

Natural England

# **Ornithological and Marine Mammal Baseline Characterisation Surveys for the POSEIDON project**

**March (Seasonal) Report – Northern Isles**

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COMMERCIAL IN CONFIDENCE

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## 1. Executive Summary

This report constitutes the third seasonal (March 2024) report outlining results from digital aerial surveys conducted in March 2024 within the Northern Isles 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 across two days in March 2024. A total of 4,961 observations were recorded during the survey in March 2024, of which 4,928 were observations of birds and 33 were observations of marine mammals. 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 originally contracted by Natural England for the supply of three seasonal Digital Aerial Surveys (DAS) within the Northern Isles, commencing from September 2023. As of March 2024, a contract variation to undertake an additional spring survey was processed, totalling the survey programme to four DAS. 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, Welsh and Scottish 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 Northern Isles to the north, east and south of Shetland, Scotland (**Figure 1**) and covers an area of 21,594 square kilometres (km<sup>2</sup>). 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) resolution 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 (March 2024) survey, undertaken in March 2024, 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.

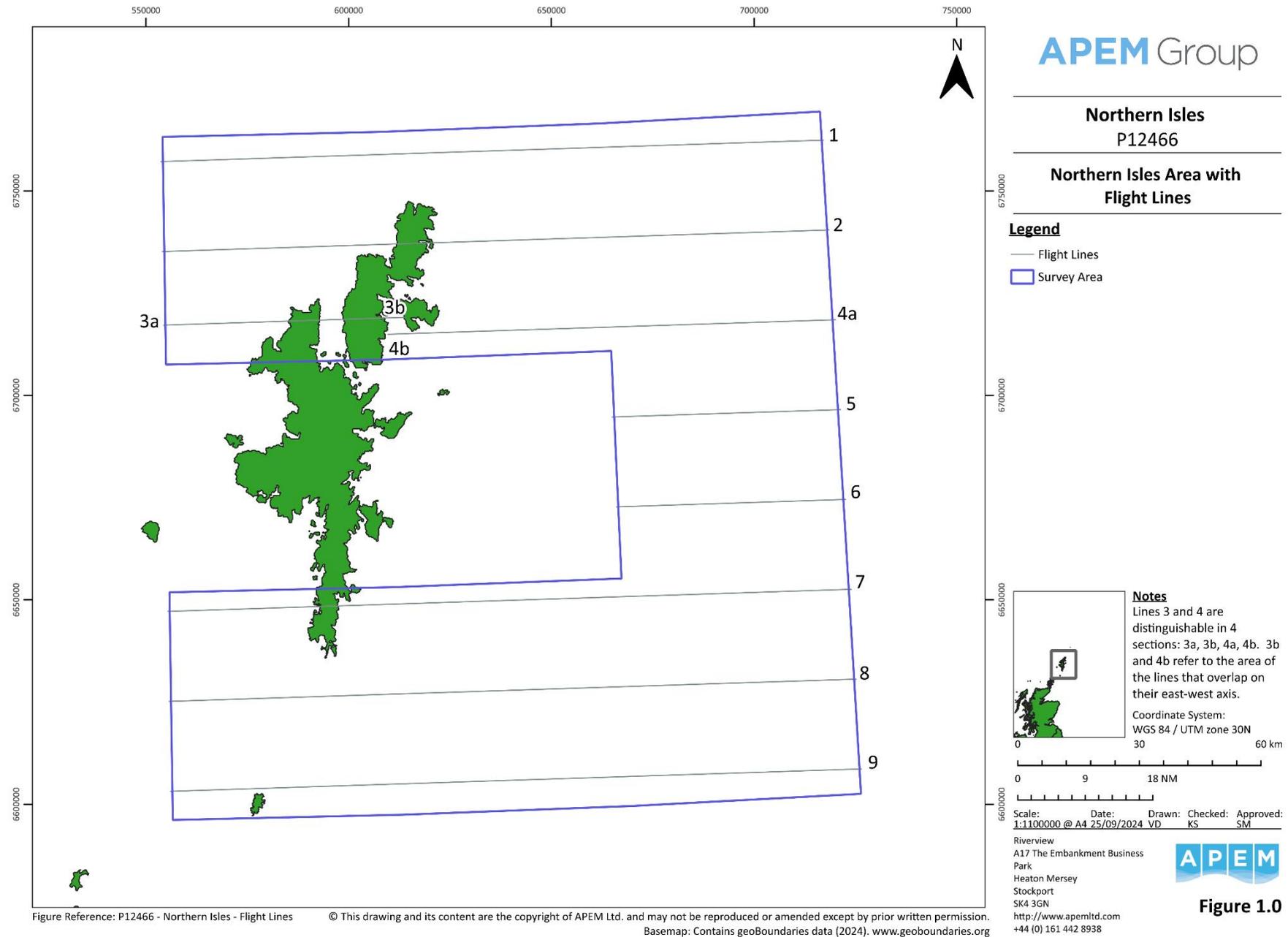


Figure 1 Location of Northern Isles Survey Area.

### 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. The process of automatically aborting data capture is called a 'cutout'. Should this occur, the plane is required to revisit and resurvey the affected section of the survey 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. Whilst the image footprint and Ground Sampling Distance (GSD) both increase with altitude, the flight plan tolerances and focus of the camera lenses ensures no discernible differences occur 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. Due to areas of high terrain, part of line 7 was planned at a higher geoidal altitude of 1,365 ft and lines 3 and 4 were split. Lines 3 and 4 are distinguishable in 4 separate sections: 3a, 3b, 4a, 4b. Lines in 3b and 4b refer to the area of the lines that overlap on their east-west axis.

Data capture comprised digital still images of an average 1.5 cm GSD. Images from each of the three cameras 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. Image resolution is therefore clearest at the nadir, although the variation is small. Images were collected in a continuous transect-based design along a single line covered by three overlapping cameras, using a Global Positioning System (GPS) linked, bespoke flight management system to ensure the tracks were flown with a high degree of accuracy. The aircraft's internal GPS and Inertial Motion Unit (IMU) systems record to an accuracy of +/- 3 to 5 m as standard.

The flights occurred on the 7<sup>th</sup> and 8<sup>th</sup> of March 2024. On the 7<sup>th</sup> of March, the first flight surveyed lines 1 and 2 (take off at 08:32, landing at 14:02)\*. On the 8<sup>th</sup> of March, the second flight surveyed lines 3 to 9 (take off at 10:37, landing at 16:38).

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\*Another project was surveyed between take off and commencement of the Northern Isles March 2024 survey, explaining the delayed time on line (**Table 3**). This had no effect on the Northern Isles survey.

The camera system captured abutting imagery along nine survey flight lines spaced approximately 22 km apart within the Survey Area (**Figure 1**). The total Survey Area was 21,594 km<sup>2</sup>. The aircraft collected the data at an average altitude of approximately 1,460 ft (445 m) according to the ellipsoid model as recorded by GPS, equivalent to 1,309 ft (399 m) above geoidal mean sea level, and at a speed of approximately 120 knots.

The Aerial Survey Technician (AST) noted camera system issues in both flights. On line 4, 22 additional nodes were captured due to a camera system issue. These misfires have been removed post-flight to ensure consistency with the planned survey design. The image quality was not compromised. On line 5, lens flushing\*\* failure occurred, though this did not impact image capture or image quality on this occasion and all images were successfully captured for this line. Additionally, the AST noted variable weather conditions across lines 1, 2, 3, 8 and 9, and due to the system freezing\*\*\* this has resulted in differing levels of darkness and brightness in the imagery. However, all images have been checked post-flight and have been deemed suitable for image analysis. Line 9 was initially attempted on the 7<sup>th</sup> of March. However, due to low cloud cover, this line was aborted with no images being captured and was flown entirely on the 8<sup>th</sup> of March.

Images were collected continuously along the survey flight lines with slight overlap between image nodes. To avoid double-counting due to image overlap, all image footprints are merged into a single file, for which total area is calculated. A total of 7,858 nodes were initially captured. Of these, 7,586 were used for analysis. The difference reflects nodes removed during clipping to the boundary area. Total analysed coverage was calculated to be 3.43% generated from 7,586 image nodes. (**Table 2**). The target coverage of 3% was achieved including a redundancy of an additional 0.43%, which is over 10% contingency with respect to the target coverage.

Effort data is calculated as the area (km<sup>2</sup>) per image footprint using trigonometric methods and the pinhole camera model (the mathematical relationship between the coordinates of a point in three-dimensional space, and its projection onto the image plane of an ideal pinhole camera). Effort is dependent on altitude, camera angle and aircraft position (pitch, roll and yaw), accounting for variation both between image nodes and individual cameras at each node. Effort data is only calculated for analysed images. It is therefore possible that some images have an effort value of zero. The effort values provided in the GPS log reflect the total footprint of each image and do not account for overlap. Therefore, summing these values for a survey would result in an overestimate of effort. The true effort for a given survey is calculated geospatially by creating polygons for each image footprint and removing the overlapping areas. Summing the analysed footprints and comparing against entire survey area gives the percentage analysed.

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**. Weather conditions are defined in **Table 4**. Weather conditions during the survey were conducive to collecting and analysing imagery for the purposes of

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\*\* Lens flushing is an error that occurs when the communication between the camera and the lens is disrupted, resulting in the system halting image download from the camera. This may effectively lead to the loss of images. The cause of this interruption may be due to turbulence jolting the system.

\*\*\* System freezing is a system error that resulted in the AST being unable to alter the camera settings.

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 3.43%, thus exceeding the 3% coverage required, enabling sufficient coverage to be collected should images be affected by glint or glare.

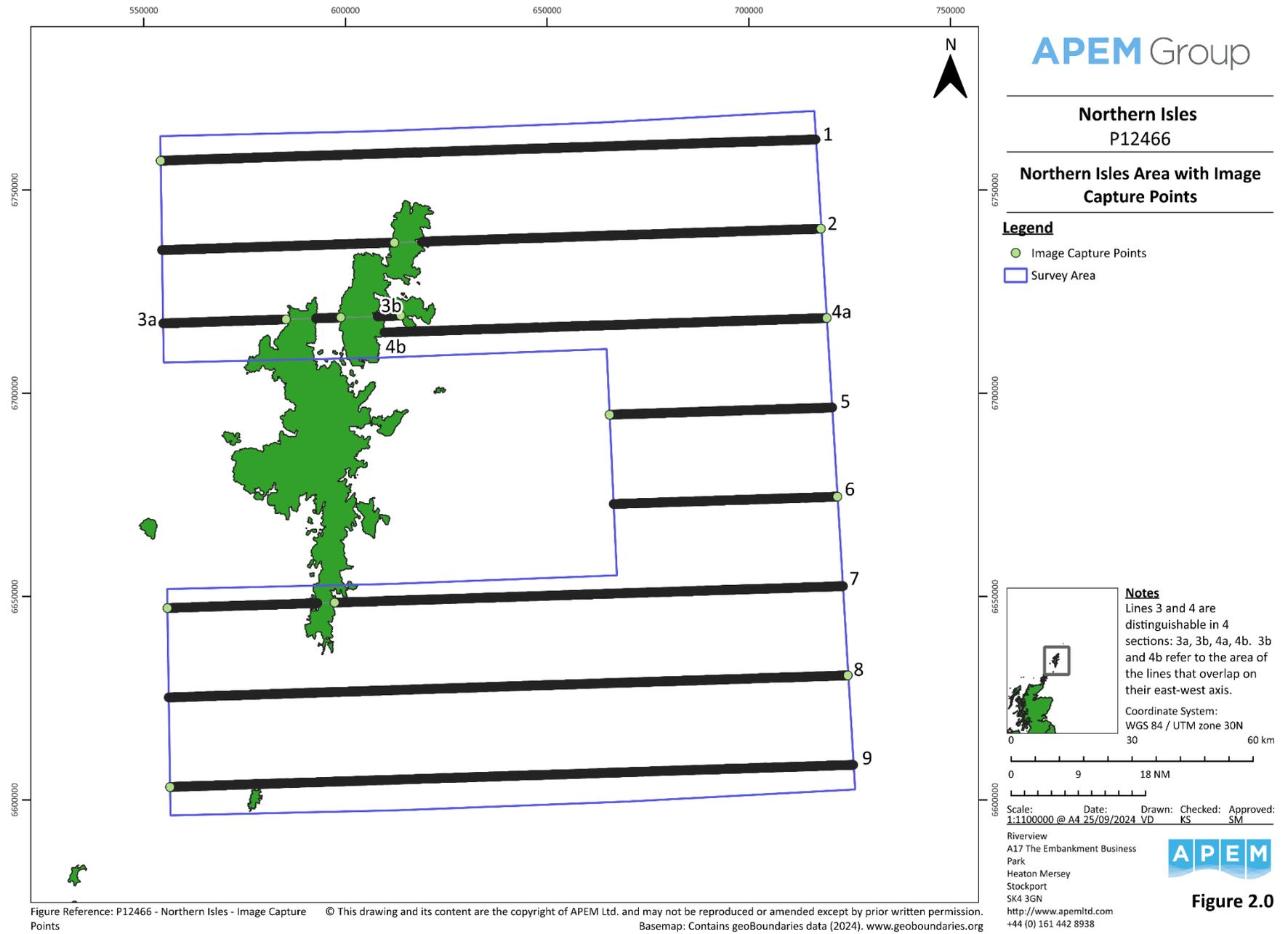


Figure 2 Individual image capture points during the March 2024 (March 2024) survey.

**Table 1 Lateral and vertical camera tolerances (m). A ‘cutout’ is the process of automatically aborting data capture. Should this occur, the plane is required to revisit and resurvey the affected section of the survey line.**

| <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 March 2024 seasonal survey (March 2024).**

| Survey line  | Transect length (km) | N cameras capturing image | N image nodes (captured) | N image nodes (analysed) | Camera issues*        | Shipping observations | Anecdotal observations | Health and Safety |
|--------------|----------------------|---------------------------|--------------------------|--------------------------|-----------------------|-----------------------|------------------------|-------------------|
| 1            | 162.48               | 3                         | 1,144                    | 1,137                    | System freezing       | -                     | **Variable weather     | -                 |
| 2            | 163.48               | 3                         | 1,151                    | 1,097                    | System freezing       | 1                     | **Variable weather     | -                 |
| 3***         | 58.94                | 3                         | 416                      | 299                      | System freezing       | -                     | **Variable weather     | -                 |
| 4***         | 109.69               | 3                         | 796                      | 768                      | System issue****      | -                     | Glint                  | -                 |
| 5            | 55.20                | 3                         | 395                      | 387                      | Lens flushing failure | Fishing Vessel        | -                      | -                 |
| 6            | 55.48                | 3                         | 396                      | 389                      | -                     | -                     | -                      | -                 |
| 7            | 168.05               | 3                         | 1,180                    | 1,144                    | -                     | -                     | -                      | -                 |
| 8            | 168.48               | 3                         | 1,186                    | 1,179                    | System freezing       | -                     | **Variable weather     | -                 |
| 9*****       | 169.48               | 3                         | 1,194                    | 1,186                    | System freezing       | -                     | **Variable weather     | -                 |
| <b>Total</b> | <b>1,111.28</b>      | <b>3</b>                  | <b>7,858</b>             | <b>7,586</b>             |                       |                       | <b>N/A</b>             |                   |

\*Due to the vast number of capture points collected during a survey it is not uncommon for camera systems to sometimes miss capture points. Typically, the number of missed capture points is low and random across the site. APEM collected additional data to ensure the required coverage was captured. Additionally, APEM’s onboard camera technician monitored data as it was being captured. Surveys are aborted or lines re-surveyed if camera issues impact data collection.

\*\*Variable weather conditions were noted by the AST along lines 1, 2, 3, 8 and 9. Due to system freezing, this resulted in varied image quality capture (darker and lighter images). On line 3, varying levels of brightness was captured in the imagery and on lines 8 and 9 varying levels of darkness was captured in the imagery. On lines 1 and 2, varying levels of darkness and brightness were captured in the imagery. However, all images have been checked post-flight and have been deemed suitable for image analysis.

\*\*\*Thirty image nodes each from line 3 and 4 overlapped on their 3b and 4b subsections, on the east-west axis (**Figure 2**). However, they were offset from each other on the north-south axis so that image nodes were not repeated.

\*\*\*\*An additional 22 nodes were captured on line 4 due to a camera system issue. These misfires have been removed post-flight to ensure consistency with the planned survey design. The image quality was not compromised.

\*\*\*\*\*Line 9 was initially attempted on the 7th of March. However, due to low cloud cover, this line was aborted with no images being captured and was flown entirely on the 8th of March.

**Table 3 Survey conditions during the March 2024 seasonal survey (March 2024).**

| Survey line | Date       | Time (UTC) on line (Start / End) | Ground speed (knots) | Cloud cover (%) | Visibility (km) | Outside temperature (°C) | Wind speed (knots) | Wind direction | Sea state (Douglas) | Turbidity |
|-------------|------------|----------------------------------|----------------------|-----------------|-----------------|--------------------------|--------------------|----------------|---------------------|-----------|
| 1           | 07/03/2024 | 11:30 / 12:15                    | 118                  | 50 - 80         | >10             | 3-4                      | 12 -16             | 150 - 160      | 3                   | 2         |
| 2           | 07/03/2024 | 12:24 / 13:12                    | 115                  | 40 - 80         | >10             | 3-4                      | 19 - 21            | 150 - 160      | 3                   | 2         |
| 3           | 08/03/2024 | 11:30 / 11:48                    | 115                  | 90              | >10             | 2                        | 30                 | 120            | 3                   | 2         |
| 4           | 08/03/2024 | 11:53 / 12:35                    | 110                  | 20 - 90         | >10             | 2                        | 19 - 30            | 120            | 3                   | 2         |
| 5           | 08/03/2024 | 12:40 / 12:56                    | 110                  | 20              | >10             | 2                        | 17                 | 80             | 3                   | 2         |
| 6           | 08/03/2024 | 13:06 / 13:22                    | 101                  | 30              | >10             | 2                        | 19                 | 90             | 3                   | 2         |
| 7           | 08/03/2024 | 13:29 / 14:16                    | 125                  | 40 - 90         | >10             | 2                        | 23 - 24            | 80 - 90        | 3                   | 2         |
| 8           | 08/03/2024 | 14:23 / 15:13                    | 116                  | 80 - 90         | >10             | 2                        | 23 - 26            | 80 - 110       | 3                   | 2         |
| 9           | 08/03/2024 | 15:21 / 16:06                    | 123                  | 40 - 70         | >10             | 2                        | 18 - 24            | 80 - 90        | 3                   | 2         |

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 &gt; 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 higher-level taxonomic groups for the March 2024 seasonal survey period (March 2024).**

| Species                   | Group Level 1             | Group Level 2      | Group Level 3    | Group Level 4             |
|---------------------------|---------------------------|--------------------|------------------|---------------------------|
| Red-breasted Merganser    | -                         |                    | Wildfowl species | Unidentified Bird species |
| Oystercatcher             | Wader species             |                    |                  |                           |
| Curlew                    |                           |                    |                  |                           |
| Kittiwake                 | Small Gull species        |                    | Gull species     |                           |
| Common Gull               |                           |                    |                  |                           |
| Greater Black-backed Gull | Black-backed Gull species | Large Gull species |                  |                           |
| Herring Gull              |                           |                    |                  |                           |
| Guillemot                 | Guillemot or Razorbill    | Auk species        |                  |                           |
| Razorbill                 |                           |                    |                  |                           |
| Black Guillemot           |                           |                    |                  |                           |
| Puffin                    |                           |                    |                  |                           |
| Great Northern Diver      | Diver species             |                    |                  |                           |
| Fulmar                    | Fulmar / Gull species     |                    |                  |                           |
| Gannet                    |                           |                    |                  |                           |

**Table 6 Marine mammal species included within higher-level taxonomic groups for the March 2024 seasonal survey period (March 2024).**

| Species          | Group Level 1   | Group Level 2      |
|------------------|-----------------|--------------------|
| Risso’s Dolphin  | Dolphin species | Dolphin / Porpoise |
| Orca             |                 |                    |
| Harbour Porpoise |                 |                    |

### 3.3 Summary of Quality Assurance

Internal QA was carried out on the data collected during the survey. This consists of two steps: Blank QA and Species ID QA.

Prior to the first step of QA, two groups of Image Analysts conducted image screening: one analysing all survey imagery and the other, a random 20% sample. During screening, where a positive target was detected in the imagery, the target pixel coordinates were recorded, and the image was marked as positive (containing at least one target of interest).

Following screening, the same 20% sample of survey imagery was subjected to a QA audit review by our dedicated QA team, in which the results from the two Image Analysts were compared. This first QA step, referred to as Blank QA (Image Screening QA), reviewed percentage agreement of two metrics: image agreement and the newly introduced target agreement. For image agreement, images identified as positive and those identified as blank (not containing any targets of interest), were reviewed. For target agreement, image pixel coordinates of positively identified targets were reviewed. During this review, agreement in positive images and target locations 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. This consisted of analysing every image from the survey again. Additional positive images and targets from the re-analysis and QA audit were then included in the data. For the current survey, the initial image agreement was 95%. No re-analysis was required on this occasion. The initial target agreement rate was 94%. No re-analysis was required on this occasion.

Prior to the second step in the QA process, the tagged data underwent initial data checks, which are a series of discretionary sense checks carried out by QA Analysts. No fixed metrics are associated with these checks; this step provides an additional layer of checks to ensure the tagged data is as accurate as possible. This process involves sense checking tagged images for missed targets such as images or areas containing large aggregations of birds, pods of marine mammals and anthropogenic structures. A selection of images was checked for accuracy in target duplication and a sample of blank images were also checked for potential missed targets around busy areas of the survey.

The second step of the QA process, referred to as Species ID QA, reviewed species identifications. Target (snag) identifications made by Image Analysts were reviewed and an agreement rate determined. If the original identification made by the Image Analyst matched that made by the QA Analyst, this was considered an agreement. Agreement was also made if the original and the QA identifications were both within the same taxonomic grouping, for example an initial identification of guillemot / razorbill, and a QA identification as guillemot. This method was adopted by BTO's method of species identification QA. As the current standard, 100% of the identifications were checked to ensure data accuracy. All data underwent a final review by a Technical Specialist. For the current survey, the identification agreement rate for targets identified to the same taxonomic rank was 91.8% for all snags recorded. The identification agreement rate for targets identified to the same taxonomic grouping was 98.31% for all snags recorded. In this step of QA, all targets underwent review; therefore, agreement rates may be inclusive of anthropogenic targets. Additional checks on behaviour, age, sex and flight height suitability were also reviewed.

### 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 Height

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)<sup>1</sup>. 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 bird measurements (based on reference lengths taken from the literature), 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.

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<sup>1</sup> 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 4,928 birds were recorded in the Survey Area during the March 2024 seasonal (March 2024) survey. Of those, 2,921 were in flight, 1,999 were sitting on the water, seven were perched and a single individual was deceased (**Table 7**).

A total of 33 marine mammals 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 March 2024 seasonal survey period (March 2024).**

| Species Group             | Species                   | Flying       | Sitting      | Perched  | Diving   | Taking off | Deceased | Total        |
|---------------------------|---------------------------|--------------|--------------|----------|----------|------------|----------|--------------|
| Wildfowl                  | Red-breasted Merganser    | -            | 5            | -        | -        | -          | -        | 5            |
| Waders                    | Oystercatcher             | 4            | -            | -        | -        | -          | -        | 4            |
|                           | Curlew                    | 20           | -            | -        | -        | -          | -        | 20           |
| Gulls                     | Kittiwake                 | 36           | 10           | -        | -        | -          | -        | 46           |
|                           | Common Gull               | 11           | 4            | -        | -        | -          | -        | 15           |
|                           | Great Black-backed Gull   | 32           | 111          | -        | -        | -          | -        | 143          |
|                           | Herring Gull              | 16           | 5            | -        | -        | -          | -        | 21           |
|                           | Large Gull species        | 1            | 3            | 6        | -        | -          | -        | 10           |
|                           | Gull species              | -            | 3            | -        | -        | -          | -        | 3            |
| Auks                      | Guillemot                 | 4            | 117          | -        | -        | -          | -        | 121          |
|                           | Razorbill                 | -            | 95           | -        | -        | -          | -        | 95           |
|                           | Guillemot / Razorbill     | -            | 341          | -        | -        | -          | -        | 341          |
|                           | Black Guillemot           | -            | 65           | -        | -        | -          | -        | 65           |
|                           | Puffin                    | -            | 5            | -        | -        | -          | -        | 5            |
|                           | Auk species               | -            | 16           | -        | -        | -          | -        | 16           |
| Divers                    | Great Northern Diver      | -            | 8            | -        | -        | -          | -        | 8            |
| Fulmar                    | Fulmar                    | 2,584        | 985          | -        | -        | -          | -        | 3,569        |
| Fulmar / Gull             | Fulmar / Gull species     | -            | 1            | -        | -        | -          | 1        | 2            |
| Gannet                    | Gannet                    | 212          | 223          | -        | -        | -          | -        | 435          |
| Cormorant or Shag         | Cormorant / Shag          | -            | -            | 1        | -        | -          | -        | 1            |
| Unidentified Bird species | Unidentified Bird species | 1            | 2            | -        | -        | -          | -        | 3            |
| <b>Total</b>              |                           | <b>2,921</b> | <b>1,999</b> | <b>7</b> | <b>-</b> | <b>-</b>   | <b>1</b> | <b>4,928</b> |

**Table 8 Total number of individuals of marine megafauna by species or species group recorded during the March 2024 seasonal survey period (March 2024).**

| Species Group | Species          | Deeply Submerged* | Submerged** | Surfacing | Bottling*** | Hauled Out | Deceased | Total            |
|---------------|------------------|-------------------|-------------|-----------|-------------|------------|----------|------------------|
| Dolphin       | Orca             | -                 | 2           | -         | -           | -          | -        | <b>2</b>         |
|               | Risso's Dolphin  | -                 | 3           | -         | -           | -          | -        | <b>3</b>         |
| Porpoise      | Harbour Porpoise | 1                 | 18          | 9         | -           | -          | -        | <b>28</b>        |
| <b>Total</b>  |                  | <b>1</b>          | <b>23</b>   | <b>9</b>  | -           | -          | -        | <b><u>33</u></b> |

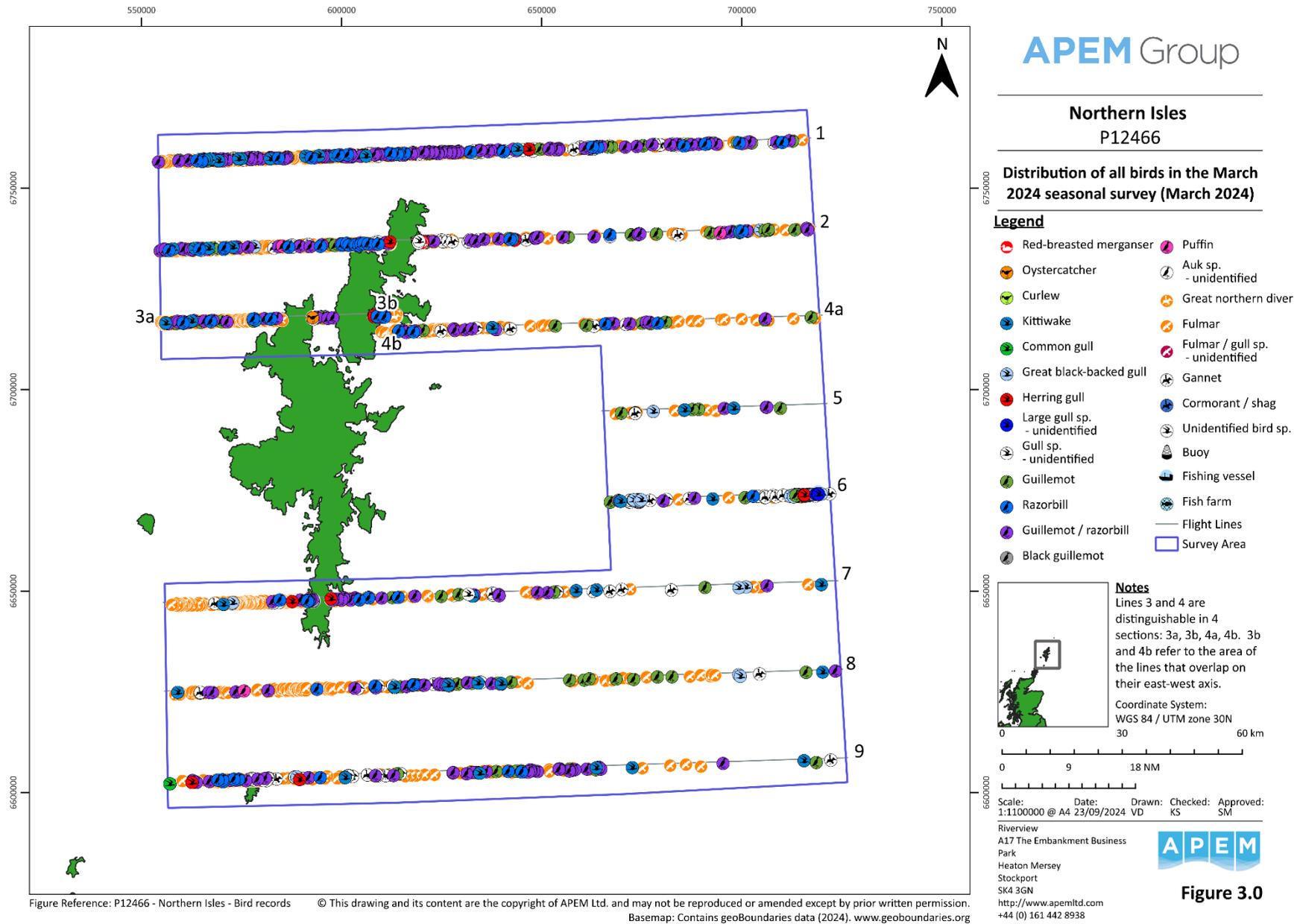
\*The target is far beneath the surface so that many features are difficult to distinguish. Deeply submerged targets may be difficult to identify to species level.

\*\*The target is wholly underwater, within the first few metres of the surface. Features used to aid identification are usually visible.

\*\*\*Applies to seals, where the head is positioned above the surface and the rest of the body is submerged vertically.

#### 4.2 Spatial Distribution

**Figure 3** and **Figure 4** show the locations of all birds and marine megafauna, respectively, recorded in the Survey Area. Birds were recorded across the Survey Area, with fewer records in the east and southeast of the Survey Area. Marine mammals were loosely scattered across the Survey Area, with the majority of records in the east. **Figure 5** to **Figure 14** show distributions of more abundant birds by species, whilst **Figure 15** shows the distribution of less frequently recorded bird species. **Figure 16** shows the distributions of more abundant marine megafauna and **Figure 17** shows the distribution of less frequently recorded marine megafauna species. **Figure 18** shows distribution of vessels and abiotic structures in the Survey Area.



**Figure 3 Distribution of all birds recorded in the March 2024 seasonal survey (March 2024).**

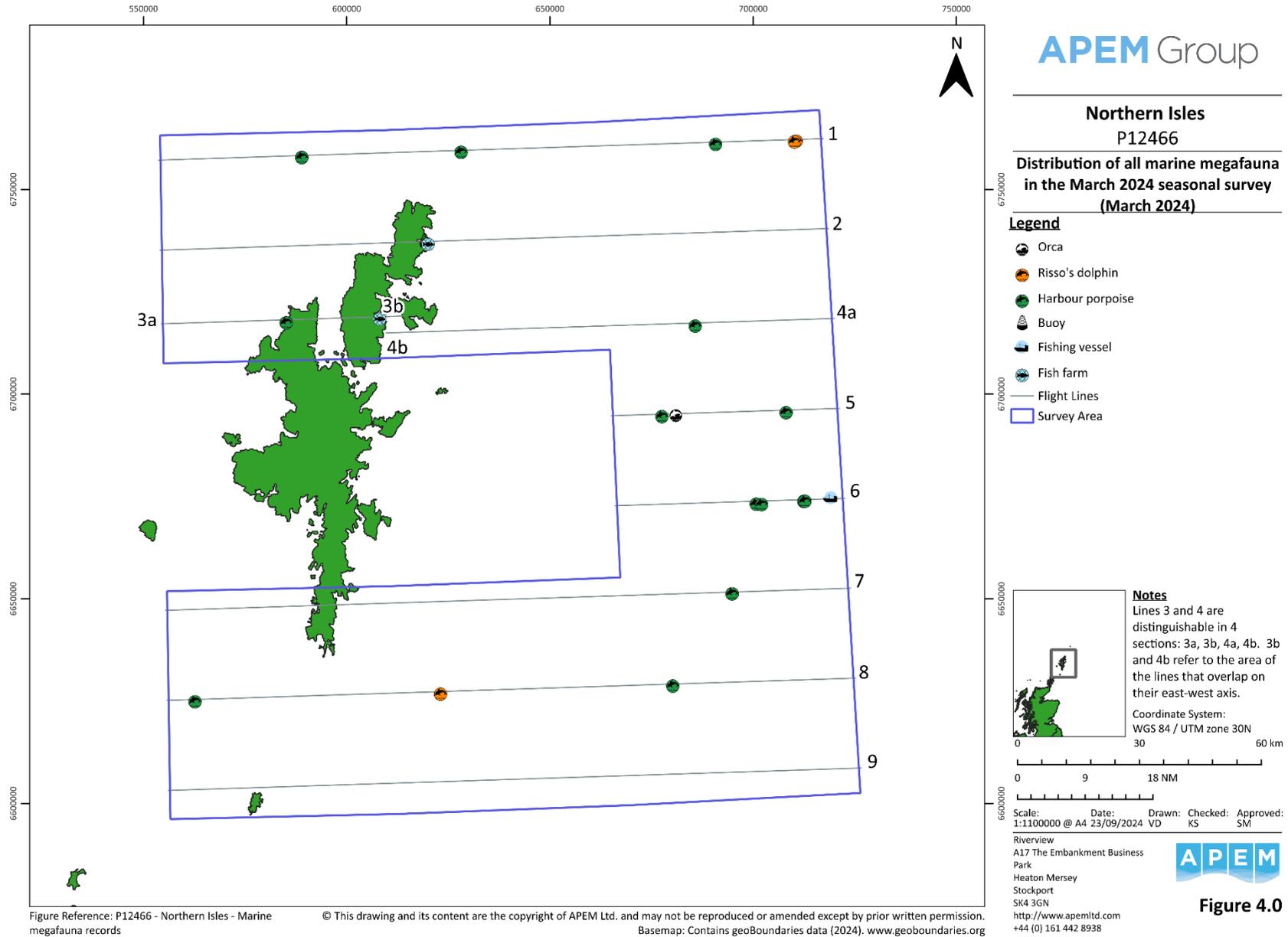
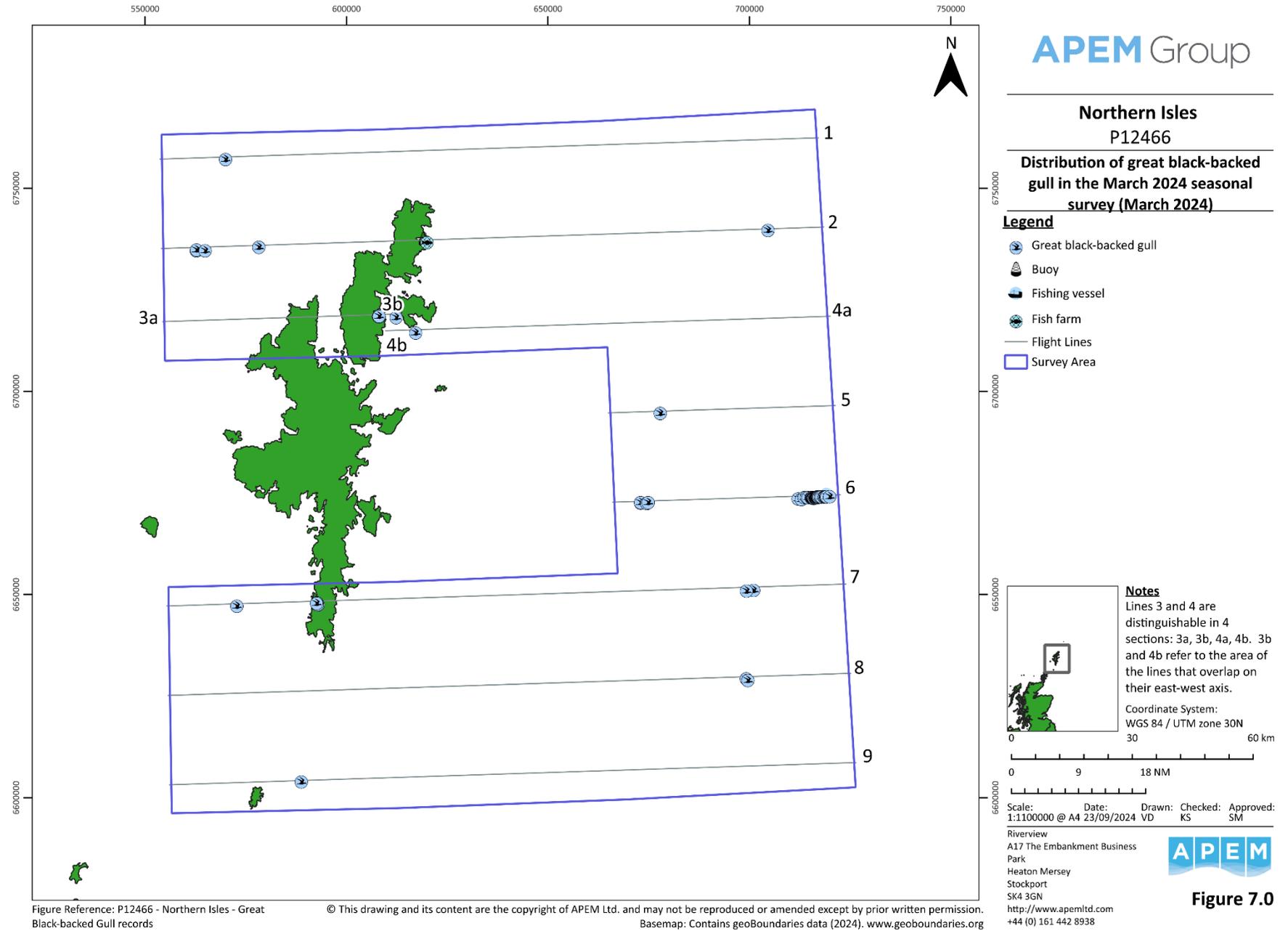


Figure 4 Distribution of all marine megafauna recorded in the March 2024 seasonal survey (March 2024).

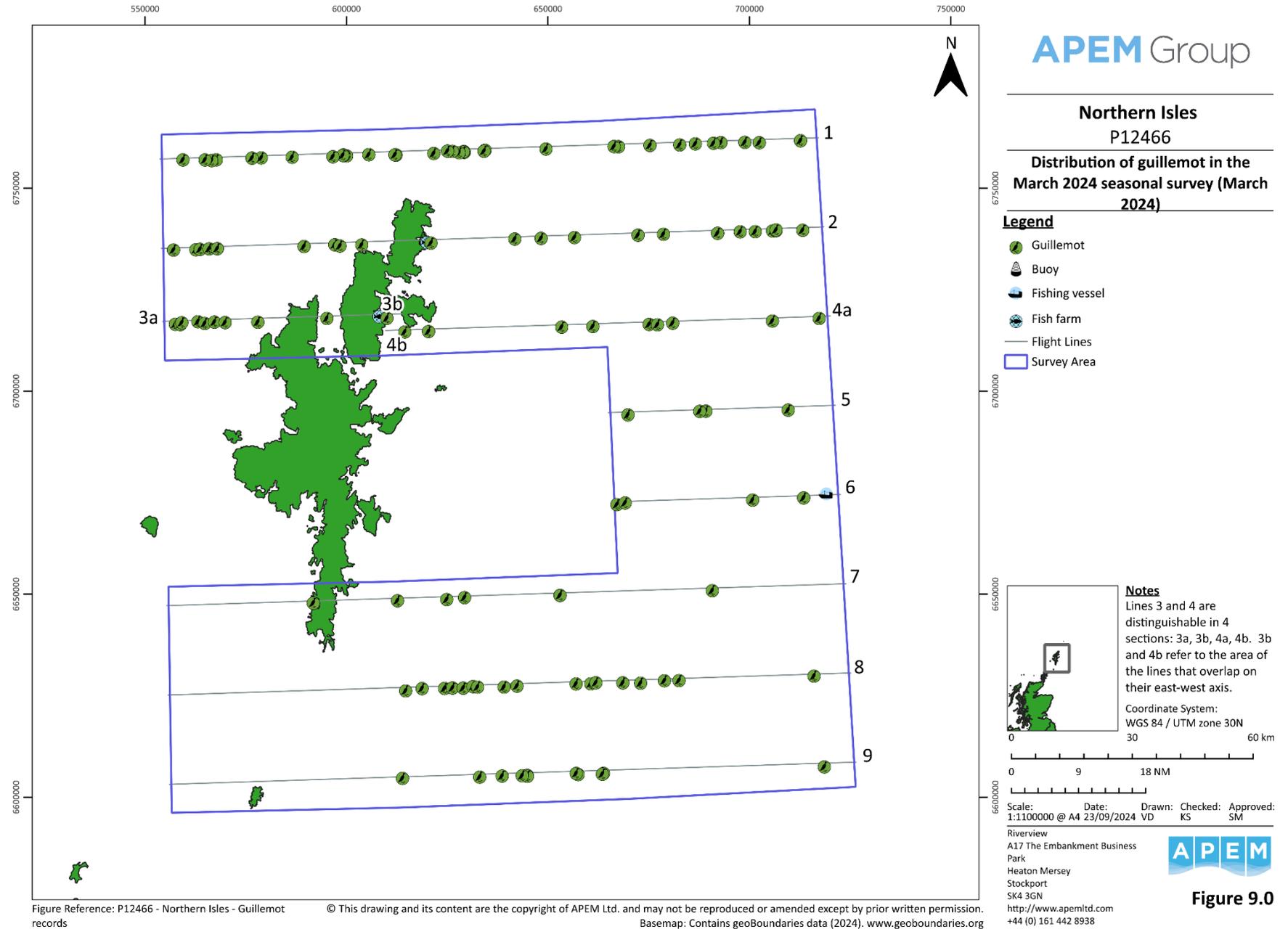






**Figure 7 Great black-backed gull distribution recorded in the March 2024 seasonal survey (March 2024).**

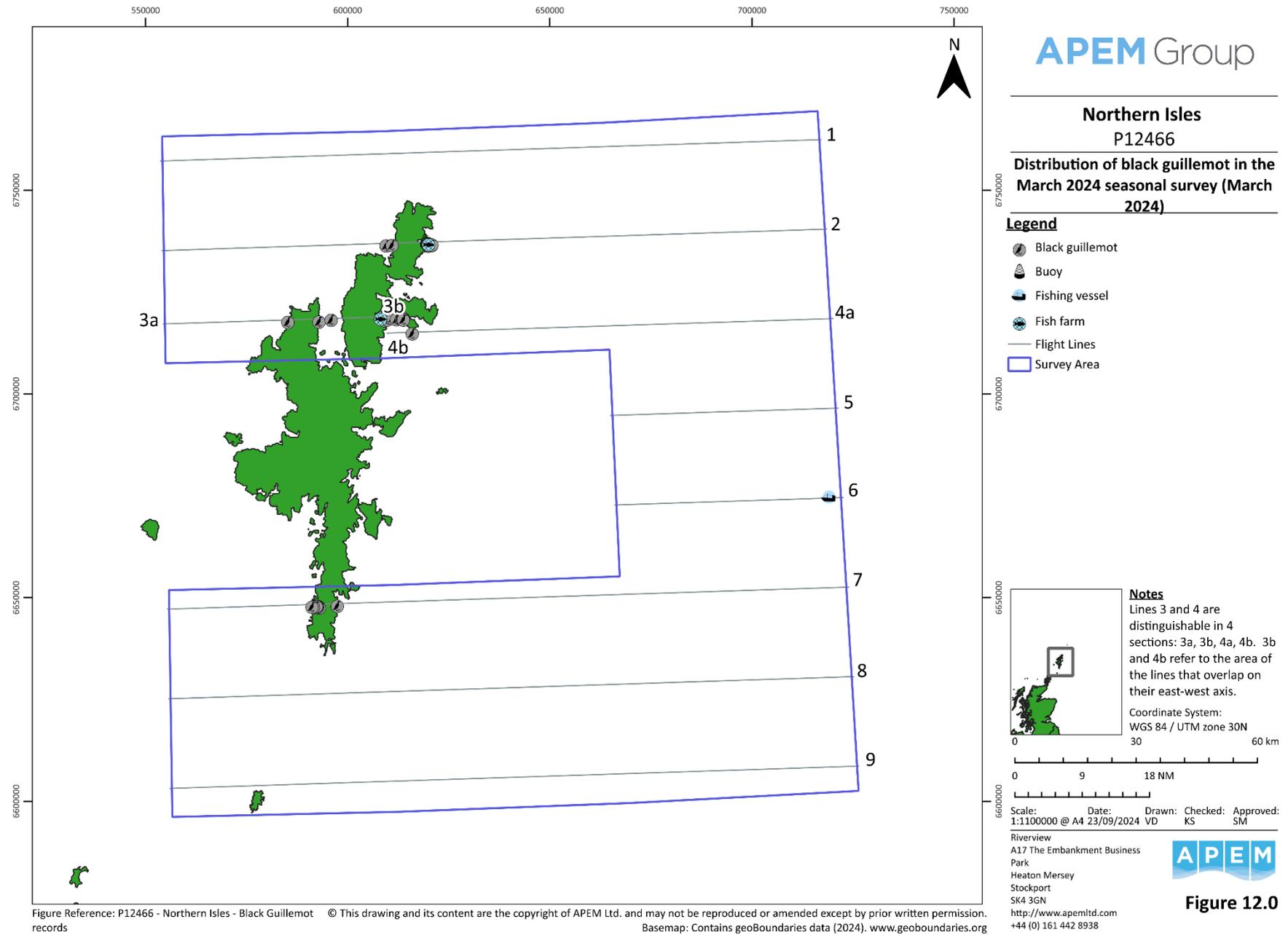




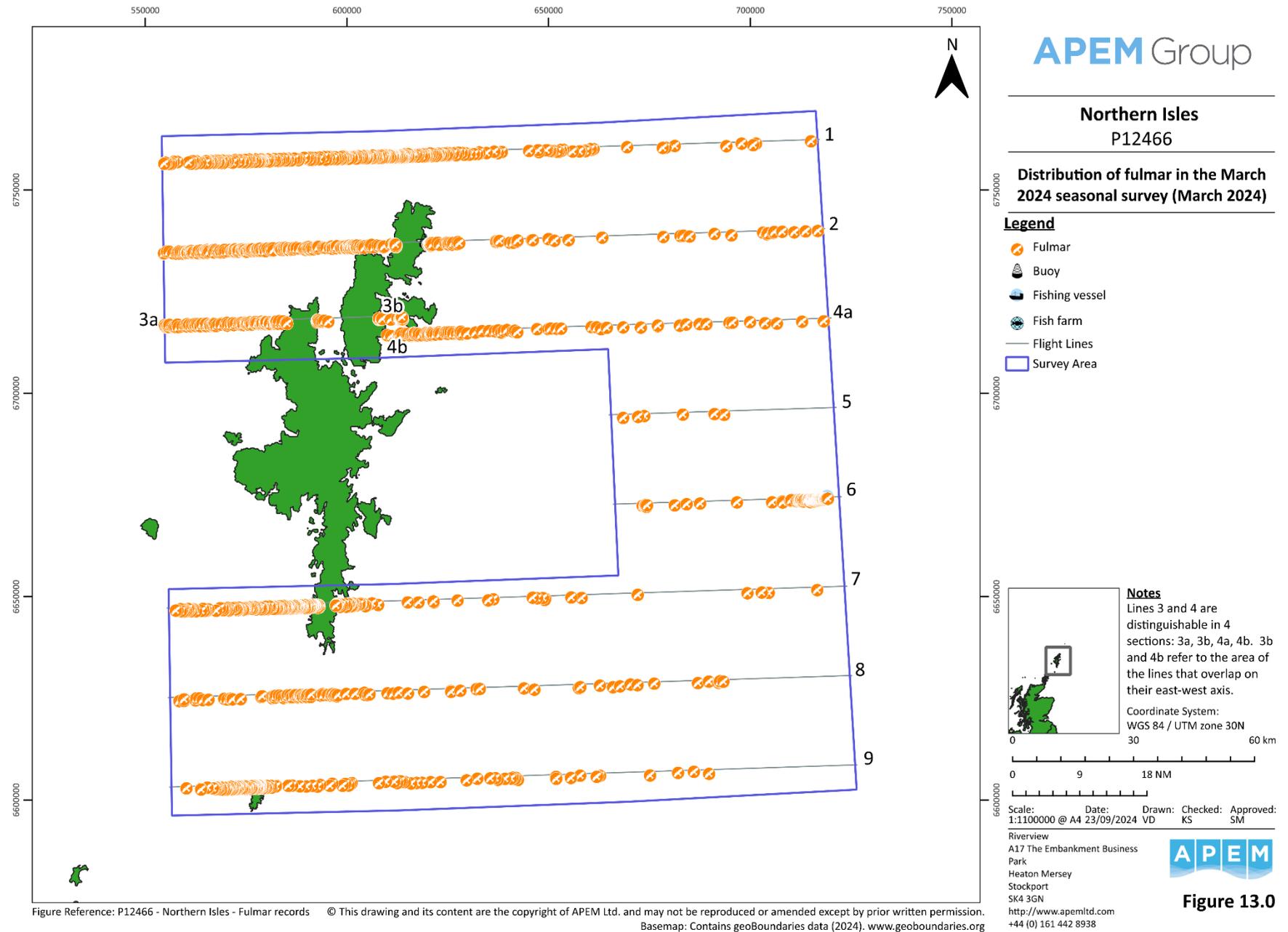
**Figure 9 Guillemot distribution recorded in the March 2024 seasonal survey (March 2024).**







**Figure 12 Black guillemot distribution recorded in the March 2024 seasonal survey (March 2024).**



**Figure 13 Fulmar distribution recorded in the March 2024 seasonal survey (March 2024).**

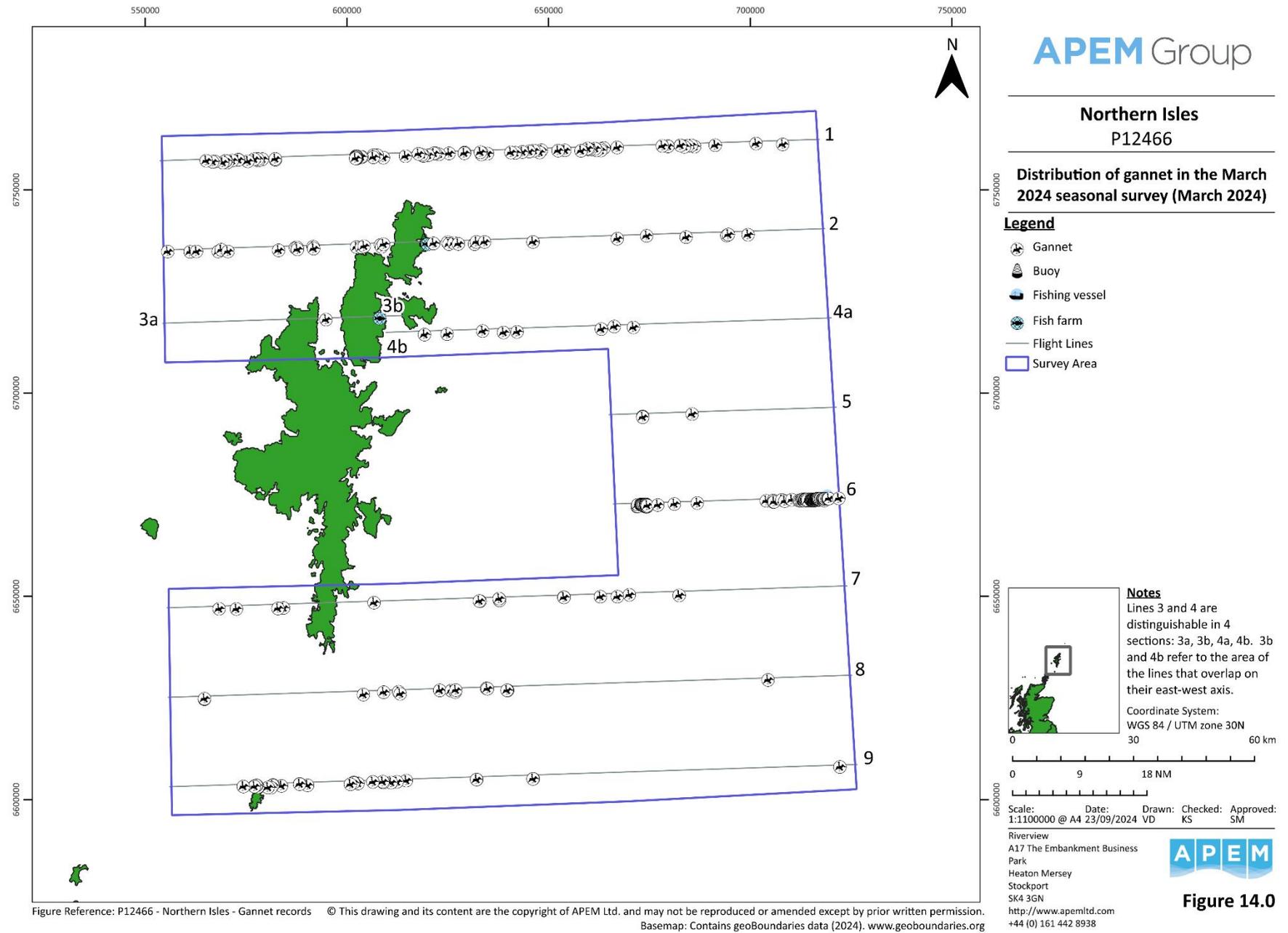
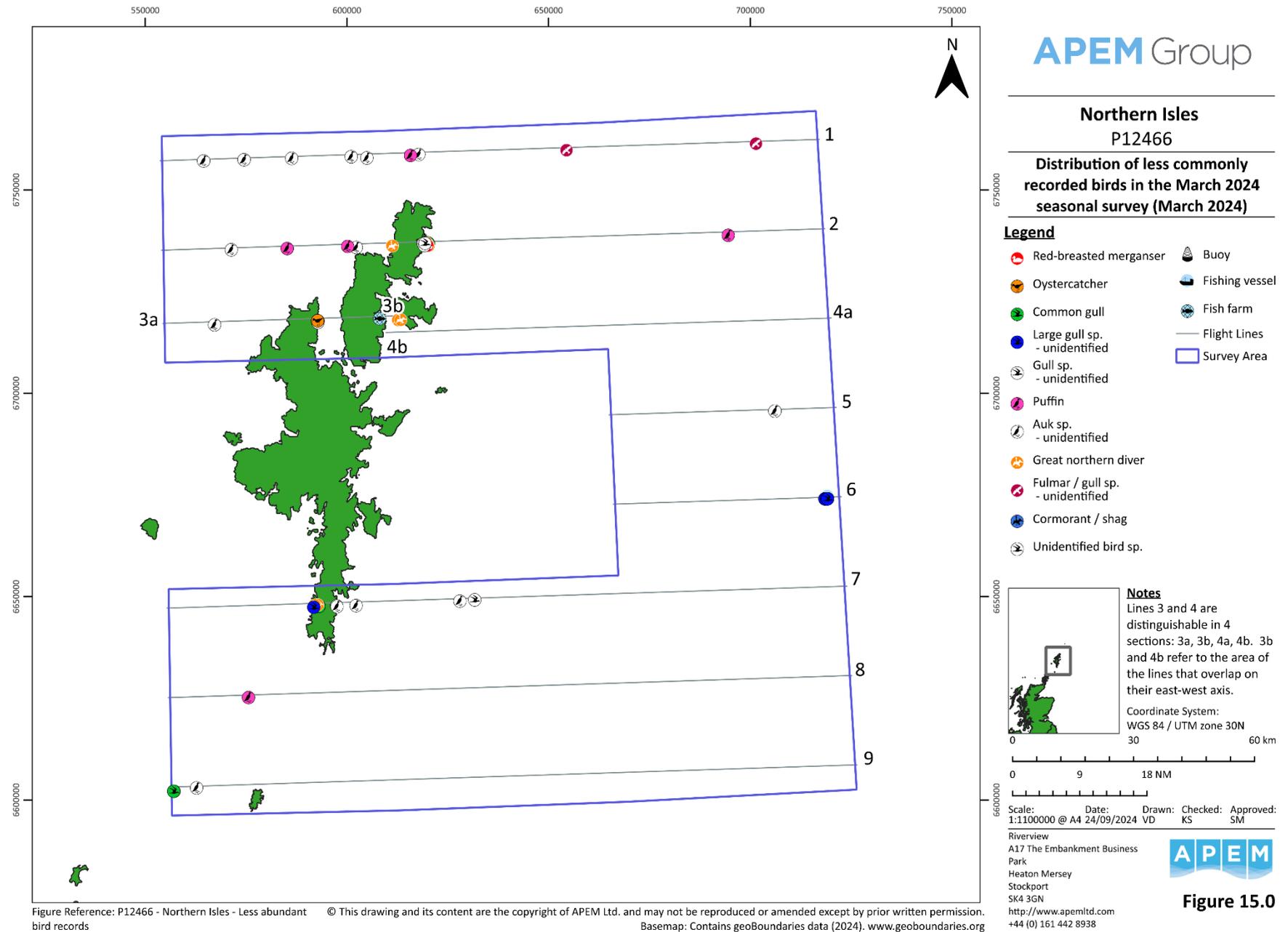
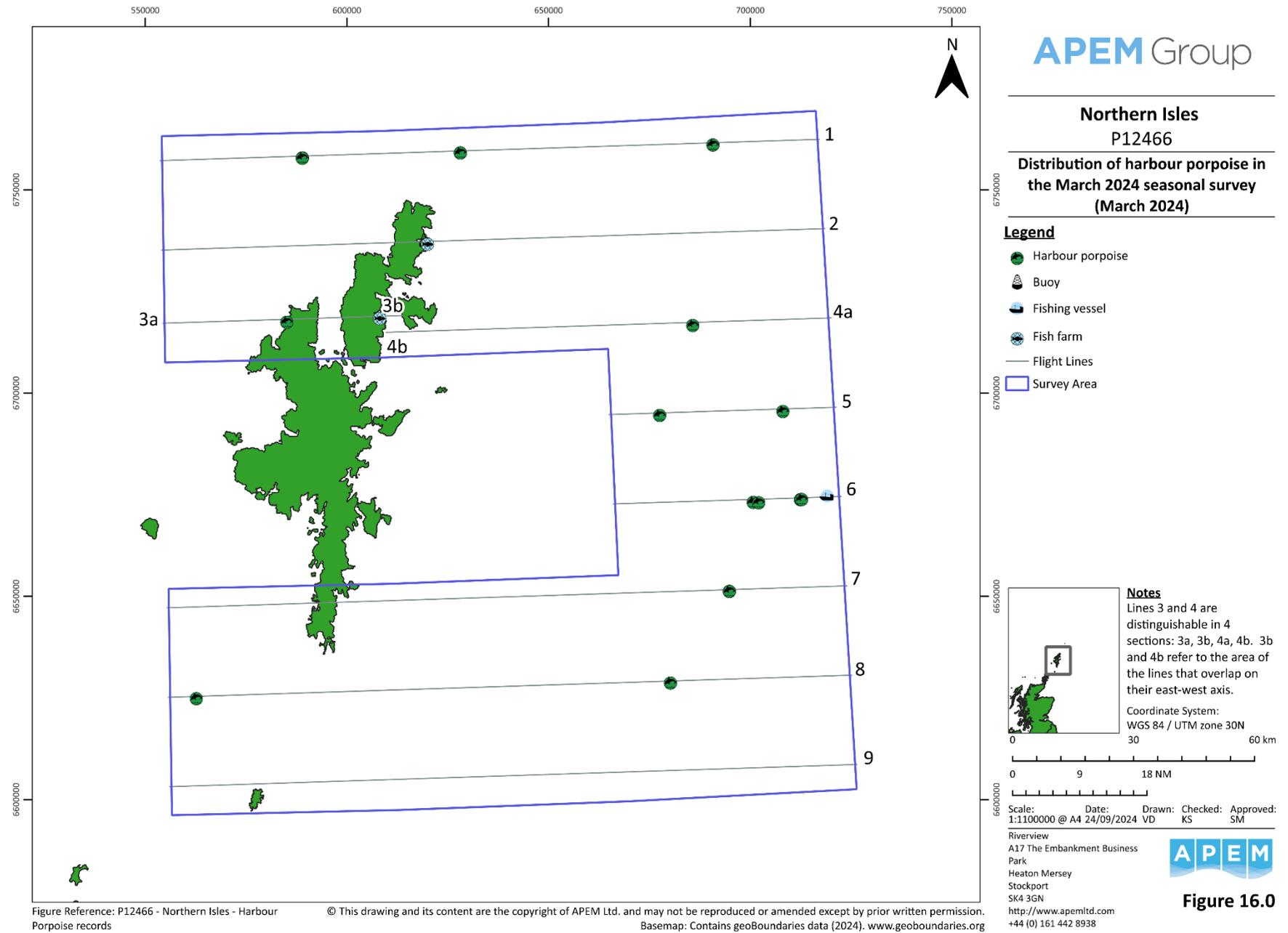


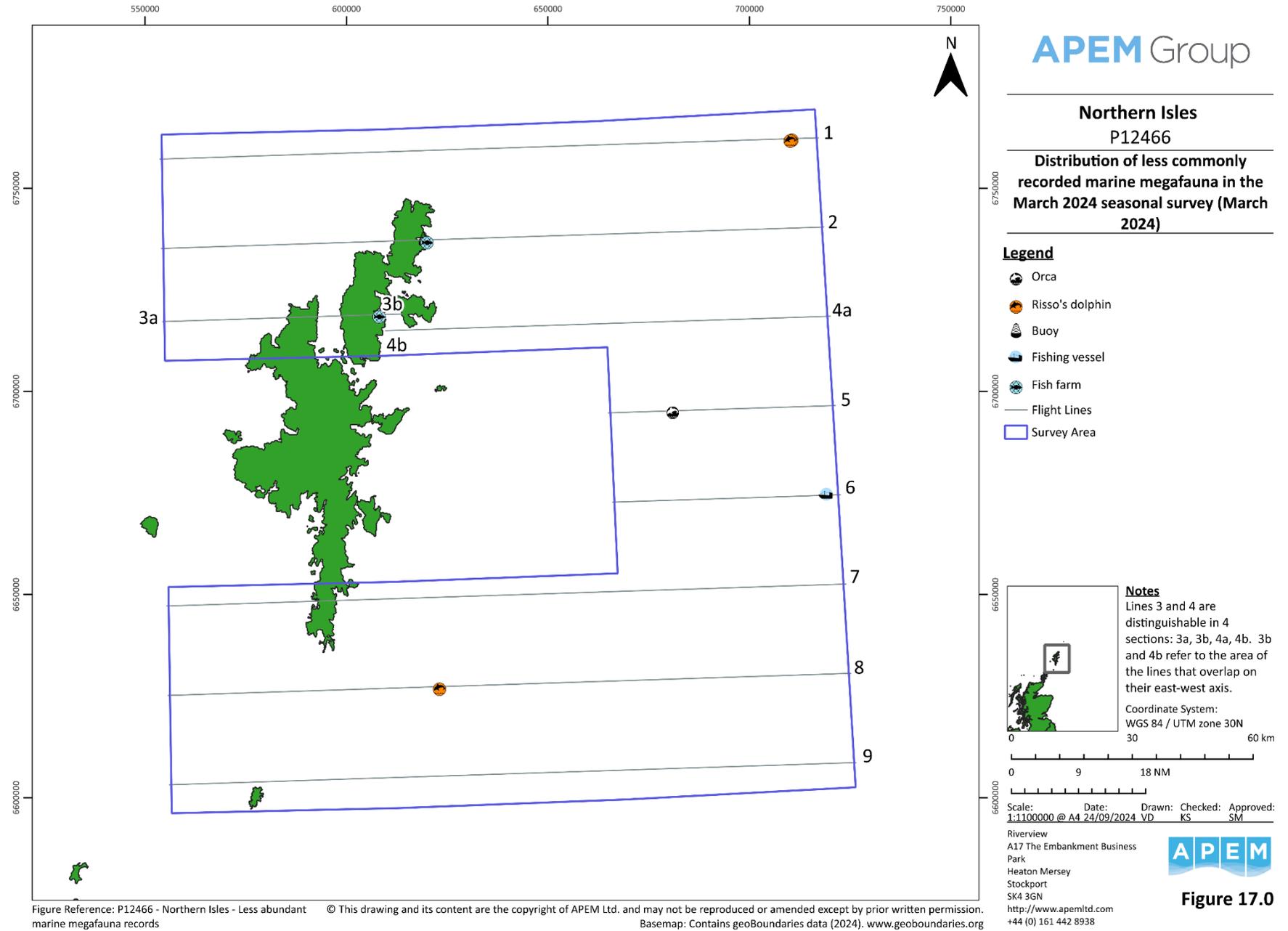
Figure 14 Gannet distribution recorded in the March 2024 seasonal survey (March 2024).



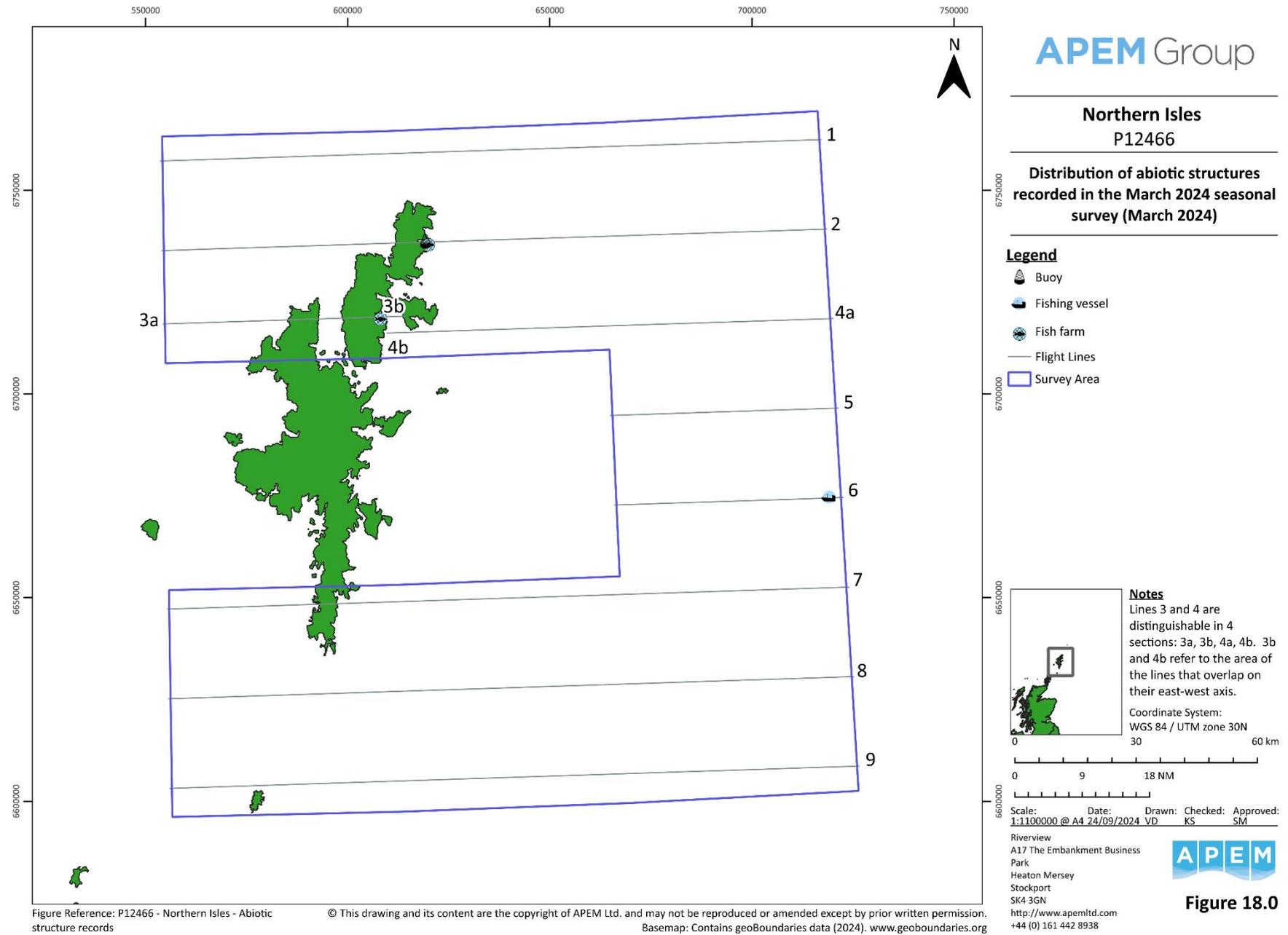
**Figure 15 Distribution of less abundant birds recorded in the March 2024 seasonal survey (March 2024).**



**Figure 16 Harbour porpoise distribution in the March 2024 seasonal survey (March 2024).**



**Figure 17 Distribution of less abundant marine megafauna recorded in the March 2024 seasonal survey (March 2024).**



**Figure 18 Distribution of abiotic structures and vessels recorded in the March 2024 seasonal survey (March 2024).**

## 5. Abiotic Structures and Observations

The following abiotic structures were observed within the imagery:

A single buoy and a fish farm were recorded on line 2 in the Balta Sound, whilst a second fish farm was recorded on line 3a in the Wick of Vatsetter. A single fishing vessel was present on line 6, which was also observed from the survey aircraft at 13:23 heading in an easterly direction.

In addition, a fishing vessel was observed bearing east at 12:44, adjacent to line 2. The vessel was not captured in the imagery.

## Appendix I Scientific Names and Taxonomy

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

| Species                 | Scientific Name              |
|-------------------------|------------------------------|
| Red-breasted Merganser  | <i>Mergus serrator</i>       |
| Oystercatcher           | <i>Haematopus ostralegus</i> |
| Curlew                  | <i>Numenius arquata</i>      |
| Kittiwake               | <i>Rissa tridactyla</i>      |
| Common Gull             | <i>Larus canus</i>           |
| Great Black-backed Gull | <i>Larus marinus</i>         |
| Herring Gull            | <i>Larus argentatus</i>      |
| Guillemot               | <i>Uria aalge</i>            |
| Razorbill               | <i>Alca torda</i>            |
| Black Guillemot         | <i>Cepphus grylle</i>        |
| Puffin                  | <i>Fratercula arctica</i>    |
| Great Northern Diver    | <i>Gavia immer</i>           |
| Fulmar                  | <i>Fulmarus glacialis</i>    |
| Gannet                  | <i>Morus bassanus</i>        |
| Orca                    | <i>Orcinus orca</i>          |
| Risso's Dolphin         | <i>Grampus griseus</i>       |
| Harbour Porpoise        | <i>Phocoena phocoena</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 19 Common gull in flight.



Figure 20 Oystercatchers in flight.

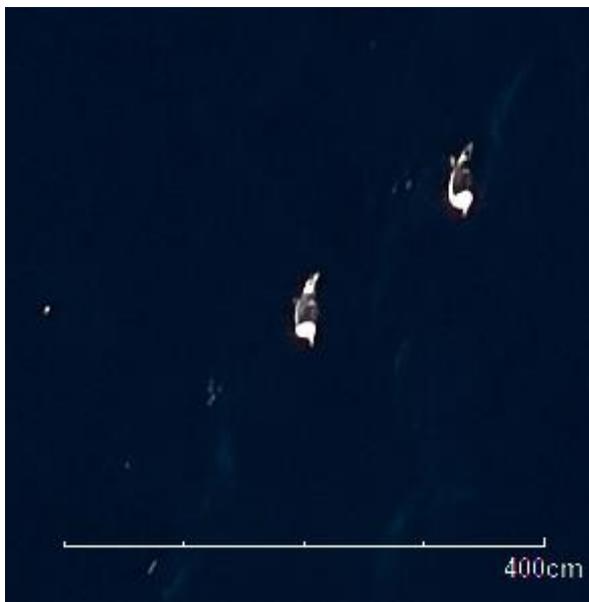


Figure 21 Great Black-backed Gulls sitting on water.



Figure 22 Harbour Porpoise surfacing.



**Figure 23** Risso's Dolphin submerged.



**Figure 24** Orca submerged with clearly visible grey saddle patch.