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Rialtais Áitiúil agus Oidhreachta**  
Department of Housing,  
Local Government and Heritage

Seabird Monitoring undertaken during  
the Western European Shelf Pelagic  
Acoustic Survey (WESPAS)  
15<sup>th</sup> June – 22<sup>nd</sup> July 2022

Report to the National Parks and Wildlife Service,  
Department of Housing, Local Government and Heritage, October 2022



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## Executive Summary

Irish waters represent one of the most important marine habitats for seabirds in Europe, utilized by a wide range of seabird species. However, the at-sea abundance and distribution of many of the seabird species occurring in Irish waters remains poorly understood. Under the EU Birds Directive, there is a requirement on member states to conduct surveillance of seabirds occurring within their waters. The Department of Housing, Local Government and Heritage (DHLGH), through the Marine Institute, commissioned a seabird survey from the MRV Celtic Explorer during the annual Western European Shelf Pelagic Acoustic Survey (WESPAS), running from 15<sup>th</sup> June- 22<sup>nd</sup> July 2022.

A standard line transect survey methodology was employed by the seabird observer with additional visual point sampling at fishing locations and oceanographic sampling stations. Survey transects were undertaken at speeds of 5-10 knots, with fishing activity being conducted at speeds of 2-3 knots. The seabird observer's survey effort was maximized and optimized during periods of sea state less than or equal to sea state 6 and with visibility of greater than 300m. A total of 161 hours and 8 minutes of survey effort was conducted over the course of WESPAS 2022. In total, 143 hours and 15 minutes of survey effort were conducted using a line transect methodology, while 5 hours and 19 minutes of effort were conducted using the point sampling methodology. A further 12 hour and 34 minutes of effort were conducted as a casual watch.

A total of 2632 seabird observations were recorded throughout the survey, totalling 7478 individuals. In total, 1763 seabirds were recorded as "in transect", while 5715 were recorded "off transect". The species encountered included 21 species from seven families. A further 11 observations of terrestrial/migratory birds were also recorded, comprising of 31 individuals.

## Introduction

Irish waters represent one of the most important marine habitats for seabirds in Europe and are utilized by a wide range of seabird species (Mackey, *et al.*, 2004; Mitchell, *et al.*, 2004; Pollock, *et al.*, 1997). The waters of the Irish EEZ consist of an area high in biological productivity within the North-East Atlantic and include widespread areas over shallower continental shelf, deep oceanic waters and waters overlying the continental slope (DEHLG, 2009), providing diverse habitats for a range of seabirds. Ireland's rugged and exposed coastline provide ample and diverse nesting habitats for a range of seabirds, and Ireland's coast hosts a number of large seabird colonies of significance at a European level (Mackey, *et al.*, 2004). At present, there are twenty-four species of seabirds known to breed in Ireland (Mitchell, *et al.*, 2004; *Table 1*).

In 1930, legal protection for birds, including most seabird species, in Ireland began with the enactment of the Wild Birds (Protection) Act. The 1976 Wildlife Act provides a legal framework for the conservation of Irish wildlife and their habitats, conferring specific protection on all bird species, including seabirds, from death, injury or disturbance at nest sites.

Seabirds in Ireland are also protected under EC Council Directive (2009/147/EEC) on the conservation of birds commonly referred to as the EU Birds Directive. The Birds Directive relates to the conservation of all wild bird species occurring in EU member states, it covers the protection and management of the birds, their nests, eggs and habitat, and mandates the creation of Special Protection Areas (SPAs) (Article 3, EC Council Directive 2009/147/EEC). A number of seabirds are listed under Annex I of the Birds Directive as species requiring special conservation measures concerning their habitat in order to ensure their survival in their natural range (Article 4, EC Council Directive 2009/147/EEC). Since 1993, the EU has funded Species Action Plans for species listed in Annex 1 of the Birds Directive, including the Balearic shearwater (*Puffinus mauretanicus*) and roseate tern (*Sterna dougallii*), providing key information on the status, ecology and threats to species as well as key steps to ensure their conservation. Seabirds gain further protection under the EC Council Directive (92/43/EEC) on the conservation of natural habitats, and of wild flora and fauna, commonly referred to as the EU Habitats Directive, through the establishment of the 'Natura 2000' network; a coherent network of SPAs and Special Areas of Conservation (SACs). Article 6 of the Habitats Directive defines how Natura 2000 sites are managed and protected, and establishes the requirement to conduct appropriate assessments in Natura 2000 sites before plans or projects likely to affect the site are conducted.

Ireland is also a signatory to the Bern convention on the conservation of European wildlife and natural habitats, the Bonn convention on the conservation of migratory species of wild animals, and the OSPAR convention for the protection of the marine environment in the North-East Atlantic, each affording further protection to seabirds.

Despite the importance Ireland holds for nesting and feeding seabirds, quantitative data on the population status and distribution, particularly the at sea distribution, of many of the seabird species occurring in Ireland remains poorly understood (Mackey, *et al.*, 2004). Under the EU Birds Directive, there is a requirement on member states to identify and classify habitats for the establishment of SPAs for seabirds, including foraging habitats within their waters.

*Table 1: Breeding seabird numbers in Ireland and Britain 1998-2002 as recorded during the Seabird 2000 census and percentage change in numbers since The Seabird Colony Register (SCR) 1985-1988 (Source: Mitchell, et al., 2004).*

<i>Species</i>	<i>Latin name</i>	<i>Northern Ireland</i>	<i>Republic of Ireland</i>	<i>All- Ireland total</i>	<i>GB &amp; Ireland Total</i>	<i>Percentage change since SCR Census (1985-88)<sup>1</sup></i>
Fulmar	<i>Fulmarus glacialis</i>	5,992	32,918	38,910	537,991	0%
Manx Shearwater <sup>2</sup>	<i>Puffinus puffinus</i>	4,633	32,545	37,178	332,267	
European Storm petrel <sup>2</sup>	<i>Hydrobates pelagicus</i>	0	99,065	99,065	124,775	
Leach's Storm petrel <sup>2</sup>	<i>Hydrobates leucorhous</i>	0	310	310	48,357	
Gannet	<i>Morus bassanus</i>	0	32,758	32,758	259,311	39%
Cormorant	<i>Phalacrocorax carbo</i>	663	4,548	5,211	13,681	7%
Shag	<i>Gulosus aristotelis</i>	301	3,426	3,727	32,306	-25%
Arctic Skua	<i>Stercorarius parasiticus</i>	0	0	0	2,136	-37%
Great Skua	<i>Stercorarius skua</i>	0	1	1	9,635	26%
Mediterranean Gull	<i>Larus melanocephalus</i>	2	3	5	113	
Black-headed Gull	<i>Chroicocephalus ridibundus</i>	10,107	3,876	13,983	141,890	2%
Common Gull	<i>Larus canus</i>	557	1,060	1,617	49,780	39%
Lesser Black-backed Gull	<i>Larus fuscus</i>	1,973	2,876	4,849	116,684	42%
Herring Gull	<i>Larus argentatus</i>	714	5,521	6,235	149,177	-17%
Great Black-backed Gull	<i>Larus marinus</i>	76	2,243	2,319	19,713	-6%
Kittiwake	<i>Rissa tridactyla</i>	13,060	36,100	49,160	415,995	-23%
Sandwich Tern	<i>Sterna sandvicensis</i>	1,954	1,762	3,716	14,252	-11%
Roseate Tern	<i>Sterna dougallii</i>	4	734	738	790	44%
Common Tern	<i>Sterna hirundo</i>	1,704	2,485	4,189	14,497	-2%
Arctic Tern	<i>Sterna paradisaea</i>	767	2,735	3,502	56,123	-29%
Little Tern	<i>Sternula albifrons</i>	0	206	206	2,153	-25%
Guillemot	<i>Uria aalge</i>	98,546	138,108	236,654	1,559,484	32%
Razorbill <sup>3</sup>	<i>Alca torda</i>	24,084	27,446	51,530	216,087	23%
Black Guillemot <sup>4</sup>	<i>Cephus grylle</i>	1,174	3,367	4,541	42,683	
Atlantic Puffin	<i>Fratercula arctica</i>	1,610	19,641	21,251	600,751	19%

<sup>1</sup> inland colonies were not surveyed during the SCR Census (1985-88)

<sup>2</sup> not surveyed during the SCR Census (1985-88)

<sup>3</sup> counts of individuals

<sup>4</sup> counts of pre-breeding adults; pre-breeding surveys were not conducted in the Republic of Ireland during the SCR Census (1985-88).

Since 1994, a number dedicated studies on seabirds have been conducted in Ireland, providing data on the presence, distribution and abundance of the numerous seabird species in coastal and offshore waters (e.g. Pollock et al. 1997; Mackey, *et al.*, 2004; O'Brien, *et al.*, 2016). In recent years, the Marine Institute has facilitated the surveillance of seabirds in Irish waters by providing berths for seabird observers on-board the national research vessels, *RV Celtic Explorer* and *RV Celtic Voyager*, during oceanographic and fisheries surveys (e.g. O'Donnell, *et al.*, 2016; 2017; 2018; 2019; 2020; 2021). Fisheries acoustic surveys are particularly suited to the conduction of seabird surveys as the vessel spends the majority of the survey travelling at a steady speed along pre-determined survey tracks.

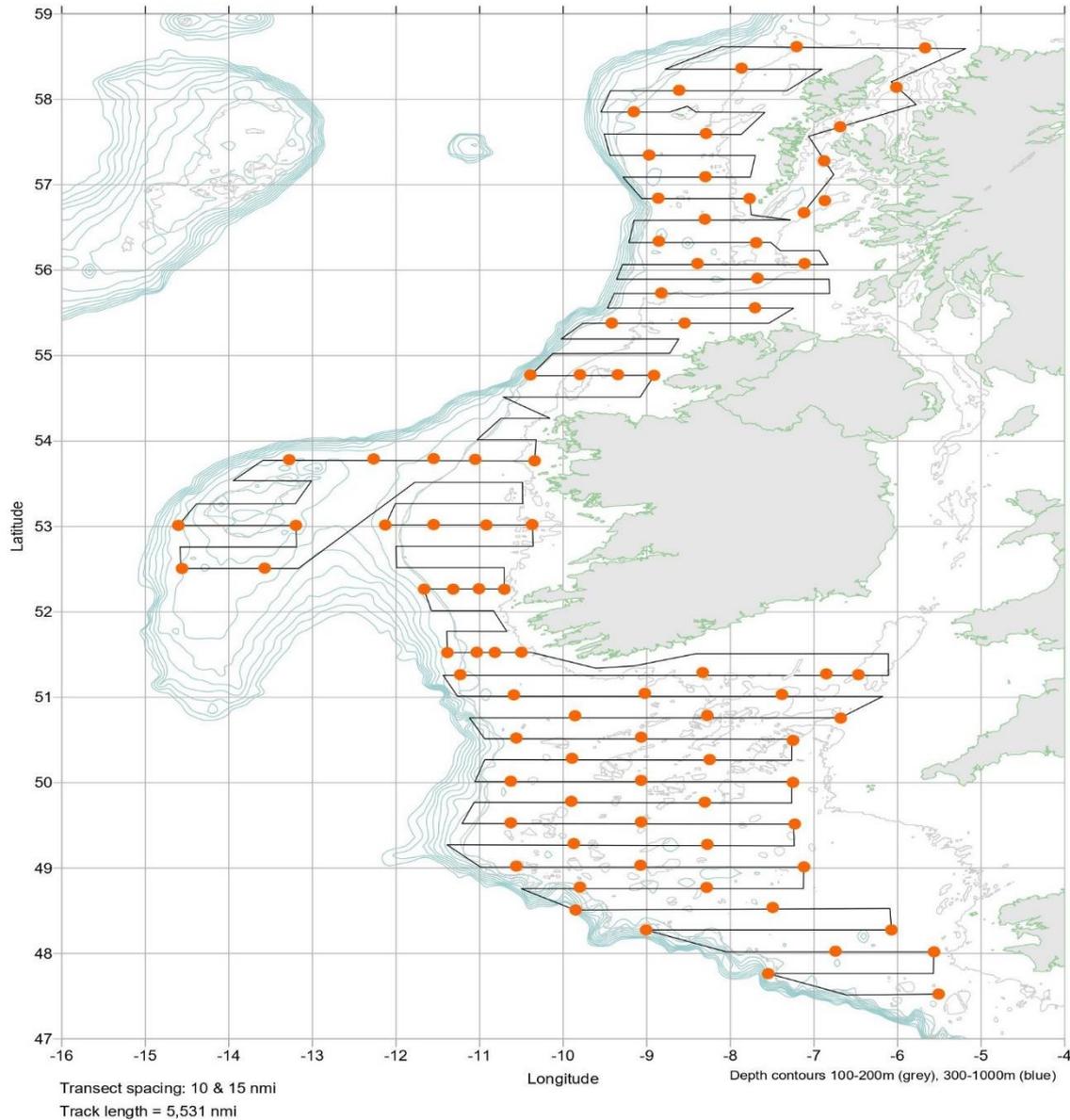
The WESPAS is an acoustic survey undertaken by the Fisheries Ecosystems Advisory Services (FEAS) department of the Marine Institute of Ireland. The survey has been undertaken annually since 2016 with the present survey being the sixth survey in the series. Prior to 2016, the survey was organised as two separate surveys: the Malin Shelf acoustic survey and the boarfish survey. The Malin Shelf acoustic survey has been carried out annually since 2008 and reports on the annual abundance of summer feeding aggregations of herring to the west of Scotland and to the north and west of Ireland from 54°N to 58°30'N (O'Donnell, *et al.*, 2021). The boarfish survey was carried out from 2011 using a chartered fishing vessel and reports on the abundance of spawning aggregations of boarfish from 47°N to 57°N (O'Donnell, *et al.*, 2021). Since 2016, these surveys were combined and undertaken across two survey legs on-board the *RV Celtic Explorer* over a 42 day period during the summer months under the unified Western European Shelf Pelagic Acoustic Survey title. WESPAS provides stratified relative stock abundance estimates of herring (*Clupea harengus*), boarfish (*Capros aper*) and horse mackerel (*Trachurus trachurus*) as part of a national stock assessment (O'Donnell, *et al.*, 2021).

The WESPAS provides a unique opportunity for surveillance of the summer distribution of seabirds in shelf water habitats along Ireland's Atlantic margins, which can be difficult to reach by other means. The waters of Ireland's Atlantic margin are highly productive owing to the upwelling of nutrient rich oceanic waters, and support large and diverse species' assemblages (Mackey *et al.*, 2004). The availability and distribution of prey is a key factor affecting the distribution of seabirds, and the complex bathymetry and hydrology of the Atlantic margin maintain a heterogeneous marine environment, making it a key habitat for seabirds (Mackey *et al.*, 2004).

In order to contribute to its current monitoring regime, the Department of Housing, Local Government and Heritage (DHLGH), through the Marine Institute, commissioned a seabird survey from the *RV Celtic Explorer* during the annual Western European Shelf Pelagic Acoustic Survey (WESPAS), running from 15<sup>th</sup> June- 22<sup>nd</sup> July 2022.

## Methodology

The seabird survey was conducted across two survey legs from the 15<sup>th</sup> June - 4<sup>th</sup> July and the 6<sup>th</sup> – 22<sup>nd</sup> July 2022, using a single seabird observer per survey leg. The seabird observer conducted visual survey effort while also recording all survey data. Given the presented survey transects for the 2022 survey (*Figure 1*), a standard line transect survey methodology was determined to be most suitable and was employed by the seabird surveyor. Survey transect were undertaken at speeds of 5-10 knots, with fishing activity being conducted at speeds of 2-3 knots.



*Figure 1: Representative cruise track of the Western European Shelf Pelagic Acoustic Survey (Source: Marine Institute, 2021).*

Visual survey watches were conducted using a standard line transect survey design while the vessel was travelling at a consistent speed and heading. Additional visual point sampling (e.g., at oceanographic sampling stations or fishing stations) was also employed, however line transect survey effort was prioritised by the observer. The observer's survey effort was maximized and optimized during periods of sea state less than or equal to sea state 6 and with visibility of greater than 300m. Regular breaks were taken by the observer to avoid observer fatigue and its associated negative consequences.

Observations for seabirds were conducted from the monkey island (deck height 13 m above sea level) or the bridge (deck height 10 m above sea level).

#### *Line transect survey methodology*

The line transect data collection methodology was based on that originally proposed by Tasker *et al.* (1984) with later adaptations applied to allow correction factors to be applied for missed birds (Camphuysen *et al.*, 2004). The method employed used a single platform line transect survey design with sub-bands to survey birds associated with the water. Observer effort was concentrated in a bow-beam arc of 90° to one side (i.e., to port or starboard) of the vessel's track-line, however, all seabirds observed outside this area were also recorded.

Survey effort for seabirds associating with the water were concentrated within a survey strip of 300m running parallel and adjacent to the vessels track-line and extending to the horizon. All birds surveyed within this region were recorded as 'in-transect' and assigned to one of four distance sub-bands (A: 0-50m, B: 50-100m, C: 100-200m, D: 200-300m) according to their perpendicular distance from the track-line. This approach allows for the evaluation of biases caused by specific differences in detection probability with increasing distance from the trackline (Camphuysen *et al.* 2004). Seabirds occurring outside of this survey strip were recorded as 'off-transect' and assigned to a separate sub-band (E: >300m). The perpendicular distance to an animal was estimated using a fixed interval range finder (Heinemann, 1981), ensuring each animal was allocated to the correct distance sub-band.

Seabirds remaining with the vessel for more than 2 minutes were deemed to be associating with the vessel (Camphuysen *et al.* 2004) and were recorded as such. Seabirds seen associating with other vessels (i.e. fishing vessels) were also recorded as such.

Searching for seabirds was done with the naked eye, however, 8x binoculars were used to confirm parameters such as species identification, age, moult, group size and behaviour (Mackey *et al.* 2004). A Nikon D300s DSLR camera with 100-400mm telephoto lens was used to visually document other information of scientific interest. Data were also collected on all migratory/ transient waterfowl and terrestrial birds encountered.

#### *Data collection and recording*

The Cybertracker (Cybertracker, 2022) data collection software package (Version 3.518) was configured for optimum use on the survey. Cybertracker was used to record positional, environmental and seabird observation data. Using the tablets in-built GPS receiver, the Cybertracker software automatically recorded the ships position directly into a Microsoft Access database every 5 seconds.

Environmental data was regularly recorded using Cybertracker, including at the start of each seabird survey transect, and included data such as; wind speed, wind direction, sea state, swell, visibility, cloud cover and precipitation. The data was time stamped with GPS data by Cybertracker and saved in the

Access database. If environmental conditions changed at any point, the seabird observer recorded an environmental update of the above listed data. Each line transect was assigned a unique transect number, and a new transect was started anytime the vessel activity changed (i.e. changing from on-transect to inter-transect). Each subsequent seabird observation was also assigned to this unique transect number. Ancillary information (such as line changes, changes in survey activity, other vessel activity, etc.) were also recorded on Cybertracker.

The GPS position of each seabird record was time stamped and digitally marked using Cybertracker. Observational data such as; species identification, distance band, group size, composition, heading, age, moult, behaviour and any associations with cetaceans or other vessels were also recorded on the time stamped Cybertracker sighting record page. Where species identification could not be confirmed, observations were recorded at an appropriate taxonomic level (i.e. large gull sp., *Larus sp.*, commic tern, etc.).

Additional visual point sampling was conducted at oceanographic sampling stations and fishing shoot/haul locations. Point sampling survey effort for seabirds was conducted in 360° arc around the vessel. Data recording methodology remained similar for both point sampling and line transect methods.

## Results

### *Effort*

A total of 161 hours and 8 minutes of survey effort was conducted over the course of WESPAS 2022. 93 hours and 42 minutes of survey effort was conducted on Leg 1, while 67 hours and 26 minutes of

survey effort was conducted on Leg 2 of the survey. In total, 143 hours and 15 minutes of survey effort were conducted using a line transect methodology, while 5 hours and 19 minutes of effort were conducted using the point sampling methodology. A further 12 hours and 34 minutes of effort were conducted as a casual watch.

The observer's survey effort was maximized and optimized during the prevailing hours of daylight. The maximum daily survey effort recorded on Leg 1 was 6 hours and 48 minutes while the average daily survey effort was 4 hours and 21 minutes. On Leg 2, the maximum daily survey effort recorded was 6 hours and 3 minutes while the average daily survey effort was 3 hours and 58 minutes.

No effort watches were conducted on the 5<sup>th</sup> of July due to a port call for crew change between survey legs. No effort watches were conducted on the 19<sup>th</sup> of June or the 9<sup>th</sup> July due to weather conditions exceeding the specified weather limits for observations. Seabird survey effort was reduced at the beginning of Leg 2 due to poor health of the observer. A graph of daily effort is provided in *Figure 2* below.

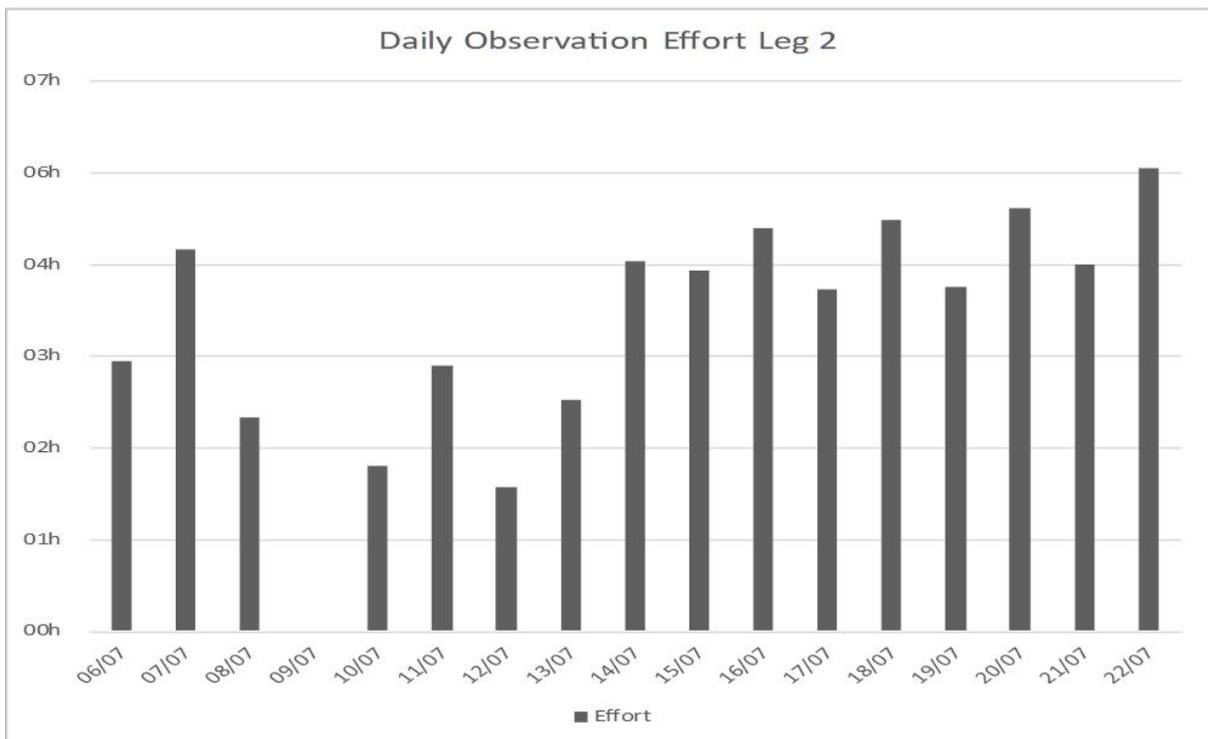
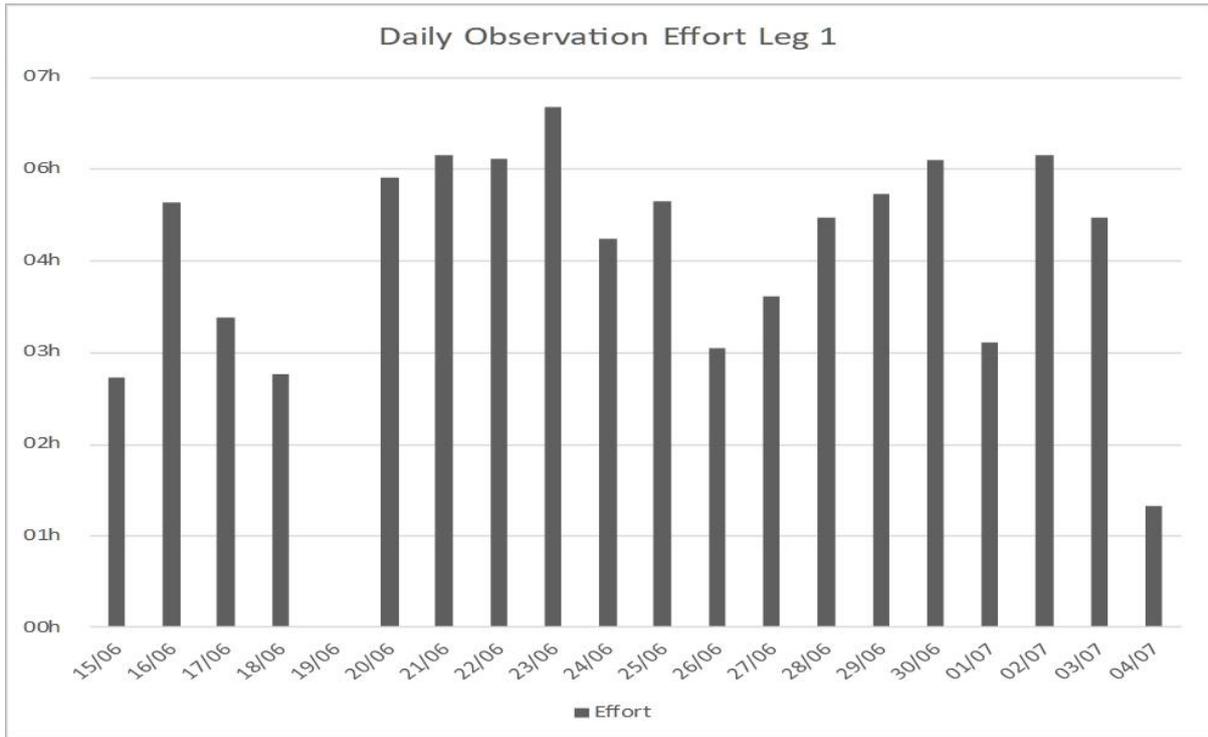


Figure 2: Daily visual effort undertaken during a) Leg 1, and b) Leg 2 of the survey.

### *Environmental Conditions*

Environmental conditions were generally fair to moderate throughout the survey, however, on a number of occasions seabird survey effort was restricted due to environmental conditions. Survey effort was maximized and optimized during periods of sea state less than or equal to sea state 6 and with visibility of greater than 300m. A number of casual watches were undertaken during periods where the environmental conditions exceeded these parameters. A breakdown of key environmental factors recorded during the survey is provided hereunder.

#### *Sea State*

Sea state was recorded both in terms of the World Meteorological Organisation (WMO) sea state scale and the Beaufort scale. The WMO sea state was judged based on the total state of agitation of the sea, taking into account the effect of wind, swell and currents (WMO, 2011) on the sea conditions, with wave height in meters used as an additional guide. Beaufort wind force/ sea state and was judged based on the effect of the wind on the sea surface.

Sea states 2, 3 and 4 were the most common sea states recorded. The most frequently recorded WMO sea state was 3, accounting over 66 hours (41%) of observation effort, while WMO sea state 4 accounted for almost 55 hours (34%). WMO sea state 2 accounted for over 22 hours (14%) of observation effort (*Fig. 3a*).

The most frequently recorded Beaufort wind force/ sea state was a sea state 3, accounting for 45 hours (28%) of survey effort. Beaufort wind force/ sea state 4 was recorded over almost 42 hours (26%) of observation effort, while Beaufort wind force/ sea state 5 accounted for 28 hours (18%) of observation effort (*Fig. 3b*).

#### *Swell*

A swell height of 0.1-1 meter was most frequently recorded throughout the survey, being recorded over almost 61 hours (38%) of survey effort. A swell height of 1.1-2 meters was recorded across 51 survey hours (32%), while swell of over 2 meters was recorded during over 30 hours (19%) of survey effort. No swell was also recorded across 18 hours (12%) of survey effort (*Fig. 3c*).

#### *Visibility*

Visibility was generally very good during seabird survey effort; however, a number of periods of heavy fog were also recorded. The most frequently recorded visibility was 11-15km, being recorded for over 120 hours (75%) of survey effort. Visibility of 6-10km was recorded on over 30 hours (19%) of survey effort, while visibility of 1-5km was recorded for 7 hours (4%) of survey effort. Visibility of less than 1km was recorded during 3 hours (2%) of survey effort, however, survey effort generally ceased if visibility reduced below 300m (*Fig. 3d*).

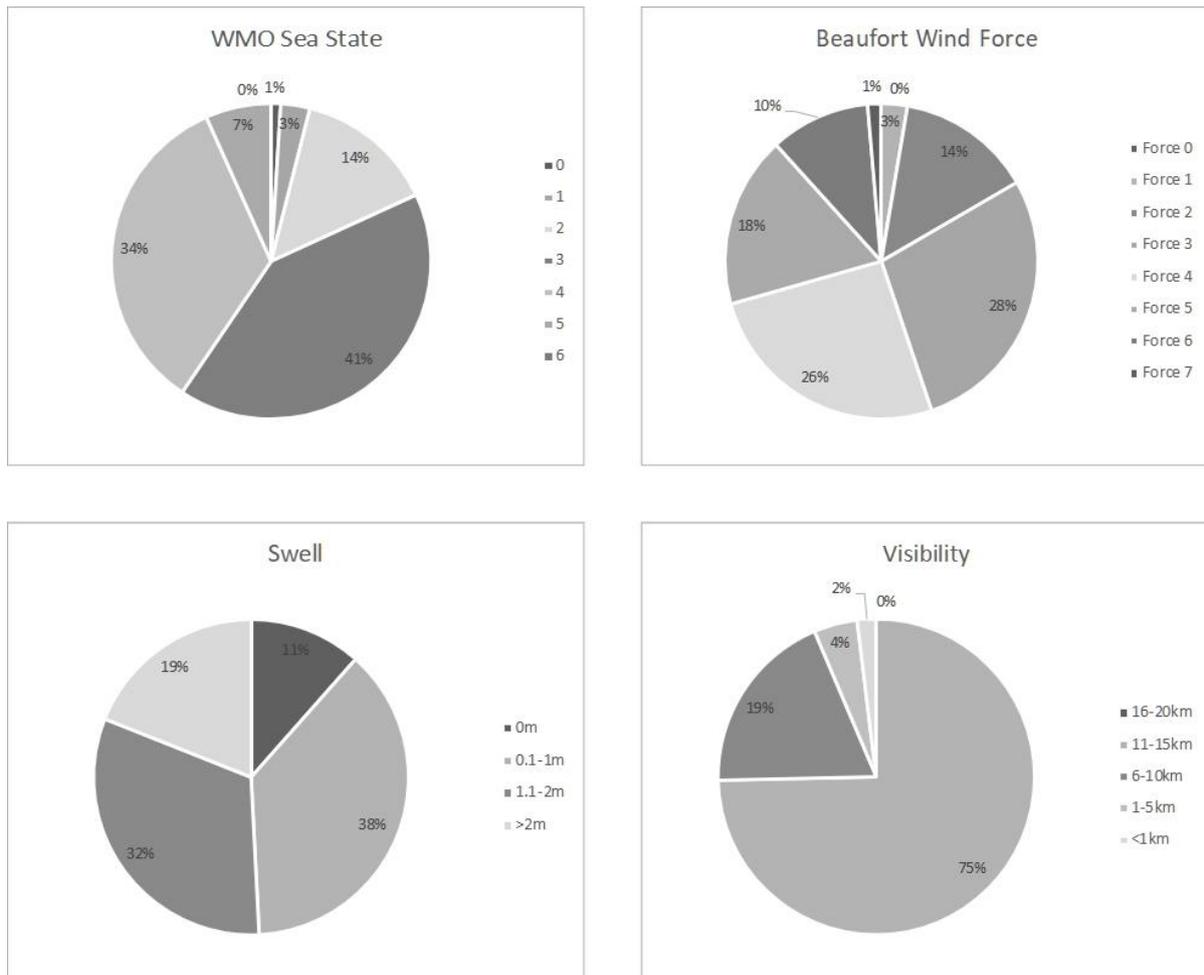


Figure 3: Summary of environmental conditions recorded on the WESPAS 2022; a) WMO sea state, b) Beaufort sea state/ wind force, c) Swell height (meters), d) Visibility (kilometres).

### Seabird records

In total, 2632 seabird observations were recorded throughout the survey, totalling 7478 individuals, with flock size ranging from one up to 120 for some species (Table 2). In total, 1763 seabirds were recorded as “in transect”, while 5715 were recorded “off transect”. A summary of all seabirds recorded on the survey is presented in Table 2 and includes birds recorded during both line transect and point sampling watches. A total of 21 species from seven families were encountered during the survey.

Of the 2632 seabird observations recorded during the survey, 2406 were recorded during line transect effort. Of the 21 seabird species recorded during the survey, all but one, Arctic skua, were recorded during line transect survey effort, while 8 species were recorded during point counts. In total, 6385 seabirds were recorded during line transect effort, with 1763 of these recorded as ‘in-transect’. The remaining 4622 seabirds were recorded as ‘off-transect’. A breakdown of all species encountered during line transect effort watches is presented in Table 3.

The distribution of all observations of seabird species recorded as ‘in-transect’ during line transect survey effort is presented in Figures 4- 6. For clarity, and brevity, seabirds recorded during point sampling watches, or those recorded as ‘off-transect’ are not displayed.

Table 2: Summary of all seabird sightings recorded on the survey during both line transect effort, point counts and casual watches.

<i>Common Name</i>	<i>Species name</i>	<i>No. of records</i>	<i>No. of Seabirds</i>	<i>Flock size</i>
Fulmar	<i>Fulmarus glacialis</i>	741	1613	1-120
Great Shearwater	<i>Ardenna gravis</i>	2	2	1
Sooty Shearwater	<i>Ardenna grisea</i>	12	14	1-2
Manx Shearwater	<i>Puffinus puffinus</i>	122	520	1-100
Shearwater sp.	<i>Procellariidae</i>	24	53	1-20
Wilson's Petrel	<i>Oceanites oceanicus</i>	1	1	1
Storm Petrel	<i>Hydrobates pelagicus</i>	90	154	1-10
Petrel sp.	<i>Hydrobatidae</i>	47	102	1-25
Gannet	<i>Morus bassanus</i>	882	2248	1-110
Pomarine Skua	<i>Stercorarius pomarinus</i>	2	3	1-2
Arctic Skua	<i>Stercorarius parasiticus</i>	1	1	1
Great Skua	<i>Stercorarius skua</i>	14	14	1
Skua sp.	<i>Stercorarius sp.</i>	1	1	1
Common Gull	<i>Larus canus</i>	2	2	1
Black-headed Gull	<i>Chroicocephalus ridibundus</i>	1	1	1
Lesser Black-backed Gull	<i>Larus fuscus</i>	103	223	1-15
Herring Gull	<i>Larus argentatus</i>	16	38	1-14
Great Black-backed Gull	<i>Larus marinus</i>	20	24	1-4
Kittiwake	<i>Rissa tridactyla</i>	102	285	1-50
Common/ Herring Gull	<i>Larus canus/ argentatus</i>	5	6	1-2
Greater/ Lesser b-b Gull	<i>Larus marinus/ fuscus</i>	10	52	1-21
Large Gull sp.	<i>Laridae</i>	25	80	1-30
Small Gull sp.	<i>Laridae</i>	1	1	1
Gull sp.	<i>Laridae</i>	4	28	1-25
Commic Tern sp.	<i>Sterna hirundo/ paradisaea</i>	3	4	1-2
Guillemot	<i>Uria aalge</i>	171	893	1-40
Black Guillemot	<i>Cephus grylle</i>	3	3	1
Razorbill	<i>Alca torda</i>	62	172	1-20
Razorbill/ Guillemot	<i>Alcidae</i>	18	155	1-30
Puffin	<i>Fratercula arctica</i>	105	271	1-20
Auk sp.	<i>Alcidae</i>	33	504	1-120
Shag	<i>Gulosus aristotelis</i>	5	6	1-2
Shag/ Cormorant	<i>Phalacrocoracidae</i>	4	4	1
	<b>Total</b>	<b>2632</b>	<b>7478</b>	

Table 3: Summary of all seabird sightings recorded during line transect effort on the survey.

<b>Common Name</b>	<b>Species name</b>	<b>No. of records</b>	<b>No. of Seabirds</b>	<b>In Transect</b>	<b>Off Transect</b>
Fulmar	<i>Fulmarus glacialis</i>	686	1279	238	1041
Great Shearwater	<i>Ardenna gravis</i>	2	2	0	2
Sooty Shearwater	<i>Ardenna grisea</i>	12	14	4	10
Manx Shearwater	<i>Puffinus puffinus</i>	97	182	17	165
Shearwater sp.	<i>Procellariidae</i>	21	31	5	26
Wilson's Petrel	<i>Oceanites oceanicus</i>	1	1	0	1
Storm Petrel	<i>Hydrobates pelagicus</i>	88	151	2	149
Petrel sp.	<i>Hydrobatidae</i>	47	102	19	83
Gannet	<i>Morus bassanus</i>	813	2054	218	1836
Pomarine Skua	<i>Stercorarius pomarinus</i>	2	3	0	3
Great Skua	<i>Stercorarius skua</i>	12	12	3	9
Skua sp.	<i>Stercorarius sp.</i>	1	1	0	1
Common Gull	<i>Larus canus</i>	1	1	0	1
Black-headed Gull	<i>Chroicocephalus ridibundus</i>	1	1	0	1
Lesser Black-backed Gull	<i>Larus fuscus</i>	87	166	24	142
Herring Gull	<i>Larus argentatus</i>	13	34	1	33
Great Black-backed Gull	<i>Larus marinus</i>	16	20	0	20
Kittiwake	<i>Rissa tridactyla</i>	82	246	56	190
Common/ Herring Gull	<i>Larus canus/ argentatus</i>	4	5	0	5
Greater/ Lesser b-b Gull	<i>Larus marinus/ fuscus</i>	10	52	1	51
Large Gull sp.	<i>Laridae</i>	22	70	2	68
Small Gull sp.	<i>Laridae</i>	1	1	0	1
Gull sp.	<i>Laridae</i>	2	26	0	26
Commic Tern sp.	<i>Sterna hirundo/ paradisaea</i>	3	4	2	2
Guillemot	<i>Uria aalge</i>	156	827	652	175
Black Guillemot	<i>Cephus grylle</i>	3	3	0	3
Razorbill	<i>Alca torda</i>	62	172	72	100
Razorbill/ Guillemot	<i>Alcidae</i>	18	155	151	4
Puffin	<i>Fratercula arctica</i>	103	260	117	143
Auk sp.	<i>Alcidae</i>	32	501	179	322
Shag	<i>Gulosus aristotelis</i>	4	5	0	5
Shag/ Cormorant	<i>Phalacrocoracidae</i>	4	4	0	4
	<b>Total</b>	<b>2406</b>	<b>6385</b>	<b>1763</b>	<b>4622</b>

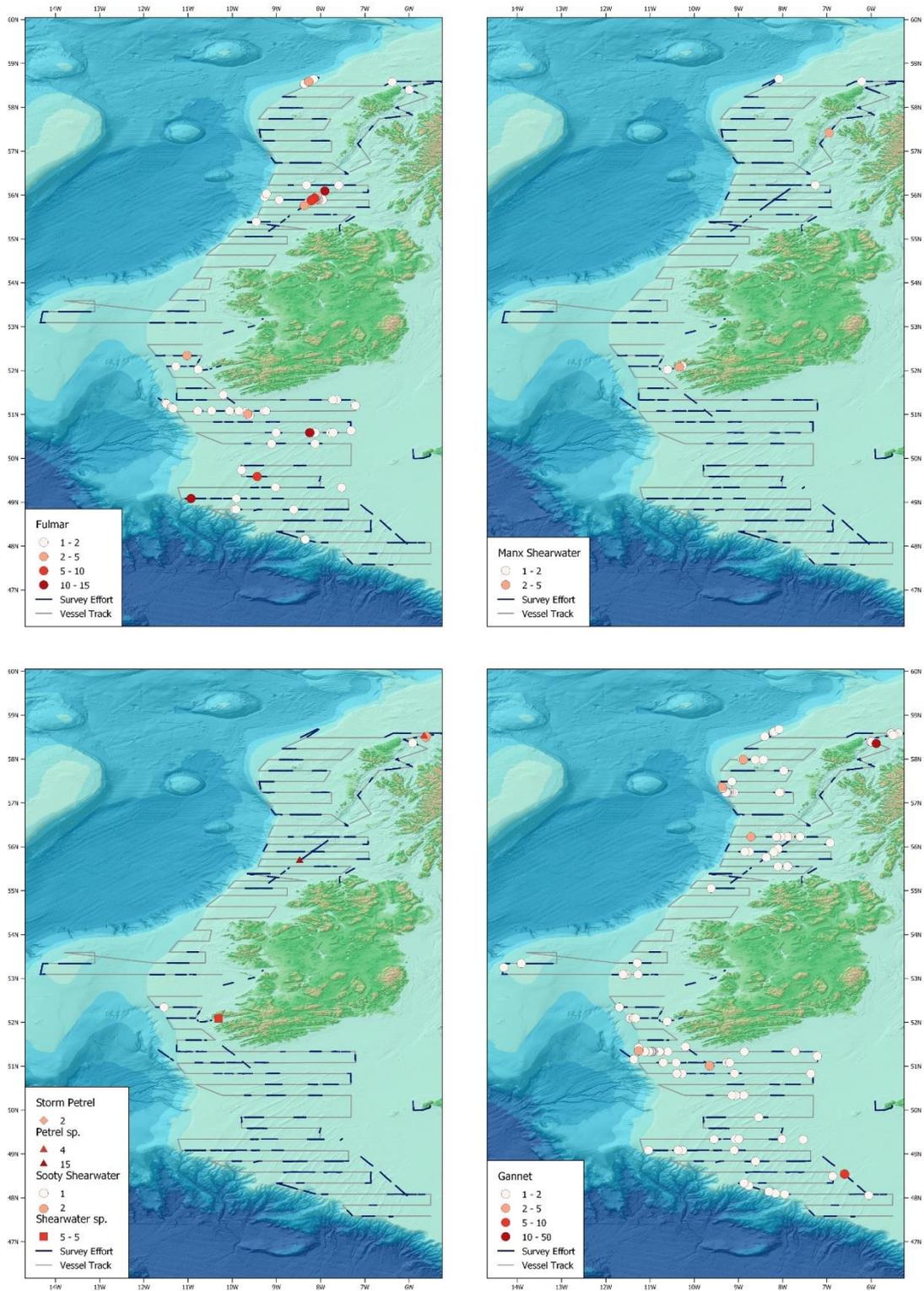


Figure 4: Distribution of a) fulmar, b) Manx shearwaters, c) shearwater and petrel spp., and d) gannet recorded as 'in-transect' during line transect survey effort.

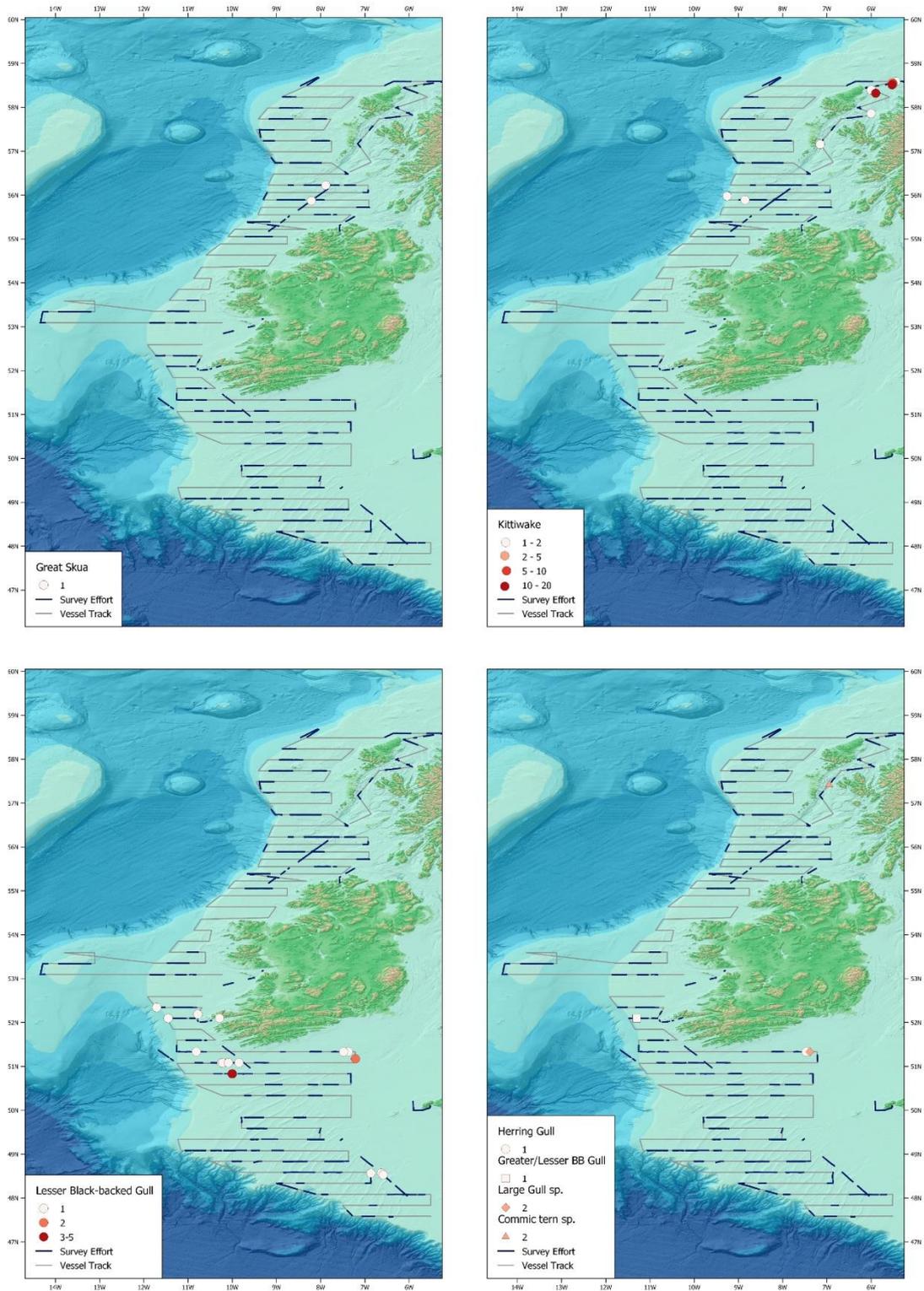


Figure 5: Distribution of a) great skua, b) kittiwake, c) lesser black-backed gull and d) gull and tern spp. recorded as 'in-transect' during line transect survey effort.

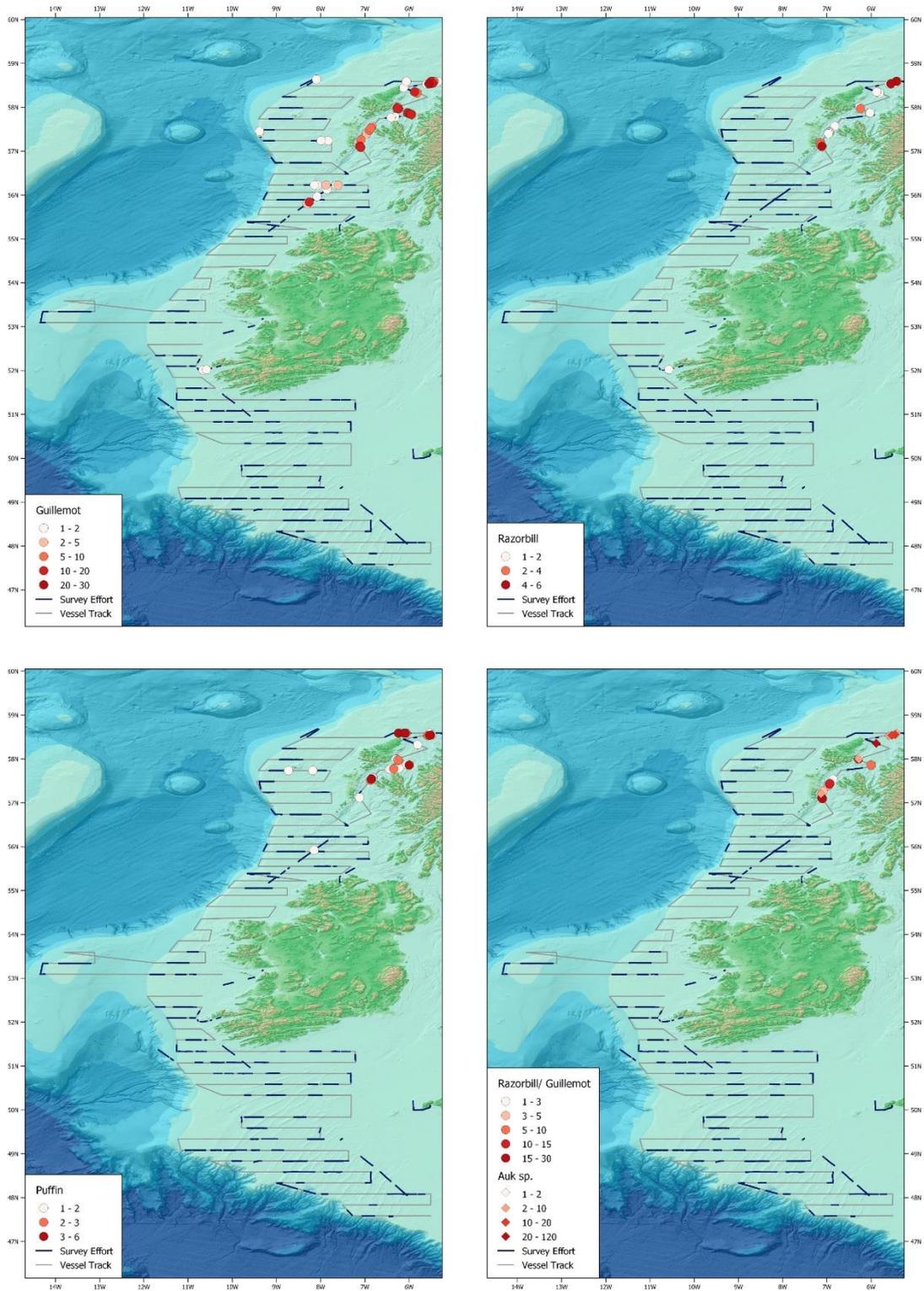


Figure 6: Distribution of a) guillemot, b) razorbill, c) puffin and d) auk spp. recorded as 'in-transect' during line transect survey effort.

Fourteen point counts were conducted at oceanographic or fishing stations. A total of 63 seabird observations were recorded during point sampling effort, comprising 206 individuals from 8 species (Table 4). All sightings recorded during point sampling watches were recorded as 'off transect'.

Table 4: Summary of all sightings recorded during point sampling effort on the survey.

<i>Common Name</i>	<i>Species name</i>	<i>No. of records</i>	<i>Off transect</i>
<b>Fulmar</b>	<i>Fulmarus glacialis</i>	19	84
<b>Shearwater sp.</b>	<i>Procellariidae</i>	1	1
<b>Storm Petrel</b>	<i>Hydrobates pelagicus</i>	2	3
<b>Gannet</b>	<i>Morus bassanus</i>	24	74
<b>Great Skua</b>	<i>Stercorarius skua</i>	2	2
<b>Lesser Black-backed Gull</b>	<i>Larus fuscus</i>	4	11
<b>Great Black-backed Gull</b>	<i>Larus marinus</i>	1	1
<b>Kittiwake</b>	<i>Rissa tridactyla</i>	7	20
<b>Large Gull sp.</b>	<i>Laridae</i>	2	9
<b>Guillemot</b>	<i>Uria aalge</i>	1	1
	<b>Total</b>	<b>63</b>	<b>206</b>

### *Fulmar*

Northern fulmar (*Fulmarus glacialis*) were both the second most frequently encountered and the second most abundant species, accounting for 741 records and comprising of 1613 individuals in total. Of these, 238 individuals were recorded as 'in transect'.

Fulmar were found to be broadly distributed in low numbers across much of the survey area however, they were also found to display a somewhat patchy distribution with higher abundances in areas such as the Labadie and Stanton banks, and the slopes of the Celtic Sea and Hebridean shelf.

### *Shearwaters*

Three species of shearwater were encountered on the survey: great shearwater (*Puffinus graves*), sooty shearwater (*Puffinus griseus*) and Manx shearwater (*Puffinus puffinus*). All three species were recorded during line transect effort. Unidentified shearwater species were also recorded on a number of occasions.

Manx shearwater were recorded on 122 occasions, totalling 520 individuals. Manx shearwater were recorded on 97 occasions (182 individuals) during line transect effort with 165 individuals recorded as 'in-transect'.

Manx shearwater were recorded in low numbers across much of the survey area, however they were infrequently recorded 'in-transect'. Manx shearwater were less frequently encountered in the offshore waters of the Celtic Sea. Some larger aggregations were recorded in areas such as off Lands' End, Dingle Bay and off the Aran Islands.

Sooty shearwater were recorded on 12 occasions with 14 individual birds recorded. All sooty shearwater were recorded during line transect effort, with four birds recorded as 'in-transect'.

Two records of solitary great shearwater were recorded 'off-transect' during line transect on the Hebridean shelf.

### *Storm Petrels*

Two species of storm petrel were recorded during the survey: European storm petrel (*Hydrobates pelagicus*) and Wilson's storm petrel (*Oceanites oceanicus*).

European storm petrel were recorded on 90 occasions and comprising of 154 individuals. In total, 88 records occurred during line transect watch, numbering 151 birds. Of these, 2 storm petrels were recorded as 'in transect'. European storm petrel were patchily distributed across the survey area with a number of areas of higher density noted such as; west of the Aran Islands and Stanton bank.

A solitary Wilson's storm petrel was recorded as 'off-transect' during line transect effort in the southern Celtic Sea.

Unidentified petrel species were recorded on 47 occasions numbering 102 individuals, of which 19 were recorded as 'in-transect'. Unidentified petrel were recorded across much of the survey area, with larger aggregations recorded west of the Blasket Islands and over Stanton bank.

### *Gannet*

Overall, Gannet (*Morus bassanus*) were the most frequently encountered and most abundant species recorded on the survey. Gannet were encountered on 882 separate occasions. Gannet records

comprised of a total of 2248 individuals, however of these, only 218 individuals were recorded as 'in transect'. Gannet were also the most frequently observed species during point counts, with 24 records totalling 74 birds observed.

Gannet were found to be broadly distributed in low numbers across the entire survey area, although, some larger aggregations were also recorded. These larger aggregations were observed in areas such as; west of the Blasket Islands, west of Mizen head, the Hebridean shelf and the Minch.

### *Skuas*

Three species of skua were encountered on the survey including great skua (*Stercorarius skua*), pomarine skua (*Stercorarius pomarinus*) and Arctic skua (*Stercorarius parasiticus*). Both great skua and pomarine skua were recorded during line transect survey effort, however, only great skua were recorded as 'in-transect'. Arctic skua was recorded on a single occasion during a casual watch when a lone bird was spotted. Of the three species, great skua were the only species recorded during point counts. A further record of a single skua was observed which could not be positively identified to species level, this was recorded as skua sp.

Great skua were the most regularly encountered skua (14 records of 14 individual birds). During line transect survey effort, great skua were encountered on 12 occasions, totalling 12 individual birds, of these, 3 great skua were recorded as 'in-transect'. Great skua were sporadically recorded across the survey area from the southern Celtic Sea to the Hebridean shelf edge.

Two records of pomarine skua, numbering 3 individuals, were noted during line transect effort on the survey; all pomarine skua were recorded as 'off-transect'.

The single record of a solitary Arctic skua was noted during a casual watch west of Liscannor bay.

### *Gulls*

Six species of gull were encountered on the survey including common gull (*Larus canus*), black-headed gull (*Larus ridibundus*), lesser black-backed gull (*Larus fuscus*), herring gull (*Larus argentatus*), greater black-backed gull (*Larus marinus*) and black-legged kittiwake (*Rissa tridactyla*). All gull species were recorded during line transect effort, however, only lesser black-backed gull, herring gull and kittiwake were recorded as 'in-transect'.

Kittiwake were the most abundant and second most frequently encountered gull species on the survey with a total of 246 individuals recorded during 82 observations on line transect effort. Of these, 56 birds were recorded as 'in-transect'.

Kittiwake were infrequently recorded in the Celtic Sea but were found to be broadly distributed in low numbers along both Ireland's and Scotland's western shelf waters, however, some larger flocks were recorded in the northern Minch. All 'in-transect' records of kittiwake were encountered north of Malin head.

Lesser black-backed gull were the most frequently encountered gull species on the survey with a total of 223 individuals recorded during 103 observations. Lesser black-backed gull were the second most abundant species of gull recorded, being recorded on 166 occasions during line transect effort. Of these, 24 birds were recorded as 'in-transect'.

Lesser black-backed gull were broadly distributed in low numbers across the survey area, although more frequently encountered on southern transects in the Celtic Sea. The south western Irish shelf

waters showed the densest aggregations, however most birds encountered were recorded as 'off-transect'.

Although less common overall, herring gull (1 bird 'in-transect, 33 birds 'off-transect) and greater black-backed gull (20 birds 'off-transect') were occasionally recorded during line transect effort. Herring gull and greater black-backed gull were patchily distributed in low numbers across Irish shelf waters, with some records in Scottish waters also. However, the majority of herring gull and greater black-backed gull observations were recorded as 'off-transect'.

Common gull and black-headed gull were each encountered on one occasion during line transect effort, however each record was of a solitary bird 'off-transect'. A further record of a single common gull was recorded during a casual watch.

A number of gulls were encountered which could not be identified to species level, these were recorded as; common/ herring gull, greater/ lesser black-backed gull, large gull sp., small gull sp. or gull sp.

### *Terns*

Terns were recorded on three occasions during the survey. However, on each occasion they could not be successfully identified to species level and were recorded instead as commic tern (common/ arctic tern). In total 3 records (of 4 birds in total) were observed during line transect effort on the survey, two commic tern were recorded as 'in-transect'.

### *Auks*

Four of the five species of auk known to occur in Irish waters were encountered on the survey. These were guillemot (*Uria aalge*), black guillemot (*Cepphus grylle*), razorbill (*Alea torda*) and Atlantic puffin (*Fratercula arctica*). All auk species were recorded 'in-transect' during line transect effort, while a single guillemot was also recorded during point sampling survey effort. A number of observations of auks identified either as guillemot/razorbill or auk sp. were also recorded during line transect survey effort.

Guillemot were the most frequently encountered of the auk species and the only auk species recorded during point count survey effort. In total, 156 observations of 827 individuals were recorded during line transect watches, with 652 birds recorded as 'in-transect'. Guillemot were recorded almost exclusively in coastal waters and were all but absent from offshore waters, particularly in the Celtic Sea. Some records of guillemot were noted around St. Kilda, however, a number of these were recorded as 'off-transect'. Guillemot were recorded in highest numbers over Stanton Bank and throughout the Minch.

Puffin were the second most frequently encountered of the auk species. In total, 103 sightings of 260 puffin were recorded during line transect watches, with 117 birds recorded as 'in-transect'. Two records totalling 11 individual puffins were also recorded during casual watches. Puffin showed a strong northern tendency in their distribution and were all but absent from the Celtic Sea and Irish western shelf waters. Puffin were recorded in highest numbers in the Minch and off St. Kilda, however, the majority of records off St. Kilda were recorded as 'off-transect'.

Razorbill were less frequently encountered during the survey and were recorded during line transect effort only. In total, 62 observations of 172 individuals were recorded during line transect watches,

with 72 individuals recorded as 'in-transect'. Although less abundant, razorbill showed a very similar distribution pattern to that of puffin with highest numbers recorded in the Minch and off St. Kilda.

Black guillemot were recorded on 3 occasions, with each a sighting of a single bird recorded as 'off-transect' in the Minch.

#### *Cormorant and Shag*

Shag were recorded on 4 occasions totalling 5 birds during line transect, however all were recorded as 'off-transect'. Shag were recorded in Dingle bay, off St. Kilda and in the Minch.

Four solitary birds recorded only as shag/ cormorant were recorded on the survey, each also recorded as 'off-transect'.

#### *Terrestrial/ migratory birds*

A number of terrestrial/ migratory birds were encountered during the survey. A total of 11 sightings of terrestrial/ migratory bird species were recorded during the survey (*Table 5*). These sightings comprised of 31 individuals from 7 species' or species groups, the distribution of which can be seen in *Figure 7* below. Species recorded included a pectoral sandpiper (*Calidris melanotos*), a collared dove (*Streptopelia decaocto*) and a juvenile white-tailed eagle (*Haliaeetus albicilla*).

*Table 5: Summary of all terrestrial/ migratory bird sightings recorded during the survey.*

<i>Common Name</i>	<i>Species name</i>	<i>No. of records</i>	<i>No. of individuals</i>
<b>Collared Dove</b>	<i>Streptopelia decaocto</i>	1	1
<b>Feral/ racing pigeon</b>	<i>Columba livia domesticus</i>	5	6
<b>Oystercatcher</b>	<i>Haematopus ostralegus</i>	1	1
<b>Pectoral Sandpiper</b>	<i>Calidris melanotos</i>	1	1
<b>Unidentified Geese</b>	<i>Anatidae sp.</i>	1	20
<b>White-tailed Eagle</b>	<i>Haliaeetus albicilla</i>	1	1
<b>Woodpigeon</b>	<i>Columba palumbus</i>	1	1
	<b>Total</b>	<b>11</b>	<b>31</b>

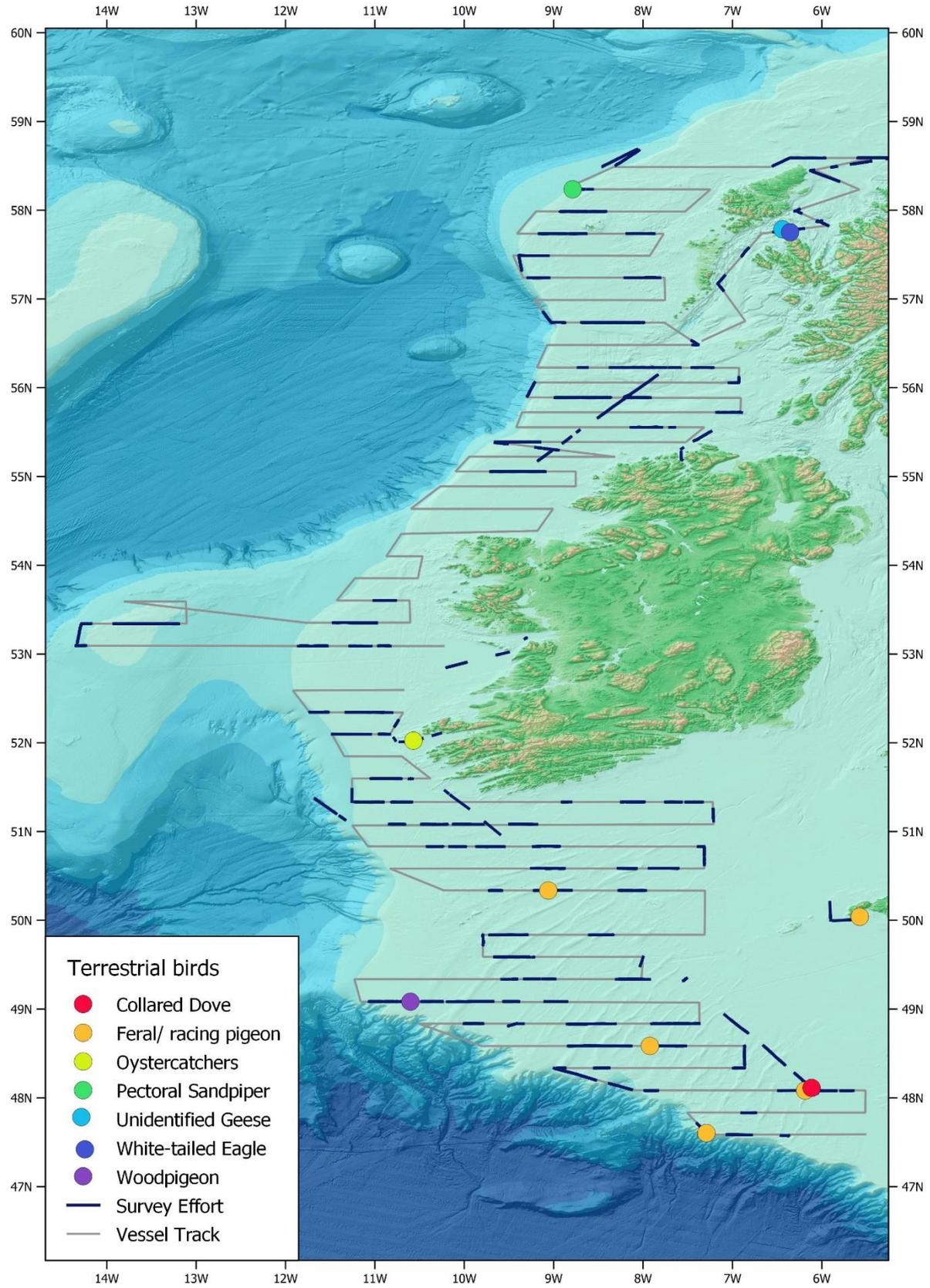


Figure 7: Distribution of terrestrial species recorded during survey effort.

## Discussion

The WESPAS has been undertaken annually aboard the *RV Celtic Explorer* since 2016 with seabird surveyors deployed on each survey (O'Donnell, *et al.*, 2016; 2017; 2018; 2019; 2020, 2021). However, the number of seabird surveyors deployed has varied across the time series of the WESPAS. Since 2019, the NPWS have commissioned a seabird survey during the WESPAS, with a single ESAS trained seabird surveyor deployed for each leg of the survey. The seabird survey during this year's survey was conducted using a single seabird surveyor, thus the level and detail of data collected was affected at times. The seabird observers' survey effort focused on the correct identification, enumeration, distance estimation and recording of species encountered while ancillary data such as age, moult stage and behaviour was de-prioritised.

While each WESPAS survey has covered the same area of the European western shelf, and with each survey employing parallel transects spaced equally at 15 nautical miles and beginning at a randomly located point, it should be noted that the 2016 survey differs from all latter surveys. WESPAS 2016 was undertaken in a north-south direction whereas all subsequent surveys were undertaken in a south-north fashion. It should also be noted that both the 2016 and 2017 seabird surveys did not run for the full duration of the WESPAS survey cruise. In 2016 seabird survey effort was undertaken from the 5<sup>th</sup> – 29<sup>th</sup> July covering the Celtic sea region, while in 2017 the seabird survey ran from the 9<sup>th</sup>- 28<sup>th</sup> June in the Celtic sea. The number of seabird observers deployed has also varied through the years with a single observer deployed on the present survey and also during WESPAS 2016, 2018, 2020 and 2021. Where as a team of two observers consisting of a primary observer and scribe/secondary observer deployed in both 2017 and 2019. As such, care should be taken when comparing survey effort and species observation and abundance results obtained across the surveys.

Survey effort has varied across the time series of surveys, however, this year's survey marked a large reduction in total survey effort compared to the 2021, 2020 and 2019 surveys. During the present survey a total of 161 hours and 8 minutes of survey effort was conducted, 143 hours and 15 minutes of survey effort were conducted using a line transect methodology, while 5 hours and 19 minutes of effort were conducted using the point sampling methodology. In 2021, a total of 262 hours and 40 minutes of survey effort was conducted. In 2020, 271 hours and 5 minutes of survey effort were recorded, and a total of 225 hours and 40 minutes of survey effort were recorded in 2019. This year's survey effort compares more favourably with surveys conducted prior to 2019; in 2018, 156 hours and 16 minutes of survey effort were recorded, 95 hours and 51 minutes of survey effort were recorded in 2017, while 129 hours and 53 minutes of survey effort were recorded in 2016.

As in previous surveys, a large number of seabird records, from a broad range of taxa and species groups were observed over the course of the survey. In total, 21 species of seabird and 6 species of terrestrial bird were recorded during the present survey. This is consistent with the species totals from previous seabird surveys during WESPAS, however, the total number of seabird species recorded this year was the lowest in the time series. This year also saw a notable increase in the number of birds unidentified to species level and recorded at higher taxonomic levels. In 2021, 26 species of seabird and 10 species of terrestrial bird were recorded. In 2020, 31 species of seabird and 8 species of terrestrial bird were recorded and in 2019, 25 species of seabird and 10 species of terrestrial bird were recorded, while in 2018, 25 species of seabird and 5 species of terrestrial bird were recorded. In 2017, 23 species of seabird and 6 species of terrestrial bird were recorded, while in 2016, 26 species of seabird and 5 species of terrestrial bird were recorded. Tables containing all species of both seabird

and terrestrial bird recorded over the entire time series of WESPAS are provided in *Tables 6 & 7* within the Appendices.

The total number of birds recorded and total number of observation across all species was significantly lower compared to numbers recorded in the years 2019-2021, however was more comparable with total numbers from 2016-2018. It is difficult to interpret this variance without taking factors such as variable effort, number of observers, and survey design into account, further analysis of all data in the time series would be required.

All flying birds were recorded as 'off-transect' during the present survey, in contrast to previous surveys which utilised a snapshot survey methodology for flying birds. This change would have resulted in the significant under recording of certain species due to species specific behaviour patterns. For example, species which infrequently land on the water, such as storm petrel, will have been infrequently recorded as 'in-transect'. Records of such species in the present dataset should be excluded from use in future abundance or density calculations.

There was a marked difference in the number of seabird records and the overall abundance and diversity of seabirds between leg 1 and leg 2 of the survey. Despite having almost 50% more observer hours of effort recorded, leg 1 had considerably fewer records and a much lower abundance of seabirds when compared to leg 2. A number of species, such as auks, were all but absent from Leg 1, especially in the Celtic Sea. Leg 1 was characterised by common species such as gannet, fulmar and occasional gulls, with few other species recorded over a number of days of effort.

Gannet, fulmar and guillemot were the most abundant species' overall in the present survey, with fulmar and gannet being the most widely distributed. Despite their abundance and generally broad distribution, these species, along with many other species' recorded, displayed a somewhat patchy distribution. A number of areas of higher seabird density and diversity were observed over the course of the survey. These included sites such as west of the Blasket Islands, Stanton Bank, around St. Kilda, along the Hebridean shelf edge and the Minch.

The high levels of seabird activity and feeding behaviour observed in these hotspots suggests abundant feeding opportunities and high prey availability for seabirds. This was further confirmed on the survey by the presence of feeding cetaceans at some of these locations. Many of the areas noted as holding a high diversity and abundance of seabirds are within foraging range of important seabird colonies. For instance, Inishtooskert hosts the largest population of European storm petrels in the British Isles. Little Skellig has the largest population of gannets in Ireland, and the cliffs of Moher hold the largest population of fulmars in Ireland (9% of the total population of Ireland and Britain) as well as having large colonies of both razorbill and guillemot, while Cruagh is home to a large population of Manx shearwaters. In Scotland, St. Kilda holds the largest gannet colony in the world as well as the largest colony of Leach's storm petrels in Europe, and the biggest colonies of Atlantic puffins and northern fulmars in the EU. At the southern end of the Outer Hebrides, Mingulay and Berneray are important nesting sites of auks, particularly razorbills, as well as kittiwakes and fulmars (Mitchell, *et al.*, 2004).

Given the outstanding international importance of the multi-species seabird colonies found in the British Isles (Kober, *et al.*, 2010), it is important to recognise the crucial role played by the foraging areas utilised by breeding seabirds that reside there. The availability and distribution of prey are known to be vital for the breeding success of many seabirds (Mackey, *et al.*, 2004). As such, the identification and management of key hotspots for foraging seabirds during the breeding season are

important steps in guarding the long-term health and stability of seabird colonies (Kober, *et al.*, 2010). Protecting seabirds in their offshore foraging habitats through the designation of SPAs would also further assist Ireland in meeting its obligation under the EU Birds Directive.

The WESPAS provides an excellent opportunity for the collection of data on the summer distribution, abundance and behaviour of seabirds in Irish shelf waters. However, the amount and quality of data collected is confounded by factors such as environmental conditions, observer effects, and seabird survey design. Although the weather was quite good throughout the survey, poor weather did reduce the total number of seabird survey hours undertaken on a number of occasions. Environmental conditions, particularly elevated sea states, likely affected the detection probability of certain species, particularly less conspicuous species. The use of a larger dedicated seabird team on future surveys could improve data collection and contribute to a more robust dataset, to better inform policy decisions and advance the scientific understanding of the at-sea summer abundance and distribution of seabirds in Ireland's shelf water habitats.

## Recommendations

An increase to the number of ESAS trained seabird observers on-board is recommended for this survey. The present survey used a single ESAS trained seabird observer, however recent surveys have also used a single ESAS trained seabird observer with a second, non-ESAS observer employed as scribe/ secondary observer. The ESAS survey methodology recommends the use of a minimum of two ESAS trained observers. The use of three ESAS seabird observers would allow a rotational system of two seabird observers on-effort (one observing, the other scribing) while the third observer takes a break. This approach would increase effort coverage of the survey area, minimise observer fatigue and allow full coverage of all daylight hours. However, the authors appreciate the constraints on using such a large seabird survey team.

The approach outlined above would facilitate more sufficient coverage, which should increase the chances of detecting seabirds, particularly rare or scarce species, while also ensuring that all seabird observers get sufficient breaks/periods of rest. Sufficient breaks/periods of rest are highly important for seabird observers for maintaining full concentration during all effort watches without suffering the ill effects of fatigue.

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Finally, the seabird team wish the RV *Celtic Explorer*, the Explorer crew and the Marine Institute staff all the best for future surveys. Both, the Explorer crew and the Marine Institute staff have been a pleasure to work with and the seabird team looks forward to future collaborations.

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Appendix 1

Table 6: Seabird sighting records from Western European Shelf Pelagic Acoustic Survey from 2016-2022 (Power, et al., 2021)<sup>1</sup>.

Common Name	Species name	2022		2021		2020		2019		2018		2017		2016	
		In-transect	Off-transect												
<b>Fulmar</b>	<i>Fulmarus glacialis</i>	238	1375	800	3631	1893	7049	1002	2706	336	1023	705	495	1216	792
<b>Balearic Shearwater</b>	<i>Puffinus mauretanicus</i>	-	-	-	-	-	-	0	1	-	-	1	0	-	-
<b>Cory's Shearwater</b>	<i>Calonectris borealis</i>	-	-	-	-	-	-	-	-	4	2	11	2	282	360
<b>Great Shearwater</b>	<i>Ardenna gravis</i>	0	2	1	0	-	-	0	1	3	3	3	1	70	45
<b>Manx Shearwater</b>	<i>Puffinus puffinus</i>	17	503	7368	7120	7696	5808	1902	859	374	394	2855	206	1111	826
<b>Barolo Shearwater</b>	<i>Puffinus baroli</i>	-	-	-	-	-	-	-	-	-	-	-	-	0	1
<b>Sooty Shearwater</b>	<i>Ardenna grisea</i>	4	10	2	18	13	3	1	5	3	10	22	8	15	43
<b>Fea's type petrel</b>	<i>Pterodroma feae/deserta</i>	-	-	-	-	1	0	-	-	-	-	-	-	-	-
<b>Unid. Shearwater sp.</b>	<i>Procellariidae</i>	5	48	-	-	-	-	-	-	1	0	-	-	-	-
<b>European Storm Petrel</b>	<i>Hydrobates pelagicus</i>	2	152	692	1326	989	925	847	1125	60	296	1097	645	957	921
<b>Leach's Storm Petrel</b>	<i>Hydrobates leucorhous</i>	-	-	-	-	1	0	2	1	-	-	2	0	3	0
<b>Wilson's Storm Petrel</b>	<i>Oceanites oceanicus</i>	0	1	3	5	6	0	1	4	0	1	3	0	9	4
<b>Unid. Storm petrel</b>	<i>Hydrobatidae</i>	19	83	0	1	1	-	-	-	1	6	-	-	-	-



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<b>Cormorant</b>	<i>Phalacrocorax carbo</i>	-	-	0	1	-	-	-	-	0	4	-	-	-	-
<b>Shag</b>	<i>Gulosus aristotelis</i>	0	6	17	4	9	0	3	0	0	5	-	-	0	1
<b>Shag/ Cormorant</b>	<i>G. aristotelis/ P. carbo</i>	0	4	-	-	-	-	-	-	-	-	-	-	-	-
<b>Great Northern Diver</b>	<i>Gavia immer</i>	-	-	-	-	1	0	-	-	1	0	-	-	-	-
<b>Gannet</b>	<i>Morus bassanus</i>	218	2030	1059	4248	3726	7658	821	3039	1032	3542	3157	1151	2345	941
<b>Grey Phalarope</b>	<i>Phalaropus fulicarius</i>	-	-	-	-	-	-	-	-	-	-	-	-	17	0
<b>Arctic Skua</b>	<i>Stercorarius parasiticus</i>	0	1	0	3	7	2	0	1	1	2	-	-	1	1
<b>Great Skua</b>	<i>Stercorarius skua</i>	3	11	38	105	91	55	50	56	23	43	11	6	16	22
<b>Long-tailed Skua</b>	<i>Stercorarius longicaudus</i>	-	-	0	4	8	0	0	1	-	-	-	-	3	3
<b>Pomarine Skua</b>	<i>Stercorarius pomarinus</i>	0	3	2	2	5	2	0	3	0	1	0	1	2	3
<b>South Polar Skua</b>	<i>Stercorarius maccormicki</i>	-	-	-	-	-	-	0	1	-	-	-	-	-	-
<b>Small skua sp.</b>	<i>Stercorarius sp.</i>	-	-	0	8	-	-	-	-	-	-	-	-	-	-
<b>Skua sp.</b>	<i>Stercorarius sp.</i>	0	1	0	1	-	-	-	-	-	-	-	-	-	-
<b>Black-headed Gull</b>	<i>Chroicocephalus ridibundus</i>	0	1	0	3	1	0	-	-	-	-	0	1	-	-
<b>Common Gull</b>	<i>Larus canus</i>	0	2	0	1	1	0	-	-	2	10	-	-	-	-



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<b>Kittiwake</b>	<i>Rissa tridactyla</i>	56	229	188	291	233	665	629	216	30	54	11	22	50	170
<b>Sabine's Gull</b>	<i>Xema sabini</i>	-	-	-	-	1	0	-	-	2	0	1	3	-	-
<b>Herring Gull</b>	<i>Larus argentatus</i>	1	37	9	32	22	7	2	16	2	33	1	15	0	6
<b>Great Black-backed gull</b>	<i>Larus marinus</i>	0	24	2	58	7	18	7	26	6	35	1	36	6	77
<b>Lesser Black-backed gull</b>	<i>Larus fuscus</i>	24	199	102	1242	156	441	27	289	238	587	458	164	14	246
<b>Yellow-legged Gull</b>	<i>Larus michahellis</i>	-	-	0	1	0	6	-	-	-	-	-	-	0	1
<b>Common/ Herring gull</b>	<i>Larus canus/ argentatus</i>	5	6	-	-	-	-	-	-	-	-	-	-	-	-
<b>Greater/ Lesser b-b gull</b>	<i>Larus marinus/ fuscus</i>	10	52	-	-	-	-	-	-	-	-	-	-	-	-
<b>Unid. gull sp.</b>	<i>Larus sp.</i>	0	28	-	-	-	-	-	-	0	2	-	-	-	-
<b>Unid. large gull sp.</b>	<i>Larus sp.</i>	2	78	-	-	-	-	-	-	21	4	150	0	-	-
<b>Unid. small gull sp.</b>	<i>Larus sp.</i>	0	1	-	-	-	-	-	-	-	-	-	-	-	-
<b>Arctic Tern</b>	<i>Sterna paradisaea</i>	-	-	10	7	10	4	9	8	0	3	3	1	16	9
<b>Commic tern sp.</b>	<i>Sterna hirundo / paradisaea</i>	2	2	-	-	17	0	0	15	-	-	-	-	-	-
<b>Common Tern</b>	<i>Sterna hirundo</i>	-	-	2	0	15	0	3	5	0	7	5	0	1	0
<b>Little Tern</b>	<i>Sternula albifrons</i>	-	-	-	-	-	-	3	0	-	-	-	-	-	-

<b>Unid. Sterna sp.</b>	<i>Sterna sp.</i>	-	-	-	-	-	-	-	-	0	17	-	-	-	-
<b>Auk sp.</b>	<i>Alcidae sp.</i>	179	325	-	-	-	-	212	145	-	-	-	-	-	-
<b>Guillemot</b>	<i>Uria aalge</i>	652	241	1322	504	745	123	1043	77	431	252	11	1	47	10
<b>Black guillemot</b>	<i>Cepphus grylle</i>	0	3	0	2	-	-	-	-	-	-	-	-	-	-
<b>Razorbill</b>	<i>Alca torda</i>	72	100	376	155	98	13	273	47	232	89	5	1	12	0
<b>Razorbill/ Guillemot</b>	<i>Alca torda/ Uria aalge</i>	151	4	92	594	-	-	-	-	552	651	-	-	-	-
<b>Atlantic Puffin</b>	<i>Fratercula arctica</i>	117	154	306	471	525	237	237	171	317	405	36	3	194	105
		<b>1763</b>	<b>5715</b>	<b>12391</b>	<b>19838</b>	<b>16277</b>	<b>23016</b>	<b>7074</b>	<b>8818</b>	<b>3670</b>	<b>7481</b>	<b>8549</b>	<b>2762</b>	<b>6387</b>	<b>4533</b>

<sup>1</sup> The survey timing, survey direction and number of seabird surveyors deployed has not remained constant annually.

## Appendix 2

 Table 7: Terrestrial / migratory species recorded on WESPAS annually since 2016 (Power, et al., 2021)<sup>1</sup>.

Common Name	Species name	2022	2021	2020	2019	2018	2017	2016
Black Redstart	<i>Phoenicurus ochruros</i>	-	-	1	-	-	-	-
Black-tailed Godwit	<i>Limosa</i>	-	-	46	-	-	-	-
Collared Dove	<i>Streptopelia decaocto</i>	1	1	2	2	6	-	-
Common Scoter	<i>Melanitta nigra</i>	-	-	14	21	-	-	-
Curlew/Whimbrel	<i>Numenius arquata/ phaeopus</i>	-	1	-	-	-	-	-
Dunlin	<i>Calidris alpina</i>	-	-	-	1	25	-	17
Feral/ Racing Pigeon	<i>Columba livia domestica</i>	6	-	-	5	7	18	1
Golden Eagle	<i>Aquila chrysaetos</i>	-	-	-	2	-	-	-
Golden Plover	<i>Pluvialis apricaria</i>	-	-	-	-	-	1	-
Greenish Warbler	<i>Phylloscopus trochiloides</i>	-	-	-	-	-	1	-
House Martin	<i>Delichon urbica</i>	-	1	-	-	-	-	-
Quail	<i>Coturnix</i>	-	1	-	-	-	-	-
Pied Wagtail	<i>Motacilla alba</i>	-	-	-	1	-	-	-
Oystercatcher	<i>Haematopus ostralegus</i>	1	-	-	-	-	2	-
Pectoral Sandpiper	<i>Calidris melanotos</i>	1	-	-	-	-	-	-
Redshank	<i>Tringa totanus</i>	-	-	-	5	-	-	-
Ringed Plover	<i>Charadrius hiaticula</i>	-	1	-	-	-	-	-
Small waders sp.	-	-	10	-	-	-	-	-
Spotted Flycatcher	<i>Muscicapa striata</i>	-	-	1	1	-	-	-
Swallow	<i>Hirundo rustica</i>	-	5	2	2	-	-	-
Swift	<i>Apus apus</i>	-	2	-	12	1	5	1
Tufted Duck	<i>Aythya fuligula</i>	-	-	4	-	-	-	-
Turnstone	<i>Arenaria interpres</i>	-	1	-	-	-	-	1
Unid. Geese	-	20	-	-	-	-	-	-
Unid. Passerine	-	-	-	-	-	1	-	-
Whimbrel	<i>Numenius phaeopus</i>	-	46	-	-	-	1	1
White-tailed Eagle	<i>Haliaeetus albicilla</i>	1	-	1	-	-	-	-
Woodpigeon	<i>Columbus palumbus</i>	1	-	-	-	-	-	-
	<b>Total</b>		<b>79</b>	<b>71</b>	<b>52</b>	<b>40</b>	<b>28</b>	<b>21</b>