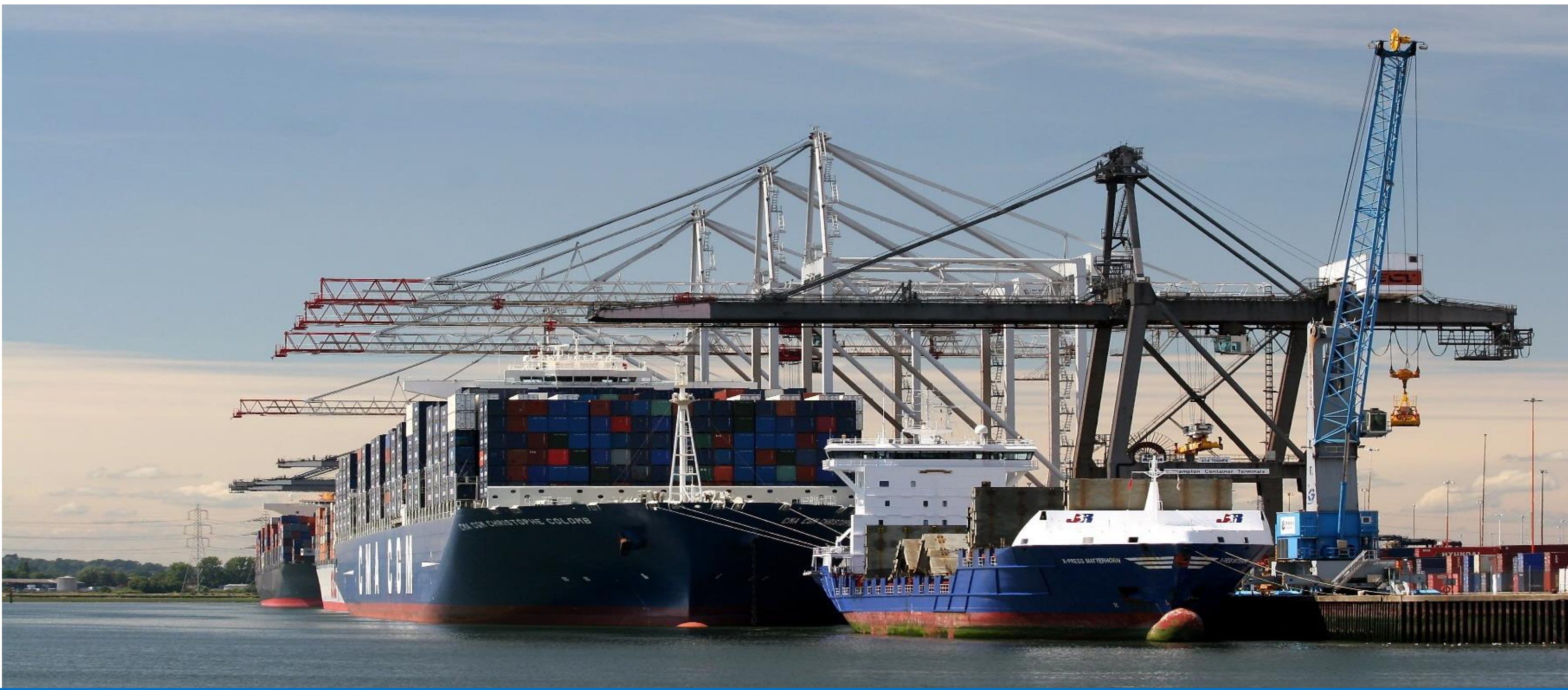
Marine Management Organisation

Mapping Shipping Cargo Value Non-Technical Summary (MMO1158)



MMO1158: Mapping Shipping Cargo Value
Non-Technical Summary

October 2019

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Executive Summary

The maritime sector plays a critical role in the growth and development of the UK as a primary facilitator of global trade. An understanding of navigation routes and trade flows is therefore important in informing planning and management of the English marine area. The Marine Management Organisation (MMO) commissioned ABPmer to deliver Project 1158, 'Mapping Shipping Cargo Value' to review, develop and apply approaches to assigning value to shipping cargo flows for use in marine plan areas, to support decision making. Information obtained from the project improves the evidence base for the development and implementation of marine plan policies thereby improving understanding of shipping cargo value associated with marine space use.

The shipping cargo values calculated as part of this project, were validated against port freight and sea passenger statistics from the major ports within the north east, south east, south west and north west marine plan areas. However, results were only presented for the north east marine plan areas, which is the case study area. The completed project also engaged with industry representatives to validate the approach used and the resulting outputs.

The outputs of this project included the mapped average weekly shipping cargo value for the case study area (i.e. the north east marine plan areas) for a range of different cargo types. The scaled average weekly shipping cargo value within the case study area ranged between less than £100k to over £1 billion pounds sterling per squared kilometre per week (£/km^2/wk.), associated with over 30,000 vessel transits. The vessels with the greatest cargo value were container vessels, pure car carriers and oil tankers.

A comparison of the mapped shipping cargo value with the AIS vessel traffic density grid showed that further detail on shipping routes is available from when cargo value was considered. Although the vessel traffic density grid was able to identify some routes, it did not identify all. Also, in the mapped shipping cargo value, it was possible to identify distinct routes, which served varying functions in terms of the cargo and value of the cargo being transported. Furthermore, the mapped shipping cargo value was able to represent relative importance of different routes based on the varying value for different cargo types across the assessed north east marine plan areas. Finally, the results demonstrated the potential significance of service craft vessels, which were beyond the scope of the present project.

1. Introduction

1.1. Background

The UK maritime sector plays a critical role in the growth and development of the country, enabling the import and export of goods and providing additional value through maritime and business services (DfT, 2019). Economic inputs into the UK from the shipping and maritime tourism and leisure industries include:

- up to 95% of British imports and exports in goods are moved by sea, including 25% of the UK's energy supply and 48% of the country's food supplies (DfT, 2018a)
- contribution from the UK ports industry amounts to approximately £9.7 billion of direct value to the UK economy (Centre for Economics and Business Research, 2019a)
- in 2017, the maritime shipping sector directly supported over £47 billion in business turnover, £17 billion in gross value added (GVA) and 220,100 jobs for UK employees (Centre for Economics and Business Research, 2019b).
- maritime business services directly contribute approximately £2 GVA to the UK economy annually (DfT, 2019)
- the total revenue from the UK's leisure, superyacht and small commercial marine industry was estimated at £3.12 billion in 2017, with exports accounting for just over 30% of the revenue (DfT, 2019)
- approximately 1.96 million cruises were sold in the UK in 2017 of which, over half started at a British port. The number of cruise passengers was four times greater in 2017 than in 2000 (DfT, 2018a)

The patterns of vessel traffic transiting UK waters have been mapped through previous Marine Management Organisation (MMO) projects, such as the MMO 1066 study (MMO, 2013; 2014a; 2014b). These outputs have been used within the marine planning process to understand the spatial distribution of vessel traffic. The MMO 1066 study concluded that during 2012, 72% of the UK vessel transits were present within English national waters, 20% in Scottish waters and around 6% in Welsh waters with 2% in Northern Irish waters. To date, there has been no direct link of vessel traffic in UK waters with the value of the cargo and goods being transported. Therefore, this project addresses the value of cargo carried by shipping.

1.2. Aims and objectives of MMO Project 1158

The MMO commissioned ABPmer to deliver Project 1158, 'Mapping Shipping Cargo Value' to review, develop and apply approaches to assigning value to shipping cargo flows and to apply a preferred approach to a case study marine plan area. It is anticipated that information obtained from the project will improve the evidence base for the development and implementation of marine plan policies thereby improving understanding of shipping cargo value associated with marine space use.

This project presently only addresses the shipping value as a result of cargo trade flows. It has developed an approach that can be used to assign cargo value to all shipping across marine plan areas. A significant proportion of traffic are ships transiting through UK waters which do not land or collect cargo at a UK port.

Therefore, the developed approach accounts for transitory vessels as well as those trading in UK ports.

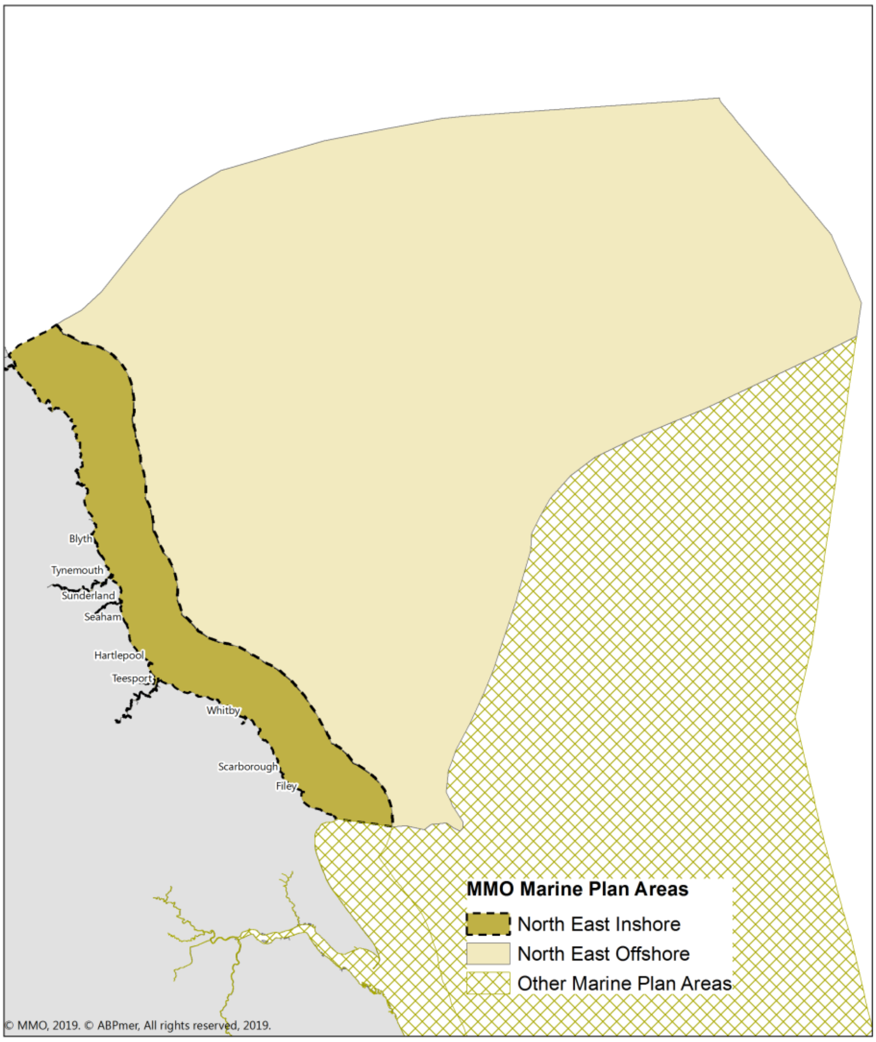
A summary of the project objectives are:

- compile a temporally referenced spatial dataset of shipping activity covering one year of data across selected marine plan area(s)
- identify, evaluate and source relevant data to determine shipping trade value
- combine the spatial data layer with the results of the value exercise to produce maps showing the value of shipping to specific geographical areas with as great a resolution as possible to support marine planning and decision making
- use stakeholder engagement to validate the approach for robustness.

1.3. Case study area: north east inshore and offshore marine plan areas

The case study area used in this project comprised the north east inshore and offshore marine plan areas, which are illustrated in Figure 1

Figure 1: Case study area, the north east inshore and offshore marine plan areas and the major and minor ports present within the area.



The marine plan areas cover approximately 687km of coastline stretching from the Scottish border to Flamborough Head in Yorkshire. It also includes approximately 56,000km² of sea as it extends from the mean high-water mark to the seaward limit of the Exclusive Economic Zone (EEZ), (MMO, 2017).

While undertaking the project, the MMO requested the project method be repeated for a further five marine plan areas, namely the:

- south east inshore marine plan area
- south west inshore and offshore marine plan areas
- north west inshore and offshore marine plan areas

The method was therefore applied across these marine plan areas, the benefit of which was an increased set of validation data allowing more refined scaling factors to be used. However, the results presented here relate only to the case study area, the north east inshore and offshore marine plan areas.

1.4. Stakeholder engagement

The project benefitted from input from industry stakeholders. The role of the stakeholders was to provide a broad view on the method and mapped shipping cargo value outputs. Several stakeholders were engaged from across the maritime sector, to ensure a range of industry expertise, from statutory advisors and industry associations to port representatives drawn primarily from the north east inshore marine plan area. The principal roles of the stakeholders were to:

- consider and comment on the proposed project approach and datasets, which was presented in a project method statement
- comment on the project approach and results, which were presented at a project workshop.

Stakeholders from the following organisations were invited to be part of the stakeholder group:

- Associated British Ports
- British Ports Association
- Chamber of Shipping
- Peel Ports Group
- PD Ports (Tees and Hartlepool)
- Port of Sunderland
- Port of Tyne
- UK Major Ports Group.

The Regulators/Governmental organisations associated with the project included:

- Marine Management Organisation
- Department for Transport.

A project workshop involving several stakeholders was held in July 2019. The stakeholders agreed on the use of expressing the spatial distribution of shipping cargo value across UK waters for planning purposes. However, an important point was raised that shipping value should not be based on cargo carrying vessels only. It was commented that a significant source of shipping value is that provided from service craft. Although these vessels do not carry cargo, they serve important functions to offshore industries and should be considered in future work (see Section 5).

1.5. Report structure

This non-technical summary report summarises the datasets, approach and results of the completed analysis in assigning and mapping value of shipping cargo flows. More detail on the analysis methods are provided in the project technical report. This non-technical summary report is structured into the following sections:

Section 2:	Provides a brief summary of the datasets and approach to achieve the project objectives.
Section 3:	Presents the project results, including the spatial distribution of shipping cargo value within the case study area.
Section 4:	Discusses the obtained results in the context of the UK shipping industry.
Section 5:	Presents the recommendations for applying and further developing the approach.

2. Datasets and approach

The key data sets used to calculate and map the shipping cargo value were:

- Automatic Identification System (AIS) and Lloyds List Intelligence (LLI) data to inform vessel properties and transits, from which the shipping cargo value was calculated and mapped
- Maritime transport and trade standards and guidelines informed by national and international regulatory bodies, such as the United Nations Economic Commission for Europe (UNECE) recommendation 21 (UNECE, 1986). These were used to determine the unit value of cargo types and capacities for the applied vessel types
- Department for Transport (DfT) maritime statistics to validate the cargo volumes used to determine shipping cargo value (DfT 2018a-2018k).

Further detail on the datasets and their applicability within the project is included in Section 2 of the project technical report (MMO, 2019).

The approach applied in this project was to estimate the cargo value representative of a particular vessel. In this project, the vessel type and Dead Weight Tonnage were used to determine the cargo and its volume on the respective vessel. A unit value informed by regulatory bodies for the applicable cargo types was multiplied with the vessel cargo capacity to determine the cargo value for the vessel. The additional vessel information was applied to all occurrences of the respective vessel in the AIS transit data, which was mapped as a grid. Each cell therefore comprised the sum of the cargo values for all the transits that intersected that cell. Sections 3 and 4 of the project technical report (MMO, 2019) provide a more detailed description of technical approach applied in this project, including the assumptions, assessments and validation steps. Of note to this summary report are the vessel types scoped in and assessed in the project, as these provide a background for discussing the achieved results presented in Section 3 below. The assessed vessel types are summarised in Table 1.

The shipping cargo values calculated as part of this project were validated against port freight and sea passenger statistics from the major ports within the north east, south east, south west and north west marine pan areas. However, results were only presented for the north east marine plan areas, the case study area.

Table 1: Assessed vessel types.

Assessed vessel types
Oil tanker
Gas carrier
Pure car carrier
Container
Ro-ro cargo and containers (Ro-con)
Dry bulk
Chemical tanker
Ferry/cruise
Ro-ro cargo and passengers (Ro-Pax)
Specialist[1]
[1]: Specialist vessels relate to vessel types that serve niche functions and in this project are taken to be a) Livestock carrier; b) Heavy load; c) Refrigerated cargo (Reefer) and d) Nuclear fuel carrier. It is worth noting that for the north east marine plan areas only reefer vessels are applicable, although the other specialist types occur within other marine plan areas.

3. Results

This section presents the shipping cargo value results obtained prior to applying the representative capacity scalar and after scaling. The results are presented for just the case study area, i.e. the north east inshore and offshore marine plan areas introduced in Section 1.3.

3.1. Shipping transit counts

Within the north east marine plan areas, there were over 100,000 AIS transits. Figure 2 provides a view of all vessel transits within the north east marine plan areas, presented as an average ‘weekly density grid’. Of the total number of transits, only 37% of these were scoped in for analysis and used in the project. This meant that up to 63% of AIS transits within the north east marine plan areas related to scoped out vessels including service craft, fishing and recreational vessels. The project workshop highlighted the potentially significant contribution made by service craft to 'the value of shipping'. In recent years, this has been particularly important for ports servicing the offshore renewable industry, plus those ports who are traditional supply bases for the oil and gas offshore industry.

Figure 2 identifies clear patterns of vessel use, including the ports of (north to south); Blyth, Tyne, Sunderland, Seaham, Hartlepool and Tees, while the harbours at Whitby, Scarborough and Filey also demonstrate some cargo vessel traffic. Transitory traffic routes can also be seen running offshore in an approximate north west/south east direction. Applying the methodology within this study, the count of scoped in vessels (for the assessed vessel types) that were directly transiting into or out of ports within the north east marine plan areas by vessel type is shown in Table 2.

Figure 2: AIS density grid of all AIS transits across the north east marine plan areas.

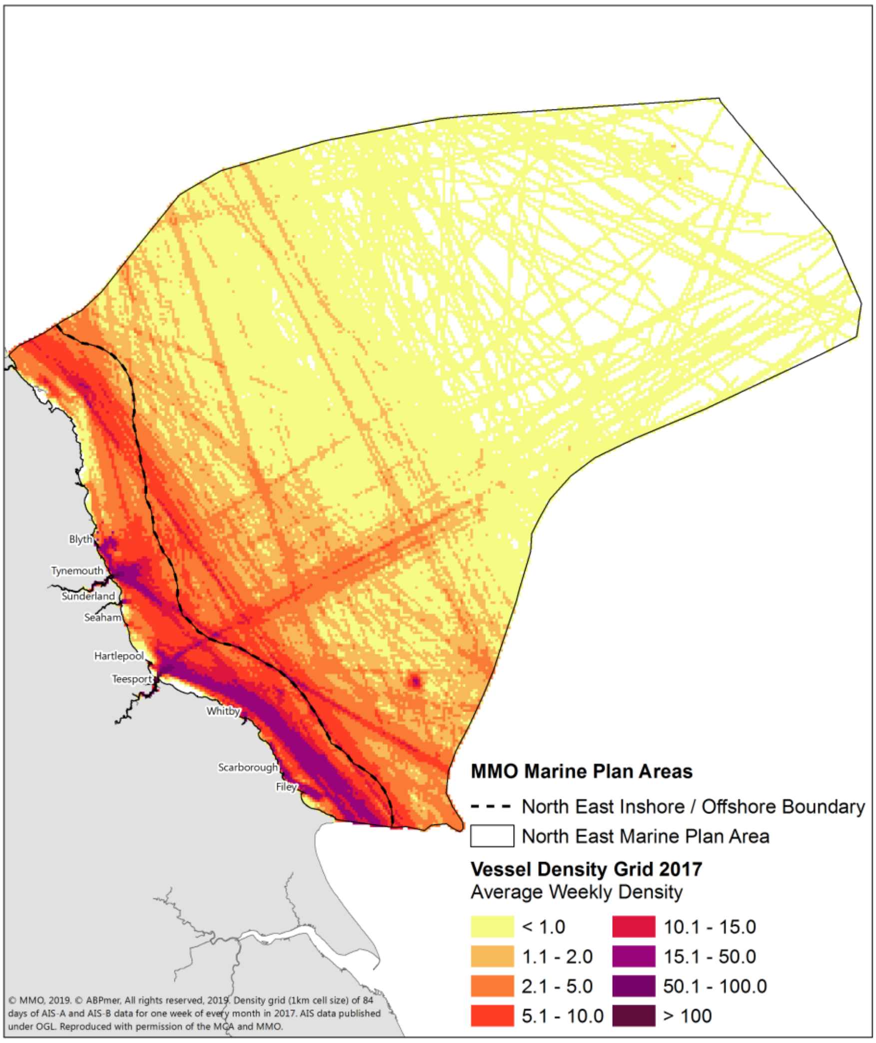


Table 2: AIS transit counts by assessed vessel types transiting into and out of ports in the north east marine plan areas.

Assessed vessel types	Sunderland	Tyne	Tees Hartlepool	Blyth	Seaham
Container		43	214	34	
Chemical tanker		13	276		
Oil tanker	2	6	79	10	
Gas carrier		2	227	1	
Ro-con[1]			99		
Pure car carrier		170	15		
Ro-pax[2]	1	150			
Dry bulk	71	55	138	34	52
Ferry/Cruise		22			
Sum	**74**	**461**	**1,048**	**79**	**52**
[1]: Ro-ro cargo and containers [2]: Ro-ro cargo and passengers					

3.2. Maximum shipping cargo value

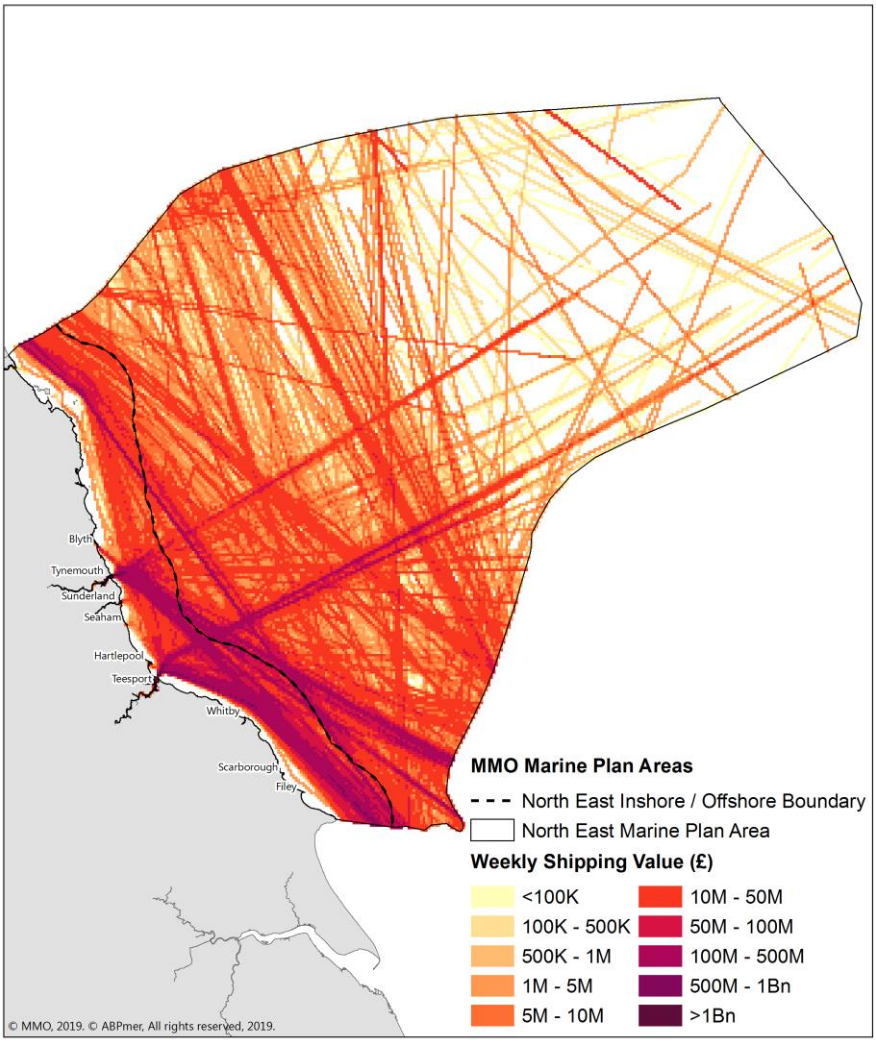
For the vessels arriving or departing the north east ports the maximum value, based on the maximum capacity fill is summarised in Table 3. The estimated sum of the cargo value (i.e. maximum value) arriving or departing the ports ranges from approximately £60 million and up to £17 billion (Figure 3). The north east ports do service a range of cargo group types, with the ports at Tyne, Tees and Hartlepool handling the largest cargo value (Table 3).

Table 3: Estimated value (£ sterling) of cargo for ports within the case study area before scaling cargo capacity, value based on 84-days of AIS data and stated to the nearest million (000,000).

Assessed vessel types	Sunderland	Tyne	Tees Hartlepool	Blyth	Seaham
Container		£1,188	£6,521		
Chemical tanker		£57	£1,192		
Oil tanker	£3	£7	£2,767	£20	
Gas carrier		£0.04	£11	£0.06	
Ro-con[1]			£4,047		
Pure car carrier		£13,584	£2,490		
Ro-pax[2]	£6	£1,198			
Dry bulk	£155	£250	£458	£64	£60
Ferry/Cruise		£44			
Sum	**£164**	**£16,328**	**£17,487**	**£84**	**£60**
[1]: Ro-ro cargo and containers [2]: Ro-ro cargo and passengers					

Figure 3 presents the mapped shipping cargo values as an average weekly shipping cargo value grid. The represented cargo value in each grid cell equates to pounds sterling per squared kilometre per week (£/km²/wk.). For ease in the remainder of the report, the cargo value across all the grid cells are referred to in monetary units.

Figure 3: Maximum cargo value across the north east marine plan areas.



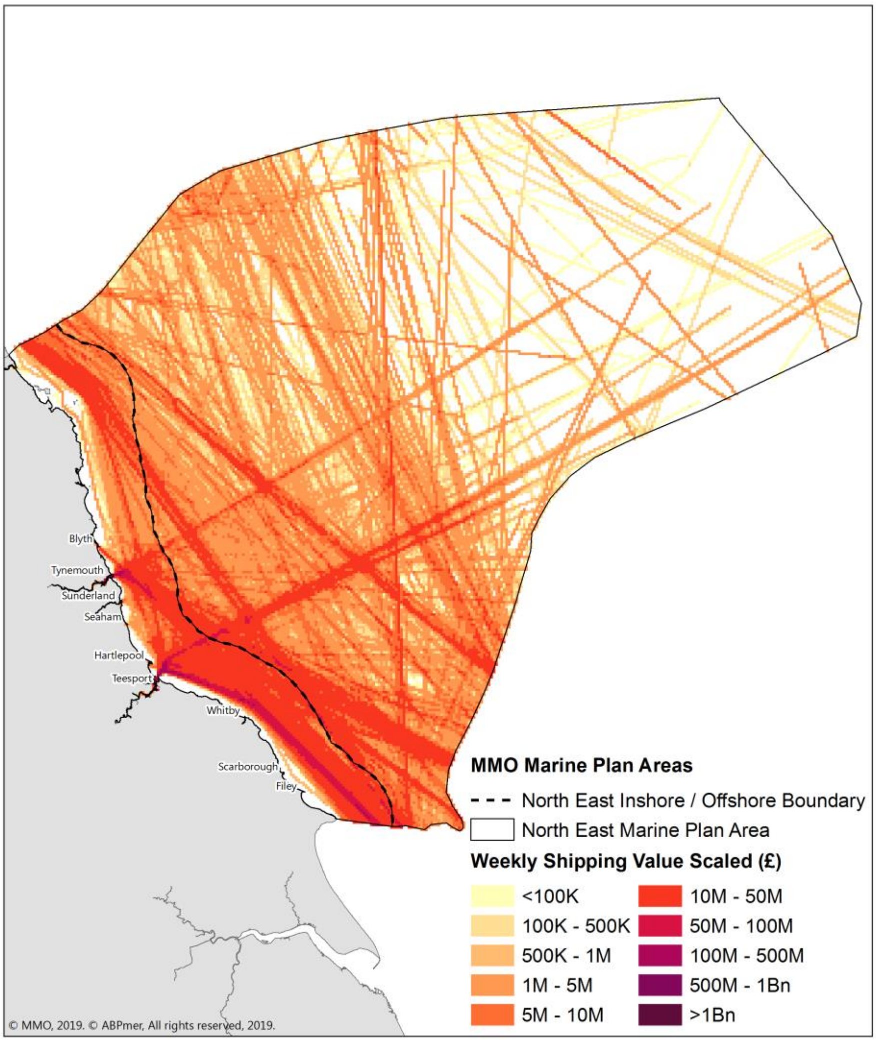
The north east ports handle a range of cargo group types, with the ports at Tyne, Tees and Hartlepool handling the largest cargo value (Table 3, Figure 3). Within the inshore part of the marine plan areas, the estimated weekly average of cargo value is up to £500 million (Figure 3). Locally to the port at Tyne and Tees and Hartlepool, the average weekly shipping value is up to £1 billion (Figure 3), which has been calculated for vessel transits in or out of these ports. Elsewhere across the marine plan areas, the weekly average maximum value of cargo is up to £50 million.

The movement of vessels across the marine plan areas are noted along shipping routes, which are visible in Figure 3 but discussed further in Section 3.4. These include routes for vessels transiting through the marine plan areas in an approximate north west/south east direction both inshore and further offshore. It is worth noting that further offshore, at the furthest extent of the plan area, the termination and breaks in value lines are a result of the AIS data capture, which is limited further offshore.

3.3. Scaled shipping cargo value

Vessels are unlikely to have their cargo capacity 100% full. Therefore, the maximum capacity was scaled down using port tonnage, passenger and unit statistics from DfT. This scaling has been applied to assessed vessel types and presented in Table 4. The appropriate scaling for each assessed vessel type was applied to the capacity for all transits across the marine plan areas for the respective vessel types.

Figure 4: Scaled cargo value across the north east marine plan areas.



The scaled value for cargo arriving and departing the north east marine plan areas ports is set out in Table 4 and the scaled value across the marine plan areas is illustrated in Figure 4.

The scaled value demonstrates similar spatial patterns of value for ports across the marine plan areas (Figure 4) as identified for the maximum value (Figure 3). However, the scaled cargo value ranges between £31 million to just over £4 billion (Table 4). The greatest value is again observed to occur within the inshore marine plan area in relation to routes that originate or terminate in the ports at Tyne and Tees and Hartlepool (Table 4). Based on the completed analyses, the largest assessed type value is that of container vessels, pure car carriers and oil tankers

(Table 4). This is also reflected in patterns of value across the marine plan areas (see Section 3.5).

Table 4: Estimated value (£ sterling) of cargo for ports within the case study area after scaling cargo capacity value based on 84-days of AIS data and stated to the nearest million (000,000).

Assessed vessel types	Sunderland	Tyne	Tees Hartlepool	Blyth	Seaham
Container		£265	£1,457		
Chemical tanker		£23	£478		
Oil tanker	£1	£3	£1,109	£8	
Gas carrier		£0.02	£4.30	£0.03	
Ro-con[1]			£667		
Pure car carrier		£2,239	£411		
Ro-pax[2]	£0.6	£123			
Dry bulk	£79	£128	£235	£33	£301
Ferry/Cruise		£40			
Sum	**£81**	**£2,820**	**£4,360**	**£41**	**£31**

[1]: Ro-ro cargo and containers
[2]: Ro-ro cargo and passengers

3.4. Potential shipping routes based on cargo value

A review of the spatial variability of the mapped shipping cargo value (Figure 4), indicates a number of clear shipping routes, based on the calculated value of cargo carried by shipping. Ten shipping routes have been identified and are illustrated in Figure 5. The routes were identified based on the presence of higher cargo value transits surrounded by lower value transits and the orientation of the transit vectors. The identified routes are considered to relate to locations where the greatest value cargoes are shipped or is the composite of multiple cargo types being carried along the same route, thereby increasing the value.

The identified routes focused around:

- vessels arriving or leaving the Major Ports within the case study area, from domestic and international destinations
- coastal transiting vessels, most likely transiting between UK ports
- international transiting routes.

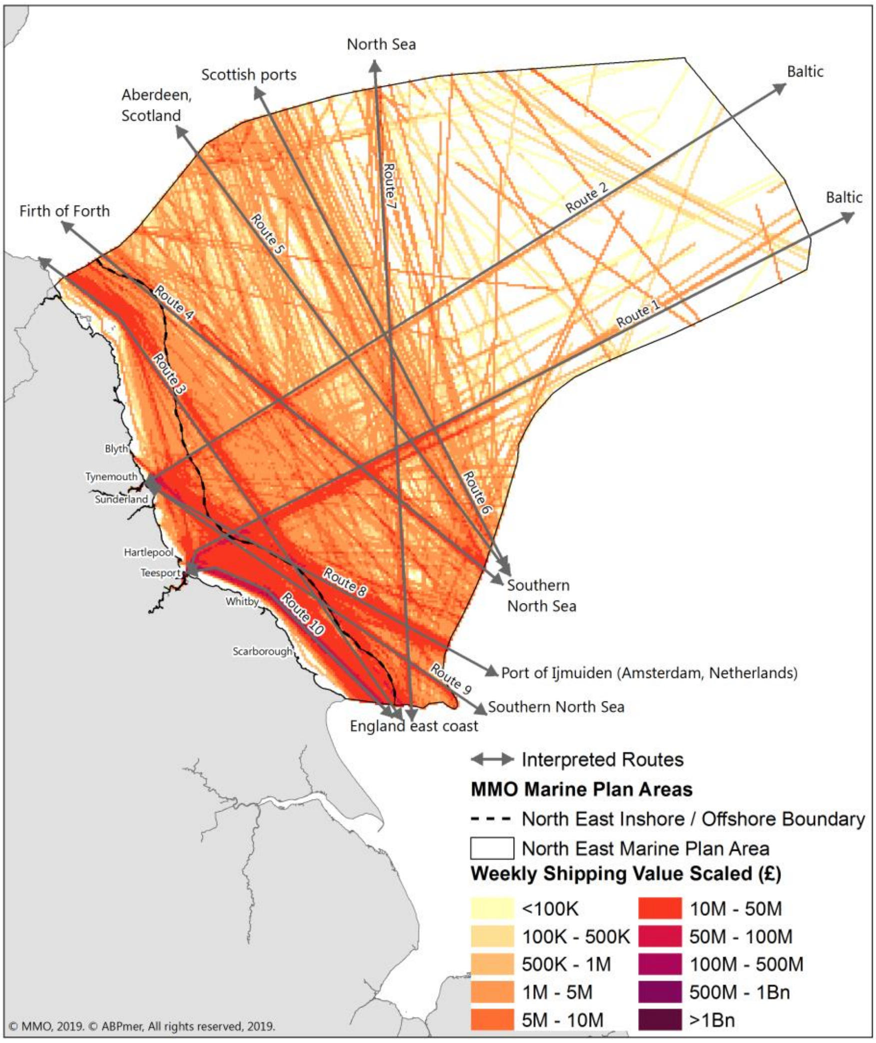
The identified routes illustrated in Figure 5 are:

Route 1. Tees and Hartlepool to the Baltic
Route 2. Tyne to the Baltic
Route 3. East coast inshore transitory traffic linking east coast English ports (i.e., Humber Estuary) to east coast Scottish ports (i.e., the Firth of Forth)

Route 4.	East coast offshore transitory traffic linking southern east coast English ports (i.e., East Anglia) to east coast Scottish ports (i.e., the Firth of Forth)
Route 5.	Southern North Sea (through the marine plan areas) and east coast Scotland (i.e., Aberdeen)
Route 6.	Southern North Sea (through the marine plan areas) and other east coast Scottish ports
Route 7.	England east coast (through the marine plan areas) and the North Sea
Route 8.	Tyne and Port of Ijmuiden (for Amsterdam), Netherlands
Route 9.	Tyne to the wider Southern North Sea
Route 10.	Tyne and Tees and Hartlepool feeders along the east coast of England

Subsequent sections consider the cargo types associated with particular routes.

Figure 5: Interpreted shipping routes based on the calculated shipping value.



3.5. Shipping cargo value by vessel type

As a result of discussions with project stakeholders, the spatial distribution of shipping cargo value was assessed in relation to the vessel type and potential cargo. During this process, it became apparent that particular vessel types (and therefore cargo) were characteristic of the identified shipping routes introduced in Section 3.4. The following sections describe the spatial distribution of the scaled shipping value and any relevant shipping route(s). For each vessel type, the weekly average shipping cargo value for the associated cargo is represented, along with the AIS transits that inform the value.

3.5.1. Container

The shipping cargo value associated with fully cellular container vessels is illustrated in Figure 6. Most of the movement of these vessels are within the inshore marine plan areas and most likely represent vessel movements between UK ports in relation to Routes 3 and 10 (Section 3.4). There is also a frequent shipping route between Tees or Hartlepool and the Baltic, with respect to Route 1. The shipping patterns would indicate that Tees and Hartlepool act as a feeder port for the container vessel type. The average weekly shipping cargo value associated with this vessel type is up to £100 million along the identified routes.

3.5.2. Chemical tanker

The shipping cargo value associated with chemical tanker carriers is demonstrated in Figure 7. The movement of this vessel and cargo type represents vessel transits between UK ports, in relation to Routes 3 and 10.

The ports at Tees, Hartlepool and Tyne handle this cargo, with the majority going into the former. The weekly average shipping cargo value ranges between £1 million and £5 million across the marine plan areas but increases to about £100 million on entry into the ports at Tees and Hartlepool (Figure 7). There also seems to be fewer international transits associated with this cargo type, with the weekly average value being less than £1 million.

3.5.3. Oil tanker

Figure 8 sets out the shipping cargo value associated for the oil tanker vessel type. The movement of this cargo has a wide coverage across the marine plan areas and mainly relates to the routes between UK ports. However, Routes 4, 5, 7, 8 and 10 demonstrate greater shipping cargo values. No international routes (i.e. Routes 1 and 2) are identified for this cargo type.

The ports at Tees and Hartlepool handle the majority of this cargo type, with weekly average shipping cargo values of up £100 million in proximity to the port. The ports at Blyth, Tyne and Sunderland also handle this cargo but to a lesser degree than Tees and Hartlepool. Elsewhere within the marine plan areas shipping cargo values range between £10 million and £50 million. What is notable for this cargo type is that the greater value movements are not in relation to the coastal routes, i.e. Routes 3 and 10. Instead the greatest value occurs for Routes 4 and 7. The latter of which may coincide with transits between oil and gas fields in the North Sea and the onshore shipment of the cargo.

3.5.4. Gas carrier

The shipping cargo value for gas, associated with the gas carrier vessel type is set out in Figure 9. The movement of this cargo type mainly relates to Routes 3, 4 and 10, which are considered as the coastal routes within this project. The movement pattern for this cargo type is very similar to that of chemical tanker (Figure 7), with similar spatial coverage across the north east marine plan areas and the presence of international routes. However, this cargo has a lower weekly average shipping cargo value, ranging between £10k and £50k, with the larger amounts occurring along Route 3. The ports at Tees and Hartlepool is the only port observed to handle this cargo type (Figure 9) within the marine plan areas.

3.5.5. Dry bulk

The dry bulk shipping cargo value is illustrated in Figure 10. This cargo type like the oil cargo has a wide coverage across the marine plan areas. There is evidence of most of the routes that have been identified across the marine plan areas (see Section 3.4), with the exception Route 2. The greatest value occurs with respect to Routes 1, 2, 3, 6 and 10. The weekly average shipping cargo values associated with these routes' ranges between £1 million and £5 million. Elsewhere within the Marine Plan Area, the value ranges between £500k and £1 million. This cargo type is identified at all the ports within the marine plan areas, but the greatest values occur at both the Tyne and Tees and Hartlepool (Figure 10).

3.5.6. Roll on – roll off and containers (Ro-Con)

The Ro-Con cargo shipping value is illustrated in Figure 11. This cargo type has fairly limited coverage across the marine plan areas compared to other cargo types and is principally associated with Routes 3 and 10. The weekly average shipping cargo value associated with both these routes ranges between £50 million and £100 million.

3.5.7. Pure car carrier

Figure 12 sets out the shipping cargo value associated for the pure car carrier vessel type. The movement of this cargo type relates to Routes 1, 2, 5, 8, 9 and 10, except Route 10 occurs from the port at Tyne. The spatial distribution of the weekly average shipping cargo value for this cargo type is mainly due to the export of Nissan cars out of the port at Tyne to other parts of the UK and internationally. However, there is the additional movement of this cargo type along Route 1, with respect to the port at Tees and Hartlepool, but the source for this is currently unknown. The weekly average shipping value for this cargo ranges between £50 million and £100 million in proximity to the Tyne but is generally between £10 million and £50 million elsewhere in the marine plan areas.

3.5.8. Roll on – roll off and passengers (Ro-Pax)

Figure 13 sets out the shipping cargo value associated for the Ro-Pax vessel type. The movement of this cargo mainly relates to Route 8, in relation to the Port of Tyne (Newcastle) – Port of Ijmuiden (Amsterdam) ferry route. The weekly shipping cargo value associated with the ferry route ranges between £500k and £1 million. There is also some movement of this cargo type along Route 10 but originating / terminating at Tyne and from Sunderland to the Baltic, which is not presently identified as a route in Section 3.4. The weekly average shipping value associated with these movements are much lower at approximately £50k to £100k.

3.5.9. Cruise

The weekly average shipping cargo value associated with cruise vessels and passengers is illustrated in Figure 14. It demonstrates that cruise vessels only sail or arrive out of the port at Tyne to varying destinations, and that there are a number of transiting cruise vessels through the north east marine plan areas. Movements for this vessel type are observed to occur along Routes 3 and 4. However there are other movements across the marine plan areas that do not coincide with the identified routes discussed in Section 3.4. The weekly average shipping cargo value predominantly ranges between £50k to £100k where present within the marine plan areas. However, there are more localised instances, where the value increases to between £500k and £1 million.

3.5.10. Specialist (Refrigerated vessels)

This vessel type only has a limited coverage across the marine plan areas, associated with very few vessel transits (Figure 15). Of note is the fact that this vessel type is only transiting through the marine plan areas, with no arrival or departures from the ports within the area. The vessel movements for this type relate to the directions identified for Routes 4 and 6. The weekly average shipping cargo value associated with this vessel and cargo type is generally less than £10k, although it can range between £10k and £50k (Figure 15).

Figure 6: Scaled shipping cargo value and AIS transits for the container vessel type.

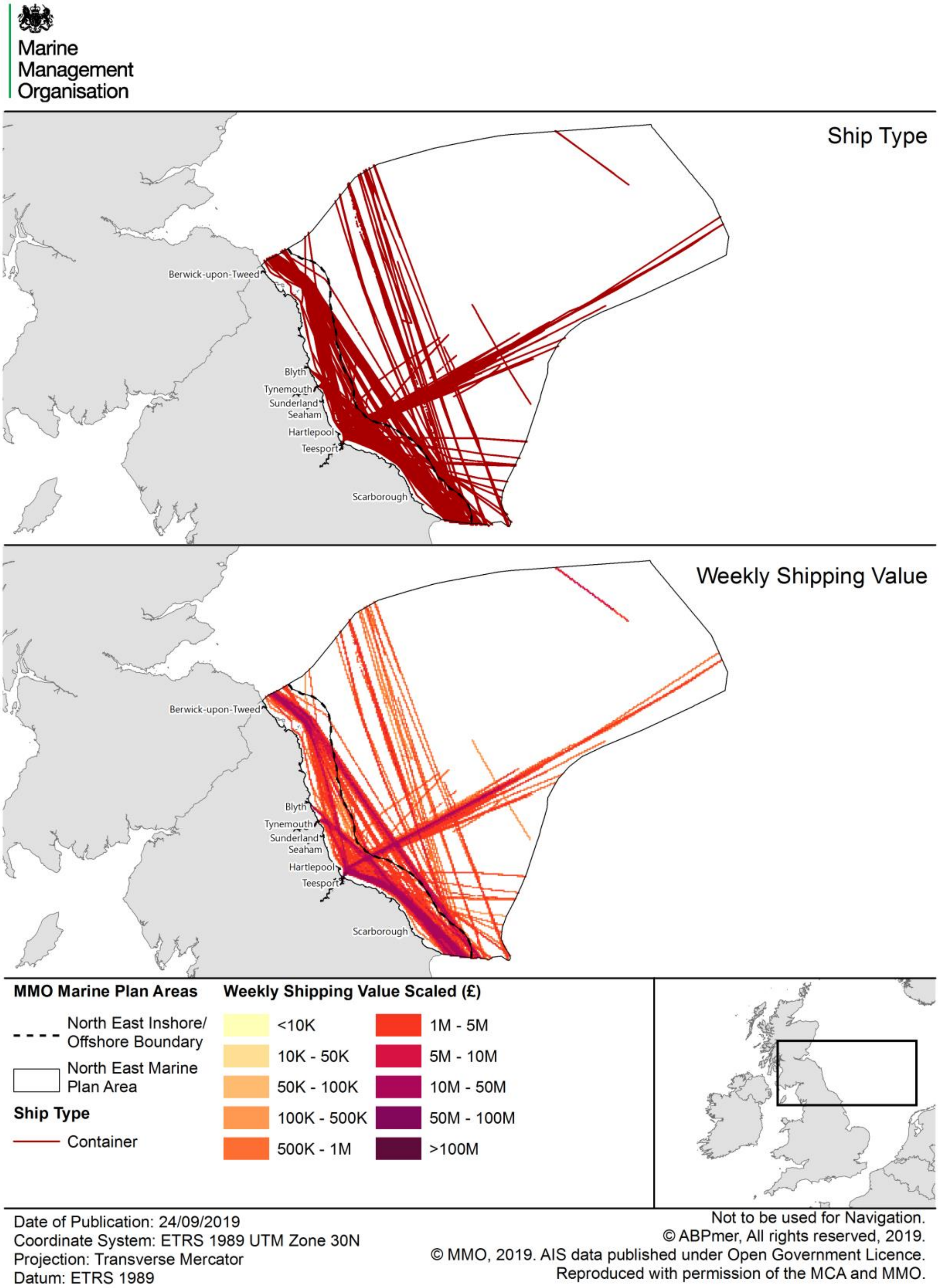


Figure 7: Scaled shipping cargo value and AIS transits for the chemical tanker carrier vessel type.

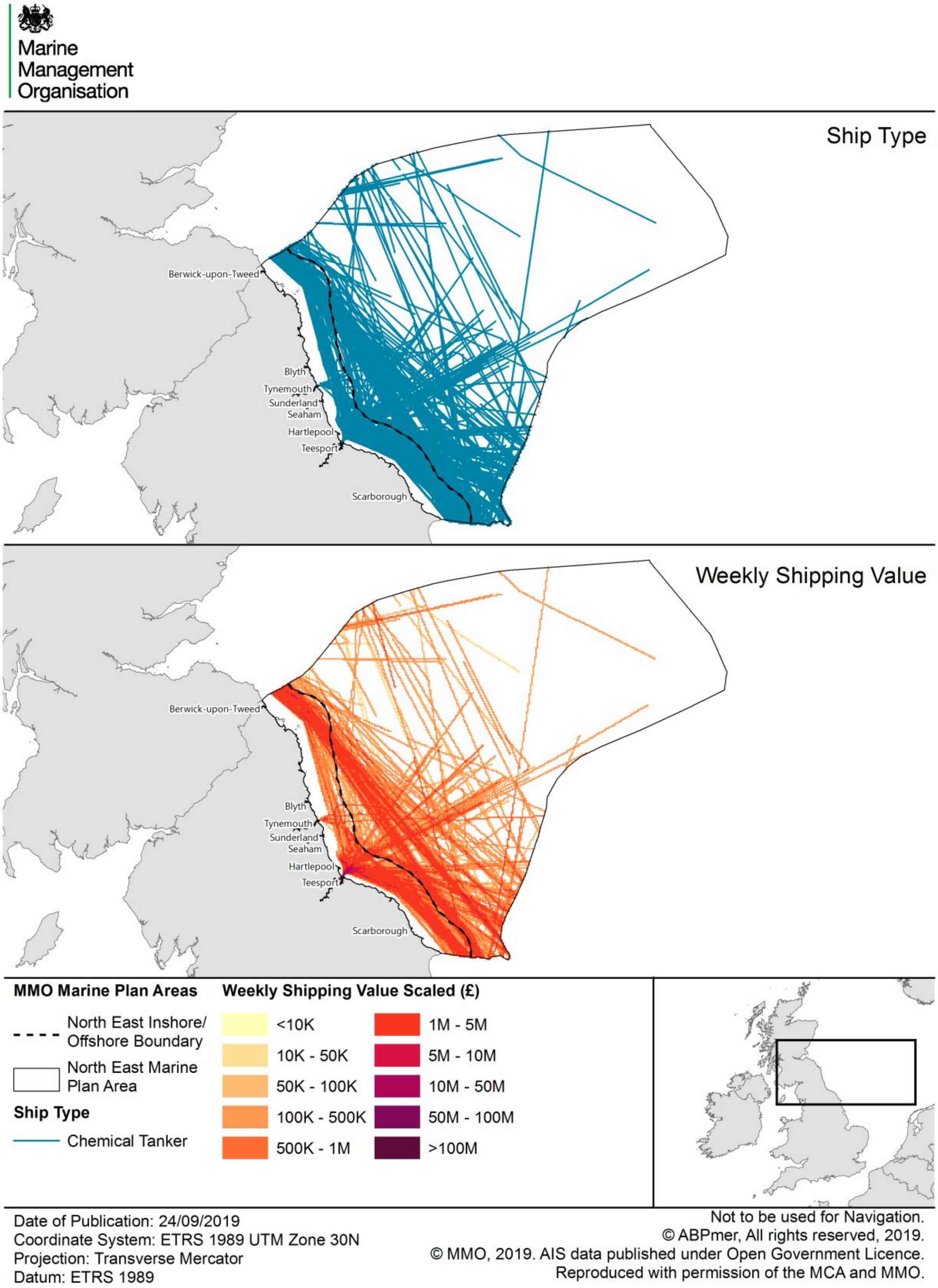


Figure 8: Scaled shipping cargo value and AIS transits for the oil tanker vessel type.

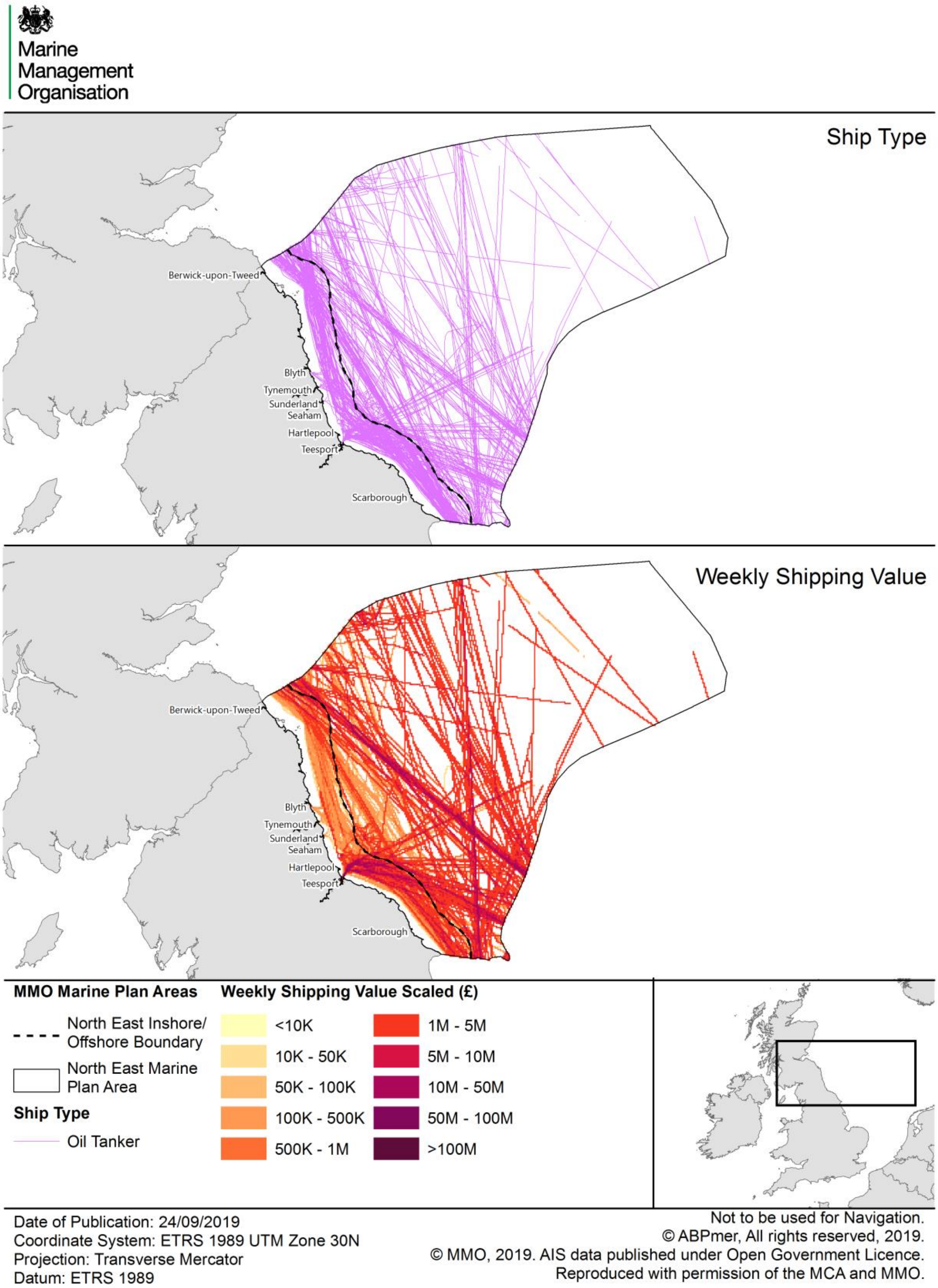


Figure 9: Scaled shipping cargo value and AIS transits for the gas carrier vessel type.

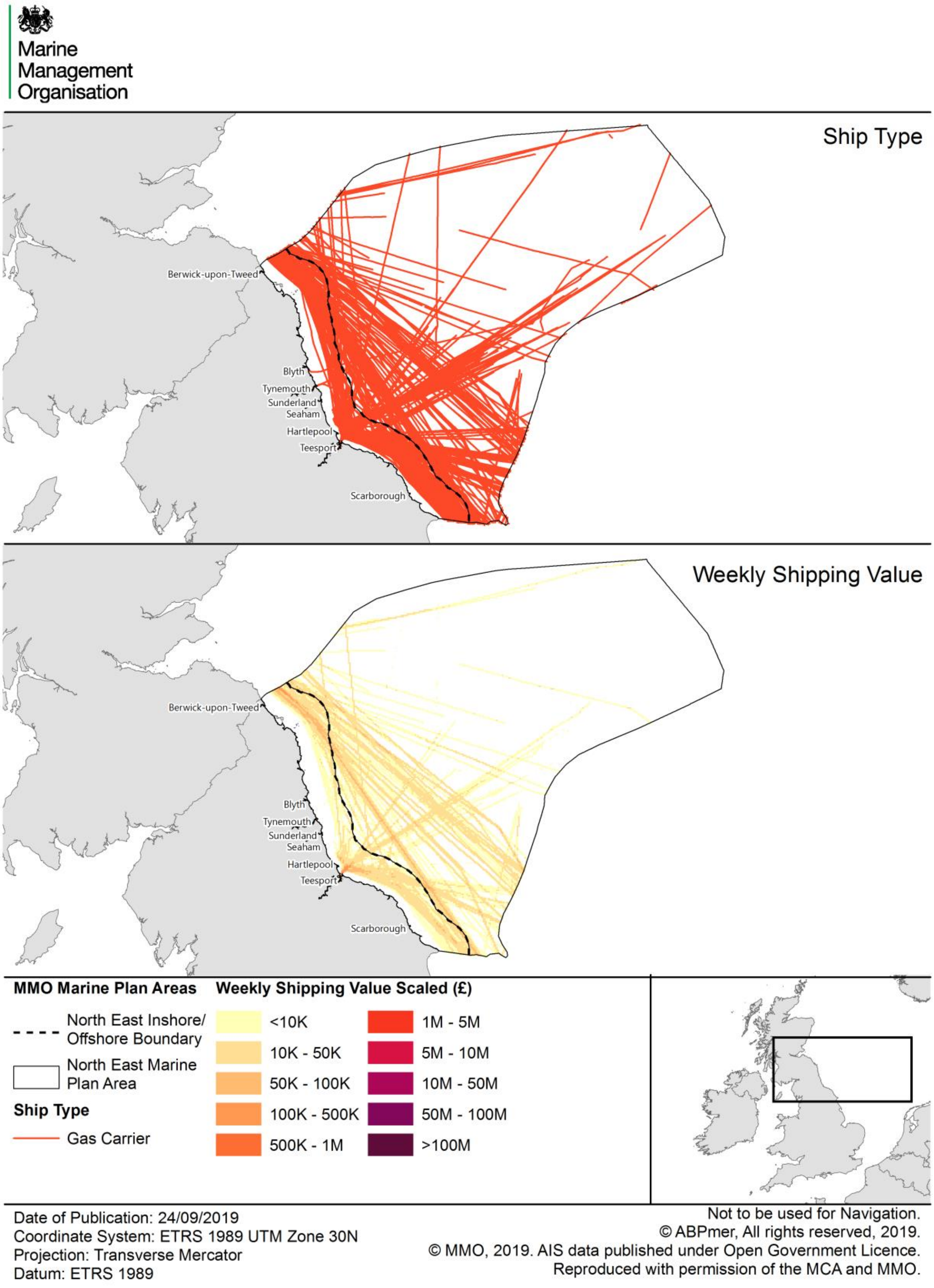


Figure 10: Scaled shipping cargo value and AIS transits for the dry bulk vessel type.

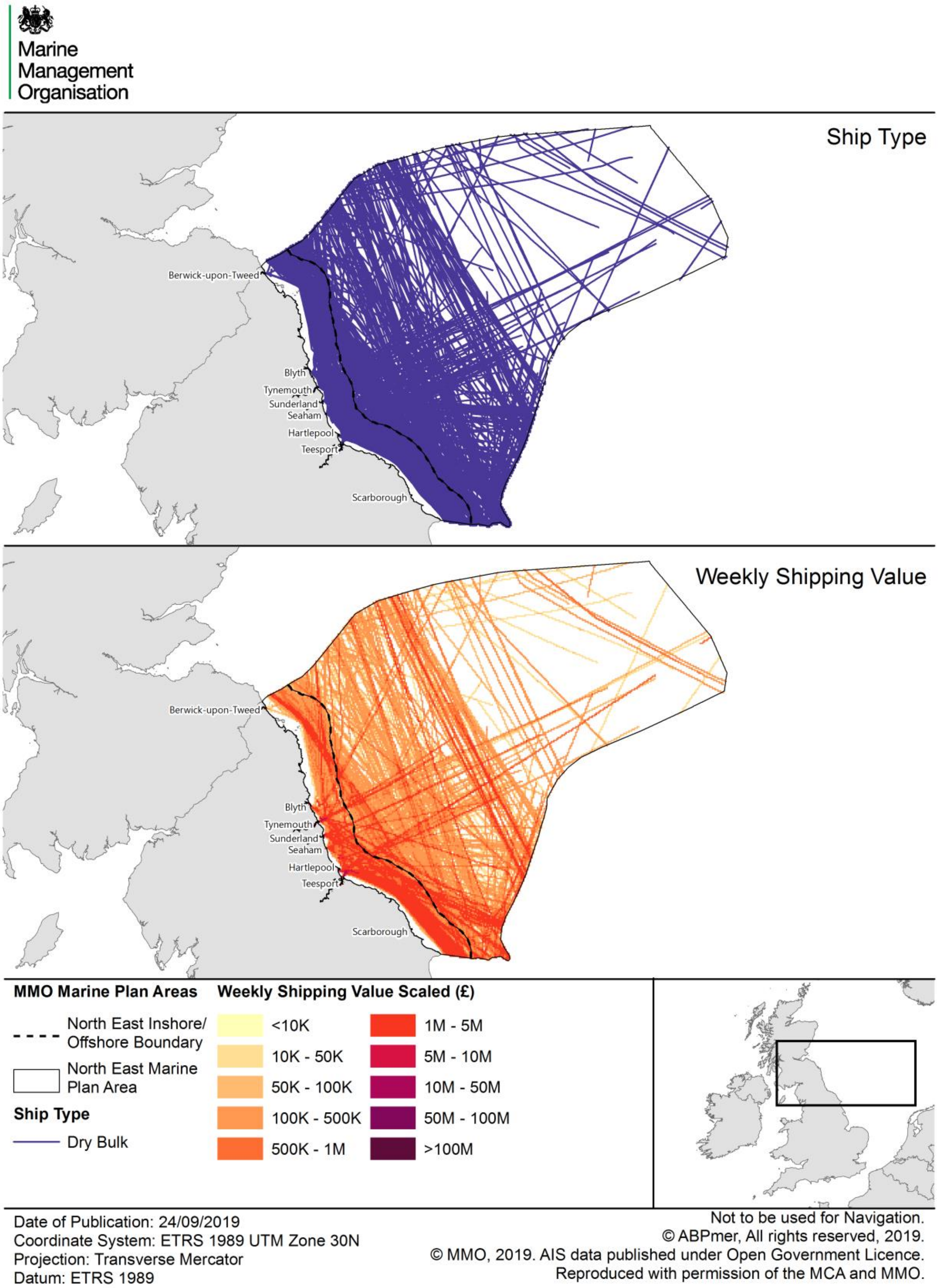


Figure 11: Scaled shipping cargo value and AIS transits for the Ro-Con vessel type.

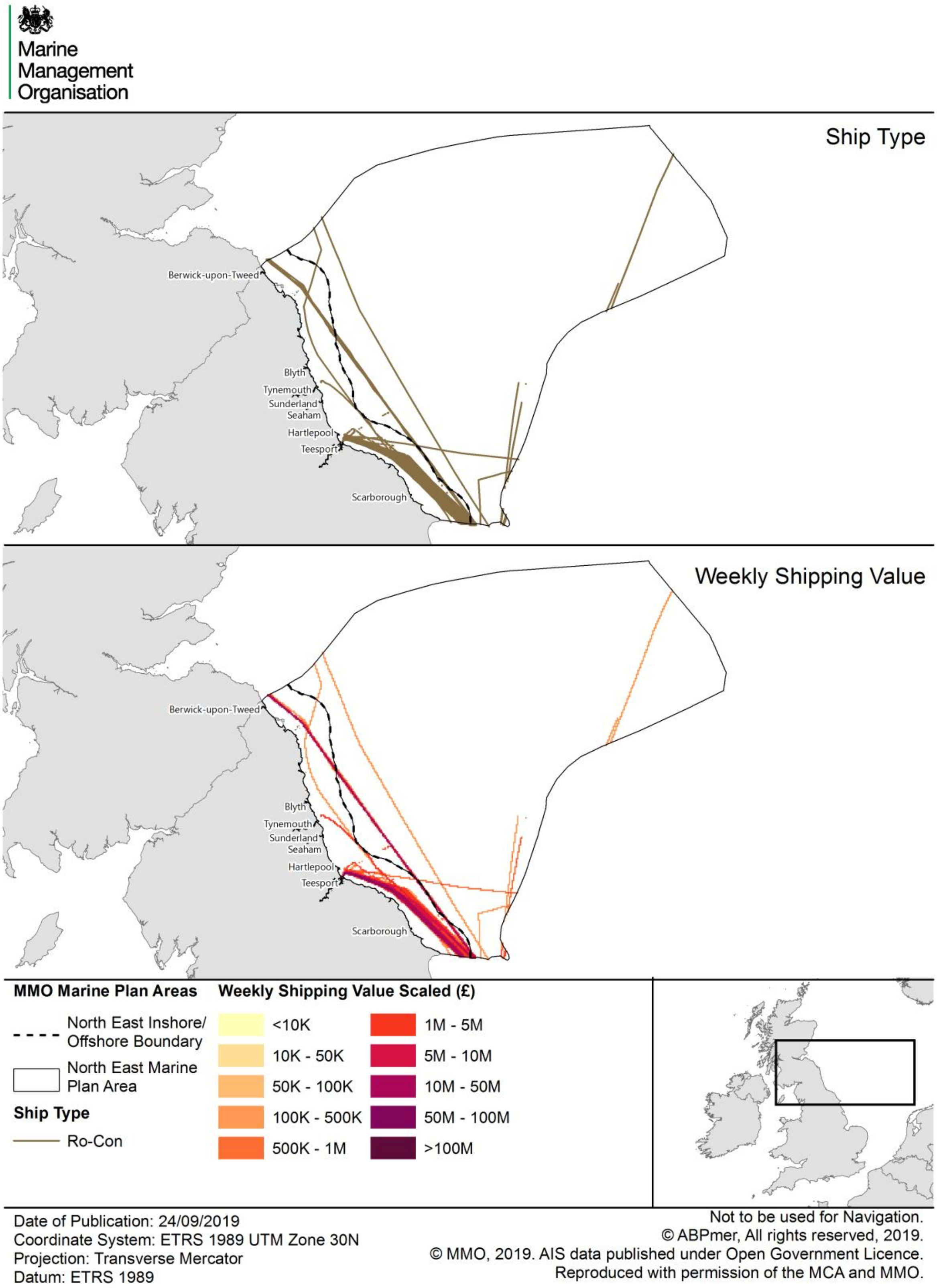


Figure 12: Scaled shipping cargo value and AIS transits for the pure car carrier vessel type.

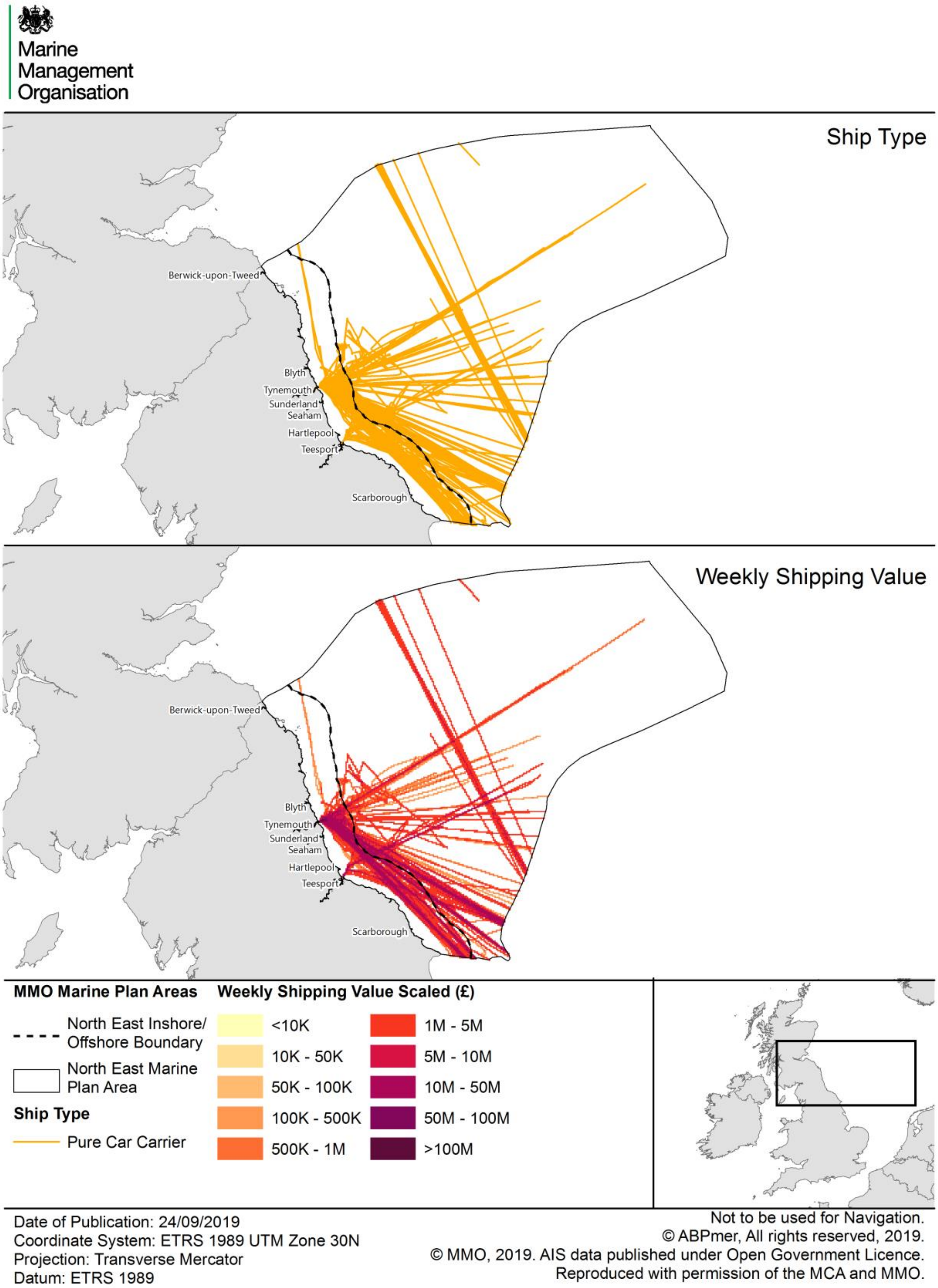


Figure 13: Scaled shipping cargo value and AIS transits for the Ro-Pax vessel type.

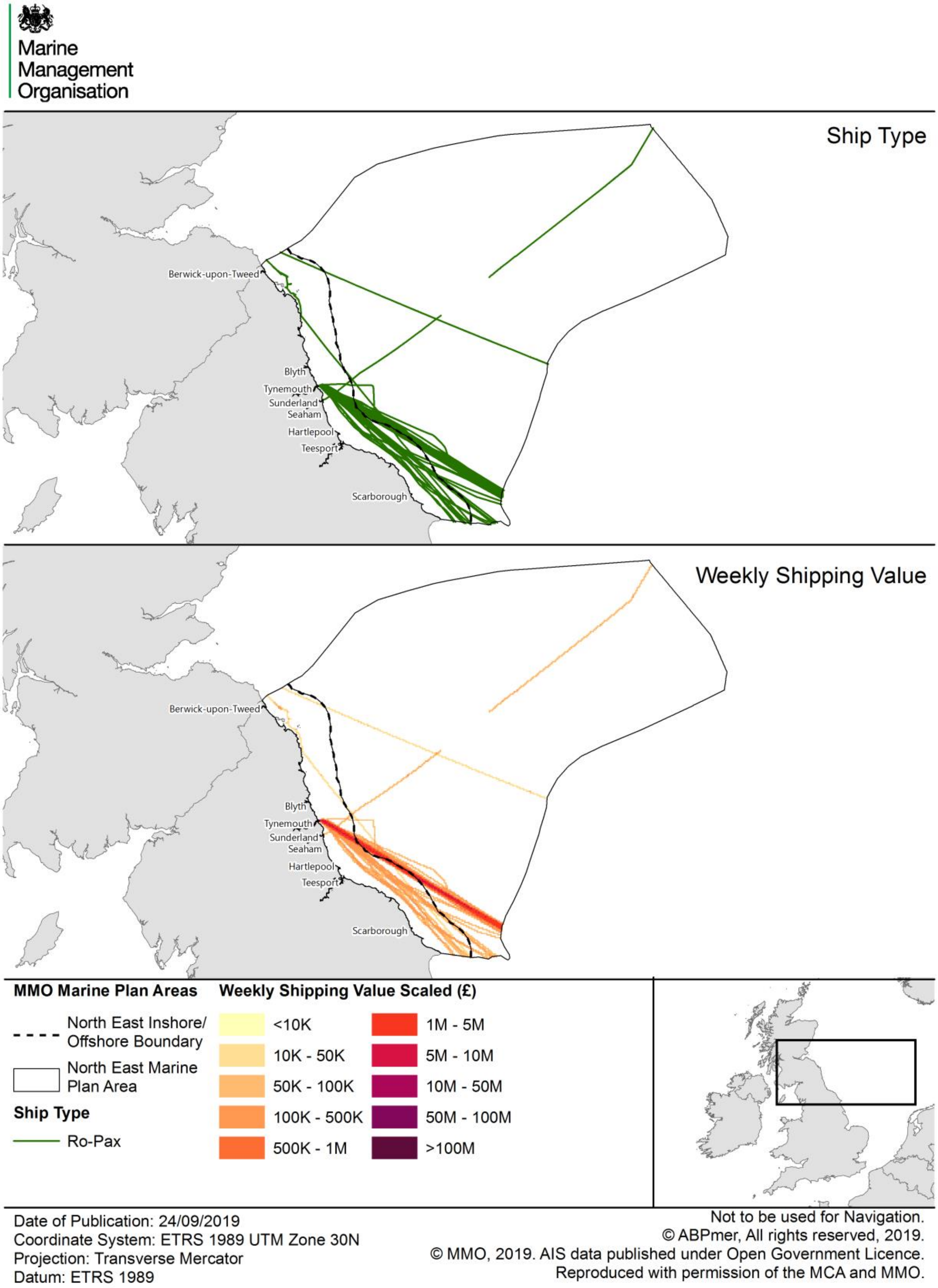


Figure 14: Scaled shipping cargo value and AIS transits for the cruise vessel type.

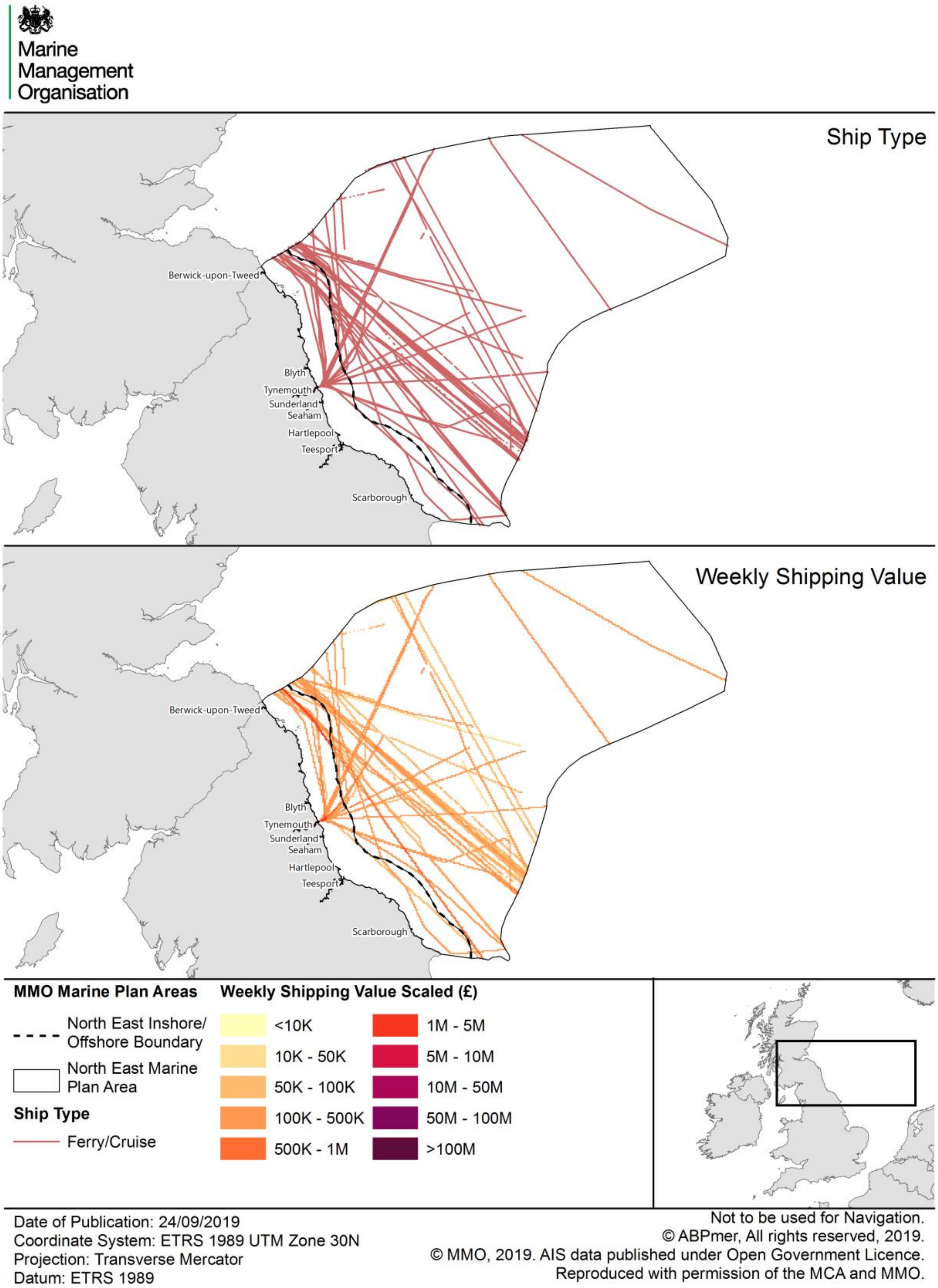
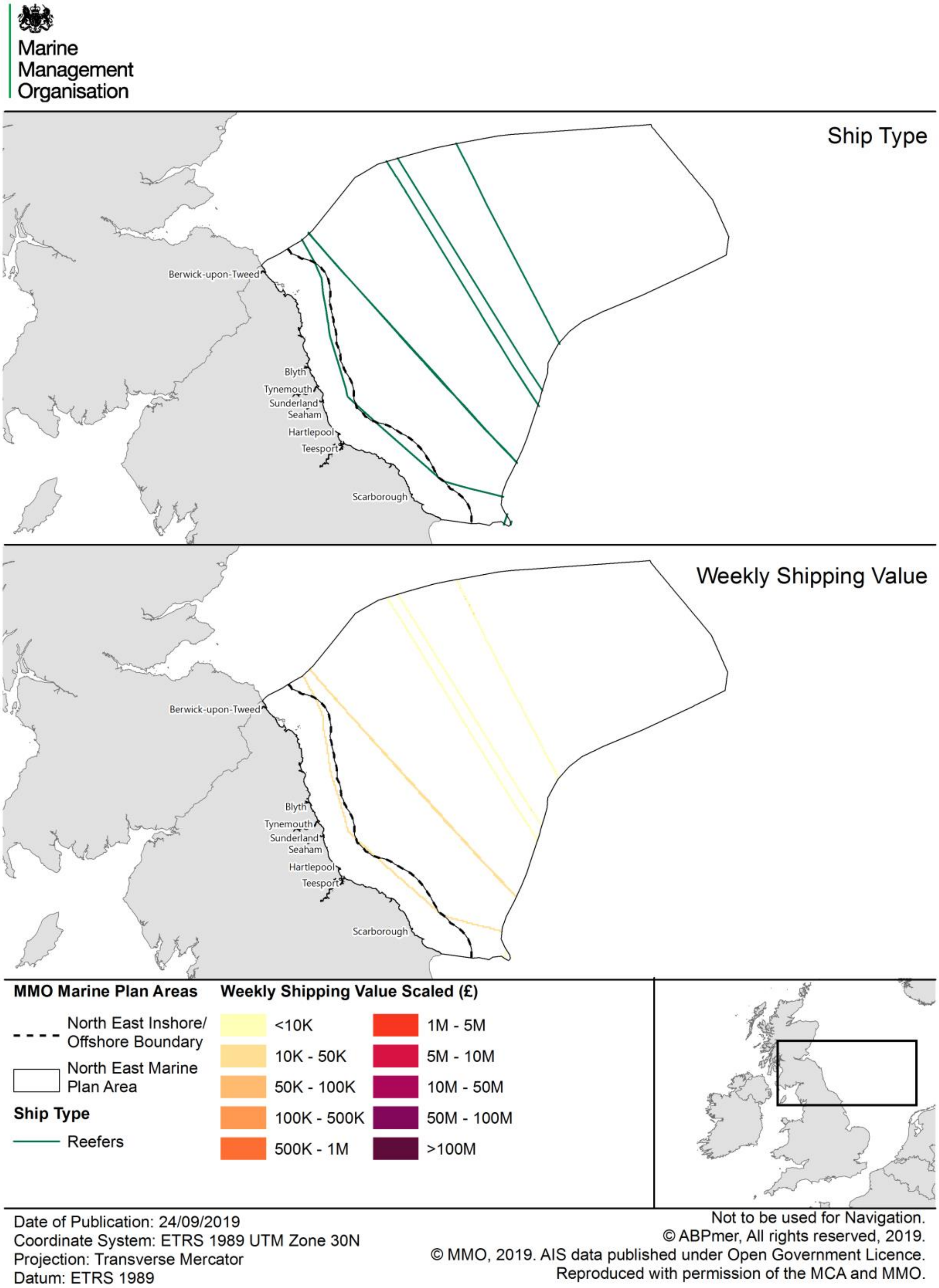


Figure 15: Scaled shipping cargo value and AIS transits for the specialist (refrigerated vessel) vessel type.



4. Discussion

In completing the mapping of shipping cargo value for the north east marine plan areas, three aspects were analysed, namely:

- determination of value routes based on shipping cargo value
- vessel density comparison with value routes across the marine plan areas
- the influence of offshore infrastructure on the spatial distribution on the mapped shipping cargo value and the potential contribution from service craft.

The above points are discussed in the following sections.

4.1. Cargo shipping routes

The shipping routes identified and introduced in Section 3.4 serve varying functions, in terms of the cargo being transported and the value of the cargo. Routes 1, 2, 8, 9 and 10 are all considered to run between the major ports at Tynemouth and Tees and Hartlepool and other locations within the UK and Europe. A review of the routes in relation to the value maps for each vessel type (Figure 6 to Figure 15) show that the routes relate to the movement of different cargo types.

Route 1 between Tees and Hartlepool and the Baltic principally relates to the movement of containers (Figure 6) and chemical tanker (Figure 7). Route 2 between Tyne and the Baltic is more in relation to the transport of dry bulk (Figure 10) and the export of cars (Figure 12). Route 8 is principally due to the ferry service between the Port of Tyne (Newcastle) and Port of Ijmuiden (Amsterdam) represented in the Ro-Pax value (Figure 13).

There are considered to be feeder routes from the ports at Tyne and Tees and Hartlepool and towards the east coast of England (i.e. Routes 9 and 10). These feeder routes are interpreted to occur for a range of cargo types including containers, oil, gas, cars and liquid and dry bulks. The sum of the weekly average shipping cargo value along these feeder routes is between to £50 million and £500 million. The greater value predominantly occurs along Route 10 from the Tees and Hartlepool, towards the east coast of England (Figure 4).

For the routes transiting through the marine plan areas (i.e. Routes 3 to 7) to and from Scotland and the east coast or the southern North Sea, these occur in relation to the transport of containers, oil, gas, cars and liquid and dry bulks. The largest values and widest distribution across the north east marine plan areas are in relation to the movement of oil (Figure 8).

Due to the representation of value in Figure 4, only transits with the greatest values were identified as routes (see Section 3.4). This meant there were a number of additional shipping routes, identified for individual cargo types, that were not identified in the sum of the weekly average shipping cargo (Figure 4). An example of this being the movement of cruise vessels (Section 3.5.9). Therefore, further work could entail identifying the individual routes for each cargo type in order to address particular questions.

4.2. Vessel density versus shipping value

A comparison of the vessel traffic density (Figure 2) and the scaled shipping value (Figure 4) shows a difference in the spatial characteristics across the north east marine plan areas. The vessel density shows high usage along the coastline, with up to 100 vessel transits per week, compared with less than 10 transits in the offshore areas (Figure 2). In terms of shipping cargo value however, the same or similar value range are observed to occur across the whole marine plan areas. This is because there is the occurrence of greater value transits in the offshore area along the identified routes (Sections 3.4 and 4.1). The average weekly shipping cargo value in proximity to the coastline up to approximately £50 million and covers most of the north east inshore marine plan areas south of Tynemouth (Figure 4). However, as previously mentioned, this value is not restricted to the coast and also occurs in offshore areas of the marine plan areas. The most common average weekly shipping cargo value ranges between £5 million and £10 million and is widely distributed across the marine plan areas, but predominantly occurs in the offshore area (Figure 4).

A number of the shipping routes illustrated in Figure 5 (Section 3.4) can clearly be recognised within the vessel traffic density grid (Figure 2). This is particularly the case for the routes closer to the coast, including Routes 1, 2, 3, 4, 6, 8 and 10 (Figure 5), noting that for Route 1 only the section closer to the coast is identifiable. Although, these routes can be identified in Figure 2, there is no further way to determine what cargo type the transits relate to, which is what Figure 4 and Figure 6 to Figure 15 all inform. Routes 5, 7 and 9 are not evident within the vessel traffic density grid, although these routes have a weekly average shipping cargo value of up to £50 million. Therefore, these routes are mostly represented by fewer, but greater cargo value shipping movements.

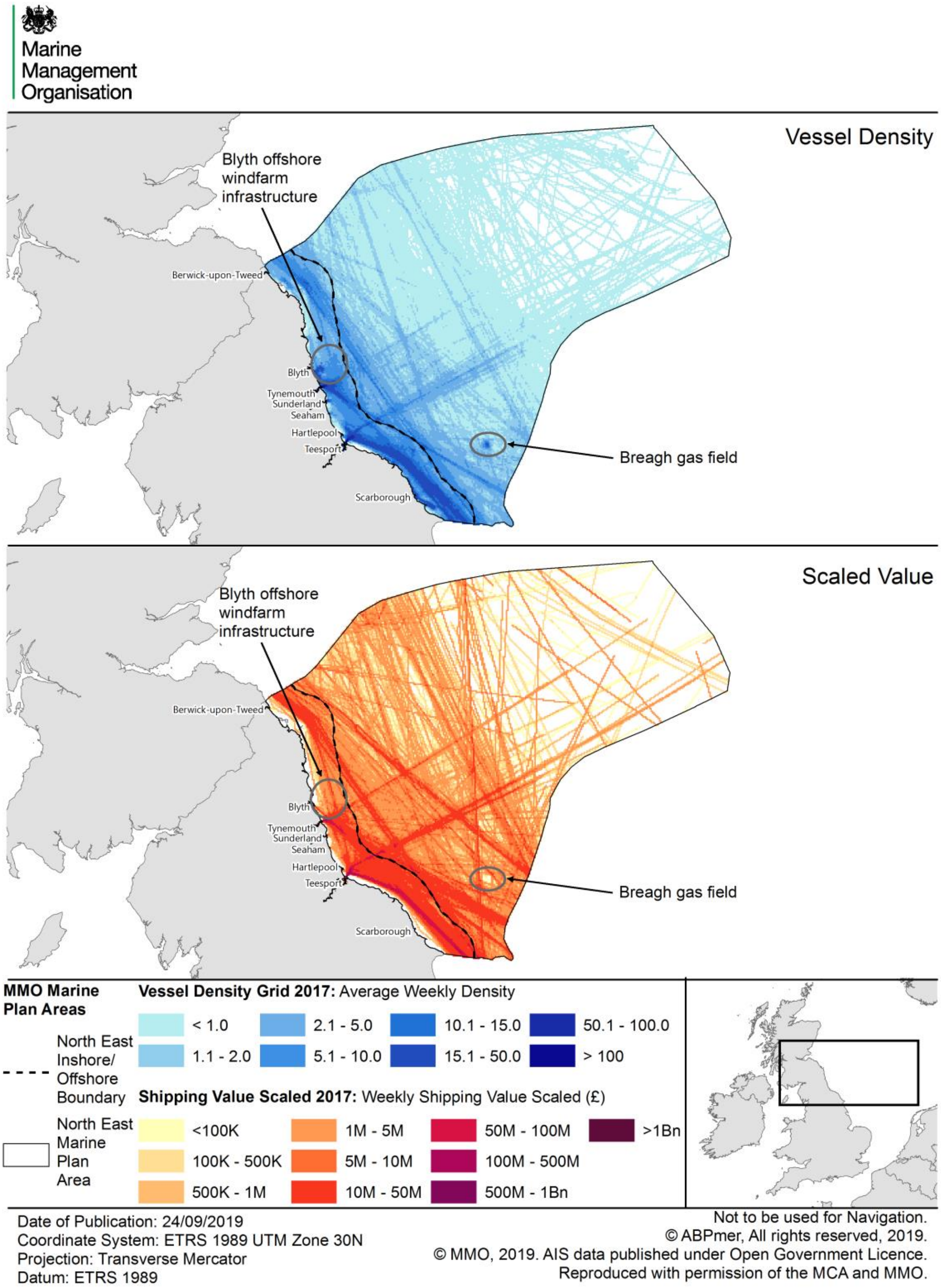
The presented vessel traffic density grid (Figure 2) and shipping cargo value maps (Figure 4 to Figure 15) would all seem to suggest transits stopping within the north east offshore marine plan area. However, as indicated earlier, this is due to the extent of the AIS transmission, rather than the end of a journey. It can therefore be assumed that similar value would continue to extend towards the marine plan area boundaries.

4.3. Influence of offshore infrastructure on value

Figure 4 demonstrates the value associated with cargo carrying vessels, but it is noted that there is additional value related to service craft vessels which is not represented. The fact that the value only relates to cargo carrying vessels would account for identified areas of little to no value surrounded by an areas of higher value and a high density of AIS transits. The areas are associated with exclusion zones in relation to offshore energy and oil and gas infrastructure and are illustrated in Figure 16 for the two offshore infrastructure locations within the north east marine plan areas, which are:

- Breagh gas field, offshore east of Tees and Hartlepool
- Blyth Offshore Wind Farm demonstration and Phase 1 sites.

Figure 16: Location of offshore infrastructure and the missing influence of service craft vessels on shipping value



For both offshore infrastructure sites, the vessel density over the same period appears as a hotspot with a high traffic density. These are emphasised on Figure 16 as locations with a vessel density in excess of 100 transits per week, which occurs due to service craft moving within the exclusion zone. Conversely, within the location, the estimated value is a lot less than the immediate and surrounding area (Figure 16). In discussions with stakeholders during the project workshop, it was noted that the service craft industry within Blyth provided considerable value in enabling the offshore wind farm operation in the area. Although the vessel density suggests this (Figure 2 and Figure 16), the scaled value does not represent this (Figure 4 and Figure 16).

5. Recommendations

The following recommendations are made in relation to the study and its outputs:

- it is recommended that Service Craft are considered, and a value layer provided to represent this category of vessels. This will require specific research to determine values applicable to Service Craft

- this study presents the shipping cargo value. As a subsequent research study, it would be useful to consider the value-added contribution of cargo types at specific ports. Some cargoes are finished goods that are in their intended end form (for example, a vehicle) and have a high value but less contribution to the value of the supply chain, whereas raw products may have lower tonnage values but much greater potential for onward value. It is recommended that this aspect of the study is further investigated to allow the assignment of value based on the cargoes' potential economic contribution.

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7. Abbreviations and acronyms

AIS	Automatic Identification System
Cebr	Centre for Economics and Business Research
DfT	Department for Transport
DWT	Dead Weight Tonnage
EEZ	Exclusive Economic Zone
GVA	Gross Value Added
LLI	Lloyds List Intelligence
MMO	Marine Management Organisation
Pax	Passenger
PCC	Pure Car Carrier
Ro-con	Ro-Ro cargo and containers
Ro-Pax	Ro-Ro cargo and passengers
Ro-Ro	Roll on / Roll off
UK	United Kingdom
UNECE	United Nations Economic Commission for Europe