

Cefas contract report C5586

Fishing Spatio-Temporal Pressures and Sensitivities Analysis for MPAs

**Report 1: Development of fishing layers from VMS data
(Fishing Industry Collaboration Pilot)**

**Fishing Spatio-Temporal Pressures and Sensitivities Analysis
for MPAs**

Fishing Industry Collaboration Pilot

(C5586)

**Milestone Report No. 1:
Development of fishing layers from VMS data**

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Project Title: Fishing Spatio-Temporal Pressures and Sensitivities Analysis for MPAs:
Fishing Industry Collaboration Pilot

Report No 1: Development of fishing layers from VMS data

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Executive summary

Knowledge of the spatio-temporal variability in fishing induced pressure distributions across habitats and the features of conservation interest in MPAs is a limiting factor in the development of conservation objectives and management measures for marine protected areas. This report contributes to a project seeking to refine an approach to calculate activity-pressure-sensitivity relationships for fishing gears used in the UK and to undertake a spatio-temporal analysis of fishing pressures within selected proposed MPA, utilising both VMS data from the MMO and fish plotter data from the fishing industry. The outputs will provide evidence to support a risk based approach to inform the setting of conservation objectives and the design of management measures for the MPA selected in this pilot as well as a methodology for wider application.

Data on the spatial distribution of fishing activities are required to demonstrate track records of the fishing industry, interactions with other users of the sea and interactions with the environment. There are particular challenges associated with mapping fishing activity, because the activity is mobile and dispersed, and because data on fishing activity are only available for those parts of the fleet that are monitored and for which data are made available. Some information on fishing activity is commercially sensitive, especially when individual vessels or small groups of vessels can be identified. Further, information on the activities of non-UK vessels may be harder to describe than those of national vessels owing to limitations on data access.

This first report utilises an approach for estimating fishing activity from satellite vessel monitoring system data to provide estimates of fishing effort for UK vessels summarised by gear groupings in each quarter of the years 2007, 2008, 2009 and 2010 within the eight ICES rectangles covering the UK portion of the Dogger Bank Special Area of Conservation (SAC). The method is applied to generate data layers and associated metadata, and this report accompanies these outputs to provide information on the limitations of the processing methods and resultant information on activity. Data layers were only produced for those gear groups/seasons where at least 5 vessels were shown to be operating across the time period within the area of interest. Vessel confidentiality could not be assured if the method were applied to lower levels of activity.

The data layers can be used to demonstrate track records of the fishing industry, interactions with other users of the sea and interactions with the environment; thus informing decision-making on conservation objectives and management measures. They will also help to catalyse further discussion on the use and limitations of VMS for mapping fishing activity.

VMS data were provided by the UK's Department for Environment, Food and Rural Affairs (Defra) and the Marine Management Organisation (MMO) in raw, uninterpreted form. The Secretary of State for the Environment, Food and Rural Affairs does not accept any liability whatsoever as to the interpretation of the data or any reliance placed thereon.

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1. Scientific objective of the project

- 1.1. To provide estimates of fishing effort for UK vessels by agreed gear groupings for 2007, 2008, 2009 and 2010 for the Dogger Bank SAC as shown in figure 1.
- 1.2. To estimate fishing effort by gear code and by quarter for each year.
- 1.3. To describe the methodology used for processing along with its known limitations.

Notes:

1. Unprocessed VMS data do not identify the fishing gear used nor differentiate between fishing and steaming. The data must therefore be combined with additional information in order to increase their utility.

2. VMS data do not cover vessels of less than 15m length and, as such, do not include a significant portion of vessels fishing in UK waters, particularly those fishing in inshore areas.

3. VMS data were provided by the UK's Department for Environment, Food and Rural Affairs (Defra) and Marine Management Organisation (MMO) in raw, uninterpreted form. The Secretary of State for the Environment, Food and Rural Affairs does not accept any liability whatsoever as to the interpretation of the data or any reliance placed thereon.

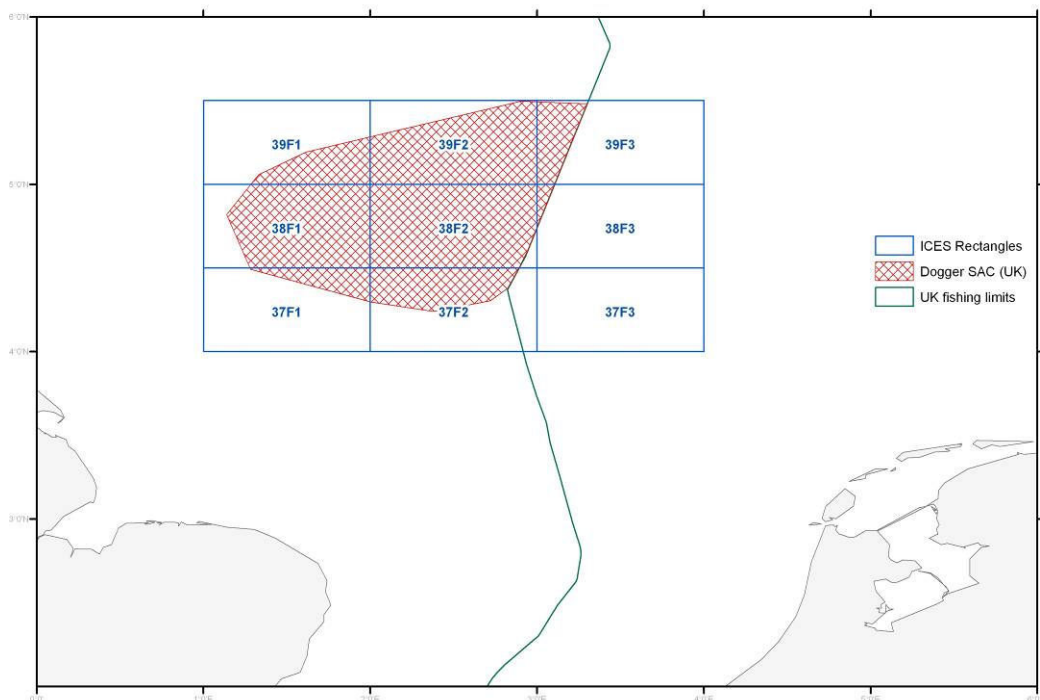


Figure 1: The pilot study area: UK Dogger Bank SAC

2. Fishing activity data layers for the UK fleet.

- 2.1 Estimates of fishing activity are derived from Vessel Monitoring System (VMS) data and are provided for 2007, 2008, 2009 and 2010. The derived surfaces represent activity for UK registered vessels of at least 15-metre length. Using date, time and vessel identification the VMS data for UK vessels have been linked to skipper logbook information in order to determine the fishing gear being employed.
- 2.2 Unprocessed VMS data have been filtered using a simple speed rule that states that vessels travelling at speeds of between 1 and 6 knots are fishing. This is applied for all gear types. The date and time information attached to the unprocessed VMS data have been used to determine the elapsed time between consecutive VMS locations for each vessel (which is usually 2 hours). This time information is then summarised to provide an estimation of 'fishing hours' at an output cell resolution of 0.05 decimal degrees.
- 2.3 In 2007 data were available for 10 gears. The 2008 data comprised 9 gears; the 2009 data comprised 12 gears, while the 2010 data comprised 11 gears. Table 1 shows the description for each of the gears and the associated codes used to summarise the gear groups.
- 2.4 Table 2 shows the number of vessels fishing each gear group in each time period. It can be seen that the majority of activity is by vessels using demersal trawl gears.
- 2.5 Vessels are identified using the EU Fleet Register identifier (often referred to as the CFR). The determination of the number of unique vessels is based on a count of the number of unique CFR identifiers occurring within the database.
- 2.6 Any differences between the total value and the 'number unique vessels' in Table 2 reflects the situation where a vessel has changed gear in the time period. The ratio of number of vessels to vessel/gear combinations ranges from 0.76 to 1.00 indicating that few vessels fish multiple gears within this study area and those that do, generally do so in the months between July and September.
- 2.7 Data layers can only be produced for those gear groups/seasons where there are found to be at least 5 vessels operating (see Table 2). Vessel confidentiality cannot be assured where vessel numbers do not meet this requirement as there are insufficient data to obscure the activities of individual vessels.
- 2.8 Because of the small number of vessels fishing nets, seines and pelagic trawls the total effort for these combined gear groups has been produced and is referred to as 'Other fishing'.
- 2.9 Two data layers were created for each quarter and for each year, one representing the demersal trawling activity and the other representing all other fishing activity. All of the data layers are continuous floating point raster

datasets and are referenced to geographical coordinate system WGS_84. Figures 2 to 5 show the estimated demersal trawl activity for UK vessels for each quarter and for each year between 2007 and 2010. Figures 6 to 9 show the equivalent estimated 'Other Fishing' activity for UK vessels during these years.

- 2.10 An index of similarity has been calculated for the demersal trawling activity for each quarter looking at consistency between years. The index returns a value of 0 if the patterns of activity are identical and a value of 1 if the patterns are maximally different. Table 3 shows the index of similarity for each quarter across the four years.
- 2.11 An index of similarity was also calculated for the demersal trawling activity to explore differences in activity between quarters in each year. The index returns a value of 0 if the patterns of activity are identical and a value of 1 if the patterns are maximally different. Table 4 shows the index of similarity for each year across the four quarters.
- 2.12 For trawled gears, the values within the raster grids indicate estimated hours fished. For the 'Other fishing' which is a combination of trawled gears, set nets and seine nets, this cannot be taken as being fully representative of the intensity of fishing as no indication is given of the time that the set nets remain *in situ*. Rather it gives an indication of the spatial extent affected by these gears and the likely intensity based on time spent setting and retrieving gear.
- 2.13 Further details on the method employed to generate the fishing layers can be found in *"Developing reliable, repeatable, and accessible methods to provide high-resolution estimates of fishing-effort distributions from vessel monitoring system (VMS) data"*, Janette Lee; Andy B. South; Simon Jennings. ICES Journal of Marine Science, 67: 1260-1271 doi:10.1093/icesjms/fsq010.

Table 1. Gear codes used for UK vessels

Gear Group	Group Code	Gear Code	Description
Trawls (Demersal)	TD	OT	Otter trawls (not specified)
		OTB	Otter trawls – bottom
		OTT	Otter twin trawls
		PTB	Pair trawls – bottom
		TBB	Beam trawls
		TBN	Nephrops trawls
		TX	Other trawls (not specified)
Nets	NT	GN	Gillnets (not specified)
		GNS	Set gillnets (anchored)
Trawls (Pelagic)	TP	OTM	Otter trawls – midwater
		TMS	Shrimp trawls – midwater
Seines	SN	SDN	Danish seines
		SSC	Scottish seines

Table 2a. Number of vessels by Gear Group for UK vessels

Gear Group	Code	2007				2008				2009				2010			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Trawls (Demersal)	TD	23	45	59	21	18	41	52	21	18	33	45	23	16	30	42	14
Nets	NT	0	1	1	2	1	2	4	1	2	2	4	3	1	1	3	0
Trawls (Pelagic)	TP	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1
Seines	SN	0	2	2	1	0	1	3	0	0	6	6	3	0	4	4	1
a: Total		23	48	62	21	19	44	59	22	20	41	56	30	17	35	49	16
b:																	
Number unique vessels		23	40	47	20	18	36	45	19	18	38	43	26	17	35	43	15
Ratio b:a		1.00	0.83	0.76	0.95	0.95	0.82	0.76	0.86	0.90	0.93	0.77	0.87	1.00	1.00	0.88	0.94

Table 2b. Number of demersal trawling vessels by gear for UK vessels

Gear Group	Code	2007				2008				2009				2010			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Unspecified Otter	OT	1	10	17	5	5	11	16	7	5	8	10	4	3	4	8	1
Demersal Otter	OTB	0	5	7	0	0	6	10	2	2	10	12	5	3	10	18	3
Twin Otter	OTT	0	4	3	0	0	1	4	1	1	2	4	3	1	3	1	0
Pair Otter	PTB	0	2	2	0	0	4	0	0	0	1	2	0	0	2	2	0
Beam Trawl	TBB	21	19	18	14	12	14	8	10	9	10	8	11	8	10	9	9
Nephrops Trawl	TBN	1	5	12	2	1	5	14	1	1	2	9	0	1	1	4	1

UK Demersal Trawling, 2007

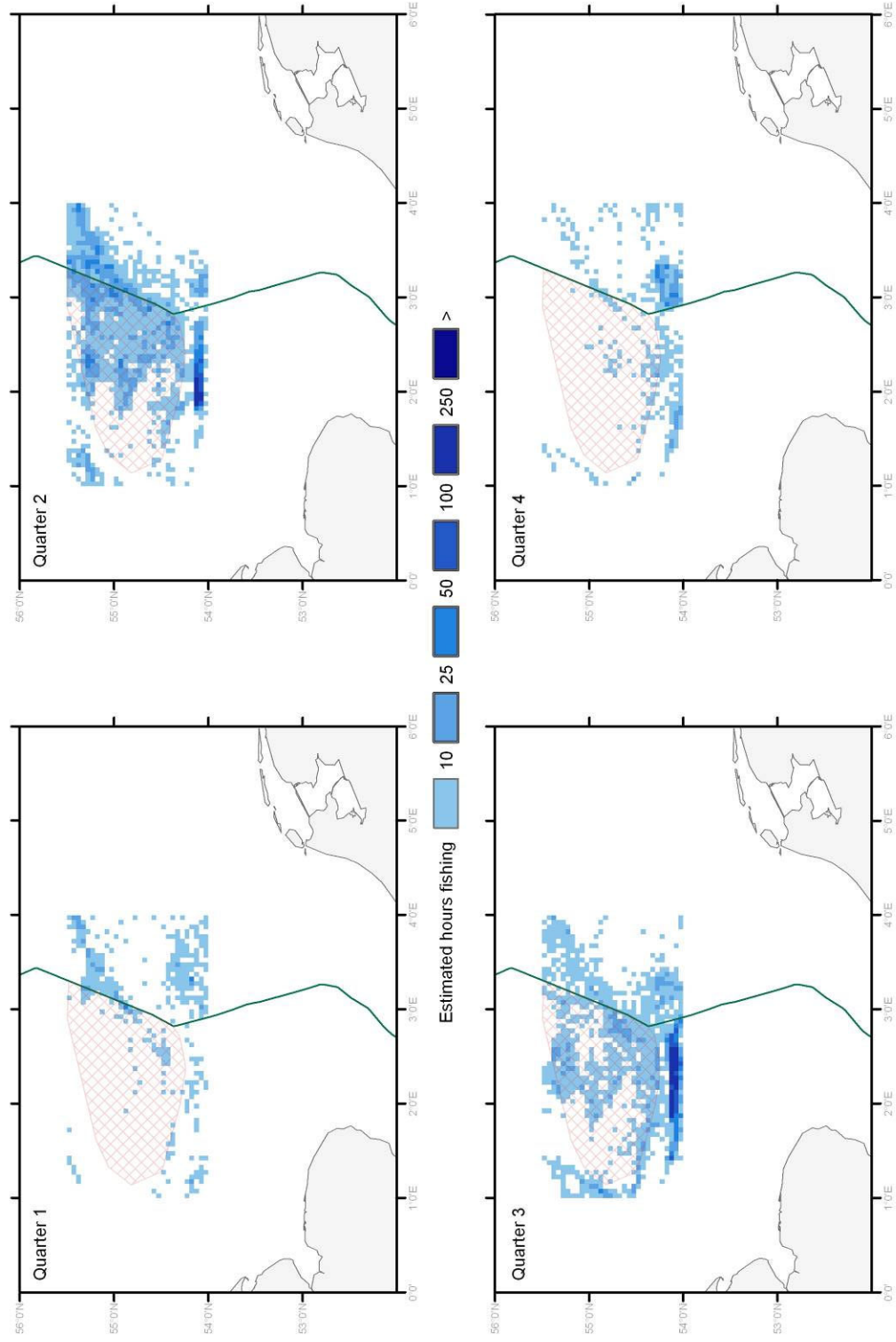


Figure 2: Estimated UK 'demersal trawl' activity for 2007

UK Demersal Trawling, 2008

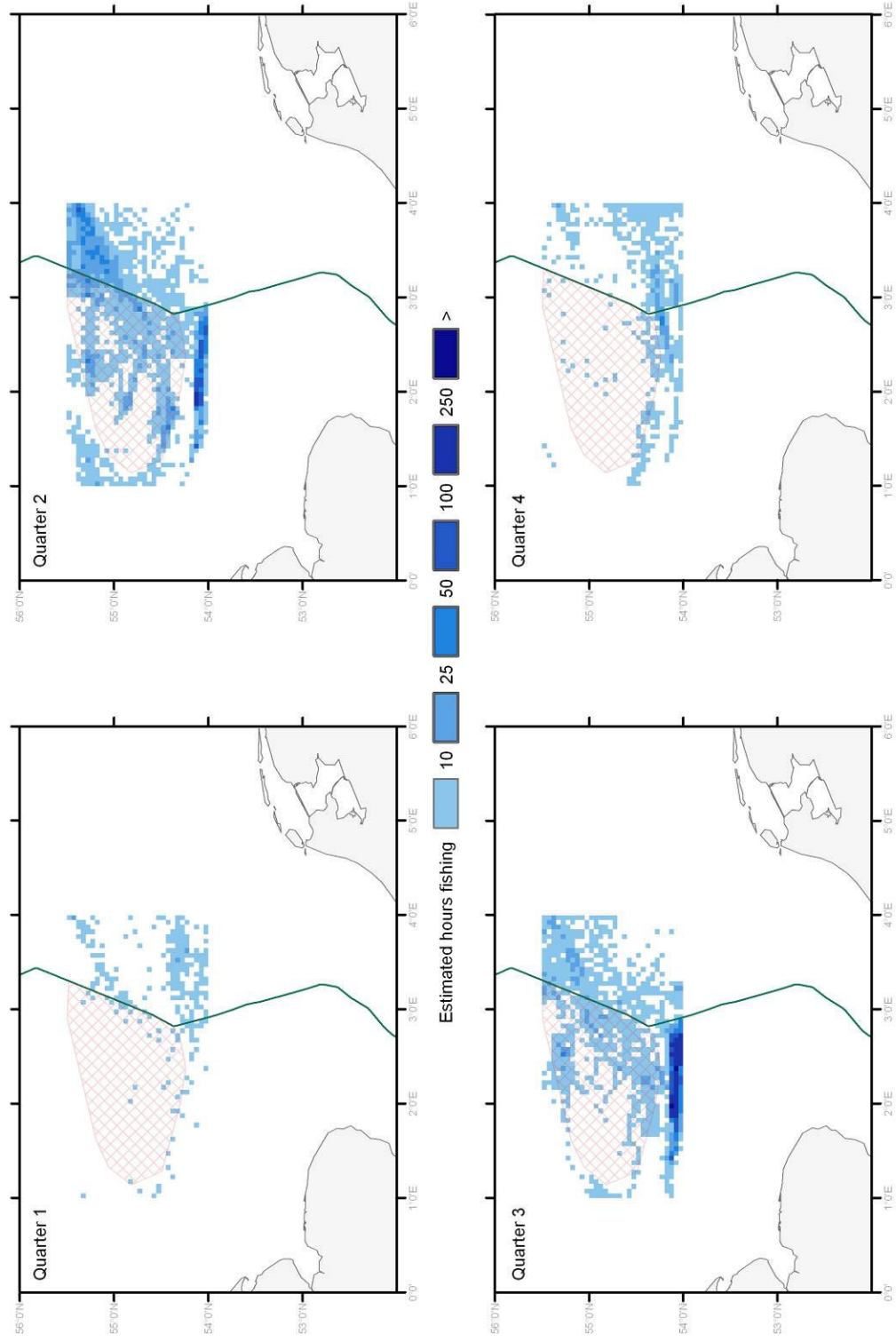


Figure 3: Estimated UK 'demersal trawl' activity for 2008

UK Demersal Trawling, 2009

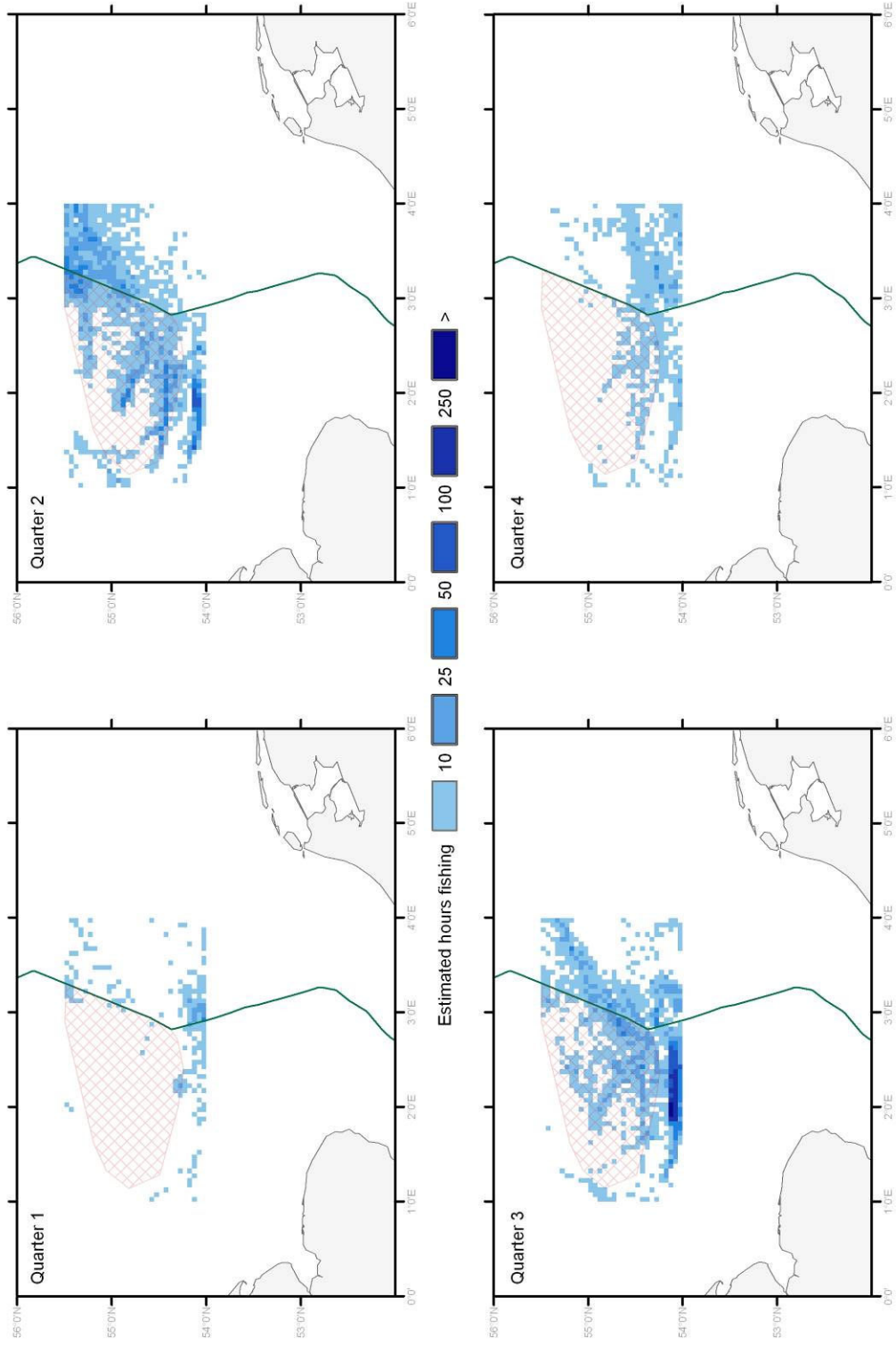


Figure 4: Estimated UK 'demersal trawl' activity for 2009

UK Demersal Trawling, 2010

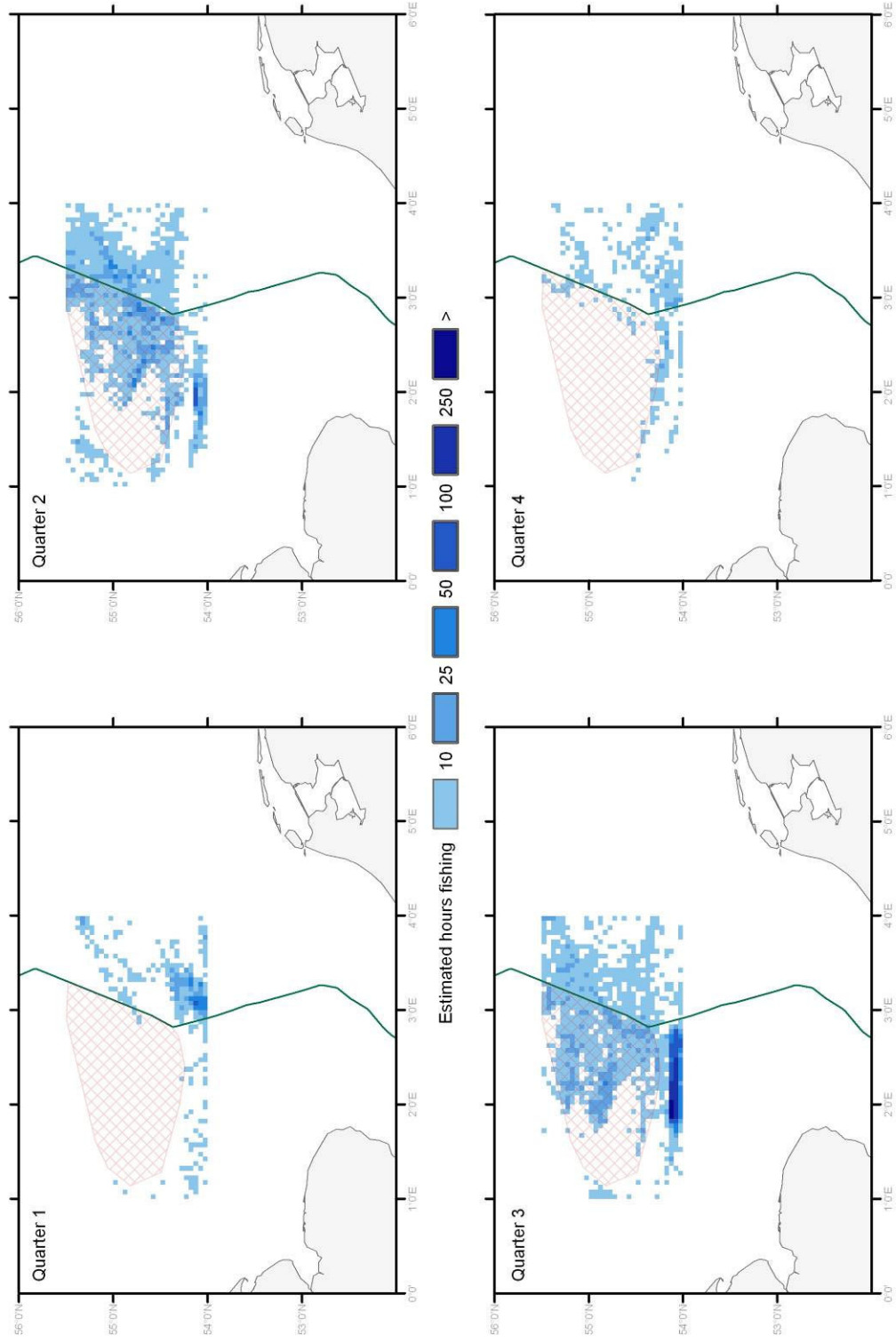


Figure 5: Estimated UK 'demersal trawl' activity for 2010

UK 'other fishing', 2007

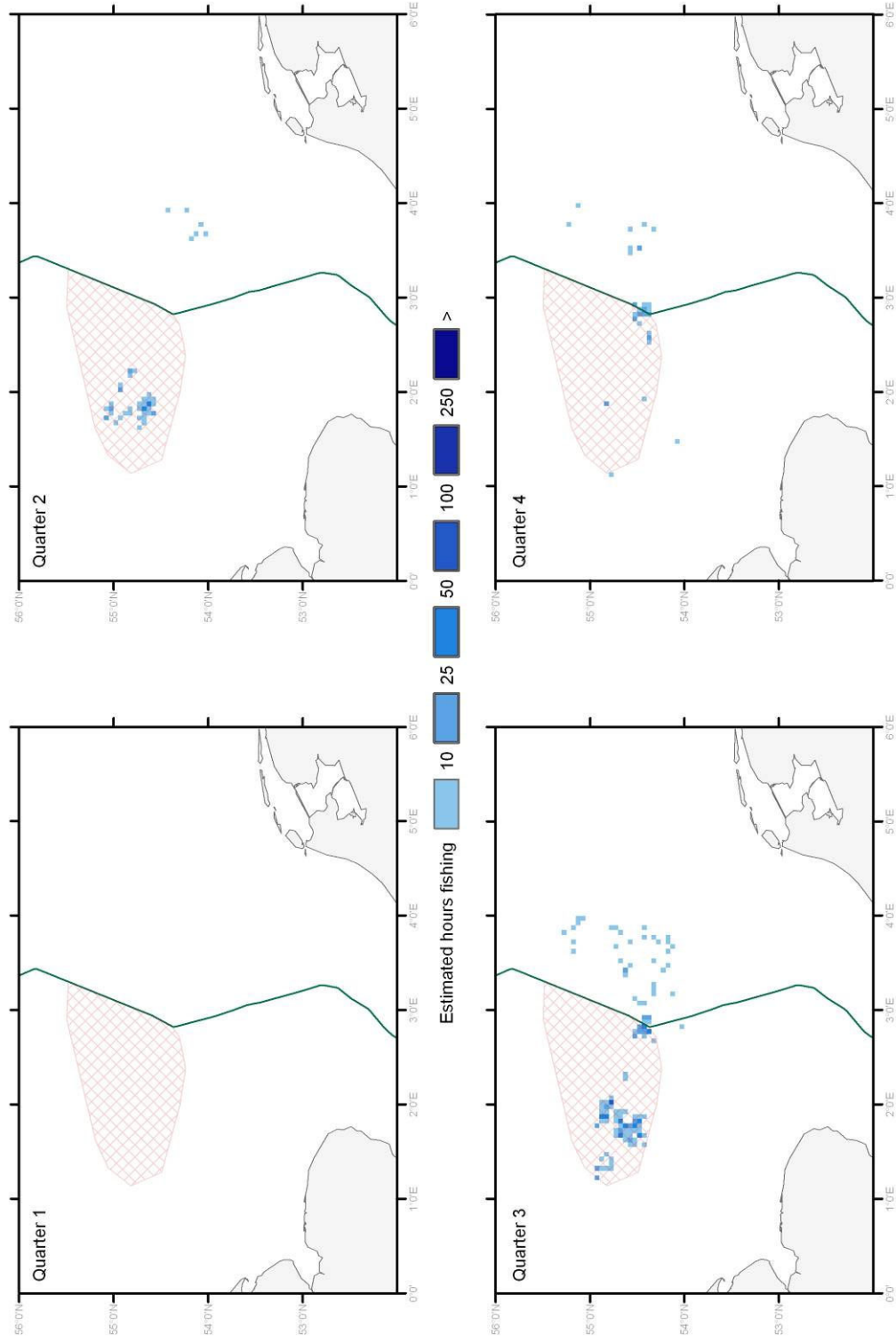


Figure 6: Estimated UK 'other fishing' activity for 2007

UK 'other fishing', 2008

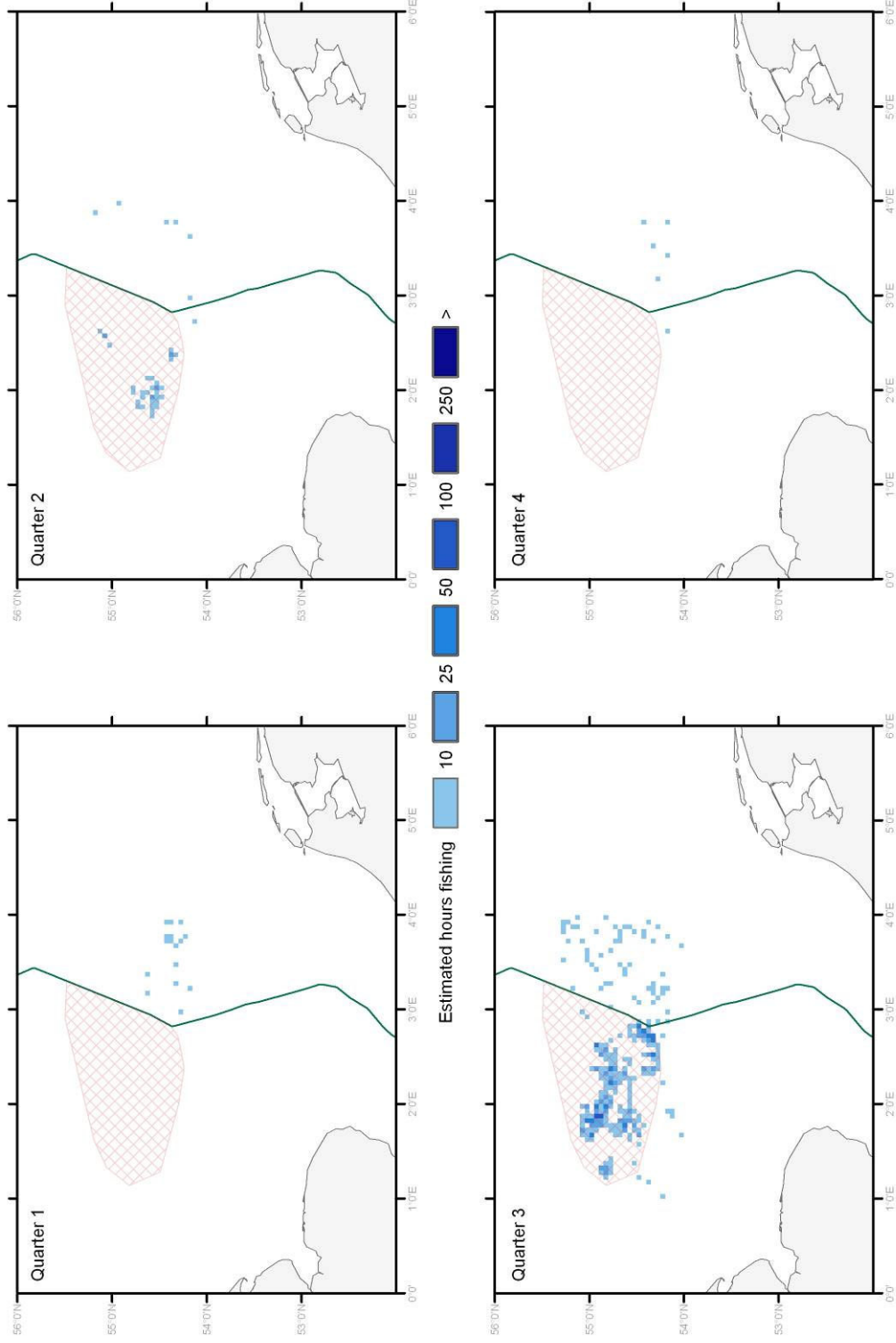


Figure 7: Estimated UK 'other fishing' activity for 2008

UK 'other fishing', 2009

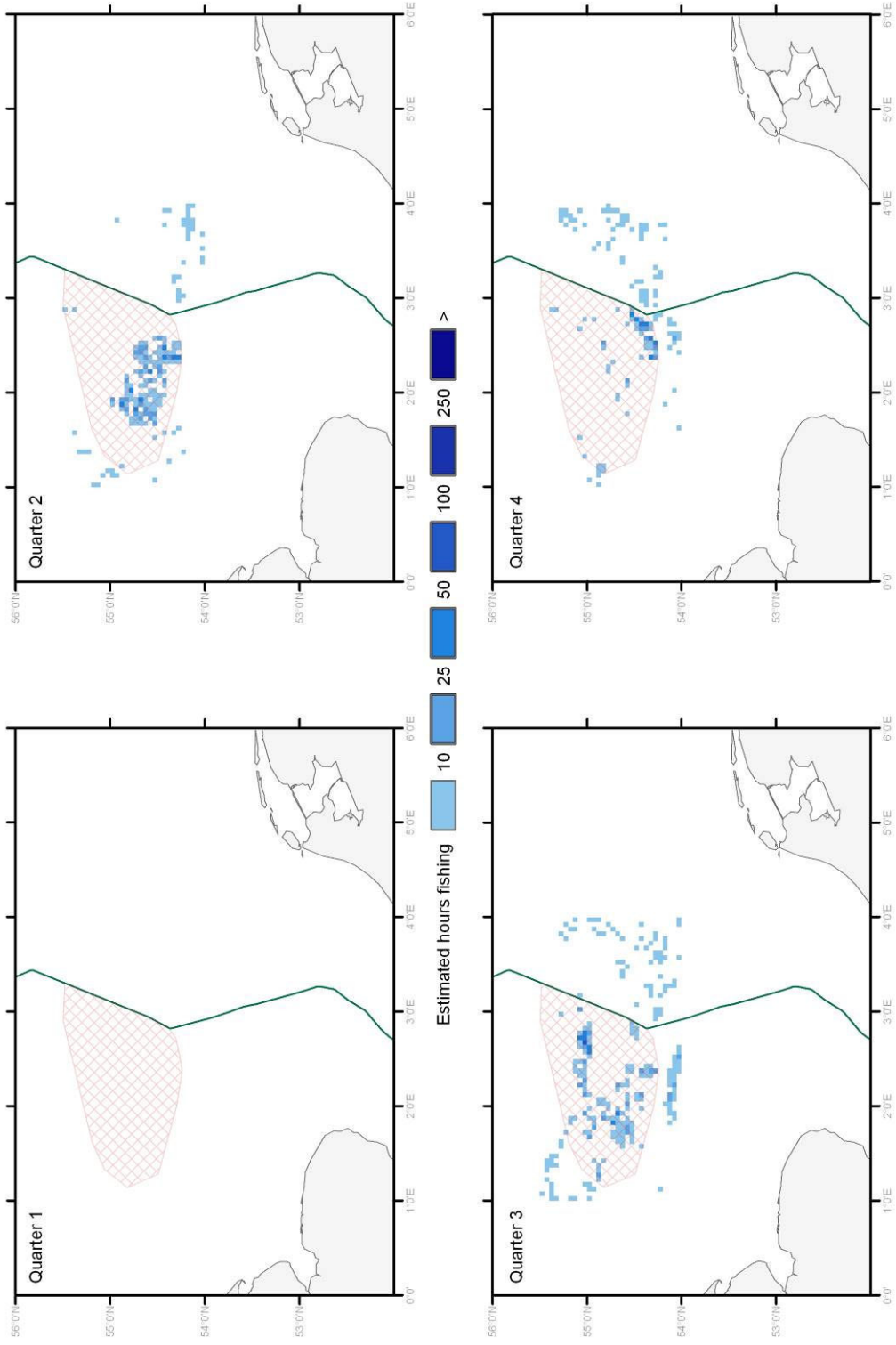


Figure 8: Estimated UK 'other fishing' activity for 2009

UK 'other fishing', 2010

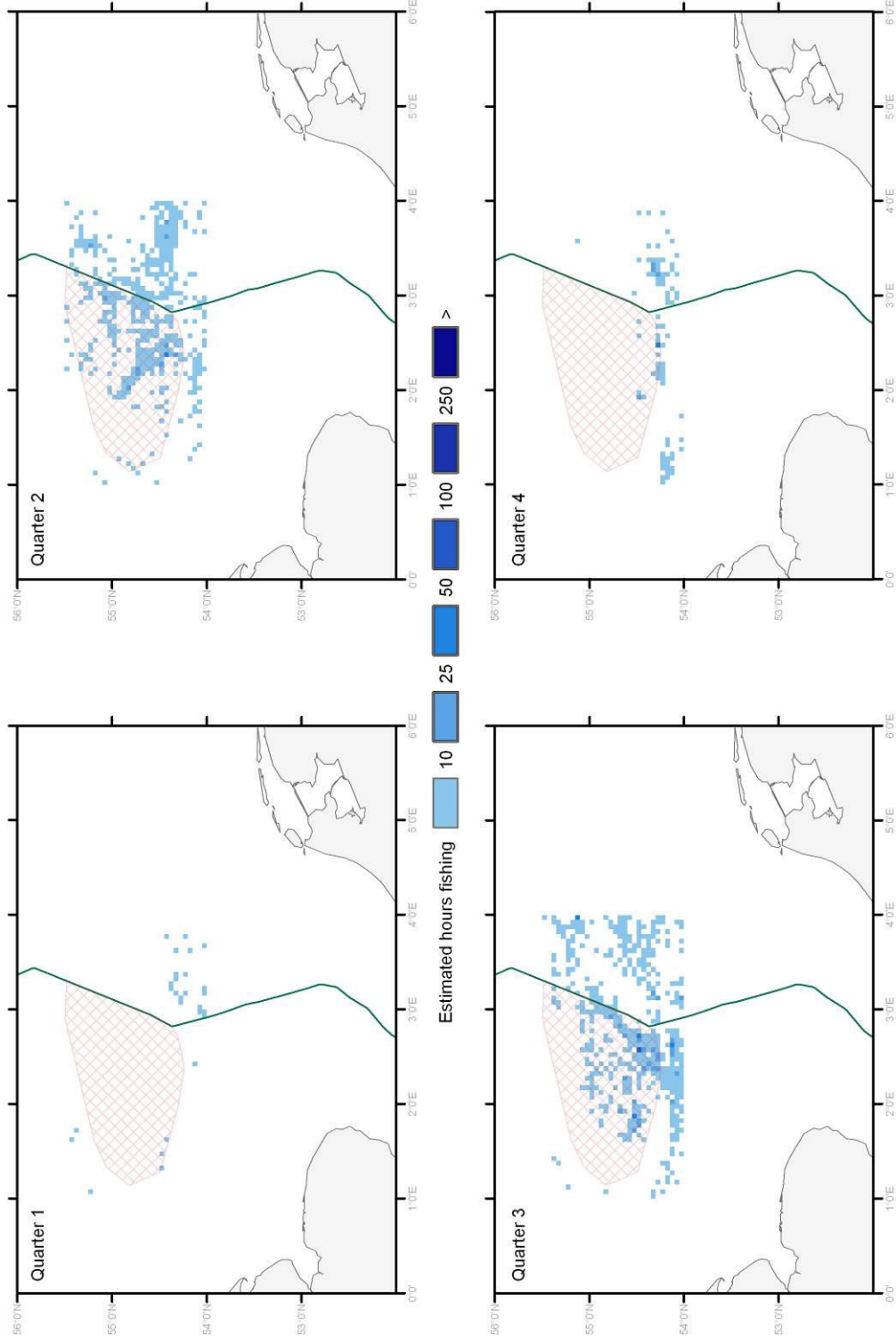


Figure 9: Estimated UK 'other fishing' activity for 2010

Table 3. UK demersal trawling, index of similarity, yearly variation
 (0 = identical pattern of activity; 1 = maximally different pattern of activity)

		2007	2008	2009	2010
Quarter 1	2007	-	0.69	0.82	0.77
	2008		-	0.82	0.75
	2009			-	0.64
		2007	2008	2009	2010
Quarter 2	2007	-	0.39	0.48	0.49
	2008		-	0.43	0.50
	2009			-	0.44
		2007	2008	2009	2010
Quarter 3	2007	-	0.40	0.37	0.38
	2008		-	0.38	0.36
	2009			-	0.33
		2007	2008	2009	2010
Quarter 4	2007	-	0.67	0.61	0.66
	2008		-	0.65	0.68
	2009			-	0.69

Table 4. UK demersal trawling, index of similarity, quarterly variation
 (0 = identical pattern of activity; 1 = maximally different pattern of activity)

		q1	q2	q3	q4
2007	q1	-	0.79	0.87	0.78
	q2		-	0.52	0.85
	q3			-	0.78
		q1	q2	q3	q4
2008	q1	-	0.86	0.92	0.74
	q2		-	0.49	0.80
	q3			-	0.83
		q1	q2	q3	q4
2009	q1	-	0.83	0.81	0.78
	q2		-	0.59	0.75
	q3			-	0.72
		q1	q2	q3	q4
2010	q1	-	0.91	0.92	0.70
	q2		-	0.57	0.83
	q3			-	0.87

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