

COWRIE FISHVALUE-07-08

Development of spatial information layers for commercial fishing and shellfishing in UK waters to support strategic siting of offshore windfarms

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Executive Summary

The aim of this study was to create a series of consistent UK-wide marine information layers relating to the distribution and economic value of commercial fishing and shellfisheries. The layers were developed using GIS software ArcGIS 9.3 and MapInfo 9.5.

The final output is a series of GIS layers displaying the annual mean Fish Value for years 2004 to 2007. The layers are a UK 'first' and it is anticipated that they will be developed further in the future to improve the information provided, particularly for inshore areas.

The layers have the flexibility to display the annual mean value per Gear Class for both Vessel Monitoring System (VMS) vessels (over 15m length) and Non-VMS vessels. The spatial information can be used to highlight areas of importance and value to the fishing industry, particularly offshore. They will also assist in informing discussions regarding the strategic planning for offshore developments, particularly R3 offshore wind as well as informing wider planning for UK's marine waters.

For spatial planning purposes, the Fish Value layers should be used in conjunction with other data sets. Economic evaluation on its own does not accurately represent the sensitivities of the fishing industry. Information such as the location of important fisheries and which fishing grounds are integral to local ports would greatly assist quantifying the impact of displacement to the fishing industry.

From the analysis it has become evident that there is a lack of spatial information available regarding the Fishing Effort of the Non-VMS fleet (vessels less than 15m in length). This information is available in various formats from the individual Sea Fishery Committees and devolved administration fisheries regulators but would need to be extensively reworked to achieve UK-wide consistency. Along with the improved Non-VMS effort, an analysis of the fishing activity from foreign vessels in UK waters also needs to be undertaken as it has been estimated to account for 27% of all activity in UK waters. It is the recommendation of this report that this further research in both Non-VMS and foreign fishing activity is undertaken to provide a more complete spatial valuation of fishing activity.

It is also recommended when interpreting the data that the limitations of the data and methodology are acknowledged. If the data is to be used for spatial planning purposes, direct consultation with the industry is highly recommended.

Acronyms

ABPmer	ABP Marine Environmental Research Ltd
Cefas	Centre for Environment, Fisheries and Aquaculture Science
COWRIE	Collaborative Offshore Windfarm Research into the Environment
FRS	Fisheries Research Services
GIS	Geographic Information System
ICES	International Council for the Exploration of the Sea
MFA	Marine and Fisheries Agency
MMO	Marine Management Organisation
SFC	Sea Fishery Committee
VMS	Vessel Monitoring System

1. Introduction

In July 2008, COWRIE (Collaborative Offshore Windfarm Research into the Environment) commissioned ABP Marine Environmental Research Ltd (in association with Centre for Environment, Fisheries and Aquaculture Science (Cefas) and Fisheries Research Services (FRS), Scotland) to create spatial information layers on the distribution and economic value of commercial fishing and shellfishing activities within UK waters (Fish Value).

1.1 Approach

To create the Fish Value layers, both the value and intensity of fishing activity must be known for a specified area.

Indicative information on the financial value of fishing activities is available from the Marine and Fisheries Agency (MFA) in the form of financial landing values. For conservation and management purposes, fishermen record the species, the type of fishing gear used (Gear Code) and value of each catch along with the location of where it was caught. The location is recorded to ICES rectangle; a spatial grid system covering Europe and the North Atlantic. Each rectangle has a unique ID and spans one degree of longitude by half a degree of latitude.

The intensity of fishing activity, known as Fishing Effort, is a measure of fishing activity in a specific area. For larger vessels, the Fishing Effort can be estimated from data extracted from the Vessel Monitoring System (VMS). Introduced in 2000, the VMS requires fishing vessels over a certain length (at present 15m) to transmit their location at regular time intervals, typically once every two hours. It is primarily used as a system for operational enforcement but can also be used to estimate the spatial distribution of fishing activity (South & Lee, 2009).

For further information about processed VMS data and how Fishing Effort is calculated see Appendix A.

Currently, a national system such as the VMS is not in place to monitor fishing activity for smaller vessels. Fishing Effort information can be obtained from the individual Sea Fishery Committees but it is not available in a consistent spatial format.

From consultations with fishing organisations and committees, there is a distinct difference in the fishing activity between larger VMS vessels and smaller, predominantly inshore, vessels. Therefore, the analysis was conducted separately with fishing effort and landing value classified according to length of the vessel; vessels with VMS and vessels without (Non-VMS).

VMS vessels represent vessels greater than 15m in length for data from 2005 to 2007 and greater than 18 metres in 2004. Non-VMS represents any vessel less than 15m in length for data from years 2005 to 2007 and less than 18m in 2004.

For vessels less than 15 metres (Non-VMS) the Fishing Effort is not available in a readily useable format at a national scale. For the purposes of this study, it has been assumed that the Fishing Effort is evenly dispersed throughout the relevant ICES rectangle.

The financial contributions for each vessel classification can be seen in Table 1.

Table 1 Annual Value per Vessel Classification

YEAR	CLASS	VALUE	% of Annual Value
2004	Non-VMS	£140,036,800.97	33%
2004	VMS	£283,046,836.21	67%
2005	Non-VMS	£112,129,440.44	23%
2005	VMS	£369,065,949.42	77%
2006	Non-VMS	£148,291,469.83	28%
2006	VMS	£374,707,867.58	72%
2007	Non-VMS	£167,241,679.70	31%
2007	VMS	£370,417,141.98	69%
Mean Annual Value	Non-VMS	£141,924,847.74	29%
	VMS	£349,309,448.80	71%
Total =		£491,234,296.53	100%

To link the Landings value to the relevant Fishing Effort, both the Fishing Effort and Landings have been classified via Gear Code according to the Metier Matrix (Level 4). See Appendix B for a full list of Gear Codes in operation in UK waters.

The value of the fishery is calculated by distributing the ICES financial value according to the intensity of fishing effort, with greater effort receiving a greater financial value. The Fish Value per unit area of sea-bed is estimated using the following formula. For each Gear Code:

$$\text{Fish Value} = \left[\frac{\text{Fishing Effort}}{\text{Total Fishing Effort within ICES Rectangle}} \right] \times \text{Landing Value per ICES Rectangle}$$

Once Fish Value has been created per Gear Code the data is grouped into a value per Gear Class (Level 2) from the Metier Matrix. The final output is an annual mean value for fishing activity for the following gear types: Dredges, Hooks and Lines, Nets, Seines, Traps and Trawls.

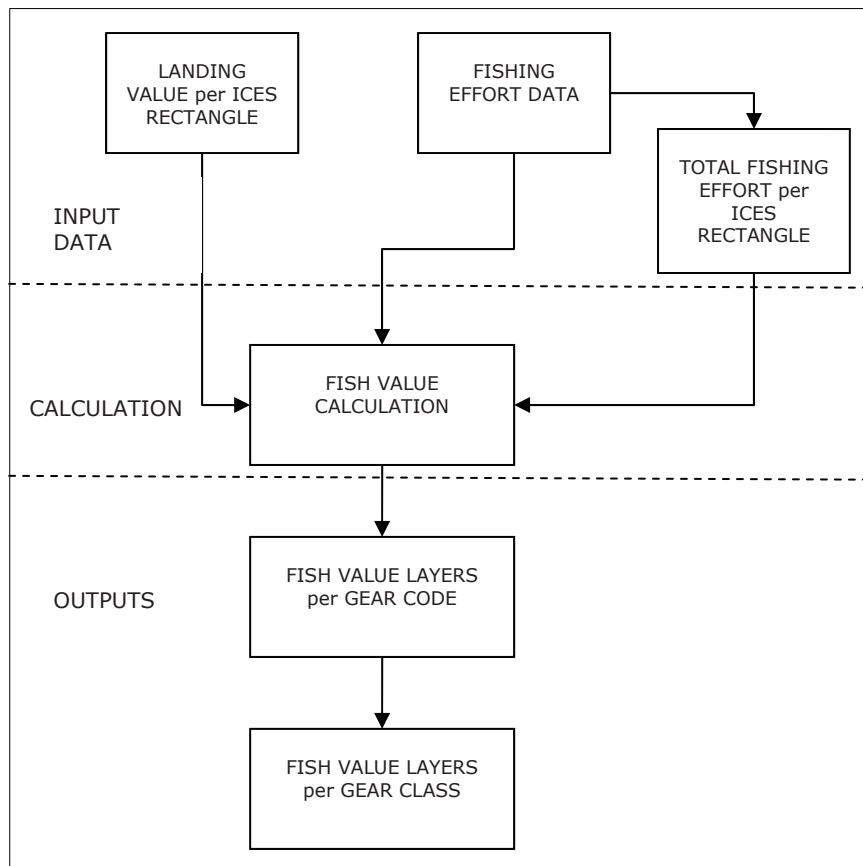
1.2 Study Area

The spatial coverage of the analysis undertaken here includes the extent of UK waters; marine areas from 24°W, 47°N to 5°E, 64°N.

2. GIS Methodology

The layers were developed using the GIS software ArcGIS 9.3 and MapInfo 9.5 and summated in Microsoft Access 2003. ESRI's Spatial Analyst extension was used to perform the Fish Value calculation. The GIS data was created using the geographic datum WGS84. For technical information see Appendix C.

The following flowchart broadly illustrates the procedure for estimating the Fish Value.



2.1 VMS Analysis

2.1.1 Input Data

For VMS analysis, the GIS layers are derived from the following information sources:

- Fishing Effort per Gear Code extracted from VMS data for UK vessels from years 2004-07. The processed VMS data was supplied by Cefas for England, Wales and Northern Ireland, and FRS for Scotland; and
- Landing Value per Gear Code per ICES rectangle extracted from MFA Landing Statistics for the years 2004 to 2007. The MFA Landings data contains the value of Landings into the UK and abroad by UK vessels.

To apportion the value according to fishing intensity within the ICES rectangle, the Total Fishing Effort per ICES rectangle was computed. This was calculated using Spatial Analyst's Zonal Statistics function.

2.1.2 Calculation

The Fish Value was calculated using the Fish Value formula. The calculation was performed using ESRI Spatial Analyst extension.

2.1.3 Outputs

The outputs were information layers containing the annual value of fishing activity per Gear Code for VMS vessels. The data was summarised for output into Value per Gear Class according to Level 2 of the Metier Matrix. The Value Gear Classes include the following: Dredges, Hooks and Lines, Nets, Seines, Traps and Trawls.

2.1.4 Assumptions

For the VMS analysis the following assumptions were made within each ICES rectangle:

- Areas of greater Fishing Effort will receive greater financial value (value is assigned in proportion to estimated fishing effort in a given area).
- Areas of Fishing Effort without a Landing Value are excluded.
- Areas of Landing Value without Fishing Effort are excluded.
- Foreign vessels have been excluded from this analysis (although a separate layer provides information on the location and intensity of foreign vessel fishing activity in UK waters, see Figure 16).

2.1.5 Limitations

For the VMS analysis, the limitations are as follows:

- Fish Value was not calculated when Fishing Effort data and mapped Landing value data did not spatially match. This resulted in losses of financial value. See Appendix C for Losses per Gear Code per Year.
- Foreign vessels are excluded from the analysis; therefore the information layers do not fully represent the true value of fishing activity within UK waters (see Section 4.2).
- For Landings data, inadvertent misreporting can lead to irregularities in Gear Code and ICES rectangle details. These are known limitations of self reporting (see Section 4.3).

2.2 Non-VMS Analysis

2.2.1 Input Data

The GIS layers are derived from the following information sources:

- The Fishing Effort is considered to be evenly distributed across the marine portion of an ICES rectangle. Where the ICES rectangle overlap the coastline the landing value was shifted to the marine portion of the ICES rectangle.
- Landing Value per Gear Code per ICES rectangle extracted from MFA Landing Statistics for the years 2004 to 2007. The MFA Landings data contains the value of Landings into the UK and abroad by UK vessels.

2.2.2 Calculation

The Fish Value was calculated based on the Fish Value formula. The calculation was performed using ESRI Spatial Analyst extension.

2.2.3 Outputs

The outputs were information layers containing the annual value of fishing activity per Gear Code for Non-VMS vessels. The data was summarised for output into Value per Gear Class according to Level 2 of the Metier Matrix. The Value Gear Classes include the following: Dredges, Hooks and Lines, Nets, Seines, Traps and Trawls.

2.2.4 Assumptions

For the Non-VMS analysis the following assumption was made:

- Fishing Effort is considered to be evenly distributed across the ICES rectangle.

2.2.5 Limitations

For the Non-VMS analysis, the limitations were as follows:

- Fishing Effort from the Non-VMS is not readily available in digital format.
- Dispersing the Fishing Effort evenly throughout the ICES rectangles is not a true representation of the fishing activity of the Non-VMS fleet. This should be acknowledged when any interpretation of the data is made.
- Foreign vessels are excluded from the analysis; therefore the information layers do not fully represent the true value of fishing activity within UK waters (see Section 4.2).
- For Landings data, inadvertent misreporting can lead to irregularities in Gear Code and ICES rectangle details. These are known limitations of self reporting (see Section 4.3).

3. Results - Data Layers

The final output is the Fish Value GIS layers, in the form of raster grids. The layers display the mean annual value for fishing activity in UK waters from 2004 to 2007 by UK vessels. A separate layer was created for each Gear Class, for both VMS and Non-VMS data. GIS Metadata was created according to the FGDC metadata standard.

3.1 Fish Value Layers

A list of the Fish Value layers produced can be seen below:

1. Mean Annual Value for VMS Dredges
2. Mean Annual Value for VMS Hooks and Lines
3. Mean Annual Value for VMS Nets
4. Mean Annual Value for VMS Seines
5. Mean Annual Value for VMS Traps
6. Mean Annual Value for VMS Trawls
7. Mean Annual Value for VMS Gear Classes combined
8. Mean Annual Value for Non-VMS Dredges
9. Mean Annual Value for Non-VMS Hooks and Lines
10. Mean Annual Value for Non-VMS Nets
11. Mean Annual Value for Non-VMS Seines
12. Mean Annual Value for Non-VMS Traps
13. Mean Annual Value for Non-VMS Trawls
14. Mean Annual Value for Non-VMS Gear Classes combined
15. Total Mean Annual Value for all Gear Classes (both VMS and Non-VMS)

The resolution, the minimum cell size of each layer, is a cell with dimensions of 0.05 degrees of longitude and 0.05 degrees latitude (approximately 3 km by 5.5 km). The Fish Value represents the financial value of fishing activity within this area.

As a process of deriving Fish Value, numerous other spatial layers have been developed; Fishing Effort and Landings Value per Gear Code per year. These layers have an inherent value and can be utilised for more specific analysis.

Along with the spatial information layers, a repeatable and consistent methodology has been developed that will assist further development as new information becomes available.

3.2 Fish Value - Mean Annual Value

Table 2 shows the calculated Fish Value per Gear Class for both VMS and Non-VMS vessels in UK waters. The value displayed is the mean annual value for each Gear Class from 2004 to 2007.

Table 2 Mean Annual Value per Gear Class

	Dredge	Hooks and Lines	Nets	Seines	Traps	Trawls	Total
VMS	£23,037,500.00	£3,956,970.00	£5,761,910.00	£13,250,900.00	£10,146,700.00	£268,822,000.00	£324,975,980.00
Non-VMS	£18,474,700.00	£5,979,890.00	£9,146,210.00	£133,079.00	£59,949,000.00	£47,145,700.00	£140,828,579.00
Total	£41,512,200.00	£9,936,860.00	£14,908,120.00	£13,383,979.00	£70,095,700.00	£315,967,700.00	£465,804,559.00

3.3 Fish Value versus Landing Value

During the VMS analysis, loss of value occurred where fishing effort and landing value didn't spatially match. This can be due to either misreporting (ICES rectangle) or the fishing activity was not been captured in the processed VMS data. The loss was greatest for 2004 equating to 9.7% of annual value, with gradual improvement for the following years; for 2005 the loss was 6.3%; for 2006 it was 6.5% and for 2007 it was 5.9%. The difference in Landing Value and Calculated Fish Value for all Gearcodes can be seen in Appendix D.

For the Non-VMS analysis there were slight gains in value, less than 1%. This occurred if an ICES rectangle overlapped the land. The Non-VMS Fishing Effort layer was created as a shapefile and then converted into a raster grid using spatial analyst extension. When converting, small gains and losses in effort occurred due to the output cell size of the raster grid and the shape of the coastline. The difference in Landing Value and Calculated Fish Value can be seen in Appendix D.

4. Interpreting the data

When viewing or interpreting the Fish Value data, users must be aware of the limitations of the analysis (see Assumptions and Limitations in GIS Methodology). The Fish Value should not be interpreted as a true value. It is a calculated value according to fishing effort. All values are approximate and are indicative of the mean annual value of fishing activity in UK waters from 2004 to 2007 by UK vessels. The resolution (minimum cell size) of the data is 0.05 degrees longitude by 0.05 degree latitude; there are 200 grid cells within one ICES rectangle. One grid cells covers an area of approximately 3km by 5.5km.

The calculated mean annual value for fishing activity in UK waters equated to almost £465 million per annum; of which £325 million was from VMS activity and £141 million from Non-VMS activity (see Table 2). There was a loss of £24 million of annual landing value for the VMS analysis. This was a result of landing value and fishing effort not spatially matching. For Non-VMS fishing activity there was no loss of value.

The maximum calculated Fish Value per unit area was £364,579, the minimum £0. Where Fish Value returns a zero value (No Value), it doesn't necessarily mean that fishing activity does not occur; it can also indicate that effort or landings for a specific area didn't correspond (see 2.1.4 – VMS Assumptions).

4.1 Fish Value Outputs

The GIS outputs can be viewed in the figures enclosed (Figure List on page iv). The Figures display the spatial distribution and calculated Fish Value for a particular Gear Class. Each Gear Class is made up of multiple Gear Codes as recorded in log books. Further information about Gear Classes can be seen in Appendix B - Metier Matrix for UK Waters.

For each figure, the applied colour scheme (symbology) represents the total mean annual Fish Value for all fishing activity. The symbology is the same for each figure for comparative purposes.

Figures 1-6 represent the Fish Value for each VMS Gear Class – Dredges, Hooks and Lines, Nets, Seines, Traps and Trawls respectively. Figure 7 represents the mean annual Fish Value for VMS vessels, all Gear Classes combined. Figures 8-13 represent the Fish Value for each Non-VMS Gear Class - Dredges, Hooks and Lines, Nets, Seines, Traps and Trawls. Figure 14 represents the mean annual Fish Value for Non-VMS vessels, all Gear Classes combined.

As can be seen in the Figures 1-7, the higher resolution data for VMS vessels clearly illustrates highly valuable fisheries from the less valuable. It also shows the extent of the fishing activity within UK waters for VMS vessels.

For Figures 8-14, the Non-VMS output mirrors the form of the ICES rectangles. Unlike the VMS data, the Non-VMS landing value has not been dispersed according to fishing effort but evenly distributed according to the cells within each ICES rectangle. When viewing or interpreting the Non-VMS data, like the VMS data it is a value per grid cell (0.05 degrees longitude by 0.05 degrees latitude) not a value per ICES rectangle as it can appear.

As the GIS layers have the same resolution, the data can be combined. The total mean annual value layer in Figure 15 is a combination of all Gear Classes for both the VMS and Non-VMS data sets. It represents the mean annual value for all fishing activity by UK vessels within UK waters from years 2004 to 2007. As can be seen in Figure 15, the output is a combination of the even distributed, predominantly inshore Non-VMS data and the finely detailed, predominantly offshore VMS data.

4.2 Foreign Fishing Activity

During this analysis fishing activity for foreign vessels was excluded. Figure 16 illustrates the fishing effort (hours fished) for foreign vessels in UK waters for years 2006 and 2007. The activity from foreign vessels comprises up to 27% of all fishing activity within UK waters (see Table 3). This was calculated using the total fishing effort of UK's VMS fleet for years 2006 and 2007 and the assumption that Non-VMS activity comprised of 30% of all UK activity (effort relative value). Although the value of foreign fishing activity has not been incorporated into this study, it is apparent that fishing activity from foreign vessels is a major component of the total amount fishing activity within UK waters. Users of the data must be aware that without the value of international fishing activity, a complete valuation of fishing activity in UK waters cannot be achieved.

Table 3 Estimated Fishing Activity in UK Waters

Year	Type of Effort	Hours Fished	% of total
2006/07	UK VMS Vessels	3677202.00	51.17%
2006/07	UK Non-VMS Vessels	1577519.66	21.95%
	<i>Total UK</i>	<i>5254721.66</i>	<i>73.12%</i>
2006/07	Foreign VMS Vessels	1932090.00	26.88%
2006/07	Total effort	7186811.66	100.00%

4.3 Delegation of Landing Value

During the project various fishing organisations, authorities and committees were consulted to validate the methodology and results. One notable issue raised was that problems can arise regarding the precise delegation of landing value (reported ICES rectangle). As the Fish Value analysis relies on a spatial match between the fishing effort data and the associated landing value, any landing value that is misreported will distort the value of fishing activity within that specific area.

The 4° W line represents a boundary between the ICES definition of North Sea and the West Coast in UK waters - areas of capture VIa and IVa. There are separate quotas for fish in the two areas. Where there are high catches for a species in one area but only limited quota available for that species there is an increased possibility of misreporting which side of the line catches have really come from. One effect of this may be to produce a sharp boundary of value (Drewery, FRS pers. Comm. Feb 2009). This can be seen in Figure 17 between areas of capture VIa and IVa. This is a complicated issue and is not something that can be addressed within this study.

5. Conclusions and Recommendations

The information layers represent a calculated value of fishing activity in UK waters, rather than a true value. Although economic evaluation alone doesn't represent the importance of fisheries, the layers can be used to highlight areas of importance and value to the fishing industry and to inform discussions regarding fishing activity and strategic planning for offshore developments and the wider marine environment within UK waters. It should be noted that fishing activity is affected by the regulatory regime in operation and market conditions, it should never be considered constant throughout time.

For spatial planning purposes, the Fish Value data can be combined with other data sets to help inform decision making. Information such as the location of important fisheries and which fishing grounds are integral to local ports would assist quantifying the impact of displacement to the fishing industry. Such information can be obtained from a review of coastal fisheries of England and Wales 2005-06 undertaken by Walmsey and Pawson (2007). A landing value per port can also be obtained from MFA's annual UK Sea Fisheries Statistics.

From the analysis, it is clear that there is a lack of information regarding the Fishing Effort from the Non-VMS fleet. The information can be acquired from Sea Fishery Committees and devolved administrative fisheries regulators but needs to be reworked into a spatial format to allow for analysis. This further research would significantly improve the quality of output information for inshore waters.

Another improvement would be to quantify the value of foreign fishing activity. Foreign activity has been estimated to account for up 27% of all fishing activity in UK waters. This information is held and can be attained from fisheries regulators for each EU member state. Therefore, to provide a complete valuation of Fish Value in UK waters, further analysis of the fishing activity from foreign vessels and UK Non-VMS vessels needs to be undertaken.

It is recommended that the layers are updated on an annual basis when new landings and fishing effort data become available. The costs of such an update are estimated to be around £5,000-8,000 per year. The analysis should be undertaken using a consistent methodology to enable comparisons to be made between years, although the methodology applied in this study is flexible enough to account for improvements in data quality and software developments.

It is recommended that the information layers should be hosted by a suitable marine organisation, possibly, in due course, the MMO (and/or equivalent bodies in the devolved administrations), given their proposed role in data management.

References

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Figures

- Figure 1 - Mean Annual Value for VMS Dredges
- Figure 2 - Mean Annual Value for VMS Hooks and Lines
- Figure 3 - Mean Annual Value for VMS Nets
- Figure 4 - Mean Annual Value for VMS Seines
- Figure 5 - Mean Annual Value for VMS Traps
- Figure 6 - Mean Annual Value for VMS Trawls
- Figure 7 - Mean Annual Value for All VMS Activity
- Figure 8 - Mean Annual Value for Non-VMS Dredges
- Figure 9 - Mean Annual Value for Non-VMS Hooks and Lines
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- Figure 15 - Mean Annual Value for All Fishing Activity (both VMS and Non-VMS)
- Figure 16 - Fishing Effort from Foreign Vessels within UK Waters
- Figure 17 - Fish Value in Relation to Area of Capture

Mean Annual Value for VMS

- Dredges / £
- 1 - 2,000
 - 2,001 - 5,000
 - 5,001 - 10,000
 - 10,001 - 20,000
 - 20,001 - 30,000
 - 30,001 - 40,000
 - 40,001 - 50,000
 - 50,001 - 60,000
 - 60,001 - 70,000
 - 70,001 - 80,000
 - 80,001 - 90,000
 - 90,001 - 100,000
 - 100,001 - 364,579
 - No Value
 - UK Continental Shelf

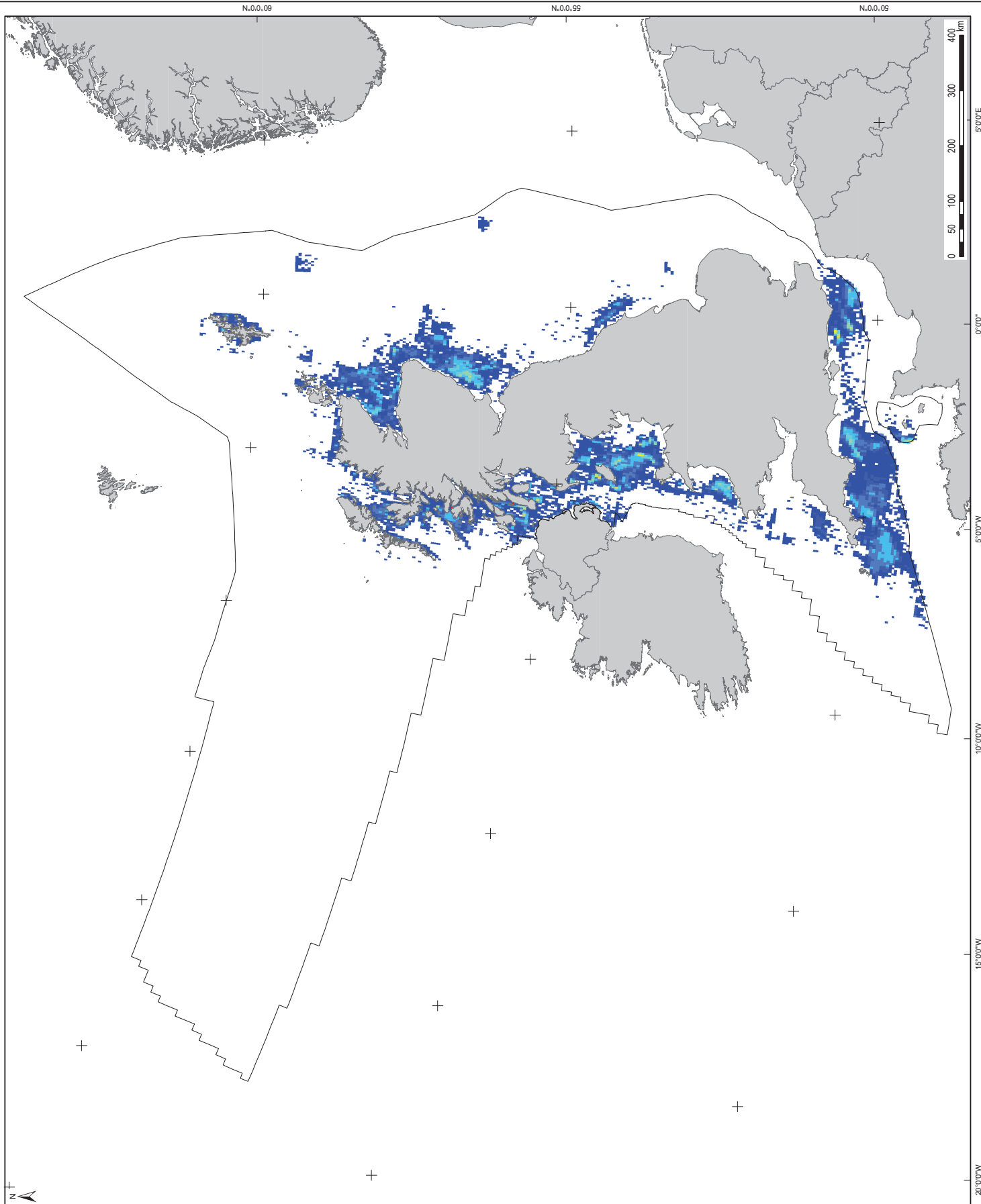
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar 09	PAR	A3	1
WGS84 UTM31N			
Projection		Scale	1:6,500,000
OA		DD	
3785 Fig. VMS_Dredge_Ann_Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEFRAS, FRS and MFA			



Mean Annual Value for VMS Dredges

Figure 1



Mean Annual Value for VMS
Hooks and Lines / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579

- No Value
- UK Continental Shelf

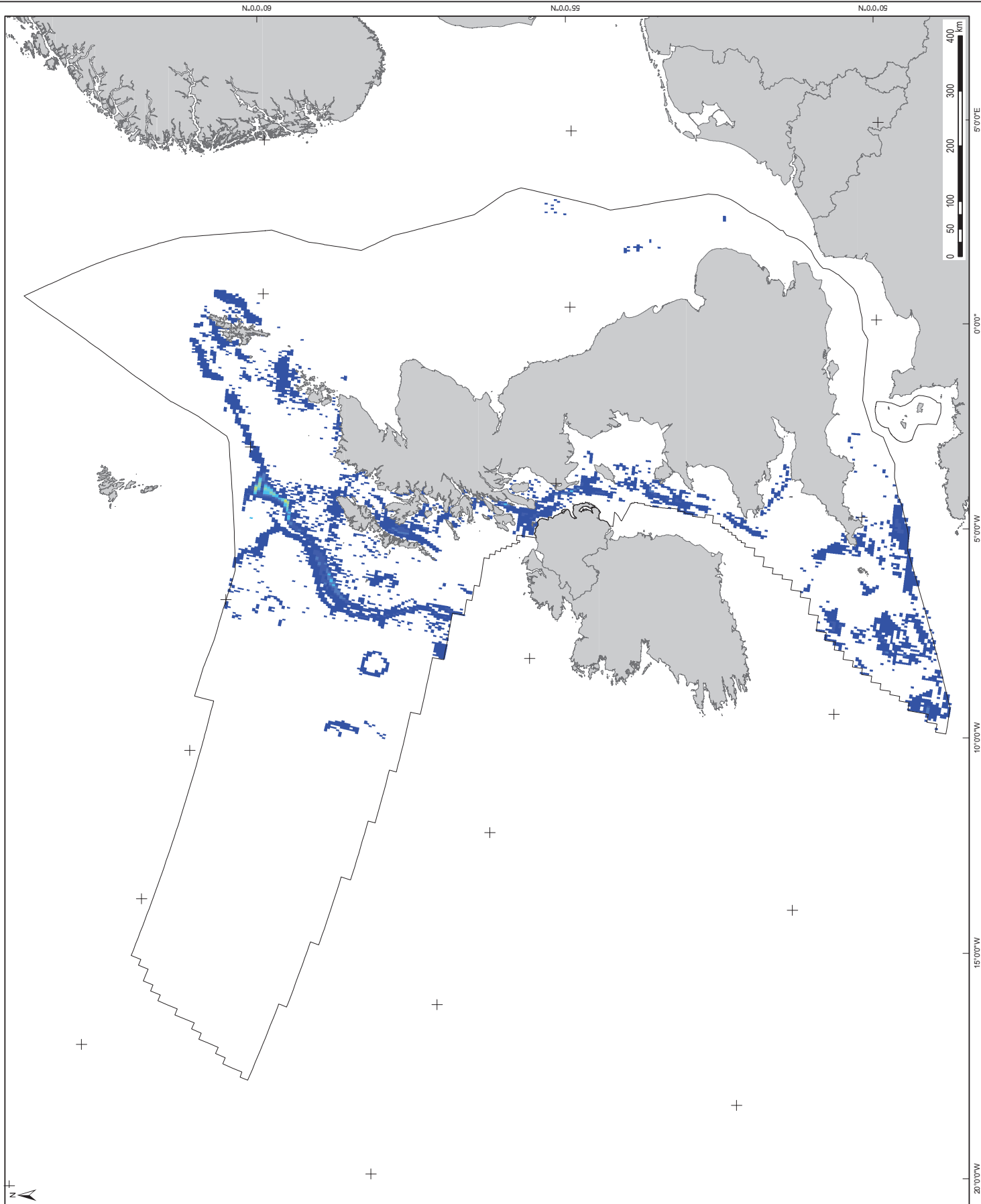
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar 09	PAR	A3	1
WGS1984 UTM31N			
Projection		Scale	
		1:6,500,000	
OA		DD	
3795-Fg_VMS_HooksLines_Ann_Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEFRAS, FRS and MFA			



Mean Annual Value
for VMS Hooks and Lines

Figure 2



Mean Annual Value for VMS
Nets / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579

- No Value
- UK Continental Shelf

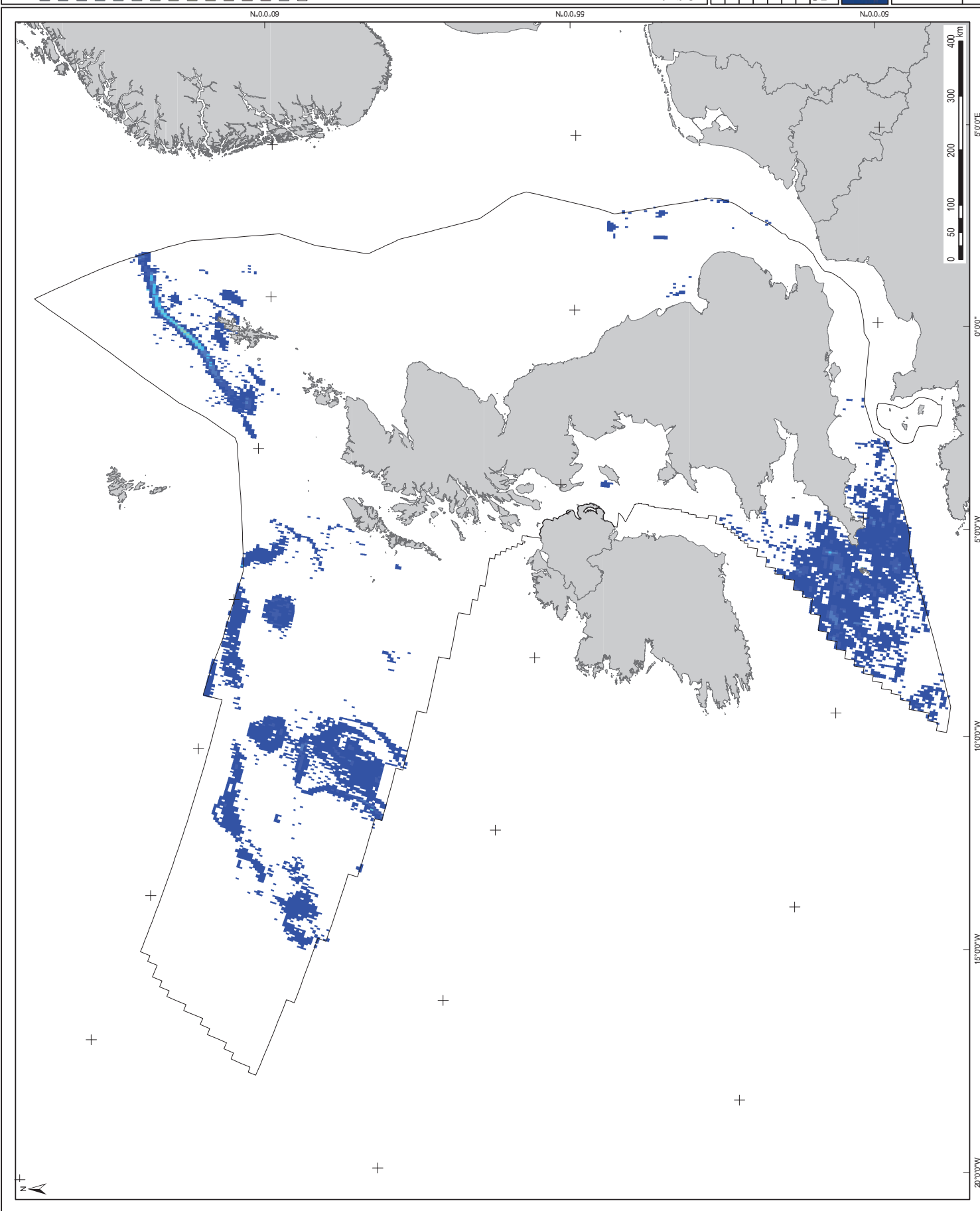
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar/09	PAR	A3	1
WGS1984 UTM31N			
Projection			
Scale 1:6,500,000			
OA DD			
3795-Fish_VMS_Net_Ann_Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEFRAS, FRS and MFA			



Mean Annual Value
for VMS Nets

Figure 3



Mean Annual Value for VMS

Series / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579

No Value

UK Continental Shelf

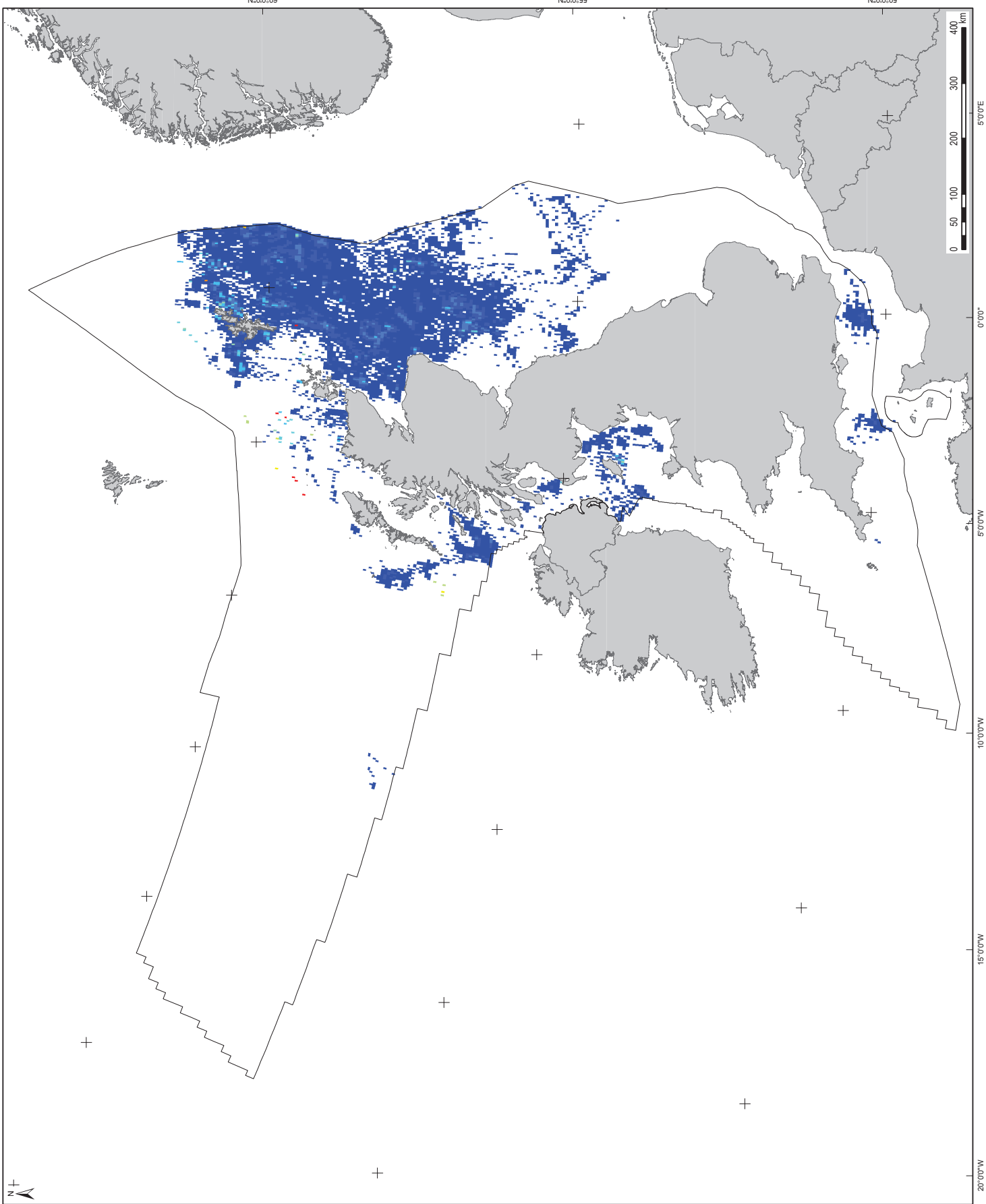
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar/09	PAR	A3	1
WGS84 UTM31N			
Projection		Scale	1:6,500,000
OA		DD	
3795 Fig. VMS, Series, Ann. Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEFRAS, FRS and MFA			



Mean Annual Value for VMS Series

Figure 4



Mean Annual Value for VMS

Traps / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579

No Value

UK Continental Shelf

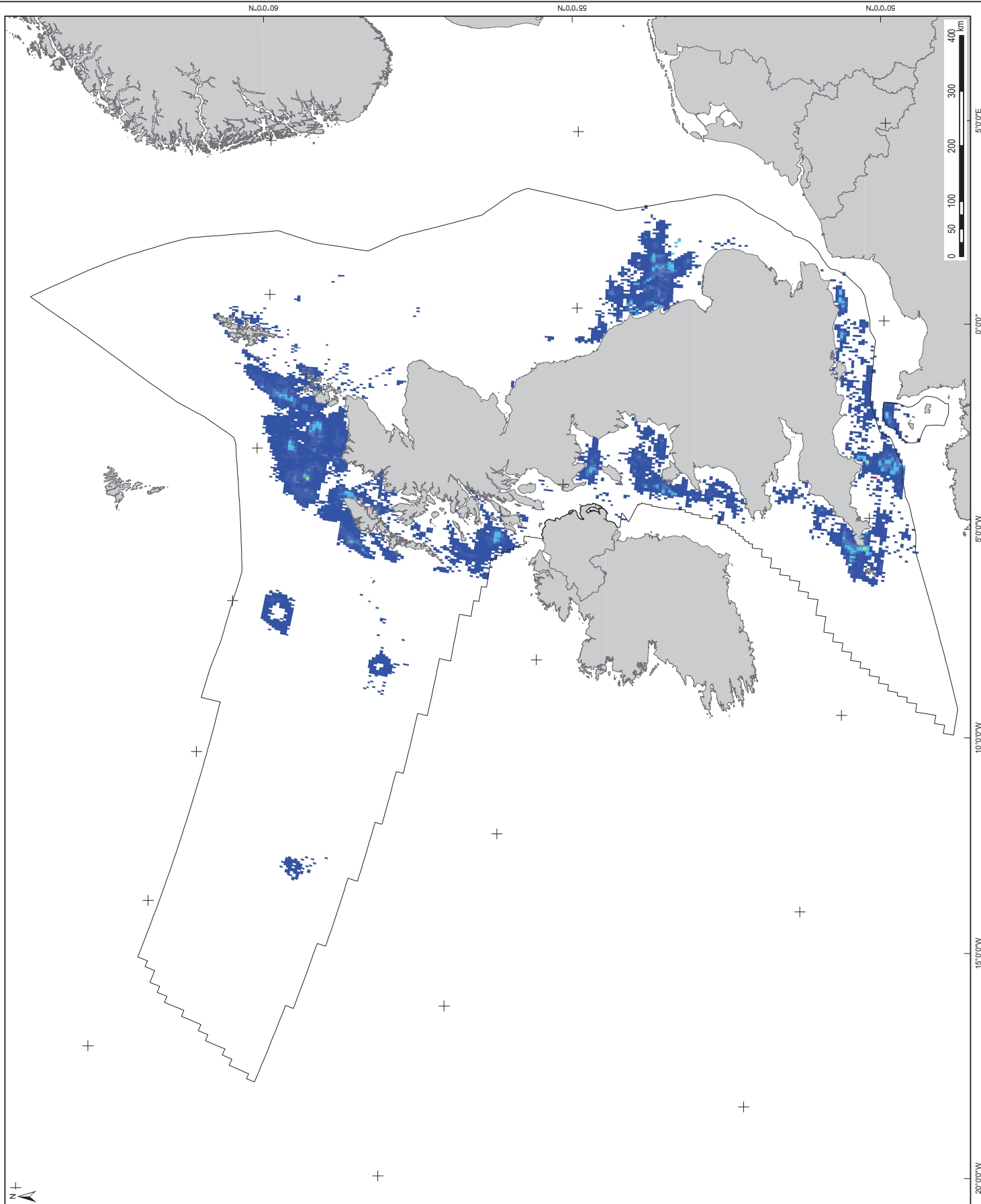
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar 09	PAR	A3	1
WGS1984 UTM31N			
Projection		Scale	1:6,500,000
OA		DD	
3795-Fig_VMS_Traps_Ann_Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEFRAS, FRS and MFA			



Mean Annual Value for VMS Traps

Figure 5



Mean Annual Value for VMS

- Trawls / £
- 1 - 2,000
 - 2,001 - 5,000
 - 5,001 - 10,000
 - 10,001 - 20,000
 - 20,001 - 30,000
 - 30,001 - 40,000
 - 40,001 - 50,000
 - 50,001 - 60,000
 - 60,001 - 70,000
 - 70,001 - 80,000
 - 80,001 - 90,000
 - 90,001 - 100,000
 - 100,001 - 364,579
 - No Value
 - UK Continental Shelf

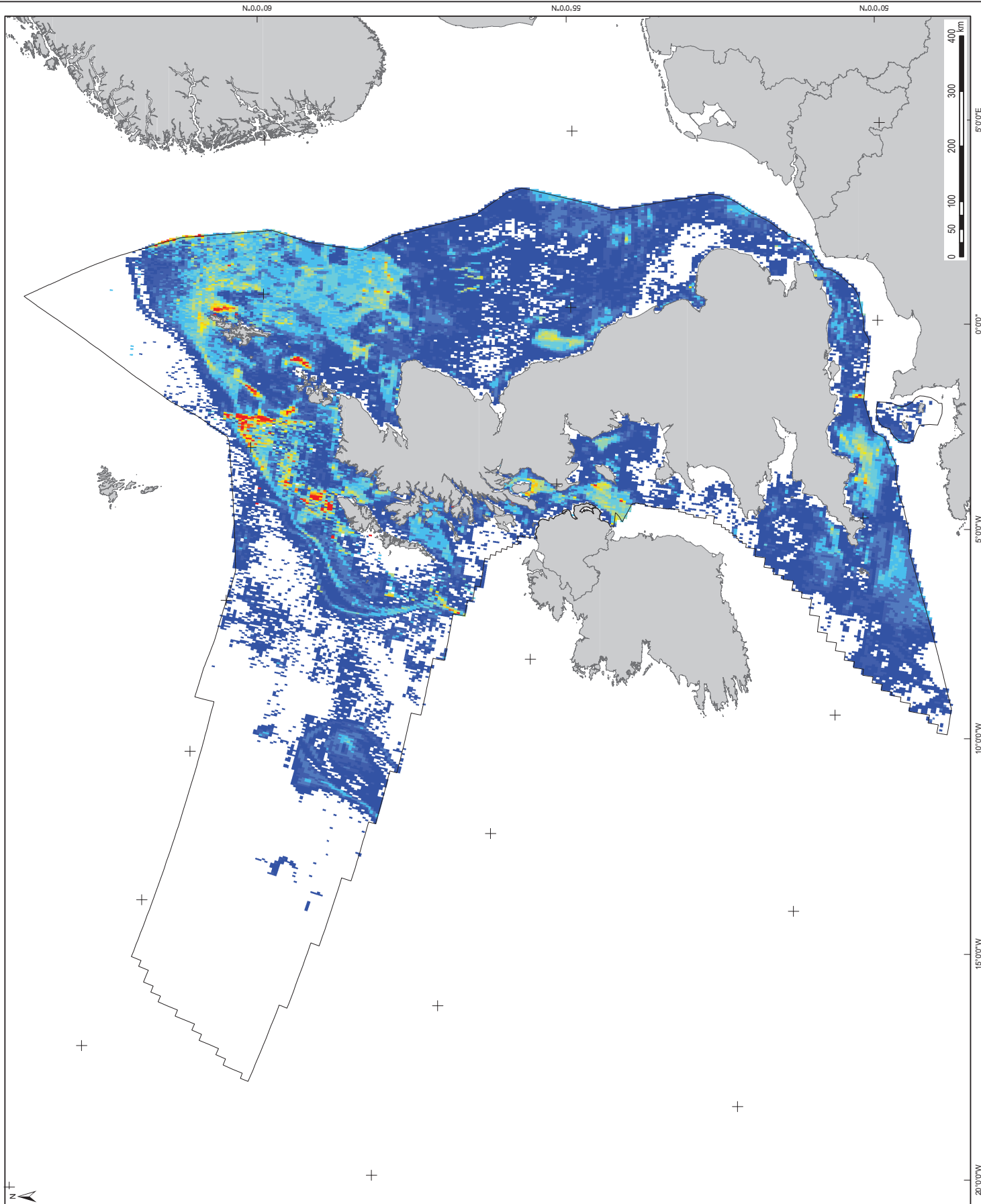
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar 09	PAR	A3	1
WGS84 UTM31N			
Projection		Scale	1:6,500,000
OA		DD	
3795 Fig_VMS_Trawls_Ann_Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEFRAS, FRS and MFA			



Mean Annual Value for VMS Trawls

Figure 6



Mean Annual Value for VMS -
All Gear Classes / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579
- No Value
- UK Continental Shelf

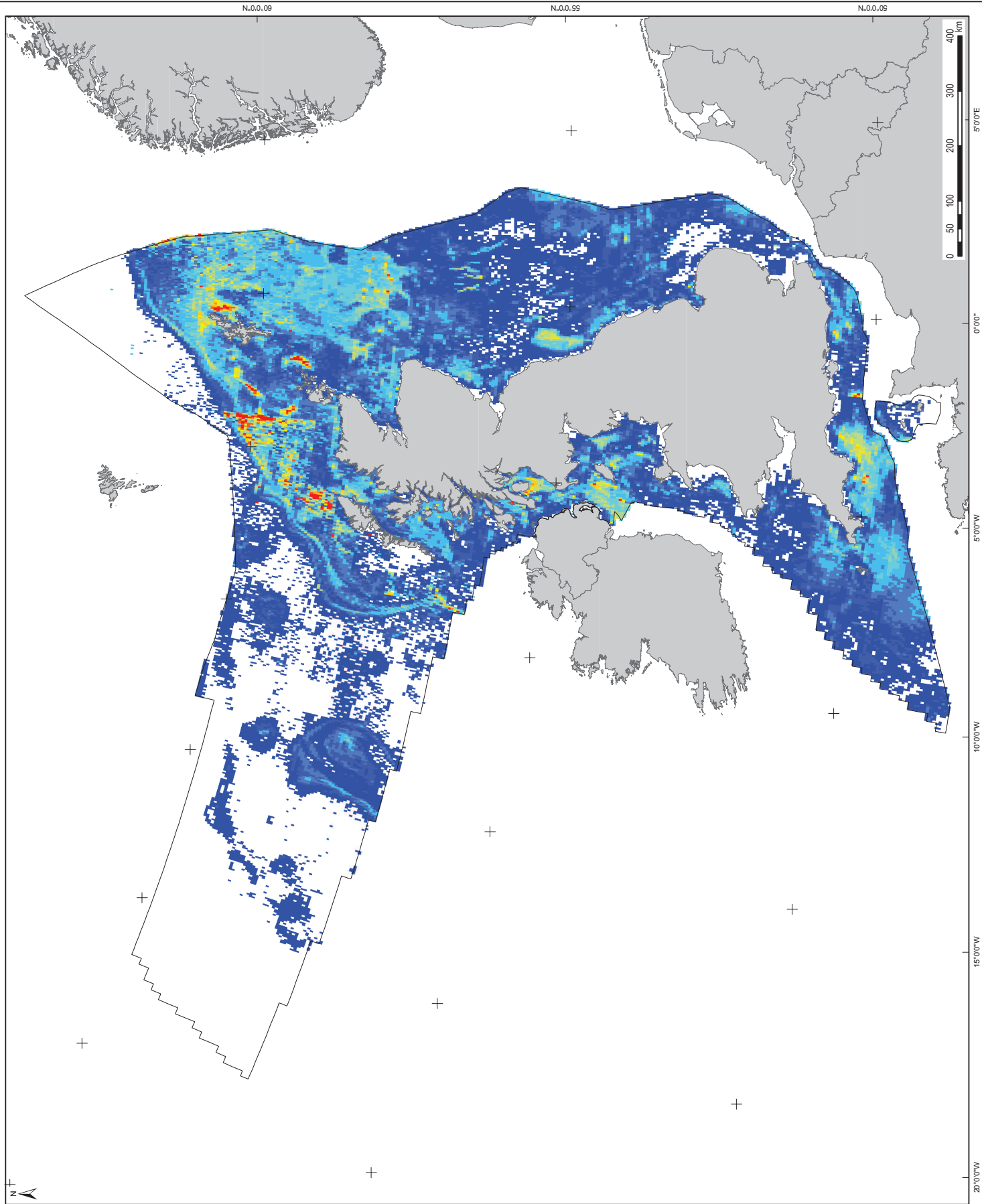
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar 09	PAR	A3	1
WGS1984 UTM31N			
Projection			
Scale			
1:6,500,000			
OA			
DD			
3795-Fig_VMS_Ind_GearClasses			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEFRAS, FRS and MFA			



Mean Annual Value
for VMS - All Gear Classes

Figure 7



Mean Annual Value for NON-VMS
Dredges / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579
- No Value
- UK Continental Shelf

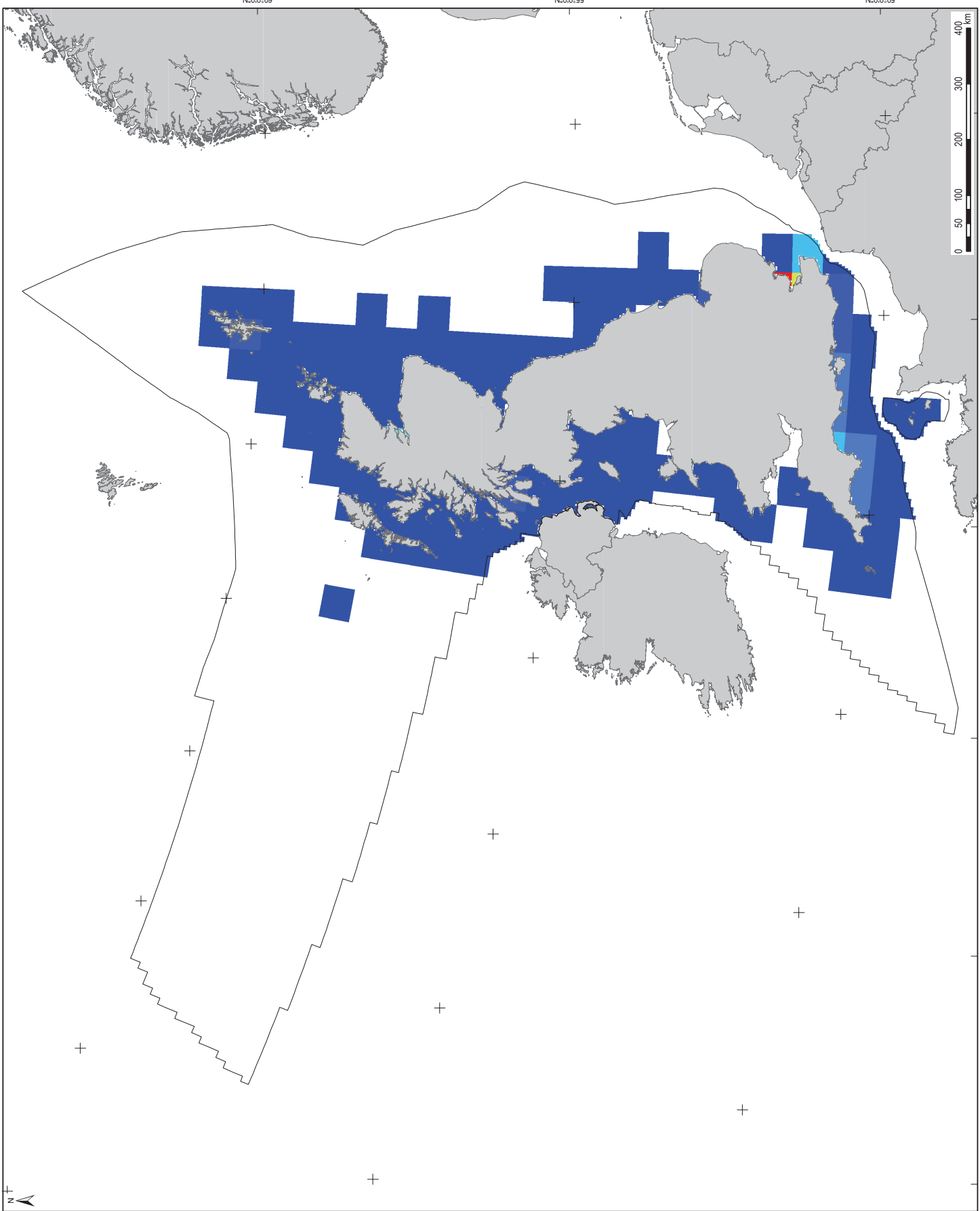
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar 09	PAR	A3	1
WGS84 UTM31N			
Projection		Scale	
		1:6,500,000	
OA		DD	
3785-FI-VMS-Dredges_Am_Main			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEFRAS, FRS and MFA			



Mean Annual Value
for Non-VMS Dredges

Figure 8



Mean Annual Value for NON-VMS Hooks and Lines /£

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579
- No Value
- UK Continental Shelf

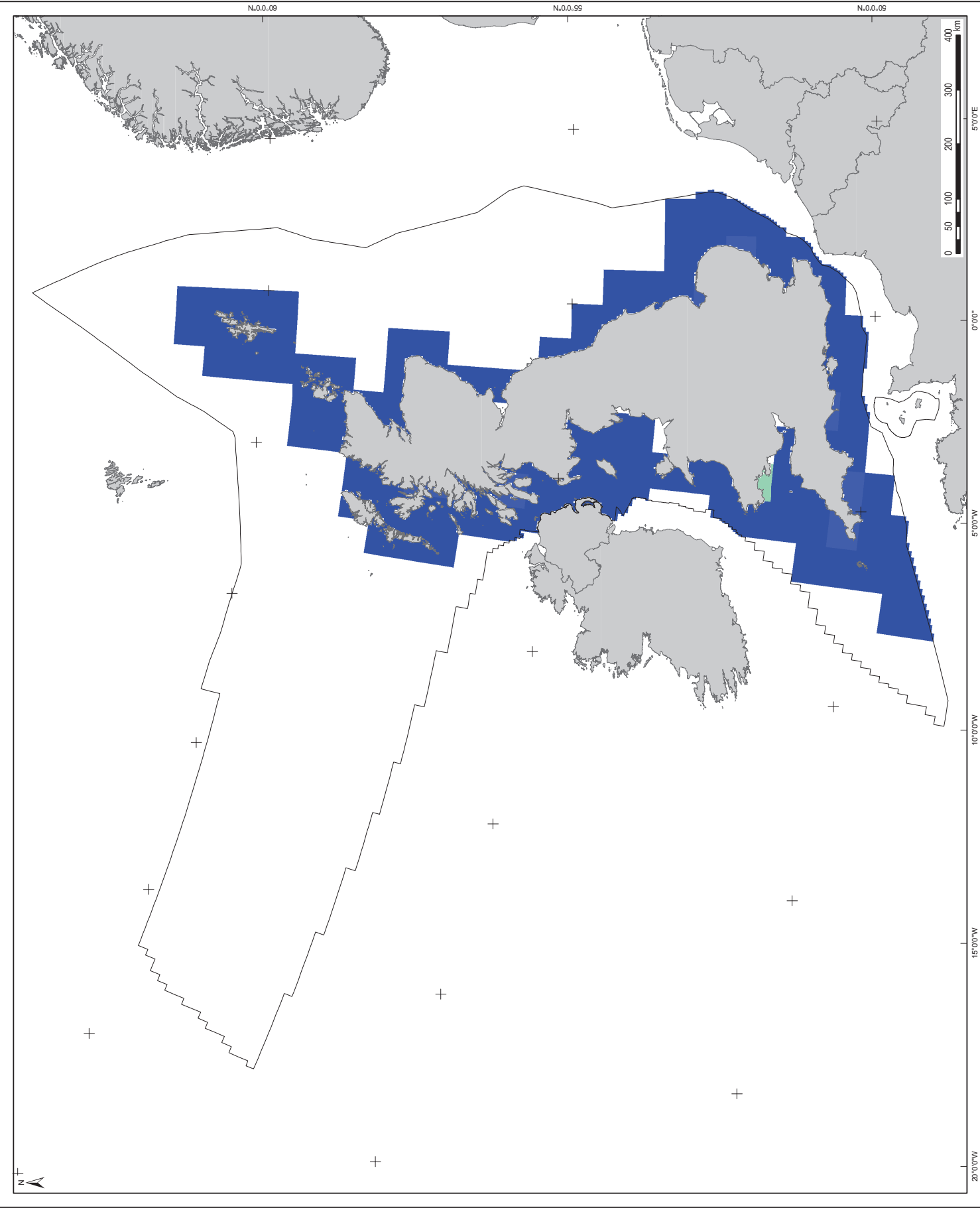
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar'09	DD	A3	1
WGS84 UTM31N			
Projection		Scale	1:6,500,000
QA		DD	DD
3795-Fig. VMS Hooks and Lines			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEPAS, IRS and MFA			



Mean Annual Value for Non-VMS Hooks and Lines

Figure 9



Mean Annual Value for NON-VMS

Nets / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579
- No Value
- UK Continental Shelf

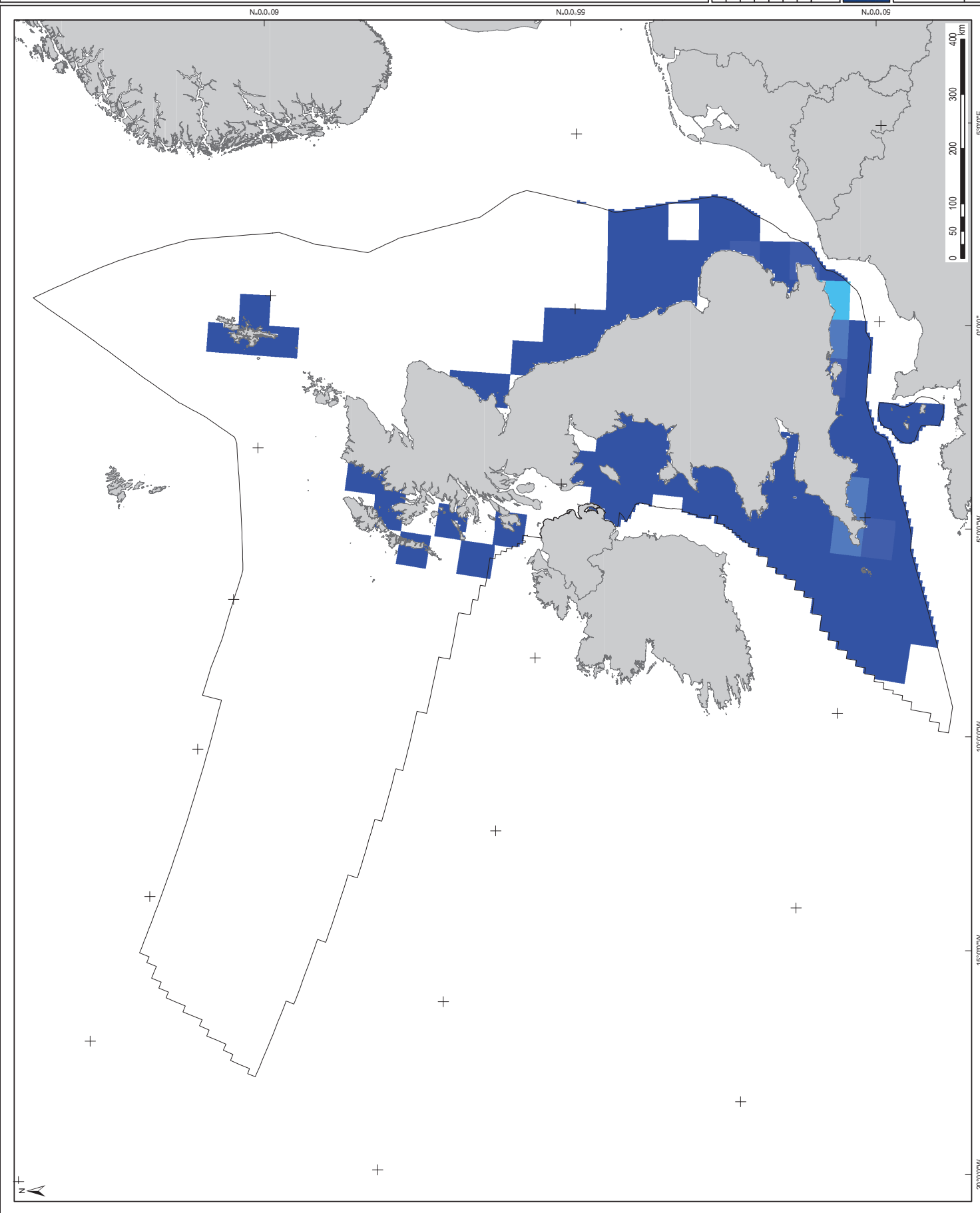
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar'09	PAR	A3	1
WGS84 UTM31N			
Projection			
Scale 1:6,500,000			
Scale			
OA DD			
3795Fig.NVMS_Met_Ann_Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEPAS, FRS and MFA			



Mean Annual Value for Non-VMS Nets

Figure 10



Mean Annual Value for NON-VMS Seines / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579
- No Value
- UK Continental Shelf

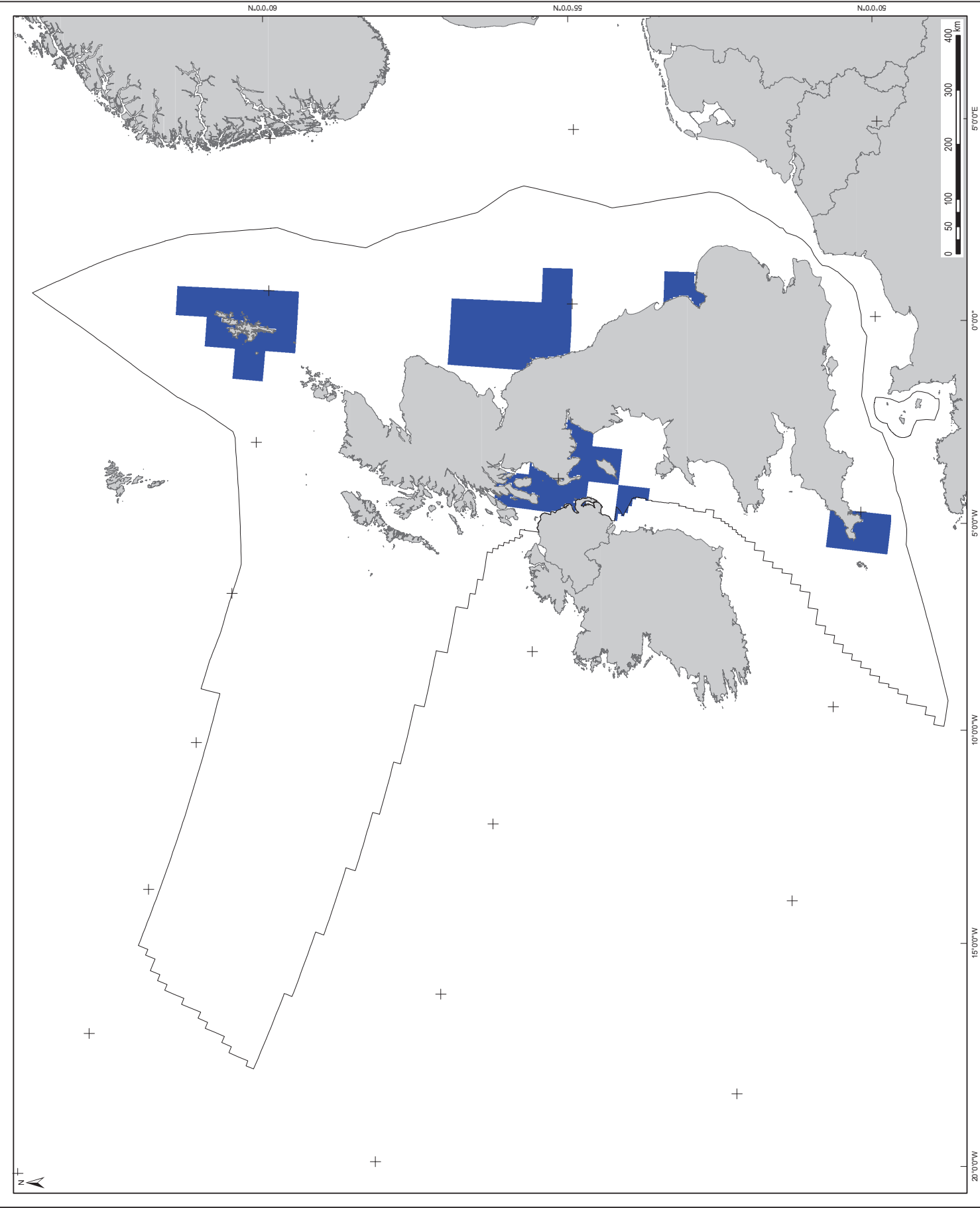
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar 09	PAR	A3	1
Projection: WGS84 UTM31N			
Scale: 1:6,500,000			
OA: DD			
3795-FG-VMS Seines_Ann_Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEPAS, FRS and MFA			



Mean Annual Value for Non-VMS Seines

Figure 11



Mean Annual Value for NON-VMS

Traps / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579
- No Value
- UK Continental Shelf

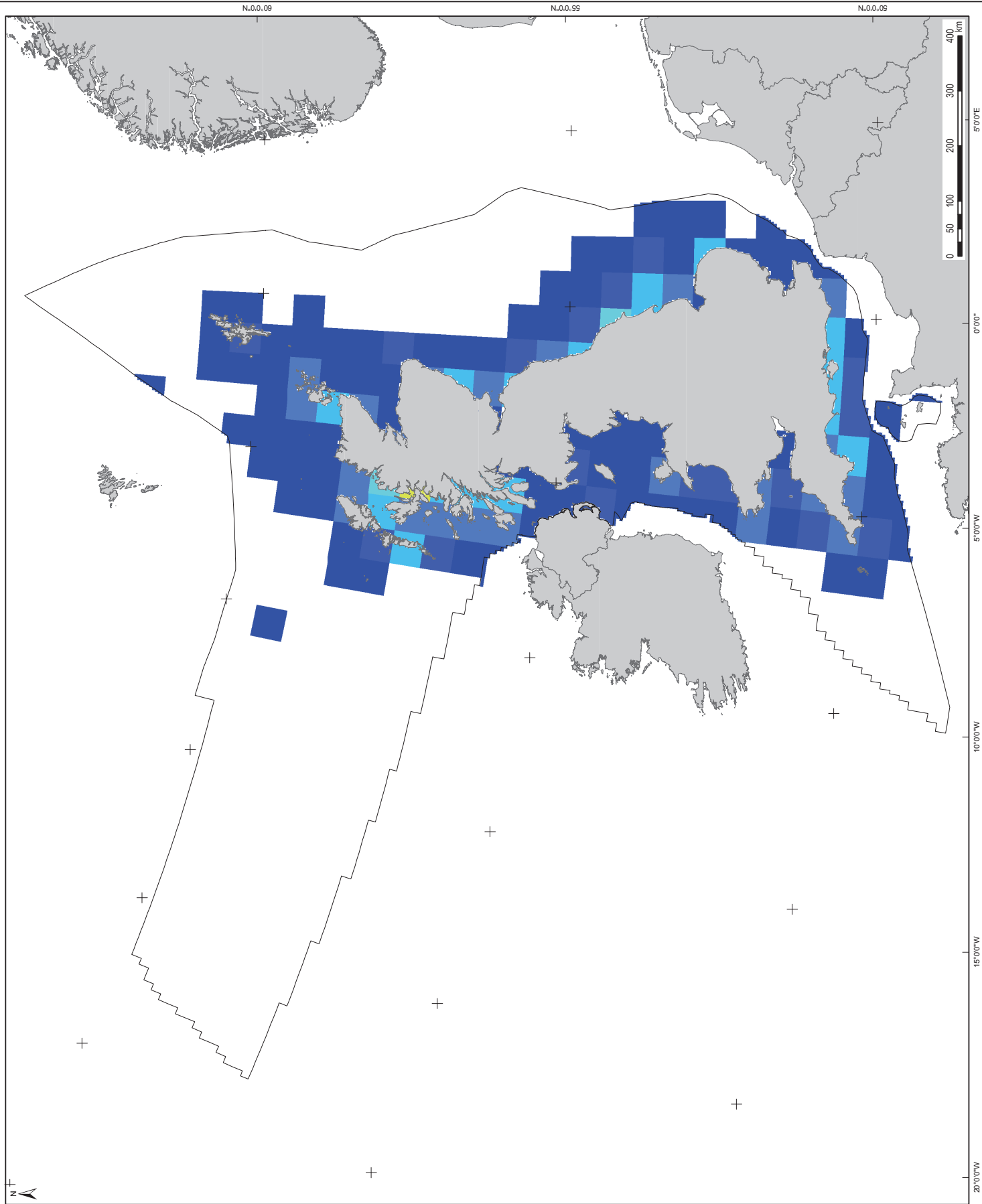
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar 09	PAR	A3	1
WGS84 UTM31N			
Projection		Scale	1:6,500,000
OA		DD	
3795-Fig. NIMS Traps Ann. Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEFAAS, FRS and MFA			



Mean Annual Value for Non-VMS Traps

Figure 12



Mean Annual Value for NON-VMS
Trawls / £

- 1,430 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579
- No Value
- UK Continental Shelf

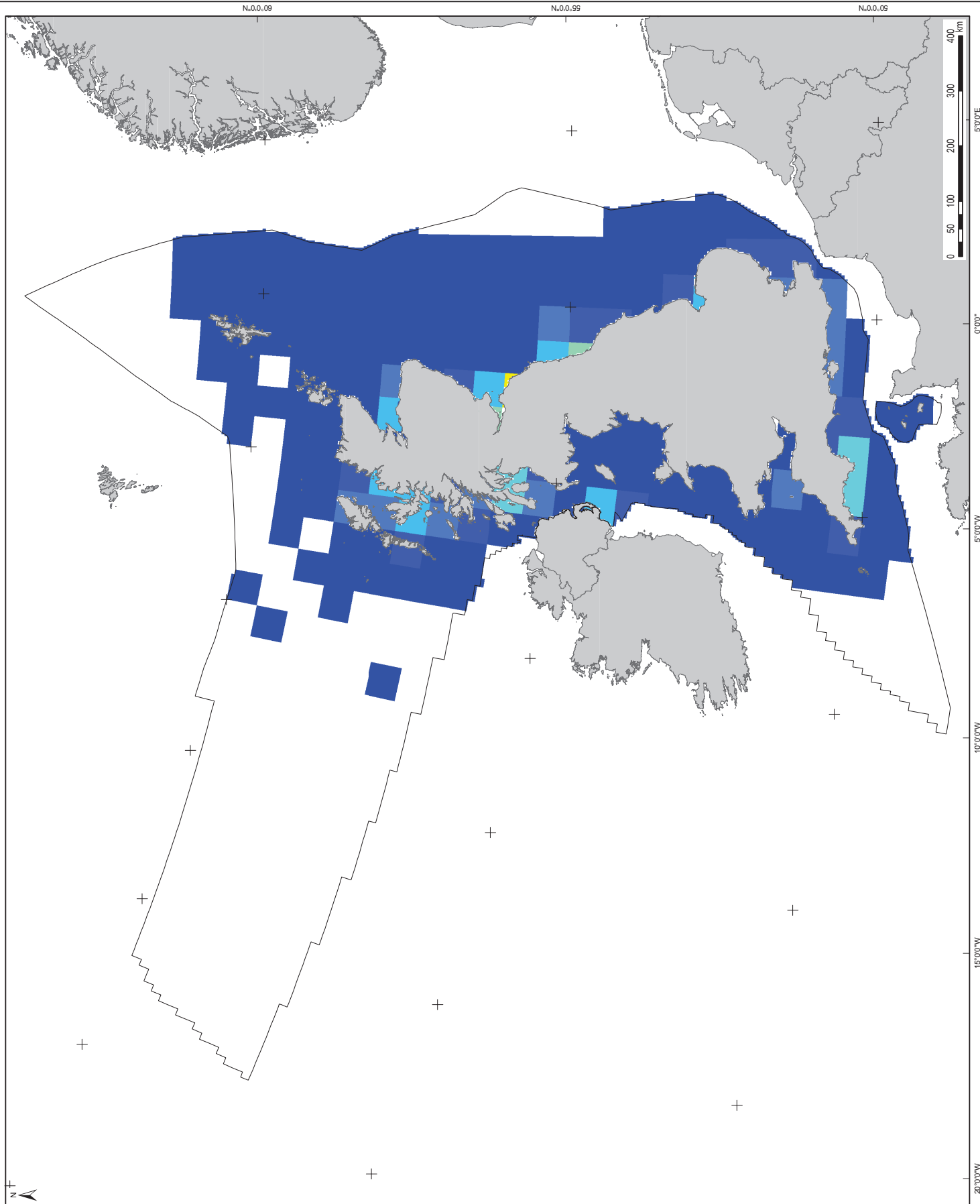
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar 09	PAR	A3	1
WGS84 UTM31N			
Projection		Scale	
OA		DD	
3785-Fig_VMS_Trawls_Ann_Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEPAS, FRS and MFA			



Mean Annual Value for
Non-VMS Trawls

Figure 13



Mean Annual Value for NON-VMS
All Gear Classes / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579
- No Value
- UK Continental Shelf

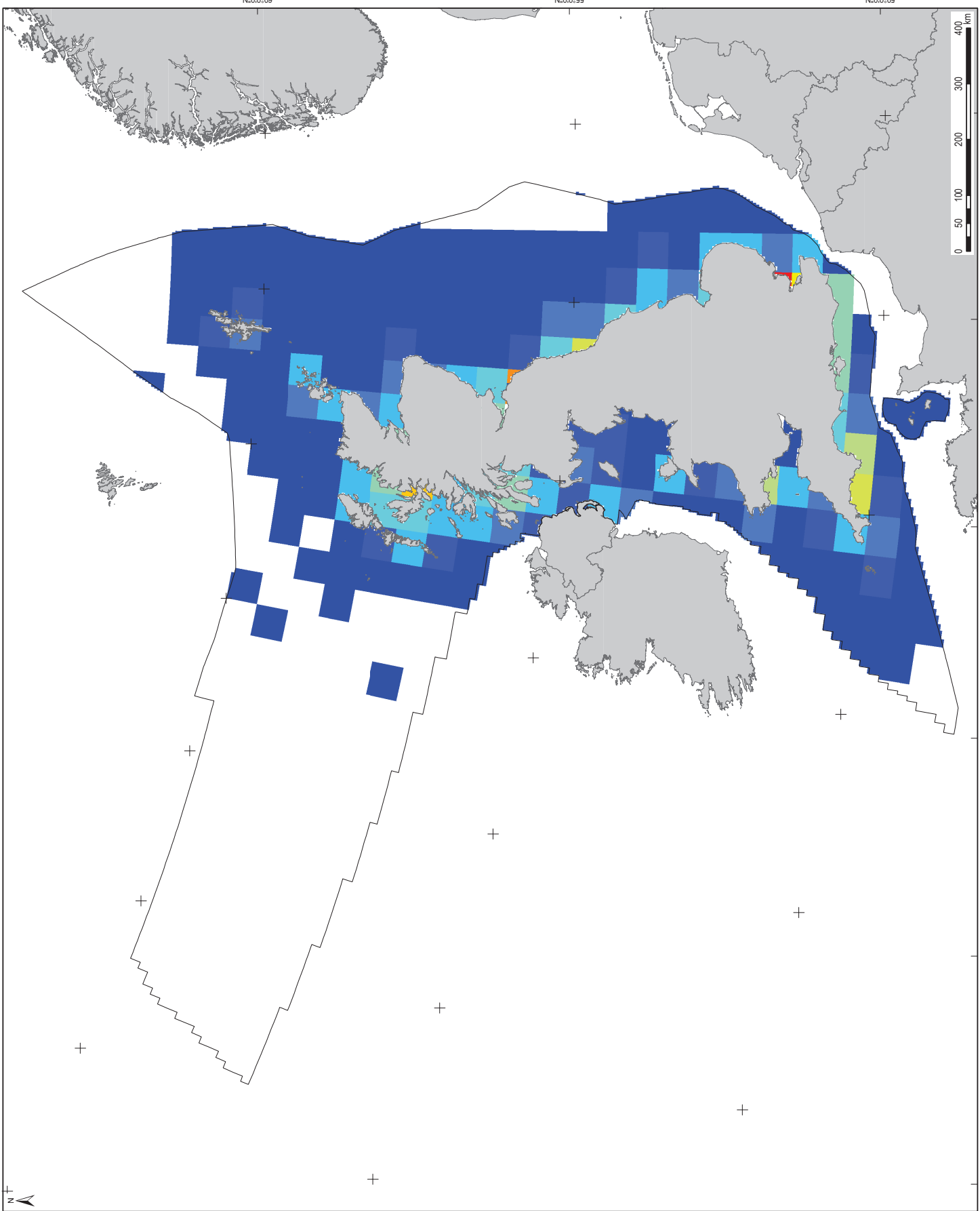
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar/09	PAR	A3	1
WGS84 UTM31N			
Projection		Scale	
		1:6,500,000	
OA		DD	
3795-Fish VMS - Total Gear Classes			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEPAS, FRS and MFA			



Mean Annual Value for
Non-VMS - All Gear Classes

Figure 14



Mean Annual Value for Combined VMS and NON-VMS - All Gear Classes / £

- 1 - 2,000
- 2,001 - 5,000
- 5,001 - 10,000
- 10,001 - 20,000
- 20,001 - 30,000
- 30,001 - 40,000
- 40,001 - 50,000
- 50,001 - 60,000
- 60,001 - 70,000
- 70,001 - 80,000
- 80,001 - 90,000
- 90,001 - 100,000
- 100,001 - 364,579
- No Value
- UK Continental Shelf

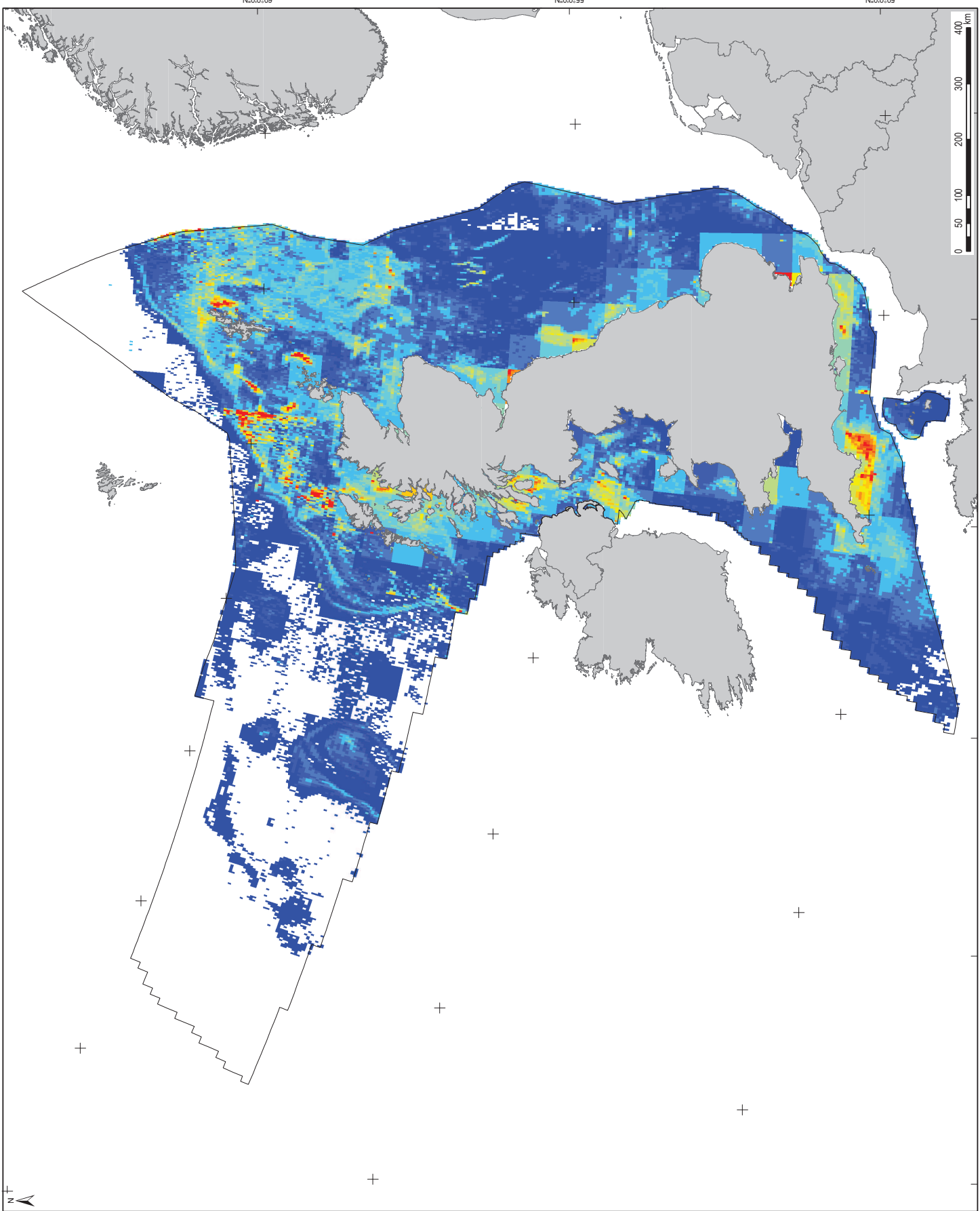
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar 09	PAR	A3	1
WGS84 UTM31N			
Projection			
Scale 1:6,500,000			
Scale			
OA			
DD			
3795 - Fig_COMB_Ann_Mean.mxd			
Produced by ABPmer Ltd			
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Data Sources: CEPAS, FRS and MFA			



Mean Annual Value for Combined VMS & Non-VMS - All Gear Classes

Figure 15



Fishing Effort for Foreign Vessels
in UK waters for 2006/07 /

Hours Fished

- 1 - 50
- 51 - 125
- 126 - 250
- 251 - 375
- 376 - 500
- 501 - 625
- 626 - 750
- 751 - 950
- 951 - 1,100
- 1,101 - 1,250
- 1,251 - 1,500
- 1,501 - 2,000
- 2,001 - 3,286

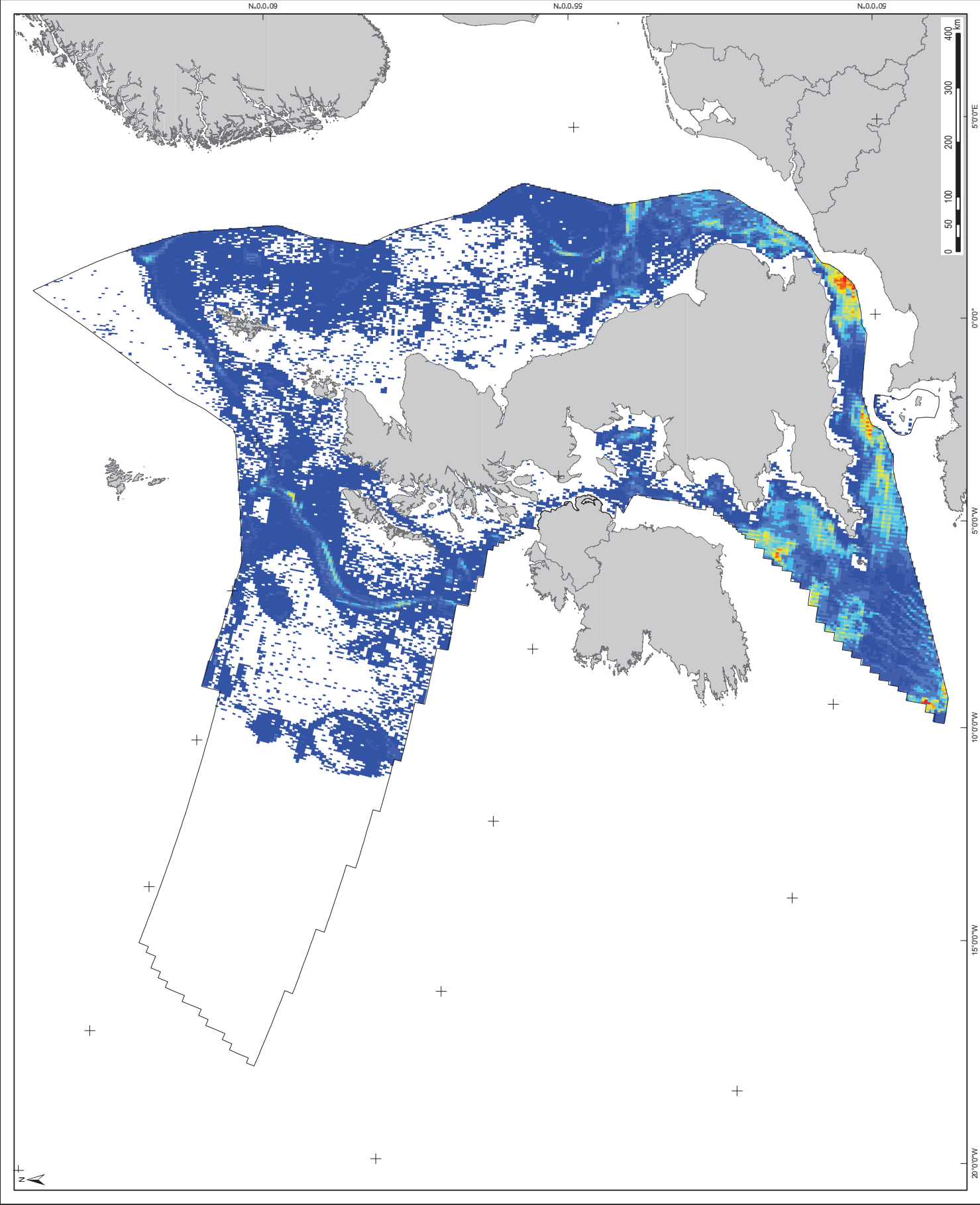
- No Effort
- UK Continental Shelf

Date	By	Size	Version
Mar 09	PAR	A3	1
WGS84 UTM31N			
Projection			
Scale 1:6,500,000			
OA			
DD			
3795 Fig. VMS, Trawls, Ann. Mean			
Produced by ABPmer Ltd			
© ABPmer. All rights reserved, 2009			
Data Sources: CEFAAS			

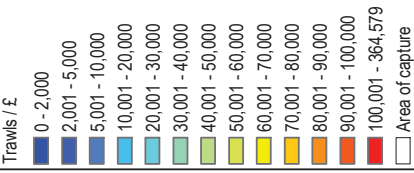


Fishing Effort from Foreign
Vessels (VMS) within UK
Waters for 2006-07

Figure 16



Mean Annual Value for VMS
Trawls / £



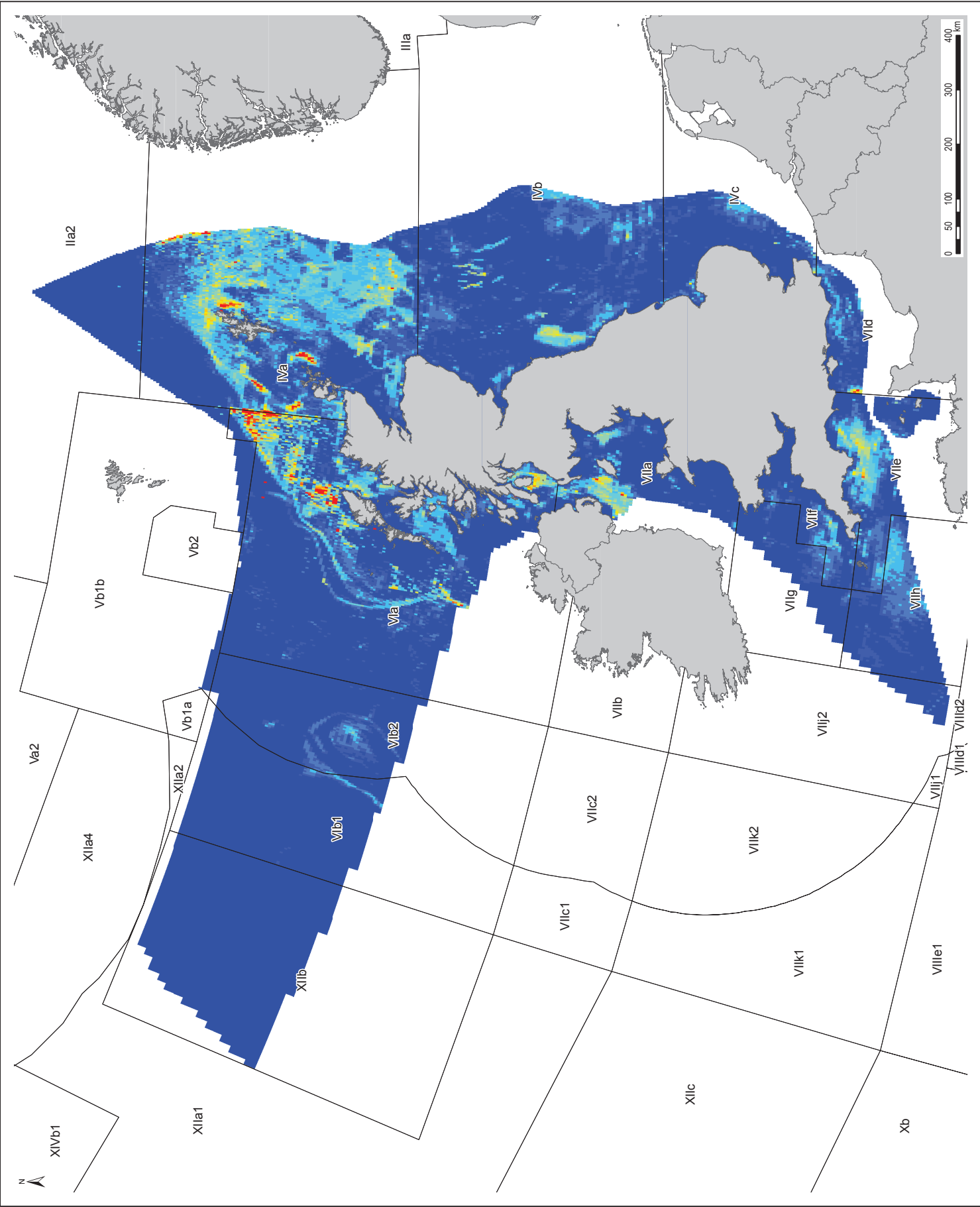
The Fish Value is a value per unit area. The unit area is equal to 0.05 degrees Longitude by 0.05 degrees Latitude.

Date	By	Size	Version
Mar'09	DD	A3	1
WGS84 UTM31N			
Projection			
Scale 1:6,500,000			
Scale			
OA DD			
3795-Fig_VMS_Mapsorting			
Produced by ABPmer Ltd			
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Data Sources: CEFAAS, IRS and MFA			



Fish Value in relation to
Area of Capture

Figure 17



APPENDIX A - VMS Analysis Methods

VMS Analysis Methods Jan09
Andy South & Janette Lee
Cefas, Lowestoft
05/01/09

Methods to estimate the spatial distribution of fishing from Vessel Monitoring System (VMS) data

Final Technical note for ABPmer Fishing Pressure Layers (contract c3353)

EC legislation in 2000 introduced a Vessel Monitoring System (VMS) that requires fishing vessels over a certain size to transmit their location at regular, typically 2 hour, time intervals. The primary purpose of this system is for operational enforcement, but the data are also stored and can be used to estimate the spatial distribution of fishing activity at a finer scale than is possible from other data sources.

The VMS data are stored in a single database table containing the coordinates of each point, the vessel identifier, the time, speed and heading. There is no gear, time interval or trip identifier within the data.

Analysing these VMS data to estimate spatial patterns of fishing activity requires a number of steps:

- 1) Cleaning the data to remove errors and duplicates
- 2) Removing locations obviously in port
- 3) Calculating the time interval between locations
- 4) Establishing the fishing gear being used
- 5) Differentiating, where possible, between fishing and steaming
- 6) Converting point locations to a spatial estimate of the density of fishing activity over an area

In the first two steps, duplicate points (for the same vessel, time and location) and those within approximately three nautical miles of recorded port locations are removed. Next, the time interval between locations is calculated (although this is usually 2 hours, there are times when locations are recorded more frequently). If the time to the preceding location is greater than 4 hours the interval is set at 2 hours and the location is classified as indicating the first location in a new trip.

Step 4 establishes the fishing gear used by linking the VMS data to UK landings logbook data by means of vessel identifier and time. If no gear is recorded in the landings database then the primary gear for that vessel is extracted from the European vessel register. Gear codes used are equivalent to the Metier Level 4 from the EU Data Collection Regulations (e.g. DRB for boat dredge and TBB for beam trawl).

Previous research work in Cefas and elsewhere (e.g. Mills et al. 2007, Fock 2008) has identified that, for trawl gears, simple speed rules can be used to classify whether a particular VMS location is associated with fishing or steaming activity. For simplicity and repeatability we used a single speed rule, classing all points with a speed of less than or equal to six knots as fishing across all gears.

To convert the VMS locations to an estimate of the spatial distribution of fishing activity, a 0.05 degree grid (each cell having an area ranging from approximately 21km² at 48°N to approximately 14km² at 64°N) was laid over the point data. The grid was based upon units of latitude and longitude so that the cells would fit exactly within the ICES rectangles used for the reporting of fish landings (200 per rectangle). Within each cell the time intervals associated with

each VMS location were summed to arrive at an estimate of the hours fished per cell. One such layer was produced for each fishing gear (Level 4) allowing a direct linkage to the landings data which are also reported by fishing gear.

Fishing activity layers created by this method were provided to ABPmer as grid ascii files by gear for the years 2004 -7 to allow further linking to landings data to estimate fishing value.

Disclaimer

The following disclaimer needs to be attached to any outputs:

VMS data were provided by the UK's Department for Environment, Food and Rural Affairs (Defra) 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.

References

- Fock, H. 2008. Fisheries in the context of marine spatial planning: Defining principal areas for fisheries in the German EEZ. *Marine Policy* 32 (4), pp. 728-739
- Mills, C.M., Townsend, S.E., Jennings, S., Eastwood, P.D., Houghton, C.A., 2007. Estimating high resolution trawl fishing effort from satellite-based vessel monitoring system data. *ICES Journal of Marine Science* 64, 248-255.
- Stelzenmüller, V., Rogers, S.I., Mills, C.M., 2008. Spatio-temporal patterns of fishing pressure on UK marine landscapes, and their implications for spatial planning and management. *ICES Journal of Marine Science* 65, 1081-1091.

APPENDIX B - Metier Matrix for UK Waters

Gear Classes	Gear Groups	Gear type	Gear type Name
Dredges	Dredges	DRB	Boat dredge
Dredges	Dredges	HMD	Mechanised/Suction dredge
Dredges	Dredges	HMP	Pumps
Hooks and Lines	Hooks and Lines	HF	Hand Fishing
Hooks and Lines	Rods and Lines	LHP	Hand and Pole lines
Hooks and Lines	Longlines	LLD	Drifting Longlines
Hooks and Lines	Longlines	LLS	Set longlines
Hooks and Lines	Rods and Lines	LTL	Trolling lines
Hooks and Lines	Hooks and Lines	LX	Hooks and Lines (not specified)
Nets	Nets	GEN	Gillnets and entangling nets (not specified)
Nets	Nets	GN	Gillnets (not specified)
Nets	Nets	GNC	Encircling gillnets
Nets	Nets	GND	Driftnet
Nets	Nets	GNS	Set gillnet
Nets	Nets	GTN	Combined gillnets-trammel nets
Nets	Nets	GTR	Trammel net
Nets	Nets	LNP	Portable lift nets
Seines	Surrounding Nets	PS	Purse seine
Seines	Seines	SB	Beach and boat seine
Seines	Seines	SSC	Fly shooting seine
Seines	Seines	SX	Seine nets (not specified)
Traps	Traps	FIX	Traps (not specified)
Traps	Traps	FPO	Pots and Traps
Traps	Traps	FYK	Fyke nets
Trawls	Pelagic or Bottom Trawls	OT	Otter trawls (not specified)
Trawls	Bottom Trawls	OTB	Bottom otter trawl
Trawls	Pelagic Trawls	OTM	Midwater otter trawl
Trawls	Bottom Trawls	OTT	Multi-rig otter trawl
Trawls	Bottom Trawls	PTB	Bottom pair trawl
Trawls	Pelagic Trawls	PTM	Pelagic pair trawl
Trawls	Bottom Trawls	TBB	Beam trawl
Trawls	Bottom Trawls	TBN	Nephrops trawls
Trawls	Pelagic Trawls	TM	Midwater Trawls (not specified)
Trawls	Pelagic or Bottom Trawls	TX	Other trawls (not specified)

APPENDIX C - Calculating Fish Value

Calculating the Fish Value involves the following steps:

1. Mapping Landings Value
2. Extracting Fishing Effort data
3. Performing the Fish Value calculation
4. Summarising and Validating the data

1. Mapping Landings Value

The Landings data for 2004-2007 was provided by MFA and contained the attributes; Landings Value per Gear Code per ICES rectangle for vessel with lengths less than and equal to 10m; vessels 10-14.99m in length; vessels 15-17.99m, and those vessels greater than 18m in length.

The Landings data was classified into Non-VMS and VMS vessels according to vessel length. VMS vessels were defined as greater than 15m in length (2005-2007) and greater than 18 metres in 2004. Non-VMS is any vessel less than 15m in length for years 2005 to 2007 and less than 18m in 2004.

Using MapInfo the Landing value for each ICES rectangle was summated by Vessel class (VMS or Non-VMS) and Gear Code for each year. The summated Landings data was linked to an ICES rectangle GIS layer by performing a tabular join. The data was then converted to an ESRI shapefile to be used in ArcGIS 9.3.

In ArcGIS the mapped Landings data was split into separate shapefiles containing a value per Gear Code per year and then converted into raster grids using ESRI's Spatial Analyst extension. The cell size was set at 0.05 decimal degrees to match that of the cell size of the processed VMS data supplied by CEFAS and FRS.

2. Extracting Fishing Effort

Fishing Effort is readily available for vessels greater than 15 metres in length from the processed VMS data. Cefas and FRS provided Fishing Effort per Gear Code in the form of Raster Grids, cell size of 0.05 decimal degrees

For vessels less than 15 metres (Non-VMS) the Fishing Effort is not available in a consistent digital format, therefore it is assumed the effort is evenly dispersed throughout the marine portion of an ICES rectangle.

3. Estimated Fish Value

Fish Value Calculation

For the purposes of the study, the value of declared landings within an ICES rectangle is proportioned according to the Fishing Effort within that rectangle.

Value of the fishery is estimated by distributing the ICES financial value according to the intensity of fishing effort; greater effort receiving a greater financial weight. The Fish Value per unit area of sea-bed is estimated using the following formula.

For each Gear Code:

$$\text{Fish Value} = [\text{Fishing Effort} / \text{Total Fishing Effort within ICES Rectangle}] \times \text{Landing Value per ICES Rectangle}$$

The sum of the Fishing Effort per ICES rectangle was calculated using Spatial Analyst's Zonal Statistics function.

The Fish Value calculation is performed using Spatial Analyst. All the data must be converted to raster grids before the calculation can be made.

The Fish Value was calculated for every Gear Code, except for Gear Codes without either Fishing Effort or Landing Value data. These were excluded.

After the Fish Value was calculated per Gear Code the grid was then combined with a zero value grid covering the extent of UK waters. This provided the extent of the data for summarisation purposes.

4. Summarising and validating the data

To collate the data, the Fish Value grids for each Gear Code were extracted using an independent ArcGIS extension. This tool extracts the value of each grid cell into a single attribute table for VMS and Non-VMS data for each year.

The attribute table from the process above was imported into a MS Access database where values per Gear Code were summarised for output into Value Gear Classes (Level 2) of the Metier Matrix into Dredges, Hooks and Lines, Nets, Seines, Traps and Trawls.

Within the MS Access database the data was summarised for final output into the following:

- Value per Gear Code was summated into Value per Gear Class (Level 4 Metier Matrix) for both VMS and Non-VMS Fish Value.
- Combined VMS and Non-VMS to create an annual Fish Value
- Calculate the mean value for years 2004-2007
- A database link within ArcMap, to link the data back to a GIS vector layer.
- Validation of data – comparisons – estimated fish value vs. MFA landings value for each Gear Code per year

APPENDIX D – Calculated Fish Value 2004-2007

Calculated for All Gear Codes within UK Waters from 2004-2007

YEAR	CLASS	GEARCODE	LANDING VALUE	CODE	FISH VALUE	LOSS	% of LANDING VALUE
2004	vms	DRB	£10,014,452.33	DRB	£9,633,096.50	£381,355.83	3.81%
2004	vms	FIX	£42,940.64	FIX	£20,016.17	£22,924.47	53.39%
2004	vms	FPO	£6,445,018.13	FPO	£4,062,553.88	£2,382,464.25	36.97%
2004	vms	GEN	£413,089.37	GEN	£271,678.96	£141,410.41	34.23%
2004	vms	GN	£1,090,240.42	GN	£791,387.64	£298,852.78	27.41%
2004	vms	GNS	£4,723,948.66	GNS	£4,153,767.57	£570,181.09	12.07%
2004	vms	GTR	£27,009.97	GTR	£26,244.64	£765.33	2.83%
2004	vms	HMD	£9,451,833.25	HMD	£8,563,606.93	£888,226.32	9.40%
2004	vms	LL	£1,418,579.98	LL	£1,260,792.49	£157,787.49	11.12%
2004	vms	LLS	£2,006,463.24	LLS	£1,983,551.79	£22,911.45	1.14%
2004	vms	OT	£3,787,519.90	OT	£2,571,783.01	£1,215,736.89	32.10%
2004	vms	OTB	£69,045,445.45	OTB	£66,575,151.94	£2,470,293.51	3.58%
2004	vms	OTT	£10,619,930.32	OTT	£9,606,889.74	£1,013,040.58	9.54%
2004	vms	PS	£5,001,348.00		£4,740,087.90	£261,260.10	5.22%
2004	vms	PTB	£12,286,947.96	PTB	£10,211,803.68	£2,075,144.28	16.89%
2004	vms	PTM	£25,637,183.98	PTM	£24,506,421.34	£1,130,762.64	4.41%
2004	vms	SSC	£9,517,046.31	SSC	£8,007,401.34	£1,509,644.97	15.86%
2004	vms	TBB	£38,697,000.41	TBB	£33,057,963.92	£5,639,036.49	14.57%
2004	vms	TBN	£7,754,982.26	TBN	£5,599,534.19	£2,155,448.07	27.79%
2004	vms	TM	£63,336,177.62	TM	£59,988,426.43	£3,347,751.19	5.29%
2004	vms	HF	£2,835.00			£2,835.00	100.00%
2004	vms	LHP	£105.68			£105.68	100.00%
2004	vms	NA	£1,714,862.33			£1,714,862.33	100.00%
2004	vms	SX	£4,993.00			£4,993.00	100.00%
2004	vms	TB	£6,882.00			£6,882.00	100.00%
Total			£283,046,836.21		£255,632,160.06	£27,414,676.15	9.69%

YEAR	CLASS	GEARCODE	LANDING VALUE	CODE	FISH VALUE	LOSS	% of LANDING VALUE
2004	non-vms	DRB	£8,859,432.09	DRB	£9,003,160.00	-£143,727.91	-1.62%
2004	non-vms	FIX	£624,162.67	FIX	£631,735.00	-£7,572.33	-1.21%
2004	non-vms	FPO	£48,479,906.99	FPO	£48,893,500.00	-£413,593.01	-0.85%
2004	non-vms	FYK	£15,979.18	FYK	£15,779.50	£199.68	1.25%
2004	non-vms	GEN	£819,874.09	GEN	£820,924.00	-£1,049.91	-0.13%
2004	non-vms	GN	£4,070,750.55	GN	£4,092,080.00	-£21,329.45	-0.52%
2004	non-vms	GNC	£89,260.96	GNC	£90,470.50	-£1,209.54	-1.36%
2004	non-vms	GND	£511,510.94	GND	£512,857.00	-£1,346.06	-0.26%
2004	non-vms	GNS	£3,547,584.23	GNS	£3,551,180.00	-£3,595.77	-0.10%
2004	non-vms	GTN	£2,702.74	GTN	£2,702.74	£0.00	0.00%
2004	non-vms	GTR	£915,455.30	GTR	£917,816.00	-£2,360.70	-0.26%
2004	non-vms	HF	£2,529,787.35	HF	£2,560,830.00	-£31,042.65	-1.23%
2004	non-vms	HMD	£15,075,876.78	HMD	£15,158,100.00	-£82,223.22	-0.55%
2004	non-vms	HMP	£50,116.80	HMP	£50,483.90	-£367.10	-0.73%
2004	non-vms	LHP	£770,914.03	LHP	£772,837.00	-£1,922.97	-0.25%
2004	non-vms	LL	£649,059.23	LL	£652,601.00	-£3,541.77	-0.55%
2004	non-vms	LLS	£2,164.70	LLS	£2,177.66	-£12.96	-0.60%
2004	non-vms	LNP	£352.57	LNP	£355.28	-£2.71	-0.77%
2004	non-vms	LX	£361,314.41	LX	£364,752.00	-£3,437.59	-0.95%
2004	non-vms	OT	£10,433,357.23	OT	£10,427,200.00	£6,157.23	0.06%
2004	non-vms	OTB	£21,251,834.64	OTB	£21,423,200.00	-£171,365.36	-0.81%
2004	non-vms	OTT	£1,456,516.01	OTT	£1,460,540.00	-£4,023.99	-0.28%
2004	non-vms	PTB	£1,243,268.25	PTB	£1,239,750.00	£3,518.25	0.28%
2004	non-vms	PTM	£656,930.82	PTM	£656,306.00	£624.82	0.10%
2004	non-vms	SSC	£480,612.60	SSC	£481,511.00	-£898.40	-0.19%
2004	non-vms	TB	£2,849.32	TB	£2,902.33	-£53.01	-1.86%
2004	non-vms	TBB	£1,648,429.05	TBB	£1,664,640.00	-£16,210.95	-0.98%
2004	non-vms	TBN	£14,683,494.28	TBN	£14,827,200.00	-£143,705.72	-0.98%
2004	non-vms	TM	£767,785.26	TM	£762,069.00	£5,716.26	0.74%
2004	non-vms	TX	£5,002.00	TX	£4,996.32	£5.68	0.11%
2004	non-vms	NA	£30,515.90			£30,515.90	100.00%
Total			£140,036,800.97		£141,044,656.23	-£1,007,855.26	-0.72%

Development of spatial information layers for commercial fishing and shellfishing in UK waters to support strategic siting of offshore wind farms

YEAR	CLASS	GEARCODE	LANDING VALUE	CODE	FISH VALUE	LOSS	% of LANDING VALUE
2005	vms	DRB	£13,600,888.66	DRB	£13,522,130.41	£78,758.25	0.58%
2005	vms	FIX	£9,563.13	FIX	£9,563.13	£0.00	0.00%
2005	vms	FPO	£12,276,681.43	FPO	£11,848,482.25	£428,199.18	3.49%
2005	vms	GEN	£653,039.18	GEN	£433,373.34	£219,665.84	33.64%
2005	vms	GN	£2,100,544.75	GN	£1,573,482.32	£527,062.43	25.09%
2005	vms	GNS	£5,559,058.86	GNS	£4,926,707.29	£632,351.57	11.38%
2005	vms	GTR	£144,229.69	GTR	£139,018.70	£5,210.99	3.61%
2005	vms	HMD	£10,822,953.55	HMD	£9,810,985.93	£1,011,967.62	9.35%
2005	vms	LHP	£7,829.15	LHP	£7,829.15	£0.00	0.00%
2005	vms	LL	£2,559,244.27	LL	£2,331,087.16	£228,157.11	8.92%
2005	vms	LLS	£3,263,789.19	LLS	£3,239,641.64	£24,147.55	0.74%
2005	vms	OT	£5,725,845.12	OT	£5,002,139.40	£723,705.72	12.64%
2005	vms	OTB	£91,827,203.87	OTB	£90,406,304.74	£1,420,899.13	1.55%
2005	vms	OTT	£14,633,450.35	OTT	£14,551,046.70	£82,403.65	0.56%
2005	vms	PS	£7,715,463.00	PS	£4,584,829.99	£3,130,633.01	40.58%
2005	vms	PTB	£17,377,992.69	PTB	£15,042,776.17	£2,335,216.52	13.44%
2005	vms	PTM	£24,644,054.33	PTM	£23,373,157.47	£1,270,896.86	5.16%
2005	vms	SSC	£11,821,737.65	SSC	£10,543,405.47	£1,278,332.18	10.81%
2005	vms	SX	£79,463.33	SX	£40,659.69	£38,803.64	48.83%
2005	vms	TB	£39,714.35	TB	£26,064.35	£13,650.00	34.37%
2005	vms	TBB	£39,317,119.29	TBB	£33,336,837.89	£5,980,281.40	15.21%
2005	vms	TBN	£13,853,601.99	TBN	£13,196,223.44	£657,378.55	4.75%
2005	vms	TM	£90,033,167.42	TM	£87,732,378.31	£2,300,789.11	2.56%
2005	vms	TX	£60,427.59	TX	£60,427.59	£0.00	0.00%
2005	vms	HF	£5,243.64			£5,243.64	100.00%
2005	vms	NA	£918,455.49			£918,455.49	100.00%
2005	vms	TMS	£15,187.45			£15,187.45	100.00%
Total			£369,065,949.42		£345,738,552.53	£23,327,396.89	6.32%

YEAR	CLASS	GEARCODE	LANDING VALUE	CODE	FISH VALUE	LOSS	% of LANDING VALUE
2005	non-vms	DRB	£2,812,738.96	DRB	£2,872,550.00	£-59,811.04	-2.13%
2005	non-vms	FIX	£557,126.37	FIX	£555,203.00	£1,923.37	0.35%
2005	non-vms	FPO	£41,158,040.39	FPO	£41,569,400.00	£-411,359.61	-1.00%
2005	non-vms	FYK	£29,085.04	FYK	£28,688.60	£396.44	1.36%
2005	non-vms	GEN	£464,508.00	GEN	£466,750.00	£-2,242.00	-0.48%
2005	non-vms	GN	£3,433,965.47	GN	£3,450,340.00	£-16,374.53	-0.48%
2005	non-vms	GNC	£195,576.26	GNC	£198,214.00	£-2,637.74	-1.35%
2005	non-vms	GND	£387,663.56	GND	£390,977.00	£-3,313.44	-0.85%
2005	non-vms	GNS	£1,733,031.42	GNS	£1,734,950.00	£-1,918.58	-0.11%
2005	non-vms	GTR	£1,252,863.02	GTR	£1,254,910.00	£-2,046.98	-0.16%
2005	non-vms	HF	£7,768,186.24	HF	£7,880,810.00	£-112,623.76	-1.45%
2005	non-vms	HMD	£13,893,124.32	HMD	£14,004,000.00	£-110,875.68	-0.80%
2005	non-vms	HMP	£120,197.00	HMP	£121,077.00	£-880.00	-0.73%
2005	non-vms	LL	£462,606.51	LL	£464,804.00	£-2,197.49	-0.48%
2005	non-vms	LLS	£747.02	LLS	£752.76	£-5.74	-0.77%
2005	non-vms	LX	£270,492.74	LX	£273,425.00	£-2,932.26	-1.08%
2005	non-vms	OT	£10,307,223.65	OT	£10,313,700.00	£-6,476.35	-0.06%
2005	non-vms	OTB	£12,985,690.11	OTB	£13,115,000.00	£-129,309.89	-1.00%
2005	non-vms	OTT	£911,486.98	OTT	£910,989.00	£497.98	0.05%
2005	non-vms	PTB	£536,432.81	PTB	£534,821.00	£1,611.81	0.30%
2005	non-vms	PTM	£726,382.81	PTM	£727,383.00	£-1,000.19	-0.14%
2005	non-vms	SSC	£453.00	SSC	£449.61	£3.39	0.75%
2005	non-vms	TB	£157.48	TB	£161.12	£-3.64	-2.31%
2005	non-vms	TBB	£1,858,809.12	TBB	£1,877,330.00	£-18,520.88	-1.00%
2005	non-vms	TBN	£9,153,314.18	TBN	£9,228,650.00	£-75,335.82	-0.82%
2005	non-vms	TM	£170,563.57	TM	£168,188.00	£2,375.57	1.39%
2005	non-vms	TX	£2,567.68	TX	£2,618.63	£-50.95	-1.98%
2005	non-vms	LHP	£906,429.74	LHP	£909,961.00	£-3,531.26	-0.39%
2005	non-vms	NA	£29,976.99			£29,976.99	100.00%
Total			£112,129,440.44		£113,056,102.72	£-926,662.28	-0.83%

Development of spatial information layers for commercial fishing and shellfishing in UK waters to support strategic siting of offshore wind farms

YEAR	CLASS	GEARCODE	LANDING VALUE	CODE	FISH VALUE	LOSS	% of LANDING VALUE
2006	vms	DRB	£14,951,330.05	DRB	£14,921,560.45	£29,769.60	0.20%
2006	vms	FIX	£6,867.20	FIX	£6,867.20	£0.00	0.00%
2006	vms	FPO	£12,208,494.53	FPO	£11,946,386.87	£262,107.66	2.15%
2006	vms	GEN	£639,946.22	GEN	£462,739.27	£177,206.95	27.69%
2006	vms	GN	£1,366,309.43	GN	£1,178,992.04	£187,317.39	13.71%
2006	vms	GNC	£1,610.00	GNC	£360.00	£1,250.00	77.64%
2006	vms	GNS	£4,420,648.78	GNS	£3,998,898.84	£421,749.94	9.54%
2006	vms	GTR	£151,338.68	GTR	£137,908.38	£13,430.30	8.87%
2006	vms	HF	£3,653.34	HF	£3,653.34	£0.00	0.00%
2006	vms	HMD	£10,334,088.56	HMD	£9,391,802.33	£942,286.23	9.12%
2006	vms	LHP	£323.08	LHP	£239.08	£84.00	26.00%
2006	vms	LL	£2,088,175.26	LL	£1,946,154.94	£142,020.32	6.80%
2006	vms	LLS	£2,327,429.09	LLS	£2,306,776.40	£20,652.69	0.89%
2006	vms	OT	£8,208,520.57	OT	£7,703,540.73	£504,979.84	6.15%
2006	vms	OTB	£107,078,702.66	OTB	£105,386,993.09	£1,691,709.57	1.58%
2006	vms	OTT	£21,682,966.44	OTT	£21,412,785.70	£270,180.74	1.25%
2006	vms	PS	£6,303,452.63	PS	£3,620,567.87	£2,682,884.76	42.56%
2006	vms	PTB	£22,199,920.88	PTB	£18,683,390.56	£3,516,530.32	15.84%
2006	vms	PTM	£13,782,432.60	PTM	£11,990,818.21	£1,791,614.39	13.00%
2006	vms	SSC	£11,844,389.11	SSC	£10,375,589.57	£1,468,799.54	12.40%
2006	vms	SX	£74,076.80	SX	£62,797.39	£11,279.41	15.23%
2006	vms	TBB	£34,939,884.04	TBB	£29,248,186.82	£5,691,697.22	16.29%
2006	vms	TBN	£14,097,545.17	TBN	£12,966,298.68	£1,131,246.49	8.02%
2006	vms	TM	£85,637,999.07	TM	£82,252,504.72	£3,385,494.35	3.95%
2006	vms	TX	£64,192.80	TX	£20,424.98	£43,767.82	68.18%
2006	vms	NA	£293,570.59			£293,570.59	100.00%
Total			£374,707,867.58		£350,026,237.46	£24,681,630.12	6.59%

YEAR	CLASS	GEARCODE	LANDING VALUE	CODE	FISH VALUE	LOSS	% of LANDING VALUE
2006	non-vms	DRB	£4,651,144.54	DRB	£4,725,300.00	-£74,155.46	-1.59%
2006	non-vms	FIX	£893,868.06	FIX	£892,935.00	£933.06	0.10%
2006	non-vms	FPO	£69,178,417.72	FPO	£69,792,400.00	-£613,982.28	-0.89%
2006	non-vms	FYK	£4,833.55	FYK	£4,770.85	£62.70	1.30%
2006	non-vms	GEN	£919,283.39	GEN	£923,591.00	-£4,307.61	-0.47%
2006	non-vms	GN	£6,486,595.54	GN	£6,517,500.00	-£30,904.46	-0.48%
2006	non-vms	GNC	£248,846.04	GNC	£252,218.00	-£3,371.96	-1.36%
2006	non-vms	GND	£244,822.93	GND	£244,936.00	-£113.07	-0.05%
2006	non-vms	GNS	£982,077.00	GNS	£983,508.00	-£1,431.00	-0.15%
2006	non-vms	GTR	£632,949.84	GTR	£636,926.00	-£3,976.16	-0.63%
2006	non-vms	HF	£1,692,474.70	HF	£1,721,200.00	-£28,725.30	-1.70%
2006	non-vms	HMD	£11,788,829.33	HMD	£11,819,900.00	-£31,070.67	-0.26%
2006	non-vms	HMP	£22,615.86	HMP	£22,781.50	-£165.64	-0.73%
2006	non-vms	LHP	£1,635,878.58	LHP	£1,649,460.00	-£13,581.42	-0.83%
2006	non-vms	LL	£399,786.69	LL	£402,959.00	-£3,172.31	-0.79%
2006	non-vms	LX	£677,596.25	LX	£681,513.00	-£3,916.75	-0.58%
2006	non-vms	OT	£14,228,733.54	OT	£14,237,300.00	-£8,566.46	-0.06%
2006	non-vms	OTB	£21,738,569.16	OTB	£21,996,200.00	-£257,630.84	-1.19%
2006	non-vms	OTT	£2,031,418.13	OTT	£2,028,280.00	£3,138.13	0.15%
2006	non-vms	PS	£3,489.90	PS	£3,537.19	-£47.29	-1.36%
2006	non-vms	PTB	£696,673.19	PTB	£695,967.00	£706.19	0.10%
2006	non-vms	PTM	£300,383.73	PTM	£298,642.00	£1,741.73	0.58%
2006	non-vms	SB	£13,360.07	SB	£13,541.10	-£181.03	-1.36%
2006	non-vms	SSC	£240.00	SSC	£233.16	£6.84	2.85%
2006	non-vms	TBB	£1,842,459.56	TBB	£1,856,170.00	-£13,710.44	-0.74%
2006	non-vms	TBN	£6,716,755.66	TBN	£6,747,400.00	-£30,644.34	-0.46%
2006	non-vms	TM	£200,382.23	TM	£197,818.00	£2,564.23	1.28%
2006	non-vms	TX	£1,469.52	TX	£1,480.81	-£11.29	-0.77%
2006	non-vms	NA	£57,515.12			£57,515.12	100.00%
Total			£148,291,469.83		£149,348,467.61	-£1,056,997.78	-0.71%

Development of spatial information layers for commercial fishing and shellfishing in UK waters to support strategic siting of offshore wind farms

YEAR	CLASS	GEARCODE	LANDING VALUE	CODE	FISH VALUE	LOSS	% of LANDING VALUE
2007	vms	DRB	£15,853,478.86	DRB	£15,781,943.46	£71,535.40	0.45%
2007	vms	FIX	£320,525.32	FIX	£320,525.32	£0.00	0.00%
2007	vms	FPO	£12,847,330.64	FPO	£12,372,326.30	£475,004.34	3.70%
2007	vms	GEN	£198,616.91	GEN	£175,333.07	£23,283.84	11.72%
2007	vms	GN	£1,718,328.44	GN	£1,328,690.48	£389,637.96	22.68%
2007	vms	GND	£7,125.14	GND	£2,302.64	£4,822.50	67.68%
2007	vms	GNS	£3,670,349.21	GNS	£3,364,635.10	£305,714.11	8.33%
2007	vms	GTR	£83,809.09	GTR	£82,126.88	£1,682.21	2.01%
2007	vms	HF	£23,181.49	HF	£23,181.50	-£0.01	0.00%
2007	vms	HMD	£12,452,026.07	HMD	£10,524,692.29	£1,927,333.78	15.48%
2007	vms	LHP	£1,574.21	LHP	£1,200.28	£373.93	23.75%
2007	vms	LL	£943,939.60	LL	£663,059.32	£280,880.28	29.76%
2007	vms	LLS	£2,089,945.16	LLS	£2,060,697.57	£29,247.59	1.40%
2007	vms	OT	£8,395,596.33	OT	£7,892,687.54	£502,908.79	5.99%
2007	vms	OTB	£111,691,831.48	OTB	£109,763,632.64	£1,928,198.84	1.73%
2007	vms	OTT	£22,855,903.42	OTT	£22,784,690.02	£71,213.40	0.31%
2007	vms	PS	£1,389,532.69	PS	£873,114.08	£516,418.61	37.16%
2007	vms	PTB	£18,183,789.73	PTB	£13,256,056.44	£4,927,733.29	27.10%
2007	vms	PTM	£15,095,549.68	PTM	£14,402,267.59	£693,282.09	4.59%
2007	vms	SSC	£11,790,364.56	SSC	£10,155,326.40	£1,635,038.16	13.87%
2007	vms	TBB	£31,743,297.48	TBB	£27,721,096.92	£4,022,200.56	12.67%
2007	vms	TBN	£14,258,922.59	TBN	£13,302,567.73	£956,354.86	6.71%
2007	vms	TM	£84,588,223.43	TM	£81,655,932.70	£2,932,290.73	3.47%
2007	vms	NA	£213,900.45			£213,900.45	100.00%
Total			£370,417,141.98		£348,508,086.27	£21,909,055.71	5.91%

YEAR	CLASS	GEARCODE	LANDING VALUE	CODE	FISH VALUE	LOSS	% of LANDING VALUE
2007	non-vms	DRB	£3,400,802.79	DRB	£3,464,150.00	-£63,347.21	-1.86%
2007	non-vms	FIX	£1,331,499.44	FIX	£1,330,640.00	£859.44	0.06%
2007	non-vms	FPO	£77,790,126.87	FPO	£78,347,200.00	-£557,073.13	-0.72%
2007	non-vms	FYK	£23,331.00	FYK	£23,013.00	£318.00	1.36%
2007	non-vms	GEN	£895,925.79	GEN	£898,402.00	-£2,476.21	-0.28%
2007	non-vms	GN	£8,590,252.80	GN	£8,627,200.00	-£36,947.20	-0.43%
2007	non-vms	GNC	£642,816.22	GNC	£648,924.00	-£6,107.78	-0.95%
2007	non-vms	GND	£353,456.32	GND	£353,373.00	£83.32	0.02%
2007	non-vms	GNS	£878,531.12	GNS	£880,643.00	-£2,111.88	-0.24%
2007	non-vms	GTN	£551.79	GTN	£558.79	-£7.00	-1.27%
2007	non-vms	GTR	£207,908.64	GTR	£208,920.00	-£1,011.36	-0.49%
2007	non-vms	HF	£2,348,663.99	HF	£2,385,280.00	-£36,616.01	-1.56%
2007	non-vms	HMD	£13,600,709.59	HMD	£13,734,000.00	-£133,290.41	-0.98%
2007	non-vms	LHP	£1,607,761.93	LHP	£1,620,470.00	-£12,708.07	-0.79%
2007	non-vms	LL	£658,862.19	LL	£663,900.00	-£5,037.81	-0.76%
2007	non-vms	LX	£955,924.71	LX	£964,872.00	-£8,947.29	-0.94%
2007	non-vms	OT	£14,478,065.70	OT	£14,491,900.00	-£13,834.30	-0.10%
2007	non-vms	OTB	£25,120,218.61	OTB	£25,424,000.00	-£303,781.39	-1.21%
2007	non-vms	OTT	£2,789,455.49	OTT	£2,778,700.00	£10,755.49	0.39%
2007	non-vms	PS	£37,207.50	PS	£37,711.70	-£504.20	-1.36%
2007	non-vms	PTB	£641,391.17	PTB	£640,403.00	£988.17	0.15%
2007	non-vms	PTM	£439,126.15	PTM	£439,602.00	-£475.85	-0.11%
2007	non-vms	SB	£14,237.30	SB	£14,425.30	-£188.00	-1.32%
2007	non-vms	TBB	£3,598,361.12	TBB	£3,648,110.00	-£49,748.88	-1.38%
2007	non-vms	TBN	£5,641,442.25	TBN	£5,671,230.00	-£29,787.75	-0.53%
2007	non-vms	TM	£1,079,755.02	TM	£1,065,000.00	£14,755.02	1.37%
2007	non-vms	TX	£2,308.21	TX	£2,361.53	-£53.32	-2.31%
2007	non-vms	NA	£112,985.99			£112,985.99	100.00%
Total			£167,241,679.70		£168,364,989.32	-£1,123,309.62	-0.67%