sea (figure 2). The fishing activity of the TR fleet is much lower, with the TR1AB fleet hardly active in quarter 1 (0.3% of total fishing activity, table 2). This pattern is congruent with previous cod monitoring project reports (Kraan *et al.* 2013, 2014, Reijden *et al.* 2015a). The TR2 fleet is dominated by the fisheries in the English Channel, and is responsible for the high cod catches in that area.

The TR1C fleet is concentrated in the central part of the North Sea (figure 4). Cod landings are relatively similar to landings of the total fleet (figure 4 (TR1C) in comparison with figure 3). However, a relative high LpUE can be observed for the central North Sea in figure 5, probably due to the TR1C fleet.

The BT2 fleet is responsible for the majority of the cod landings, with 216 tonnes of the 318 tonnes in total, representing ~68% of the total cod landings (figure 4, table 2). These cod are mainly caught in The Falls and Off Horns Reef. However, these areas do not have remarkable higher LpUE than other areas fished with BT2 gears, which indicate that the high cod landings are solely caused by the concentrated fishing activity in these areas and not by higher cod abundances.

Compared with 2014, fishing activity for the first quarter has decreased over 500.000 kW-days, a reduction of 8.7% (Reijden *et al.* 2015a). Especially the TR1C (36.7%) and the TR2 (32.0%) have decreased remarkably. However, the relative small decrease (6.7%) in fishing effort of the BT2 fleet has the most impact on the decrease in absolute kW-days (a reduction of 344.000 kW-days) because of the size of the BT2 fleet. The reduction in kW-days in the BT2 fleet may be explained by the recent transition towards the lighter pulse beam and the corresponding reduced vessel's power engine. Switched pulse vessels remain part of the BT2 fleet.

In contrast to the decreased fishing activity, total cod landings have increased with 3.9% to 318 Tonnes. Interestingly, both the BT2 and the TR2 fleet have caught more cod than in quarter 1 of 2014 (5.9% and 12.0% respectively) while the TR1AB fleet has caught less cod than last year (14.0%). This may indicate differences in cod catchability for the BT2, the TR1C and the TR2 fleet, as fishing activity has decreased whilst landings have increased or remain stable. Average LpUE for these three fleets has increased in comparison with quarter 1 of 2014. For TR1AB, a different pattern is shown. Fishing activity is reduced a little and total cod landings have decreased more (14.0%). The average LpUE of the TR1AB fleet has reduced from 2.33 to 2.12. This may be explained by the differences in spatial distribution of the TR1AB fleet, with fishing activity in the opening of the Skagerrak in 2014 but not in 2015 (Reijden *et al.* 2015a).

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 between the BT and the TR gears for which cod is bycatch (TR1C and TR2) was determined based on the LpUE in quarter 1, the conversion factor would be 1:2.8. 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 1.**

	Fishing activity (*1000 kW-days)		Cod Landings (Ton)		Average LpUE (kg per kW-days)
<b>BT2</b>	4794	(90.1%)	216	(67.9%)	0.05
<b>TR1AB</b>	17	(0.3%)	37	(11.6%)	2.12
<b>TR1C</b>	57	(1.1%)	8	(2.5%)	0.14
<b>TR2</b>	454	(8.5%)	56	(17.6%)	0.12
<b>Total</b>	<b>5322</b>		<b>318</b>		<b>0.06</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 C084/15  
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: 10 June 2015

Approved: Nathalie Steins  
Head of department Fisheries

Signature:



Date: 10 June 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.