Technical Appendix 11.2: Baseline Site Characterisation

MachairWind Offshore Ornithology

ScottishPower Renewables (SPR)

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	Click to enter a date.			

Table of Contents

Tables in Text

Figures in Text

1.0 Introduction

1.1 Project Summary

1. Machairwind Limited ('the Applicant') is proposing the development of the MachairWind Windfarm ('the Project'), an Offshore Windfarm, located off the west coast of Scotland approximately 15 kilometres (km) to the northwest of Islay and approximately 12.4 km west of Colonsay at the closest points (**Figure 1**).

2. The Project will comprise up to 144 wind turbine generators (WTGs) with fixed-bottom foundations. The area within which the WTGs and associated infrastructure will be located is the Windfarm Development Area (WDA) which covers an area of 448 km^2.

1.2 Purpose of this report

3. This **Technical Appendix 11.2: Baseline Site Characterisation** report provides detailed information on the marine ornithology interests in and around the WDA, providing a baseline site characterisation prior to any development in the area. This baseline ornithology information is used to inform the impact assessments presented in **Chapter 11 Offshore Ornithology** of the Environmental Impact Assessment (EIA) Report (EIAR) and the Report to Inform Appropriate Assessment (RIAA).

4. The baseline site characterisation was informed by 30 digital aerial surveys (DAS; each survey used for baseline characterisation is herein considered a DAS 'sample') that took place between March 2021 and September 2023, in addition a summary review of other information relevant to baseline characterisation of the area is included in this technical appendix.

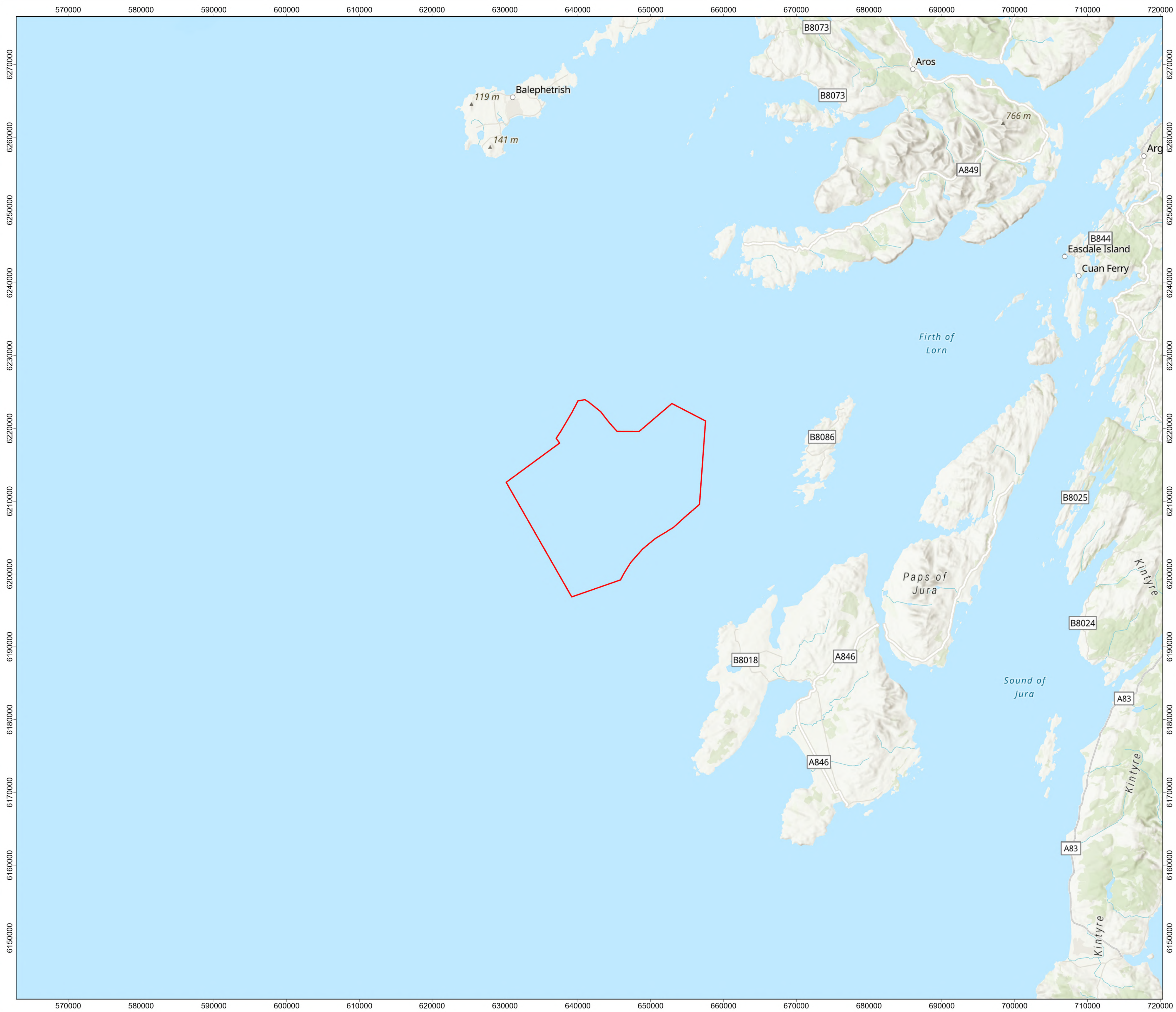
5. This technical appendix provides the following information:

- Methodologies regarding characterisation of baseline conditions of marine ornithology interests in and around the Project, including:
    - DAS survey methodology and survey design for data collection;
    - Estimating densities and abundances of birds;
    - Resampling procedures to determine uncertainties around estimates, including details for assessing autocorrelation to inform a blocked resampling structure;
    - Apportioning group level identifications to species (e.g. assigning 'Auk species' identifications appropriately to its constituent species); and
    - Applying diving availability bias corrections.
- Raw counts, design-based density estimates and design-based abundance estimates of birds sat on the water and in flight within the WDA, WDA plus 2 km buffer and WDA plus 4 km buffer recorded during DAS;
- Species accounts of the following key marine bird species recorded during DAS, including maps of all observations recorded in each survey:
    - Arctic tern, *Sterna paradisaea*;
    - Common gull, *Larus canus*;
    - Common tern, *Sterna hirundo*;
    - European storm-petrel, *Hydrobates pelagicus*;
    - Fulmar, *Fulmarus glacialis*;
    - Gannet, *Morus bassanus*;

  - Great black-backed gull, *Larus marinus*;
  - Great northern diver, *Gavia immer*;
  - Great skua, *Stercorarius skua*;
  - Guillemot, *Uria aalge*;
  - Herring gull, *Larus argentatus*;
  - Kittiwake, *Rissa tridactyla*;
  - Manx shearwater*, Puffinus puffinus*;
  - Puffin, *Fratercula arctica*; and,
  - Razorbill, *Alca torda*.

6. Additionally, this technical appendix includes the following Annexes:
   - Annex 11.2A: Project DAS Final Report (All Project Surveys);
   - Annex 11.2B: Third-Party DAS survey 5 (01 plus 04 March 2021);
   - Annex 11.2C: Third-Party DAS survey 6 (21 March 2021);
   - Annex 11.2D: Third-Party DAS survey 15 (15 December 2021);
   - Annex 11.2E: Raw Counts;
   - Annex 11.2F: Density estimates per survey of birds sat on the water;
   - Annex 11.2G: Density estimates per survey of birds in flight;
   - Annex 11.2H: Density estimates per survey of sitting and flying birds;
   - Annex 11.2I: Abundance estimates per survey of birds sat on the water;
   - Annex 11.2J: Abundance estimates per survey of birds in flight;
   - Annex 11.2K: Abundance estimates per survey of sitting and flying birds;
   - Annex 11.2L: Rarely Recorded Species Information;
   - Annex 11.2M: Regional Breeding Adult Population Estimates;
   - Annex 11.2N: Number of birds present in transect segments;
   - Annex 11.2O: Manx Shearwater Tracking Work on Lunga in 2025; and,
   - Annex 11.2P: Evaluation of seabird attraction to lighting on offshore wind farms.

7. Importantly, this report is intended to describe the baseline conditions, which are those that exist in the absence of the Project (CIEEM, 2018). The impact assessments, which are provided in the EIAR and the RIAA, determine how the baseline is predicted to change during Project construction, operation and maintenance and decommissioning stages.



Windfarm Development Area (WDA)

N

0 5 10 20 Kilometres

REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER
1	21/04/2026	MMM	MMM	NG/SO	NG/SO

DRAWING NUMBER	MCW-DWF-ENV-MAP-RHS-000203		
DATUM	ETRS89	PROJECTION	UTM Zone 29N
SCALE	1:500,000	PAGE SIZE	A3
PROJECT TITLE	MachairWind		
DRAWING TITLE	**MachairWind Windfarm Development Area**		

NOT TO BE USED FOR NAVIGATION

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Name: MachairWind Windfarm Development Area

1.3 Terminology

8. The following terminology is used in this report:

- The WDA plus 2 km buffer is a boundary extending 2 km away from and surrounding the WDA;
- The WDA plus 4 km buffer is a boundary extending 4 km away from and surrounding the WDA;
- 'Flying birds' are birds recorded in flight in the DAS data;
- 'Sitting birds' are birds recorded as sat on the water in the DAS data;
- 'Species group' are birds which could not be identified in the DAS data as belonging to any one species, so instead, they were assigned to a species group. 'Auk species' (which includes birds that could be a guillemot, razorbill or a puffin) or 'Guillemot/Razorbill' (which includes birds that could be a guillemot or a razorbill) are examples of species groups;
- 'Raw observations' are the numbers of birds that were recorded in the DAS data before any data analysis took place (i.e. before raw counts, density and abundance estimates were calculated). Raw observations for each named species do not include birds which have been apportioned from a broader species group (for apportioning of species groups to species level, refer to **Section 3.3.3**) and for guillemots, razorbills and puffins, raw observations are not corrected to account for the number of birds under the water at the time of each DAS (for availability bias correction methods, refer to **Section 3.3.4**). In this report, raw observations are reported in figures (refer to **Section 4.5**) showing distributions of birds within and outwith the WDA and 4 km buffer; and,
- 'Raw counts' are the numbers of birds used to inform density and abundance estimates within the WDA, WDA plus 2 km buffer and WDA plus 4 km buffer. Raw counts presented in this report include birds that were apportioned from species groups and corrected for availability bias (refer to **Sections 3.3.3** and **3.3.4** respectively).

1.4 Offshore ornithology survey area

9. Bird abundance and density were estimated over three spatial scales for the baseline site characterisation:

- WDA only: this is the area within which the WTGs and associated infrastructure is proposed to be located. Densities of birds in flight within the WDA only were used in collision risk modelling;
- WDA plus 2 km buffer: this includes a 'zone of influence' around the WDA, allowing for changes in bird behaviour (e.g. disturbance/displacement) in the vicinity of the WDA. Bird abundance within the WDA plus 2 km buffer was used to estimate displacement mortality for species except divers; and,
- WDA plus 4 km buffer: the area within the WDA plus a 4 km buffer was used to characterise the baseline marine ornithology interests. Diver abundance within the WDA plus 4 km buffer was used to estimate displacement mortality for divers.

10. The area over which Project DAS were carried out was larger than the WDA plus 4 km buffer to ensure the entirety of the 4 km buffer area was fully captured. NatureScot, in their response to the Scoping Report (22 November 2024) agreed to an offshore study area consisting of a 4 km buffer around the WDA.

2.0 Information to inform baseline site characterisation for the EIAR and RIAA

11. A desk-based review of existing literature and data of relevance to the Project and surrounding area was undertaken with the aim of providing conservation status and temporal and spatial context on bird density, abundance and distribution to the new data collected by the Project.

12. The new data collected by the Project to inform the baseline site characterisation and EIAR/RIAA assessments consisted of DAS data of marine bird distribution, density and abundance.

2.1 Key data sources

13. Key information sources drawn from the desk-based review are summarised in **Table 1** below.

Table 1: Summary of key information resources.

Information source	Description	Year	Author
Project-specific DAS data (**Annex 11.2A)**	APEM Ltd. DAS data recorded to inform the Project baseline site characterisation. A total of 27 Project DAS samples were selected out of 30 samples collected to inform the Project baseline characterisation, as agreed with NatureScot (NatureScot letter dated 7 August 2025).	2021 to 2023	APEM Ltd.
Third-Party DAS data (**Annex 11.2B, 11.2C and 11.2D**)	APEM Ltd. DAS data recorded in a Third-Party survey area which spatially and temporally overlapped with the Project survey area. A total of three Third-Party DAS samples were selected to inform the Project baseline characterisation, as agreed with NatureScot (NatureScot letter dated 7 August 2025).	2021	APEM Ltd.
Seabirds Count (Most recent (4th) National seabird census)	National seabird census of breeding seabirds in Britain and Ireland. The Seabirds Count dataset is available from the Joint Nature Conservation Committee (JNCC) website (Version last updated July 2024): Seabirds Count Datasets | JNCC Resource Hub	2015 to 2021	Burnell et al., 2023
Seabird Monitoring Programme (SMP) database	Counts of breeding seabirds and, for some colonies, additional information, e.g. productivity, adult return rates.	2000 to 2025	Programme coordinated and managed by BTO

Information source	Description	Year	Author
	Data available at: https://app.bto.org/seabirds/public/data.jsp.		
Scientific paper entitled 'Distribution maps of cetacean and seabird populations in the North-East Atlantic'	Species Distribution model (SDM) maps showing predicted densities of seabirds (including kittiwake, puffin, guillemot, fulmar, storm-petrel, great skua, gannet and razorbill) around the British Isles. Available online at: https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/1365-2664.13525.	1980 to 2018 but mostly data from 1980-2000	Waggitt et al., 2020
BirdLife International Seabird Tracking Database	Seabird tracking data. Data available online at: http://www.seabirdtracking.org/.	2004 to present	Coordinated by BirdLife International
Scientific paper entitled 'Breeding density, fine-scale tracking, and large-scale modelling reveal the regional distribution of four seabird species'	Models showing distribution of four breeding seabird species (shag, kittiwake, guillemot and razorbill) around the British Isles. Paper available at: Ecological Applications, 27(7), pp.2074-2091, available online at:https://esajournals.onlinelibrary.wiley.com/doi/10.1002/eap.1591.	Data collected up to 2017	Wakefield et al., 2017
Mapping Seabird Sensitivity to Offshore Wind Farms	Available online at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0106366	2014 (corrected in 2017)	Bradbury et al., 2017
Combining habitat modelling and hotspot analysis to reveal the location of high density seabird areas across the UK. Technical Report	Model predictions of seabird hotspot distributions around the UK. RSPB Research Report no. 63.	Data collected up to 2018	Cleasby et al., 2018
Marine Scotland Science Report 04/14: Statistical Modelling of Seabird and Cetacean data: Guidance Document	Guidance document focusing on statistical issues related to improving wildlife surveys in the measurement of distribution of animals in areas of near-shore and off-shore renewable energy development. Available online at: https://tethys.pnnl.gov/sites/default/files/publications/Mackenzie-et-al-2014.pdf.	2013	Mackenzie et al., 2013
UK seabird colony counts in 2023 following the 2021-22 outbreak of Highly Pathogenic Avian Influenza (HPAI)	Colony counts and other surveys to ascertain the impact of HPAI on key species and colonies	2023	Tremlett et al., 2024

Information source	Description	Year	Author
NatureScot Scientific Advisory Committee Sub-Group on Avian Influenza Report on the H5N1 outbreak in wild birds 2020-2023	An assessment of the current and emerging impact of High Pathogenicity Avian Influenza (HPAI) on wild bird populations in Scotland, noting the wider geographical and biological context of these impacts, and the emerging evidence base is developing rapidly (and constrained due to restrictions on ringing and related activities in 2022) Available online at: NatureScot Scientific Advisory Committee Sub-Group on Avian Influenza Report on the H5N1 outbreak in wild birds 2020-2023 | NatureScot	2020-2023	NatureScot, 2023

2.2 Review of additional bird data relevant to baseline characterisation

2.2.1 Counts of seabird colonies

14. Through the Seabird Monitoring Programme (SMP[1]), regular monitoring of 25 species of seabird that breed regularly in Britain and Ireland has been undertaken since 1986 to the present time. In addition to the annual counts at a sample of colonies provided through the SMP, periodic breeding seabird censuses have taken place to help identify where and why changes might be happening. The last complete count, the 'Seabirds Count' was undertaken between 2015 to 2021 (Burnell et al., 2023), this last count is the fourth national seabird census to take place in Britain and Ireland. Previous censuses have included:

- Operation Seafarer - count data collected in 1969 and 1970 (Cramp et al., 1974);
- Seabird Colony Register (SCR) Census - count data collected between 1985 and 1988 (Lloyd et al., 1991); and,
- Seabird 2000 - count data collected between 1998 and 2002 (Mitchell et al., 2004).

15. Data from the Seabirds Count 2015–2021 census, which highlighted trends in colony counts for breeding birds, particularly since the previous census (Seabird 2000) were collated for species included in the collision risk impact assessment (refer to **Technical Appendix 11.3: Collision Risk Modelling**) and the displacement impact assessment refer to **Technical Appendix 11.4: Displacement**). NatureScot advised at the Expert Topic Group meeting 2 (ETG 2, 23 January 2024) that some new colony counts may be available since the Seabirds Count data were published. Therefore, the SMP database was searched to provide any updated colony counts recorded between 2022 to 2025. If updated SMP colony counts were available, these were used to replace colony counts provided in the Seabirds Count dataset. Colony counts are provided in **Annex 11.2M: Regional Breeding Adult Population Estimates**.

[1] Seabird Monitoring Programme: Seabird Monitoring Programme | JNCC

2.2.2 Post-census colony counts to assess HPAI impacts

16. High Pathogenicity Avian Influenza (HPAI) is known to have killed many seabirds. Gannet and great skua populations were particularly impacted but also kittiwake, guillemot, gull and tern populations. Consequently, the Royal Society for the Protection of Birds (RSPB) coordinated counts of colonies of species known to be impacted by HPAI, during 2023, to assess changes in populations since the Seabirds Count census in 2015-2021. Results of these surveys are presented in Tremlett et al., (2024). Further consideration of the impacts of HPAI is presented in the RIAA.

17. It is noted that the Project and Third-Party survey programmes (refer to **Table 1**) included the outbreak of HPAI, particularly in 2022 (Tremlett et al., 2024) and the interpretation of the data in the RIAA takes into account that exceptional situation.

2.2.3 Regional distribution of seabirds at sea

18. Aerial and vessel survey data have been presented in a range of studies to show spatial and temporal distributions of seabirds, including the key seabird species assessed in this report, around the UK (Kober et al., 2010; Bradbury et al., 2014; Wakefield et al., 2017; Cleasby et al., 2018; Waggitt et al., 2020). These data have been used to predict densities of seabirds in the north-east Atlantic (Waggitt et al., 2020), map seabird sensitivity to offshore windfarms in English territorial waters (Bradbury et al., 2014) and identify possible SPAs in the marine environment (Kober et al., 2010). These studies have provided background information on how seabirds utilise the sea in the region surrounding the WDA.

2.2.4 GPS tracking of seabirds – BirdLife International Seabird Tracking Database

19. Tracking of key seabird species from colonies with potential connectivity to the Project are available from the BirdLife International Seabird Tracking Database (**Table A**). For the purposes of this **Technical Appendix 11.2: Baseline Site Characterisation**, summaries of GPS tracking projects and the number of tracked individuals logged on the Tracking Database for key marine species considered in the EIAR and RIAA are described to give additional context on the patterns of abundance and distribution seen in the WDA plus 4 km buffer during the digital aerial survey programme.

20. For each species presented below, the BirdLife International Seabird Tracking Database was searched to identify if any GPS tracks have been recorded within a 10 km area surrounding the Project. All GPS tracks that have been recorded within the 10 km area are summarised:

Arctic tern

21. No GPS tracks were recorded in the tracking database for Arctic tern within an area of 10 km surrounding the Project.

Common tern

22. No GPS tracks were recorded in the tracking database for common tern within an area of 10 km surrounding the Project.

European storm-petrel

23. No tracks were recorded in the tracking database for European storm-petrel within an area of 10 km surrounding the Project. A project tracking two storm-petrels from Inishtrahull in Ireland recorded one storm-petrel within approximately 120 km from the Project 10 km area.

Fulmar

24. No GPS tracks were recorded in the tracking database for fulmar within an area of 10 km surrounding the Project.

Gannet

25. Records for gannet indicated two tracking projects resulted in tracks within an area of 10 km surrounding the Project. One individual tracked from Bass Rock in 2018/2019 entered the Project area briefly. Tracking work from the colony at Ailsa Craig during the brood guard phase (total tracking sample size of 16 birds providing 110 tracks) indicated the presence of tracked individuals in the Project area.

Great black-backed gull

26. No GPS tracks were recorded in the tracking database for great black-backed gull within an area of 10 km surrounding the Project.

Great northern diver

27. No GPS tracks were recorded in the tracking database for great northern diver within an area of 10 km surrounding the Project.

Guillemot

28. Two GPS tracking projects with tracks within an area of 10 km surrounding the Project were available in the database. These projects consisted of 77 individuals between the years of 2010 and 2014 during the incubation and brood-guarding phases, all from the Colonsay colony. Tracks were recorded within the 10 km area surrounding the Project.

Herring gull

29. No GPS tracks were recorded in the tracking database for herring gull within an area of 10 km surrounding the Project.

Kittiwake

30. Kittiwake GPS data are available for three projects, spanning the years 2010 to 2014. These projects tracked 84 birds, all from the Colonsay colony. Data from 2010 to 2012 showed tracks entering the 10 km area surrounding the Project, but data from 2014, consisting of 24 individuals, showed more limited activity within the Project area, with most tracks venturing east from Colonsay towards the mainland, suggesting strong variation in foraging areas used in different breeding seasons.

Manx shearwater

31. GPS data for four projects with tracks intersecting an area of 10 km surrounding the Project were present in the database. These projects included data from the following colonies: High Island (Ireland, 2014 to 2015, incubation and chick-rearing phases, n = 56); Blasket Islands (Ireland, 2014 to 2015, chick-rearing phase, n = 24); Bardsey Island (Wales, 2017, incubation, chick-rearing and non-breeding phases, n = 25); Inishtrahull (Ireland, 2021, chick-rearing phase, n = 3).

32. Of these projects, 5 individual tracks (two tracks from High Island, one track each from Blasket Islands, Bardsey Island and Inishtrahull) entered the 10 km area surrounding the Project.

Puffin

33. No GPS tracks were recorded in the tracking database for puffin within an area of 10 km surrounding the Project.

Razorbill

34. Three tracking projects had available GPS data. Two of these projects spanned 2010 to 2014 at the Colonsay colony, tracking a total of 42 individuals. These tracked individuals showed very limited movement within the 10 km area surrounding the Project, primarily foraging eastward towards the Argyll mainland. The third project tracked seven individuals from Lunga; only one individual briefly entered the proposed Project.

2.2.5 GPS tracking of seabirds – other sources

35. Beyond data present in the Seabird Tracking Database, relatively few seabird tracking studies have been carried out in colonies near the proposed Project. Additional sources identified as relevant to colonies with potential connectivity to the Project are summarised below by species (for species not listed, no publicly available tracking data was located).

European storm-petrel

36. Deakin et al., (2022) highlights few tracking data exist for European storm-petrels in the Atlantic, with only two UK sources: Bolton (2021) and a recent tracking study conducted by the RSPB on Lunga in the Treshnish Isles in 2021. Bolton (2021) described tagging work on Mousa and results illustrated that storm-petrels did not fly west from Mousa, nor did they further north than the north coast of Shetland. The tracking study on Lunga resulted in data from 19 breeding individuals, with all individuals travelling throughout the West sectoral marine plan region (where the Project is located; data is unpublished). Subsequent storm-petrel tagging on Lunga was carried out in July and August of 2021, 2023 and 2024 with funding provided by the Scottish Government's Marine Directorate and additional tags paid for by an offshore wind developer (Bolton et al., 2025). A total of 48 complete foraging trips from 38 individuals were successfully obtained, which was found by the study to be representative of space use by European storm-petrels breeding on Lunga. Individual European storm-petrels were found to have foraging specialisation, with individuals more likely to use the same marine areas on repeated trips. Foraging ranges varied among years and with stage of breeding, with longer foraging ranges recorded for the three complete foraging trips from birds tracked during incubation (mean = 153.9 km, SD = 25.1), compared with chick-rearing in the same year (mean = 89.6 km, SD = 69.9).

37. The European Seabirds-at-Sea ('ESAS'; data collected by observers from vessels at sea) has been examined to supplement the paucity of GPS tracking studies. Kober et al., (2010) used Poisson kriging on at-sea data to derive hotspots of European storm-petrel, resulting in an analysis-derived density of 0.9-2.9 birds per km^2 in the Project (a relatively lower density than other 'hotspots', with the densest 'hotspots' consisting of a density of 52.5-110.5 individuals per km^2).

Manx shearwater

38. SPR commissioned a tracking study of Manx shearwaters breeding on Lunga in the Treshnish Isles during the 2025 breeding season (**Annex 11.2O: Manx Shearwater Tracking Work on Lunga in 2025**). This represents the first GPS tracking work conducted for this species at this colony. Tagging took place during the incubation period, resulting in eleven adult birds being fitted with remote-download GPS tags. Data were retrieved from all 11 tags, of which complete foraging trip data were resolved for seven individuals. Across these seven birds, twelve complete trips and three partial trips were recorded. Mean trip duration was 34.3 hours (range 15.7–116.7 hours) and mean maximum foraging range was

61.2 km from the colony (range 26.8–121.4 km). Kernel density analysis indicated core areas of use between Mull and Tiree, with additional apparent hotspots in the Sound of Jura, north of Coll, and approximately 25 km south-west of the MachairWind WDA. Five of the seven birds with resolved tracks entered the proposed WDA. Time spent within the footprint ranged from approximately 18 minutes to 242 minutes on a single visit, with behaviour interpreted from track structure as including transit (three birds), foraging (one bird), and rafting/resting (one bird). Two individuals did not enter the footprint: one approached to within 2.8 km of the boundary, while one bird did not undertake any foraging trips during the deployment period. This study confirms functional connectivity between the Lunga Manx shearwater colony and the Project during incubation, though the study highlights that the dataset represents a short window within a single breeding stage (incubation).

39. Deakin et al., (2022) summarises tracking work of Manx shearwaters in the Irish Sea and western Scottish waters (Guilford et al., 2008, Dean et al., 2010, Freeman et al., 2012, Dean et al., 2013, Dean et al., 2015, Padget et al., 2019, Critchley et al., 2020, Kane et al., 2020). Across these studies, individuals were tracked at colonies in Lundy, Skomer, Copeland, the west coast of Ireland, and Rum. With the exception of individuals tagged at Rum, tracked individuals suggested limited connectivity to the Project. Results from the tracking study at Rum (Dean et al., 2015) showed stronger connectivity to the Project, as derived from two years of tagging adult individuals during chick-rearing. The number of tracks intersecting the Project was not specifically reported, though results show a handful of tracks passing through the area (noting that a very small proportion of adults at the Rum colony were tagged). Foraging range restriction/central-place foraging during chick-rearing was evident during both years, with ranges <200 km in 2010 and 2011 during the study period. Notably, kernel density analyses in both years suggested very localised foraging near the colony. The 90%-range did not overlap the Project in 2010, and weakly did so in 2011.

40. RSPB undertook GPS tracking of European storm-petrel at Lunga (Treshnish Isles) in 2021. This work is summarised in the Scottish Government-commissioned review A Review to Inform the Assessment of the Risk of Collision and Displacement of Petrels and Shearwaters in Offshore Wind Developments in Scotland (Furness et al., 2023). The review reports that 19 individuals were tracked during the breeding season, providing information on trip duration and foraging range. Movements extended across the Hebridean shelf and into offshore waters west of the Inner Hebrides. Although detailed spatial datasets are not publicly archived, the study confirms that storm-petrels from Lunga forage widely within west coast Scottish waters.

FAME/STAR Projects – Kittiwake, guillemot, razorbill and shag

41. The Future of the Atlantic Marine Environment (FAME) and Seabird Tracking and Research (STAR) projects (Wakefield et al., 2017) characterised coarse scale utilisation distributions of four seabird species (kittiwake, guillemot, razorbill and shag) between 2010 and 2014. This was carried out at widespread seabird colonies. Wakefield et al., (2017) and Cleasby et al., (2018) provide full details, but for the purposes of assessing colony connectivity to the Project, these projects showed connectivity to the Project for all four species breeding on Colonsay. Strongest concentrations/'hotspots' identified through analyses were to the west and in close proximity to Colonsay, though higher concentrations were notable extending into the Project.

Arctic and common terns

42. A search of publicly available GPS tracking data for west coast colonies of terns yielded no results, though visual tracking study (whereby tern individuals departing a colony were followed by boat) was conducted by the JNCC in 2011 at Glas Eileanan SPA (Wilson et al., 2014). A total of 63 common terns and two Arctic terns were tracked during the chick-rearing period of the breeding season. No individuals approached the Project.

Herring gull

43. A review of published literature identified one relevant GPS tracking study of herring gull from west coast Scotland. O'Hanlon et al., (2022) deployed GPS tags on adult breeding herring gulls at colonies on Islay and Oronsay during the 2014/15 non-breeding season. Individuals from these colonies dispersed south after breeding and utilised coastal waters of southwest Scotland and Northern Ireland during the non-breeding period. Movements extended up to approximately 185 km from breeding colonies, with kernel density analyses indicating utilisation of coastal and shelf waters within the wider west coast region. Habitat selection analyses showed strong selection for intertidal habitats, with additional use of grassland, arable and built-up terrestrial habitats. Offshore marine habitat was used less frequently relative to availability. This study confirms that herring gulls breeding at Islay and Oronsay utilise coastal waters within the wider west coast sector during the annual cycle. Importantly, analysed home ranges (95% utilisation distributions) from individuals tagged at these colonies showed limited overlap with the Project despite close proximity (with the analysed home range for birds tagged at Islay visually showing no overlap).

3.0 Estimating bird density and abundance

3.1 Digital Aerial Survey Methodology

3.1.1 Digital Aerial Survey methodology

44. DASs to record all bird species present within the WDA plus 4 km buffer were conducted by APEM Limited (hereafter "APEM") using methods described in Buckland et al., (2012), Weiß et al., (2016) and Webb and Nehls (2019).

45. Methods used to collect and process the DAS data are summarised in **Section 3.1**. Further details can be found in **Annex 11.2A: Project DAS Final Report (All Project Surveys)** as well as **Annexes 11.2B to D**, containing Third-Party survey reports for Third-Party surveys included in analyses (refer to **Section 3.1.3**).

3.1.2 Data collection

46. APEM captured abutting still imagery with a camera system affixed to a twin-engine aircraft. Surveys used a transect-based design with a ground sampling distance (the distance between two consecutive pixel centres) of 1.5 centimetres reported by APEM. Transect lines were spaced approximately 3.2 km apart with a transect width of 0.46 km. Surveys from April 2021 to January 2022 consisted of 13 transect lines, covering the Project WDA plus a six km buffer. Based on emergent research, this was increased to 15 transect lines over the Project area plus a 10 km buffer from February 2022 onwards (refer to **Annex 11.2A: Project DAS Final Report (All Project Surveys)**). The survey design was intended to achieve a minimum of 10% coverage of the Project area; coverage captured exceeded 10% for each survey.

47. The aircraft flight altitude of approximately 453 m, and other technical parameters of the adopted method conform with the recommended minimum aircraft altitude from Thaxter and Burton (2009) and updated in Thaxter et al., (2016).

3.1.3 Data source and survey programme

48. Two sources of baseline DAS data, both collected by APEM, were available for the Project baseline site characterisation:

Project DAS data

49. Bespoke Project DAS data were collected for the Project in the WDA plus 4 km buffer (**Figure 2**). A total of 30 samples (i.e. complete surveys) were collected between April 2021 and September 2023.

50. The aim of the Project DAS survey programme was to record one DAS sample in one day each consecutive month, however, there were some exceptions made to this survey strategy; no Project DAS samples were recorded in December 2021, February 2022 or June 2022, two samples per month were recorded in March, July and December 2022, the October 2022 sample was completed on November 4th 2022 and one survey was recorded over two days in March 2023. These baseline data issues were discussed during pre-consultation discussion and it was agreed with NatureScot to use 27 of the Project DAS datasets (listed in **Table 2**) combined with Third-Party DAS data (refer to **paragraph 52**) to inform the Project baseline site characterisation (NatureScot letter dated 7 August 2025). Note, two DAS samples were recorded over two days with gap of a few days in between completion of the surveys (samples 12 and 24; refer to **Table 2**). Surveys may have missed a peak number of birds between the survey start date and the date of completion (in the first instance, a gap between March 1st and March 4th, and in the second instance, a gap

between March 19th and March 23rd). The density and abundance estimates from combining these surveys may be an underestimate and should be interpreted with caution.

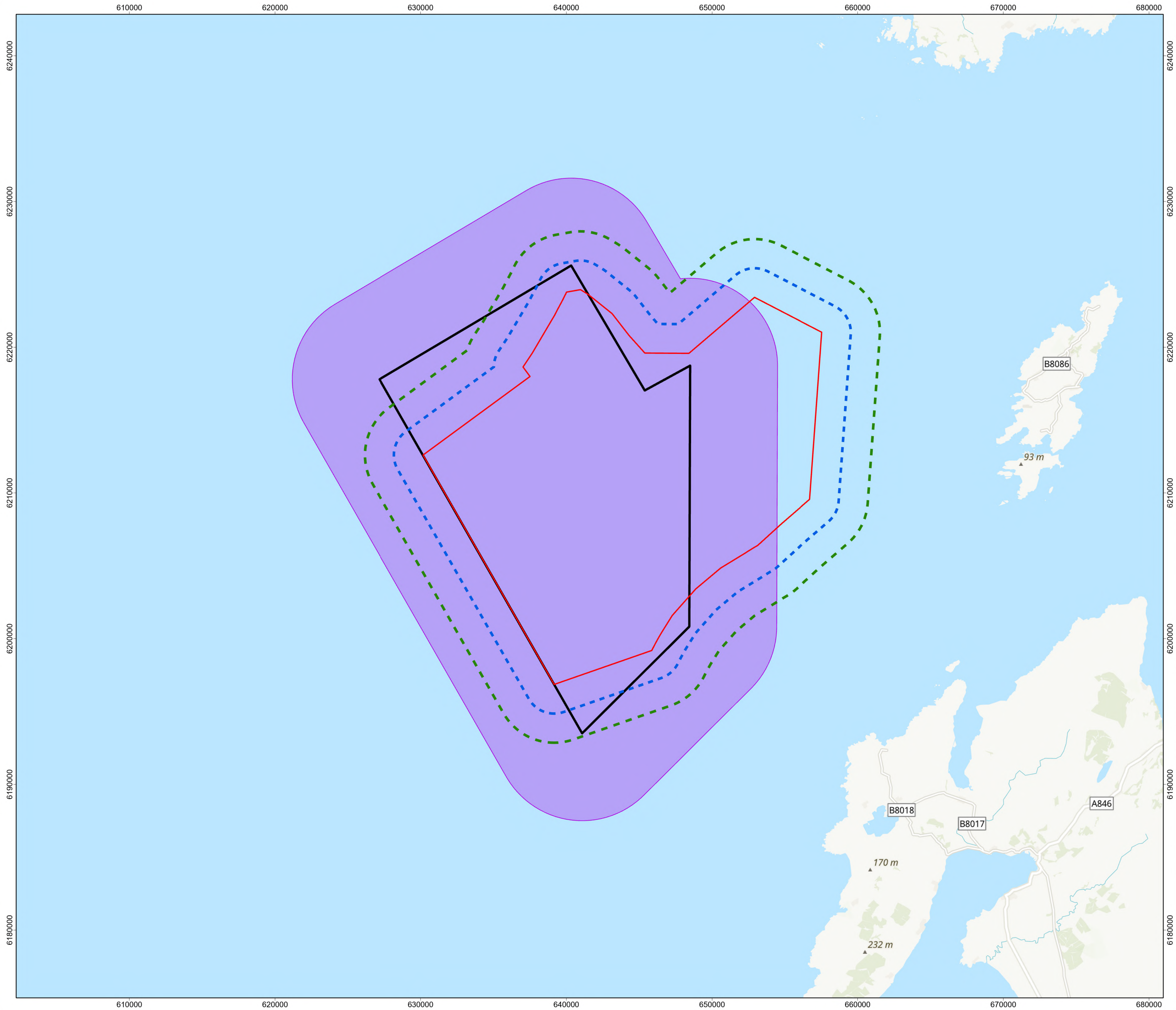
51. Additional Project DAS data beyond the 4 km buffer surrounding the WDA were collected up to a 10 km buffer; details of all DAS data collected for the Project are available in the DAS Programme Final Report (**Annex 11.2A: Project DAS Final Report (All Project Surveys)**).

Third-Party DAS data

52. Third-Party DAS data were collected in an area which covered the Third-Party Boundary plus a 6 km buffer, this Third-Party survey area partially overlapped with the Project WDA plus 4 km buffer (**Figure 2**). A total of 16 Third-Party DAS samples (complete surveys) were collected between October 2020 and January 2022. It was agreed with NatureScot to use three Third-Party DAS samples (listed below and in **Table 2**) to combine with Project DAS data to inform the Project baseline site characterisation (NatureScot letter dated 7 August 2025):

- Third-Party DAS data recorded 1 and 4 March 2021 (**Annex 11.2B: Third-Party DAS survey 5 (01 plus 04 March 2021)**);
- Third-Party DAS data recorded 21 March 2021 (**Annex 11.2C: Third-Party DAS survey 6 (21 March 2021)**); and,
- Third-Party DAS data recorded 15 December 2021 (**Annex 11.2D: Third-Party DAS survey 15 (15 December 2021)**).

53. Third-Party aerial surveys captured data along 16 transects with nodes spaced 2 km apart. Coverage of the survey aera was approximately 12%. **Annex 11.2B, C and D** provide full details of survey techniques. **Figure 2** illustrates the location of the Project offshore ornithology survey areas (WDA plus 2 km and 4 km buffers surrounding the WDA) and the Third-Party DAS survey areas (Third-Party Boundary plus 6 km buffer surrounding the Third-Party Boundary). There was a large degree of overlap between the Project and Third-Party survey areas; approximately, 91% of the Third-Party survey area overlapped with the Project WDA, 86% overlapped with the WDA plus 2 km buffer and 81% overlapped with the WDA plus 4 km buffer.



Windfarm Development Area (WDA)
WDA 2 km Buffer
WDA 4 km Buffer
Third Party Boundary
Third Party Boundary 6 km Buffer

N

0 5 10 Kilometres

1	23/04/2026	MMM	LD	NG	NG
REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER

DRAWING NUMBER	MCW-DWF-ENV-MAP-RHS-000206		
DATUM	ETRS89	PROJECTION	UTM Zone 29N
SCALE	1:250,000	PAGE SIZE	A3
PROJECT TITLE	MachairWind		

Windfarm Development Area and Third Party Boundary

Sources: Esri, TomTom, Garmin, GEBCO, National Geographic, NOAA, and the GIS User Community, OceanWise, Esri, GEBCO, Garmin, NaturalVue, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

NOT TO BE USED FOR NAVIGATION

MacArthur Green
ScottishPower Renewables

Project: Y:_MG\Projects\Machair_Copy_20251027\03_GIS\06_Aprx\Figures_Final\MCW-DWF-ENV-MAP-RHS-000206_Machairwind_WindfarmDevelopmentAreaandThirdPartyBoundary.aprx
Name: MCW-DWF-ENV-MAP-RHS-000206_Machairwind_WindfarmDevelopmentAreaandThirdPartyBoundary

54. **Table 2** provides a summary list of DAS samples, agreed with NatureScot (NatureScot letter dated 7 August 2025), used to inform the Project baseline site characterisation.

Table 2: Summary of Project and Third-Party DAS samples used to inform the Project baseline site characterisation.

Date of DAS survey	Project or Third-Party DAS (survey number)	ID sample number
21 March 2021	Third-Party (6)	1
20 April 2021	Project (1)	2
11 May 2021	Project (2)	3
12 June 2021	Project (3)	4
06 July 2021	Project (4)	5
14 August 2021	Project (5)	6
29 September 2021	Project (6)	7
22 October 2021	Project (7)	8
23 November 2021	Project (8)	9
15 December 2021	Third-Party (15)	10
20 January 2022	Project (9)	11
01 plus 04 March 2021 (proxy sample for February 2022)	Third-Party (5)	12
28 March 2022	Project (11)	13
24 April 2022	Project (12)	14
28 May 2022	Project (13)	15
June 2022	No sample	N/A
27 July 2022	Project (15)	16
21 August 2022	Project (16)	17
13 September 2022	Project (17)	18
04 November 2022 (proxy sample for October 2022)	Project (18)	19
22 November 2022	Project (19)	20
02 December 2022	Project (20)	21
28 January 2023	Project (22)	22
24 February 2023	Project (23)	23
19 plus 23 March 2023	Project (24)	24
22 April 2023	Project (25)	25
13 May 2023	Project (26)	26
07 June 2023	Project (27)	27
21 July 2023	Project (28)	28
16 August 2023	Project (29)	29
06 September 2023	Project (30)	30

55. Dates, flight times and survey effort of all Project and Third-Party DAS datasets used to inform the Project baseline site characterisation are presented in **Table 3**. The boundary

area for the WDA plus 4 km buffer was 852.78 km^2. Coverage in all samples was >10% within the Project WDA plus 4 km buffer boundary.

Table 3: Summary of survey effort for DAS samples. Analysed survey effort describes the total image footprints analysed within the WDA plus 4 km buffer boundary area. Coverage is in relation to survey effort within the WDA plus 4 km buffer boundary area.

Sample No.	Project/ Third-party	Date	Start time	End time	Analysed survey effort (km^2)	Coverage (%)
1	Third-Party	21 March 2021	10:06	13:01	120.94	14.18
2	Project	21 April 2021	13:15	16:07	134.34	15.75
3	Project	11 May 2021	09:38	12:21	133.79	15.69
4	Project	12 June 2021	12:34	15:14	132.10	15.49
5	Project	06 July 2021	14:45	17:45	132.83	15.58
6	Project	14 August 2021	10:13	10:35	132.48	15.54
6	Project	14 August 2021	14:34	17:05	132.48	15.54
7	Project	29 September 2021	13:00	15:36	134.93	15.82
8	Project	22 October 2021	11:50	14:31	133.10	15.61
9	Project	23 November 2021	10:00	13:19	129.97	15.24
10	Third-Party	03 December 2021	10:27	13:04	119.21	13.98
11	Project	20 January 2022	10:09	12:36	139.23	16.33
12	Third-Party[2]	01 March 2021	11:47	12:44	118.64	13.91
12	Third-Party	01 March 2021	16:06	17:23	118.64	13.91
12	Third-Party	04 March 2021	14:26	15:10	118.64	13.91
13	Project	28 March 2022	09:36	13:11	129.21	15.15
14	Project	24 April 2022	13:53	17:16	134.30	15.75
15	Project	28 May 2022	11:17	14:18	134.61	15.78
15	Project	28 May 2022	18:18	18:44	134.61	15.78
16	Project	27 July 2022	10:40	14:04	134.30	15.75
17	Project	21 August 2022	10:47	14:10	135.26	15.86
18	Project	13 September 2022	11:36	15:00	135.97	15.94
19	Project	04 November 2022	10:51	13:25	148.30	17.39
20	Project	22 November 2022	11:37	15:08	133.39	15.64
21	Project	02 December 2022	10:47	14:26	133.48	15.65
22	Project	28 January 2023	12:21	15:46	133.18	15.62
23	Project	24 February 2023	12:11	15:44	135.79	15.92
24	Project	19 March 2023	11:34	14:12	132.53	15.54
24	Project	23 March 2023	10:50	11:43	132.53	15.54

[2] The Third-Party March 2021 survey was split across two days (01 March and 04 March) due to adverse weather impacting the survey.

Sample No.	Project/ Third-party	Date	Start time	End time	Analysed survey effort (km^2)	Coverage (%)
25	Project	22 April 2023	10:29	14:00	130.17	15.26
26	Project	13 May 2023	13:24	16:35	130.49	15.30
27	Project	07 June 2023	10:21	12:31	131.35	15.40
27	Project	07 June 2023	14:39	15:53	131.35	15.40
28	Project	21 July 2023	07:55	11:29	130.67	15.32
29	Project	16 August 2023	14:34	18:01	129.01	15.13
30	Project	06 September 2023	08:33	12:20	130.44	15.30

3.1.4 Data review, object identification and processing

56. Images were viewed by trained reviewers who identified birds, other marine megafauna and all other objects in the footage. All images with identifications were reviewed for quality assurance and an additional review of 20% of images without any observations was carried out as part of the quality assurance process.

57. Birds were identified to the lowest taxonomic level possible. The approximate age of each bird, as well as behaviour (sat on the water, in flight, diving and perching) visible from the imagery, were also recorded, where possible. Ageing of birds was based on plumage characteristics and was conducted, where possible, on species which show age variation in plumage.

58. Raw data from DAS were supplied as observation logs, containing details of all objects (seabird, marine mammal, vessel, etc.) as well as latitude and longitude coordinates for each object. All non-bird records were removed prior to analysis.

3.2 Consideration of biological seasons

59. Bird abundances and distribution vary greatly throughout the year, dictated largely by season and bird biology and phenology. The EIAR and RIAA informed by the information in this baseline report uses biologically distinct seasons, which aid in understanding the importance of the WDA plus 4 km buffer for each species at different points during a yearly cycle.

60. Following NatureScot Guidance Note 2[3], this report presents density and abundance data in accordance with the breeding and non-breeding seasons presented in NatureScot (2023) Guidance Note 9[4]. These seasons are presented for each species recorded in the WDA plus 4 km buffer in **Table 4**.

61. NatureScot Short Guidance Note 9[4] defines breeding and non-breeding seasons as:

- Breeding season: birds are strongly associated with nest site, including nesting, egg-laying and provisioning young.
- Non-breeding season: period of time where no breeding takes place, which may encompass birds over-wintering in an area and migration periods between breeding and wintering sites, dependent on the species.

[3] NatureScot Guidance Note 2 (version 1 January 2023): https://www.nature.scot/doc/guidance-note-2-guidance-support-offshore-wind-applications-advice-marine-ornithology-baseline

[4] NatureScot Guidance Note 9 (version 2 October 2020): Guidance note - Seasonal definitions for birds in the Scottish Marine Environment.pdf

62. NatureScot Short Guidance Note 9[4] defines some months as being split between the between the breeding and non-breeding seasons. For example, for kittiwake, the first half of April is considered to be part of the non-breeding season and the second half of April is part of the breeding season (**Table 4**).

63. Almost all seabirds are migratory, meaning distributions and abundances of birds around the UK change with season. The at-sea populations of birds that breed in the UK are also supplemented by birds that have bred in other countries. Furness (2015) captured these seasonal changes in seabird populations by identifying Biologically Defined Minimum Population Scales (BDMPS) for each species. Furness (2015) identified key seasons in which seabird populations were migratory and estimated the size of the population in each season, separating out the UK component and the overseas component.

64. Density and abundance data are presented in this report for the NatureScot breeding season and the BDMPS non-breeding seasons as defined in Furness (2015). For those species where the autumn and spring passage and winter periods are defined within the non-breeding season, these BDMPS seasons are also summarised in **Table 4**.

Table 4: Species specific seasonal definitions for all species recorded during DAS, taken from NatureScot (2023, Guidance Note 9[4]) and the BDMPS report (Furness, 2015). Note, species recorded during DAS but not included in Guidance Note 9 nor the BDMPS report are not included here.

Species	NatureScot (2023)		Furness (2015)		
	Breeding season	Non-breeding season	Spring migration	Autumn migration	Winter
Kittiwake	mid-April to August	September to mid-April	January to April	August to December	-
Black-headed gull[2]	April to August	September to March	-	-	-
Common gull[2]	April to August	September to March	-	-	-
Great black-backed gull	April to August	September to March	September to March (single non-breeding BDMPS season)		
Herring gull	April to August	September to March	September to March (single non-breeding BDMPS season)		
Lesser black-backed gull	mid-March to August	September to mid-March[1]	March to April	August to October	November to February
Common tern	May to mid-September	mid-September to April[1]	April to May	Late July to September	-
Arctic tern	May to August	September to April[1]	Late April to May	July to early September	-
Great skua	mid-April to mid-September	mid-September to mid-April[1]	March to April	August to October	November to February
Arctic skua	May to August	September to April	April to May	August to October	-
Guillemot	April to mid-August	mid-August to March	Single non-breeding season: August to February		
Razorbill	April to mid-August	mid-August to March	January to March	August to October	November to December

Species	NatureScot (2023)		Furness (2015)		
	Breeding season	Non-breeding season	Spring migration	Autumn migration	Winter
Black guillemot	April to August	September to March	-	-	-
Puffin	April to mid-August	mid-August to March	Single non-breeding season: mid-August to March		
Red-throated diver	May to mid-September	mid-September to April	February to April	September to November	December to January
Great northern diver	N/A[1]	October to mid-May	Single non-breeding season September-May		
European storm-petrel[2]	mid-May to October	November to mid-May[1]	-	-	-
Fulmar	April to mid-September	mid-September to March	December to March	September to October	November
Sooty shearwater[2]	Not a breeding species in the UK	Not present in significant numbers	-	-	-
Great shearwater[2]	Not a breeding species in the UK	Not present in significant numbers	-	-	-
Manx shearwater	April to mid-October	mid-October to March	Late March to May	August to early October	-
Gannet	mid-March to September	October to mid-March	December to March	September to November	-

1) Not present in significant numbers in Scottish marine areas.
2) Species not included in Furness, 2015.

3.3 Method for estimating bird density and abundance

65. Design-based methods were used to estimate bird densities and abundances. Design-based methods calculate density based on observations recorded per amount of survey effort and extrapolate bird abundances from observations from within the survey transect lines across the WDA, WDA plus 2 km buffer and WDA plus 4 km buffer.

3.3.1 Design-based analysis methods: abundance and density estimates per survey calculated from raw bird counts

66. Design-based densities (birds/km^2) and abundances were estimated from raw bird counts (defined in **Section 1.3**) obtained from the baseline DAS data recorded in each of the 30 DAS samples using the 'R' Project statistical software (R Development Core Team, 2024). Raw bird counts included apportioned birds (**Section 3.3.3**) and birds which had been corrected for availability bias (**Section 3.3.4**).

67. Density estimates for each species in each survey were calculated as the raw bird counts divided by the area of imagery used to derive the counts. For example, to calculate the density of a species within the WDA plus 2 km buffer, all images within the WDA plus 2 km buffer boundary were extracted, raw counts of this species within those images were counted and this count was divided by the area of the imagery used for this count. This calculation was performed for each species, each survey and each boundary level (WDA, WDA plus 2 km buffer and WDA plus 4 km buffer) to derive densities.

68. Abundance estimates were calculated as the density multiplied by the total area over which the abundance was to be estimated (the WDA, the WDA plus 2 km buffer or the WDA plus 4 km buffer). This is a simple extrapolation, that assumes the same densities were present in the un-surveyed space between transects as in the transects. These calculations were conducted for the WDA, WDA plus 2 km buffer and WDA plus 4 km buffer.

69. These density and abundance estimates were calculated for individual species, species groups, apportioned species (where appropriate, refer to **Section 3.3.3**) and apportioned/corrected species (for guillemots, razorbills and puffins, refer to **Section 3.3.4**).

70. This method to calculate density and abundance for each species in each survey assumes that the surveyed area is representative of the un-surveyed region. In such a case, the design of the survey is important (hence the name ‘design-based’).

71. Bird records in the DAS data were assigned a behaviour classification including: ‘sitting’, ‘flying’, ‘diving’ and ‘perched’. Prior to analyses, observations of individual birds that were classified as ‘diving’ or ‘perched’ were re-classified. Perched birds were re-classified as a bird sat on the water and diving birds were re-classified as a bird sat on the water, except in the case of gannet, where ‘diving’ gannets were classified as a bird in flight.

72. A small number of dead birds (refer to **Table 55** in **Annex 11.2E: Raw Counts**), possibly victims of HPAI, were recorded during surveys floating in the sea within transects including: 11 gannets, two kittiwakes and five birds not identified to species.

3.3.2 Design-based methods: quantifying variance and uncertainty

73. The simple extrapolation approach described above does not have any measure of uncertainty associated with it. To quantify uncertainty around density and abundance estimates, a ‘bootstrap’ approach was used.

74. A non-parametric bootstrap of 1,000 iterations with resampling was used to estimate standard deviation (SD), lower 95% bootstrap confidence intervals (lci), upper 95% confidence bootstrap confidence intervals (uci) and coefficient of variation (CV).

75. The observations for each species in each survey per boundary level (WDA, WDA plus 2 km buffer and WDA plus 4 km buffer) were resampled using a time-series bootstrap function (R library ‘boot’, with function ‘tsboot’). Resampling occurred with a blocking structure. The autocorrelation between adjacent flight segments was calculated between lag lengths of zero and 50. The maximum lag length at which the autocorrelation function was significant (determined by a Bonferroni-corrected upper confidence limit) informed the blocking structure length from which to resample, e.g. a maximum significant lag length of four would mean resampling was drawn from five adjacent segments’ combined count of birds. Autocorrelation was measured on the full extent of the data.

76. Following the bootstrap procedure, for each species a table with 30 columns (samples/surveys) and 1,000 rows (resamples) was obtained. Each bootstrap iteration provided a re-estimated number of observations which were analysed to obtain mean abundance and density. To derive variances from the bootstrap samples, the SD, lci and uci (which are the 25th and 975th ordered values in the ranked bootstraps) were extracted to provide measures of uncertainty.

77. This resampling procedure was conducted separately for birds recorded in flight, sat on the water and for both birds sitting and flying combined.

78. The density estimates and SD (calculated from bootstrap values) as well as the mean of bootstrapped values and lower/upper confidence intervals calculated from 1000 bootstrap values are also presented for each species in each survey in the WDA, WDA plus 2 km and WDA plus 4 km buffer for:

- Birds sat on the water: **Annex 11.2F: Density estimates per survey of birds sat on the water**;
- Birds in flight: **Annex 11.2G: Density estimates per survey of birds in flight**; and,
- Birds sat on the water and birds in flight: **Annex 11.2H: Density estimates per survey of sitting and flying birds**.

79. The abundance estimates and SD (calculated from bootstrap values) as well as the mean of bootstrapped values and lower/upper confidence intervals calculated from 1000 bootstrap values are also presented for each species in each survey in the WDA, WDA plus 2 km and WDA plus 4 km buffer for:

- Birds sat on the water: **Annex 11.2I: Abundance estimates per survey of birds sat on the water**;
- Birds in flight: **Annex 11.2J: Abundance estimates per survey of birds in flight**; and,
- Birds sat on the water and birds in flight: **Annex 11.2K: Abundance estimates per survey of sitting and flying birds**.

3.3.3 Design-based methods: apportioning species groups to species-specific categories

80. DAS imagery was analysed to classify observations of birds to species level where possible. In instances when it was not possible to identify observations to the species level, observations would be identified to a higher taxonomic level called a ‘species group’ (e.g. ‘Large gull species’, ‘Guillemot/Razorbill’, etc.). These species group identifications were apportioned to species specific identifications where possible according to a procedure examining the ratios of identified birds within lower taxonomic groups. Apportioning was applied to both raw counts and bootstrapped data (allowing for quantifying of uncertainty for apportioned categories).

81. Apportioning ratios were calculated for each species per survey and by behaviour (apportioning ratios for species group identifications that were sitting were calculated separately from species group identifications that were flying); however, within a survey, apportioning ratios were calculated on the full extent of the data (i.e. analyses by boundary shared apportioning ratios, applied to data at each respective boundary).

82. In some instances where species groups would virtually all be assigned to a single category, these observations were re-assigned prior to analyses. This was done for four categories: all ‘small shearwater species’ (n = 623 across all surveys within the 4 km buffer boundary) were assigned to Manx shearwater; all ‘shearwater species’ (n = 11 across all surveys within the 4 km buffer boundary) were assigned to Manx shearwater; all ‘storm-petrel species’ (n = 85 across all surveys within the 4 km buffer boundary) were assigned to European storm-petrel; all ‘tern species’ (n = 4 across all surveys within the 4 km buffer boundary) were assigned to ‘Commic’ tern.

83. Five species groups were not apportioned:

- The ‘Cormorant/Shag’ species group included seven identifications within the WDA plus 4 km buffer across all 30 surveys (**Table 7**). However, as no cormorants or shags were specifically identified with the WDA plus 4 km buffer boundary, it was not possible to apportion the ‘Cormorant/Shag’ species group;
- The ‘Fulmar/gull species’ species group included three identifications within the WDA plus 4 km across all 30 surveys (**Table 7**). Due to the very small size of this species group, it was not apportioned to individual species as only small fractions of a bird would be apportioned;

- The ‘Diver species’ species group included two identifications within the WDA plus 4 km across all 30 surveys (**Table 7**). Due to the very small size of this species group, it was not apportioned to individual species as only small fractions of a bird would be apportioned;
- The ‘Wader species’ species group included 47 identifications within the WDA plus 4 km across all 30 surveys (**Table 7**). However, as only one grey phalarope and one golden plover were specifically identified with the WDA plus 4 km buffer boundary, there were insufficient data to inform an apportioning ratio; and,
- The ‘Unidentified Bird species’ species group included 32 identifications within the WDA plus 4 km across all 30 surveys (**Table 7**). Without any classification to identify what sort of birds these were, it was not possible to calculate an apportioning ratio for these unidentified birds.

84. The hierarchy of species groups are presented in **Table 5**.

3.3.4 Availability bias of guillemots, razorbills and puffins

85. Auks (e.g. guillemots, razorbills and puffins) spend a proportion of their time foraging beneath the water surface and therefore a proportion of individuals present in an area will be missed during the period the survey aircraft passes over. Density and abundance estimates were adjusted to account for these individuals not recorded during digital aerial surveys by multiplying the number of birds recorded as sat on the water with species-specific correction factors (birds in flight are not adjusted). The adjustment rates used were 1.311 for guillemot and 1.211 for razorbill (i.e. this assumes 24% of guillemots and 17% of razorbills are underwater at any given time; Thaxter et al., 2013) and 1.165 for puffin (i.e. 14% of puffins were assumed to be underwater at any time; Spencer, 2012). Great northern divers also forage by pursuit diving from the sea surface. However, no correction for availability bias was made for great northern diver, as the appropriate correction factor for that species is unknown.

Table 5: Hierarchy of group level and species level identifications used for apportioning.

<table>
<tr><th>Species</th><th>Group Level 1</th><th>Group Level 2</th><th>Group Level 3</th><th>Group Level 4</th></tr>
<tr><td>Golden plover</td><td rowspan="3">Wader species</td><td colspan="3" rowspan="3"></td></tr>
<tr><td>Dunlin</td></tr>
<tr><td>Grey phalarope</td></tr>
<tr><td>Great northern diver</td><td rowspan="3">Diver species</td><td colspan="3" rowspan="3"></td></tr>
<tr><td>Black-throated diver</td></tr>
<tr><td>Red-throated diver</td></tr>
<tr><td>Kittiwake</td><td colspan="2" rowspan="4">Small gull species</td><td rowspan="7">Gull species</td><td rowspan="8">Fulmar/Gull species</td></tr>
<tr><td>Black-headed gull</td></tr>
<tr><td>Little gull</td></tr>
<tr><td>Common gull</td></tr>
<tr><td>Great black-backed gull</td><td colspan="2" rowspan="3">Large gull species</td></tr>
<tr><td>Lesser black-backed gull</td></tr>
<tr><td>Herring gull</td></tr>
<tr><td>Fulmar</td><td colspan="3"></td></tr>
<tr><td>Common tern</td><td colspan="2" rowspan="2">‘Commic’ tern</td><td rowspan="2">Tern species</td><td rowspan="2"></td></tr>
<tr><td>Arctic tern</td></tr>
<tr><td>Guillemot</td><td rowspan="2">Guillemot/razorbill</td><td rowspan="4">Auk species</td><td rowspan="7">Auk/shearwater species</td><td rowspan="7"></td></tr>
<tr><td>Razorbill</td></tr>
<tr><td>Black guillemot</td><td rowspan="2"></td></tr>
<tr><td>Puffin</td></tr>
<tr><td>Manx shearwater</td><td>Small shearwater species</td><td rowspan="3">Shearwater species</td></tr>
<tr><td>Sooty shearwater</td><td rowspan="2"></td></tr>
<tr><td>Great shearwater</td></tr>
<tr><td>European storm-petrel</td><td>Storm-petrel species</td><td colspan="3" rowspan="3"></td></tr>
<tr><td>Cormorant</td><td rowspan="2">Cormorant/shag</td></tr>
<tr><td>Shag</td></tr>
</table>

4.0 Results

4.1 Raw observations

86. 'Raw observations' are the numbers of birds that were recorded in the DAS data before any data analysis took place (i.e. before raw counts, density and abundance estimates were calculated). Raw observations for each named species do not include birds which have been apportioned from a broader species group (for apportioning of species groups to species level, refer to **Section 3.3.3**) and for guillemots, razorbills and puffins, raw observations are not corrected to account for the number of birds under the water at the time of each DAS (for availability bias correction methods, refer to **Section 3.3.4**).

87. The following DAS reports present the total number of raw observations of birds within the whole offshore ornithology survey area (i.e. an area larger than the WDA plus 4 km buffer), across all surveys:

- **Annex 11.2A: Project DAS Final Report (All Project Surveys)**;
- **Annex 11.2B: Third-Party DAS survey 5 (01 plus 04 March 2021)**;
- **Annex 11.2C: Third-Party DAS survey 6 (21 March 2021)**; and,
- **Annex 11.2D: Third-Party DAS survey 15 (15 December 2021)**.

88. Raw observations recorded for each species in each survey (up to a total of 30 surveys) are illustrated in maps in the species accounts (**Section 4.5**). This data is available in a tabulated format in **Annex 11.2E: Raw Counts**; tables of raw counts contained therein for species that are not apportioned nor corrected for availability bias are equivalent to raw observations recorded during surveys.

4.2 Raw counts

89. 'Raw counts' are the numbers of birds used to inform density and abundance estimates within the WDA, WDA plus 2 km buffer and WDA plus 4 km buffer.

90. Raw bird counts include apportioned birds (**Section 3.3.3**) and birds which have been corrected for availability bias (**Section 3.3.4**).

91. A summary of raw counts recorded during the 30 surveys of birds in flight in the WDA (the offshore ornithology survey area which provided density inputs into the collision risk assessment, refer to **Technical Appendix 11.3: Collision Risk Modelling**), as well as birds in flight and sat on the water in the WDA plus 2 km buffer or in the WDA plus 4 km buffer (the offshore ornithology survey areas which provided abundance inputs into the displacement assessment, refer to **Technical Appendix 11.4: Displacement**) are presented in **Table 6**.

92. A summary of raw bird counts which were recorded as sat on the water and in flight in the WDA plus 4 km buffer which could not be identified to species level, but were assigned to a broader species group (as described in **Section 3.3.3**) is presented in **Table 7**.

93. Altogether, 117,039 raw bird counts (after birds had been apportioned and availability bias corrected, refer to **Section 3.3.3** and **Section 3.3.4** respectively) were recorded in the WDA plus 4 km buffer, across the 30 surveys (**Table 6**). Common guillemot was the most frequently recorded species, with a total of 76,809 records. Razorbill and Manx shearwater were also recorded frequently in the WDA plus 4 km buffer, with a total of 13,393 and 11,605 records respectively across all 30 surveys. There were also 10,811 records of 'Guillemot/Razorbill' which were apportioned to individual species of guillemot or razorbill. Kittiwake and puffin were present in slightly lower numbers (9,899 and 3,228 birds respectively) in the WDA plus 4 km buffer. Gannet, fulmar, herring gull and great black-backed gull were recorded in lower numbers still (989, 303, 232 and 225 records respectively) in the WDA plus 4 km buffer. Other species were all recorded less frequently (**Table 6**).

Table 6: Summary of raw counts of all birds identified to species recorded flying in the WDA, sitting and flying in the WDA plus 2 km buffer and sitting and flying in the WDA plus 4 km bufferNumbers presented are rounded to the nearest integer. The counts presented are combined totals across all 30 DAS samples. The counts for each species include apportioned birds that were initially assigned to a species group. Guillemot, razorbill and puffin counts are corrected to account for birds under the water at the time of the aerial surveys.

Species	Raw counts (apportioned and corrected)		
	Flying – WDA	Sitting and Flying WDA + 2 km	Sitting and Flying WDA + 4 km
Arctic skua	4	5	5
Arctic tern	62	116	156
Common gull	6	16	23
Common tern	21	27	31
European storm-petrel	25	57	85
Fulmar	112	237	303
Gannet	243	797	989
Golden plover	1	1	1
Great black-backed gull	26	128	225
Great northern diver	0	10	17
Great shearwater	0	1	1
Great skua	9	21	27
Grey phalarope	0	0	1
Guillemot	912	62,614	76,809
Herring gull	42	201	232
Kittiwake	2,743	7,522	9,899
Lesser black-backed gull	0	0	2
Manx shearwater	1,606	9,616	11,605
Puffin	8	2,567	3,228
Razorbill	248	10,508	13,393
Red-throated diver	2	2	2
Sooty shearwater	2	4	5
Total for all species	**6,068**	**94,450**	**117,039**

Table 7: Summary of raw counts all birds recorded in the WDA plus 4 km buffer that were assigned to a 'species group'. Numbers presented are combined totals across all 30 DAS samples. Species groups (except for those indicated with an *) were apportioned to a species.

Species group	Raw counts in the WDA plus 4 km
Auk species	420
Auk/Shearwater species	659
Commic Tern	80
Cormorant/Shag*	7
Diver species*	2
Fulmar/Gull species*	3
Guillemot/Razorbill	10,811
Gull species	9
Large Gull species	25
Small Gull species	11
Unidentified Bird species*	32
Wader species*	47
Shearwater species	11
Small Shearwater species	626
Storm-petrel species	85
Tern species	11

*Species groups were not apportioned to individual species (for an explanation of why these species groups were not apportioned, refer to **Section 3.3.3**).

4.3 Design-based density estimates

95. Design-based density estimates of birds identified to species, birds assigned to a species group (**Section 3.3.3**) and also of all birds in a species which included apportioned and corrected birds (refer to **Section 3.3.3** and **Section 3.3.4** respectively) are provided in the following annexes:

- Birds sat on the water: **Annex 11.2F: Density estimates per survey of birds sat on the water**;
- Birds in flight: **Annex 11.2G: Density estimates per survey of birds in flight**; and,
- Birds sat on the water and birds in flight: **Annex 11.2H: Density estimates per survey of sitting and flying birds**.

96. Design-based density estimates presented in the annexes include the mean density with S.D. and upper and lower C.I. values calculated using the 'bootstrap method' (**Section 3.3.2**) for birds recorded in the WDA, WDA plus 2 km buffer and WDA plus 4 km buffer.

97. **Table 8** presents the proportions of birds in flight in the WDA; the proportions of birds in flight were calculated from apportioned and corrected bird data (refer to **Section 3.3.3** and **Section 3.3.4** respectively). The proportion of birds in flight is only provided for the WDA as this is the spatial scale used in collision risk modelling (refer to **Technical Appendix 11.3: Collision Risk Modelling**). Common tern and Arctic terns within the WDA had a high proportion of flying birds (100% of common terns; 88.6% of Arctic terns). Auk species and great northern divers were predominantly recorded as sat on the water (2.2%, 4.1% and 0.5% of guillemots, razorbills and puffins were recorded flying, respectively; no flying great

northern divers were recorded). Other species were recorded flying in moderate proportions, though Manx shearwater was notable with only 27.9% of individuals recorded flying.

Table 8: Proportion of birds in flight recorded in the WDA Raw counts presented are combined totals across all 30 DAS samples.

Species	Raw counts (apportioned and corrected)		Proportion of flying birds (%)
	Flying – WDA	Sitting - WDA	
Arctic tern	62	8	88.6
Common gull	6	2	75.0
Common tern	21	0	100.0
European storm-petrel	25	0	100.0
Fulmar	112	42	72.7
Gannet	243	283	46.2
Great black-backed gull	26	41	38.8
Great northern diver	0	7	0.0
Great skua	9	4	69.2
Guillemot	912	41,356	2.2
Herring gull	42	46	47.7
Kittiwake	2,743	1,530	64.2
Manx shearwater	1,606	4,150	27.9
Puffin	8	1,695	0.5
Razorbill	248	5,871	4.1

98. **Table 9** summarises the design-based density estimates of birds in flight within the WDA for each species included in the Species Accounts (**Section 4.5**). Density estimates of birds in flight within the WDA were used to assess collision risk impacts in the EIAR and RIAA. Collision risk was estimated for six species (Arctic tern, common tern, gannet, great black-backed gull, herring gull and kittiwake), refer to **Technical Appendix 11.3: Collision Risk Modelling** for details.

Table 9: Design-based density estimates of birds in flight (including apportioned and corrected birds) recorded in the WDA during 30 digital aerial surveys.

Density estimates (birds/km^2) in the WDA for birds in flight															
Survey date (Sample number)	**Arctic tern**	**Common gull**	**Common tern**	**European storm-petrel**	**Fulmar**	**Gannet**	**Great black-backed gull**	**Great northern diver**	**Great skua**	**Guillemot**	**Herring gull**	**Kittiwake**	**Manx shearwater**	**Puffin**	**Razorbill**
21st March 2021 **(1)**	0.00	0.00	0.00	0.00	0.04	0.03	0.00	0.00	0.00	0.75	0.00	0.46	0.31	0.00	0.20
20th April 2021 **(2)**	0.00	0.00	0.00	0.00	0.01	0.08	0.00	0.00	0.00	0.98	0.00	0.25	0.72	0.00	0.00
11th May 2021 **(3)**	0.25	0.00	0.00	0.00	0.07	0.12	0.00	0.00	0.00	0.79	0.00	1.41	2.71	0.00	0.00
12th June 2021 **(4)**	0.00	0.00	0.00	0.03	0.01	0.15	0.00	0.00	0.00	0.60	0.00	0.51	0.63	0.00	0.00
6th July 2021 **(5)**	0.00	0.00	0.00	0.00	0.04	0.17	0.01	0.00	0.01	0.40	0.01	0.58	2.79	0.00	0.00
14th August 2021 **(6)**	0.01	0.00	0.23	0.00	0.07	0.20	0.00	0.00	0.00	0.01	0.01	0.24	0.85	0.00	0.00
29th September 2021 **(7)**	0.03	0.00	0.03	0.00	0.00	0.23	0.00	0.00	0.00	0.19	0.00	0.55	0.00	0.00	0.10
22nd October 2021 **(8)**	0.00	0.00	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.03	0.00	1.20	0.00	0.00	0.00
23rd November 2021 **(9)**	0.00	0.01	0.00	0.00	0.10	0.03	0.08	0.00	0.00	0.61	0.05	4.43	0.00	0.00	0.46
15th December 2021 **(10)**	0.00	0.03	0.00	0.00	0.09	0.01	0.09	0.00	0.00	0.23	0.32	6.48	0.00	0.00	0.01
20th January 2022 **(11)**	0.00	0.00	0.00	0.00	0.42	0.00	0.01	0.00	0.00	0.08	0.00	0.47	0.00	0.00	0.01
1st plus 4th March 2021 (proxy sample for February 2022) **(12)**	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.06	0.00	0.14	0.01	0.00	0.05
28th March 2022 **(13)**	0.00	0.00	0.00	0.00	0.01	0.10	0.01	0.00	0.00	1.73	0.00	0.78	0.27	0.00	0.31
24th April 2022 **(14)**	0.01	0.00	0.02	0.00	0.03	0.14	0.00	0.00	0.01	0.43	0.00	0.52	4.00	0.00	0.00
28th May 2022 **(15)**	0.01	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.06	0.17	0.00	2.26	1.10	0.00	0.00
June 2022	No Survey														

Density estimates (birds/km^2) in the WDA for birds in flight															
27th July 2022 **(16)**	0.15	0.00	0.03	0.08	0.06	0.03	0.00	0.00	0.00	0.15	0.00	2.42	2.31	0.06	0.01
21st August 2022 **(17)**	0.27	0.00	0.00	0.00	0.04	0.10	0.00	0.00	0.01	0.00	0.00	0.04	0.37	0.01	0.00
13th September 2022 **(18)**	0.00	0.00	0.00	0.00	0.07	0.11	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.44
4th November 2022 (proxy sample for October 2022) **(19)**	0.00	0.00	0.00	0.00	0.01	0.08	0.01	0.00	0.00	0.29	0.03	2.09	0.00	0.00	0.43
22nd November 2022 **(20)**	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.74	0.10	2.60	0.00	0.00	0.20
2nd December 2022 **(21)**	0.00	0.00	0.00	0.00	0.03	0.01	0.03	0.00	0.00	0.10	0.00	1.39	0.00	0.00	0.22
28th January 2023 **(22)**	0.00	0.01	0.00	0.00	0.08	0.01	0.04	0.00	0.00	0.24	0.06	2.09	0.00	0.00	0.00
24th February 2023 **(23)**	0.00	0.03	0.00	0.00	0.00	0.03	0.04	0.00	0.00	0.15	0.01	2.54	0.00	0.00	0.00
19th plus 23rd March 2023 **(24)**	0.00	0.00	0.00	0.00	0.10	0.07	0.00	0.00	0.00	0.84	0.00	0.77	0.20	0.00	0.52
22nd April 2023 **(25)**	0.00	0.00	0.00	0.00	0.03	0.06	0.00	0.00	0.00	0.84	0.00	0.87	1.63	0.00	0.00
13th May 2023 **(26)**	0.00	0.00	0.00	0.00	0.03	0.11	0.00	0.00	0.01	0.78	0.00	0.65	0.26	0.00	0.09
07th June 2023 **(27)**	0.01	0.00	0.00	0.01	0.03	0.23	0.00	0.00	0.01	0.89	0.00	1.77	1.33	0.01	0.00
21st July 2023 **(28)**	0.03	0.00	0.00	0.23	0.07	0.06	0.00	0.00	0.00	0.51	0.00	0.58	1.98	0.03	0.22
16th August 2023 **(29)**	0.07	0.00	0.00	0.00	0.06	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00
06th September 2023 **(30)**	0.00	0.00	0.00	0.00	0.00	0.33	0.01	0.00	0.00	0.04	0.00	0.07	0.61	0.00	0.16

4.4 Design-based abundance estimates

99. Design-based abundance estimates of birds identified to species, birds assigned to a species group (**Section 3.3.3**) and also of all birds in a species which included apportioned and corrected birds (refer to **Section 3.3.3** and **Section 3.3.4** respectively) are provided in the following annexes:

- Birds sat on the water: **Annex 11.2I: Abundance estimates per survey of birds sat on the water**;
- Birds in flight: **Annex 11.2J: Abundance estimates per survey of birds in flight**; and,
- Birds sat on the water and birds in flight: **Annex 11.2K: Abundance estimates per survey of sitting and flying birds**.

100. Design-based abundance estimates presented in the annexes include the mean abundance with S.D. and upper and lower C.I. values calculated using the ‘bootstrap method’ (**Section 3.3.2**) for birds recorded in the WDA, WDA plus 2 km buffer and WDA plus 4 km buffer.

101. **Table 10** summarises the design-based abundance estimates of birds sat on the water and in flight within the WDA plus 2 km buffer (all species except great northern diver) or WDA plus 4 km buffer (great northern diver only) for each species included in the Species Accounts (**Section 4.5**). Abundance estimates of birds sat on the water and in flight within the WDA plus 2 km buffer (for all species except great northern diver) or the WDA plus 4 km buffer (great northern diver only) are used to assess displacement impacts in the EIAR and RIAA.

102. Mean seasonal peak (MSP) abundance estimates (calculated as the mean of the peak DAS survey abundance estimate recorded in each complete biological season for each of the two defined survey years) of birds sat on the water and in flight within the WDA plus 2 km buffer (all species except great northern diver) or the WDA plus 4 km buffer (great northern divers only) which were used to estimate displacement impacts for nine species (Arctic tern, common tern, fulmar, gannet, great northern diver, guillemot, kittiwake, puffin and razorbill) are provided in **Technical Appendix 11.4: Displacement**.

Table 10: Design-based abundance estimates of birds sat on the water and in flight (including apportioned and corrected birds) recorded in the WDA plus 2 km buffer (all species except great northern diver) or WDA plus 4 km buffer (great northern diver only) during 30 digital aerial surveys.

Abundance estimates for birds sat on the water and in flight in the WDA + 2 km buffer (all species except great northern diver) or WDA + 4 km buffer (great northern diver)															
Survey date (Sample number)	**Arctic tern**	**Common gull**	**Common tern**	**European storm-petrel**	**Fulmar**	**Gannet**	**Great black-backed gull**	**Great northern diver**	**Great skua**	**Guillemot**	**Herring gull**	**Kittiwake**	**Manx shearwater**	**Puffin**	**Razorbill**
21st March 2021 **(1)**	0.00	0.00	0.00	0.00	60.53	20.18	6.73	7.05	0.00	18,258.32	0.00	417.01	793.67	31.67	9,898.23
20th April 2021 **(2)**	0.00	0.00	0.00	0.00	6.02	78.30	0.00	6.35	0.00	8,446.30	0.00	174.67	969.73	14.12	213.67
11th May 2021 **(3)**	120.70	0.00	0.00	0.00	54.31	156.91	0.00	6.37	0.00	14,957.49	0.00	1,188.88	2,274.84	28.12	360.56
12th June 2021 **(4)**	0.00	0.00	0.00	12.24	6.12	128.48	0.00	0.00	12.24	6,490.93	0.00	477.22	643.09	290.04	283.79
6th July 2021 **(5)**	0.00	0.00	0.00	0.00	36.36	460.57	10.10	0.00	6.06	13,796.12	20.20	533.29	3,822.87	21.38	353.96
14th August 2021 **(6)**	14.63	0.00	125.57	0.00	97.53	207.26	0.00	0.00	6.10	3,305.01	12.19	335.27	684.49	262.18	164.49
29th September 2021 **(7)**	11.97	0.00	11.97	0.00	11.97	125.71	0.00	0.00	0.00	1,648.39	0.00	287.33	0.00	7.41	363.39
22nd October 2021 **(8)**	0.00	0.00	0.00	0.00	12.16	36.48	0.00	0.00	0.00	1,916.64	0.00	1,070.03	0.00	7.17	81.34
23rd November 2021 **(9)**	0.00	31.17	0.00	0.00	86.93	93.14	304.65	0.00	0.00	9,424.84	623.63	7,752.66	0.00	0.00	6,470.13
15th December 2021 **(10)**	0.00	13.54	0.00	0.00	81.23	20.31	137.72	7.15	0.00	14,984.72	376.70	6,782.32	0.00	0.00	1,298.79
20th January 2022 **(11)**	0.00	0.00	0.00	0.00	202.95	0.00	75.38	0.00	0.00	6,440.98	0.00	568.25	0.00	0.00	1,275.63

Abundance estimates for birds sat on the water and in flight in the WDA + 2 km buffer (all species except great northern diver) or WDA + 4 km buffer (great northern diver)															
1st plus 4th March 2021 (proxy sample for February 2022) **(12)**	0.00	0.00	0.00	0.00	27.45	0.00	27.45	7.19	0.00	3,450.16	0.00	185.27	13.72	0.00	2,338.17
28th March 2022 **(13)**	0.00	0.00	0.00	0.00	25.05	93.93	12.52	6.60	0.00	33,381.80	0.00	563.60	1,640.36	73.36	7,242.83
24th April 2022 **(14)**	9.03	6.02	9.03	0.00	12.04	607.87	0.00	0.00	6.02	34,384.91	0.00	3,496.73	16,833.61	56.21	376.63
28th May 2022 **(15)**	6.00	0.00	0.00	0.00	0.00	689.55	0.00	12.67	59.96	3,791.77	0.00	1,337.13	4,239.06	70.14	120.34
June 2022	No Survey														
27th July 2022 **(16)**	84.69	0.00	18.15	84.69	120.99	54.45	0.00	0.00	12.10	31,740.60	0.00	3,859.61	3,656.45	8,781.28	6,266.15
21st August 2022 **(17)**	298.61	0.00	0.00	23.89	41.81	238.89	0.00	0.00	5.97	3,551.65	0.00	35.83	880.69	2,122.25	507.77
13th September 2022 **(18)**	0.00	0.00	0.00	0.00	88.75	177.50	0.00	0.00	0.00	1,233.98	0.00	17.75	50.29	278.42	360.81
4th November 2022 (proxy sample for October 2022) **(19)**	0.00	5.45	0.00	0.00	98.18	141.81	40.22	5.75	0.00	4,910.20	79.77	3,556.13	1.56	0.02	5,821.39
22nd November 2022 **(20)**	0.00	6.07	0.00	0.00	18.22	12.15	18.22	19.18	0.00	10,893.27	66.80	2,550.67	6.07	7.08	1,532.06
2nd December 2022 **(21)**	0.00	0.00	0.00	0.00	12.13	6.07	30.33	0.00	0.00	4,352.48	12.13	1,601.25	0.00	28.43	3,926.38
28th January 2023 **(22)**	0.00	6.07	0.00	0.00	42.51	18.22	33.51	0.00	0.00	12,913.10	39.37	1,554.75	0.00	0.00	426.15
24th February 2023 **(23)**	0.00	29.85	0.00	0.00	0.00	184.77	77.70	0.00	0.00	23,681.06	23.95	3,480.37	0.00	27.83	299.80

Abundance estimates for birds sat on the water and in flight in the WDA + 2 km buffer (all species except great northern diver) or WDA + 4 km buffer (great northern diver)															
19th plus 23rd March 2023 **(24)**	0.00	0.03	0.00	0.00	73.37	110.05	12.23	6.43	0.00	14,220.93	6.11	996.55	459.77	64.39	6,659.87
22nd April 2023 **(25)**	0.00	0.00	0.00	0.00	12.45	112.06	0.00	0.00	6.23	14,517.16	0.00	890.29	4,625.76	36.27	253.96
13th May 2023 **(26)**	62.12	0.03	0.00	0.00	49.70	68.33	0.00	19.60	6.21	19,259.46	0.00	552.84	1,087.93	218.26	1,861.36
07th June 2023 **(27)**	6.17	0.00	0.00	18.52	43.21	370.36	0.00	6.49	6.17	22,811.03	0.00	1,253.07	6,505.87	689.28	581.95
21st July 2023 **(28)**	55.69	0.00	0.00	191.82	68.06	74.25	0.00	0.00	0.00	39,233.19	0.00	519.77	8,024.43	1,653.33	4,911.48
16th August 2023 **(29)**	31.29	0.00	0.00	18.78	43.81	156.47	0.00	0.00	0.00	3,441.16	0.00	12.52	412.56	556.68	388.58
06th September 2023 **(30)**	0.00	0.00	0.00	0.00	6.21	384.74	6.21	0.00	0.00	3,860.26	0.00	80.67	1,071.06	262.56	327.46

4.5 Species Accounts

103. A total of 15 species (Arctic tern, common gull, common tern, European storm-petrel, fulmar, gannet, great black-backed gull, great northern diver, great skua, guillemot, herring gull, kittiwake, Manx shearwater, puffin and razorbill) were recorded in 'non-trivial' numbers in the WDA plus 4 km buffer, (non-trivial was defined as more than 10 counts recorded across all 30 DAS samples, refer to **Table 6**). Species accounts for these 'non-trivial' species are presented in **Section 4.6** to **Section 4.20**.

104. A total of seven species (Arctic skua, golden plover, great shearwater, grey phalarope, lesser black-backed gull, red-throated diver and sooty shearwater) were recorded in 'trivial' numbers, i.e. fewer than 10 counts across all 30 surveys (**Table 6**). For all these species, a summary of their raw counts, density and abundance estimates is provided in **Annex 11.2L: Rarely Recorded Species Information** and these species are not considered further in this report.

Each species account includes the following information:

- **Conservation status:**
  - For all species except great northern diver: European and updated UK conservation status under Birds of Conservation Concern 5 (BoCC5a; Stanbury et al., 2024);
  - For great northern diver: UK conservation status under BOCC5 (Stanbury et al., 2021), European status stated in British Trust for Ornithology (BTO) BirdFacts[5];
- **Raw observations:** Maps are provided illustrating the distribution of DAS raw observations recorded for each survey (up to a total of 30 surveys). For surveys where there were no raw observations recorded, a map is not provided. Note that the maps illustrate the distribution of birds identified to species, it is not possible to illustrate apportioned birds (**Section 3.3.3**) or any birds that were corrected when under the water at the time of the surveys (**Section 3.3.4**);
- **Raw counts:** Summary of peak raw bird counts recorded in flight and sat on the water in the WDA plus 4 km buffer (these counts are provided in **Annex 11.2E: Raw Counts**). For each species where appropriate, peak counts include additional birds apportioned from species groups (refer to **Section 3.3.3**) and for guillemot, razorbill and puffin, peak counts include the number of birds calculated to be under the water at the time of the surveys (refer to **Section 3.3.4**);
- **Design-based density estimates:** Summary of peak design-based density estimates of birds in flight in the WDA. These density estimates are provided in **Annex 11.2G: Density estimates per survey of birds in flight**. For each species where appropriate, peak density estimates include additional birds apportioned from species groups (refer to **Section 3.3.3**). The species accounts present density estimates of birds in flight within the WDA because it is the density of birds in flight within the WDA that are used as data inputs to assess collision risk in the EIAR and RIAA; and,
- **Design-based abundance estimates:** Summary of peak design-based abundance estimates of birds sat on the water and in flight in the WDA plus 2 km buffer (for all species except great northern divers) or the WDA plus 4 km buffer (great northern divers only). These abundance estimates are provided in **Annex 11.2K: Abundance estimates per survey of sitting and flying birds**. For each species where

[5] BTO BirdFacts: https://www.bto.org/learn/about-birds/birdfacts/

appropriate, peak density estimates include additional birds apportioned from species groups (refer to **Section 3.3.3**) and for guillemot, razorbill and puffin, peak density estimates include the number of birds calculated to be under the water at the time of the surveys (refer to **Section 3.3.4**). The species accounts present abundance estimates of birds sat on the water and in flight within the WDA plus 2 km buffer (all species except great northern diver) or birds sat on the water and in flight within the WDA plus 4 km buffer (great northern divers only) because it is the abundance of sitting and flying birds in these offshore ornithology survey areas that are used as data inputs to assess displacement impacts in the EIAR and RIAA.

4.6 Arctic tern

4.6.1 Conservation status

UK Red Listed

European: Endangered

4.6.2 Raw observations

105. Raw observations of Arctic terns (including birds sat on the water and in flight, but not including apportioned birds, refer to **Section 3.3.3**) are presented for each survey in **Figure 3** and **Figure 4**. Arctic terns were identified within the WDA plus 4 km buffer in 12 out of 30 surveys.

106. Arctic terns displayed a relatively weak spatial pattern across the WDA plus 4 km buffer. Arctic terns were more frequently recorded in the 2 km and 4 km buffer areas, though some distribution within the WDA near the edge of the WDA boundary was also recorded.

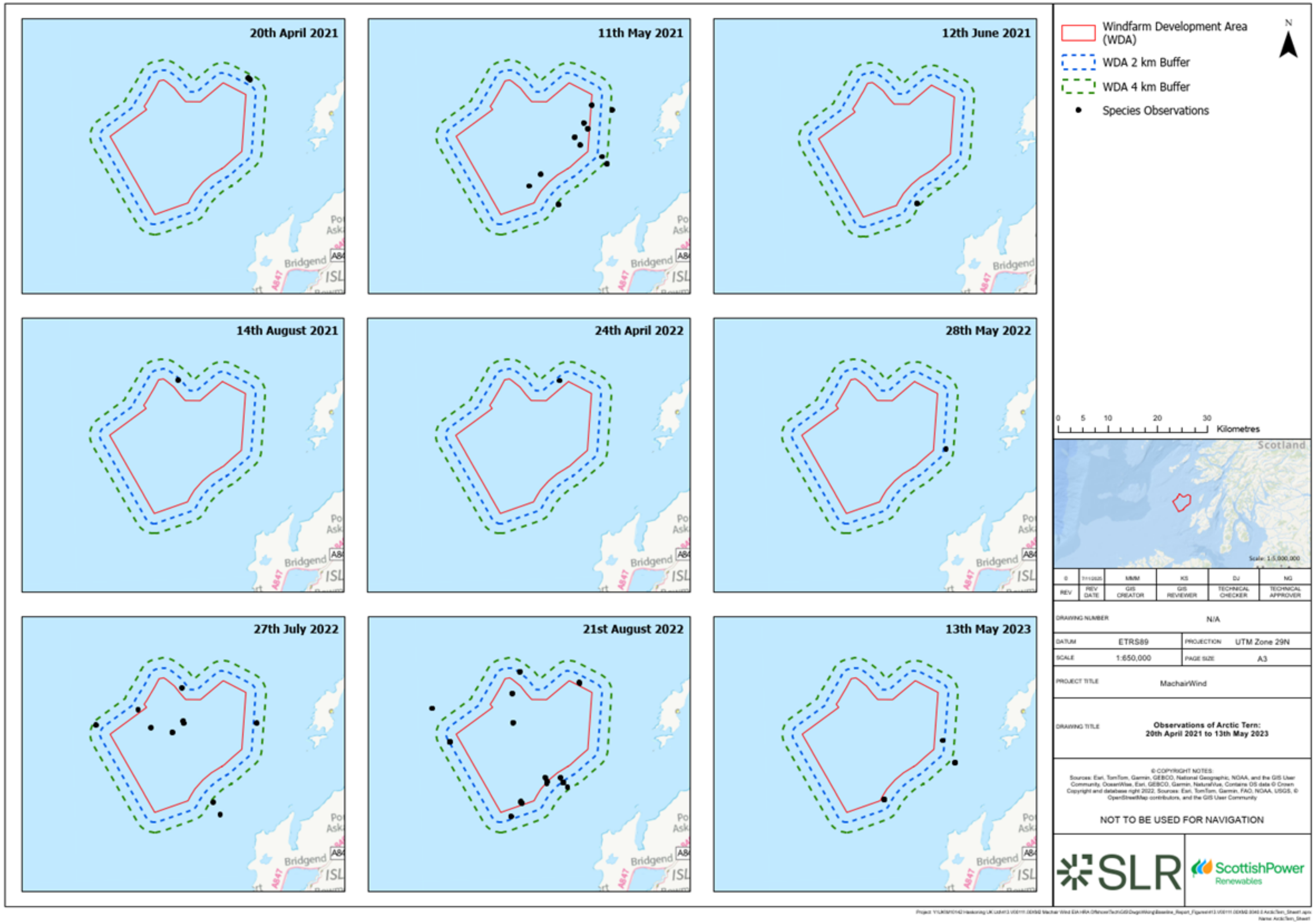


Figure 3: Raw observations of Arctic tern: April 2021 to May 2023

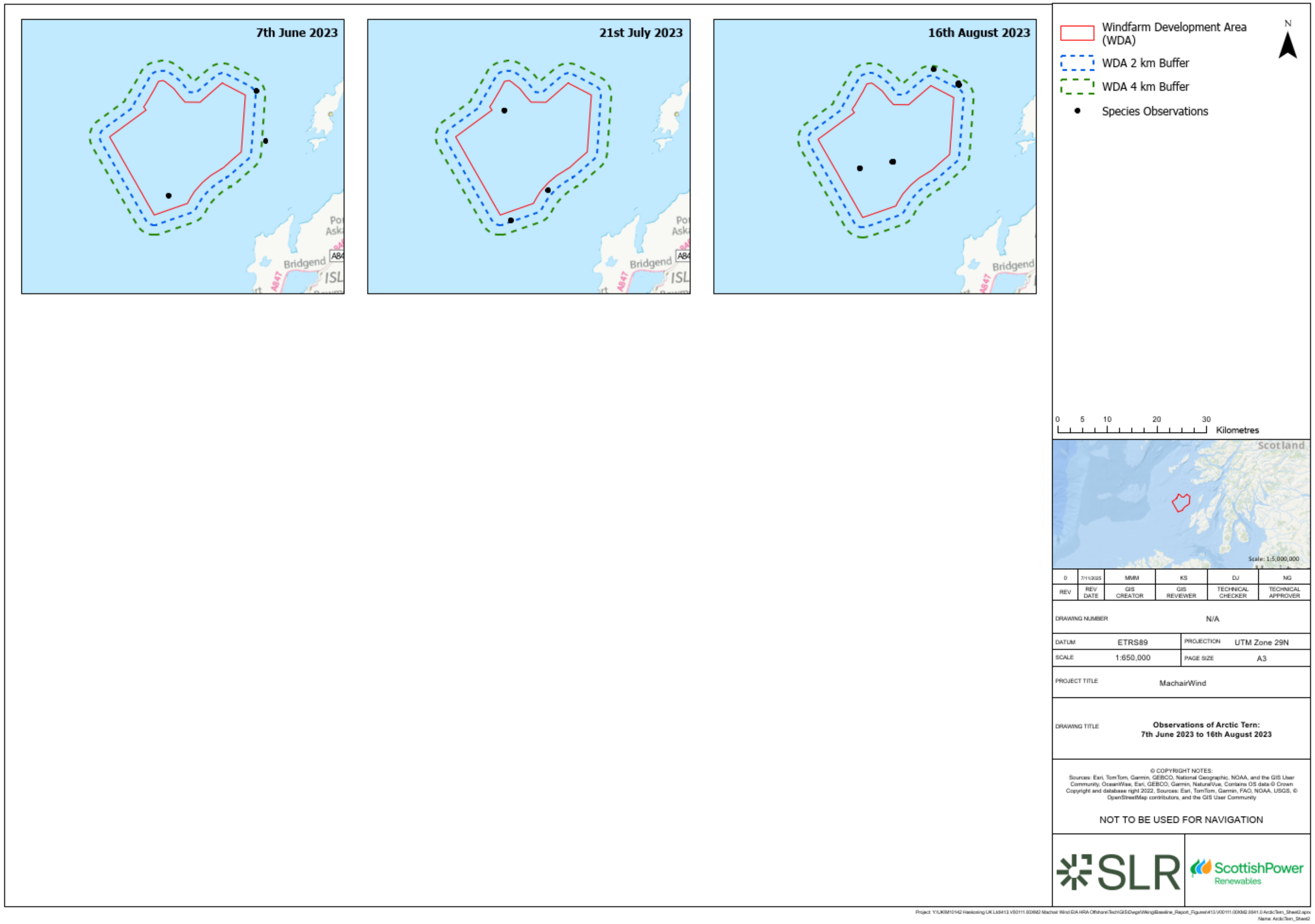


Figure 4: Raw observations of Arctic tern: June 2023 to August 2023

4.6.3 Raw counts

107. Raw counts of Arctic terns (including apportioned birds) in the WDA plus 4 km buffer fluctuated between surveys (refer to **Annex 11.2E: Raw Counts**). Most counts were recorded in the breeding season and autumn migration period (**Table 4**); a peak count of 66 Arctic terns, including apportioned birds, was recorded in the WDA plus 4 km buffer in August 2022 (refer to **Annex 11.2E: Raw Counts, Table 4**). No Arctic tern counts were recorded between the calendar months of September to March.

4.6.4 Design-based density estimates

108. Design-based density estimates of Arctic terns (including apportioned birds) in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 4.**

109. Arctic tern density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.27 bird/km^2, **Table 9**) was recorded in August 2022 during the Arctic tern breeding season and autumn migration period (**Table 4**). The density of Arctic terns in flight in the WDA was less than one bird/km^2 in all survey months when this species was recorded.

110. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Of Arctic terns recorded within the WDA across all surveys, most (88.6%), were recorded in flight.

4.6.5 Design-based abundance estimates

111. Design-based abundance estimates of Arctic terns (including apportioned birds) recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 4**.

112. Arctic tern abundance estimates fluctuated between surveys. The highest peak abundance (a peak abundance of 298.61 birds) of all Arctic terns sat on the water and in flight recorded in the WDA plus 2 km buffer) was recorded in August 2022 (**Table 10**) during the Arctic tern breeding season and autumn migration period (**Table 4**). One other peak of over 100 birds was recorded in May 2021 (120.70 birds) during the Arctic tern breeding season and spring migration period.

113. Arctic tern MSP abundance calculations are presented in **Technical Appendix 11.4: Displacement.** The highest MSP abundance in the WDA plus 2 km buffer (91.4 birds) was in the breeding season, including the BDMPS spring migration period. The BDMPS autumn migration period abundance in the WDA plus 2 km buffer was lower (35.2 birds).

4.7 Common gull

4.7.1 Conservation status

UK: Red listed

European: Endangered

4.7.2 Raw observations

114. Raw observations of common gulls (including birds sat on the water and in flight, but not including apportioned birds, refer to **Section 3.3.3**) are presented for each survey in **Figure 5** and **Figure 6**. Common gulls were identified within the WDA plus 4 km buffer in 8 out of 30 surveys.

115. Common gulls were recorded infrequently and their distribution in the WDA plus 4 km buffer did not display any consistent spatial pattern. The majority of observations were outwith the WDA boundary, with only sparse observations within the WDA in November/December 2021 and January/February 2023. In other months, observations were predominantly in the 2 km and 4 km buffer areas. Locations of observations varied considerably between months.

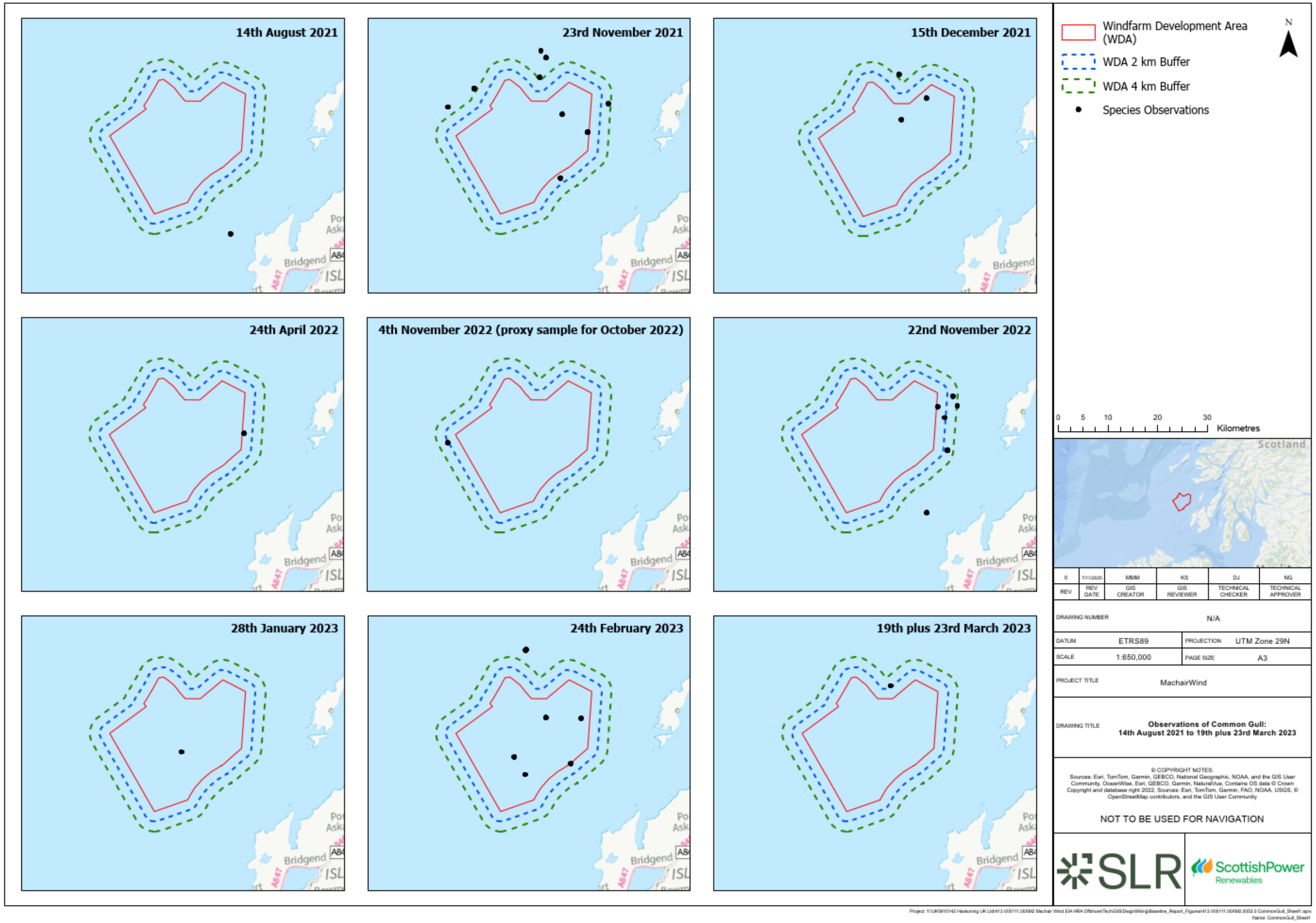


Figure 5: Raw observations of common gull: August 2021 to March 2023

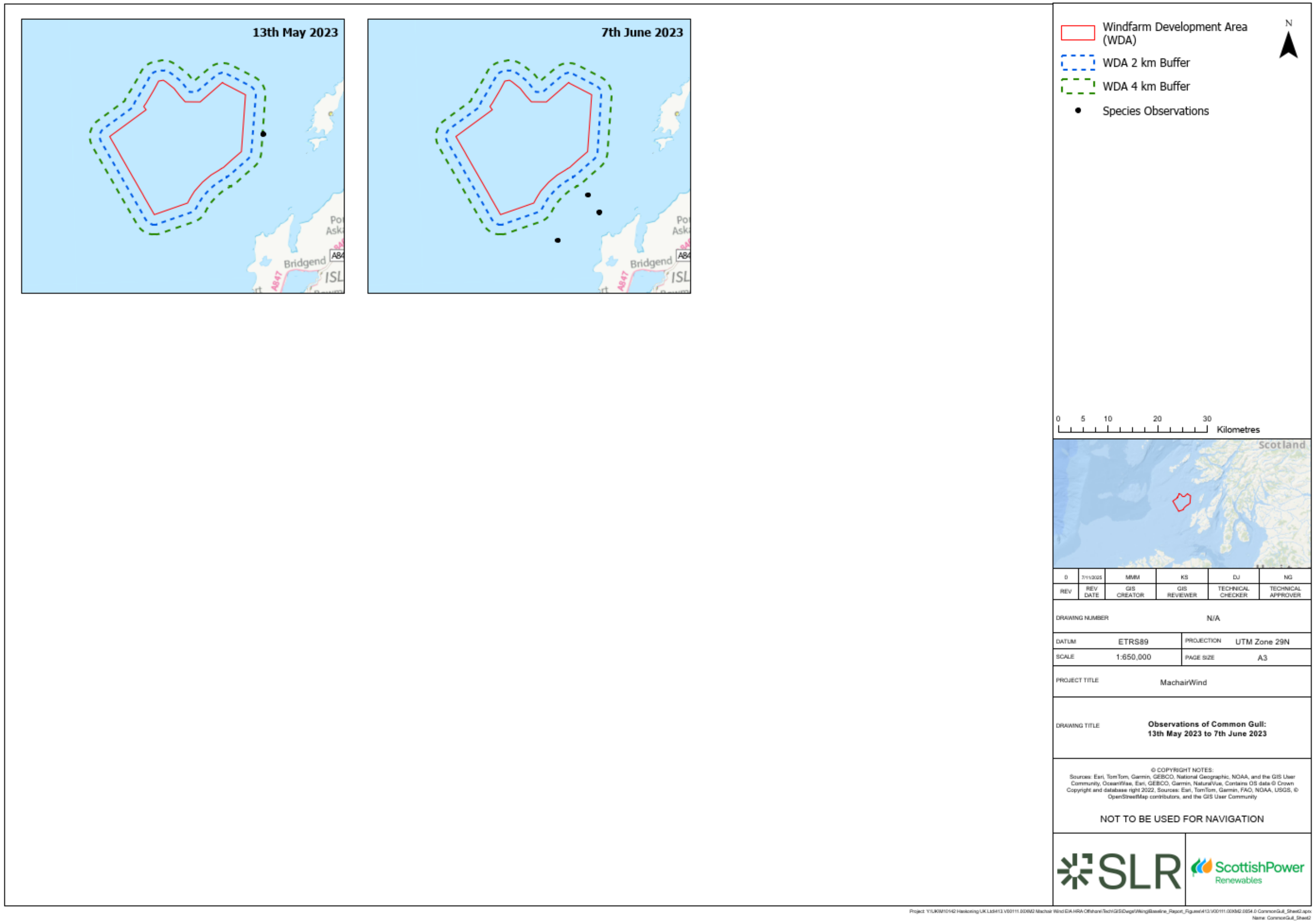


Figure 6: Raw observations of common gull: May 2023 and June 2023

4.7.3 Raw counts

116. Raw counts of common gulls (including apportioned birds) were relatively low across surveys (refer to **Annex 11.2E: Raw Counts**), with most counts recorded in the non-breeding season (**Table 4**); a peak count of 6.03 common gulls, including apportioned birds, was recorded in the WDA plus 4 km buffer in November 2021 (refer to **Annex 11.2E: Raw Counts, Table 12**). Very few common gulls were recorded within the WDA plus 4 km buffer during the breeding season (one bird was recorded in April 2022 and 0.01 apportioned bird was recorded in May 2023). A few common gull counts were recorded outside of the 4 km buffer in August 2021, May 2023 and June 2023.

4.7.4 Design-based density estimates

117. Design-based density estimates of common gulls (including apportioned birds) in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 12.**

118. Common gull density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.03 bird/km^2, **Table 9**) was recorded in December 2021 and February 2023 during the common gull non-breeding season (**Table 4**). The density of common gulls in flight in the WDA was less than one bird/km^2 in all survey months when this species was recorded.

119. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Of common gulls recorded in the WDA across all surveys, most (75%) were recorded in flight.

4.7.5 Design-based abundance estimates

120. Design-based abundance estimates of common gulls (including apportioned birds) recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 12**.

121. Common gull abundance estimates were low in all surveys where this species was recorded. The highest peak abundance (a peak abundance of 31.17 birds) of all common gulls sat on the water and in flight in the WDA plus 2 km buffer was recorded in November 2021 (**Table 10**) during the common gull non-breeding season (**Table 4**). One other peak of over 20 birds recorded in the WDA plus 2 km buffer was 29.80 birds in February 2023, again during the common gull non-breeding season.

122. Common gull was not assessed for displacement mortality (**Technical Appendix 11.4: Displacement**). As such, mean seasonal peak abundances (which inform displacement mortalities) are not presented herein.

4.8 Common tern

4.8.1 Conservation status

UK: Amber listed

European: Vulnerable

4.8.2 Raw observations

123. Raw observations of common terns (including all birds flight, but not including apportioned birds, refer to **Section 3.3.3**) are presented for each survey in **Figure 7**. Common terns were identified within the WDA plus 4 km buffer in 4 out of 30 surveys.

124. As common terns were recorded very infrequently, no spatial patterns across the WDA plus 4 km buffer are apparent in the data.

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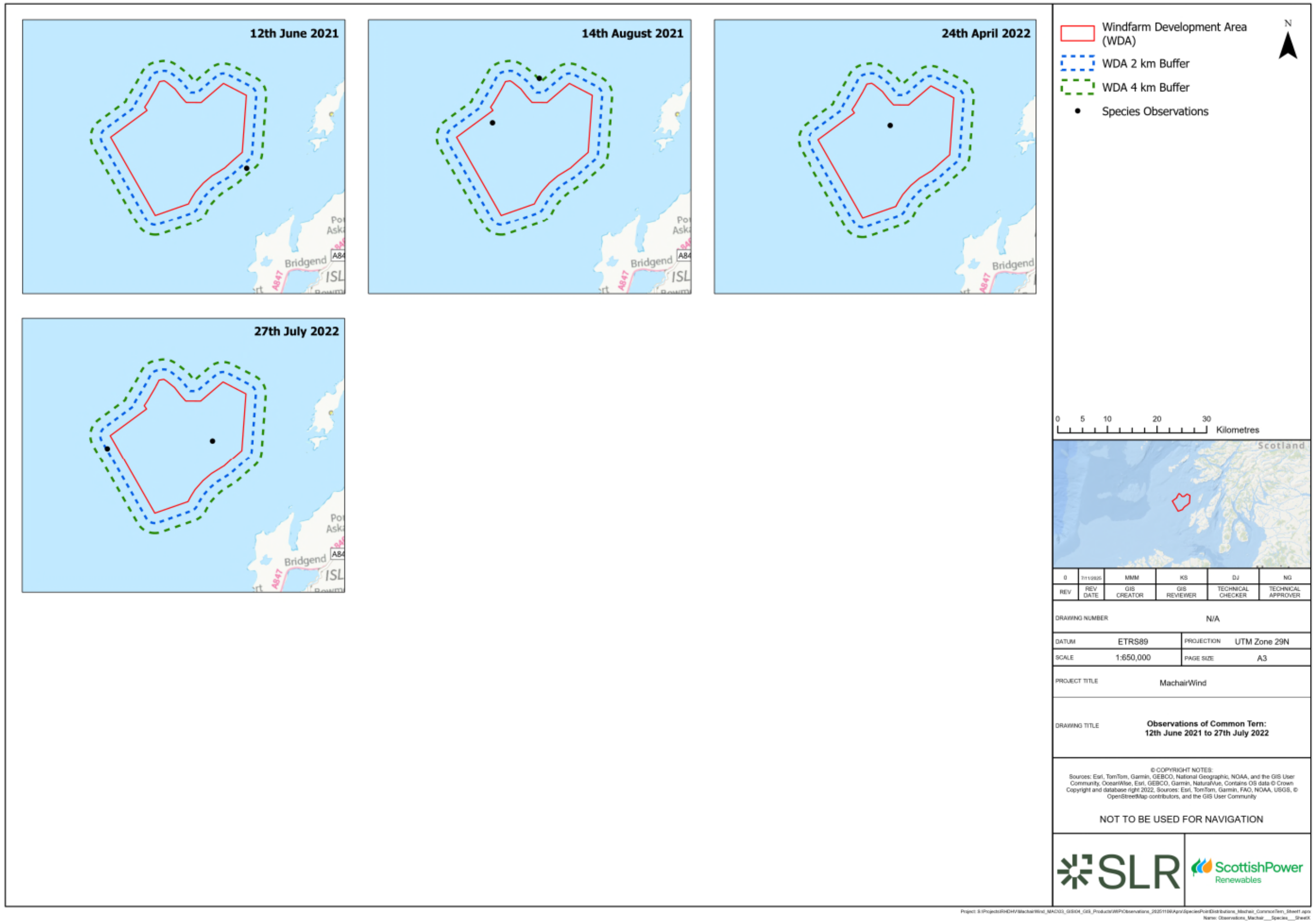

Figure 7: Raw observations of common tern: June 2021 to July 2022

4.8.3 Raw counts

125. There were relatively few counts of common tern (including apportioned birds) during surveys (refer to **Annex 11.2E: Raw Counts**), with most counts recorded in the breeding season and autumn migration period (**Table 4**). A peak count of 21.5 common terns, including apportioned birds, was recorded in the WDA plus 4 km buffer in August 2021, refer to **Annex 11.2E: Raw Counts, Table 14**). There were no common tern counts recorded during the calendar months of October to March.

4.8.4 Design-based density estimates

126. Design-based density estimates of common terns (including apportioned birds) in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 14**.

127. Common tern density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.23 bird/km^2, **Table 9**) was recorded in August 2021 which coincides with the common tern breeding season and autumn migration period (**Table 4**). The density of common terns in flight in the WDA was less than one bird/km^2 in all survey months when this species was recorded.

128. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Of common terns recorded in the WDA across all surveys, all (100%) were recorded in flight.

4.8.5 Design-based abundance estimates

129. Design-based abundance estimates of common terns (including apportioned birds) recorded in flight (all common terns were recorded in flight, **paragraph 128**) in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 14**.

130. The highest peak abundance (a peak abundance of 125.57 birds) of all common terns in flight (no birds recorded sat on the water) recorded in the WDA plus 2 km buffer was recorded in August 2021 (**Table 10**) during the common tern breeding season and the autumn migration period (**Table 4**). The abundance of common terns recorded flying in the WDA plus 2 km buffer was fewer than 20 birds in all other survey months when this species was recorded (**Table 10**).

131. Common tern MSP abundance calculations are presented in in **Technical Appendix 11.4: Displacement.** The highest MSP abundance in the WDA plus 2 km buffer (62.8 birds) was in the breeding season, including the BDMPS autumn migration period. There were no common terns recorded during the BDMPS spring migration period in the WDA plus 2 km buffer, therefore the MSP abundance for the spring migration period was zero.

4.9 European storm-petrel

4.9.1 Conservation status

UK: Amber listed

European: Least Concern

4.9.2 Raw observations

132. One European storm-petrel was identified in flight outside of the 4 km buffer during an aerial survey in May 2023 (presented in **Figure 8,** which additionally shows observations identified as ‘storm-petrel species’ as all of these were apportioned to European storm-petrel). No European storm-petrels were identified within the WDA plus 4 km buffer during any of the 30 surveys.

133. Deakin et al., (2022) concluded that there is an important need for experimental validation of potential biases in aerial survey methods, including detectability, identification, and diel variation. In particular, there seems to be a lack of validation of DAS for detecting particularly small seabirds such as storm-petrels. The dark upper surface plumage may render European storm-petrel cryptic against the sea, especially for birds sat on the water and during rougher sea conditions.

134. Tracking data indicate that most species of Hydrobates/Oceanodroma storm-petrel fly more at night than during the day (Miller et al., 2025), spending about 50% of daylight hours resting on the sea surface, so the absence of any detected European storm-petrels on the sea surface in the DAS data is unexpected. It would be appropriate to assume that DAS data under-represent numbers of European storm-petrels present, but the magnitude of this bias has yet to be determined experimentally.

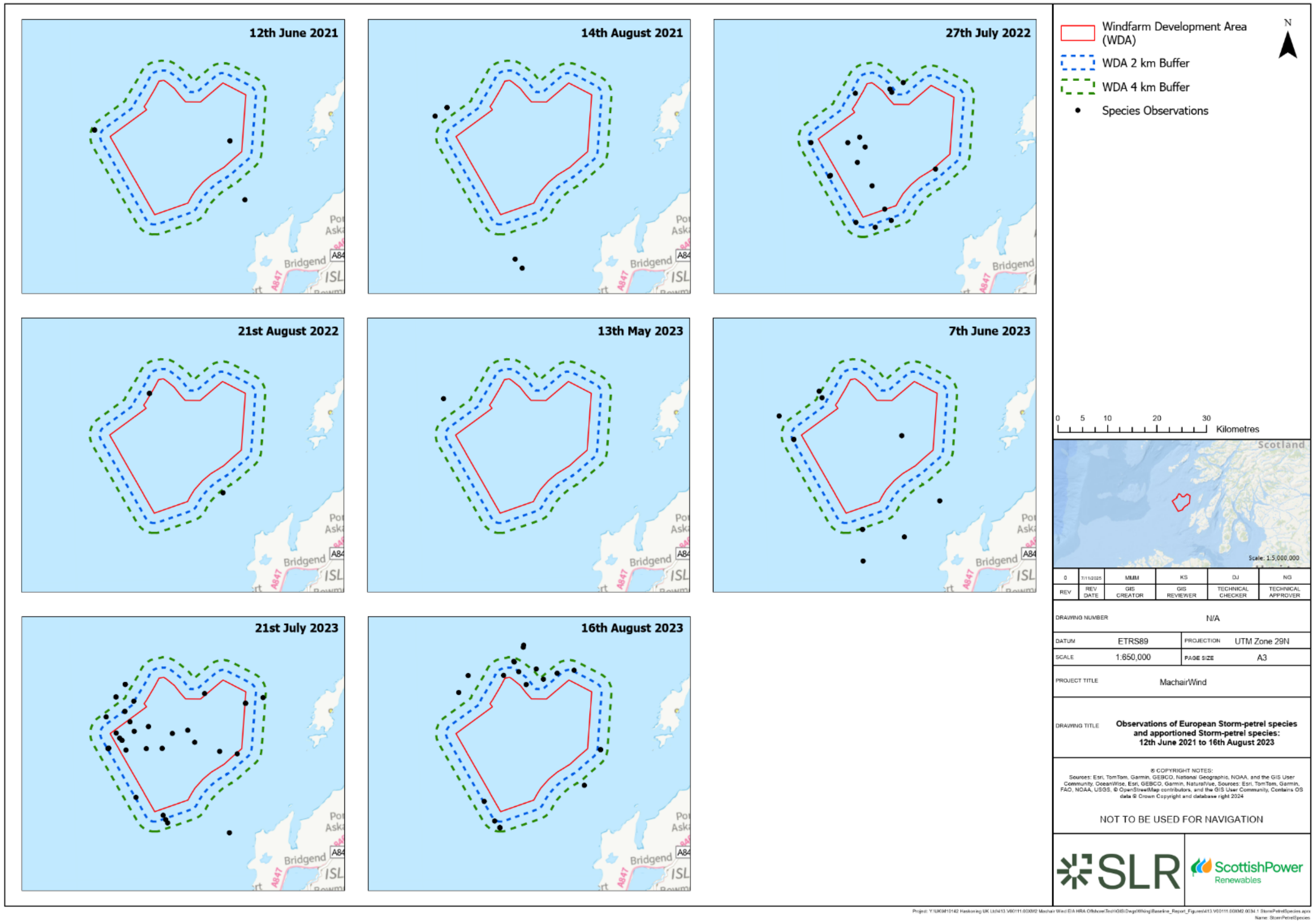

Figure 8: Raw observations of European storm-petrel and apportioned storm-petrel species: June 2021 to August 2023

4.9.3 Raw counts

135. All European storm-petrel counts within the WDA plus 4 km buffer were apportioned to European storm-petrel from the species group ‘storm-petrel species’ (refer to **Section 3.3.3**). All apportioned European storm-petrels were recorded during the calendar months of June to August in the breeding season (**Table 4**). A peak count of 35 apportioned European storm-petrels was recorded in the WDA plus 4 km buffer in July 2023 (refer to **Annex 11.2E: Raw Counts, Table 18**). Apportioned European storm-petrels were not recorded in the WDA plus 4 km buffer between September and May in any survey year.

4.9.4 Design-based density estimates

136. Design-based density estimates of apportioned European storm-petrels in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 18**.

137. Apportioned European storm-petrel density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.23 bird/km^2, **Table 9**) was recorded in July 2023 during the European storm-petrel breeding season (**Table 4**). The density of apportioned European storm-petrels in flight in the WDA was less than one bird/km^2 in all survey months when this apportioned species was recorded.

138. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. All apportioned European storm-petrels (100%) recorded in the WDA across 30 surveys were recorded in flight.

4.9.5 Design-based abundance estimates

139. Design-based abundance estimates of apportioned European storm-petrels in flight (all storm-petrels were recorded in flight, **paragraph 138**) in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 18**.

140. Apportioned storm-petrel abundance estimates were relatively low in all surveys. The highest peak abundance (a peak abundance of 191.82 birds) of apportioned storm-petrels in the WDA plus 2 km buffer was recorded in July 2023 (**Table 10**) during the breeding season (**Table 4**). One other peak of 84.69 flying birds was recorded in the WDA plus 2 km buffer in July 2022. The abundance of apportioned European storm-petrels recorded flying in the WDA plus 2 km buffer was lower than 25 birds in all other survey months when this species was recorded (**Table 10**).

141. European storm-petrel was not assessed for displacement mortality (**Technical Appendix 11.4: Displacement).** As such, mean seasonal peak abundances (which inform displacement mortalities) are not presented herein.

4.10 Fulmar

4.10.1 Conservation status

UK: Amber listed

European: Critically Endangered

4.10.2 Raw observations

142. Raw observations of fulmars (including birds sat on the water and in flight) are presented for each survey in **Figure 9** to **Figure 12**. Fulmars were identified within the WDA plus 4 km buffer in 29 out of 30 surveys.

143. No consistent pattern of spatial distributions was observed for fulmar; observations were distributed throughout the boundary areas as well as outside the boundary of the 4 km buffer. Fulmars were dispersed within the WDA throughout the non-breeding period across all years. Distribution within and outside the WDA boundary appeared relatively consistent between the breeding and non-breeding periods, though observations were less frequent during the breeding period.

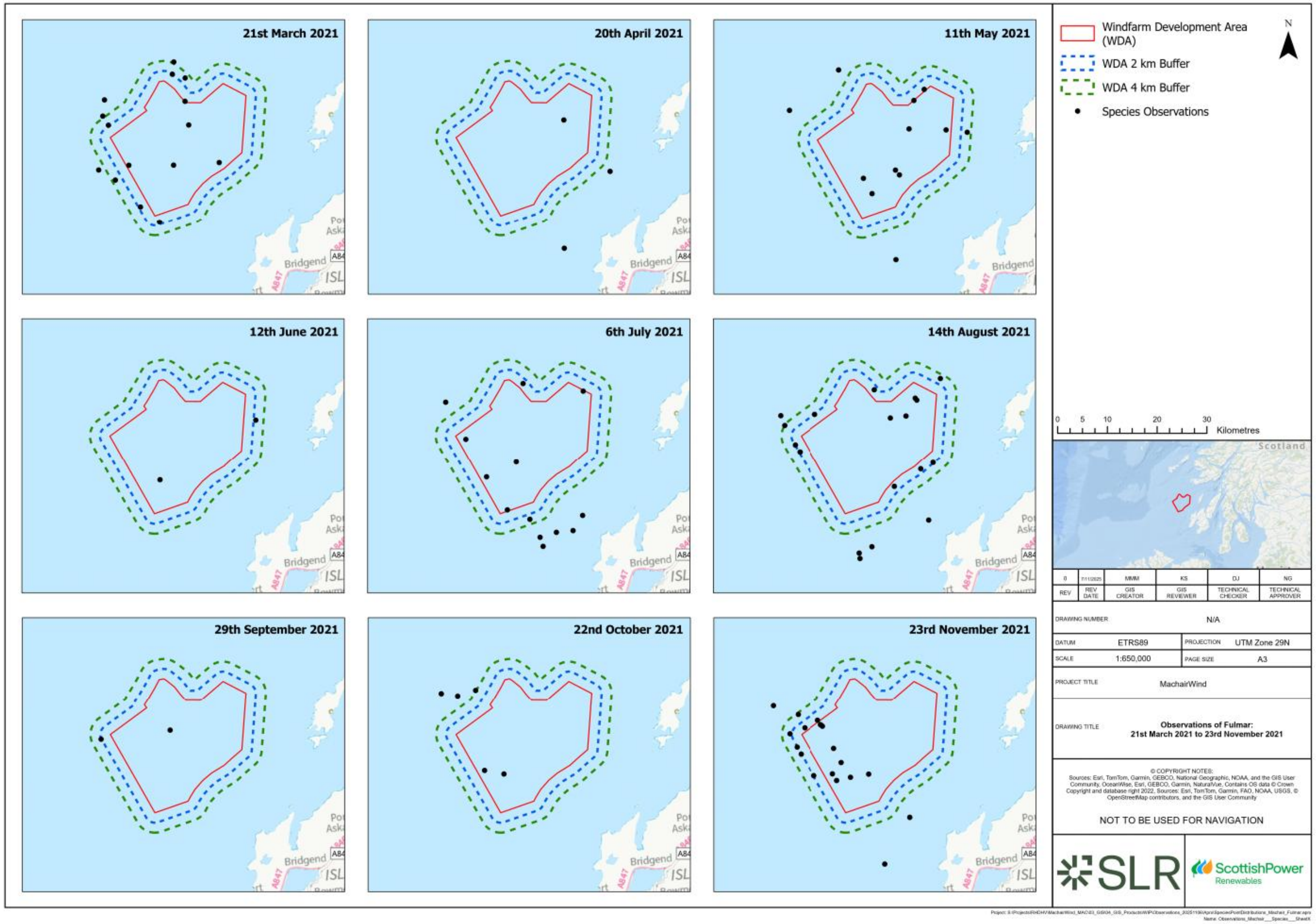

Figure 9: Raw observations of fulmar: March 2021 to November 2021

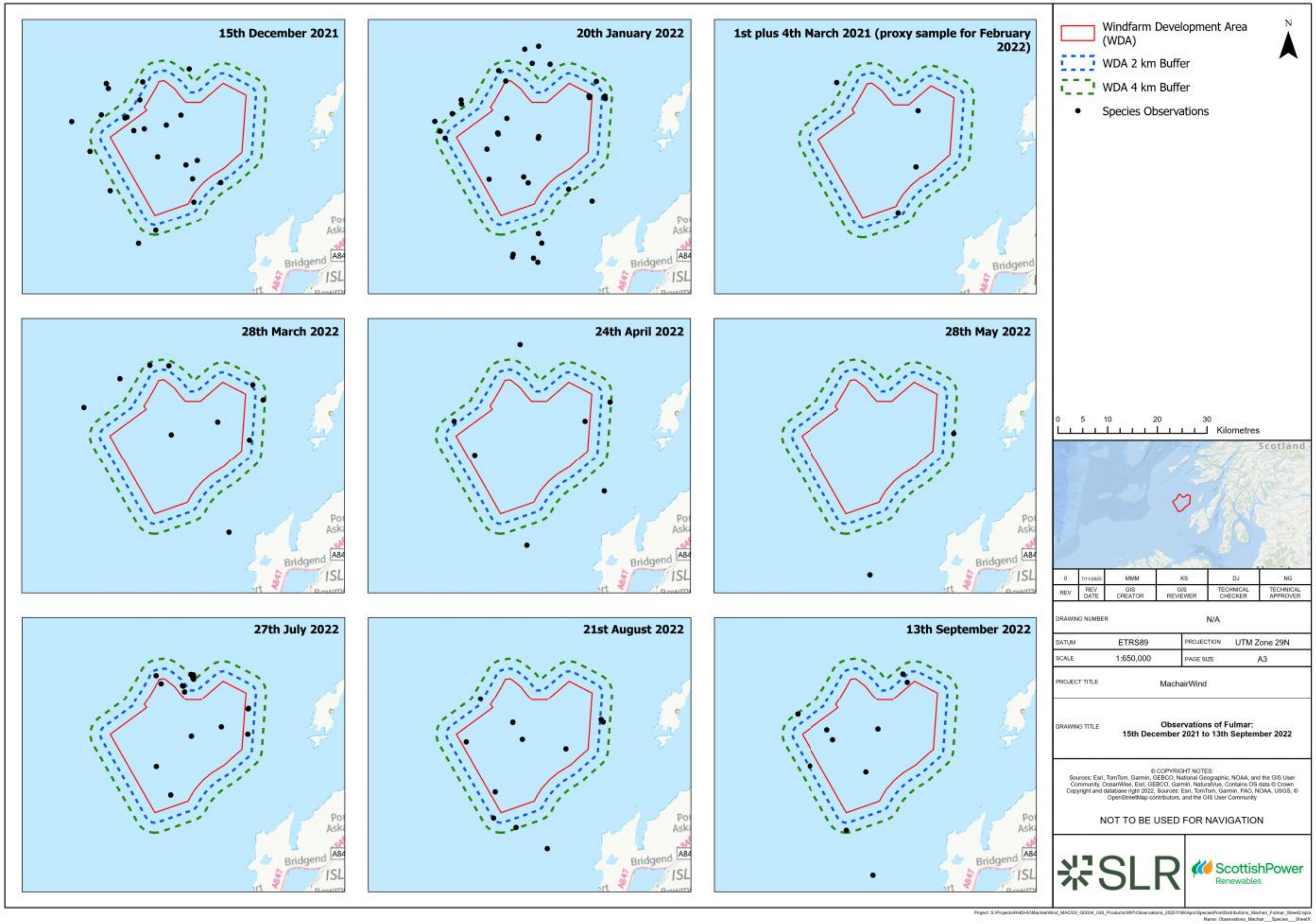

Figure 10: Raw observations of fulmar: December 2021 to September 2022

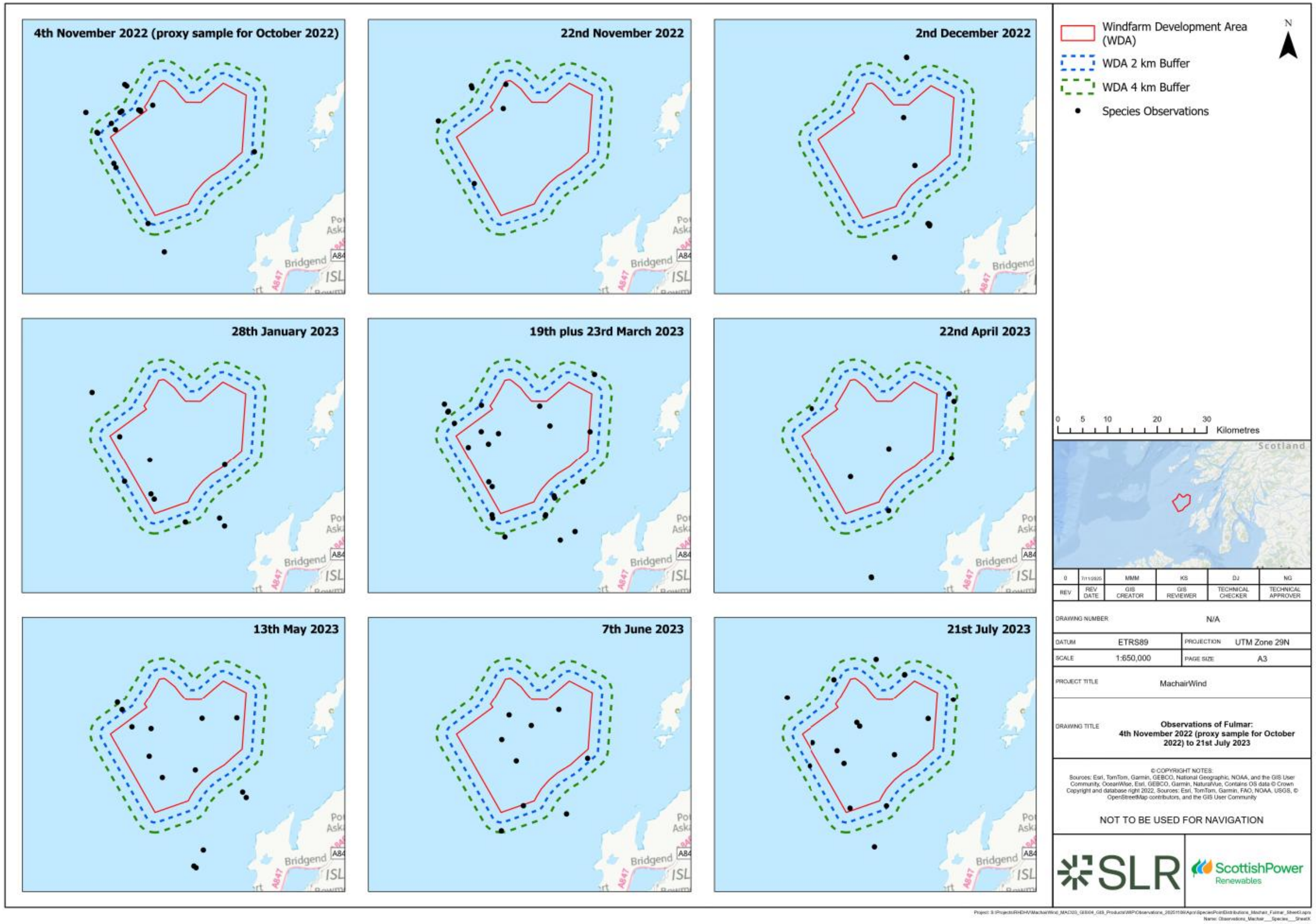

Figure 11: Raw observations of fulmar: October 2022 to July 2023

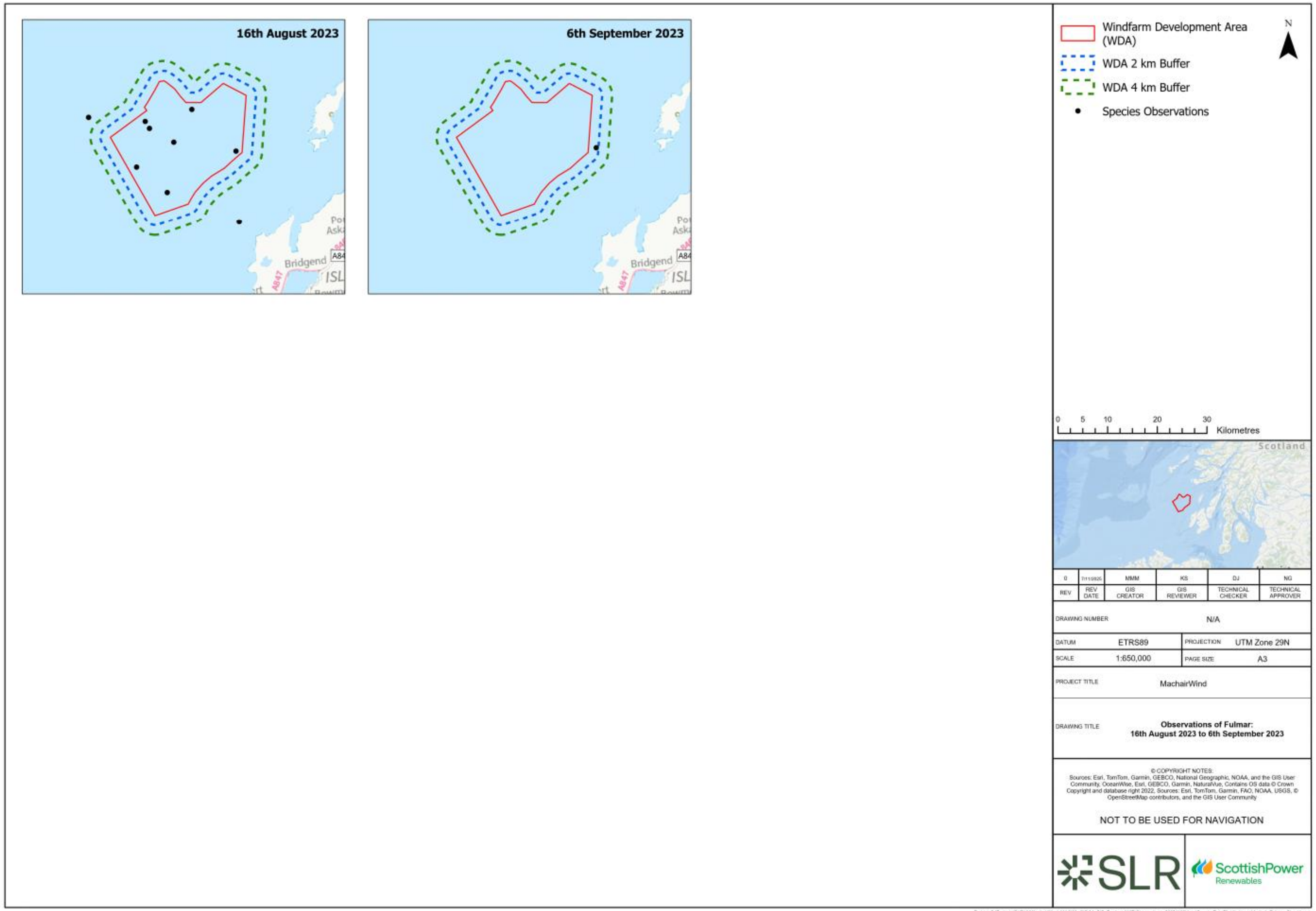

Figure 12: Raw observations of fulmar: August 2023 and September 2023

4.10.3 Raw counts

144. Fulmar counts fluctuated between surveys, but counts were generally low (refer to **Annex 11.2E: Raw Counts**). Most fulmar counts were recorded during the spring and autumn migration periods (**Table 4**). A peak count of 45 fulmars were recorded in the WDA plus 4 km buffer in January 2022 (refer to **Annex 11.2E: Raw Counts, Table 19**). Fewer counts were recorded during the breeding season. No fulmar counts were recorded in February 2023. Fulmar counts do not include additional birds apportioned from the 'fulmar/gull species' species group (**Table 7**) because there were too few 'fulmar/gull species' identifications to apportion to fulmar (**paragraph 83**).

4.10.4 Design-based density estimates

145. Design-based density estimates of fulmars in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 19**.

146. Fulmar density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.42 bird/km^2, **Table 9**) was recorded in January 2022 during the fulmar spring migration period (**Table 4**). The density of fulmars in flight in the WDA was less than one bird/km^2 in all survey months when this species was recorded.

147. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Of fulmars recorded in the WDA across all surveys, most (72.7%) were recorded in flight.

4.10.5 Design-based abundance estimates

148. Design-based abundance estimates of fulmars recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 19**.

149. Fulmar abundance estimates were generally low. The highest peak abundance (a peak abundance of 202.95 birds) of all fulmars sat on the water and in flight recorded in the WDA plus 2 km buffer was recorded in January 2022 (**Table 10**) during the fulmar spring migration period (**Table 4**). One other peak of over 100 sitting and flying birds was recorded in the WDA plus 2 km buffer during the fulmar breeding season in July 2022 (120.99 birds). The abundance of fulmars recorded sitting and flying in the WDA plus 2 km buffer was lower than 100 birds in all other survey months (**Table 10**).

150. Fulmar MSP abundance calculations are presented in in **Technical Appendix 11.4: Displacement.** The highest MSP abundance in the WDA plus 2 km buffer (150.6 birds) was recorded in the non-breeding season. The BDMPS spring migration period MSP abundance in the WDA plus 2 km buffer was slightly lower (138.2 birds) and the breeding season MSP abundance was lower again (82.8 birds). The lowest MSP abundances were during the BDMPS autumn migration period (55.2 birds) and the winter period (52.6 birds).

4.11 Gannet

4.11.1 Conservation status

UK: Amber listed

European: Least Concern

4.11.2 Raw observations

151. Raw observations of gannets (including birds sat on the water and in flight) are presented for each survey in **Figure 13** to **Figure 16** Gannets were identified within the WDA plus 4 km buffer in 29 out of 30 surveys.

152. During the breeding period, gannet observations were dispersed with no apparent pattern throughout the WDA and 2 km and 4 km buffer boundaries. During the non-breeding season, gannets were primarily recorded outside the WDA; records were particularly concentrated in the northwestern portion of the buffer boundaries during the non-breeding period in 2022 to 2023.

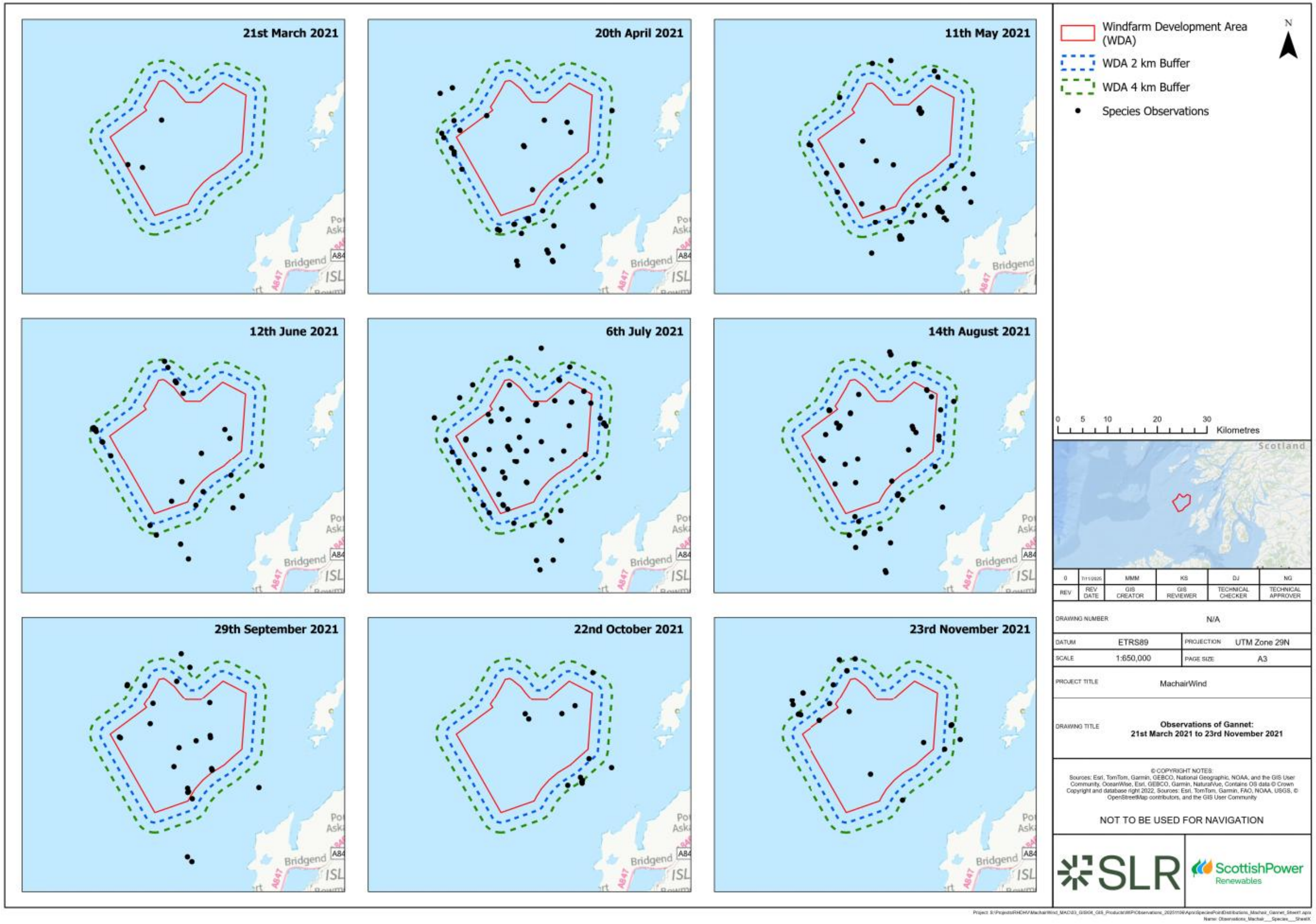

Figure 13: Raw observations of gannet: March 2021 to November 2021

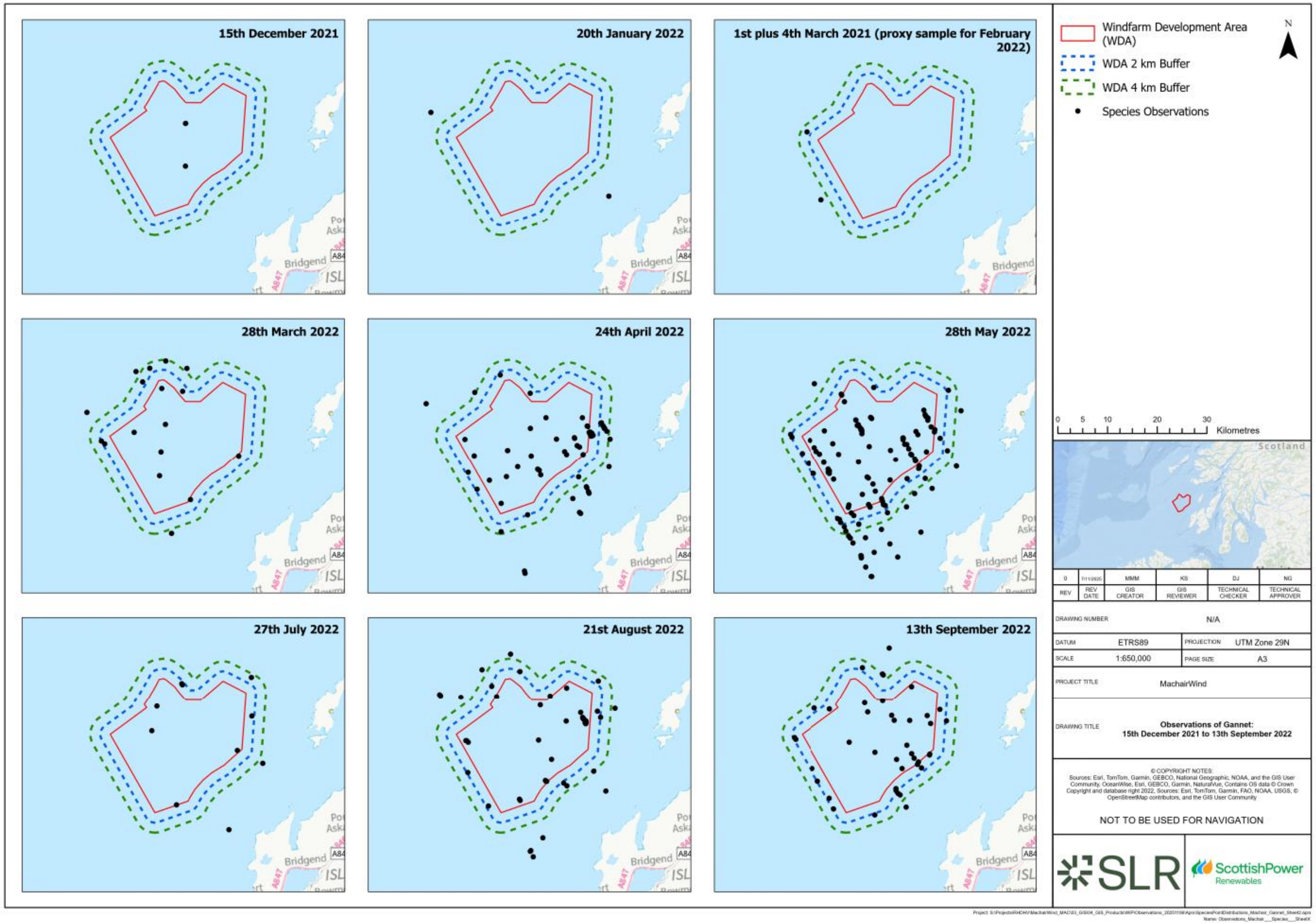

Figure 14: Raw observations of gannet: December 2021 to September 2022

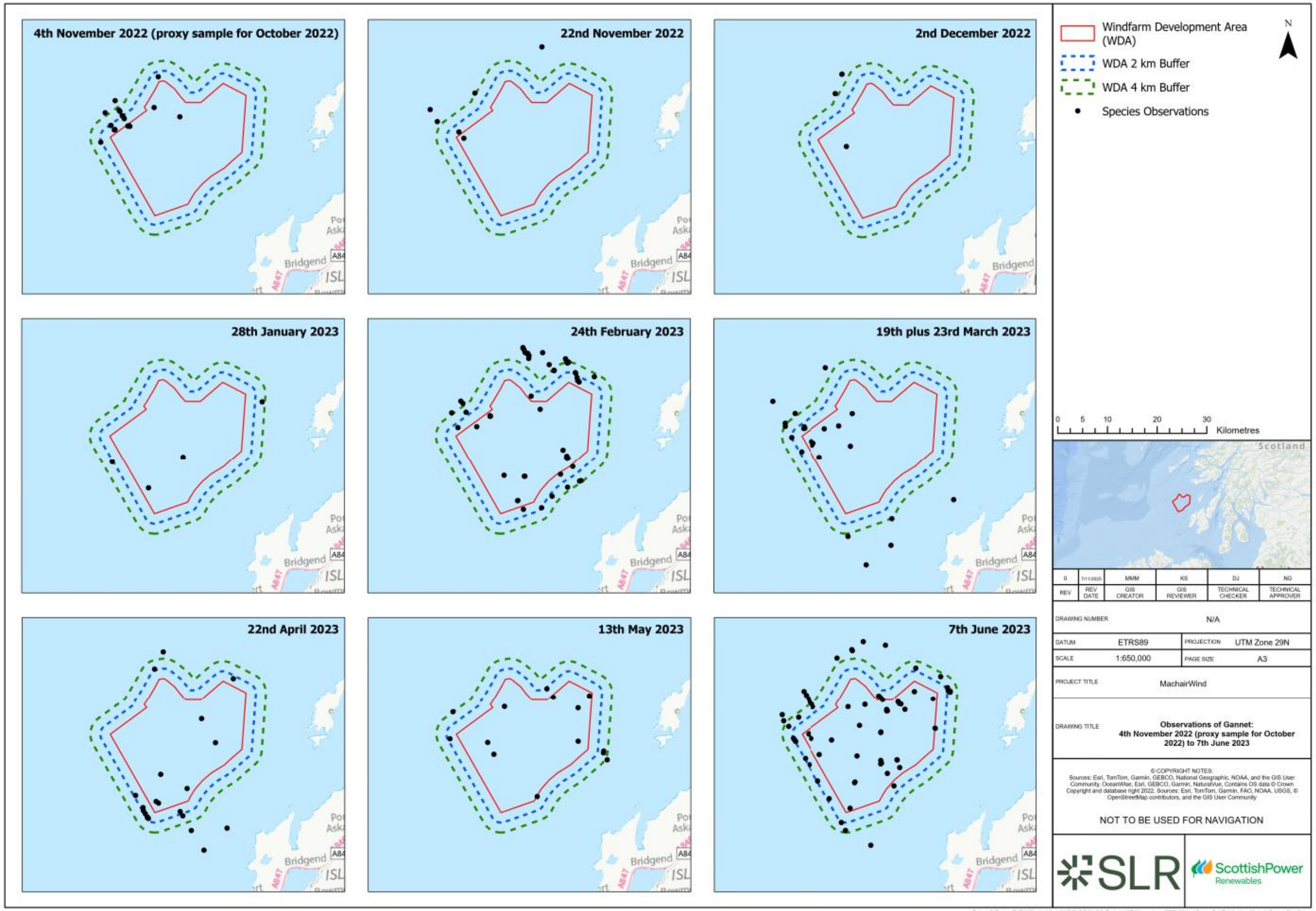

Figure 15: Raw observations of gannet: October 2022 to June 2023

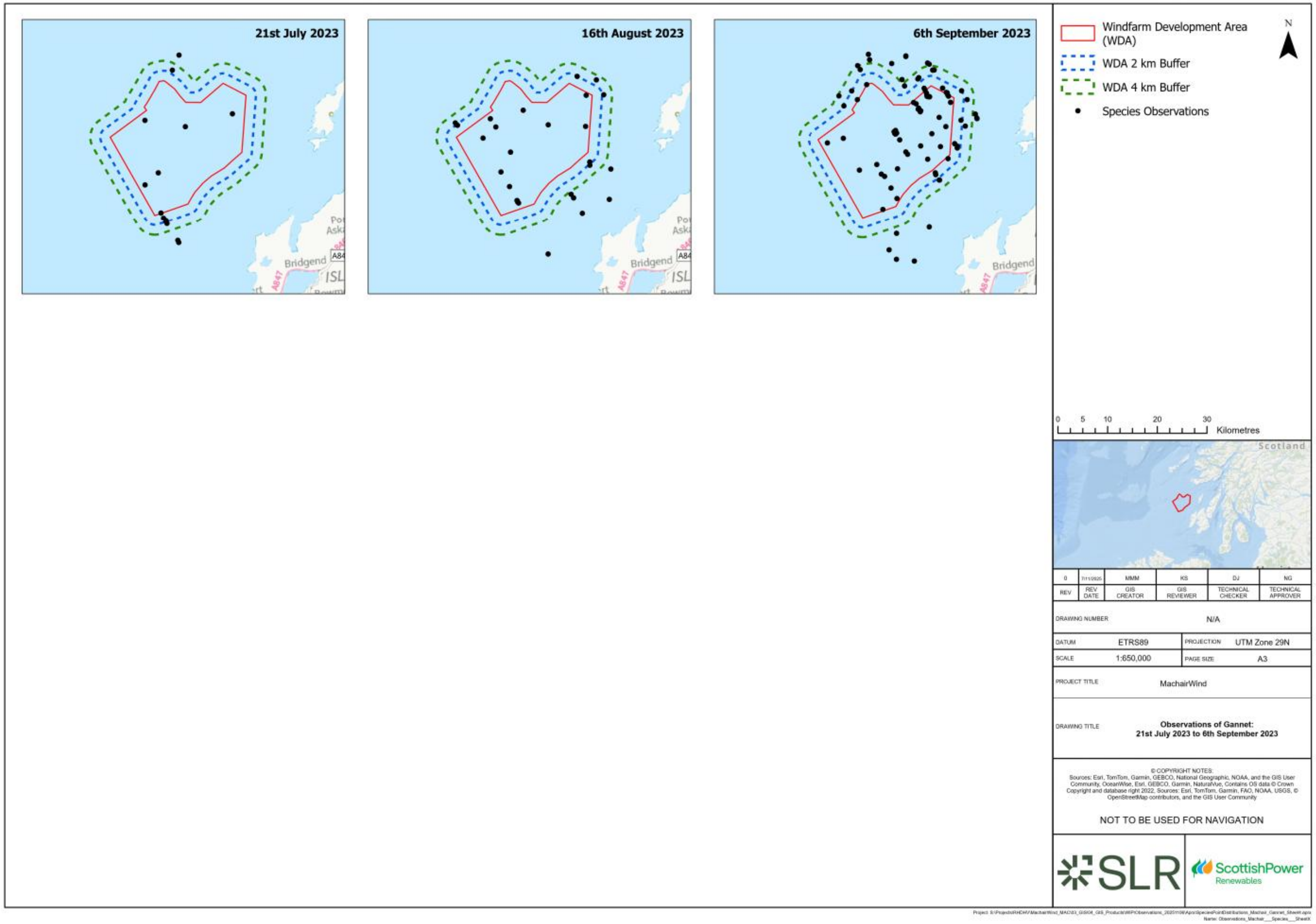

Figure 16: Raw observations of gannet: July 2023 to September 2023

4.11.3 Raw counts

153. Gannet counts fluctuated between surveys, but counts were generally low (refer to **Annex 11.2E: Raw Counts**). Most gannet counts were recorded during the breeding season (**Table 4**). A peak count of 126 gannets was recorded in the WDA plus 4 km buffer in May 2022, refer to **Annex 11.2E: Raw Counts, Table 21**). One other survey, April 2022 (118 birds), recorded over 100 gannet counts. Generally fewer counts per survey were recorded during the spring and autumn migration periods.

4.11.4 Design-based density estimates

154. Design-based density estimates of gannets in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 21**.

155. Gannet density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.59 bird/km^2, **Table 9**) was recorded in May 2022 during the gannet breeding season (**Table 4**). The density of gannets recorded in flight in the WDA was less than one bird/km^2 in all survey months when this species was recorded.

156. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Of gannets recorded in the WDA across all surveys, slightly less than half (46.2%) were recorded in flight.

4.11.5 Design-based abundance estimates

157. Design-based abundance estimates of gannets recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 21.**

158. Gannet abundance estimates fluctuated between surveys. The highest peak abundance (a peak abundance of 689.55 birds) of all gannets sat on the water and in flight recorded in the WDA plus 2 km buffer was recorded in May 2022 (**Table 10**) during the gannet breeding season (**Table 4**). Other, lower peaks (over 300 birds in the WDA plus 2 km buffer) were recorded during the gannet breeding season including July 2021 (460.57 birds), April 2022 (607.87 birds), June 2023 (370.36 birds) and September 2023 (384.74 birds). In all other survey months, fewer than 300 gannets were recorded in the WDA plus 2 km buffer (**Table 10**).

159. Gannet MSP abundance calculations are presented in **Technical Appendix 11.4: Displacement**. The highest MSP abundance in the WDA plus 2 km buffer (422.7 birds) was in the breeding season. The BDMPS autumn migration period MSP abundance was lower (151.6 birds). The non-breeding season MSP abundance, including the BDMPS spring migration period in the WDA plus 2 km buffer was with the lowest (139.4 birds).

4.12 Great black-backed gull

4.12.1 Conservation status

UK: Red listed

European: Critically Endangered

4.12.2 Raw observations

160. Raw observations of great black-backed gulls (including birds sat on the water and in flight, but not including apportioned birds, refer to **Section 3.3.3**) are presented for each survey in **Figure 17** and **Figure 18**. Great black-backed gulls were identified within the WDA plus 4 km buffer in 15 out of 30 surveys.

161. Great black-backed gull observations exhibited a limited degree of spatial pattern. Observations tended to be in the 2 km and 4 km buffer areas, and when within the WDA, tended to be closer to the WDA boundary. Additionally, particularly during the non-breeding period, observations appeared clustered towards the northern side of the WDA plus 4 km buffer. The number of great-black-backed gull observations was greatest around the edges of the WDA plus 4 km buffer, rather than in the middle of the WDA, though an exception was in December 2021 when more great black-backed gulls than usual were recorded within the WDA.

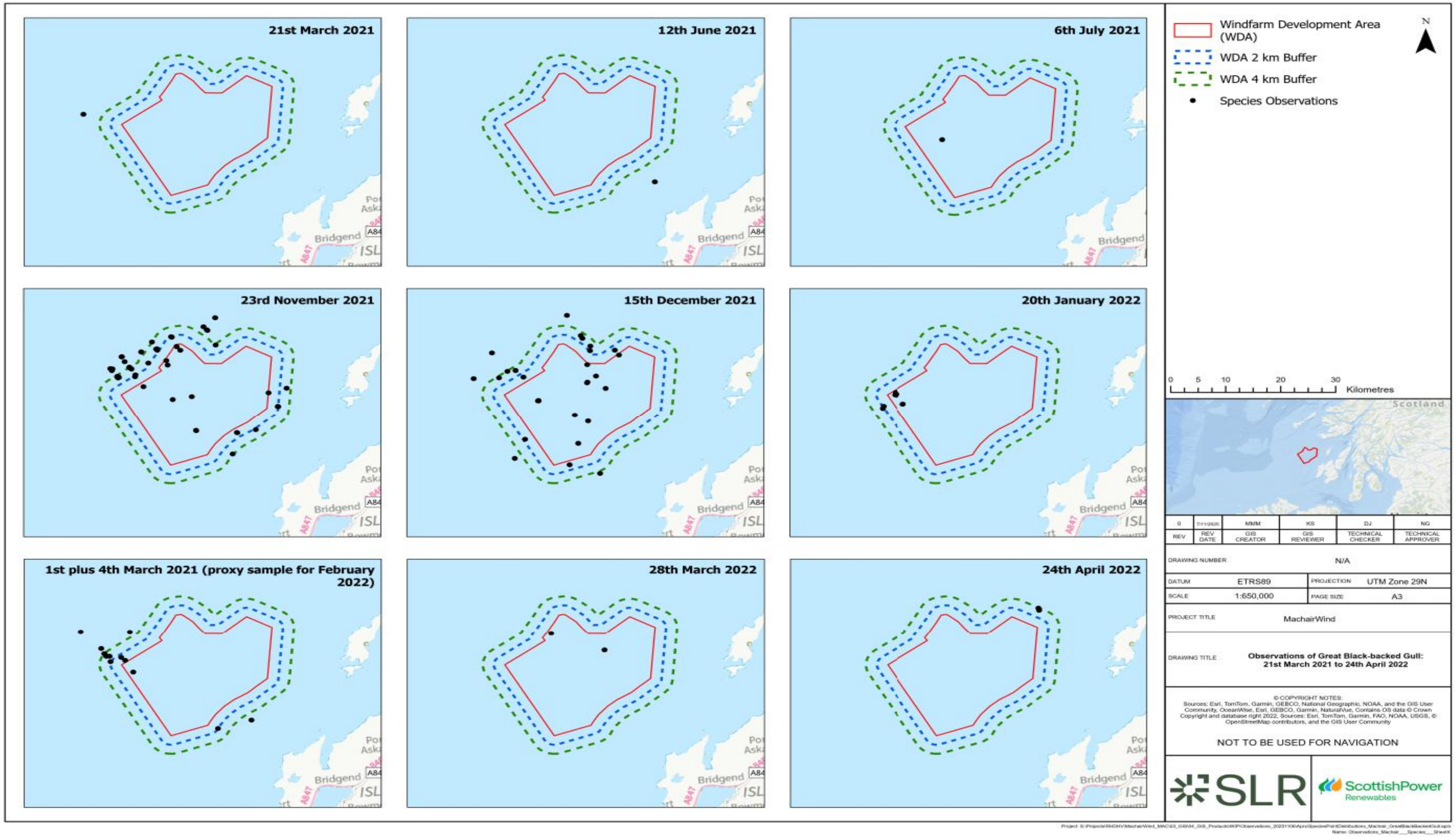

Figure 17: Raw observations of great black-backed gull: March 2021 to April 2022

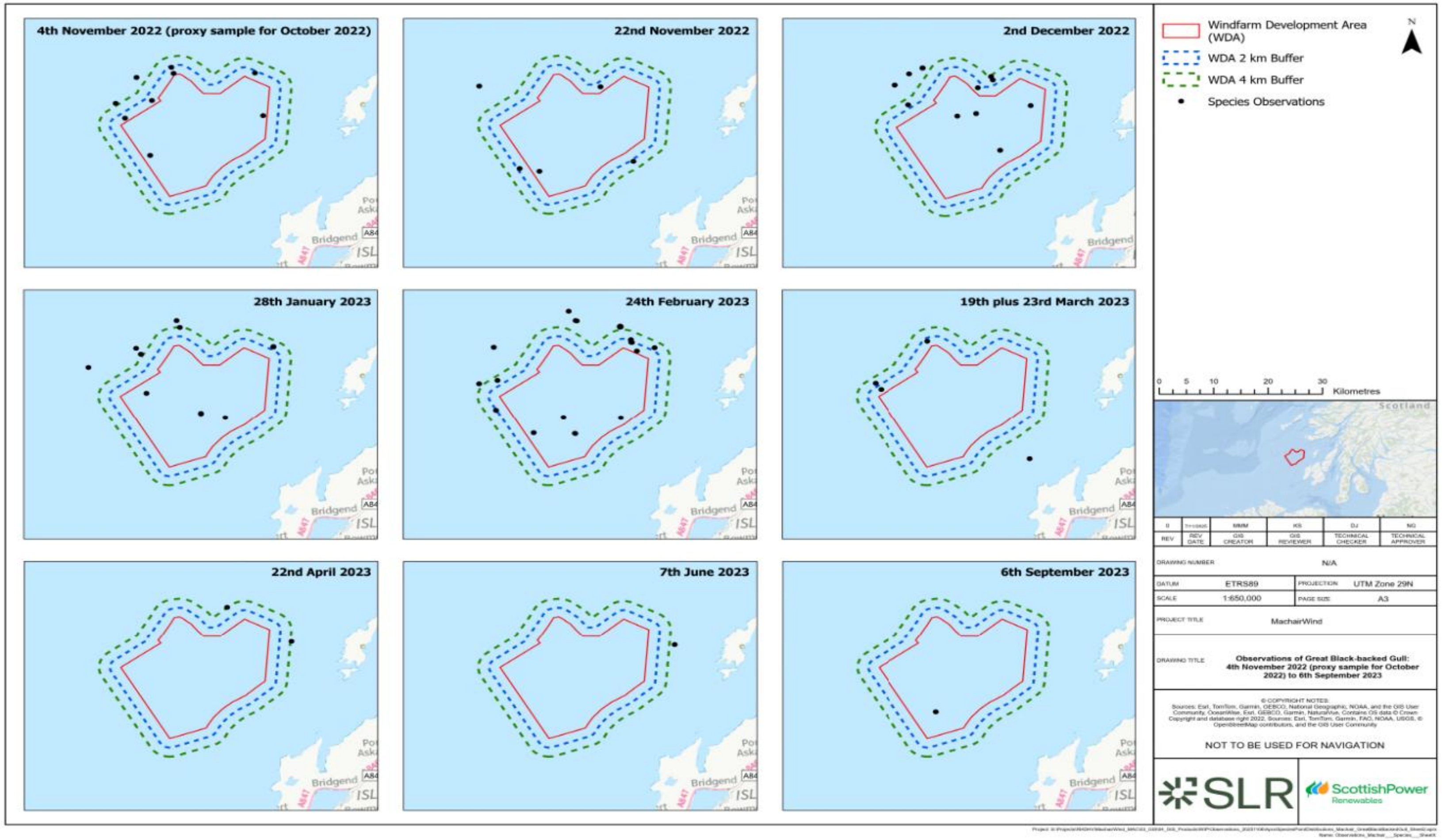

Figure 18: Raw observations of great black-backed gull: October 2022 to September 2023

4.12.3 Raw counts

162. There were relatively few great black-backed gull counts (including apportioned birds) recorded across surveys (refer to **Annex 11.2E: Raw Counts**). Most counts were recorded in the non-breeding season (**Table 4**). A peak count of 100.05 great black-backed gulls, including apportioned birds, was recorded in the WDA plus 4 km buffer in November 2021, refer to **Annex 11.2E: Raw Counts, Table 24**). Very few great black-backed gulls were recorded within the WDA plus 4 km buffer during the breeding season: apportioned birds were recorded in July 2021 (1.69 birds), April 2022 (2 birds) and April 2023 (1 bird).

4.12.4 Design-based density estimates

163. Design-based density estimates of great black-backed gulls (including apportioned birds) in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 24.**

164. Great black-backed gull density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.09 bird/km^2, **Table 9**) was recorded in December 2021 during the great black-backed gull non-breeding season (**Table 4**). The density of great black-backed gulls recorded in flight in the WDA was less than one bird/km^2 in all survey months when this species was recorded.

165. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Of great black-backed gulls recorded in the WDA across all surveys, most were recorded sat on the water, with only 38.8% recorded in flight.

4.12.5 Design-based abundance estimates

166. Design-based abundance estimates of great black-backed gulls (including apportioned birds) recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 24.**

167. Great black-backed gull abundance estimates fluctuated between surveys. The highest peak abundance (a peak abundance of 304.65 birds) of all great black-backed gulls sat on the water and in flight recorded in the WDA plus 2 km buffer was recorded in November 2021 (**Table 10**) during the great black-backed gull non-breeding season (**Table 4**). One other peak of over 100 sitting and flying birds was recorded in the WDA plus 2 km buffer during the great black-backed gull non-breeding season in December 2021 (137.72 birds). The abundance of great black-backed gull recorded sitting and flying in the WDA plus 2 km buffer was lower than 100 birds per survey in all other survey months when this species was recorded (**Table 10)**.

168. Great black-backed gull was not assessed for displacement mortality (**Technical Appendix 11.4: Displacement).** As such, mean seasonal peak abundances (which inform displacement mortalities) are not presented herein.

4.13 Great northern diver

4.13.1 Conservation status

UK: Amber listed

European: Least Concern

4.13.2 Raw observations

169. Raw observations of great northern divers are presented for each survey in **Figure 19** to **Figure 21**. Great northern divers were identified sat on the water within the WDA plus 4 km buffer in 12 out of 30 surveys, in an additional 5 out of 30 surveys (including June 2021, January 2022, April 2022, July 2022 and January 2023), great northern divers were identified outwith the 4 km buffer.

170. Great northern divers were frequently recorded outside of the 4 km buffer boundary southwest of the Project area towards Islay.

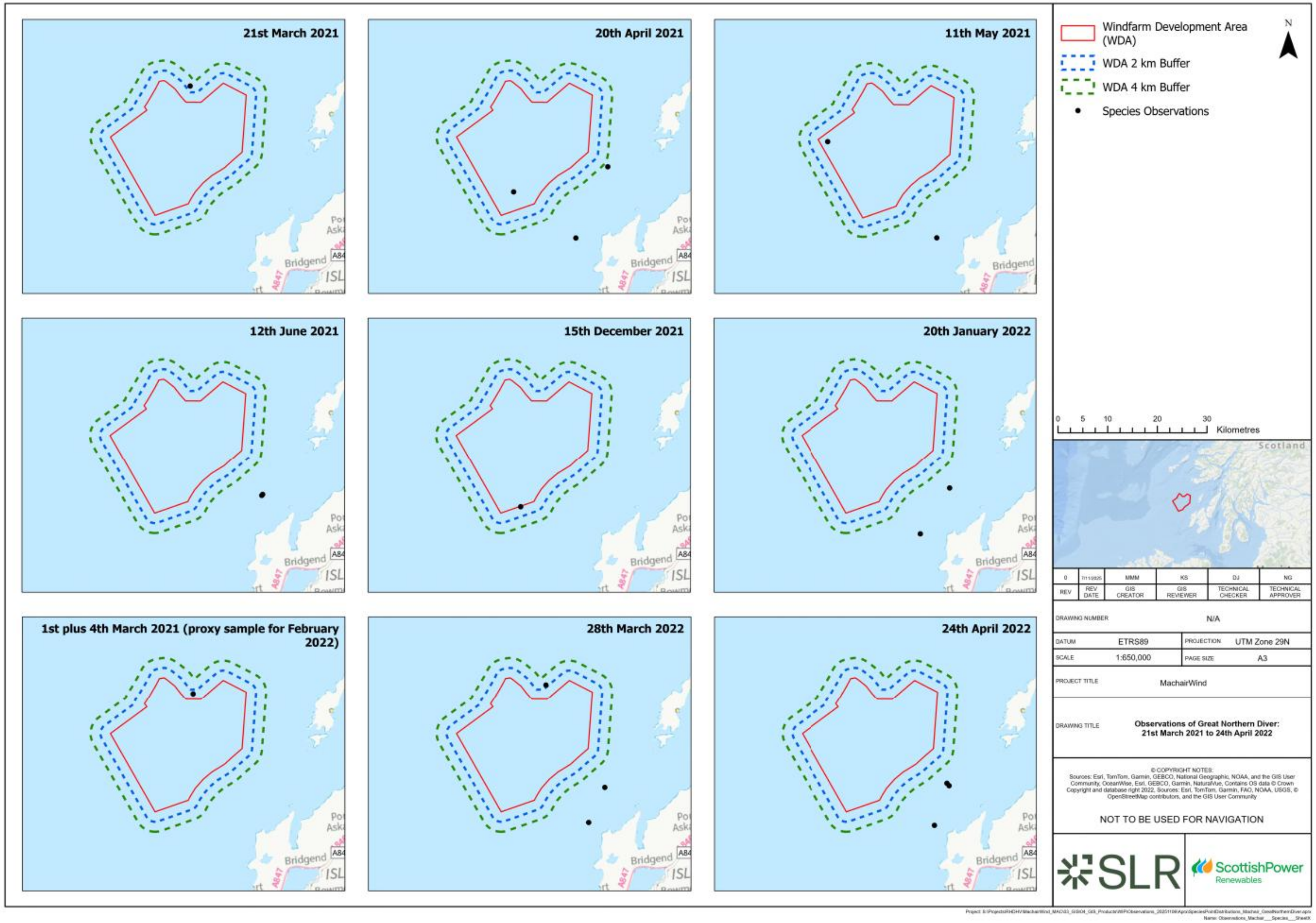

Figure 19: Raw observations of great northern diver: March 2021 to April 2022

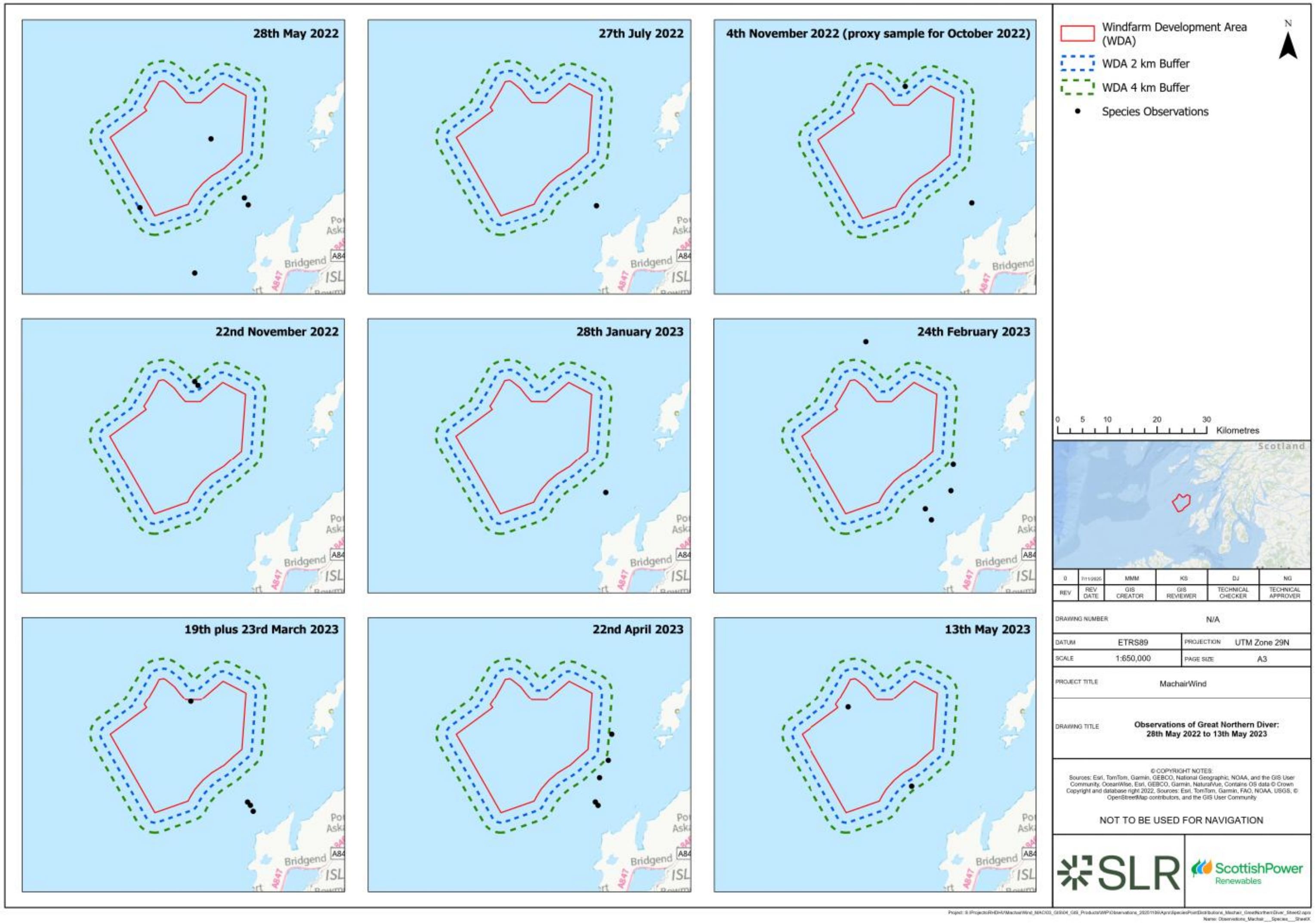

Figure 20: Raw observations of great northern diver: May 2022 to May 2023

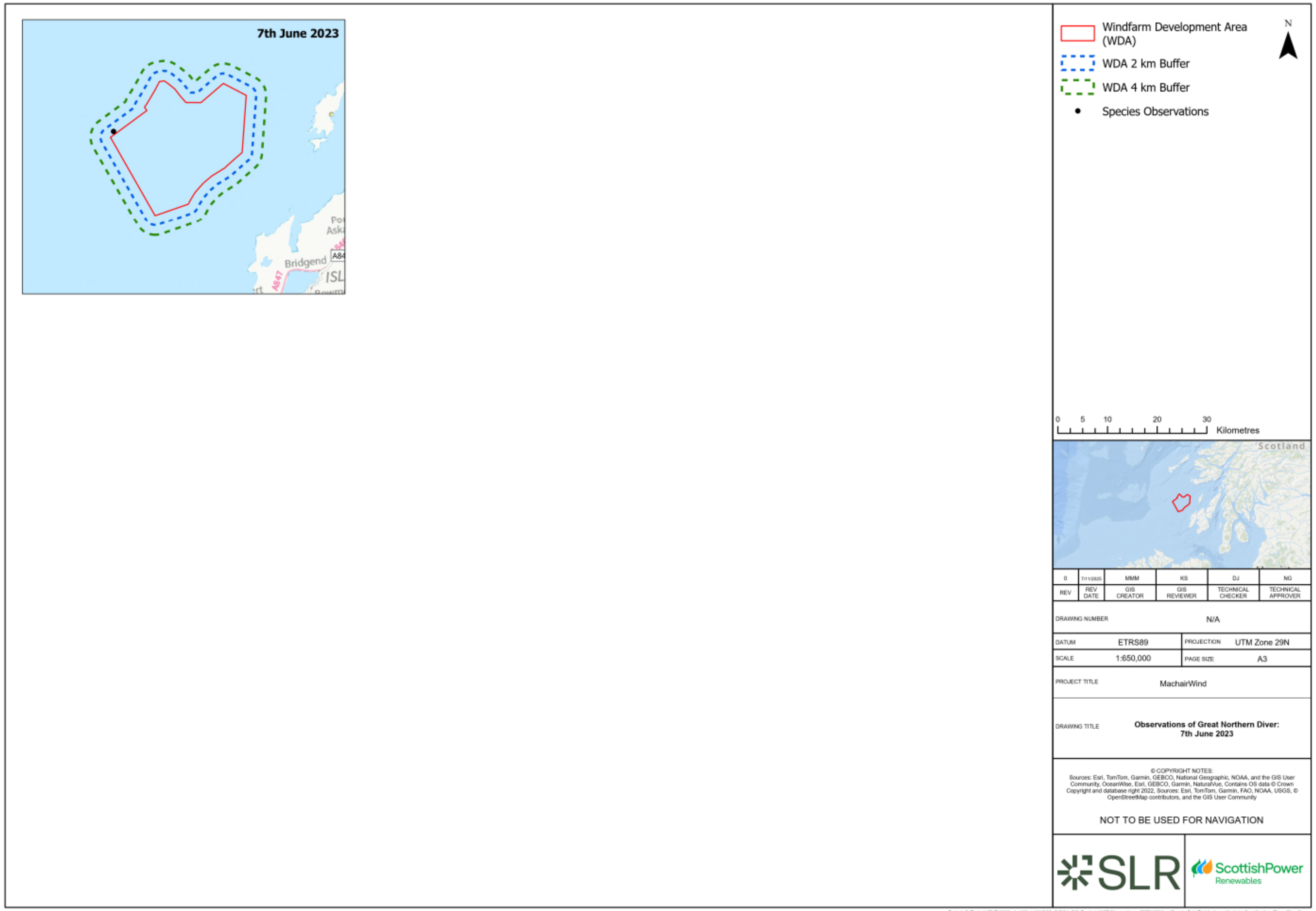

Figure 21: Raw observations of great northern diver: June 2023

4.13.3 Raw counts

171. Relatively few great northern diver counts were recorded during surveys (refer to **Annex 11.2E: Raw Counts**). All counts were recorded in the non-breeding season including spring and autumn migration seasons (**Table 4**). Peak counts of 3 great northern divers were recorded in the WDA plus 4 km buffer in November 2022 and May 2023, refer to **Annex 11.2E: Raw Counts, Table 25**). NatureScot Guidance Note 9[4] states that great northern divers are not present in significant numbers in Scottish marine areas during the breeding season and very few great northern divers were recorded between mid-May to September (great northern diver breeding season, refer to **Table 4**). A few exceptions included counts in May 2021 (1 bird), June 2021 (one count outwith the 4 km buffer), May 2022 (2 birds), July 2022 (one count outwith the 4 km buffer), May 2023 (3 birds) and June 2023 (1 bird).

4.13.4 Design-based density estimates

172. Design-based density estimates of great northern divers in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 25**.

173. There were no great northern divers recorded in flight in the WDA during any survey (**Table 9**).

4.13.5 Design-based abundance estimates

174. Design-based abundance estimates of great northern divers recorded sat on the water and in flight in each survey within the WDA plus 4 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 25.**

175. The highest peak abundance (a peak abundance of 19.60 birds) of all great northern divers sat on the water in the WDA plus 4 km buffer was recorded in May 2023 (**Table 10**) at the end of the great northern diver non-breeding season (**Table 4**). Two other smaller peaks of over 10 sitting birds were recorded in the WDA plus 4 km buffer in May 2022 (12.67 birds) and November 2022 (19.18 birds). The abundance of great northern divers recorded sat on the water in the WDA plus 4 km buffer was lower than 10 birds in all other survey months when this species was recorded (**Table 10**).

176. Great northern diver MSP abundance was calculated as 16.2 birds in the non-breeding season. This is presented in **Technical Appendix 11.4: Displacement.**

4.14 Great skua

4.14.1 Conservation status

UK: Red listed

European: Vulnerable

4.14.2 Raw observations

177. Raw observations of great skuas (including birds sat on the water and in flight) are presented for each survey in **Figure 22** and **Figure 23**. Great skuas were identified within the WDA plus 4 km buffer in 11 out of 30 surveys.

178. Most great skua observations were located within the WDA, but observations were generally very infrequent except in May 2022, which had a greater number of observations compared with other survey months. No consistent spatial pattern is present for great skua observations.

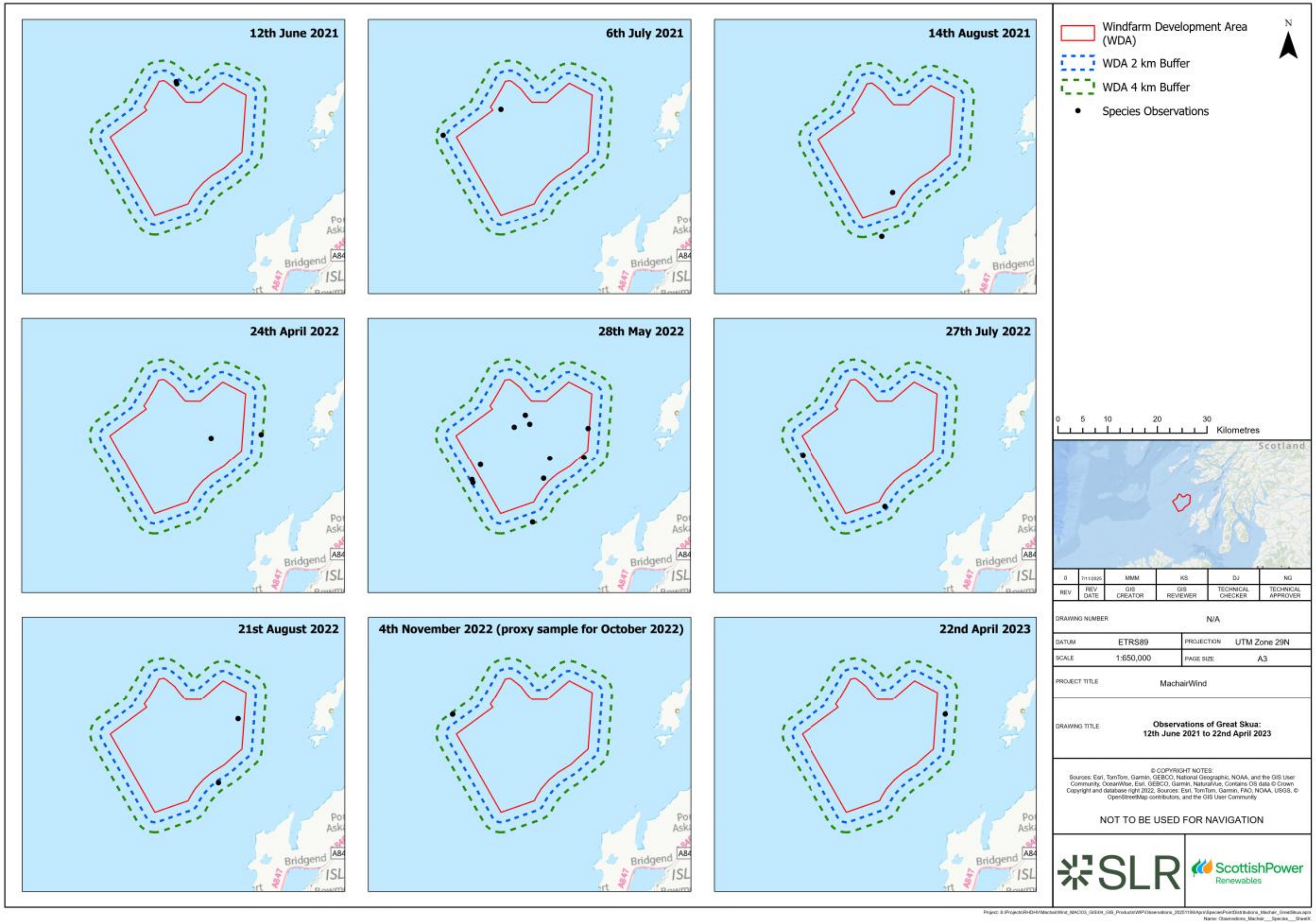

Figure 22: Raw observations of great skua: June 2021 to April 2023

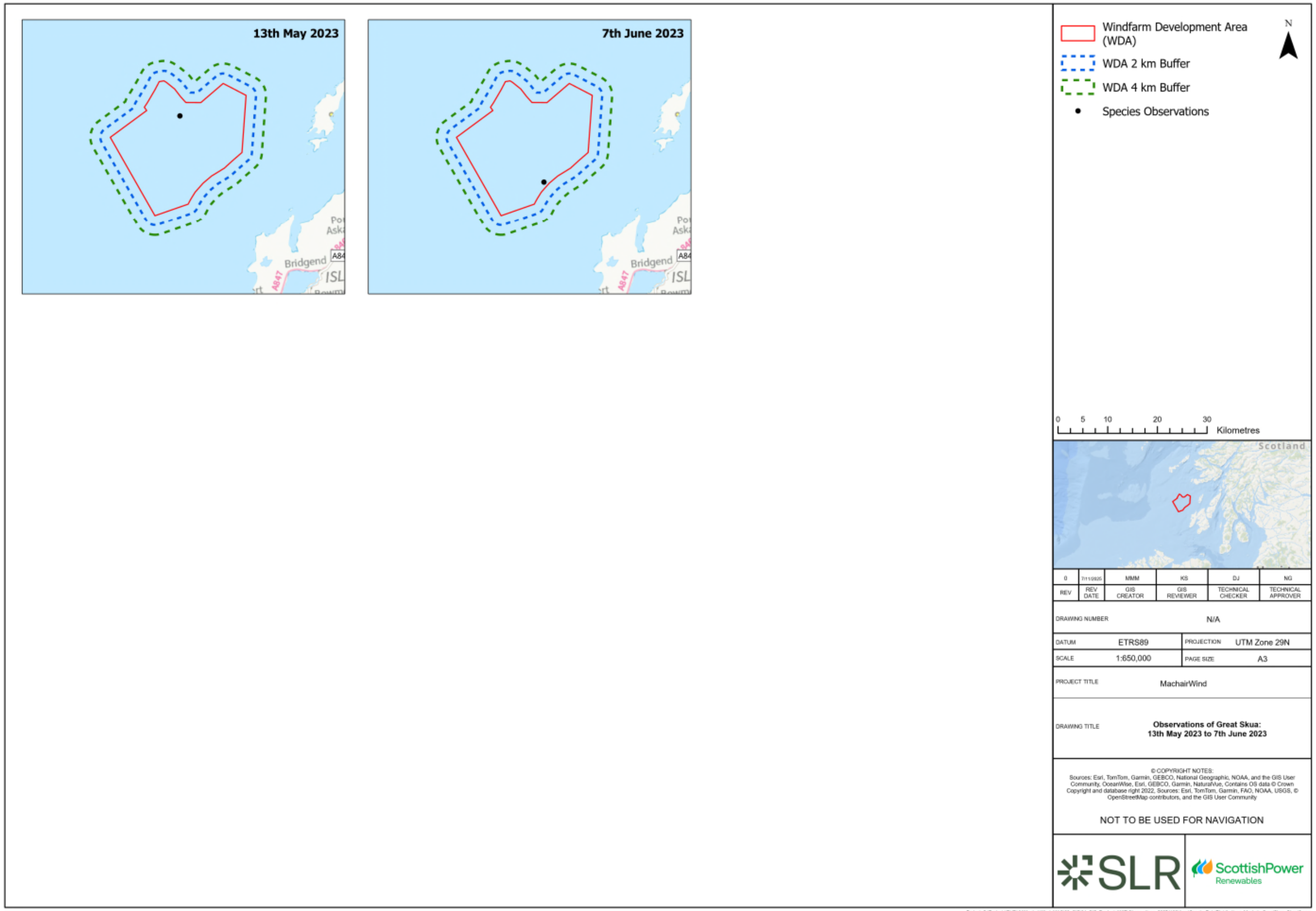

Figure 23: Raw observations of great skua: May 2023 and June 2023

4.14.3 Raw counts

179. Few great skua counts were recorded across all surveys (refer to **Annex 11.2E: Raw Counts**). Most great skua counts were recorded during the breeding season and the spring migration period (**Table 4**); a peak count of 11 great skuas was recorded in the WDA plus 4 km buffer in May 2022, refer to **Annex 11.2E: Raw Counts, Table 27**). One exception was two counts of great skua recorded in the survey month of October 2022 (a survey on the 4 November was used as a proxy sample for October 2022) which was during the BDMPS autumn migration / winter period.

4.14.4 Design-based density estimates

180. Design-based density estimates of great skuas in flight in the WDA in each survey are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 27.**

181. Great skua density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.06 bird/km^2, **Table 9**) was recorded in May 2022 during the great skua breeding season (**Table 4**). The density of great skuas recorded in flight in the WDA was less than one bird/km^2 in all survey months when this species was recorded.

182. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Of great skuas recorded in the WDA across all surveys, the majority (69.2%) were recorded in flight.

4.14.5 Design-based abundance estimates

183. Design-based abundance estimates of great skuas recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 27.**

184. Great skua abundance estimates were low in all surveys where this species was recorded. The highest peak abundance (a peak abundance of 59.96 birds) of all great skuas sat on the water and in flight in the WDA plus 2 km buffer was recorded in May 2022 (**Table 10**) during the great skua breeding season (**Table 4**). Two other smaller peaks of over 10 sitting and flying birds were recorded in the WDA plus 2 km buffer in June 2021 (12.24 birds) and July 2022 (12.10 birds). The abundance of great skuas recorded sitting and flying in the WDA plus 2 km buffer was lower than 10 birds in all other survey months when this species was recorded (**Table 10**).

185. Great skua was not assessed for displacement mortality (**Technical Appendix 11.4: Displacement).** As such, mean seasonal peak abundances (which inform displacement mortalities) are not presented herein.

4.15 Guillemot

4.15.1 Conservation status

UK: Amber listed

European: Vulnerable

4.15.2 Raw observations

186. Raw observations of guillemots (including birds sat on the water and in flight, but not including apportioned birds, refer to **Section 3.3.3**) are presented for each survey in **Figure 24** to **Figure 27**. Guillemots were recorded within the WDA plus 4 km buffer in all 30 surveys.

187. Guillemots were recorded across the WDA plus 4 km buffer in all 30 surveys. Guillemot temporal patterns were present, with more even and widespread distributions throughout the breeding period and noticeably fewer observations in the non-breeding period. Interannual variation was present; for example, there were noticeably fewer observations during the post-breeding dispersal period in 2021 and 2022 than in 2023 (see September surveys for each year). Similarly, 2023 appeared to have more intense and even distribution of observations in January and February than in 2021/2022. Observations following the conclusion of the breeding season were relatively low for a longer period of time in 2021 than in 2022 or 2023 (observations were relatively sparse in August to December in 2021, versus August to October for 2022; data for September 2023 showed higher concentrations than in the corresponding month in 2021 or 2022).

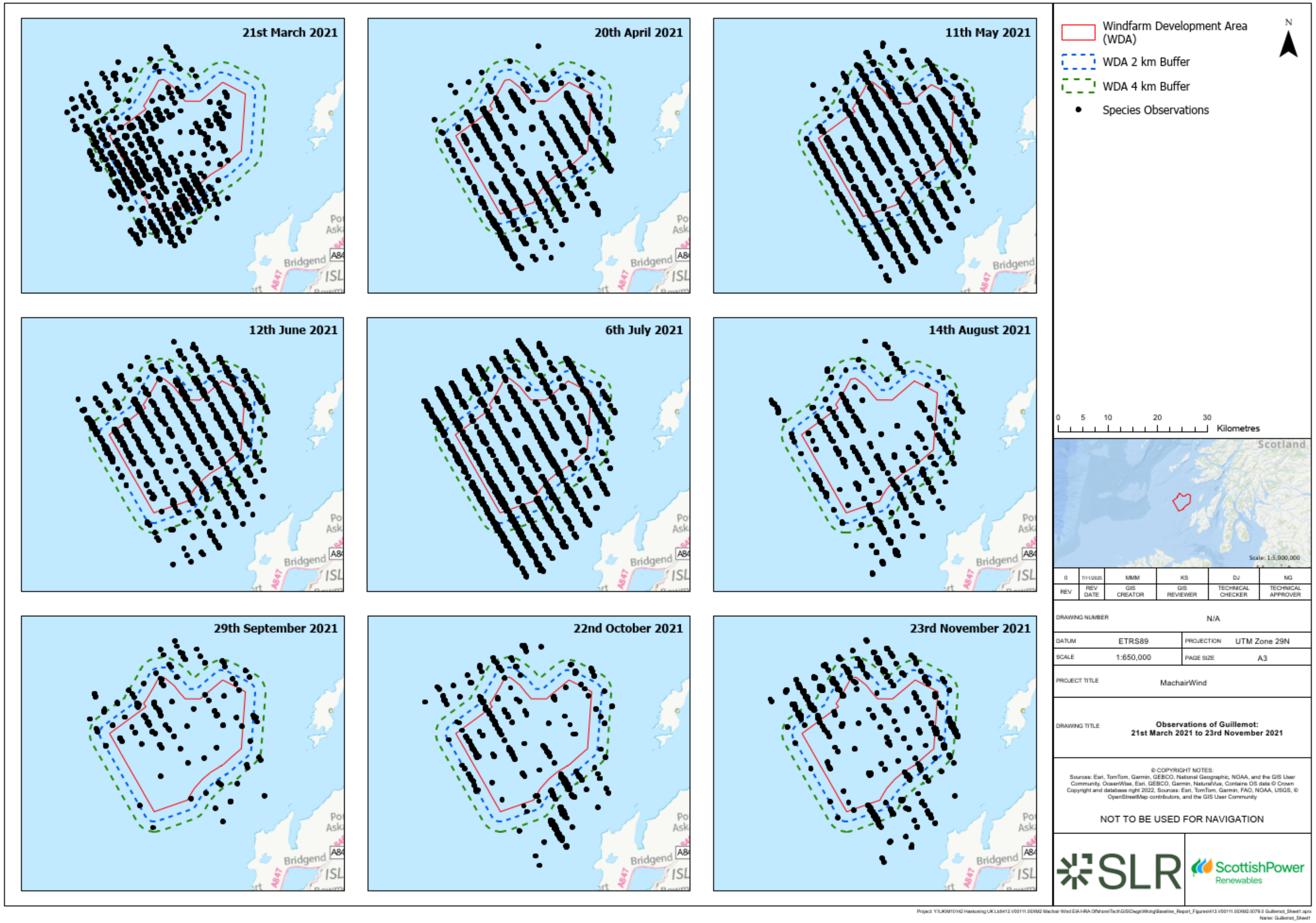

Figure 24: Raw observations of guillemot: March 2021 to November 2022

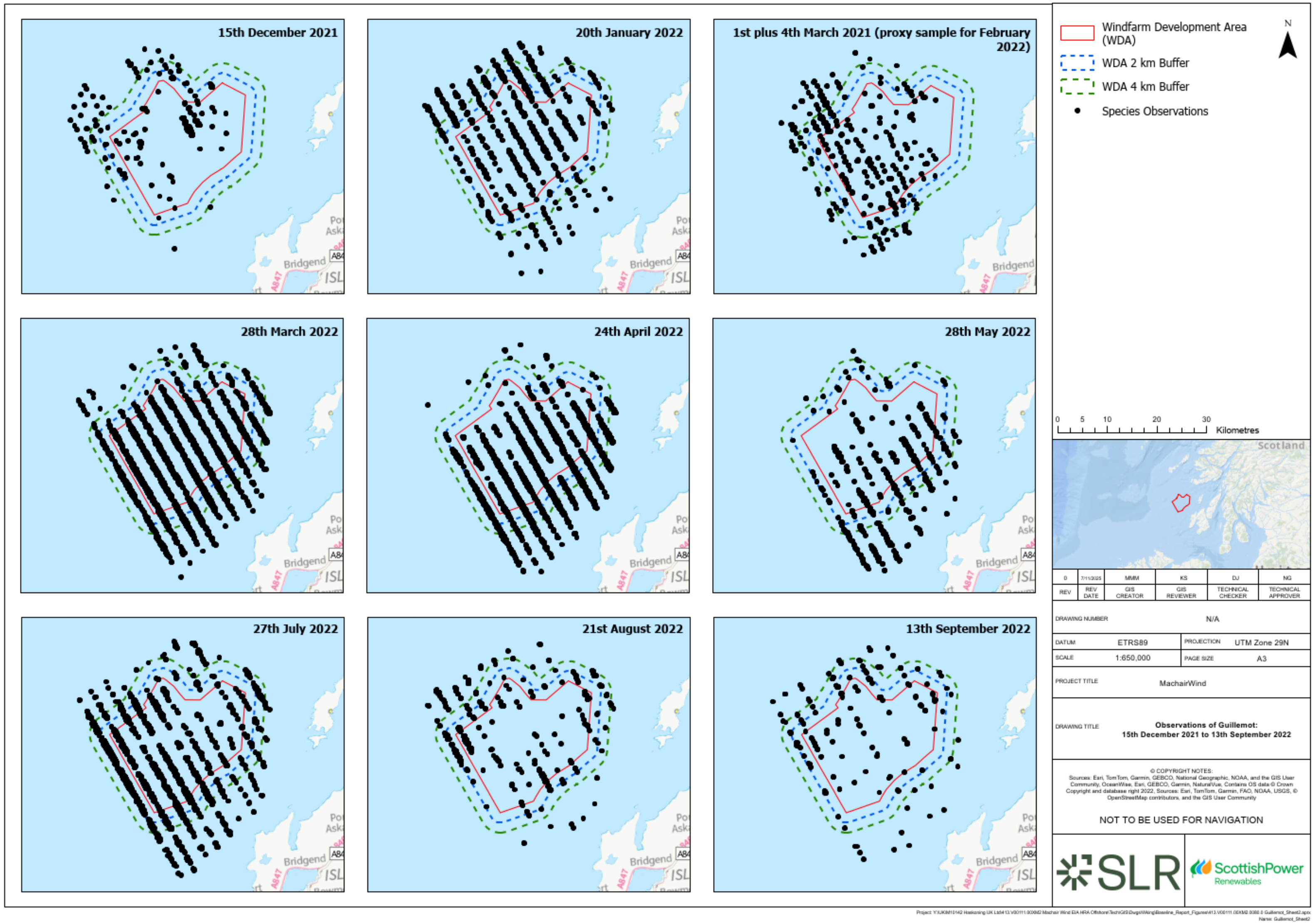

Figure 25: Raw observations of guillemot: December 2021 to September 2022

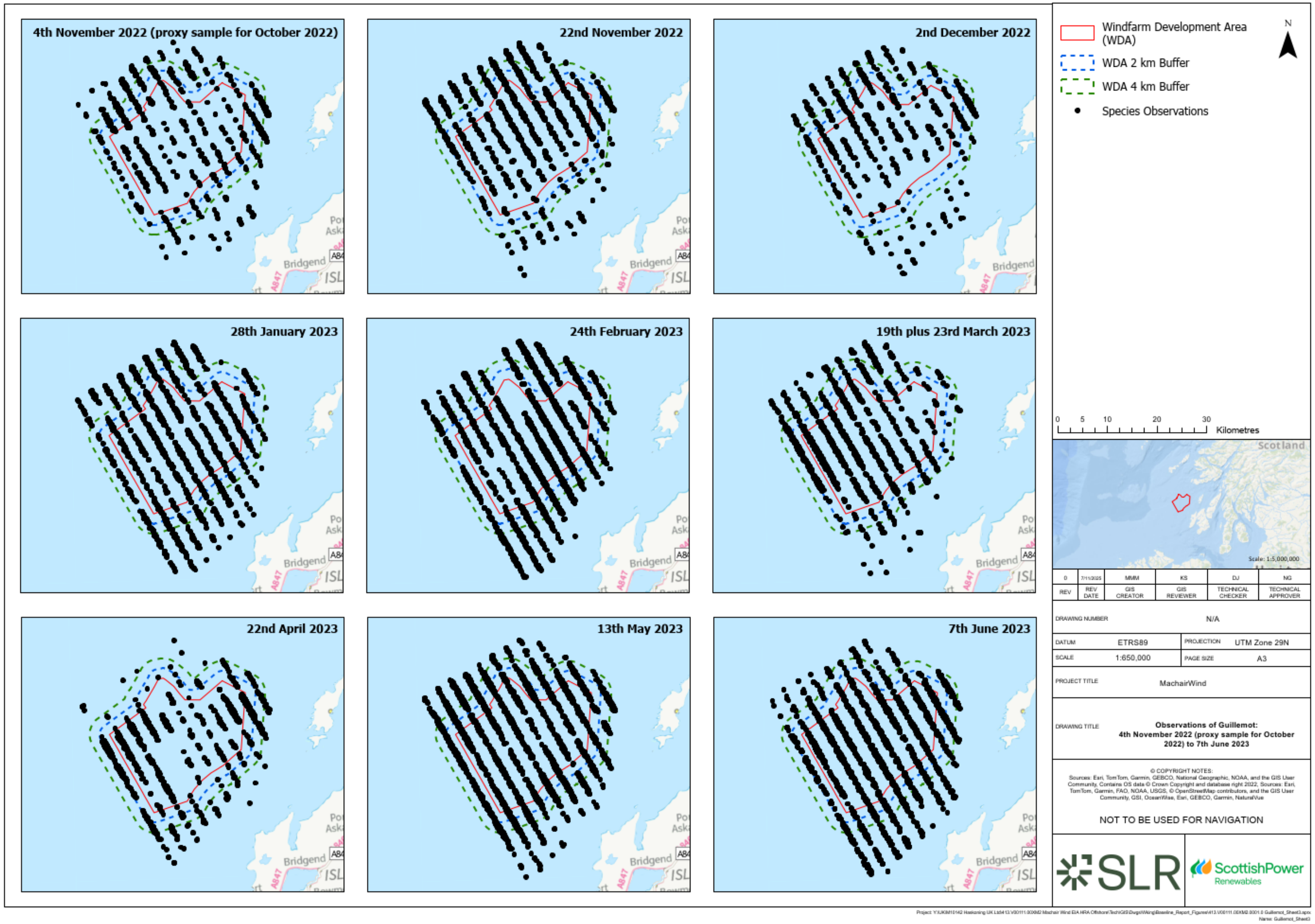

Figure 26: Raw observations of guillemot: October 2022 to June 2023

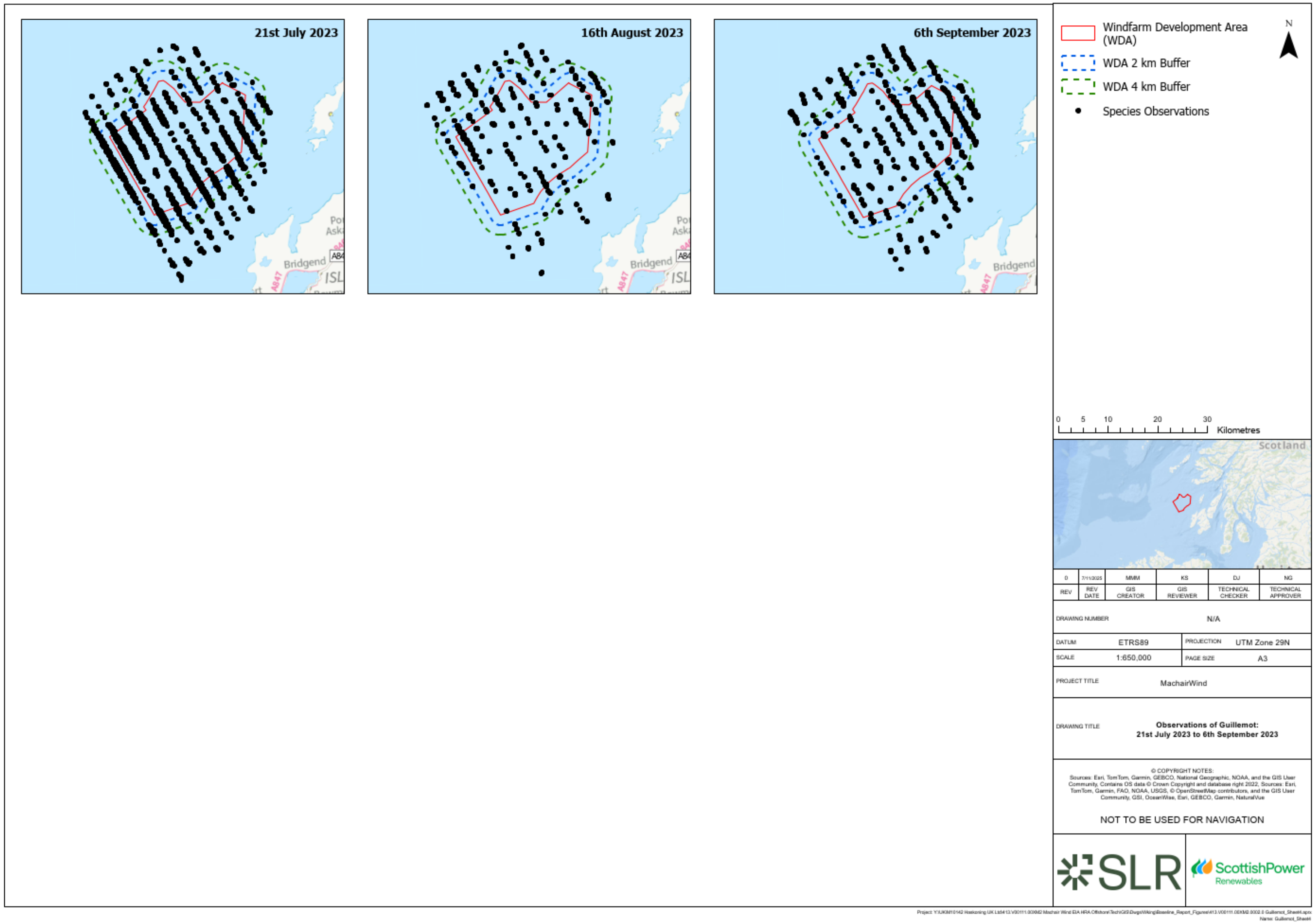

Figure 27: Raw observations of guillemot: July 2023 to September 2023

4.15.3 Raw counts

188. Guillemots (including apportioned and dive bias corrected birds) were recorded in large counts during surveys (refer to **Annex 11.2E: Raw Counts**). Guillemot counts were highest in the breeding season (**Table 4**). A peak count of 6,940.71 guillemots, including apportioned birds, was recorded in the WDA plus 4 km buffer in July 2023, refer to **Annex 11.2E: Raw Counts, Table 31**). Lower numbers of guillemots were recorded during the non-breeding season. A peak count recorded in the WDA plus 4 km buffer in the non-breeding season was recorded in March 2022 (a peak count of 6,333.63 guillemots, including apportioned and dive bias corrected birds).

4.15.4 Design-based density estimates

189. Design-based density estimates of guillemots (including apportioned birds) in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 31**.

190. Guillemot density estimates of birds in flight in the WDA were low. The highest peak density of birds in flight in the WDA (1.73 birds/km^2, **Table 9**) was recorded in March 2022 at the end of the guillemot non-breeding season (**Table 4**). In all other survey months, the density of guillemots in flight in the WDA was smaller than one bird/km^2.

191. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Almost all guillemots were recorded as sat on the water, with only 2.2% of guillemots recorded in flight.

4.15.5 Design-based abundance estimates

192. Design-based abundance estimates of guillemots (including apportioned and dive bias corrected birds) recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 31.**

193. Guillemot abundance estimates fluctuated between surveys. The highest peak abundance (a peak abundance of 39,233.19 birds) of all guillemots sat on the water and in flight recorded in the WDA plus 2 km buffer was recorded in July 2023 (**Table 10**) during the guillemot breeding season (**Table 4**). Other, lower peaks (over 20,000 birds in the WDA plus 2 km buffer) were recorded during the guillemot breeding season including March 2022 (33,381.80 birds), April 2022 (34,384.91 birds), July 2022 (31,740.60 birds) and June 2023 (22,811.03 birds). One peak above 20,000 birds was recorded during the guillemot non-breeding season in February 2023 (23,681.06 birds). In all other survey months, abundance was less than 20,000 birds in the WDA plus 2 km buffer.

194. Guillemot MSP abundance calculations are presented in **Technical Appendix 11.4: Displacement**. The highest MSP abundance in the WDA plus 2 km buffer (28,531.5 birds) was in the non-breeding season. The breeding season MSP abundance in the WDA plus 2 km buffer was slightly lower (27,095.4 birds).

4.16 Herring gull

4.16.1 Conservation status

UK: Red listed

European: Endangered

4.16.2 Raw observations

195. Raw observations of herring gulls (including birds sat on the water and in flight, but not including apportioned birds, refer to **Section 3.3.3**) are presented for each survey in **Figure 28** and **Figure 29**. Herring gulls were identified within the WDA plus 4 km buffer in 10 out of 30 surveys. In one other survey (March 2021 which was used as a proxy sample for February 2022) one herring gull observation was identified outwith the 4 km buffer.

196. Most herring gull observations were located within the WDA, with the exception of November 2021, where most observations were located outside the 2 km buffer and beyond the 4 km buffer on the northern side of the Project area. Given the sparse data, no consistent spatial pattern can be identified.

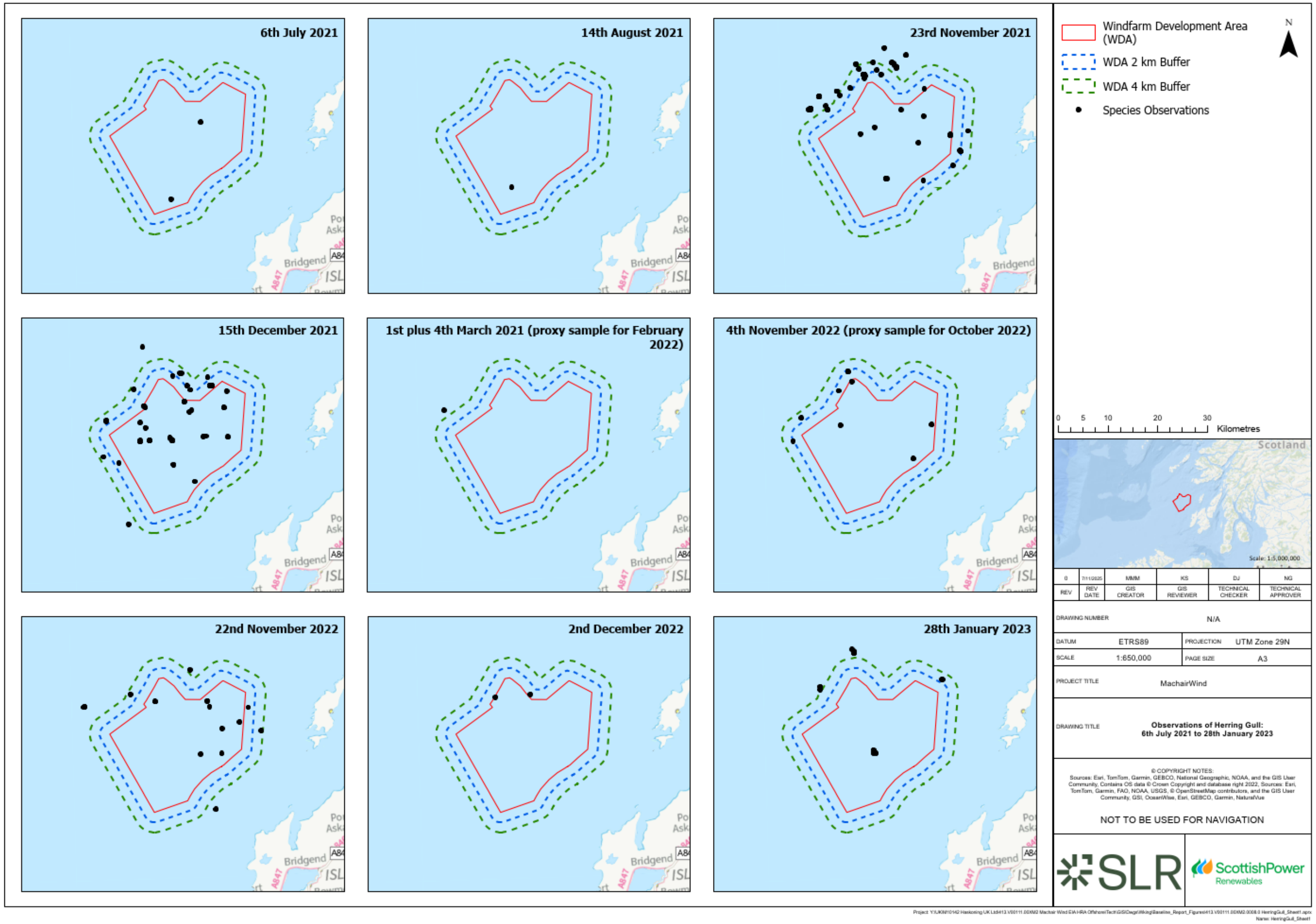

Figure 28: Raw observations for herring gull: July 2021 to January 2023

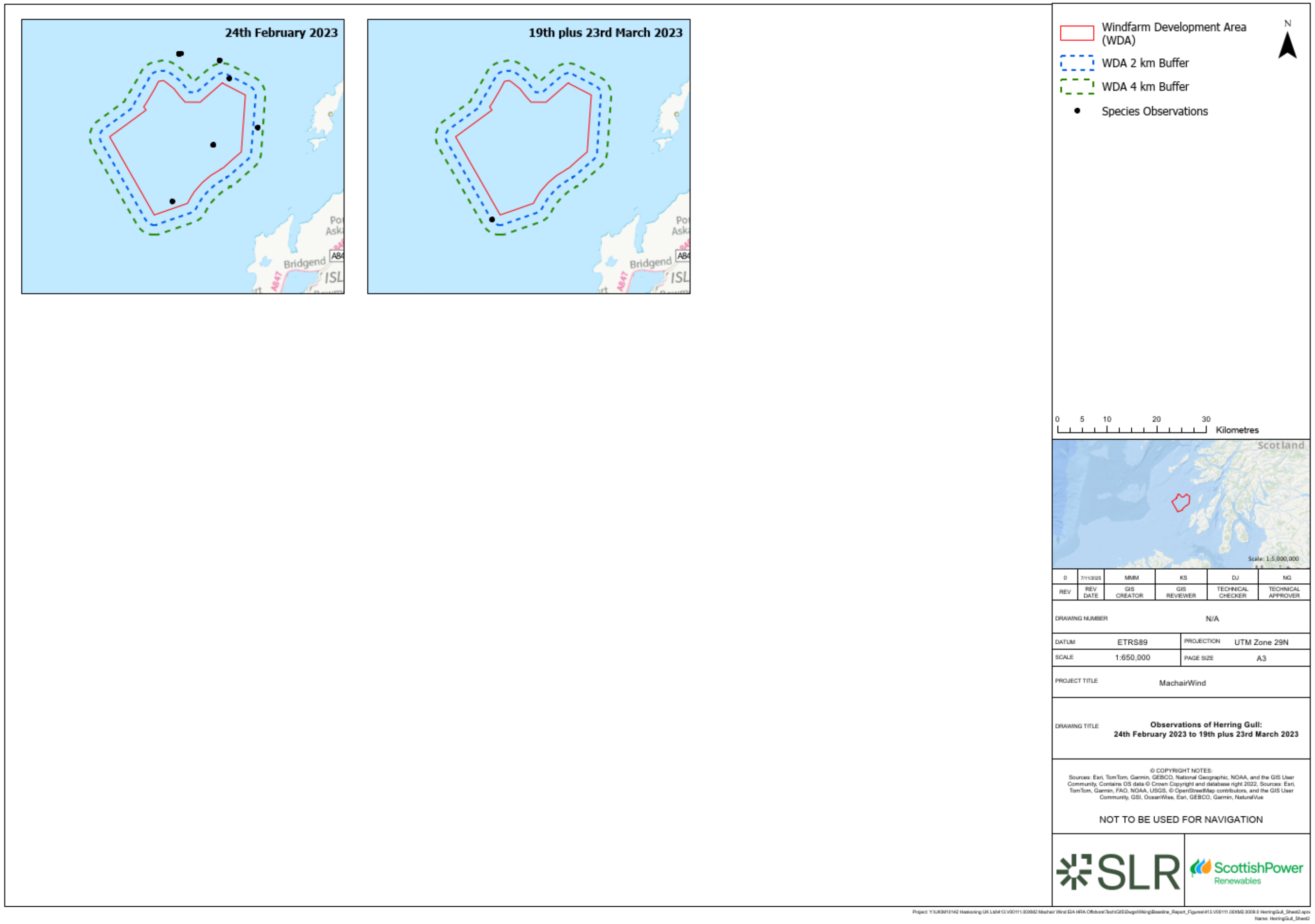

Figure 29: Raw observations for herring gull: February 2023 and March 2023

4.16.3 Raw counts

197. There were relatively few herring gull counts (including apportioned birds) recorded across surveys (refer to **Annex 11.2E: Raw Counts**). Most counts were recorded in the non-breeding season (**Table 4**). A peak count of 117.56 herring gulls, including apportioned birds, was recorded in the WDA plus 4 km buffer in November 2021, refer to **Annex 11.2E: Raw Counts, Table 35**). Very few herring gulls were recorded within the WDA plus 4 km buffer during the breeding season: apportioned birds were recorded in July 2021 (3.38 birds) and August 2021 (2 birds).

4.16.4 Design-based density estimates

198. Design-based density estimates of herring gulls (including apportioned birds) in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 35**.

199. Herring gull density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.32 bird/km^2, **Table 9**) was recorded in December 2021 during the herring gull non-breeding season (**Table 4**). The density of herring gulls recorded in flight in the WDA was less than one bird/km^2 in all survey months when this species was recorded.

200. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Of herring gulls recorded in the WDA across all surveys, slightly less than half (47.7%) were recorded in flight.

4.16.5 Design-based abundance estimates

201. Design-based abundance estimates of herring gulls (including apportioned birds) recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 35**.

202. Herring gull abundance estimates fluctuated between surveys. The highest peak abundance (a peak abundance of 623.63 birds) of all herring gulls sat on the water and in flight recorded in the WDA plus 2 km buffer was recorded in November 2021 (**Table 10**) during the herring gull non-breeding season (**Table 4**). One other peak of over 100 sitting and flying birds was recorded in the WDA plus 2 km buffer during the herring gull non-breeding season in December 2021 (376.70 birds). The abundance of herring gulls recorded sitting and flying in the WDA plus 2 km buffer was lower than 100 birds in all other survey months when this species was recorded (**Table 10**).

203. Herring gull was not assessed for displacement mortality (**Technical Appendix 11.4: Displacement**)**.** As such, mean seasonal peak abundances (which inform displacement mortalities) are not presented herein.

4.17 Kittiwake

4.17.1 Conservation status

UK: Red listed

European: Endangered

4.17.2 Raw observations

204. Raw observations of kittiwakes (including birds sat on the water and in flight, but not including apportioned birds, refer to **Section 3.3.3**) are presented for each survey in **Figure 30** to **Figure 33**. Kittiwakes were recorded within the WDA plus 4 km buffer in all 30 surveys.

205. Kittiwakes displayed a relatively weak spatial pattern across the WDA plus 4 km buffer, this species was recorded scattered across this offshore ornithology survey area particularly during January/February and November/December which coincides with part of the spring and autumn migration seasons, respectively (refer to **Table 4**). The greatest number of kittiwake observations tended to be located along the edge of the WDA plus 2 km buffer and WDA plus 4 km buffer and to a lesser extent, in the middle of the WDA, although areas of high numbers of observations varied between months.

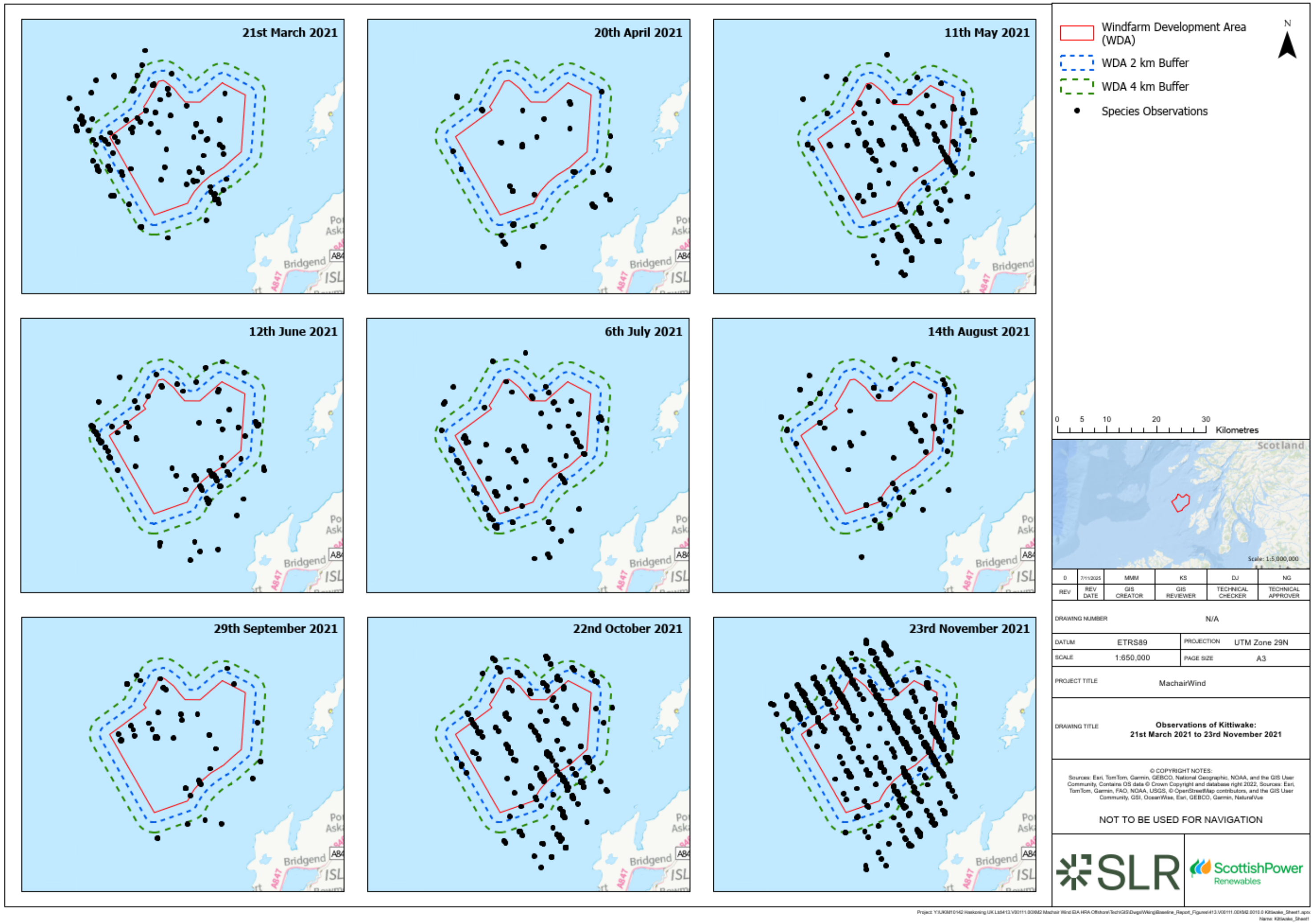

Figure 30: Raw observations of kittiwake: March 2021 to November 2021

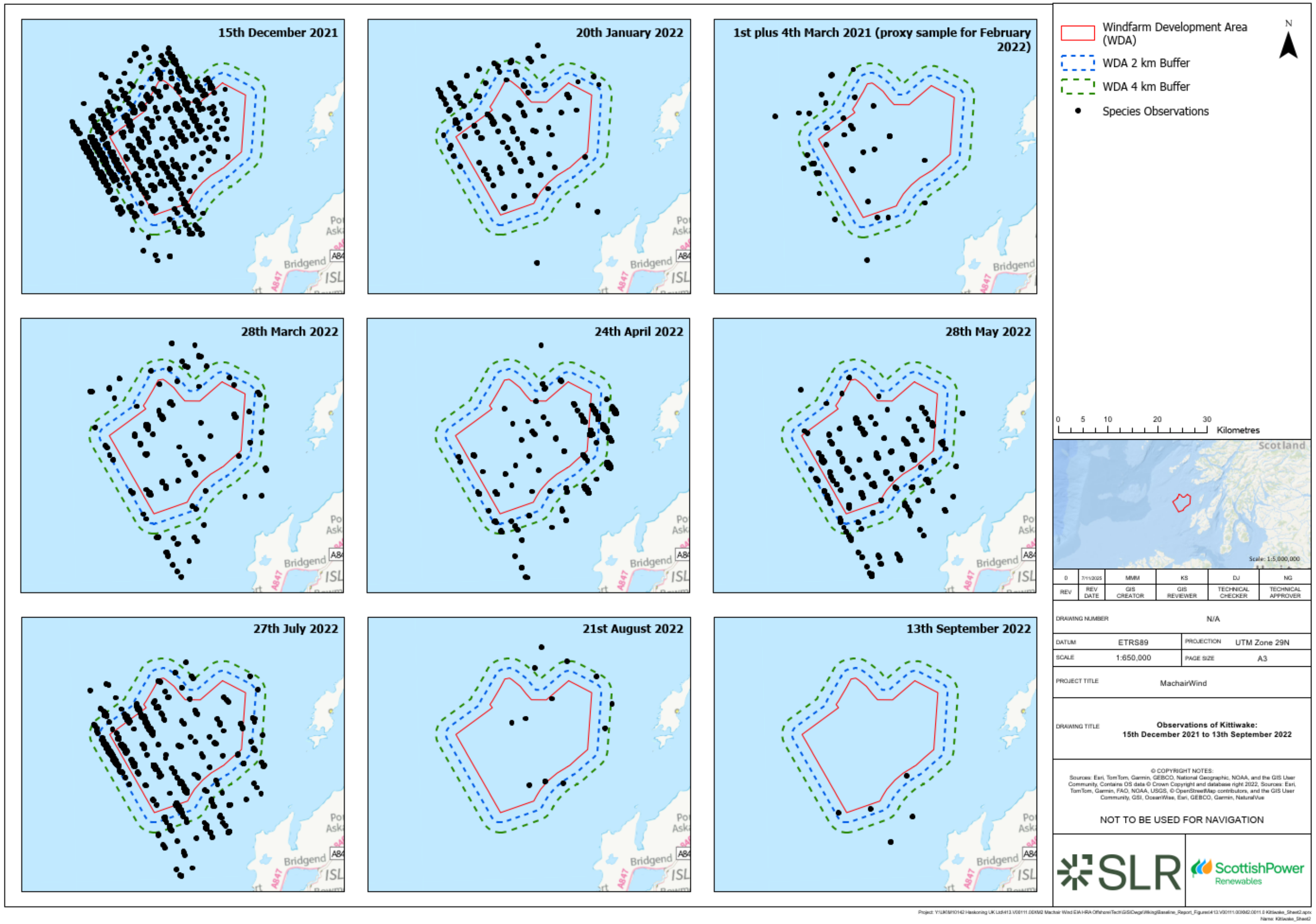

Figure 31: Raw observations of kittiwake: December 2021 to September 2022

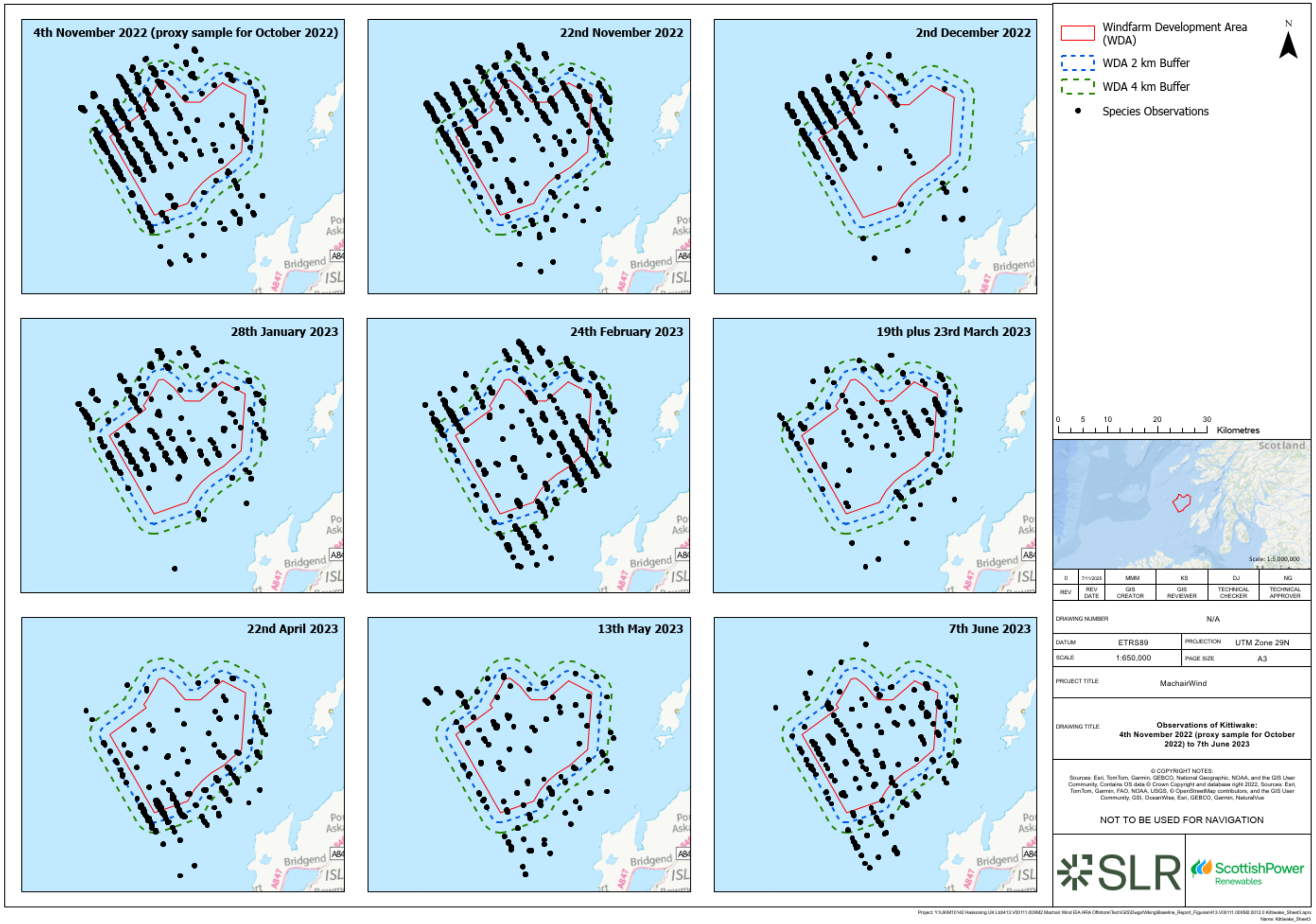

Figure 32: Raw observations of kittiwake: October 2022 to June 2023

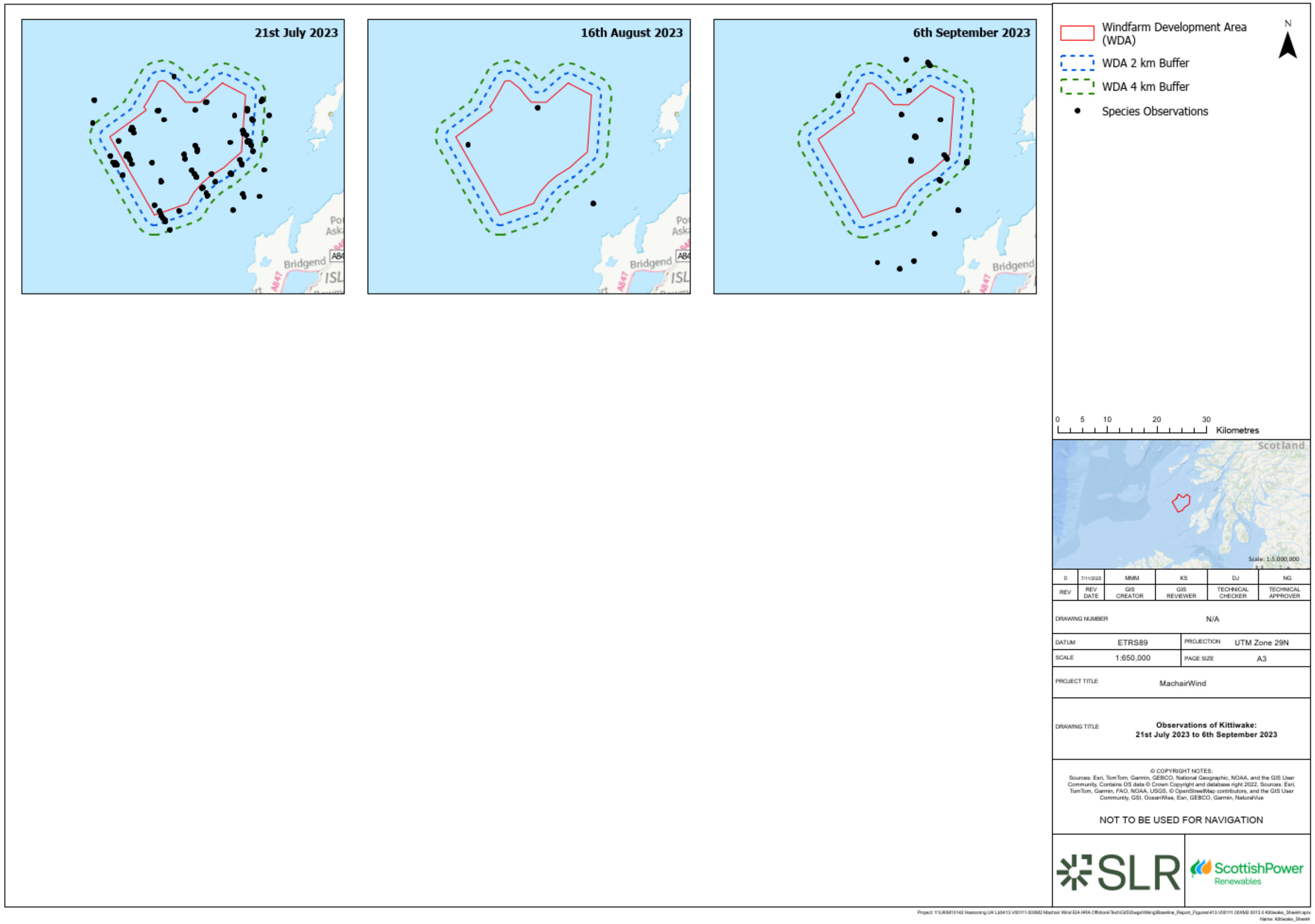

Figure 33: Raw observations of kittiwake: July 2023 to September 2023

4.17.3 Raw counts

206. Raw counts of kittiwakes (including apportioned birds) in the WDA plus 4 km buffer fluctuated between surveys (refer to **Annex 11.2E: Raw Counts**). Most counts were recorded in the early spring and late autumn months (**Table 4**); a peak count of 1,730.36 kittiwakes, including apportioned birds, was recorded in the WDA plus 4 km buffer in November 2021 (refer to **Annex 11.2E: Raw Counts, Table 37**). Kittiwake counts were generally lower in the breeding season, except July 2022, when a large number of kittiwakes were recorded in the WDA plus 4 km buffer. The relatively few kittiwake counts recorded in the breeding seasons (July 2022 being the exception) suggests that the WDA plus 4 km buffer tends to be used more by birds on spring or autumn passage, rather than by breeding birds.

4.17.4 Design-based density estimates

207. Design-based density estimates of kittiwakes (including apportioned birds) in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 37**.

208. Kittiwake density estimates of birds in flight in the WDA were moderately high. The highest peak density of birds in flight in the WDA (6.48 birds/km^2, **Table 9**) was recorded in December 2021 during the kittiwake autumn migration season (**Table 4**). In most months, the density of kittiwakes in flight in the WDA was smaller than two birds/km^2. Kittiwake densities in flight within the WDA greater than two birds/km^2 occurred in 8 survey months, usually during the spring and autumn migration periods, although densities greater than two birds/km^2 were recorded during the 2022 breeding season in May (2.26 birds/km^2) and July (2.42 birds/km^2).

209. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Of kittiwakes recorded in the WDA across all surveys, most (64.2%) were recorded in flight.

4.17.5 Design-based abundance estimates

210. Design-based abundance estimates of kittiwakes (including apportioned birds) recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 37.**

211. Kittiwake abundance estimates fluctuated between surveys. The highest peak abundance (a peak abundance of 7,752.66 birds) of all kittiwakes sat on the water and in flight recorded in the WDA plus 2 km buffer was recorded in November 2021 (**Table 10**) during the kittiwake autumn migration season (**Table 4**). Other, lower peaks (over 3,000 birds in the WDA plus 2 km buffer) were recorded during the kittiwake spring and autumn migration seasons including December 2021 (6,782.32 birds), April 2022 (3,496.73 birds), July 2022 (3,859.61), October 2022 (3,556.13 birds) and February 2023 (3,480.37 birds). One exception was the abundance recorded during the breeding season in July 2022 (3,859.61 birds), this was the highest abundance recorded during any survey conducted during the breeding season and was higher compared to the same month in other years including July 2021 (533.29 birds) and July 2023 (519.77 birds).

Kittiwake MSP abundance calculations are presented in **Technical Appendix 11.4: Displacement.** The highest MSP abundance in the WDA plus 2 km buffer (5,654.4 birds) was in the non-breeding season, including the BDMPS autumn migration period. The BDMPS spring migration period abundance estimate in the WDA plus 2 km buffer was slightly lower (3,488.6 birds), with the lowest estimate recorded in the breeding season (1,221.0 birds).

4.18 Manx shearwater

4.18.1 Conservation status

UK: Amber listed

European: Least Concern

4.18.2 Raw observations

212. Raw observations of Manx shearwaters (including birds sat on the water and in flight, but not including apportioned birds, refer to **Section 3.3.3**) are presented for each survey in **Figure 34** to **Figure 36**. Manx shearwaters were identified within the WDA plus 4 km buffer in 21 out of 30 surveys, in one other survey (November 2022, proxy sample for October 2022) one Manx shearwater was identified outwith the 4 km buffer.

213. Manx shearwaters were distributed throughout the Project area consistently in a manner that did not vary considerably between months or interannually.

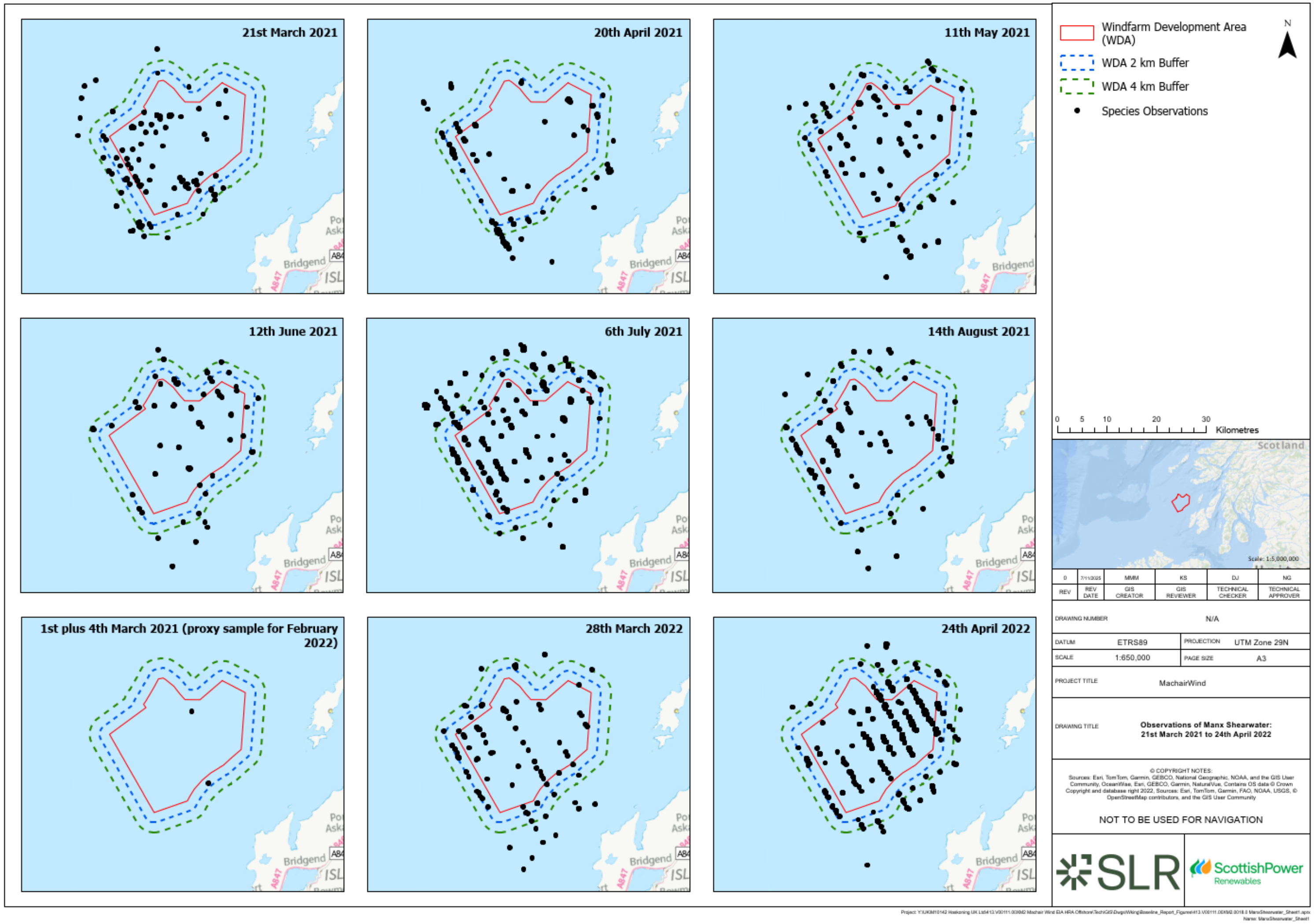

Figure 34: Raw observations of Manx shearwater: March 2021 to April 2022

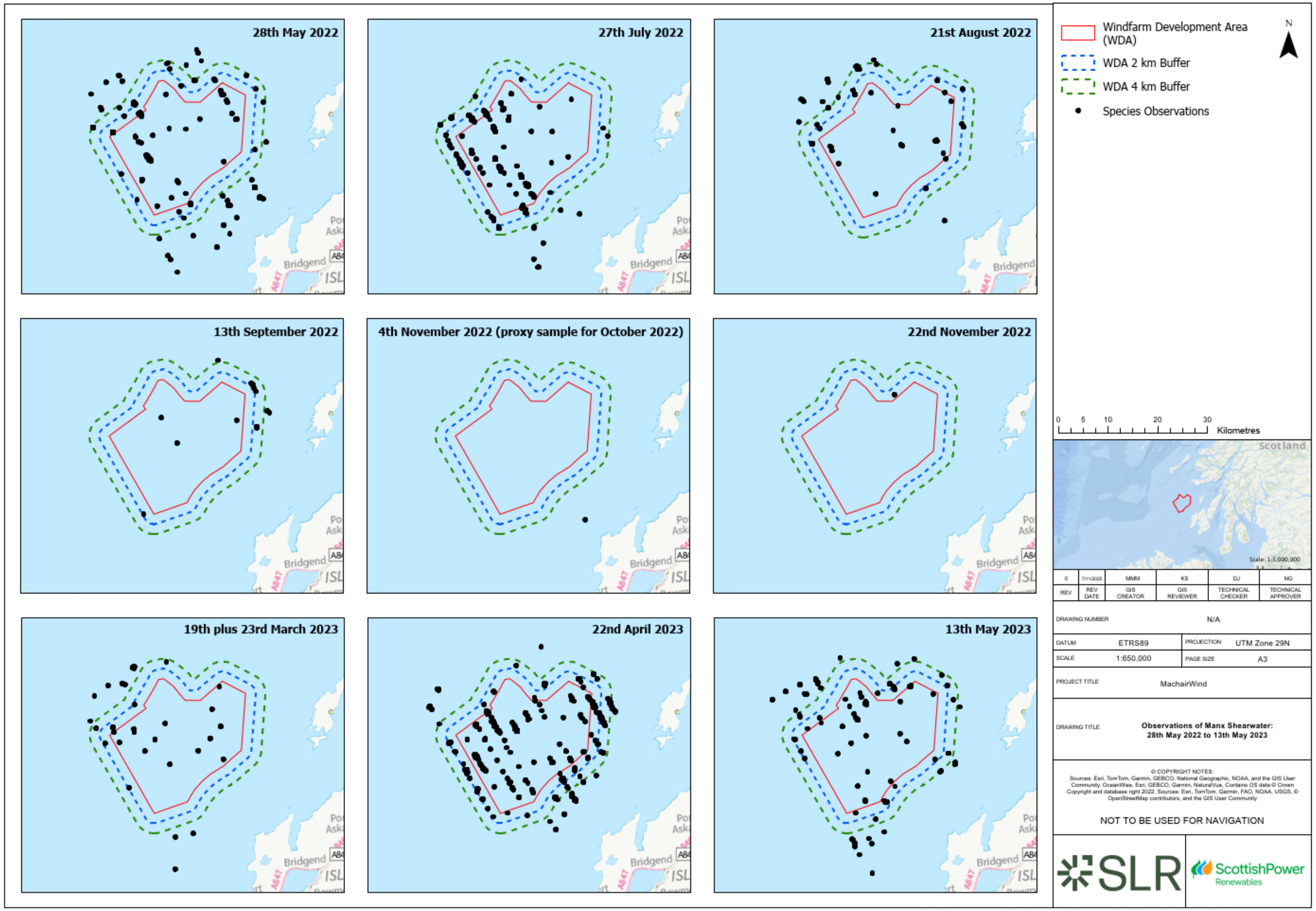

Figure 35: Raw observations of Manx shearwater: May 2022 to May 2023

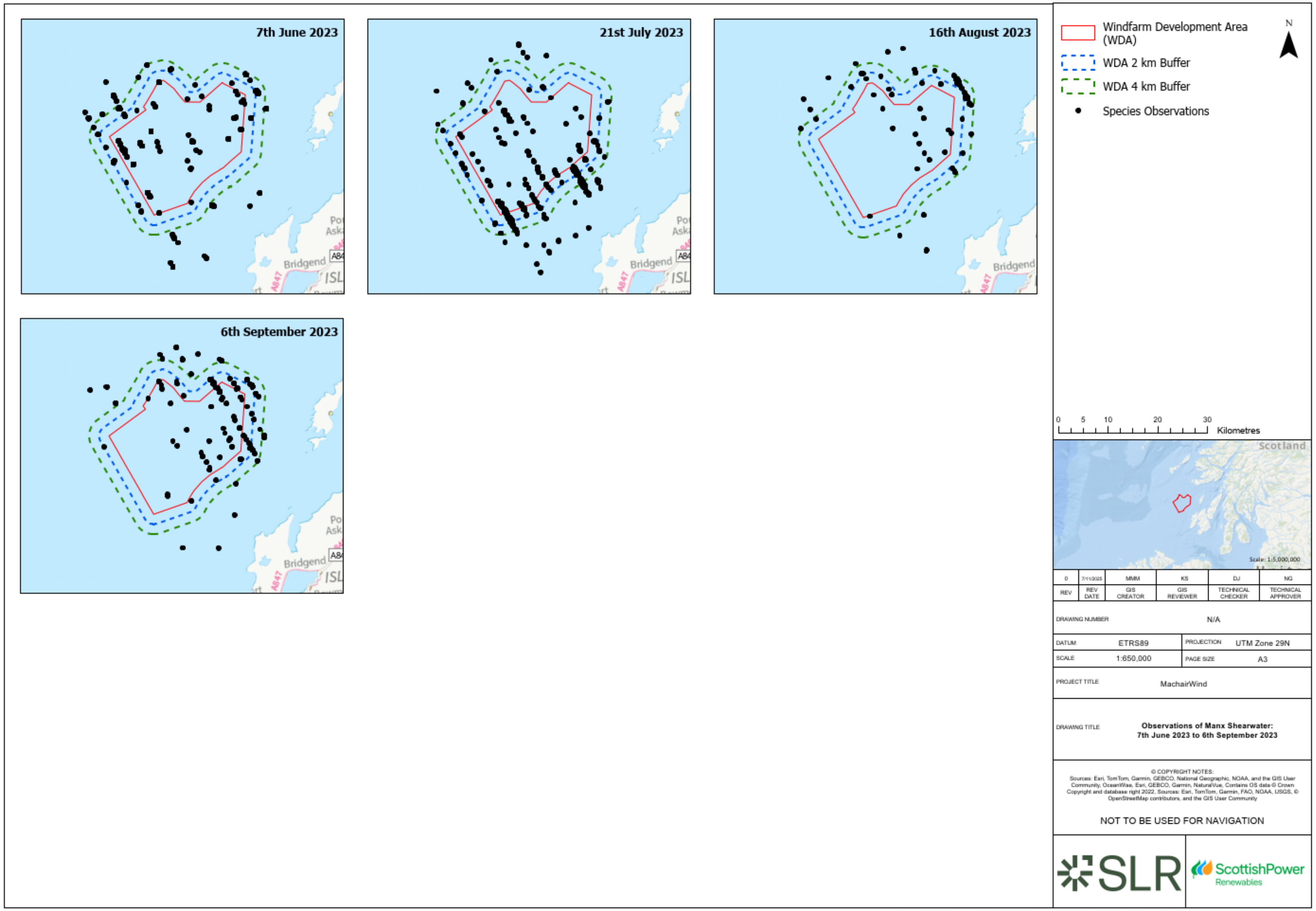

Figure 36: Raw observations of Manx shearwater: June 2023 to September 2023

4.18.3 Raw counts

214. Relatively large Manx shearwater counts (including apportioned birds) were recorded during surveys (refer to **Annex 11.2E: Raw Counts**). Most counts were recorded in the breeding season and spring migration period (**Table 4**). A peak count of 2,864.99 Manx shearwaters, including apportioned birds, was recorded in the WDA plus 4 km buffer in April 2022, refer to **Annex 11.2E: Raw Counts, Table 43**). Very few Manx shearwaters were recorded within the WDA plus 4 km buffer between October and January: apportioned birds in these calendar months were only recorded in November 2022 including 4 November 2022 (proxy sample of October 2022, 0.43 apportioned birds) and 22 November (1 apportioned bird).

4.18.4 Design-based density estimates

215. Design-based density estimates of Manx shearwaters (including apportioned birds) in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 43**.

216. The highest peak density of Manx shearwaters in flight in the WDA (4.00 birds/km^2, **Table 9**) was recorded in April 2022 during the Manx shearwater breeding season and spring migration period (**Table 4**). In most months, the density of Manx shearwaters in flight in the WDA was smaller than two birds/km^2. Manx shearwater densities greater than two birds/km^2 (but less than three birds/km^2) occurred in four survey months, always during the breeding season and spring migration periods.

217. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Of Manx shearwaters recorded in the WDA across all surveys, most were recorded as sat on the water, with only 27.9% recorded in flight.

4.18.5 Design-based abundance estimates

218. Design-based abundance estimates of Manx shearwaters (including apportioned birds) recorded sat on the water and in flight in each survey are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds**.

219. Manx shearwater abundance estimates fluctuated between surveys. The highest peak abundance (a peak abundance of 16,833.61 birds) of all Manx shearwaters sat on the water and in flight recorded in the WDA plus 2 km buffer (refer to **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 43**) was recorded in April 2022 during the Manx shearwater breeding season and spring migration period (**Table 4**). Other, lower peaks (over 2,000 birds in the WDA plus 2 km buffer), were recorded during the Manx shearwater breeding season and spring migration period including May 2021 (2,274.84 birds), July 2021 (3,822.87 birds), May 2022 (4,239.06 birds), July 2022 (3,656.45 birds), April 2023 (4,625.76 birds), June 2023 (6,505.87 birds) and July 2023 (8,024.43 birds). The abundance of Manx shearwaters recorded sitting and flying in the WDA plus 2 km buffer was lower than 2,000 birds in all other survey months.

220. Manx shearwater was not quantitatively assessed for displacement mortality (**Technical Appendix 11.4: Displacement**). As such, mean seasonal peak abundances (which inform displacement mortalities) are not presented herein.

4.19 Puffin

4.19.1 Conservation status

UK: Red listed

European: Critically Endangered

4.19.2 Raw observations

221. Raw observations of puffins (including birds sat on the water and in flight, but not including apportioned birds, refer to **Section 3.3.3**) are presented for each survey in **Figure 37** to **Figure 39**. Puffins were recorded within the WDA plus 4 km buffer in 25 out of 30 surveys. In one other survey (January 2023) one puffin observation was identified outwith the 4 km buffer.

222. Puffins were recorded in each of the Project areas (within the WDA, the WDA plus 2 km buffer, the WDA plus 4 km buffer and beyond) relatively consistently, though no other spatial pattern was apparent. Records in July consisted of widespread distributions in 2022 and 2023, though notably very limited and sparse observations in July 2021.

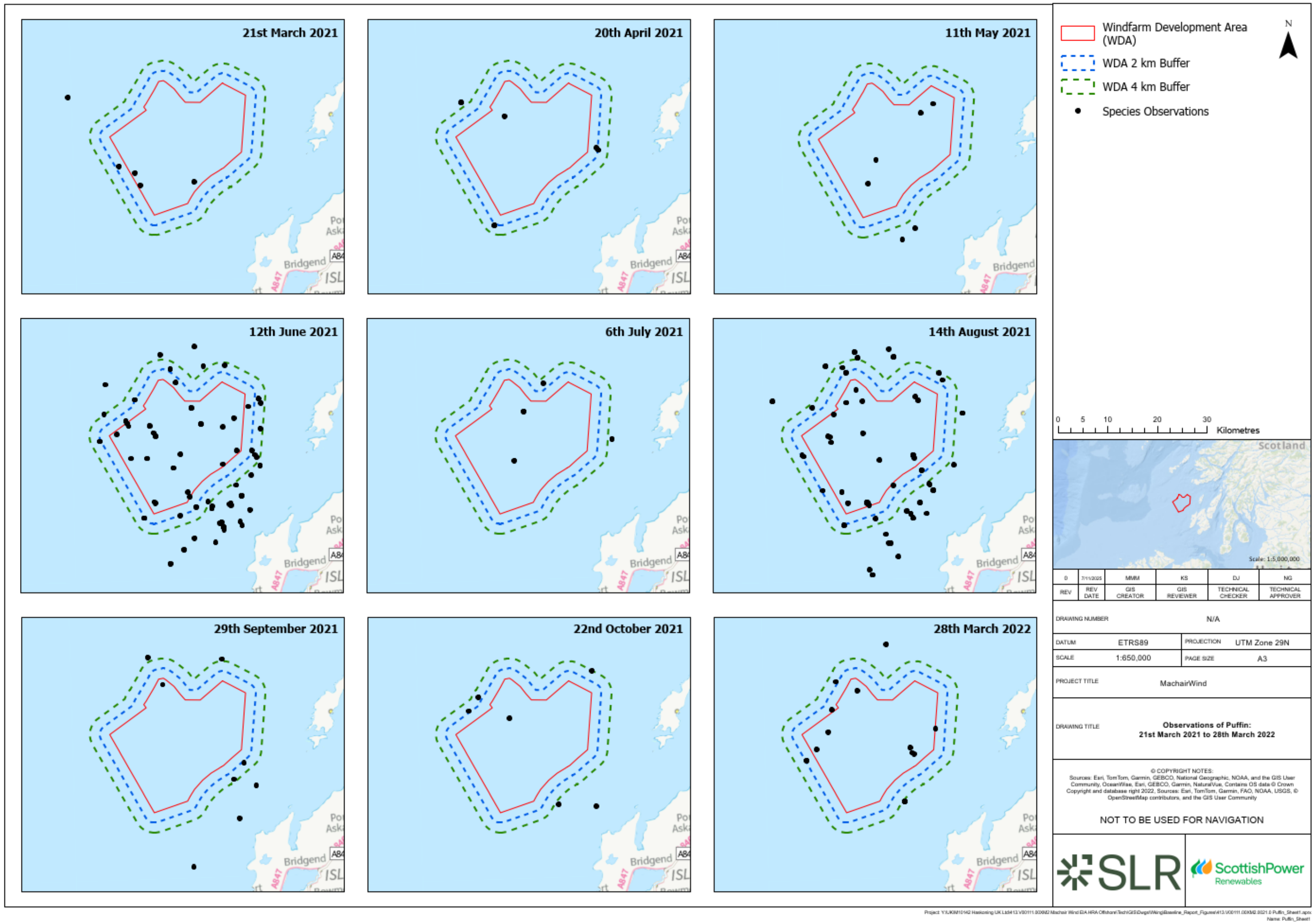

Figure 37: Raw observations of puffin: March 2021 to March 2022

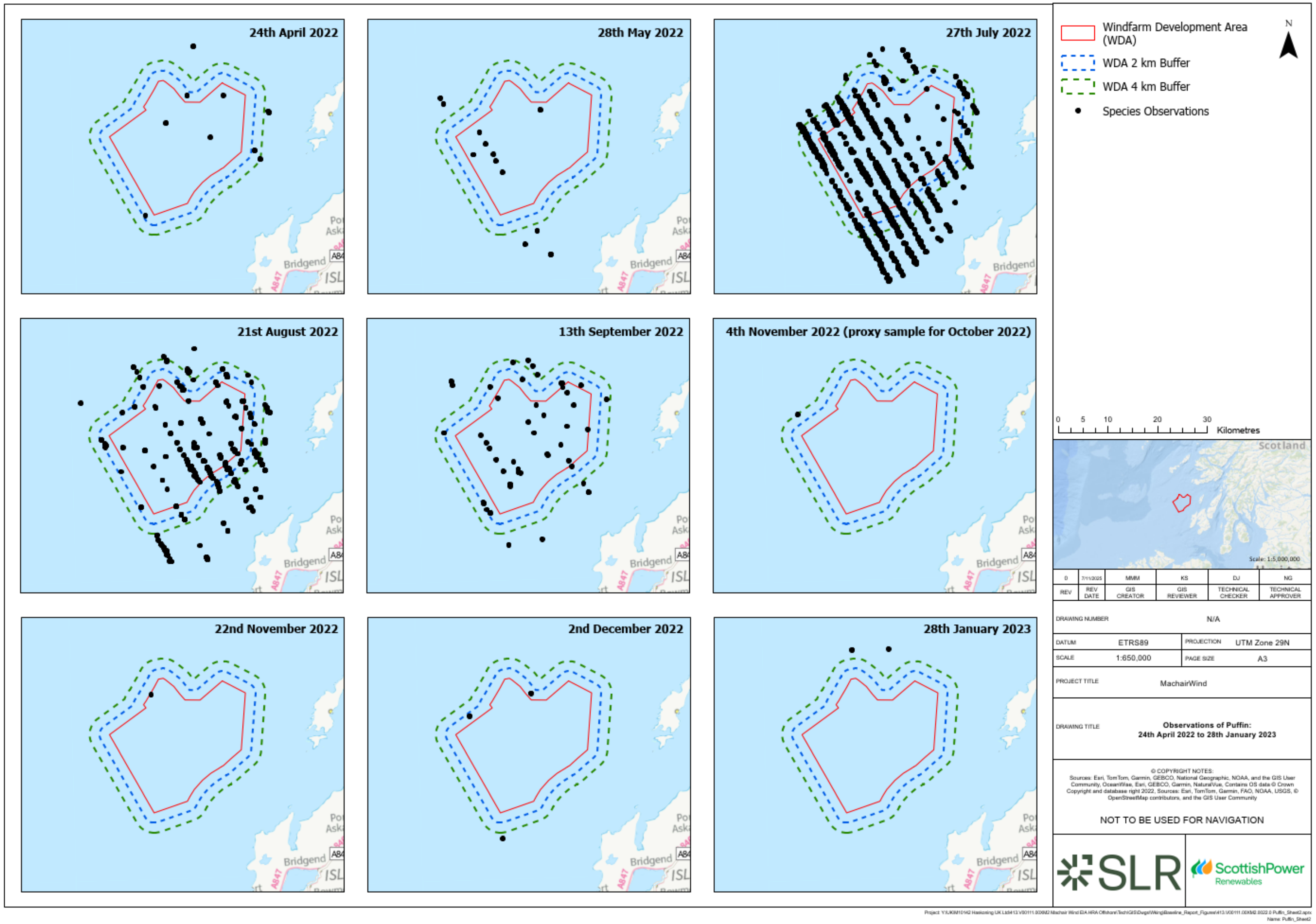

Figure 38: Raw observations of puffin: April 2022 to January 2023

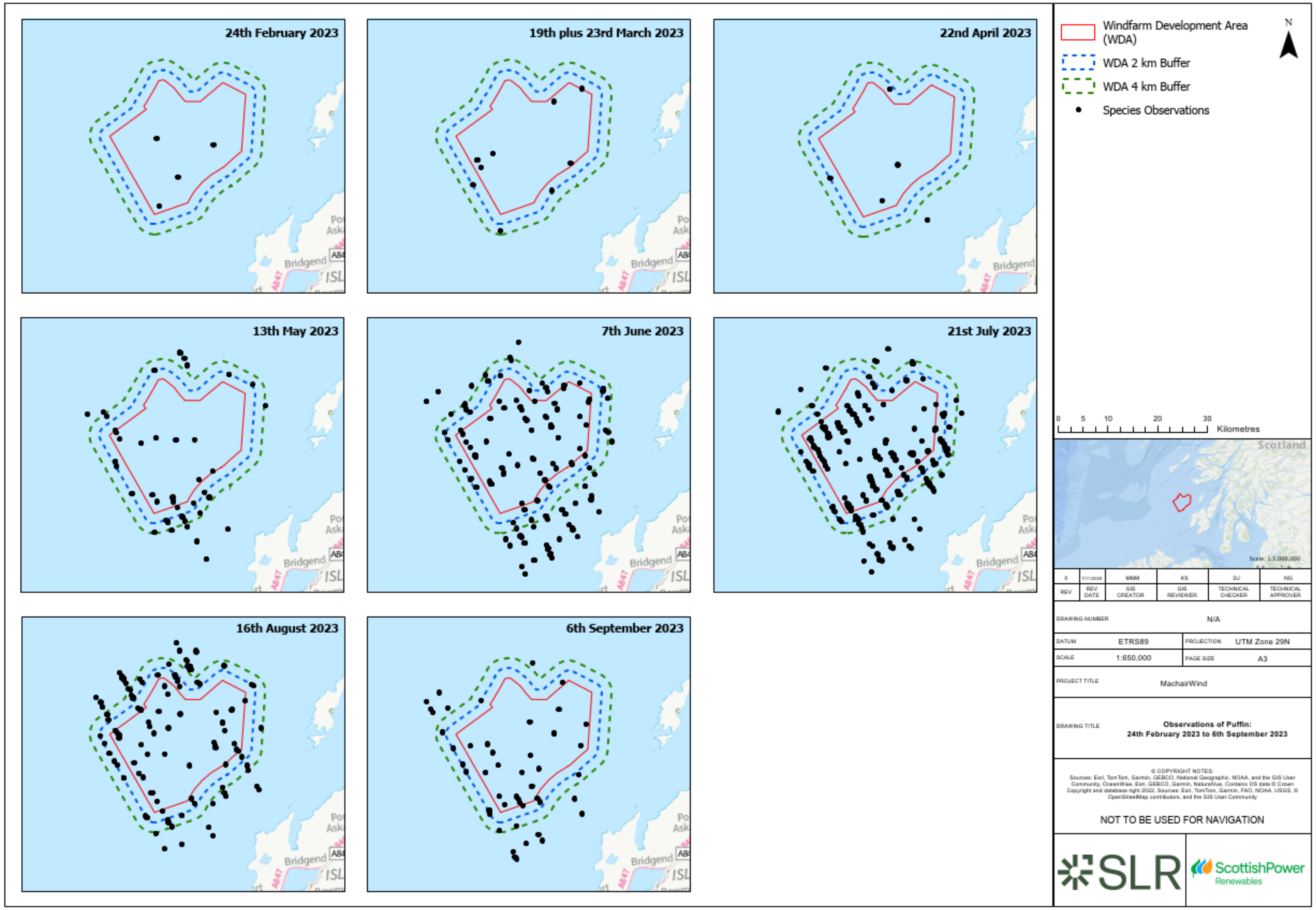

Figure 39: Raw observations of puffin: February 2023 to September 2023

4.19.3 Raw counts

223. Puffins (including apportioned and dive bias corrected birds) were recorded in relatively low numbers during surveys (refer to **Annex 11.2E: Raw Counts**). Most puffin counts were recorded in the breeding season (**Table 4**). A peak count of 1,832.01 puffins, including apportioned birds, were recorded in the WDA plus 4 km buffer in July 2022, refer to **Annex 11.2E: Raw Counts, Table 46**). Lower numbers of puffins were recorded during the non-breeding season. A peak count recorded in the WDA plus 4 km buffer in the non-breeding season was recorded at the end of the breeding season in September 2022 (a peak count of 52.02 puffins, including apportioned and dive bias corrected birds).

4.19.4 Design-based density estimates

224. Design-based density estimates of puffins (including apportioned birds) in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 46**.

225. Puffin density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.06 bird/km^2, **Table 9**) was recorded in July 2022 during the puffin breeding season (**Table 4**). The density of puffins recorded in flight in the WDA was less than one bird/km^2 in all survey months when this species was recorded (**Table 9**).

226. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. Almost all puffins recorded in the WDA across all surveys were recorded as sat on the water, with only 0.5% of puffins recorded in flight.

4.19.5 Design-based abundance estimates

227. Design-based abundance estimates of puffins (including apportioned and dive bias corrected birds) recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 46**.

228. Puffin abundance estimates fluctuated between surveys. The highest peak abundance (a peak abundance of 8,781.28 birds) of all puffins sat on the water and in flight recorded in the WDA plus 2 km buffer was recorded in July 2022 (**Table 10**) during the puffin breeding season (**Table 4**). Two other peaks of over 1,000 birds were recorded in August 2022 (2,122.25 birds) and July 2023 (1,653.33 birds). The abundance of puffins recorded sitting and flying in the WDA plus 2 km buffer was lower than 700 birds in all other survey months (**Table 10**).

229. Puffin MSP abundance calculations are presented in **Technical Appendix 11.4: Displacement**. The highest MSP abundance in the WDA plus 2 km buffer (1,192.4 birds) was recorded in the non-breeding season. The breeding season MSP abundance in the WDA plus 2 km buffer was slightly lower (971.7 birds).

4.20 Razorbill

4.20.1 Conservation status

UK: Amber listed

European: Vulnerable

4.20.2 Raw observations

230. Raw observations of razorbills (including birds sat on the water and in flight, but not including apportioned birds, refer to **Section 3.3.3**) are presented for each survey in **Figure 40** to **Figure 43**. Razorbills were recorded within the WDA plus 4 km buffer in all 30 surveys.

231. Razorbills tended to utilise all areas of the Project area (within the WDA, WDA plus 2 km buffer boundary, WDA plus 4 km buffer boundary and beyond). No pattern of spatial distribution was consistently present during any season, though in May 2023, observations tended to be concentrated towards the southwest side of the WDA, and sparse observations were clustered around the southern and northern boundaries of the 4 km buffer between August 2021 and October 2021. Seasonal spatial patterns varied interannually (e.g., the distributions around the boundaries in August 2021 to October 2021 were not present in other years).

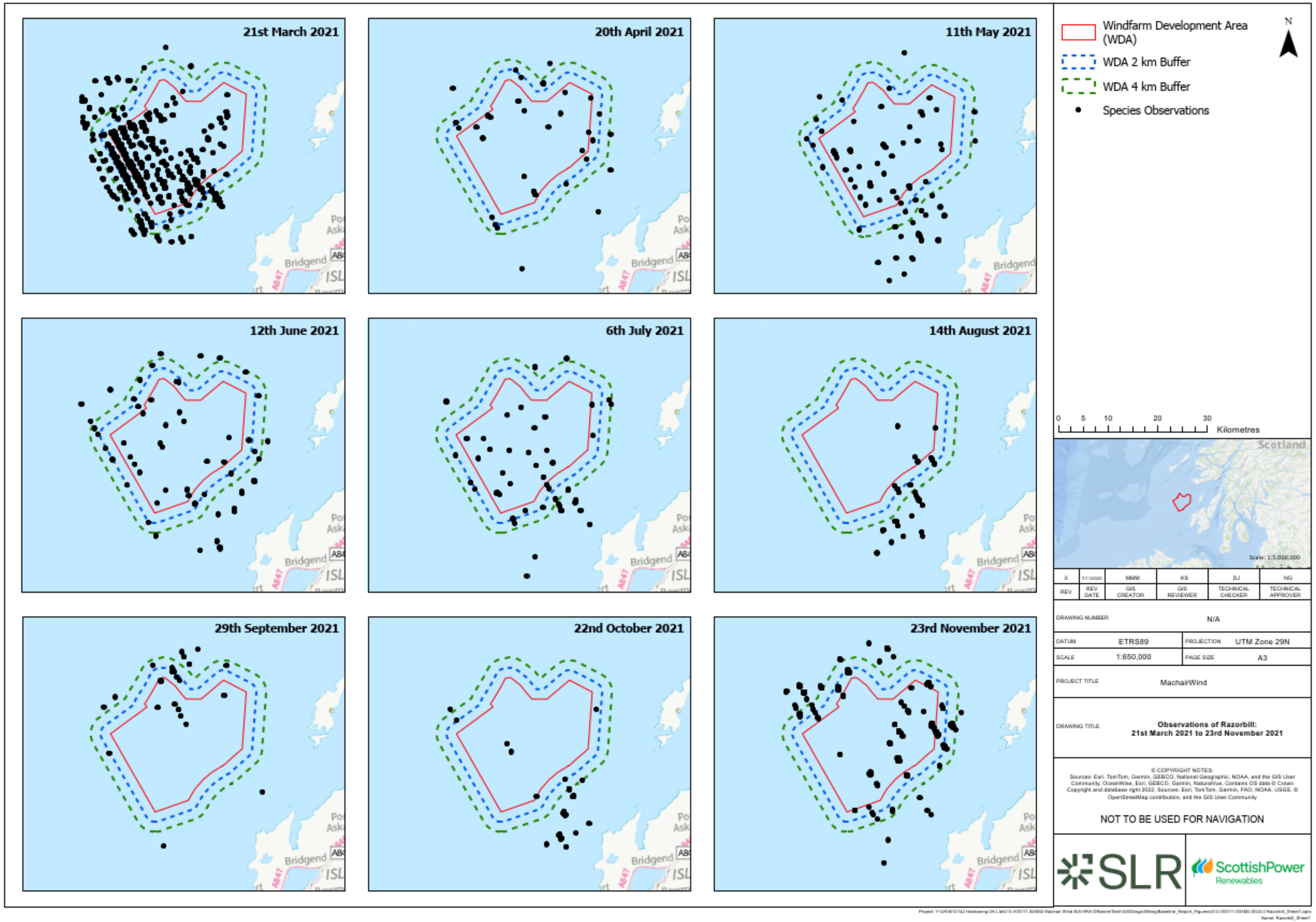

Figure 40: Raw observations of razorbill: March 2021 to November 2021

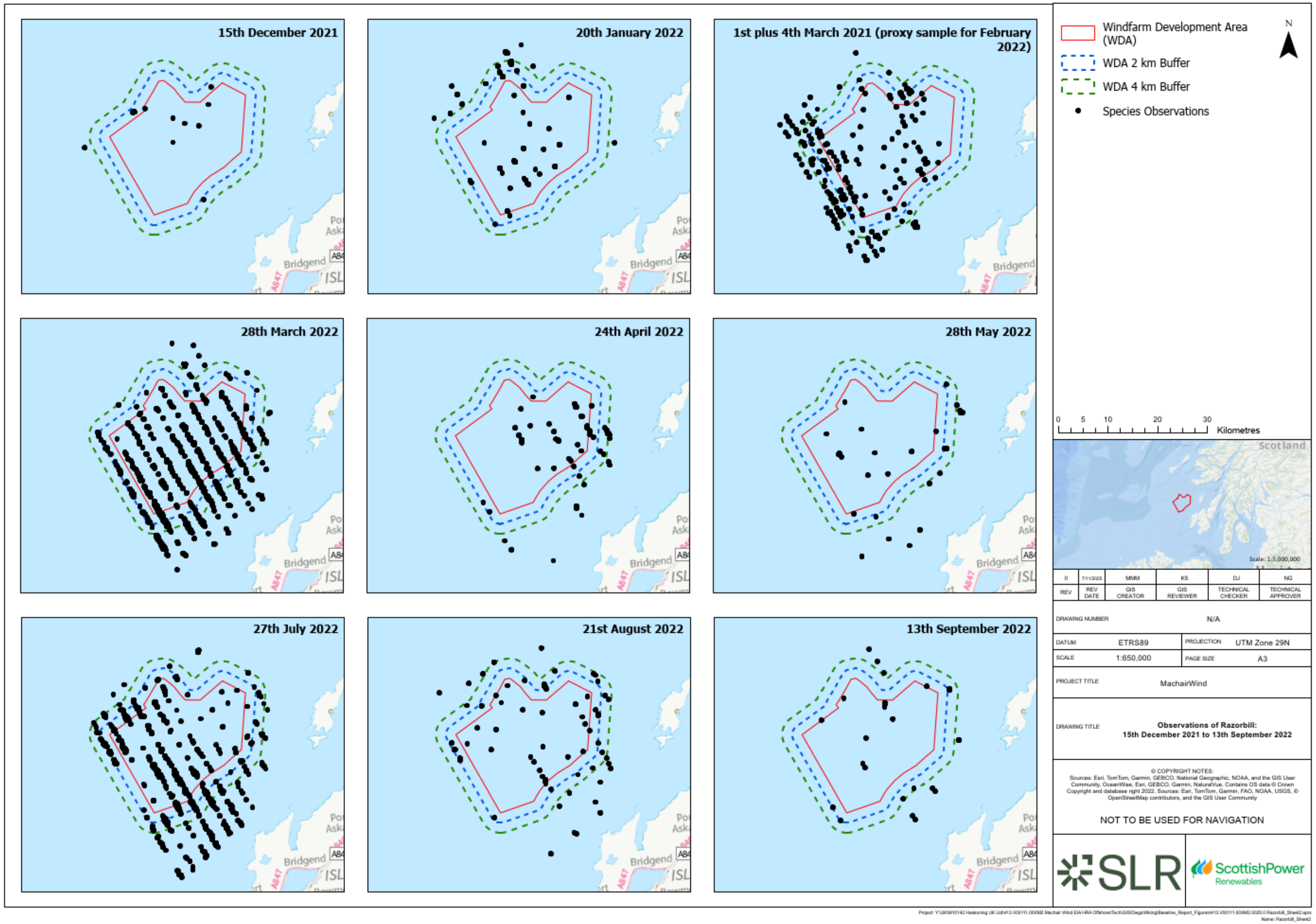

Figure 41: Raw observations of razorbill: December 2021 to September 2022

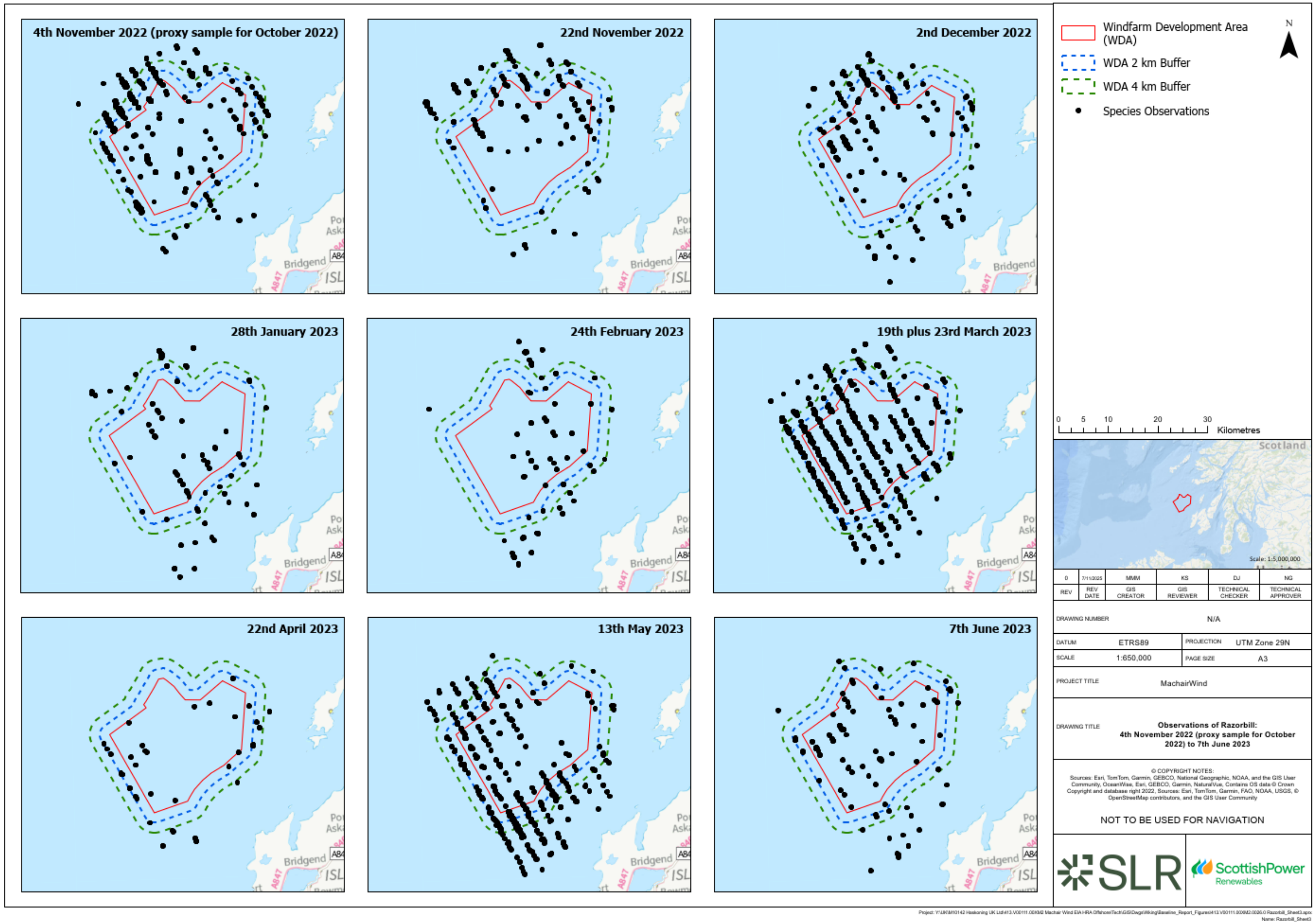

Figure 42: Raw observations of razorbill: October 2022 to June 2023

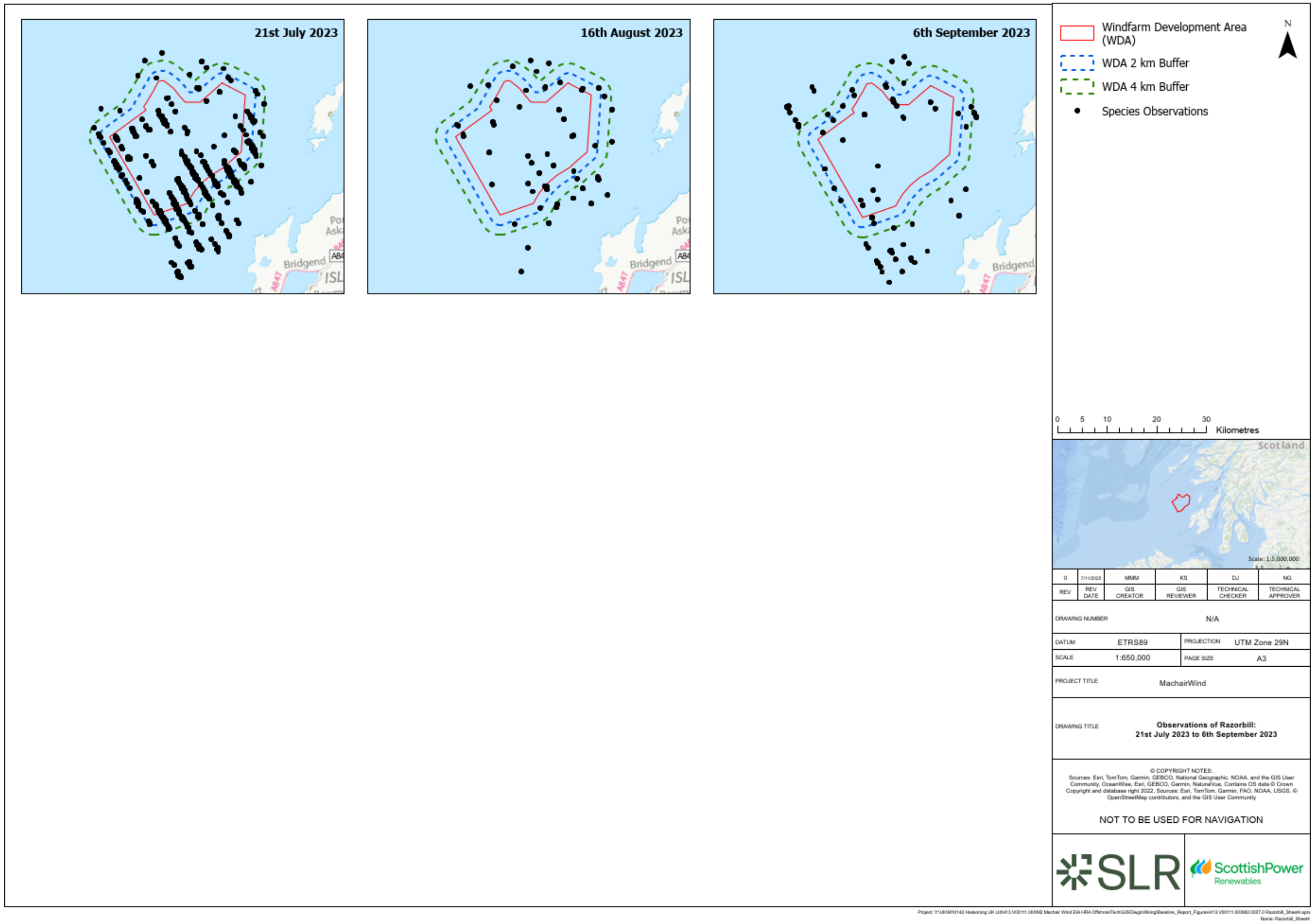

Figure 43: Raw observations of razorbill: July 2023 to September 2023

4.20.3 Raw counts

232. Razorbills (including apportioned and dive bias corrected birds) were recorded in moderate numbers during surveys (refer to **Annex 11.2E: Raw Counts**). Razorbill counts were highest in the BDMPS winter, spring migration and autumn migration periods (**Table 4**). A peak count of 1,687.48 razorbills, including apportioned birds, was recorded in the WDA plus 4 km on 4 November 2022 (a proxy sample for October 2022), refer to **Annex 11.2E: Raw Counts, Table 49**). Lower numbers of razorbill counts were recorded during the breeding season. A peak count recorded in the WDA plus 4 km buffer in the breeding season was recorded in July 2022 (a peak count of 1,191.22 razorbills, including apportioned and dive bias corrected birds).

4.20.4 Design-based density estimates

233. Design-based density estimates of razorbills (including apportioned birds) in flight in each survey within the WDA are provided in **Table 9** and **Annex 11.2G: Density estimates per survey of birds in flight, Table 49.**

234. Razorbill density estimates of birds in flight in the WDA were very low. The highest peak density of birds in flight in the WDA (0.52 bird/km^2, **Table 9**) was recorded in March 2023 during the razorbill non-breeding season and spring migration period (**Table 4**). The density of razorbills recorded in flight in the WDA was less than one bird/km^2 in all survey months when this species was recorded (**Table 9**).

235. **Table 8** presents the overall proportion of birds in flight in the WDA across 30 surveys. The vast majority of razorbills recorded in the WDA across all surveys were recorded as sat on the water, with only 4.1% of razorbills recorded in flight.

4.20.5 Design-based abundance estimates

236. Design-based abundance estimates of razorbills (including apportioned and dive bias corrected birds) recorded sat on the water and in flight in each survey within the WDA plus 2 km buffer are provided in **Table 10** and **Annex 11.2K: Abundance estimates per survey of sitting and flying birds, Table 49.**

237. Razorbill abundance estimates fluctuated between surveys. The highest peak abundance (a peak abundance of 9,898.23 birds) of all razorbills sat on the water and in flight recorded in the WDA plus 2 km buffer was recorded in March 2021 (**Table 10**) during the razorbill non-breeding season and spring migration period (**Table 4**). Other peaks of over 1,000 birds were recorded during the razorbill breeding season: July 2022 (6,266.15 birds), May 2023 (1,861.36 birds) and July 2023 (4,911.48 birds), BDMPS spring migration period: January 2022 (1,275.63 birds), February 2022 (proxy sample 12, 2,338.17 birds), March 2022 (7,242.83 birds) and March 2023 (6,659.87 birds), BDMPS autumn migration period: October 2022 (proxy sample 19, 5,821.39 birds) and BDMPS winter period: November 2021 (6,470.13 birds), December 2021 (1,298.79 birds), November 2022 (1,532.06 birds) and December 2022 (3,926.38 birds). The abundance of razorbills recorded sitting and flying in the WDA plus 2 km buffer was lower than 1,000 birds in all other survey months (**Table 10**).

238. Razorbill MSP abundance calculations are presented in **Technical Appendix 11.4: Displacement.** The highest MSP abundance in the WDA plus 2 km buffer (6,951.4 birds) was recorded in the non-breeding season, including the BDMPS spring migration period. The BDMPS winter period abundance estimate (5,198.3 birds) and the BDMPS autumn migration period estimate (3,092.4 birds) in the WDA plus 2 km buffer were slightly lower, with the lowest estimate recorded in the breeding season (2,636.1 birds).

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