EMFF Operational Programme 2014-2020

Marine Biodiversity Scheme

Marine Institute Seabird Monitoring

During the Western European Shelf Pelagic Acoustic Survey

June -July 2020

Lead Agency: Marine Institute

Lead Partners: National Parks and Wildlife Service,

Authors: Emerald Marine

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An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

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Foras na Mara
Marine Institute

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Executive Summary

Irish waters represent one of the most important marine habitats for seabirds in Europe and are 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 Arts, Heritage and the Gaeltacht (DAHG), 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 the 1st June to the 12th of July 2020.

A standard line transect survey methodology was employed by the seabird survey team 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 271 hours and 5 minutes of survey effort was conducted over the course of the WESPAS 2020 survey. In total, 211 hours and 54 minutes of survey effort were conducted using a line transect methodology, while 51 hours and 46 minutes of effort were conducted using the point sampling methodology. A further 7 hours and 25 minutes of effort were conducted as a casual watch.

A total of 5750 seabird sightings were recorded throughout the survey, totalling 65242 individuals (*Table 1*). In total, 21468 seabirds were recorded as "in transect", while 43774 were recorded "off transect". The species encountered included 31 species' or species groups from 10 families. A further 10 sightings of terrestrial/migratory birds were also recorded, comprising of 71 individuals (*Table 2*).

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 roseatte 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 impact 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).

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

[1] inland colonies were not surveyed during the SCR Census (1985-88)

[2] not surveyed during the SCR Census (1985-88)

[3] counts of individuals

[4] 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., 2016b; 2017b; 2018b; 2019b). 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 WESAPS 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 fourth 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., 2019b). 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., 2018). Since 2016, these surveys were combined and undertaken 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., 2019b).

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 Arts, Heritage and the Gaeltacht (DAHG), through the Marine Institute, commissioned the conduction of a seabird survey from the MRV Celtic Explorer during the annual Western European Shelf Pelagic Acoustic Survey (WESPAS), running from 1st to 22nd of June and the 23rd of June to the 12th July 2020.

Methodology

The seabird survey was conducted from the 02/06/20 to the 10/07/20 using a single seabird surveyor on each survey leg. The seabird observer conducted visual survey effort, while also collecting and recording all survey data. Given the presented survey transects (*Figure 1)*, a standard line transect survey methodology was determined to be most suitable and was employed by the seabird observer. Survey transect were undertaken at speeds of 5-10 knots, with fishing activity being conducted at speeds of 2-3 knots.

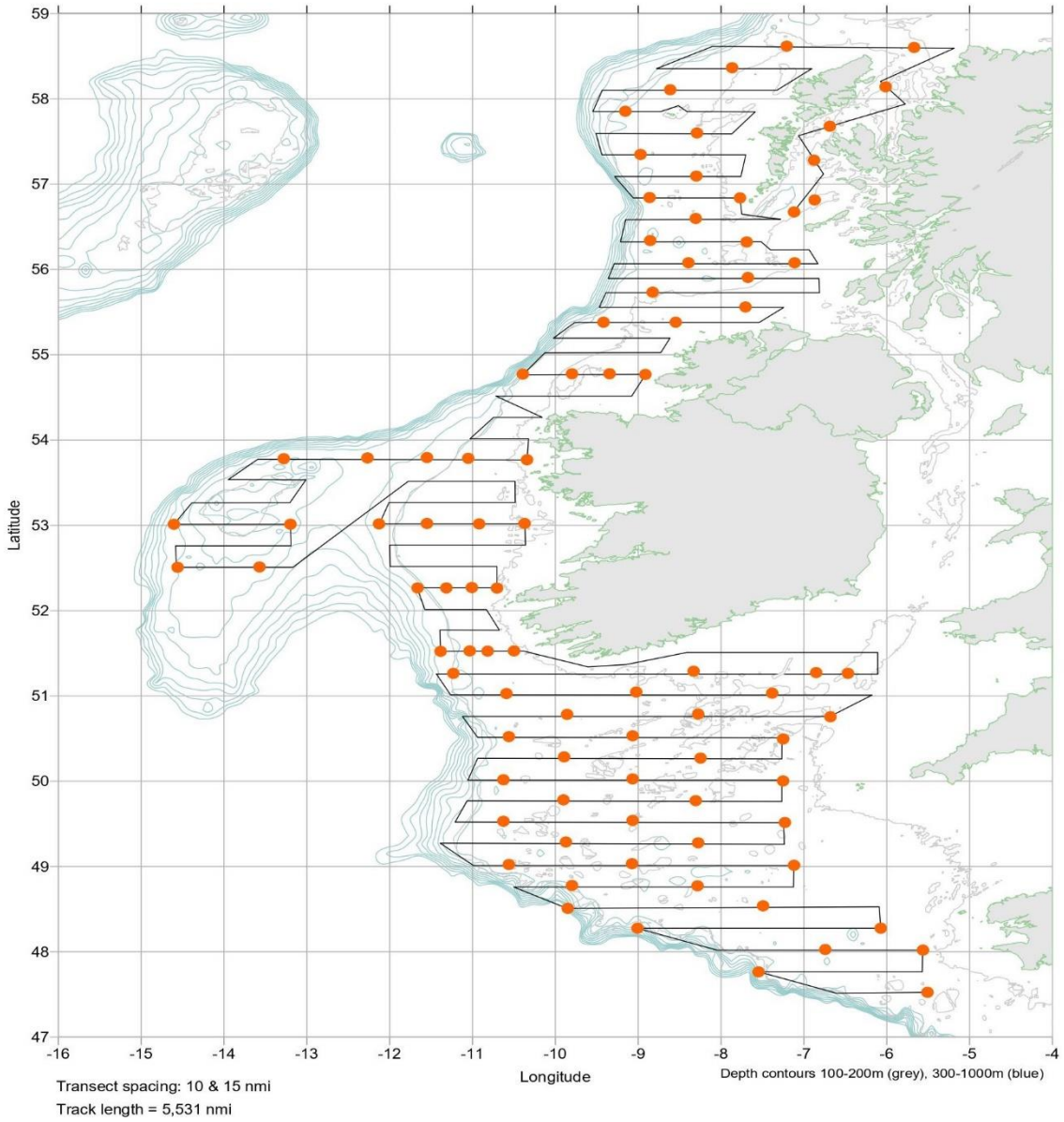

Figure 1: The planned WESPAS 2020 cruise track (Source: Marine Institute, 2020).

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). Observations were conducted from the monkey island preferably, however, as in previous surveys aboard the R.V. Celtic Explorer, access to the monkey island was dependent on weather conditions.

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, while flying birds were surveyed using a 'snapshot' technique. Observer effort was concentrated in a bow-beam arc of 90^{o} 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.

Flying birds were surveyed using 'snapshots', where instantaneous counts of flying birds within a survey quadrant of 300m x 300m were conducted. The periodicity of these 'snapshots' was vessel speed dependent but timed to allow counts to occur as the vessel passes from one survey quadrant to the next. This method minimises biases in counts of flying birds relative to the movement of the vessel (Pollock *et al.,* 2000, Camphuysen *et al.* 2004).

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, Leika Ultravid 8x42 HD binoculars were used to confirm parameters such as species identification, age, moult, group size and behaviour (Mackey *et al.* 2004). A Canon EOS 7D Mark II DSLR camera with a Canon EF 100-400mm F4.5-5.6 IS II USM telephoto lens was used to visually document other information of scientific interest. Data was also collected on all migratory/ transient waterfowl and terrestrial birds encountered.

Data collection and recording

The Cybertracker (https://cybertracker.org) data collection software package (Version 3.514) was configured for optimum use on the survey. Cybertracker was used to record all positional, environmental and sightings data on a handheld tablet PC. Using a portable GPS receiver with USB connection, 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 observers 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 sighting 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 sighting was time stamped and digitally marked using Cybertracker. Sighting 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, sightings 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 ^{o} arc around the vessel. Data recording methodology remained similar for both point sampling and line transect methods.

Results

Effort

In total, 271 hours and 5 minutes of survey effort was conducted over the course of WESPAS 2020, 132 hours and 14 minutes of survey effort was conducted on Leg 1, while 138 hours and 51 minutes of survey effort was conducted on Leg 2 of the survey. In total, 211 hours and 54 minutes of survey effort were conducted using a line transect methodology, while 51 hours and 46 minutes of effort were conducted using the point sampling methodology. A further 7 hours and 25 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 recorded daily survey effort was 11 hours and 42 minutes while the average daily survey effort was 6 hours and 57 minutes.

Seabird survey effort was reduced on the 2nd of June due to necessary calibration of the vessels acoustic survey equipment in Dunmanus Bay. No effort watches were conducted on the 18th of June due to a port call. Survey effort was also restricted on the 22nd of June due to transiting from port. No seabird survey effort was undertaken on the 10th and 11th of July due to necessary calibration of the vessels acoustic survey equipment in Killary Harbour and transit back to port.

Seabird survey effort was greatly reduced on the 20th, 21st and 28th of June due to weather conditions exceeding the specified weather limits for observations. Poor weather conditions also resulted in reduced visual survey effort on a number of occasions over the course of the survey. During these periods of unsuitable environmental conditions, a number casual watches were conducted by the observer. A graph of daily effort is provided in *Figure 2 b*elow.

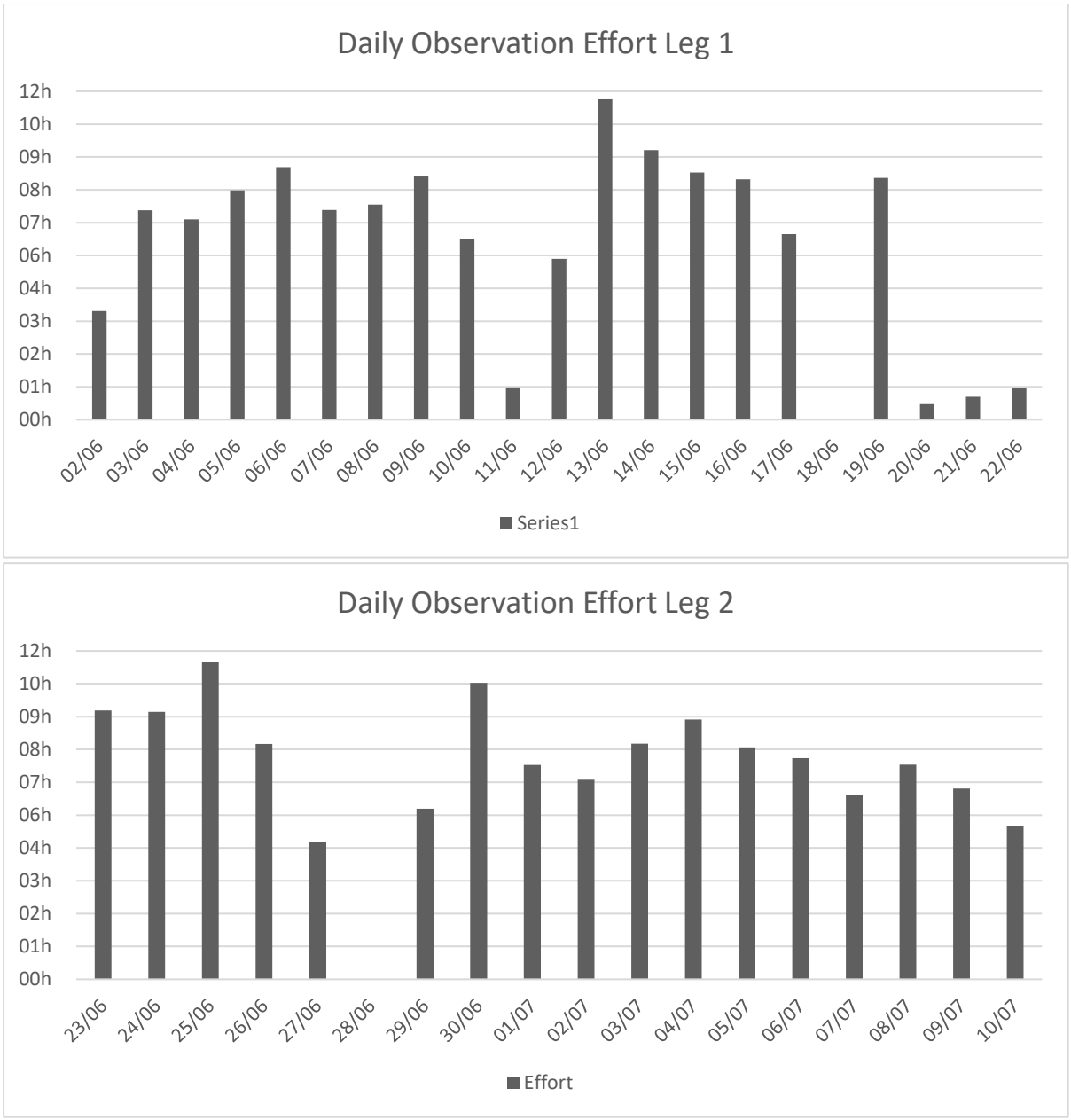

Figure 2: Daily visual effort undertaken during the survey.

Environmental Conditions

Environmental conditions were generally good 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 using the World Meteorological Organisation (WMO) sea state scale, while the Beaufort scale was used to assess wind force/sea state. The WMO scale takes account of the effect of wind, swell and currents (WMO, 2011) on the sea conditions and is judged in terms of wave height in meters. Beaufort sea state was recorded in terms of Beaufort wind force and was judged based on the effect of the wind and currents on the sea surface.

WMO sea states 3, 4 and 5 were the most common sea states recorded. The most frequently recorded WMO sea state was 3, accounting for over 93 hours (34%) of observation effort. WMO sea state 2 accounted for over 73 hours (27%) of observation effort, while WMO sea state 4 accounted for over 60 hours (22%) (*Fig. 3a*).

The most frequently recorded Beaufort wind force/sea state was a Beaufort 2, accounting for over 90 hours (33%) of survey effort. Beaufort 3 and 4 were regularly recorded, accounting for approximately 47 hours (17%) and 42 hours (15%) of survey effort respectively. Sea state 2 was also frequently recorded, accounting for 90 hours (33%) of survey effort (*Fig. 3b*).

Swell

A swell height of 0.1-1 meter was most frequently recorded throughout the survey, being recorded on over 134 hours (50%) of survey effort. A swell height of 1.1-2 meters was recorded for 80 hours (30%) of survey effort, while a swell height of >2 meters was recorded for 55 hours (20%) of survey effort (*Fig. 3c*).

Visibility

Visibility was generally very good during seabird survey effort. The most frequently recorded visibility was 11-15km, being recorded over 169 hours (62%) of survey effort, while visibility of 16-20km was recorded over 37 hours (14%) of survey effort (*Fig. 3d*).

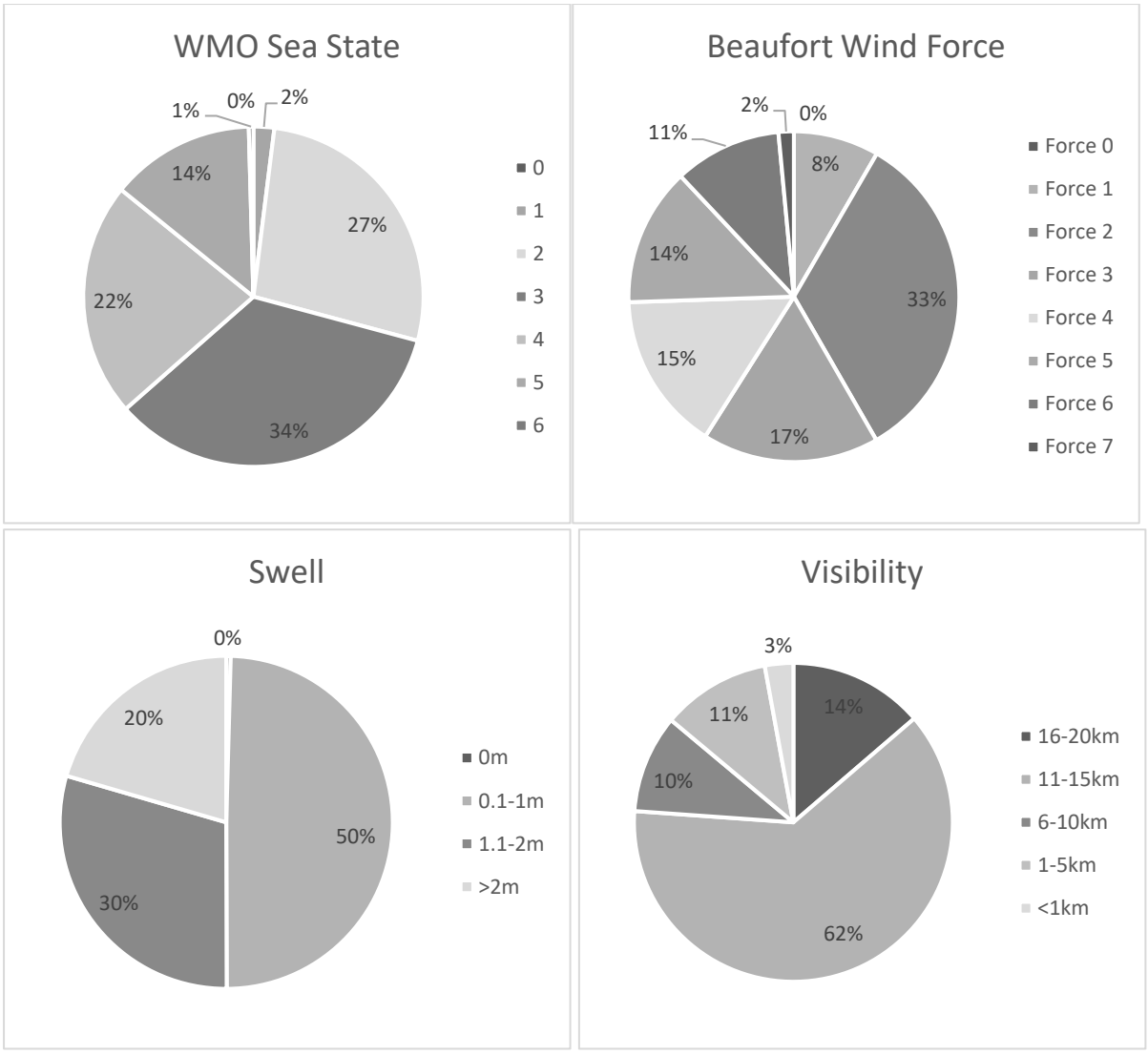

Figure 3: Summary of environmental conditions recorded on the WESPAS 2020; a) WMO sea state, b) Beaufort sea state/ wind force, c) Swell height (meters), d) Visibility (kilometres).

Sightings

A total of 5750 seabird sightings were recorded throughout the survey, totalling 65242 individuals (*Table 2*). In total, 21468 seabirds were recorded as "in transect", while 43774 were recorded "off transect". A summary of all sightings recorded on the survey is presented in *Table 2* and includes sightings recorded during both line transect and point sampling watches. The species encountered included 31 species' or species groups from 10 families. A further 10 sightings of terrestrial/migratory birds were also recorded, comprising of 71 individuals (*Table 5*).

Table 2: Summary of all seabirds recorded during both line transect and point sampling watches.

Common Name	***Species name***	***No. of records***	***No. of Seabirds***	***In Transect***	***Off Transect***
Fulmar	*Fulmarus glacialis*	1344	14115	1901	12214
Sooty Shearwater	*Puffinus griseus*	15	23	13	10
Manx Shearwater	*Puffinus puffinus*	553	26098	12381	13717
Fea's type Petrel	*Pterodroma feae/ deserta*	1	1	1	0
Wilson's Petrel	*Oceanites oceanicus*	7	7	6	1
Storm Petrel	*Hydrobates pelagicus*	555	3628	1083	2545
Leach's Petrel	*Oceanodroma leucorhoa*	1	1	1	0
Gannet	*Morus bassanus*	2048	16681	3899	12782
Pomarine Skua	*Stercorarius pomarinus*	7	9	5	4
Arctic Skua	*Stercorarius parasiticus*	10	12	7	5
Long-tailed Skua	*Stercorarius longicaudus*	9	12	8	4
Great Skua	*Stercorarius skua*	144	240	91	149
Common Gull	*Larus canus*	1	1	1	0
Sabine's gull	*Larus sabini*	1	1	1	0
Black-headed Gull	*Larus ridibundus*	1	1	1	0
Lesser Black-backed Gull	*Larus fuscus*	192	1187	164	1023
Herring Gull	*Larus argentatus*	18	51	22	29
Yellow-legged gull	*Larus michahellis*	5	6	0	6
Great Black-backed Gull	*Larus marinus*	26	39	9	30
Kittiwake	*Rissa tridactyla*	152	1089	237	852
Common Tern	*Sterna hirundo*	9	22	15	7
Arctic Tern	*Sterna paradisaea*	9	14	10	4
Commic tern sp.	*Sterna hirundo / Sterna paradisaea*	2	17	17	0
Guillemot	*Uria aalge*	205	925	795	130
Razorbill	*Alea torda*	47	116	99	17
Razorbill / Guillemot	*Alea torda / Uria aalge*	1	60	60	0
Puffin	*Fratercula arctica*	382	876	631	245
Shag	*Phalacrocorax aristotelis*	4	9	9	0
Great Northern Diver	*Gavia immer*	1	1	1	0
	Total	**5750**	**65242**	**21468**	**43774**

Of the 5750 seabird records collected during the survey, 5106 were recorded during line transect effort. All 25 seabird species recorded during the survey were recorded during line transect survey effort, however, one species group, razorbill/guillemot, was not recorded during line transect effort. In total, 39293 seabirds were recorded during line transect effort, with 16277 of these recorded as 'in-transect'. The remaining 23016 seabirds were recorded as 'off-transect'. A breakdown of all species encountered during line transect effort watches is presented in *Table 3*.

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

Common Name	***Species name***	***No. of records***	***No. of Seabirds***	***In Transect***	***Off Transect***
Fulmar	*Fulmarus glacialis*	1220	8942	1893	7049
Sooty Shearwater	*Puffinus griseus*	10	16	13	3
Manx Shearwater	*Puffinus puffinus*	497	13504	7696	5808
Fea's type Petrel	*Pterodroma feae/ deserta*	1	1	1	0
Wilson's Petrel	*Oceanites oceanicus*	6	6	6	0
Storm Petrel	*Hydrobates pelagicus*	482	1914	989	925
Leach's Petrel	*Oceanodroma leucorhoa*	1	1	1	0
Gannet	*Morus bassanus*	1836	11384	3726	7658
Pomarine Skua	*Stercorarius pomarinus*	5	7	5	2
Arctic Skua	*Stercorarius parasiticus*	7	9	7	2
Long-tailed Skua	*Stercorarius longicaudus*	6	8	8	0
Great Skua	*Stercorarius skua*	114	146	91	55
Common Gull	*Larus canus*	1	1	1	0
Sabine's gull	*Larus sabini*	1	1	1	0
Black-headed Gull	*Larus ridibundus*	1	1	1	0
Lesser Black-backed Gull	*Larus fuscus*	141	597	156	441
Herring Gull	*Larus argentatus*	12	29	22	7
Yellow-legged gull	*Larus michahellis*	5	6	0	6
Great Black-backed Gull	*Larus marinus*	17	25	7	18
Kittiwake	*Rissa tridactyla*	129	898	233	665
Common Tern	*Sterna hirundo*	7	15	15	0
Arctic Tern	*Sterna paradisaea*	9	14	10	4
Commic tern sp.	*Sterna hirundo / Sterna paradisaea*	2	17	17	0
Guillemot	*Uria aalge*	179	868	745	123
Razorbill	*Alea torda*	43	111	98	13
Puffin	*Fratercula arctica*	369	762	525	237
Shag	*Phalacrocorax aristotelis*	4	9	9	0
Great Northern Diver	*Gavia immer*	1	1	1	0
	Total	**5106**	**39293**	**16277**	**23016**

The distribution of all sightings of seabird species recorded during line transect survey effort can be seen in *Figures 4 to 7*.

Point sampling was conducted at 23 oceanographic and 32 fishing stations. A total of 428 sightings were recorded during point sampling effort, comprising 10704 individuals belonging to 18 (*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.

Common Name	***Species name***	***No. of records***	***Off Transect***
Fulmar	*Fulmarus glacialis*	106	4926
Sooty Shearwater	*Puffinus griseus*	5	7
Manx Shearwater	*Puffinus puffinus*	20	133
Wilson's Petrel	*Oceanites oceanicus*	1	1
Storm Petrel	*Hydrobates pelagicus*	47	1450
Gannet	*Morus bassanus*	136	3447
Pomarine Skua	*Stercorarius pomarinus*	2	2
Arctic Skua	*Stercorarius parasiticus*	3	3
Long-tailed Skua	*Stercorarius longicaudus*	3	4
Great Skua	*Stercorarius skua*	29	93
Lesser Black-backed Gull	*Larus fuscus*	40	460
Herring Gull	*Larus argentatus*	2	5
Great Black-backed Gull	*Larus marinus*	6	10
Kittiwake	*Rissa tridactyla*	18	143
Common Tern	*Sterna hirundo*	2	7
Guillemot	*Uria aalge*	3	3
Razorbill	*Alea torda*	2	3
Puffin	*Fratercula arctica*	3	7
	Total	**428**	**10704**

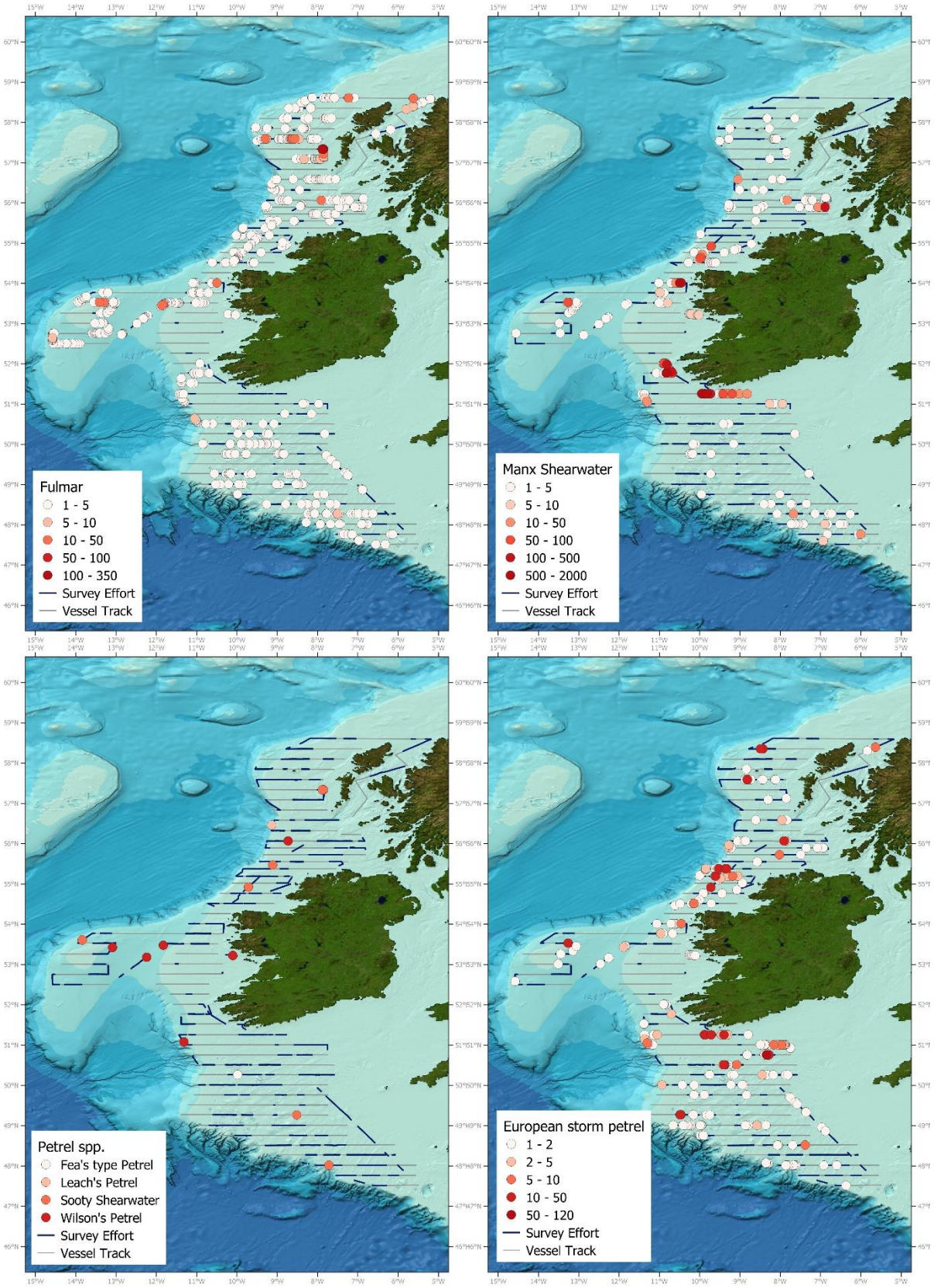

Figure 4: Distribution and abundance of seabird sightings recorded as 'In transect' during line transect effort on the survey; a) fulmar, b) Manx shearwater, c) petrel spp., d) European storm petrel. Seabird survey effort transects are overlaid on the survey track line.

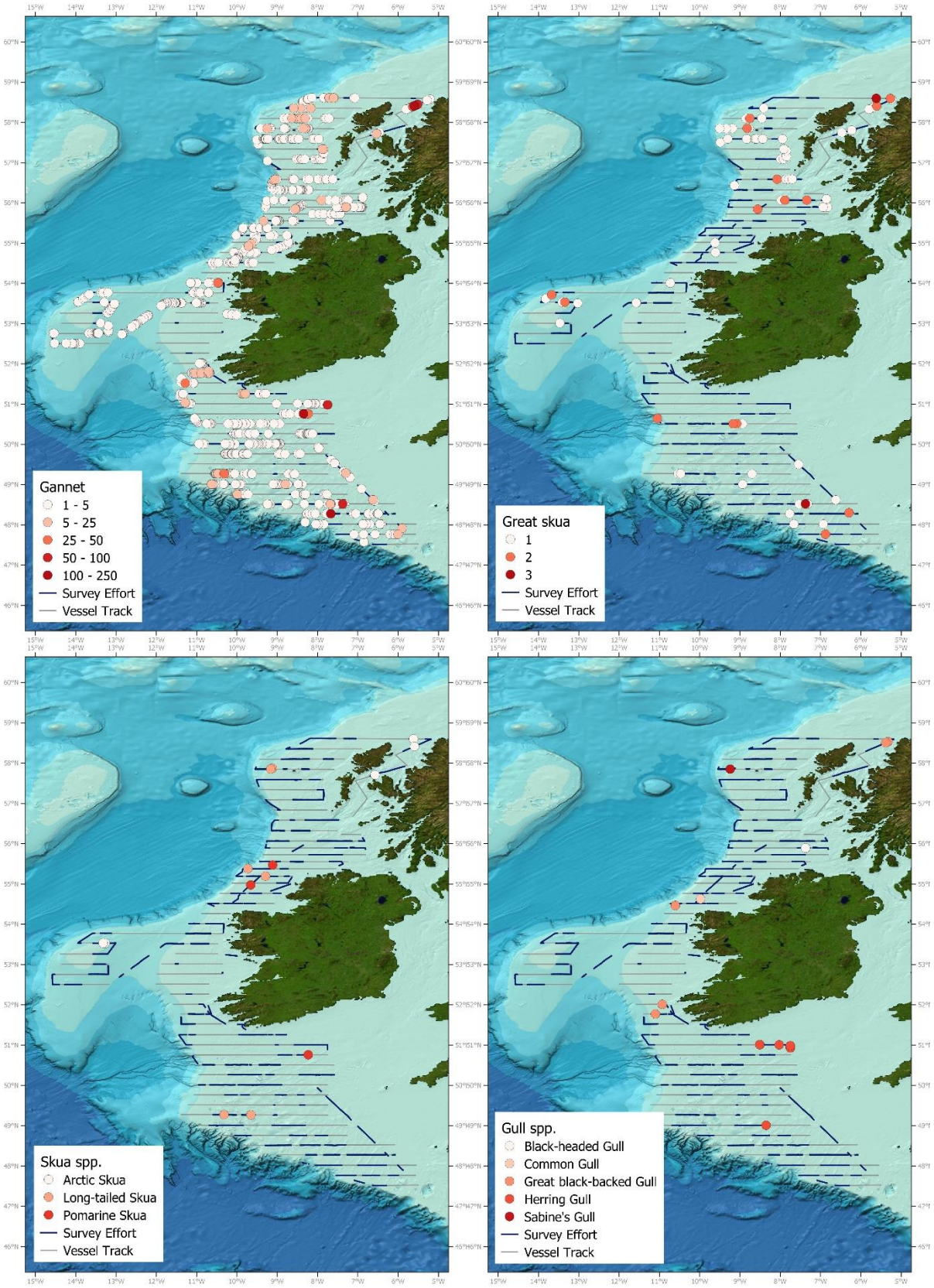

Figure 5: Distribution and abundance of seabird sightings recorded as 'In transect' during line transect effort on the survey; a) gannet, b) great skua, c) skua spp., d) gull spp. Seabird survey effort transects are overlaid on the survey track line.

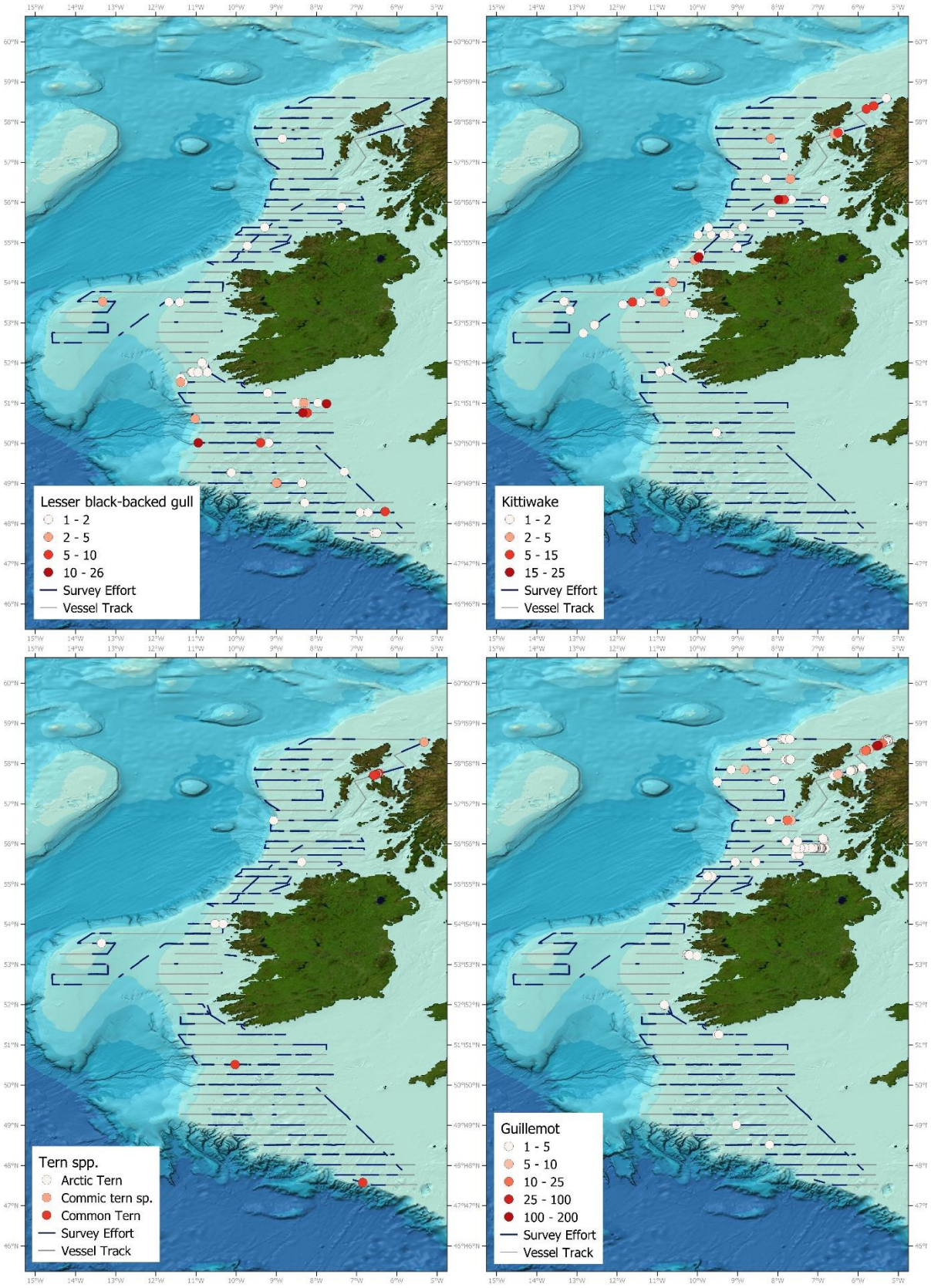

Figure 6: Distribution and abundance of seabird sightings recorded as 'In transect' during line transect effort on the survey; a) lesser black-backed gull, b) kittiwake, c) tern spp., d) guillemot Seabird survey effort transects are overlaid on the survey track line.

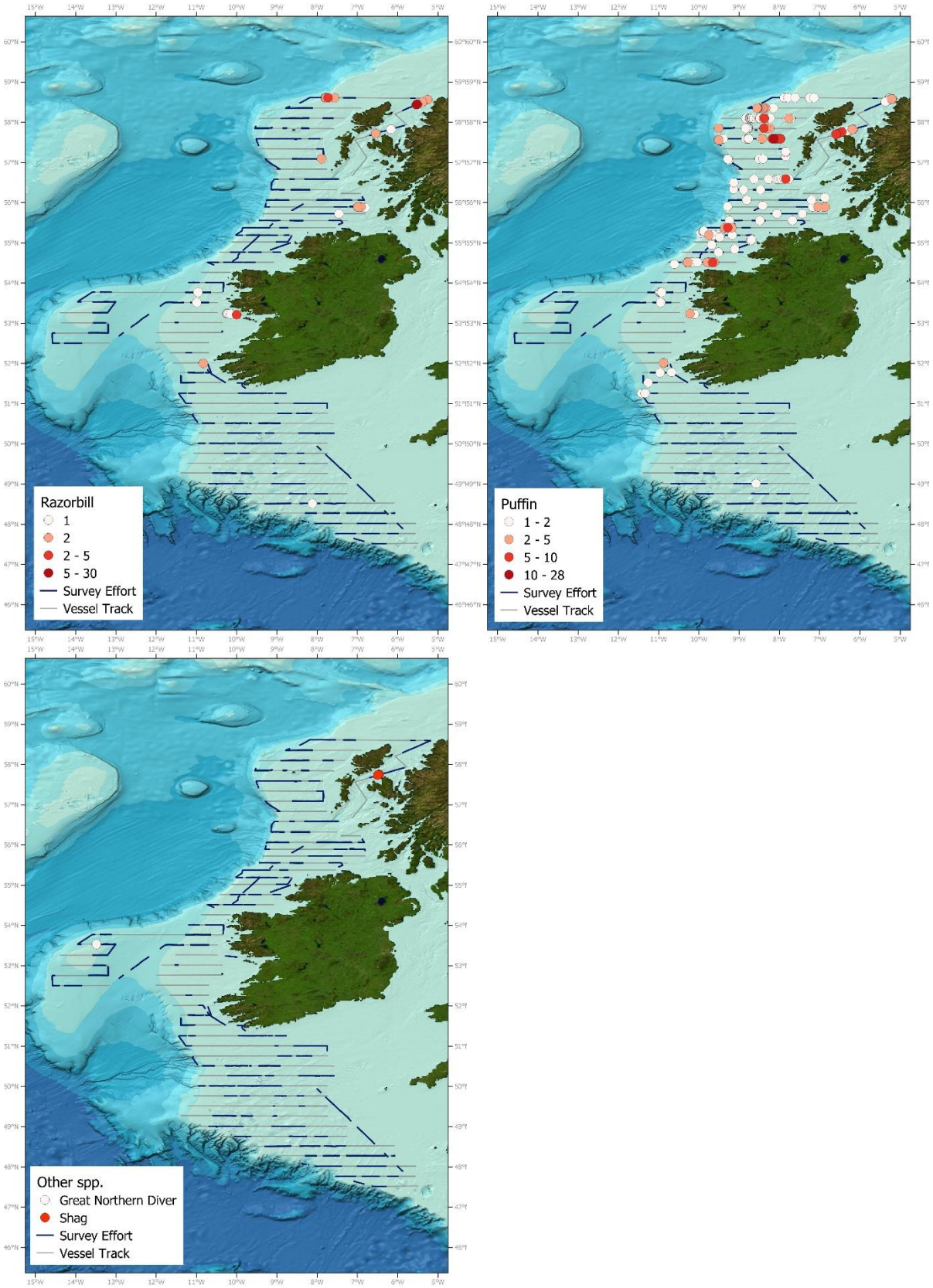

Figure 7: Distribution and abundance of seabird sightings recorded as 'In transect' during line transect effort on the survey; a) razorbill, b) puffin, c) other spp. Seabird survey effort transects are overlaid on the survey track line.

Gannet

Overall, Gannet (*Morus bassanus*) were the most frequently encountered seabird species on the survey, being recorded on 2048 occasions and totalling 16681 individuals. In total, 1836 sightings of 11384 individuals were recorded during line transect watches, with 3726 individuals recorded as 'in-transect', making gannets one of the most abundant species recorded during line transect effort. Gannets were also regularly recorded during point sampling watches (136 sightings totalling 1447 individuals), being regular attendants during fishing events. Gannets were found to be broadly distributed in low numbers across the entire survey area, although they were found to display a somewhat patchy distribution with high abundances recorded in a number of locations such as; the Whittard canyon system, Labadie bank, west of the Skellig Islands, Stanton bank and around St. Kilda and the western reaches of the Scottish continental shelf, and the upper Minch.

Fulmar

Northern fulmar (*Fulmarus glacialis*) were the second most frequently encountered seabird species on the survey being recorded on 1344 occasions and totalling 14115 individuals. In total, 1220 sightings of 8942 individuals were recorded during line transect watches, with 1893 individuals recorded as 'in-transect', making fulmars the third most abundant species recorded during line transect effort. Fulmars too were in regular attendance at fishing haul locations, with 106 records totalling 4926 individuals recorded during point sampling watches. Similar to gannets, fulmars were found to be broadly distributed in low numbers across the entire survey area, although they were recorded more frequently in the more northerly latitudes, with fewer records in the Celtic sea. Fulmars were also found to display a somewhat patchy distribution with particularly high abundances recorded around Stanton bank, St. Kilda, west of Barra, and the western reaches of the Scottish continental shelf.

Storm petrels

Three species of storm petrel were encountered on the survey including; European storm petrel (*Hydrobates pelagicus*), Leach's storm petrel (*Oceanodroma leucorhoa*) and Wilson's storm petrel (*Oceanites oceanicus*). All three species were recorded as 'in-transect' during line transect survey effort. Both the European storm petrel and Wilson's storm petrel were also recorded during point sampling watches.

European storm petrels were the most frequently encountered species of storm petrel and one of the most commonly sighted seabirds on the survey, totalling 555 sightings of 3628 individuals. In total, 482 sightings of 1914 individuals were recorded during line transect watches, with 989 individuals recorded as 'in-transect', making storm petrels one of the most abundant species recorded during line transect effort.

European storm petrels were found to display a broad distribution across the survey area, however, they were very patchily distributed with particularly high abundances recorded in the waters over the Labadie bank, south of Mizen head, outer shelf waters west of Donegal, Stanton bank and the western reaches of the Scottish continental shelf.

Wilson's storm petrel were recorded on 7 occasions (comprising 7 individuals) during the survey, with all but one of these being recorded as 'in-transect' during line transect watches. A single sighting of a lone Leach's storm petrel was recorded as 'in-transect' during line transect effort on the continental shelf slopes west of Barra.

Shearwaters & petrels

Two species of shearwater were encountered on the survey; sooty shearwater (*Puffinus griseus*) and Manx shearwater (*Puffinus puffinus*). One Fea's type petrel (*Pterodroma feae/ deserta*) was also recorded during the survey. All three species were recorded during line transect survey effort, with all each species also recorded as 'in-transect' on at least one occasion. Both the Manx shearwater and sooty shearwater were also recorded during point sampling watches.

Manx shearwaters were the most frequently encountered shearwater species on the survey. Manx shearwater were the most abundant and one of the most frequently recorded species overall, with a total of 553 recorded sightings of 26098 individuals. In total, 497 sightings of 13504 individuals were recorded during line transect watches. Manx shearwaters were the most abundant species recorded during line transect effort with 7696 individuals recorded as 'in-transect'.

Manx shearwaters were less frequently encountered in the greater Celtic sea, and when they were sighted, they were recorded in low numbers. However, very large numbers of Manx shearwater were encountered along the south coast of Cork from the Seven Heads to Mizen head. The waters west of the Skellig islands, west of Achill and over Stanton bank were also found to be rich with Manx shearwaters.

Auks

Three species of auk were encountered on the survey including; Atlantic puffin (*Fratercula arctica*), guillemot (*Uria aalge*) and razorbill (*Alea torda*). All three species were recorded during both line transect and point sampling survey effort. All three species were also recorded as 'in-transect' during line transect watches. A single sighting of 60 auks identified razorbill/ guillemot (*Alea torda/ Uria aalge*) was also recorded during a casual watch.

Auks were rarely encountered in the Celtic sea with only 5 records of auks being recorded as 'in-transect'. Auks were more commonly encountered along Ireland's west coast but were found to be particularly abundant around the Minch, Outer Hebrides and Stanton bank areas.

Guillemots were the most frequently encountered of the three auk species and one of most frequently encountered species on the survey (205 sightings of 925 individuals). In total, 179 sightings of 868 individuals were recorded during line transect watches, with 745 individuals recorded as 'in-transect', making guillemots one of most abundant species recorded during line transect effort. Guillemots were frequently recorded in the waters over Stanton bank and at in the upper Minch.

Puffins were the second most frequently encountered of the three auk species and one of most frequently encountered species on the survey (382 sightings of 876 individuals). In total, 369 sightings of 762 individuals were recorded during line transect watches, with 525 individuals recorded as 'in-transect'. Puffins were more frequently recorded as 'in-transect' along the Scottish continental shelf margins and around St. Kilda than either of the other two auk species. The waters along the north Mayo coast and over Stanton bank were found to have abundant puffins.

Razorbills were the most infrequently encountered of the three auk species (47 sightings of 116 individuals). In total, 43 sightings of 111 individuals were recorded during line transect watches, with 98 individuals recorded as 'in-transect'. Similar to guillemots, razorbills were most abundant in the waters over Stanton bank and at in the upper Minch.

Skuas

Four species of skua were encountered on the survey including; Arctic skua (*Stercorarius parasiticus*), great skua (*Stercorarius skua*), long-tailed skua (*Stercorarius longicaudus*) and pomarine skua (*Stercorarius pomarinus*). All four species were recorded during line transect survey effort, and each species was also recorded as 'in-transect'. Each species was also recorded during point sampling watches.

Great skuas were regularly encountered in low numbers throughout the survey (144 sightings of 240 individuals), however, they were recorded more frequently and in higher numbers around Stanton bank, St. Kilda, west of Barra, and the western reaches of the Scottish continental shelf. During line transect survey effort, great skuas were encountered on 114 occasions, totalling 146 individuals. Of these, 91 individuals were recorded as 'in-transect'.

Gulls

Eight species of gull were encountered on the survey including; common gull (*Larus canus*), Sabine's gull (*Larus sabini*), black-headed gull (*Chroicocephalus ridibundus*), lesser black backed gull (*Larus fuscus*), herring gull (*Larus argentatus*), yellow-legged gull (*Larus michahellis*), great black-backed gull (*Larus marinus*) and black-legged kittiwake (*Rissa tridactyla*). All species were recorded during line transect, with all except for yellow-legged gull also recorded as 'in-transect' during line transect watches.

Lesser black-backed gulls were the most frequently encountered gull species on the survey with a total of 1187 individuals recorded during 192 sighting events. They were the second most abundant species of gull with 597 individuals recorded during 141 sightings while conducting line transect watches. Of these, 156 birds were recorded as 'in-transect'. A large number of the 192 lesser black-backed gull records were recorded during point sampling watches (40 sightings totalling 460 individuals). Lesser black-backed gulls were most commonly encountered in the Celtic sea, particularly on the Labadie bank.

Kittiwakes were the second most frequently encountered gull species on the survey with a total of 1089 individuals recorded during 152 sighting events. However, kittiwakes were the most abundant species of gull and one of the most abundant seabird species with 898 individuals recorded during 129 sightings while conducting line transect watches. Of these, 233 birds were recorded as 'in-transect'. Kittiwakes were also regularly recorded during point sampling watches (18 sightings totalling 143 individuals). Kittiwakes were commonly encountered in the waters west of Achill, on the Stanton bank and through the Minch, however, they were much less common in the Celtic sea.

The remaining 6 species of gull recorded during the survey were encountered much less frequently. Great black-backed gulls were recorded 26 times during the survey with 17 records of 25 birds being recorded as 'in-transect'. Herring gull were recorded 18 times during the survey with 12 records of 29 birds being recorded as 'in-transect'. Yellow-legged gulls were encountered on 5 occasions with a total of 6 birds being recorded. All of these records were recorded during line transect watches, however all were recorded as 'off-transect'. As such, yellow-legged gulls do not feature in the 'in-transect' species maps presented in this report, however all records were recorded on the more southerly transects in the Celtic sea. Common, Sabine's and black-headed gulls were each recorded once during the survey, with each record being 'in-transect'.

Terns

Two species of tern were encountered on the survey including; Arctic tern (*Sterna paradisaea*) and common tern (*Sterna hirundo*). Both species were on 9 occasions during the survey and both were also recorded as 'in-transect' during line transect survey effort. Two sighting which could not be identified to species level were also recorded during line transect effort, these were recorded as commic tern sp. (*Sterna hirundo / Sterna paradisaea*) and were both 'in-transect'.

Arctic terns were the tern species most frequently recorded during line transect effort. There were 9 records of 14 individuals recorded during line transect watches, 10 of which were recorded as 'in-transect'.

Common terns were recorded on 7 occasions during line transect effort, totalling 15 individuals, all of which were recorded as 'in-transect'. Common terns were also recorded on two occasions during point sampling watches.

Great northern diver

A single record of a lone great northern diver (Gavia immer) was also recorded as 'in-transect' during line transect effort. This was individual was recorded on the Porcupine bank over 120 nautical miles west of Slyne head.

Shag

Shag (*Phalacrocorax aristotelis*) were recorded on 4 occasions during the survey. Each encountered during line transect effort in the Minch, with all 9 birds recorded as 'in-transect'.

Terrestrial/ migratory birds

A number of terrestrial/ migratory birds were encountered during the survey. A total of 10 sightings of terrestrial/ migratory bird species were recorded during the survey (*Table 5*). These sightings comprised of 71 individuals from 8 species. Notable sightings included a spotted flycatcher (*Muscicapa striata*), a black redstart (*Phoenicurus ochruros*), a white-tailed eagle (*Haliaeetus albicilla*), and a group of 4 tufted duck (*Aythya fuligula*).

All terrestrial/ migratory bird species recorded during the survey were recorded as 'off transect' regardless of whether they were recorded during line transect or point sampling watches. The distribution of terrestrial/ migratory bird can be seen in *Figure 8* below.

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

Common Name	***Species name***	***No. of Sightings***	***No. of Individuals***
Black Redstart	*Phoenicurus ochruros*	1	1
Black-tailed Godwit	*Limosa limosa*	1	46
Collared Dove	*Streptopelia decaocto*	2	2
Common Scoter	*Melanitta nigra*	1	14
Spotted Flycatcher	*Muscicapa striata*	1	1
Swallow	*Hirundo rustica*	2	2
Tufted Duck	*Aythya fuligula*	1	4
White-tailed Eagle	*Haliaeetus albicilla*	1	1
	Total	**10**	**71**

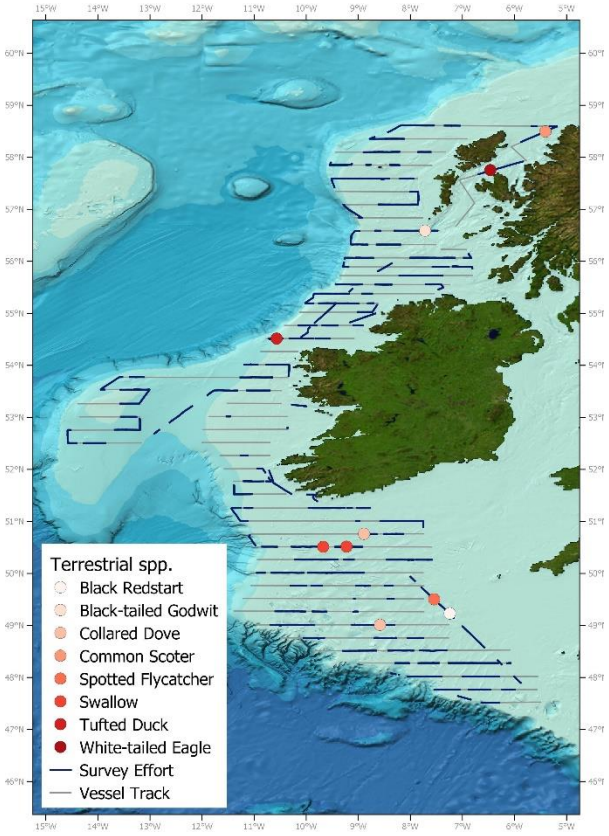

Figure 7: Distribution of terrestrial/ migratory bird sightings recorded on the survey.

Discussion

As in previous surveys, a large number of sightings, from a broad range of taxa and species groups, and a high abundance of seabirds were observed over the course of the survey. In total, 31 species of seabird and 8 species of terrestrial bird were recorded during the present survey. This is consistent with the species totals from previous seabird surveys during WESPAS. 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.

Survey effort has varied across the time series of surveys. During the present survey a total of 271 hours and 5 minutes of survey effort was conducted, 211 hours and 54 minutes of survey effort were conducted using a line transect methodology, while 51 hours and 46 minutes of effort were conducted using the point sampling methodology. A total of 225 hours and 40 minutes of survey effort were recorded in 2019, and 156 hours and 16 minutes of survey effort were recorded in 2018. 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.

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 in that it 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 5th – 29th July covering the Celtic sea region, while in 2017 the seabird survey ran from the 9th- 28th June in the Celtic sea. The 2018 seabird survey did run for the duration of WESPAS from the 10th- 27th June and 4th- 23rd July, as did the present survey. The number of seabird observers deployed has also varied through the years with a single observer deployed in 2016, 2018 and 2020, 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 species sighting and abundance results obtained across the surveys.

This year saw the notable addition of a Fea's type Petrel to the list of seabirds recorded during WESPAS. This sighting was the earliest recorded in Irish waters. This rare sighting demonstrates the value of conducting seabird surveys in offshore waters.

Large shearwater species were notably absent this year. Great shearwater were not recorded during the present survey despite having been recorded on all previous WESPAS surveys. Similarly Cory's shearwater were not recorded during this years' survey despite having been recorded in 2016, 2017 and 2018. Great shearwater were recorded in low numbers in 2017, 2018 and 2019, while Cory's shearwater were recorded in low numbers in both 2017 and 2018. Both species were present in high numbers during the 2016 survey, however, this was most likely due to the differing survey schedule that year. The difference in occurrence of these large shearwaters in the present survey in comparison to previous surveys is also likely a result of the differing survey schedule. This year's survey began two weeks earlier than the surveys of preceding years, thus the large shearwaters had probably yet to reach Irish waters during their annual migration.

European storm petrels were one of the most commonly encountered and most abundant species recorded on the survey. In fact, all species of storm petrel frequenting Irish waters were recorded on this year's survey. The sighting rate, however, was found to be particularly weather dependant. With

increasing sea state, the sightings of storm petrel were found to drop off dramatically, indicating the presence of a detection bias in higher sea states. It is therefore likely that the results obtained in this survey may substantially underestimate the true abundance of storm petrels. A suitable correction factor, such as that proposed by Tasker *et al,* (1984) and used in previous studies (e.g. Mackey, *et al.*, 2004; Pollock, *et al.*, 1997) should be applied to account for this detection bias. Similar biases likely also exist for other inconspicuous species'.

Also of note was the recording of Wilson's Storm-petrel near to the Islands of St. Kilda. The record has been submitted to the Scottish rarities committee, provided it is accepted, this record would constitute the 5th ever record for Scottish waters (SOC, 2020).

Manx shearwater, guillemot, fulmar, gannet and European storm petrel were the most abundant and widespread species' 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 very high seabird density and diversity were observed over the course of the survey. These included sites such as; the Whittard canyon system, Labadie bank, south of Mizen head, west of the Skellig and Blasket Islands, the North Mayo coast, outer shelf waters west of Donegal, Stanton bank, west of Barra, the Minch, St. Kilda and the western Scottish continental slopes.

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 together with fish school 'marks' detected near the surface using the ships acoustic survey equipment. 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 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 would be recommended for this survey in order to meet the minimum requirements for proper implementation of ESAS survey methodology. The present survey used a single ESAS trained seabird observer acting as both observer and scribe. 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 and minimise observer fatigue but would not be sufficient to cover all daylight hours. This approach could be used to conduct survey effort over a 10-12 hour period but with breaks in effort required during meal times.

To maximize the potential of the survey, a team of six seabird observers would be required. This would allow the survey to be conducted using two teams of three working on opposite shifts. This approach should allow full coverage of all survey areas during daylight hours. However, the authors appreciate the constraints on using such a large seabird survey team.

Both approaches 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 times without suffering the ill effects of fatigue.

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Finally, the seabird observers 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 observers look forward to future collaborations.

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Appendix 1

Table 6: Seabird sighting records from Western European Shelf Pelagic Acoustic Survey from 2016-2020 (Power and Connaughton, 2019)[1].

		2020		2019		2018		2017		2016	
Common Name	*Species name*	*On-transect*	*Off-transect*	*On-transect*	*Off-transect*	*On-transect*	*Off-transect*	*On-transect*	*Off-transect*	*On-transect*	*Off-transect*
Fulmar	*Fulmarus glacialis*	1893	7049	1002	2706	336	1023	705	495	1216	792
Balearic Shearwater	*Puffinus mauretanicus*	-	-	0	1	-	-	1	0	-	-
Cory's Shearwater	*Calonectris diomedea*	-	-	-	-	4	2	11	2	282	360
Great Shearwater	*Puffinus graves*	-	-	0	1	3	3	3	1	70	45
Manx Shearwater	*Puffinus puffinus*	7696	5808	1902	859	374	394	2855	206	1111	826
Macaronesian Shearwater	*Puffinus baroli*	-	-	-	-	-	-	-	-	0	1
Sooty Shearwater	*Puffinus griseus*	13	3	1	5	3	10	22	8	15	43
Fea's type petrel	Pterodroma feae/ deserta	1	0								
Unidentified Shearwater sp.		-	-	-	-	1	0	-	-	-	-
European Storm Petrel	*Hydrobates pelagicus*	989	925	847	1125	60	296	1097	645	957	921
Leach's Petrel	*Oceanodroma leucorhoa*	1	0	2	1	-	-	2	0	3	0
Wilson's Petrel	*Oceanites oceanicus*	6	0	1	4	0	1	3	0	9	4
Unidentified Storm petrel		-	-	-	-	1	6	-	-	-	-
Cormorant	*Phalacrocorax carbo*	-	-	-	-	0	4	-	-	-	-
Shag	*Phalacrocorax aristotelis*	9	0	3	0	0	5	-	-	0	1
Great Northern Diver	*Gavia immer*	1	0	-	-	1	0	-	-	-	-
Gannet	*Morus bassanus*	3726	7658	821	3039	1032	3542	3157	1151	2345	941
Grey Phalarope	*Phalaropus fulicarius*	-	-	-	-	-	-	-	-	17	0
Arctic Skua	*Stercorarius parasiticus*	7	2	0	1	1	2	-	-	1	1
Great Skua	*Stercorarius skua*	91	55	50	56	23	43	11	6	16	22
Long-tailed Skua	*Stercorarius longicaudus*	8	0	0	1	-	-	-	-	3	3
Pomarine Skua	*Stercorarius pomarinus*	5	2	0	3	0	1	0	1	2	3
South Polar Skua	*Stercorarius maccormicki*	-	-	0	1	-	-	-	-	-	-
Black Headed Gull	*Chroicocephalus philadelphia*	1	0	-	-	-	-	0	1	-	-
Common Gull	*Larus canus*	1	0	-	-	2	10	-	-	-	-
Kittiwake	*Rissa tridactyla*	233	665	629	216	30	54	11	22	50	170
Sabine's Gull	*Xema sabini*	1	0	-	-	2	0	1	3	-	-
Herring Gull	*Larus argentatus*	22	7	2	16	2	33	1	15	0	6
Great Black-backed Gull	*Larus marinus*	7	18	7	26	6	35	1	36	6	77
Lesser Black-backed Gull	*Larus fuscus*	156	441	27	289	238	587	458	164	14	246
Yellow-legged Gull	*Larus michahellis*	0	6	-	-	-	-	-	-	0	1

Unidentified gull sp.	*Larus sp.*	-	-	-	-	0	2	-	-	-	-
Unidentified Large gull sp.	*Larus sp.*	-	-	-	-	21	4	150	0	-	-
Arctic Tern	*Sterna paradisaea*	10	4	9	8	0	3	3	1	16	9
Commic tern sp.	*Sterna hirundo / paradisaea*	17	0	0	15	-	-	-	-	-	-
Common Tern	*Sterna hirundo*	15	0	3	5	0	7	5	0	1	0
Little Tern	*Sterna albifrons*	-	-	3	0	-	-	-	-	-	-
Unidentified Sterna sp.	*Sterna sp.*	-	-	-	-	0	17	-	-	-	-
Auk sp.	*Alcidae sp.*	-	-	212	145	-	-	-	-	-	-
Guillemot	*Uria aalge*	745	123	1043	77	431	252	11	1	47	10
Razorbill	*Alea torda*	98	13	273	47	232	89	5	1	12	0
Unid. Razorbill/ Guillemot	*Alea torda/ Uria aalge*	-	-	-	-	552	651	-	-	-	-
Atlantic Puffin	*Fratercula arctica*	525	237	237	171	317	405	36	3	194	105
		16277	**23016**	**7074**	**8818**	**3670**	**7481**	**8549**	**2762**	**6387**	**4533**

[1] *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 and Connaughton, 2019)[1].

Common Name	*Species name*	*2020*	*2019*	*2018*	*2017*	*2016*
Black Redstart	*Phoenicurus ochruros*	*1*	-	-	-	-
Black-tailed Godwit	*Limosa limosa*	*46*	-	-	-	-
Collared Dove	*Streptopelia decaocto*	*2*	2	6	-	-
Common Scoter	*Melanitta nigra*	*14*	21	-	-	-
Dunlin	*Calidris alpina*	-	1	25	-	17
Feral/ Racing Pigeon	*Columba livia domestica*	-	5	7	18	1
Golden Eagle	*Aquila chrysaetos*	-	2	-	-	-
Golden Plover	*Pluvialis apricaria*	-	-	-	1	-
Greenish Warbler	*Phylloscopus trochiloides*	-	-	-	1	-
Pied Wagtail	*Motacilla alba*	-	1	-	-	-
Oystercatcher	*Haematopus ostralegus*	-	-	-	2	-
Redshank	*Tringa totanus*	-	5	-	-	-
Spotted Flycatcher	*Muscicapa striata*	*1*	1	-	-	-
Swallow	*Hirundo rustica*	*2*	2	-	-	-
Swift	*Apus apus*	-	12	1	5	1
Tufted Duck	*Aythya fuligula*	*4*	-	-	-	-
Turnstone	*Arenaria interpres*	-	-	-	-	1
Unidentified Passerine		-	-	1	-	-
Whimbrel	*Numenius phaeopus*	-	-	-	1	1
White-tailed Eagle	*Haliaeetus albicilla*	*1*	-	-	-	-
	Total	**71**	**52**	**40**	**28**	**21**

[1] *The survey timing, survey direction and number of seabird surveyors deployed has not remained constant annually.*

Further details available on www.emff.marine.ie

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