

Natural England

Ornithological and Marine Mammal Baseline Characterisation Surveys for the POSEIDON project

**October-December (Seasonal) Report – South-West
Celtic Sea**

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Contents

1.	Executive Summary.....	1
2.	Introduction	2
2.1	Background	2
2.2	Aim of Report.....	2
3.	Survey and Analysis Methodologies	4
3.1	Digital Aerial Survey Methods.....	4
3.2	Species Identification	10
3.3	Summary of Quality Assurance.....	12
3.4	Species Distribution Maps	12
3.5	Species Flight Heights	12
4.	Abundance and distribution	13
4.1	Abundance	13
4.2	Spatial Distribution	14
5.	Abiotic Structures and Observations	25
	Appendix I Scientific Names and Taxonomy	26
	Appendix II Example images (snags) of birds and marine mammals.	27

List of Figures

Figure 1	Location of the South-West Celtic Sea Survey Area	3
Figure 2	Individual image capture points during the October to December 2022 (January 2023) survey	6
Figure 3	Distribution of all birds recorded in the October to December 2022 seasonal survey (January 2023).....	15
Figure 4	Distribution of all marine megafauna recorded in the October to December 2022 seasonal survey (January 2023).....	16
Figure 5	Kittiwake distribution recorded in the October to December 2022 seasonal survey (January 2023).....	17
Figure 6	Guillemot distribution recorded in the October to December 2022 seasonal survey (January 2023).....	18

Figure 7 Puffin distribution recorded in the October to December 2022 seasonal survey (January 2023).....	19
Figure 8 Fulmar distribution recorded in the October to December 2022 seasonal survey (January 2023).....	20
Figure 9 Distribution of less abundant bird species recorded in the October to December 2022 seasonal survey (January 2023).....	21
Figure 10 Common dolphin distribution recorded in the October to December 2022 seasonal survey (January 2023).	22
Figure 11 Distribution of less abundant marine megafauna recorded in the October to December 2022 seasonal survey (January 2023).....	23
Figure 12 Distribution of vessels recorded in the October to December 2022 seasonal survey (January 2023).....	24
Figure 13 Beaked whale	27
Figure 14 Common dolphin. Although submerged, it is still visible and identifiable.....	27
Figure 15 Kittiwake in flight.....	27
Figure 16 Gannet in flight, still easy identifiable against foamy background	27
Figure 17 Sitting guillemot.....	28
Figure 18 Sitting guillemot / razorbill	28

List of Tables

Table 1 Lateral and vertical camera tolerances (m)	7
Table 2 Image capture and other observations during the October to December 2022 seasonal survey (January 2023).	7
Table 3 Survey conditions during the October to December 2022 seasonal survey (January 2023).....	8
Table 4 Explanation of weather conditions.....	9
Table 5 Avian species included within higher-level taxonomic groups for the October to December 2022 seasonal survey period (January 2023)	10
Table 6 Marine mammal species included within higher-level taxonomic groups for the October to December 2022 seasonal survey period (January 2023)	11
Table 7 Total number of individuals of birds by species or species group recorded during the October to December 2022 seasonal survey period (January 2023)	13

Table 8	Total number of individuals of marine megafauna by species or species group recorded during the October to December 2022 seasonal survey period (January 2023)	13
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1. Executive Summary

This report constitutes the first seasonal (October to December 2022) report outlining results from digital aerial surveys conducted in January 2023 within the South-West Celtic Sea under the POSEIDON project and commissioned by Natural England. Surveys were undertaken using APEM's high-resolution camera system to capture digital still imagery of birds and marine megafauna within the Survey Area.

The survey was successfully carried out in a single day in January 2023, with no technical or safety issues. Due to weather delays, it was not possible to carry out the survey by the end of December 2022. A total of 746 observations were recorded in January 2023, of which 658 were observations of birds and 88 observations of marine megafauna. APEM will continue to monitor the site for these species and others during the remaining seasonal surveys.

2. Introduction

2.1 Background

APEM has been contracted by Natural England for the supply of four seasonal digital aerial surveys within the South-West Celtic Sea, commencing from December 2022. The surveys form part of the POSEIDON project which is led by Natural England and funded through the Crown Estates Offshore Wind Evidence and Change (OWEC) programme. Analysis of existing seabird and marine mammal data for English and Welsh waters identified gaps in the evidence base for the Survey Area. The main purpose of the survey programme is to address these evidence gaps through providing baseline information on the abundance, distribution and behaviour of birds and marine mammals within the Survey Area.

The Survey Area is located within the Celtic Sea to the west of Cornwall and Brittany (**Figure 1**) and covers an area of 18,011 square kilometres (km²). The survey method has been designed to optimise the data collection for all bird, marine mammal, and other marine megafauna species using a transect-based survey design at 1.5-centimetre (cm) ground sampling distance (GSD) to achieve a minimum of 3% captured and 3% analysed coverage using a twin-engine aircraft. These surveys have been carried out to meet the aims and objectives of the work by Natural England and the POSEIDON project.

This report describes the seasonal (October to December 2022) survey, undertaken in January 2023 due to weather delays throughout December, as part of the survey programme.

2.2 Aim of Report

The report presents information on marine birds, mammals, and other megafauna, which includes the following:

- Description of, and rationale for, survey methods and design
- Map of survey route and coverage
- Survey details as actually flown (including dates/times, weather and other relevant conditions)
- Raw count observations for behaviours of all avian and marine mammal species, as well as any other marine megafauna recorded per month within the Survey Area.
- Bird flight heights and direction
- Spatial distribution maps of avian, marine mammal, and other marine megafauna species.



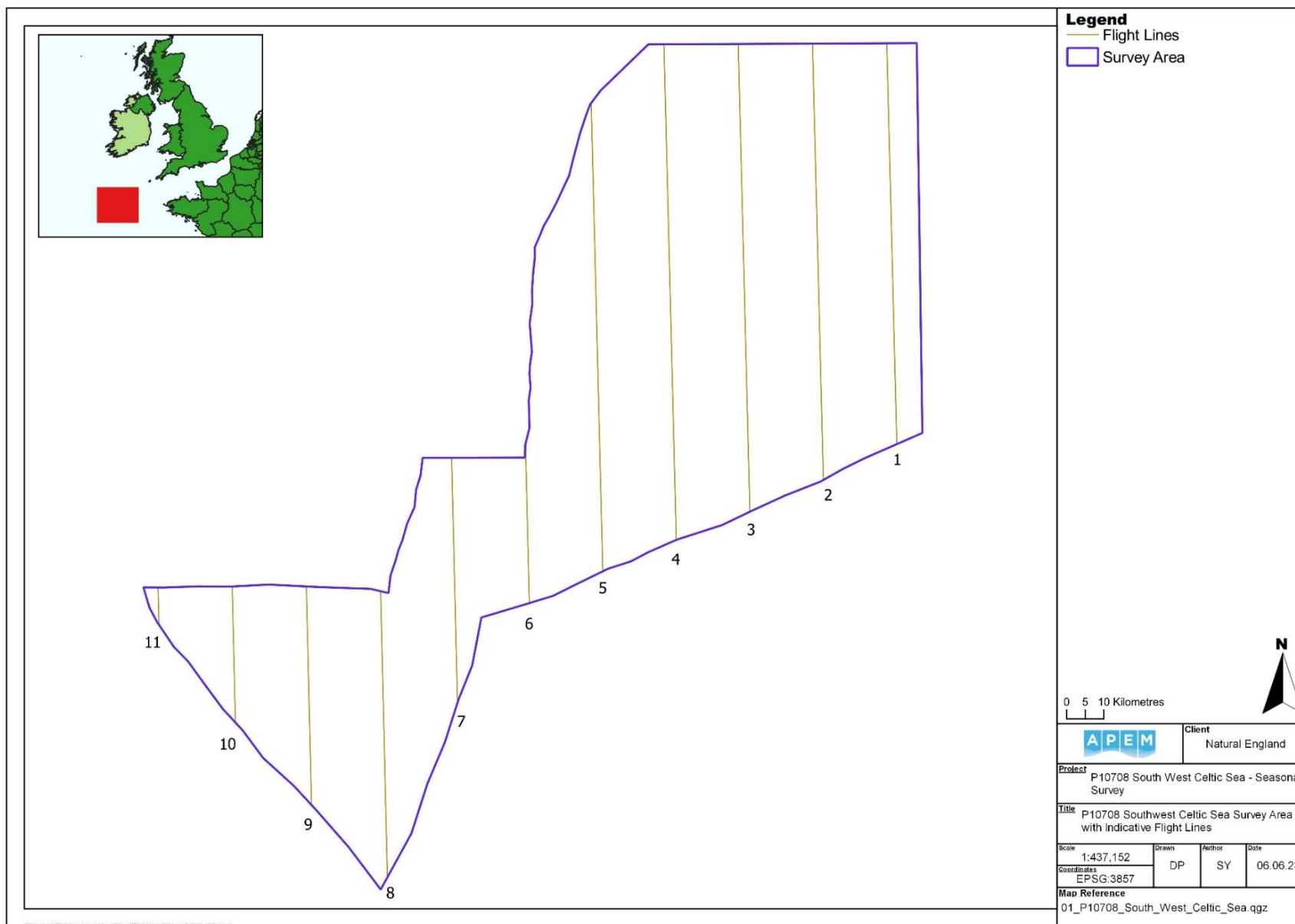


Figure 1 Location of the South-West Celtic Sea Survey Area

3. Survey and Analysis Methodologies

3.1 Digital Aerial Survey Methods

The survey was conducted using APEM's bespoke camera system, termed "Shearwater V", customised by in-house specialists for surveying the offshore environment. The camera system is integrated with custom flight planning software that allows each survey flight line to be accurately mapped before the aircraft leaves the ground. Each image capture node is precisely defined, allowing the system to fire the camera exposures at exactly the right location. This ensures that each survey is flown with the same orientation and the camera is triggered at the same position within set tolerances (**Table 1**). APEM's flight planning software enables tolerances along survey lines to be set, meaning the camera system would automatically abort data capture should the aircraft drift away from the planned flight line.

APEM's on-board camera technician continually monitored the imagery as it was collected to ensure data collected was fit for purpose. The camera technician would make the decision to cease data collection should conditions become unsuitable for surveying or data collection. Subsequently, the survey would then be resumed at the next earliest opportunity. All completed surveys therefore maintained conditions conducive to successful surveying.

Favourable conditions for surveying were defined as: a cloud base (lowest altitude of the visible portion of the cloud) of at least 1,300 ft, according to a geoidal model, to ensure there is no cloud below the planned altitude of the aircraft, visibility of greater than 5 km, wind speed of less than 30 knots, and sea state of 4 (moderate) or less. Naturally, the cloud base may vary in altitude, but aircraft will always fly lower than the lowest cloud level, if cloud base is lower than the planned aircraft altitude the survey would not take place. APEM's flight planning software allows for sideways, up and down movement of the aircraft to set tolerances ensuring the aircraft does not drift away from the line, and altitude remains suitable to achieve the required GSD. Whilst the image footprint and GSD both increase with altitude, the focus of the camera lenses ensures no discernible differences within the range of altitudes potentially flown. Wind speed was recorded at the same altitude as the aircraft, whereas sea state was determined from the appearance of the sea surface recorded by the onboard aerial survey technician. The two measures therefore do not necessarily correlate. For safety reasons, no surveying can take place in icing conditions.

Data capture comprised digital still images of an average 1.5 cm GSD. Images at each camera are processed at each node, resulting in slight variation in GSD across the swath width. GSD is smaller than 1.5 cm GSD at the nadir and increases with distance from the nadir, resulting in an average GSD of 1.5 cm. Images were collected in a continuous transect-based design using a Global Positioning System (GPS) linked, bespoke flight management system to ensure the tracks were flown with a high degree of accuracy (**Figure 2**). The aircraft's internal GPS and Inertial Motion Unit (IMU) systems record to an accuracy of +/- 3 to 5 m as standard.

The camera system captured abutting imagery along 11 survey flight lines spaced approximately 2 km apart within the Survey Area (**Figure 2**). The total Survey Area was 18,011 km². The aircraft collected the data at an altitude of approximately 1,450 ft (440m) according to the ellipsoid model as recorded by GPS, equivalent to 1,300 ft (395 m) above geoidal mean sea level, and at a speed of approximately 120 knots. Images were collected continuously along the survey flight lines with slight overlap between image nodes. For analysis purposes each transect should be treated as a single sample, therefore for the current survey design, n=11. Total coverage was calculated to be 3.29% captured and 3.29% analysed, generated from 6,285 image nodes. A total of 18 nodes were not captured across lines 2, 3, 4 and 8 (**Table 2**). Impact on coverage was negligible, with the target of 3% coverage achieved, including a redundancy of an additional 0.41%, which is over 10% contingency with respect to the target coverage.

Imagery was captured in raw format and post-processed to ensure optimal quality for the subsequent stage of image analysis, to extract information on marine fauna or other notable occurrences. When a survey was completed, data were checked to ensure the number of lines and the number of images collected was correct, and that the quality of the imagery was acceptable. Once image analysis was completed, further quality assurance (QA) processes took place (see **Section 3.3**).

Survey conditions are summarised in **Table 3**. Whilst strong winds (close to the standard limit of 30 knots during which condition are considered favourable for surveys) were noted during some lines, they did not constitute a health and safety risk. Weather conditions are defined in **Table 4**.

Weather conditions during all surveys were conducive to collecting and analysing imagery for the purpose of providing data on the identification, distribution, and abundance of bird species and marine fauna within the Survey Area.

Measures were taken to minimise glint and glare, such as avoiding surveying when the sun angle had the greatest potential to impact image quality. Furthermore, data collected provided coverage of 3.41%, thus exceeding the 3% coverage required, enabling sufficient coverage to be collected should images be affected by glint or glare.

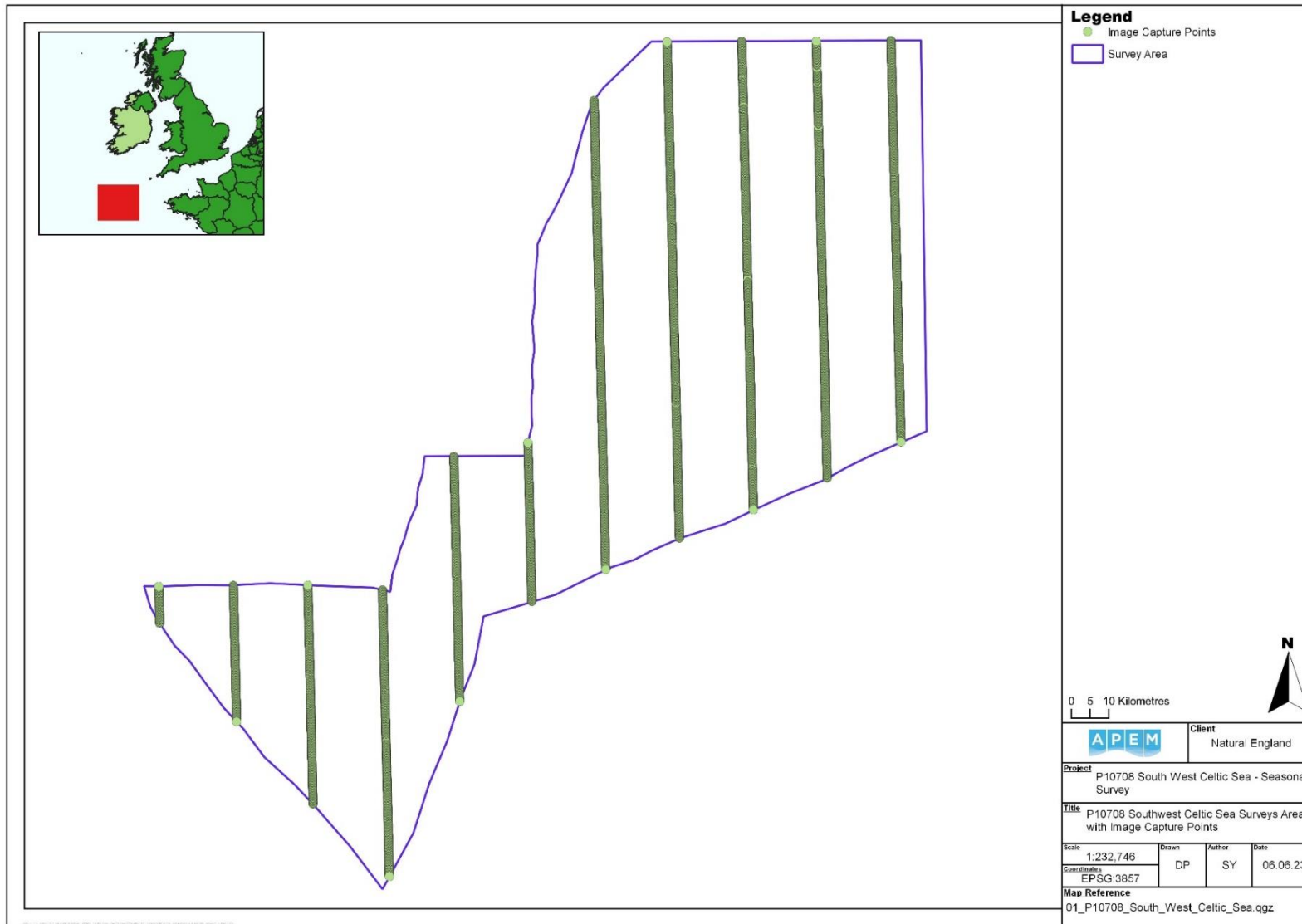


Figure 2 Individual image capture points during the October to December 2022 (January 2023) survey

Table 1 Lateral and vertical camera tolerances (m)

<u>Survey Tolerances</u>	Warning	Cutout	
Lateral Tolerance	30	60	m
Vertical tolerance	15	30 (No auto cutout)	m

Table 2 Image capture and other observations during the October to December 2022 seasonal survey (January 2023).

Survey line	Transect length (km)	N cameras capturing image	N image nodes	Camera issues	Shipping observations	Anecdotal observations	Health and Safety
1	247.00	3	761	1 missing node	-	-	-
2	248.14	3	829	10 missing nodes	-	-	-
3	248.99	3	888	-	-	-	-
4	250.14	3	941	-	-	-	-
5	250.99	3	891	-	-	-	Strong winds
6	252.14	3	308	-	1 unknown vessel	-	Strong winds
7	189.79	3	471	-	-	-	Strong winds
8	190.78	3	546	-	-	-	Strong winds
9	191.34	3	420	1 missing node	-	-	Strong winds
10	64.05	3	265	-	-	-	Strong winds
11	64.19	3	79	-	-	-	Strong winds

Table 3 Survey conditions during the October to December 2022 seasonal survey (January 2023)

Survey line	Date	Time on line (UTC) (Start / End)	Ground speed (knots)	Cloud cover (%)	Visibility (km)	Outside temperature (°C)	Wind speed (knots)	Wind direction	Sea state (Douglas)	Turbidity
1	26/01/2023	13:39 / 14:12	107	80 - 100	10+	7	25	50	2	1
2	26/01/2023	13:02 / 13:30	135	80 - 100	10+	7	25	50	2	1
3	26/01/2023	12:16 / 12:55	107	80 - 100	10+	7	24	50	2	1
4	26/01/2023	11:37 / 12:10	138	80	10+	7	24	50	2	1
5	26/01/2023	13:56 / 14:35	116	70	15	7	27	50	3	1
6	26/01/2023	13:37 / 13:49	125	70	15	7	27	50	3	1
7	26/01/2023	13:12 / 13:31	115	60 - 70	15	7	25	50	3	1
8	26/01/2023	12:39 / 13:01	107	60	15	6	30	50	3	1
9	26/01/2023	12:15 / 12:31	125	60	20	7	27	50	3	1
10	26/01/2023	11:57 / 12:08	110	60	20	7	32	50	3	1
11	26/01/2023	11:45 / 11:48	120	60	20	6	32	50	3	1

Table 4 Explanation of weather conditions.

Wind (Beaufort Scale)			Douglas Sea State			Cloud cover (%)		Turbidity	
Scale	Description	Mean wind speed (knots)	Scale	Description	Wave height	% Cover	Description	Scale	Description
0	Calm	0	0	Calm (glass)	No wave	0	Clear	0	Clear
1	Light air	2	1	Calm (rippled)	0 – 0.10 m	1-10	Few	1	Slightly Turbid
2	Light breeze	5	2	Smooth	0.10 – 0.50 m	11-50	Scattered	2	Moderately Turbid
3	Gentle breeze	9	3	Slightly Moderate	0.50 – 1.25 m	51-95	Broken	3	Highly Turbid
4	Moderate breeze	13	<i>Surveys not typically flown at sea states > 3.</i>			Overcast	96-100		
5	Fresh breeze	19	4	Moderate	1.25 – 2.50 m				
6	Strong breeze	24							
7	Near gale	30							
8	Gale	37							

3.2 Species Identification

The images were analysed to enumerate birds and marine mammals to species level where possible. Targets identified from the images were ‘snagged’ (i.e., located within the images) and categorised.

There were occasions when it was not possible to identify an individual in the digital aerial survey imagery to the species level and the individual was therefore identified as belonging to a higher-level taxonomic group (e.g., ‘small gull species’ or ‘dolphin / porpoise species’). The possible groups and the individual species attributed to them are listed in **Table 5** for birds and **Table 6** for marine mammals.

Table 5 Avian species included within higher-level taxonomic groups for the October to December 2022 seasonal survey period (January 2023)

Species	Group Level 1	Group Level 2	Group Level 3	Group Level 4
Golden Plover	Wader species			Unidentified Bird species
Grey Phalarope				
Kittiwake	Small Gull species		Gull species	
Great Black-backed Gull	Black-backed Gull species	Large Gull species		
Lesser Black-backed Gull				
Herring Gull				
Common Tern	'Commic' Tern		Tern species	
Arctic Tern				
Great Skua	Skua species			
Arctic Skua				
European Storm Petrel	Storm Petrel species			
Leach's Storm Petrel				
Guillemot	Guillemot and / or Razorbill	Auk species	Auk and / or shearwater species	
Razorbill				
Puffin				
Cory's Shearwater	Large Shearwater species	Shearwater species		
Sooty Shearwater				
Great Shearwater				
Manx Shearwater	Small Shearwater species			

Table 6 Marine mammal species included within higher-level taxonomic groups for the October to December 2022 seasonal survey period (January 2023)

Species	Group Level 1	Group Level 2	Group Level 3	Group Level 4
Grey Seal	Seal species			Unidentified Marine Mammal species
Common Dolphin	Dolphin species		Dolphin / Porpoise species	
Risso's Dolphin				
White-beaked Dolphin				
Common Bottlenose Dolphin				
Harbour Porpoise				

3.3 Summary of Quality Assurance

Internal QA was carried out on the data collected during the survey. A random sample of 20% of survey imagery were subjected to a QA audit review, in which agreement in positive images (those containing any target of interest) should reach 90% agreement versus the main analysis of the whole survey. Where 90% agreement was not reached, a complete re-analysis of the survey data was undertaken and extra positives from the re-analysis and QA audit are included in the data. For the current survey, the initial agreement was 70%. After re-analysis, agreement of 100% was attained.

In addition, identifications of targets (snags) are reviewed by our dedicated QA team. A minimum of 10% of snags are checked with the proportion increasing depending on survey difficulty and accuracy of identifications. For this survey 100% of identifications were checked.

3.4 Species Distribution Maps

Each animal recorded during the surveys was geo-referenced, enabling locations to be related to the boundary of the Survey Area. Corresponding coordinates for each observation were accurate to \pm 3 to 5 m. Spatial distribution maps for birds and other marine megafauna within the Survey Area have been produced using QGIS by separating individual species records during the surveys and representing these as symbols on a map. Symbols are determined by the species group, with a relevant icon and a unique colour assigned on a per species basis, the latter of which allows for a differentiation across the board between species that use the same icon. Icons in the distribution map will appear to overlap when individuals recorded during the surveys are in close proximity to each other.

3.5 Species Flight Heights

Bird flight heights were estimated from the digital still images using a size-based methodology developed by APEM from techniques described by Johnston and Cook (2016)¹. They were determined using bespoke APEM software that applies a set of rules developed in-house and trigonometry to provide an estimate of flight height above mean sea level (MSL). The accuracy of the application of the trigonometric rules varies depending on the size and position of the bird. The trigonometric calculation is based on species-specific (based on reference lengths taken from the literature) bird measurements, image GSD (the distance between pixel centres), the known height of the aircraft as the image was taken, and the pitch, roll, and yaw of the aircraft. These parameters are entered into APEM's flight height calculator to estimate the height of each individual bird captured in survey images. Flight height estimates are less reliable for birds that are diving or turning sharply (this affects the measurement of body length and wingspan from the image) or other aspects that may affect the body length measurement. Such birds are removed from the sample used to calculate flight heights. Flight height data is included within the separate raw data files.

¹ Johnston, A. and Cook, A.S.C.P., 2016. *How High Do Birds Fly?: Development of Methods and Analysis of Digital Aerial Data of Seabird Flight Heights*. British Trust for Ornithology.

4. Abundance and distribution

4.1 Abundance

A total of 658 birds were recorded in the Survey Area during the October – December 2022 seasonal (January 2023) survey. Of those, 196 were sitting on the water and 462 were in flight (**Table 7**). A total of 88 marine megafauna were recorded in the Survey Area (**Table 8**). Scientific names and taxonomy of species recorded are provided in **Appendix I Scientific Names and Taxonomy**.

Table 7 Total number of individuals of birds by species or species group recorded during the October to December 2022 seasonal survey period (January 2023)

Species Group	Species	Flying	Sitting	Total
Gulls	Kittiwake	293	109	402
	Great Black-backed Gull	-	1	1
	Lesser Black-backed Gull	2	1	3
	Gull species	1	-	1
Skua	Great Skua	-	1	1
Auk	Guillemot	-	22	22
	Guillemot / Razorbill	-	1	1
	Puffin	-	26	26
Fulmar	Fulmar	159	35	194
Gannet	Gannet	7	-	7
Total		462	196	<u>658</u>

Table 8 Total number of individuals of marine megafauna by species or species group recorded during the October to December 2022 seasonal survey period (January 2023)

Species Group	Species	Submerged	Surfacing	Deceased	Total
Dolphin	Common Dolphin	55	5	-	60
Porpoise	Harbour Porpoise	3	1	-	4
Dolphin/Porpoise	Dolphin / Porpoise	12	2	-	14
Whale	Beaked Whale species	-	-	1	1
Fish	Blue Shark	2	-	-	2
	Ocean Sunfish	6	1	-	7
Total		78	9	1	<u>88</u>

4.2 Spatial Distribution

Figure 3 and **Figure 4** show the locations of all birds and other marine megafauna, respectively, recorded in the Survey Area. **Figure 5** to **Figure 8** show the locations of the most abundant birds by species within the Survey Area. **Figure 9** shows the aggregated distribution of less abundant bird species recorded in the Survey Area. **Figure 10** shows the location of Common Dolphin within the Survey Area and **Figure 11** shows the aggregated distribution of less abundant marine megafauna recorded in the Survey Area. Lastly, **Figure 12** shows the location of the fishing vessel within the Survey Area. Birds were evenly distributed across the Survey Area. Marine megafauna species were also evenly distributed throughout the Survey Area.

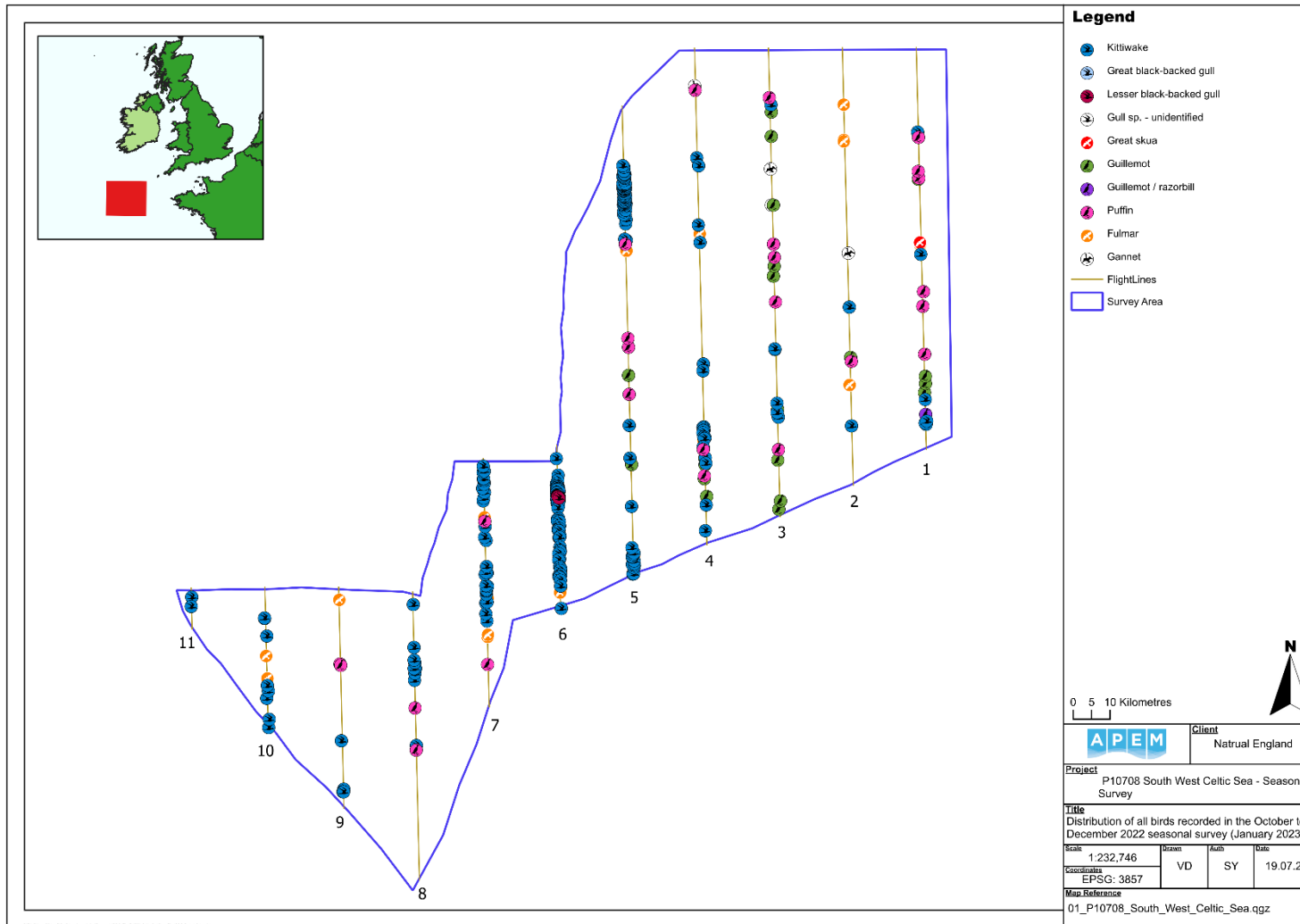


Figure 3 Distribution of all birds recorded in the October to December 2022 seasonal survey (January 2023).

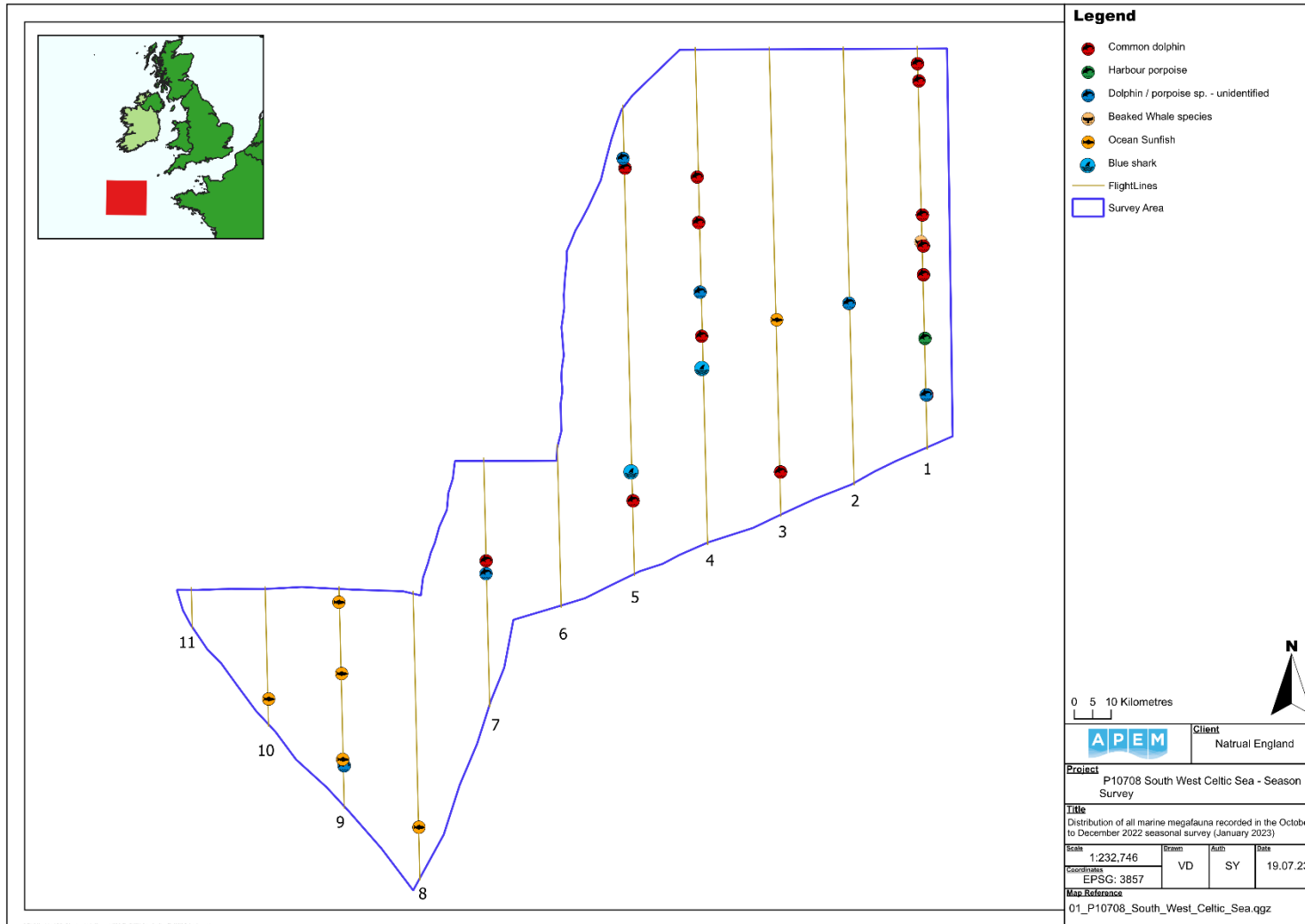


Figure 4 Distribution of all marine megafauna recorded in the October to December 2022 seasonal survey (January 2023)

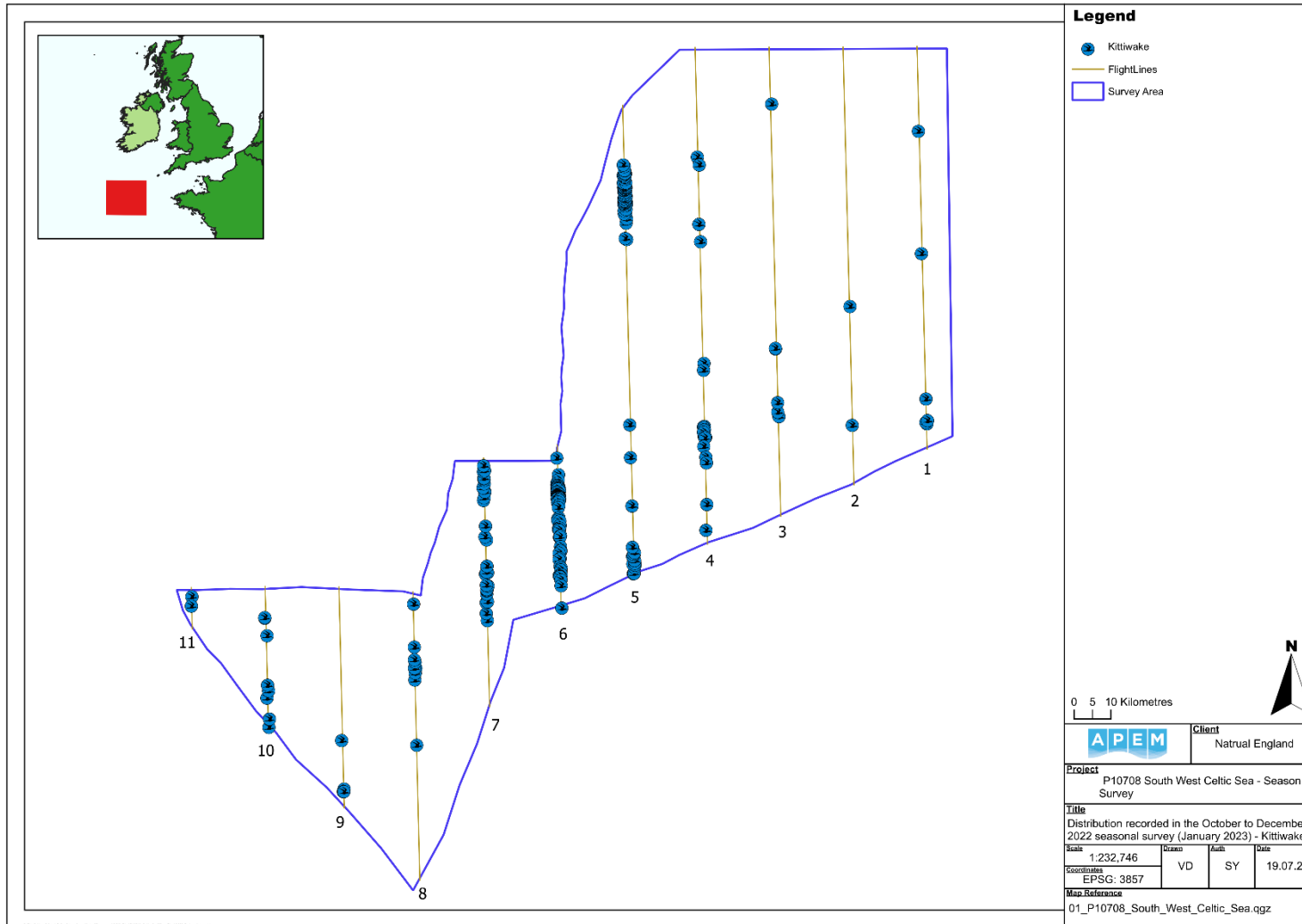


Figure 5 Kittiwake distribution recorded in the October to December 2022 seasonal survey (January 2023).

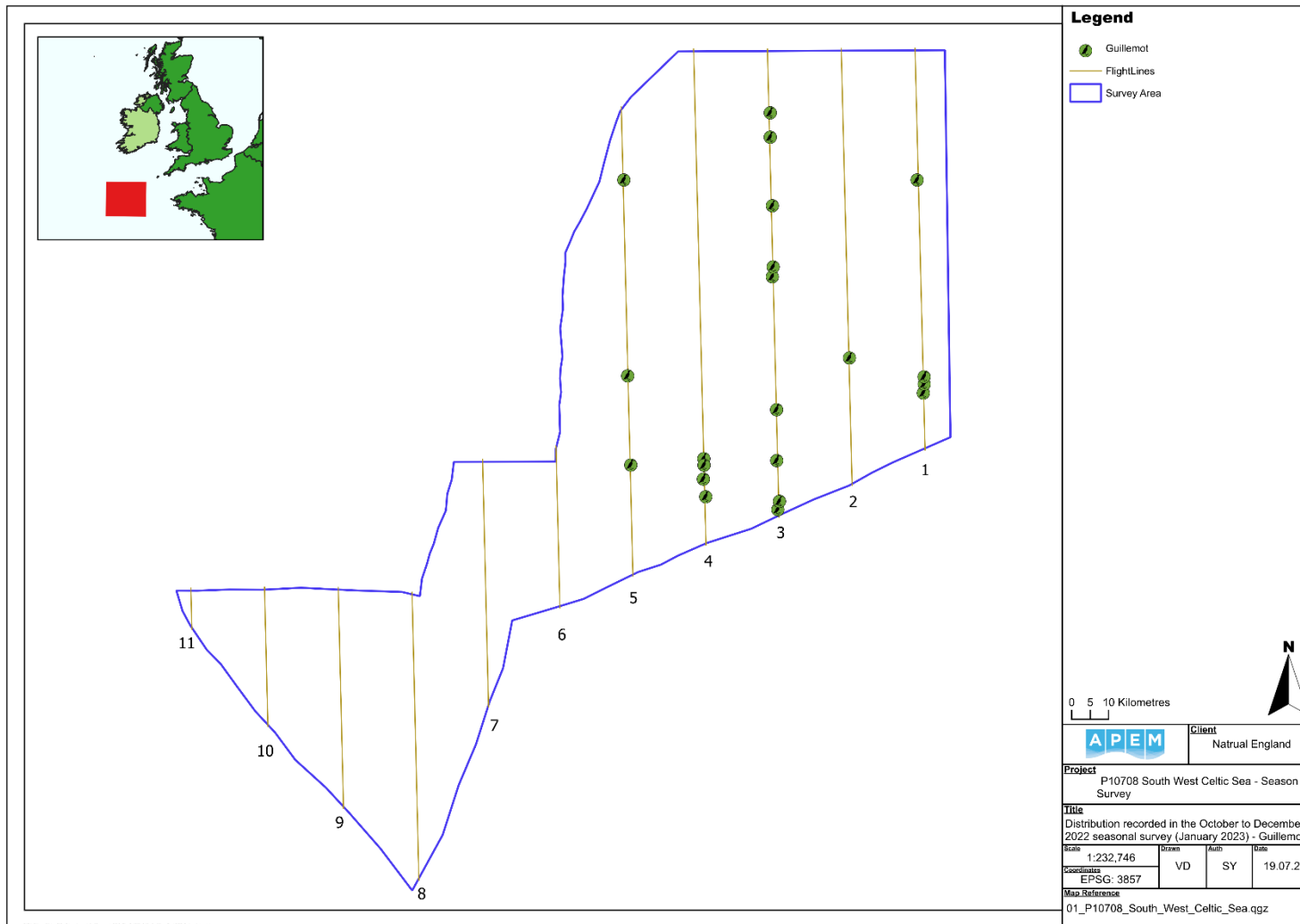


Figure 6 Guillemot distribution recorded in the October to December 2022 seasonal survey (January 2023).

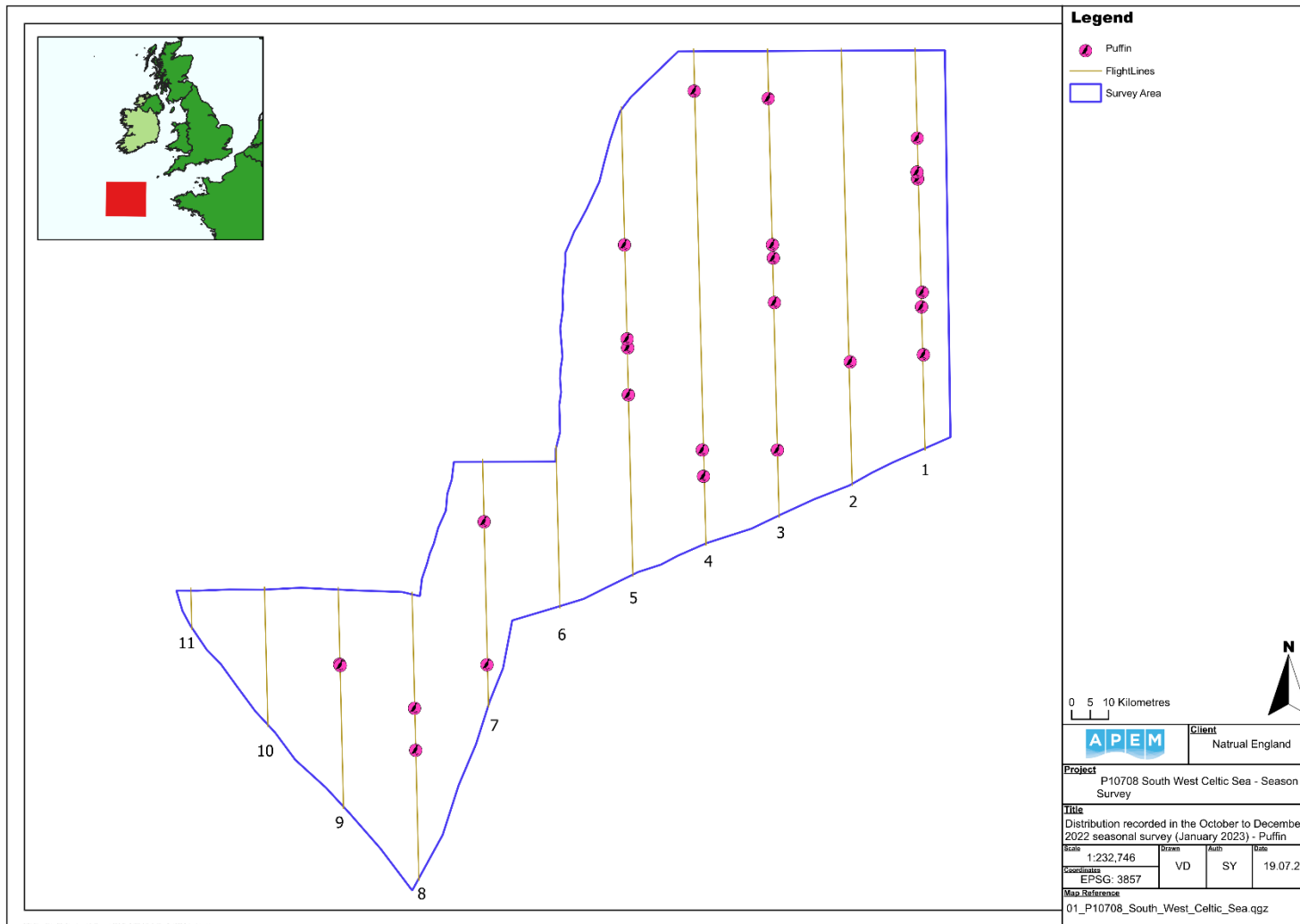


Figure 7 Puffin distribution recorded in the October to December 2022 seasonal survey (January 2023).

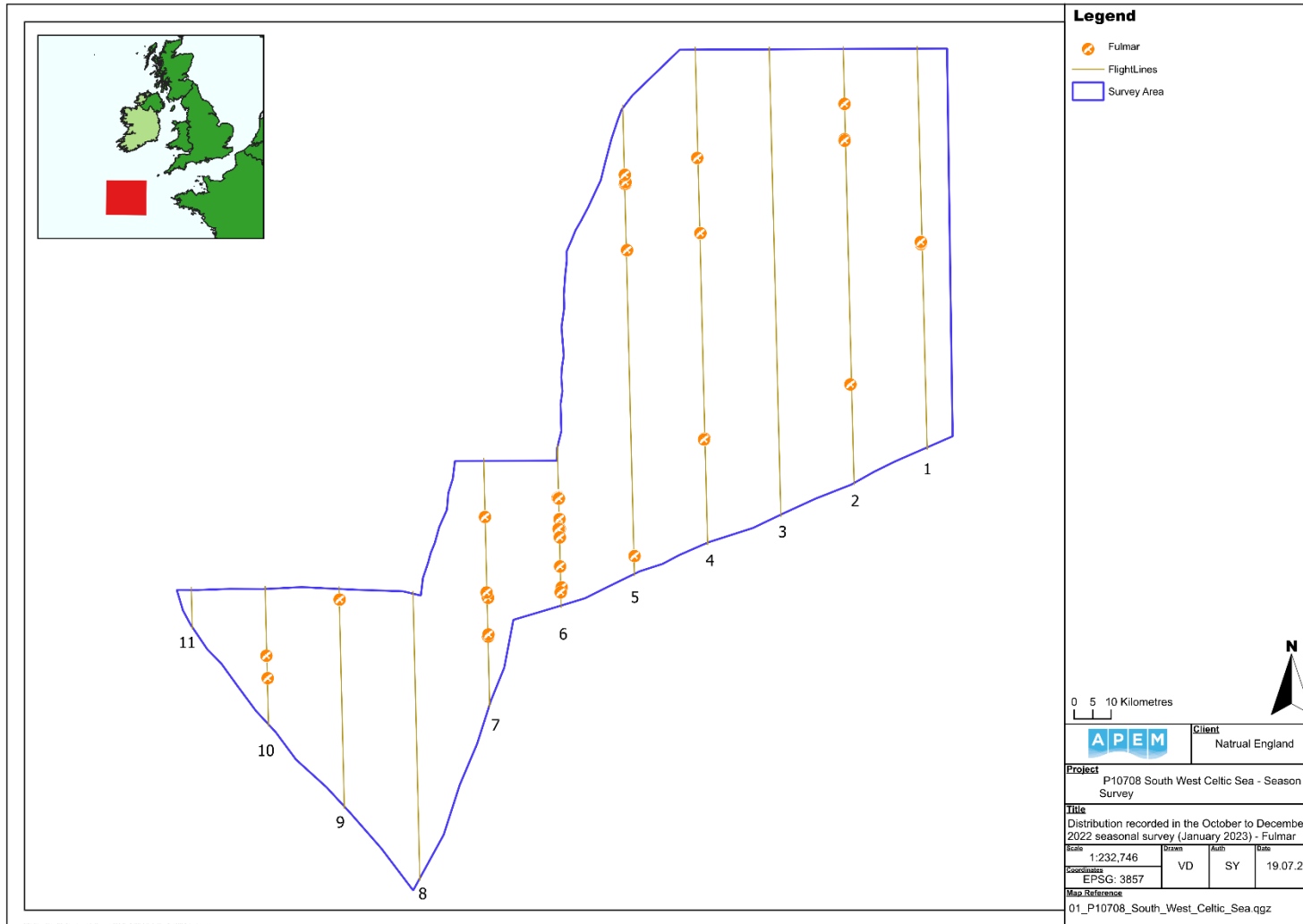


Figure 8 Fulmar distribution recorded in the October to December 2022 seasonal survey (January 2023).

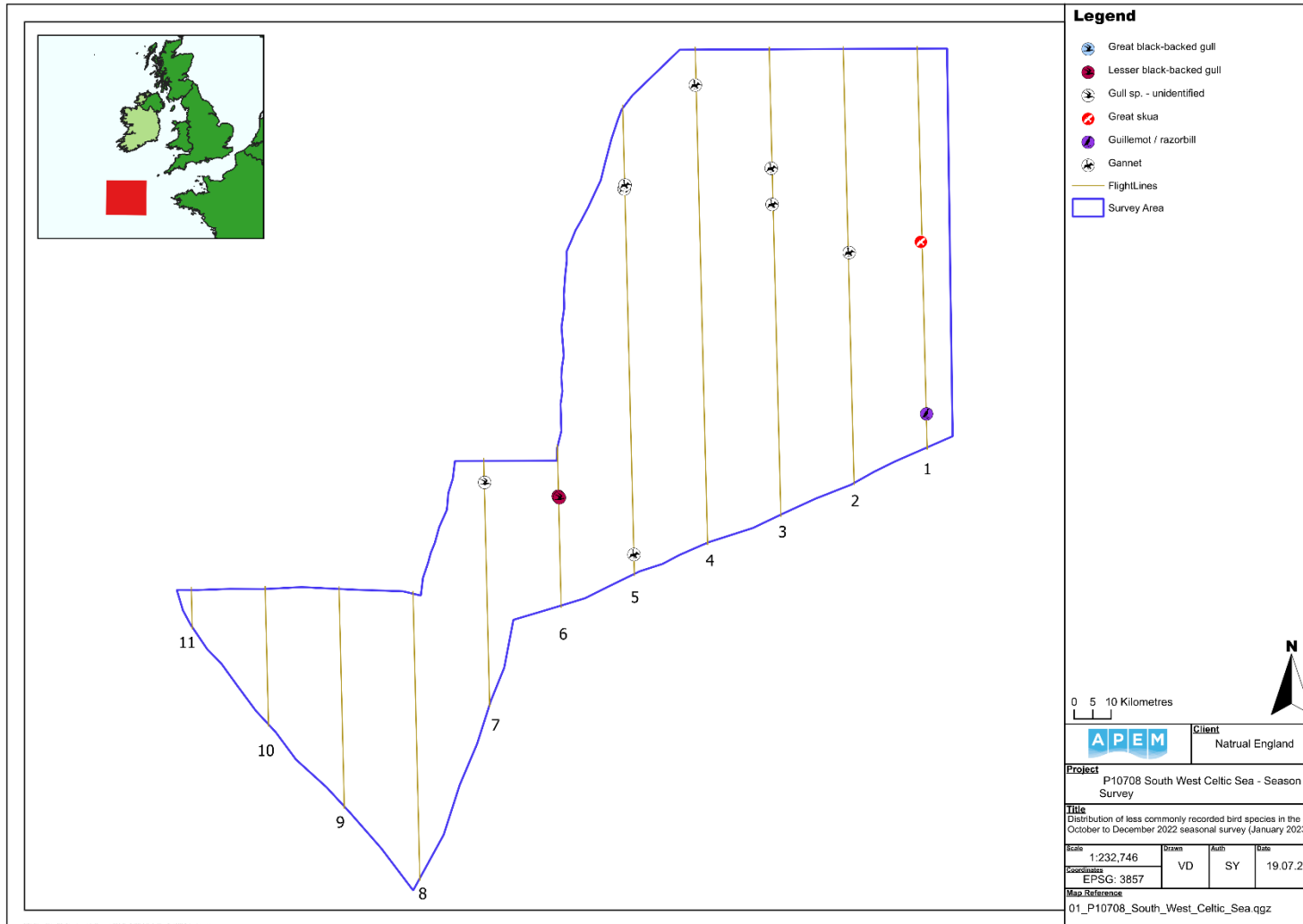


Figure 9 Distribution of less abundant bird species recorded in the October to December 2022 seasonal survey (January 2023).

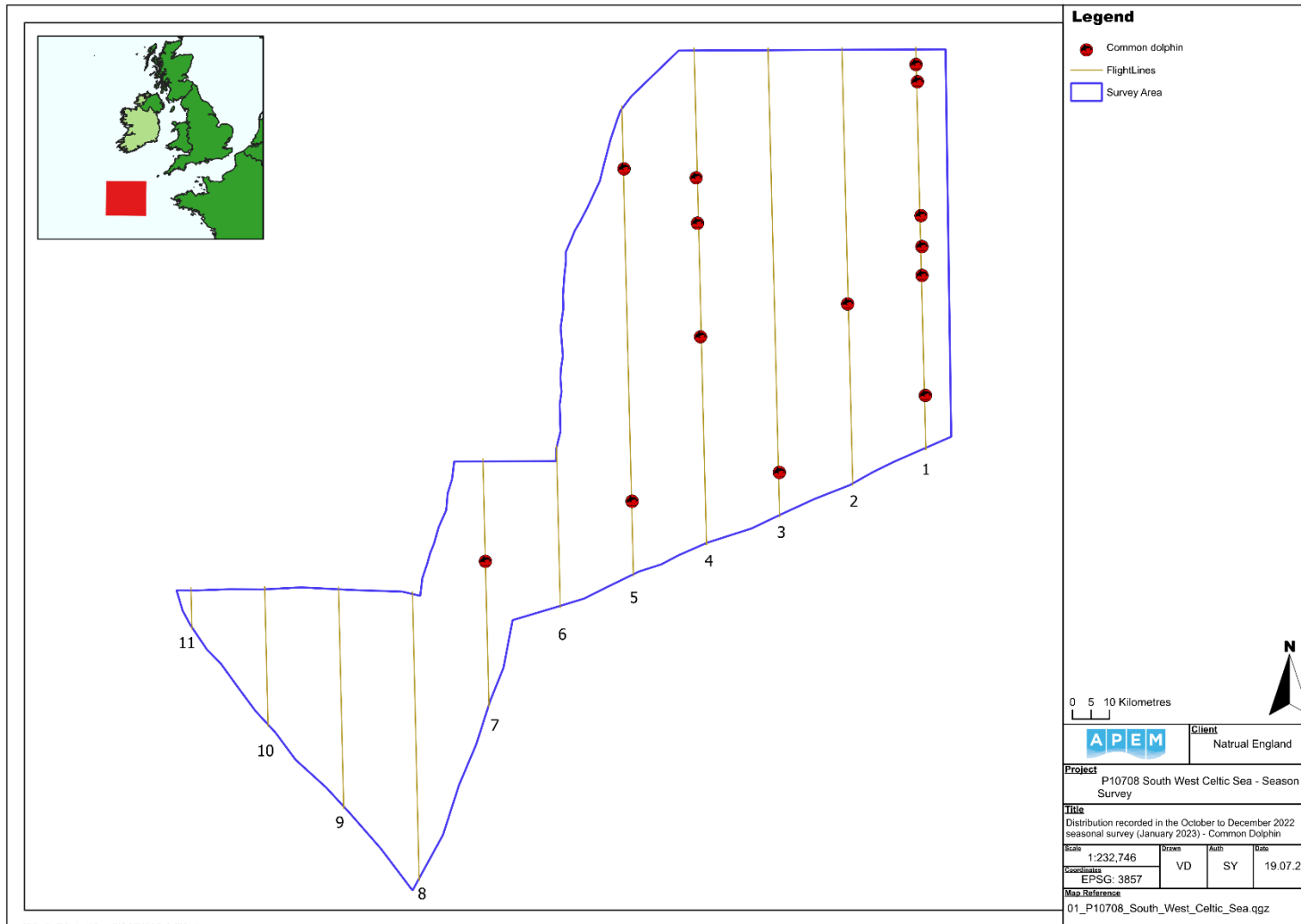


Figure 10 Common dolphin distribution recorded in the October to December 2022 seasonal survey (January 2023).

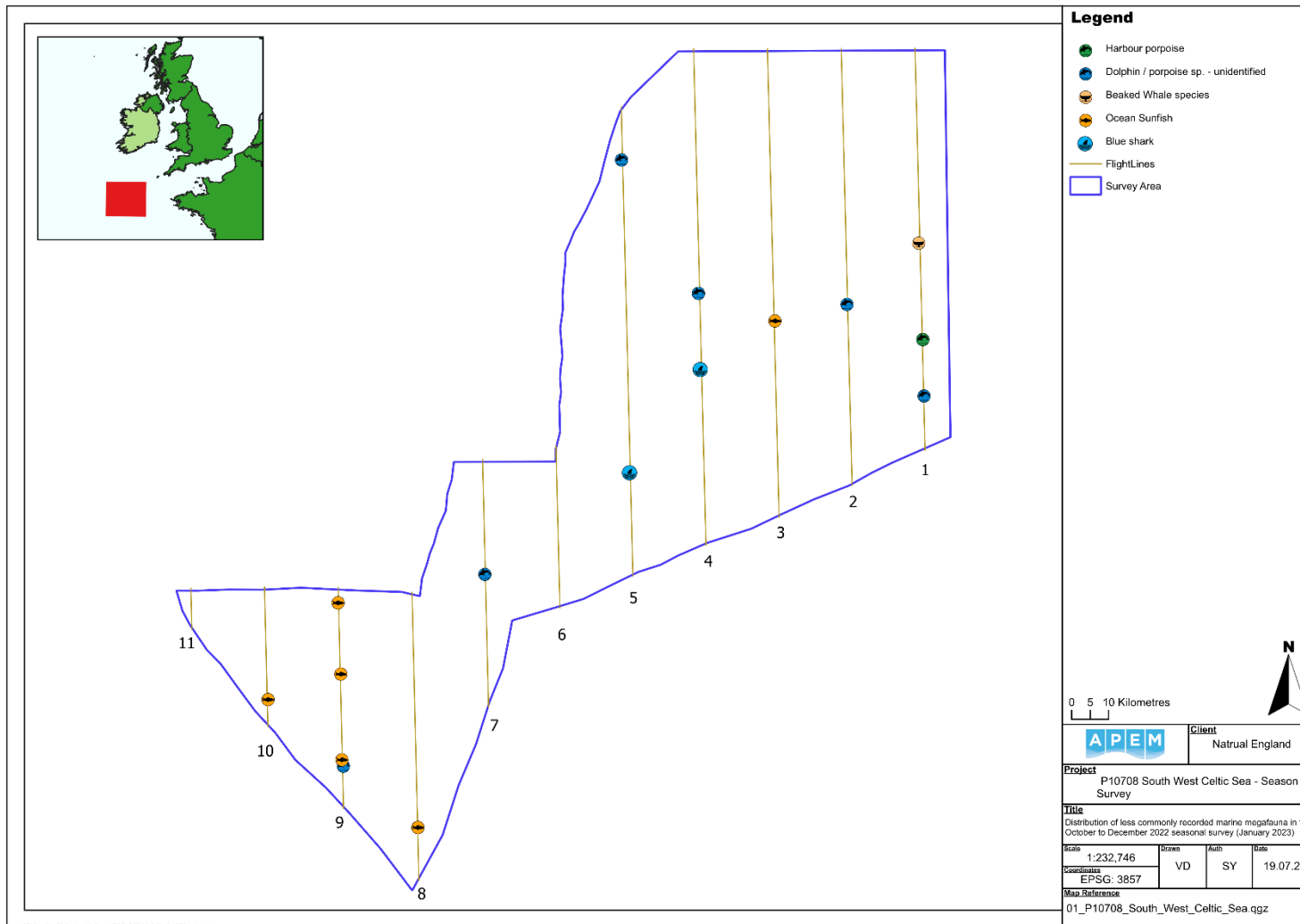


Figure 11 Distribution of less abundant marine megafauna recorded in the October to December 2022 seasonal survey (January 2023).

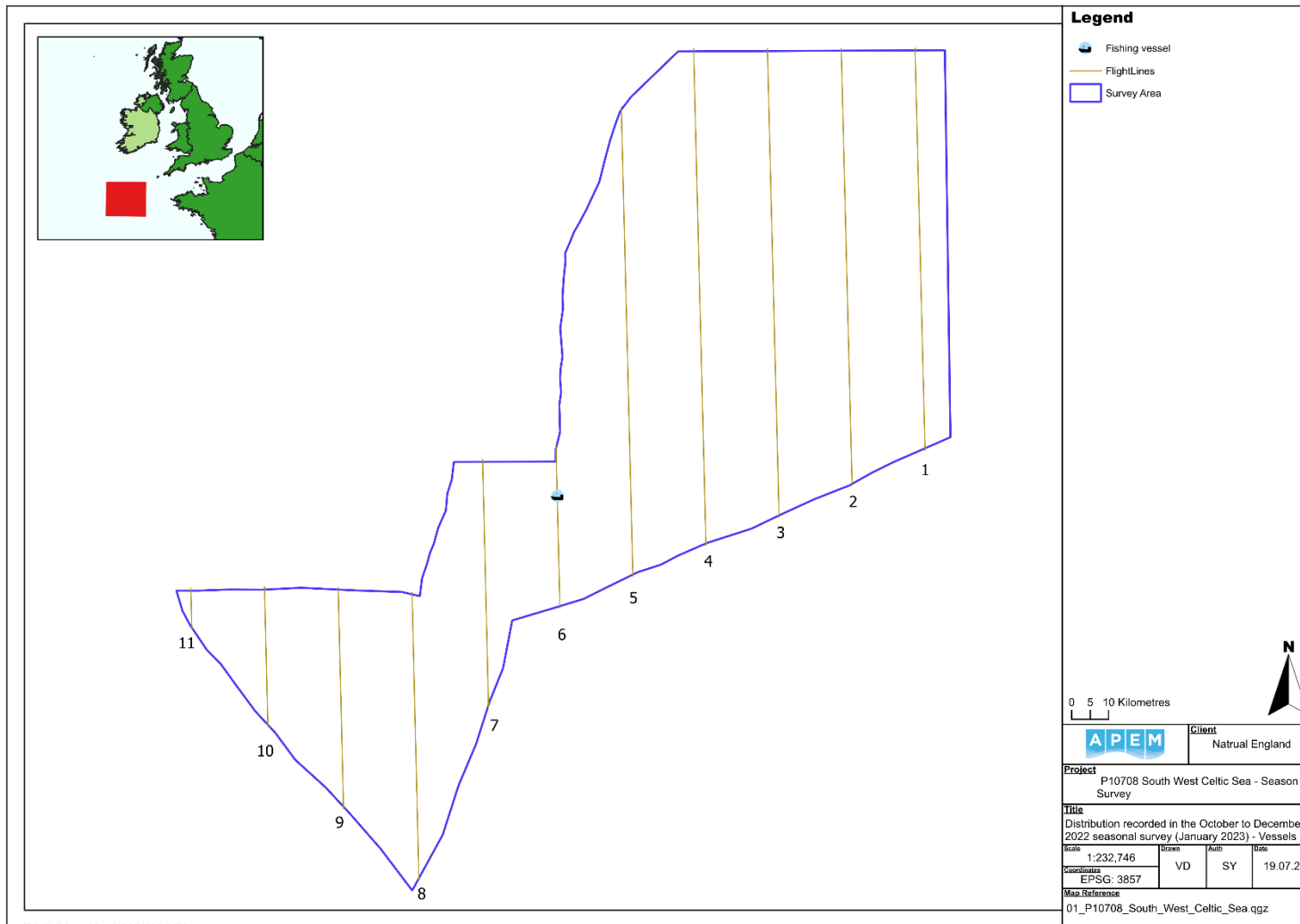


Figure 12 Distribution of vessels recorded in the October to December 2022 seasonal survey (January 2023).

5. Abiotic Structures and Observations

The following abiotic structures were observed during the survey period:

Two fishing vessels were observed from the aircraft. Both vessels were recorded along survey line number 1 on 26th of January, heading in a northerly direction. In addition to the two fishing vessels recorded, many other fishing vessels were seen in the general area on 26th of January.

Appendix I Scientific Names and Taxonomy

Scientific names and taxonomy for all species can be found in the below appendix.

Species	Scientific.Name
Kittiwake	<i>Rissa tridactyla</i>
Great Black-backed Gull	<i>Larus marinus</i>
Lesser Black-backed Gull	<i>Larus fuscus</i>
Great Skua	<i>Stercorarius skua</i>
Puffin	<i>Fratercula arctica</i>
Fulmar	<i>Fulmarus glacialis</i>
Gannet	<i>Morus bassanus</i>
Common Dolphin	<i>Delphinus delphis</i>
Harbour Porpoise	<i>Phocoena phocoena</i>
Blue Shark	<i>Prionace glauca</i>
Ocean Sunfish	<i>Mola mola</i>

Appendix II Example images (snags) of birds and marine mammals.

Images are jpeg files of a lower resolution than those used by image analysts when performing identifications.



Figure 13 Beaked whale

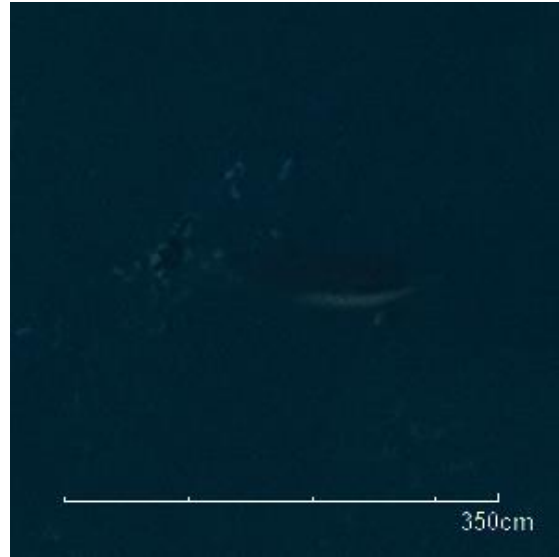


Figure 14 Common dolphin. Although submerged, it is still visible and identifiable



Figure 15 Kittiwake in flight



Figure 16 Gannet in flight, still easy identifiable against foamy background

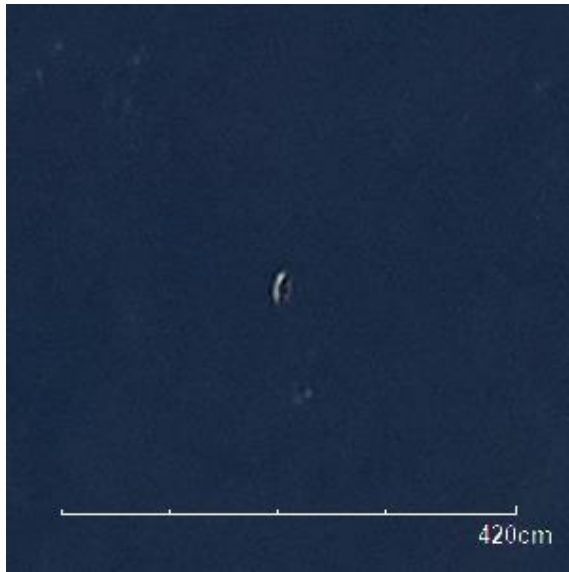


Figure 17 Sitting guillemot

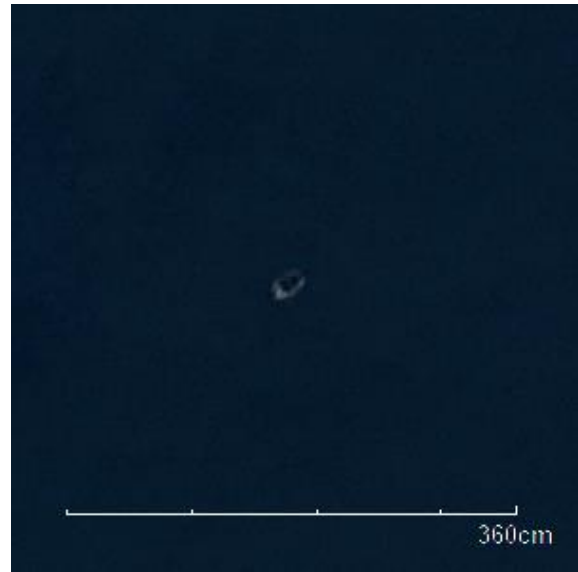


Figure 18 Sitting guillemot / razorbill