CASTLEBANNY WIND FARM, CO. KILKENNY: LITERATURE REVIEW, ANALYSES OF GPS TRACKING DATA, AND ANALYSES OF VANTAGE POINT SURVEY DATA, TO INFORM THE ASSESSMENT OF COLLISION RISK TO THE SALTEE ISLANDS LESSER BLACK-BACKED GULL POPULATION

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1. INTRODUCTION

Vantage point surveys for the Castlebanny Wind Farm recorded a relatively high level of Lesser Black-backed Gull flight activity and preliminary collision risk modelling indicated that non-negligible levels of collision mortality are likely. Lesser Black-backed Gull is a Qualifying Interest of the Saltee Islands SPA. While the Castlebanny Wind Farm site is around 51 km from the Saltee Islands, a review by Thaxter *et al.* (2012) indicated that Lesser Black-backed Gulls may have a mean foraging range from their breeding colonies of 71.9 km. Therefore, there is potential for development of the wind farm to cause collision mortality impacts to the Lesser Black-backed Gull Qualifying Interest of the Saltee Islands SPA. There is also potential for cumulative impacts in combination with other wind farms. In particular, the Richfield Wind Farm, which is around 11 km from the Saltee Islands colony, and is likely to be on a commuting route used by birds from the colony, may be of particular significance in contributing to any cumulative impacts.

However, while some of the Lesser Black-backed Gull activity at the wind farm site is likely to be associated with this Qualifying Interest, there are other breeding colonies whose foraging ranges are also likely to include the wind farm site, while non-breeding summering birds, birds dispersing from other breeding colonies in late summer, and migrating birds, may also dilute the Saltee Islands component. Therefore, to obtain a reliable estimate of the likely collision mortality to the Saltee Islands Lesser Black-backed Gull population it is necessary to consider a number of factors that could influence the occurrence patterns of birds from the Saltee Islands population and their contribution to the total numbers of Lesser Black-backed Gulls at Castlebanny.

Because of the potential significance of any impacts to the Saltee Islands Lesser Black-backed Gull population, it is also important to make sure that the collision risk modelling takes account of any spatial or temporal structure, or other factors, that could bias the model.

This report contains:

- A literature review and analysis of publicly available GPS tracking data to update Thaxter *et al.*'s (2012) review of Lesser Black-backed Gull foraging ranges, and to assess the likely frequency of Lesser Black-backed Gull flight activity at distances from their colonies representative of the distance of the Castlebanny Wind Farm from the Saltee Islands colony.
- An analysis of a large year-round GPS tracking dataset to assess dispersal patterns of Lesser Black-backed Gull from their breeding colonies, to help identify the appropriate seasonal divisions for the Castlebanny Wind Farm collision risk modelling.
- A review of Irish Lesser Black-backed Gull count data from a number of sites to assess the timing of Lesser Black-backed Gull migration through Ireland, which also helped to identify the appropriate seasonal divisions for the Castlebanny Wind Farm collision risk modelling.
- Analyses of the Lesser Black-backed Gull data from the vantage point surveys carried out for the Castlebanny Wind Farm to assess occurrence patterns at Castlebanny in relation to the general movement and migration patterns identified in this review.

It should be noted that the analyses of the GPS tracking datasets presented in this report are simple analyses that are designed to indicate broad patterns, rather than to provide precise quantitative data, or statistical tests.

2. LESSER BLACK-BACKED GULL FORAGING RANGES

2.1. LITERATURE REVIEW

A variety of parameters can be used to summarise seabird foraging ranges but three widely used simple parameters are the mean, mean maximum and maximum foraging ranges. The mean foraging range is the mean of the farthest straight line distance travelled from the colony on each foraging trip, the mean maximum is the mean of the maximum foraging range recorded across multiple studies, while the maximum is the maximum foraging range recorded across a number of studies.

Thaxter *et al.* (2012) published a review of seabird foraging range studies, which reviewed the literature that was available at the time. For Lesser Black-backed Gull, they gave a mean foraging range of 71.9 km, a mean maximum of 141 km and a maximum of 181 km. However, these were based on only two (mean) or three (mean maximum and maximum) studies. Since publication of their study, there has been a dramatic increase in the availability of seabird foraging range data due to developments in GPS tracking technology. Data on mean/median foraging ranges is now available for at least 12 Lesser Black-backed Gull colonies, as summarised in Table 2.1. All these studies report lower mean/median foraging ranges than the mean foraging range reported by Thaxter *et al.* (2012). The overall mean foraging range across all the studies in Table 2.1 is 32 km, the overall mean maximum is 127 km and the maximum remains as 181 km.

Table 2.1. Summary of foraging range data from tracking studies of breeding Lesser Black-backed Gulls.

Country	Colony	Tracking period	Foraging range (km)			Statistics	Source
			maximum	mean / median	error		
Belgium	Zeebrugge	breeding season	123	37	3	mean, SE	6
England	Orford Ness	breeding season	141	23	8	mean, SD	7
Germany	Amrum	incubation		47	20.8-53.6	mean, CI	2
	Borkum	incubation		20	10.2-26.5	mean, CI	2
	Helgoland	incubation		19	10.0-23.7	mean, CI	2
	Juist	incubation		20	9.8-23.2	mean, CI	2
	Norderney	incubation		34	11.6-40.2	mean, CI	2
	Spiekeroog	incubation	73	29		mean	4
Netherlands	Texel	incubation		26		mean	1
	Vlieland	breeding season	181	65	82	mean, SD	3
	Vlissingen	breeding season	115	41	5	mean, SE	6
Sweden	Stora Karlsö	incubation	128	22	15.3-37.5	median, IQR	5

Notes: Orford Ness and Texel statistics are the means of separate data for males and females; Orford Ness statistics refer to offshore foraging trips only; Spiekeroog statistics the means of separate data for offshore and onshore foraging trips; Vlissingen statistics do not include the birds that relocated from Zeebrugge (see Kavelaars et al, 2020); maximum foraging ranges for Vlissingen and Zeebrugge measured from GPS tracking data, which is provided as a supporting dataset by Kavelaars *et al.*, (2020).

Sources: 1 = Camphuysen *et al.*, (2015); 2 = Coman *et al.*, (2016); 3 = Ens *et al.*, (2008); 4 = Garthe *et al.*, (2016); 5 = Isaksson *et al.*, (2016); 6 = Kavelaars *et al.*, (2020); 7 = Thaxter *et al.*, (2015).

The foraging range data used by Thaxter *et al.* (2012) came from three of the colonies that are included in Table 2.1: Helgoland, Orford Ness and Vlieland. However, for two of these colonies (Helgoland and Orford Ness) the sources were earlier publications with more limited data: Shamoun-Baranes *et al.*(2011) for Helgoland and Thaxter *et al.* (2011) for Orford Ness. Shamoun-Baranes *et al.*, (2011) do not provide a mean foraging range value, or data which could be used to derive it. Therefore, the mean foraging range value reported by Thaxter *et al.* (2012) appears to have been derived from data from the Orford Ness and Vlieland colonies. However, there appears to have been a calculation error in deriving this value. Thaxter *et al.* (2011) do not explicitly state a mean foraging range value for the Orford Ness colony, but the value used by Thaxter *et al.* (2012) must be 79.1 km given the mean foraging range reported for the Vlieland colony by Ens *et al.* (2008). This value (79.1 km) corresponds to the mean of the maximum foraging ranges for individual birds in Table 4b of Thaxter *et al.* (2011). The mean of the mean foraging ranges for individual birds in the same table is 43.9 km.

My review indicates that the published estimates of Lesser Black-backed Gull foraging ranges by Thaxter *et al.* (2012) are unreliable due to the limited data that they are based on, and an apparent calculation error. The much more extensive data that is now available indicates that mean Lesser

Black-backed Gull foraging ranges are usually significantly less than the distance of the Castlebanny Wind Farm site from the Saltee Islands colony, but the wind farm site is well within the mean maximum foraging range of the colony.

2.2. ANALYSIS OF GPS TRACKING DATA

The mean/median and maximum foraging ranges provide summary statistics on the distances travelled from colonies. The distance of the Saltee Islands colony from the Castlebanny Wind Farm (51 km) is greater than all but one of the mean/median foraging ranges shown in Table 2.1, and 60% higher than the overall mean across all the studies. However, it is well within the maximum foraging ranges. Therefore, the distribution of foraging trip distances between the mean and maximum values is the relevant factor to consider.

I used three publicly available GPS tracking datasets to investigate the distribution of Lesser Black-backed Gull activity in distance bands from their colonies. These datasets are: the GPS tracking data provided as a supporting dataset by Kavelaars *et al.* (2020), which provides data for the Vlissingen colony in the Netherlands and the Zeebrugge colony in Belgium; and GPS tracking data provided by Garthe (2016) for the Spiekeroog colony in Germany.

Before carrying out the analyses, I deleted records from within 1 km of the colony location, as these will include birds loafing, etc., rather than making foraging trips. I also excluded the relocated birds in the analyses of the Vlissingen dataset (see Kavelaars *et al.*, 2020). I then carried out two analyses of these datasets, using 10 km distance bands centred on the colony locations.

Firstly, I calculated the maximum daily distance from the colony for each individual bird on each day included in the dataset. This will generally correspond to the maximum distance travelled on each foraging trip, as Lesser Black-backed Gulls rarely make overnight trips, but there may be some differences if birds sometimes make more than one foraging trip per day. I then calculated the mean percentage of foraging trips reaching each distance band across all individual-day records. This is a cumulative percentage: e.g., a trip that had a maximum distance from the colony of 20-30 km will have also passed through the 0-10 and 10-20 km distance bands. There was a broadly similar pattern of decay in percentage of trips with distance across the three colonies (Table 2.2). The percentage of trips reaching the 50-60 km distance band (the band that represents the distance of the Castlebanny Wind Farm from the Saltee Islands colony) is 20-32% (mean 26%). Therefore, while the Castlebanny Wind Farm is likely to be outside the mean foraging range of the Saltee Islands colony, this analysis indicates that it could still be frequently visited by birds from the colony.

Table 2.2. Cumulative frequency of distances from colony travelled per day at three North Sea Lesser Black-backed Gull colonies.

Distance band	Spiekeroog	Vlissingen	Zeebrugge
0-10 km	100%	100%	100%
10-20 km	92%	92%	97%
20-30 km	78%	88%	76%
30-40 km	59%	82%	52%
40-50 km	46%	57%	35%
50-60 km	32%	20%	24%
60-70 km	22%	11%	23%
70-80 km	8%	8%	6%
80-90 km	2%	6%	4%
90-100 km	0%	1%	4%
> 100 km	0%	1%	3%

Source: analyses of datasets provided by Garthe (2016) and Kavelaars *et al.* (2020).

For assessing collision risk, it is also relevant to consider the intensity of Lesser Black-backed Gull activity. Lesser Black-backed Gulls on foraging trips typically do not travel straight to the farthest point, feed, and then return to the colony. Instead they may follow circuitous routes and forage at

a number of sites at intermediate locations. Therefore, my second analysis looked at the way the intensity of Lesser Black-backed Gull activity (as measured by GPS registrations) varied with distance bands from their colony location. I restricted this analysis to records from inland foraging trips as the factors that affect Lesser Black-backed Gull movement patterns are likely to vary significantly between offshore and inland foraging trips. The Spiekeroog colony is around 10 km offshore, so I excluded the 0-10 km distance band from the analysis of that dataset. Table 2.3 also shows a general pattern of decay in Lesser Black-backed Gull activity, although there are some bumps (e.g., the relatively high level in the 30-40 km distance band at Vlissingen). However, while 24-32% of foraging trips reach the 50-60 km distance band, only 8-15% of activity occurred at distances of 50 km or greater from the colonies, with 2-7% within the 50-60 km distance band. This data suggests that a relatively low intensity of Lesser Black-backed Gull flight activity from the Saltee Islands colony would be expected around Castlebanny Wind Farm.

Table 2.3. Percentages of activity of Lesser Black-backed Gulls foraging inland in distance bands from three North Sea colonies.

Distance band	Spiekeroog	Vlissingen	Zeebrugge
0-10 km	-	23%	25%
10-20 km	44%	16%	23%
20-30 km	26%	15%	19%
30-40 km	12%	23%	11%
40-50 km	11%	13%	8%
50-60 km	7%	5%	2%
60-70 km	1%	2%	8%
70-80 km	0%	1%	1%
80-90 km	0%	2%	1%
90-100 km	0%	1%	2%
> 100 km	0%	0%	1%

Source: analyses of datasets provided by Garthe (2016) and Kavelaars *et al.* (2020).

The Richfield Wind Farm is around 11 km from the Saltee Islands colony, so it falls within the 10-20 km distance band. However, due to the offshore position of the Saltee Islands colony, there is only a small amount of land within the 0-10 km distance band. Therefore, it is more similar to the Spiekeroog colony, than the Vlissingen or Zeebrugge colonies. However, unlike Spiekeroog, the amount of land within the 0-10 km distance band is not negligible. Therefore, to estimate the likely intensity of flight activity in this distance band, I used the following equation:

Equation 1: $LB_{SI(10\text{-}20)} = LB_{VZ(0\text{-}10)} - (land_{0\text{-}10} / land_{0\text{-}20} \times LB_{VZ(0\text{-}10)}) + LB_{VZ(10\text{-}20)}$

$LB_{SI(10\text{-}20)}$ = estimated percentage of activity of Lesser Black-backed Gulls foraging inland from the Saltee Islands colony within the 10-20 km distance band; $land_{0\text{-}10}$ = land area in the 0-10 km distance band from the Saltee Islands colony; $land_{0\text{-}20}$ = land area in the 0-20 km distance band from the Saltee Islands colony; $LB_{VZ(0\text{-}10)}$ = mean percentage of Lesser Black-backed Gull activity in the 0-10 km distance bands from the Vlissingen and Zeebrugge colonies; $LB_{VZ(10\text{-}20)}$ = mean percentage of Lesser Black-backed Gull activity in the 10-20 km distance bands from the Vlissingen and Zeebrugge colonies

This gives an indicative estimate that 42% of the activity of Lesser Black-backed Gulls foraging inland from the Saltee Islands colony will occur within the 10-20 km distance band. Therefore, the intensity of Lesser Black-backed Gull activity in the 10-20 km distance band (which contains the Richfield Wind Farm) from the Saltee Islands colony may be around an order of magnitude higher than in the 50-60 km distance band (which contains the Castlebanny Wind Farm site)

3. LESSER BLACK-BACKED GULL DISPERSAL FROM BREEDING COLONIES

A large dataset of GPS tracking data is available for the Lesser Black-backed Gull colony at Zeebrugge, Belgium (Stienen *et al.*, 2016, 2020). This dataset contains year-round tracking data for 150 individuals from the colony between 2013 and 2018, and includes a total of over six million

records of GPS registrations. I used this dataset to analyse the movement patterns of Lesser Black-backed Gulls away from the colony across the breeding season.

I used a distance band of 127 km to assess association with the colony. This distance band is based on the mean maximum foraging range estimated in Section 2.1. I then carried out two analyses.

Firstly, I looked at the percentage of individuals that occurred each month within the mean maximum foraging range of the colony. As new birds were tagged in June each year, the analysis only includes the months from June onwards. Individual birds were only included in the analysis if they had GPS records in June and up to at least October in the relevant year. Therefore, by definition, the percentage occurrence is 100% in June. There is little change in July, but there is then a sharp drop to 50-75% occurrence in August, with progressive movement away from the colony continuing across the subsequent months (Figure 3.1).

The analysis in Figure 3.1 indicates the association of individuals with the colony, but does not indicate the overall proportion of activity in the mean maximum foraging range of the colony. My second analysis looked at the distribution of Lesser Black-backed Gull activity as represented by GPS registrations. Figure 3.2 shows the percentage of all GPS records that occurred within the mean maximum foraging range of the colony each month. While this is a relatively crude measurement it shows a clear pattern of a strong concentration of activity within the mean maximum foraging range of the colony from April to July. This is followed by a sharp drop in activity in August, with a mean of 44% of records within the mean maximum foraging range across the six years (range 31-58%). The rest of the activity mainly occurred within distance bands representing the next two multiples of the mean maximum foraging range (i.e., 128-254 km, and 255-381 km), with a mean of 41% of records (range 32-54%) within these distance band across the six years (Table 3.1).

Table 3.1. Distribution of August activity of adult Lesser Black-backed Gulls from the Zeebrugge colony in distance bands from the colony.

Year	% of activity within			
	0-127 km	**128-254 km**	**255-381 km**	**> 381 km**
2013	58%	35%	7%	1%
2014	53%	17%	15%	14%
2015	33%	17%	36%	13%
2016	38%	28%	11%	23%
2017	31%	33%	14%	22%
2018	49%	27%	3%	21%

Source: analysis of GPS tracking data from Stienen *et al.* (2020).

If the movement patterns of Lesser Black-backed Gull from the Zeebrugge colony are representative of typical Lesser Black-backed Gull movement patterns from their breeding colonies, these analyses indicate that most breeding Lesser Black-backed Gull activity occurs within the mean maximum foraging range from April to July. In August, while many individuals remain associated with the colony, the concentration of activity within the mean maximum foraging range decreases sharply and birds may travel much longer distances. In the case of the Castlebanny Wind Farm, a distance band of 254 km from the site would include most of the Irish population as well as many colonies in Wales, while a 381 km distance band would include the remainder of the Irish population and a wide swathe of western Britain.

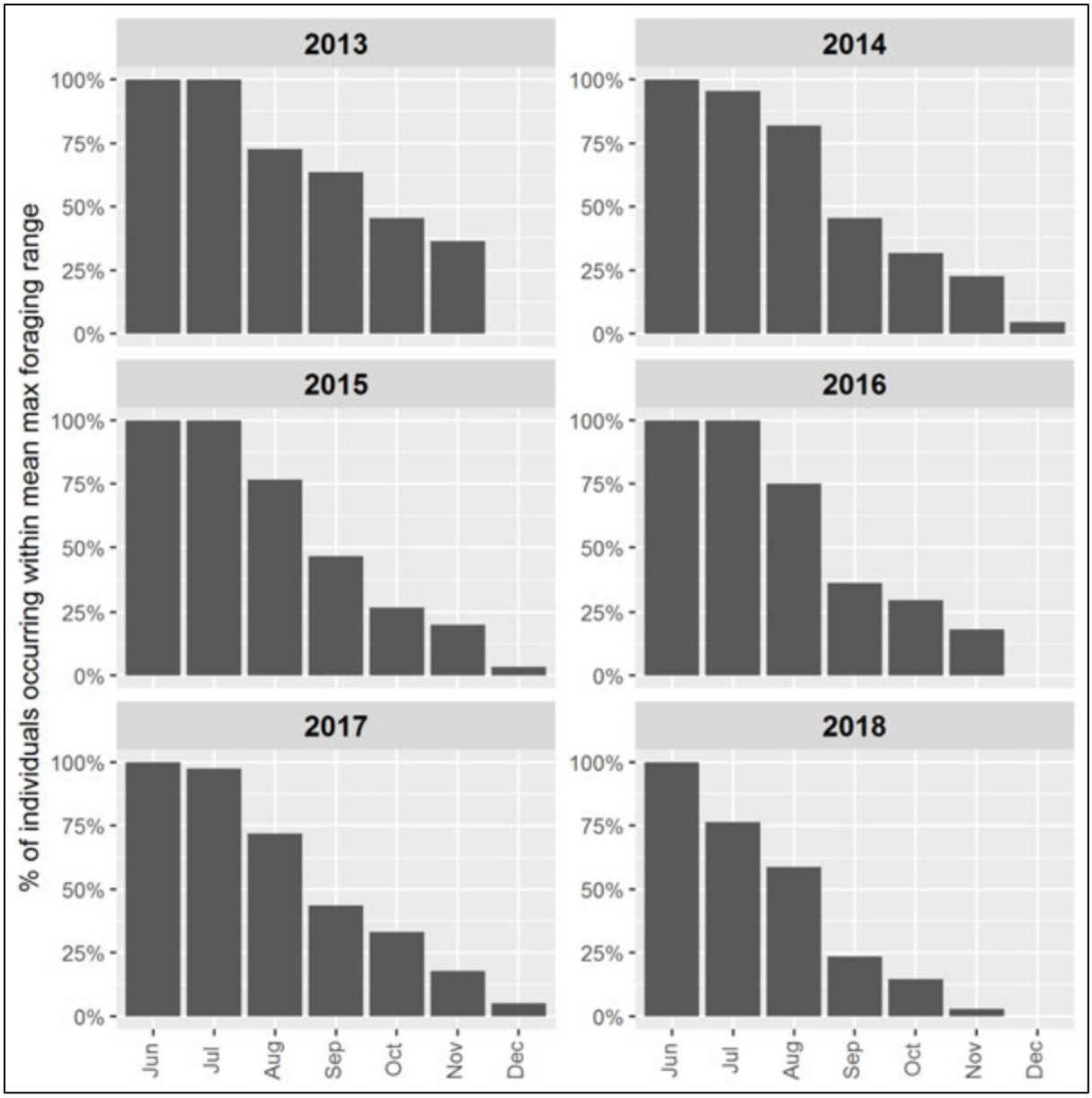

Figure 3.1. Lesser Black-backed Gull movement away from the Zeebrugge breeding colony, as indicated by the percentage of individuals that occurred within the mean maximum foraging range of the colony each month.

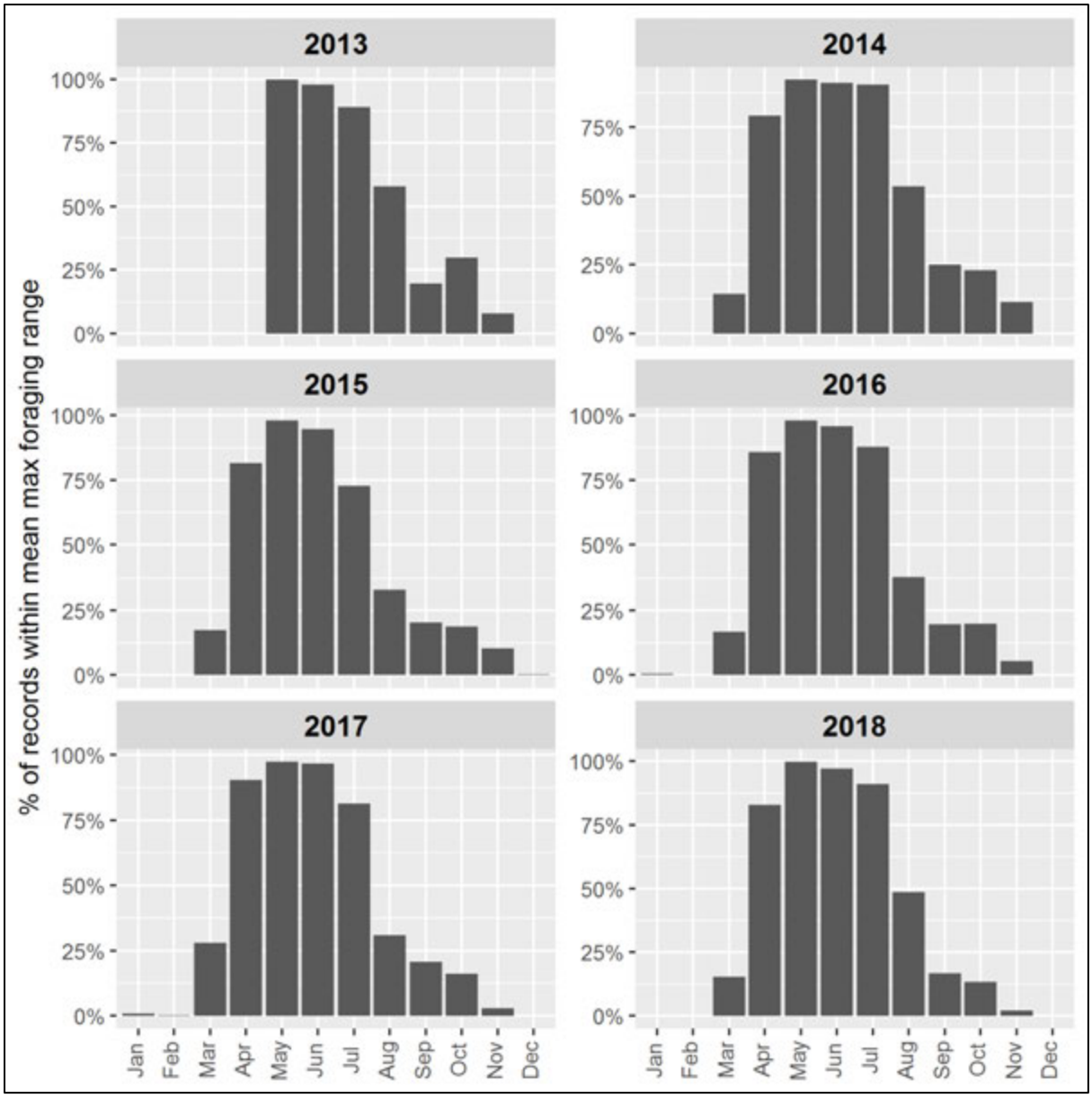

Figure 3.2. Lesser Black-backed Gull occurrence patterns within the mean maximum foraging range of the Zeebrugge colony.

4. LESSER BLACK-BACKED GULL MIGRATION

4.1. GENERAL PATTERNS

Lesser Black-backed Gull typically arrive at their breeding colonies in March/April and depart from late June to August (Table 4.1). However, as indicated by the analyses of the GPS tracking data from the Zeebrugge breeding colony, the overall migration seasons are very protracted. Barnes (1953) described the spring migration period in Britain and Ireland as extending from the middle of February to the end of May, with the autumn migration extending from the end of June to the end of November and noted that the late arrivals in spring included many non-breeding immatures.

Table 4.1. Lesser Black-backed Gull arrival and departure dates at three breeding colonies in north-west Europe.

Country	Colony	Arrival		Departure		Source
		mean	range	mean	range	
Iceland	-	09-Apr	-	12-Aug	-	1
Netherlands	Texel	01-Apr	11 Mar - 25 Apr	14-Jul	10 Jul - 25 Jul	3
Netherlands	Vlieland	16-Apr	30 Mar - 19 May	14-Jul	21 Jun - 5 Aug	2

Sources: 1 = Hallgrimsson *et al.* (2012); 2 = Klaassen *et al.* (2012); 3 = Shamoun-Baranes *et al.* (2017).

Lesser Black-backed Gulls mainly winter along the western seaboard of Europe and Africa with migration routes concentrated along this region. Migrant and wintering Lesser Black-backed Gulls in Ireland include birds from the British and Icelandic breeding populations (Wenham *et al.*, 2002).

4.2. LESSER BLACK-BACKED GULL MIGRATION IN IRELAND

There is little detailed information available about Lesser Black-backed Gull migration patterns in Ireland. Counts are available for many wetland sites through the Irish Wetland Bird Survey (I-WeBS). However, these only cover the period September-March. Also, the presence of large Lesser Black-backed Gull wintering populations in Ireland complicates the interpretation of these count data.

Cork Harbour is a major wintering site for Lesser Black-backed Gulls. However, there are differences in their spatial occurrence patterns within the harbour between autumn and winter. There is a nocturnal roost site in the Glounthaune Estuary, which is occupied from July-October. This roost site is abandoned by late October / early November, while numbers in the main wintering roost site in Lough Mahon build up in mid-winter to peaks of several thousand birds. In 2017, I carried out biweekly counts in the Glounthaune Estuary / Slatty Water complex from April-November. These counts show that small numbers of Lesser Black-backed Gulls occurred across the summer, with a sharp build-up in numbers in early August and with high numbers continuing until mid-October (Figure 4.1). These were daytime counts and much larger numbers occur at the nocturnal roost. For example, on 5th August 2020, I counted 670 Lesser Black-backed Gulls at the roost, while a month later on 3rd September the numbers at the roost had increased to 1,290.

Harper's Island Wetlands is one of the key daytime roost sites for Lesser Black-backed Gulls within the Glounthaune Estuary / Slatty Water complex. The numbers at the roost depend on tidal conditions and other factors, so time sequences of counts do not produce easily interpretable patterns. However, analysis of the large dataset of counts available through the Harper's Island Wetlands eBird hotspot (https://ebird.org/hotspot/L4227847) again shows a clear peak in numbers between August and October, corresponding to the autumn migration period (Figure 4.2). Ballybrannagan Strand on the south Cork coastline shows an even stronger peak in the autumn migration period. At this site, Lesser Black-backed Gull are scarce or absent for most of the year, with a peak count between December and July of 20 birds. However, between mid-August and mid-October, large flocks are regularly present with a mean count of 464 and a peak count of 2,360 (personal data).

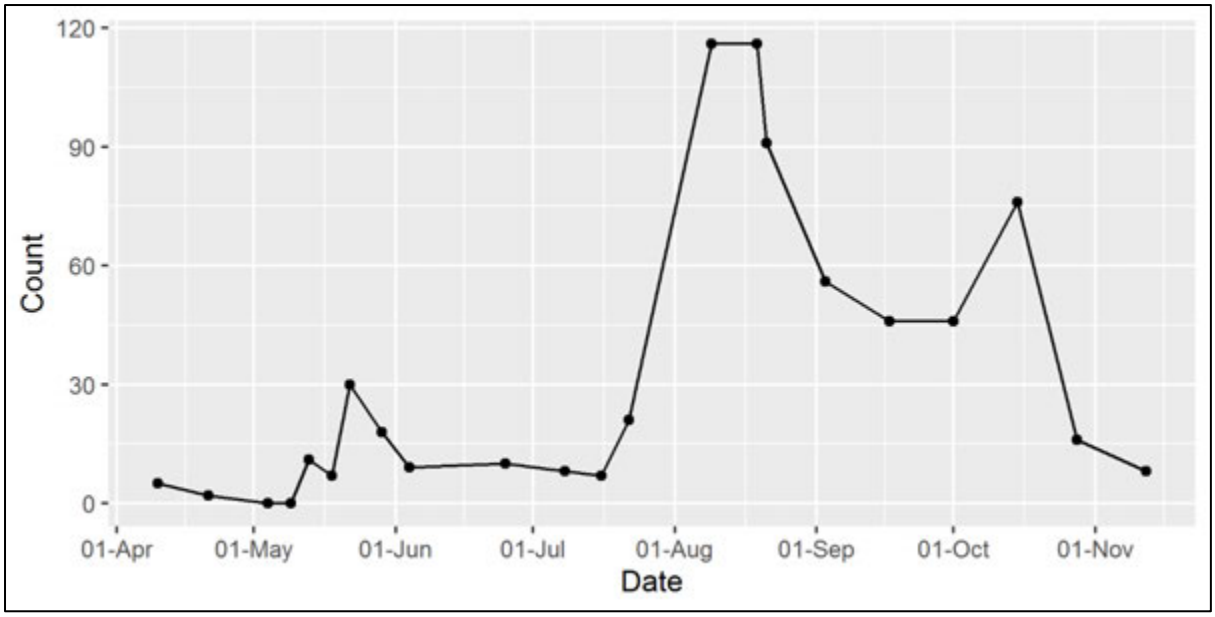

Figure 4.1. Lesser Black-backed Gull counts at in the Glounthaune Estuary/Slatty Water complex, Cork Harbour, April-November 2017.

Along with Harper's Island Wetlands, Tacumshin Lake on the south Wexford coast is one of the few sites in Ireland for which a good series of Lesser Black-backed Gull counts are available through eBird (https://ebird.org/hotspot/L1649011), although there is limited data for the January-March period. Despite the proximity of this site to the Saltee Islands colony, this site also shows a clear peak in Lesser Black-backed Gull numbers corresponding to the autumn migration period (Figure 4.2).

There are few inland sites in Ireland for which regular waterbird monitoring data is available across the summer / autumn period, so data on inland patterns of Lesser Black-backed Gull numbers across is very limited. However, during the autumn migration period, it is common to see large flocks of Lesser Black-backed Gulls feeding on fields long distances from the coast. At the Glounthaune Estuary autumn nocturnal roost, the main direction of arrival in the evening is from the north-east indicating that the birds are arriving from inland areas (personal observations). However, a major Lesser Black-backed Gull roost at Kildavin in Carlow does not start to be occupied until early October (Brian Power, personal communication), indicating that the roost is mainly used by wintering birds.

The limited count data reviewed here does not show much evidence of a spring migration peak, apart from a single high count at Tacumshin Lake in early March. This is consistent with general waterbird migration patterns in western Europe, which, with a few exceptions, follow more easterly migration routes in spring.

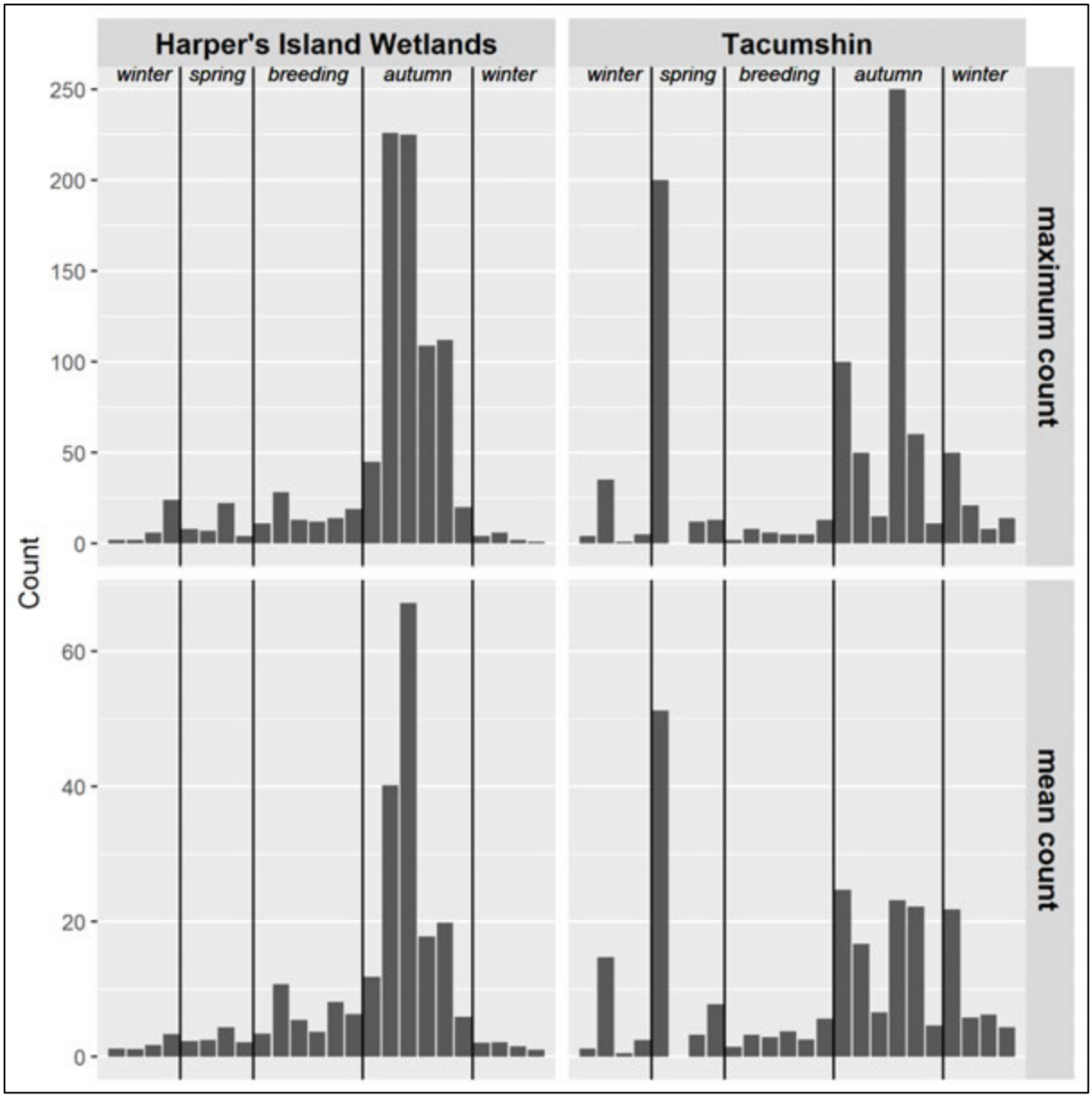

Figure 4.2. Mean and maximum Lesser Black-backed Gull counts at Harper's Island Wetlands and Tacumshin in fortnightly intervals across the year, with the spring (March-April), breeding season (May-July), autumn (August-October) and winter (November-February) periods demarcated.

6. LESSER BLACK-BACKED GULL OCCURRENCE PATTERNS AT CASTLEBANNY

Independent vantage point surveys were carried out at Castlebanny by two survey teams. One survey team was led by Tom Gittings with survey work carried out by TG, Tony Nagle and John Meade and is referred to as the GNM survey team. The other survey team comprised personnel from Malachy Walsh and Partners and is referred to as the MWP survey team. Full details about the surveys carried out by the two survey teams are provided by Gittings (2020b) and MWP (2019a, 2019b, 2019c, 2020).

The Lesser Black-backed Gull flight activity recorded in the GNM surveys was concentrated at six of the ten vantage points surveyed and showed distinct movement corridors across and around the wind farm site (Map 1). From analysis of these flightlines, I divided the viewsheds for the GNM vantage points into two categories, corresponding to areas of high and low flight activity, respectively (Gittings, 2020a). In the following analyses, the analyses of the GNM dataset is mainly restricted to the data from the high Lesser Black-backed Gull flight activity viewsheds.

The monthly distribution of Lesser Black-backed Gull records recorded during the Castlebanny Wind Farm vantage point surveys are shown in Table 6.1. Overall, there was an increase in both the sighting rates, and the numbers of birds recorded, across the summer, with the highest sighting rate in August and the highest numbers of birds in September (combined rates in Table 6.1). However, there were differences in the patterns recorded by the two survey teams. The GNM survey team mainly recorded Lesser Black-backed Gulls between April and August and in October, with the highest frequency of sightings and numbers of birds in July and August. The monthly distribution of sightings recorded by the MWP survey team was more variable with the highest frequency of sightings in June and September and the highest numbers in September.

Table 6.1. Monthly occurrence patterns of Lesser Black-backed Gull flight records during the Castlebanny Wind Farm vantage point surveys.

Month	GNM dataset		MWP dataset		Combined rates	
	sightings rate	count rate	sightings rate	count rate	sightings rate	count rate
Jan	0.0	0.0	0.4	0.0	0.2	0.0
Feb	1.0	0.3	0.4	0.1	0.7	0.1
Mar	0.0	0.0	0.2	0.0	0.1	0.0
Apr	4.0	1.3	0.8	0.2	2.4	0.4
May	3.8	1.3	0.4	0.1	2.1	0.9
Jun	4.5	1.5	5.2	1.0	4.9	0.8
Jul	10.1	3.4	1.0	0.1	5.6	0.4
Aug	11.0	3.7	2.6	0.4	6.8	2.1
Sep	0.0	0.0	6.6	8.9	3.3	4.5
Oct	4.0	1.3	1.6	3.0	2.8	2.3
Nov	0.0	0.0	0.6	0.5	0.3	0.3
Dec	0.4	0.1	1.0	2.4	0.7	1.2

The sightings rates are the numbers of sightings per 24 hours of vantage point watches. The count rates are the total numbers of birds per vantage point watch hour. Data is only included for the GNM vantage points with high Lesser Black-backed Gull flight activity viewsheds.

There were also differences between the survey teams in the flock sizes recorded. Most of the GNM records involved individuals or small groups of birds, with only four records of flocks of more than 10 birds (Figure 6.1). Somewhat surprisingly, one of these records was of a flock of 60 in late May, which may be an example of the late spring arrival of non-breeding birds referred to by Barnes (1953). The MWP spring and breeding season records also mainly involved individuals or small groups of birds. However, in autumn and winter, a much higher frequency of larger flocks were recorded (Figure 6.1).

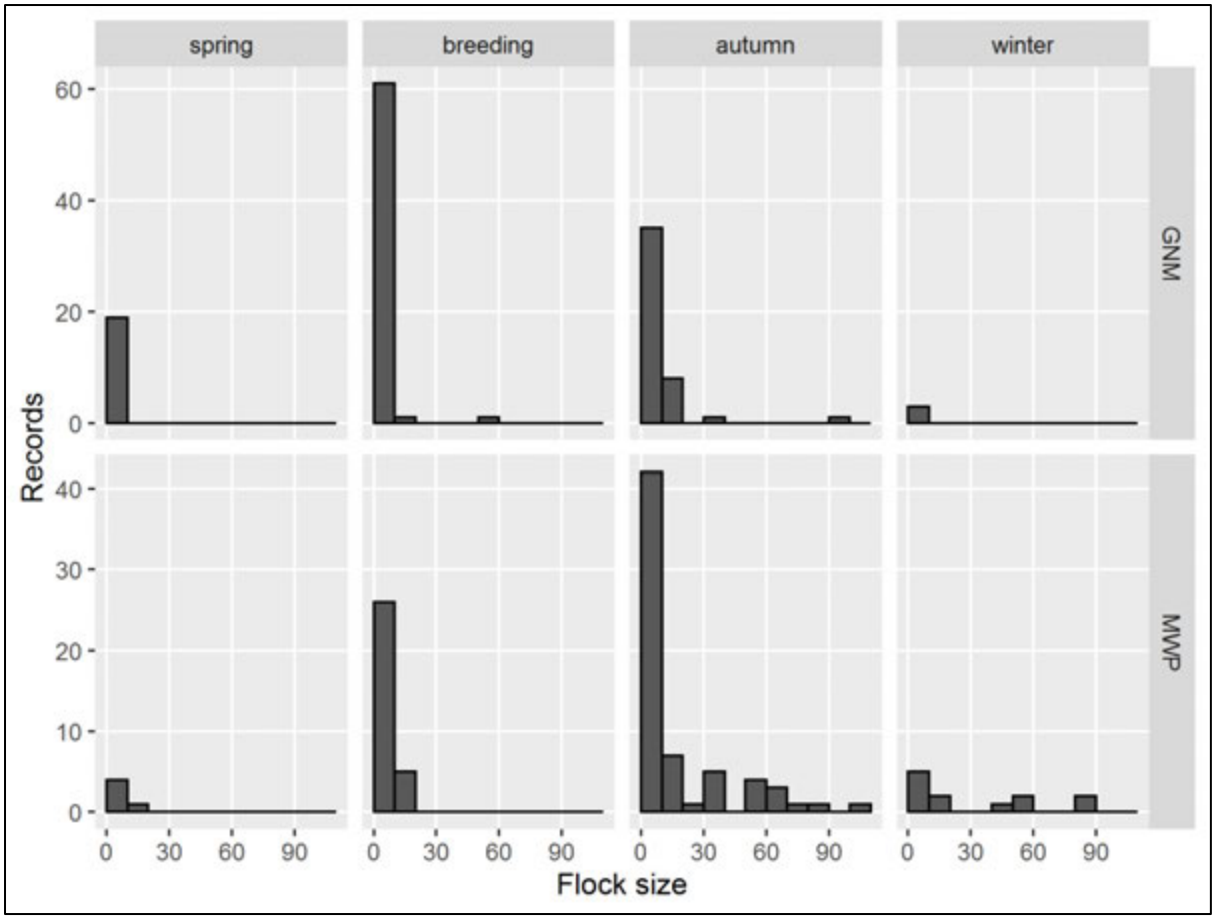

Figure 6.1. Frequency distribution of the flock sizes recorded during the GNM and MWP vantage point surveys, in spring (Mar-April), summer (May-July), autumn (Aug-Oct) and winter (Nov-Feb).

The differences between the Lesser Black-backed Gull records from the two survey teams appear to reflect differences in the vantage point positions and directions of viewsheds, which affected the types of Lesser Black-backed Gull activity recorded. The GNM vantage points were nearly all located within the wind farm site, or close to the edge and looking towards the wind farm, while several of the MWP vantage points were located some distance from the wind farm or looking away from the wind farm. The flight activity recorded in the GNM vantage point survey was almost entirely of birds commuting across the wind farm site. Apart from GNM VP8 (see below), the only exceptions were a single record of Lesser Black-backed Gulls feeding on fields at GNM VP5, and some of the flight activity at GNM VP7, which was associated with birds feeding on nearby fields (outside the viewshed). Compared to the single record in the GNM dataset of birds feeding on fields (less than 1% of the total records), the MWP dataset contains 21 records of birds feeding, or roosting, on fields (16% of the total records) and many of the other records were probably of local flight activity associated with field feeding. Therefore, the monthly distribution of records in the MWP dataset will partly reflect the chance occurrence of factors that created attractive field feeding conditions in the vicinity of the vantage point locations, such as ploughing, reseeding, or spreading slurry. Similarly the higher incidence of large flocks reflects the aggregation of birds when attractive field feeding conditions occurred.

Most of the Lesser Black-backed Gull flightlines recorded during the GNM vantage point surveys either occurred within the 500 m turbine buffers, or were along general movement corridors that intersected the 500 m turbine buffers (Map 1). The exceptions were the flight activity at GNM VP8, which was mainly associated with a movement corridor along the Arrigle River, and some of the flight activity at GNM VP7 which was associated with local field feeding. The flight activity data from GNM VP8 was excluded from the collision risk model (Gittings, 2020a). By contrast, most of the Lesser Black-backed Gull flightlines recorded in the MWP vantage point surveys were outside

the 500 m turbine buffers and did not obviously reflect movement corridors that intersected the 500 m turbine buffers (Map 2).

7. CONCLUSIONS

The literature review and analyses of GPS tracking datasets indicates that Castlebanny Wind Farm is likely to be outside the mean foraging range of the Saltee Islands colony and, while birds from the colony may visit the area quite frequently, it is unlikely to support a high concentration of foraging or flight activity. Lesser Black-backed Gull flight activity around the Richfield Wind Farm may be an order of magnitude higher than at Castlebanny, so the existing collision risk at Richfield is likely to dwarf any collision risk that occurs from the development of the Castlebanny Wind Farm.

The analyses of the year-round Zeebrugge GPS tracking dataset, and the review of count data and observations on Lesser Black-backed Gull migration patterns in Ireland, indicate that May-July is the main period when Lesser Black-backed Gull flight activity at the Castlebanny Wind Farm is likely to include a relatively high component of birds from local breeding colonies (including the Saltee Islands). By August, many birds will have dispersed long distances from their breeding colony: based on the results of the analysis of the Zeebrugge dataset, Lesser Black-backed Gulls occurring at Castlebanny in August could include birds from the entire Irish breeding population and a wide swathe of western Britain. Unlike during the breeding season, high proportions of activity occur at distances of 100s of kilometres from the source colonies in August. The Irish count data shows large increases in Lesser Black-backed Gull numbers from early August. The increase in flock sizes in the Castlebanny vantage point survey data in the autumn period is likely to reflect the increasing occurrence of birds dispersing from distant breeding colonies and/or passing through on migration.

The Saltee Islands population is around 4% of the Irish breeding population, and an even smaller proportion of the potential source population for birds at Castlebanny in autumn when the occurrence of birds from western Britain is taken into account. Therefore, the proportional contribution of collision risk at Castlebanny to birds from the Saltee Islands colony from August onwards is likely to be negligible. The available data does not indicate a strong spring migration through Ireland. However, there was very little flight activity recorded in the Castlebanny vantage point surveys in spring, so the inclusion, or otherwise, of the spring collision risk will have a negligible effect on the potential impact on the Saltee Islands population. Overall, therefore, this review indicates that the assessment of collision risk impacts on the Saltee Islands population should focus on the May-July period.

The seasonal pattern of flight activity, and overall numbers, in the Castlebanny Wind Farm vantage point datasets increases in late summer / autumn, when increasing numbers of birds are expected to occur due to dispersal from distant breeding colonies and migration. The analyses of these datasets indicate that the MWP vantage point survey data is not likely to be very representative of flight activity in the collision risk zone (the 500 m turbine buffers). Therefore, this analysis supports the restriction of the collision risk modelling to the GNM dataset (Gittings, 2020a). The spatial patterns of flight activity in the GNM dataset have already been used to develop a spatially structured collision risk model for Lesser Black-backed Gull (Gittings, 2020a).

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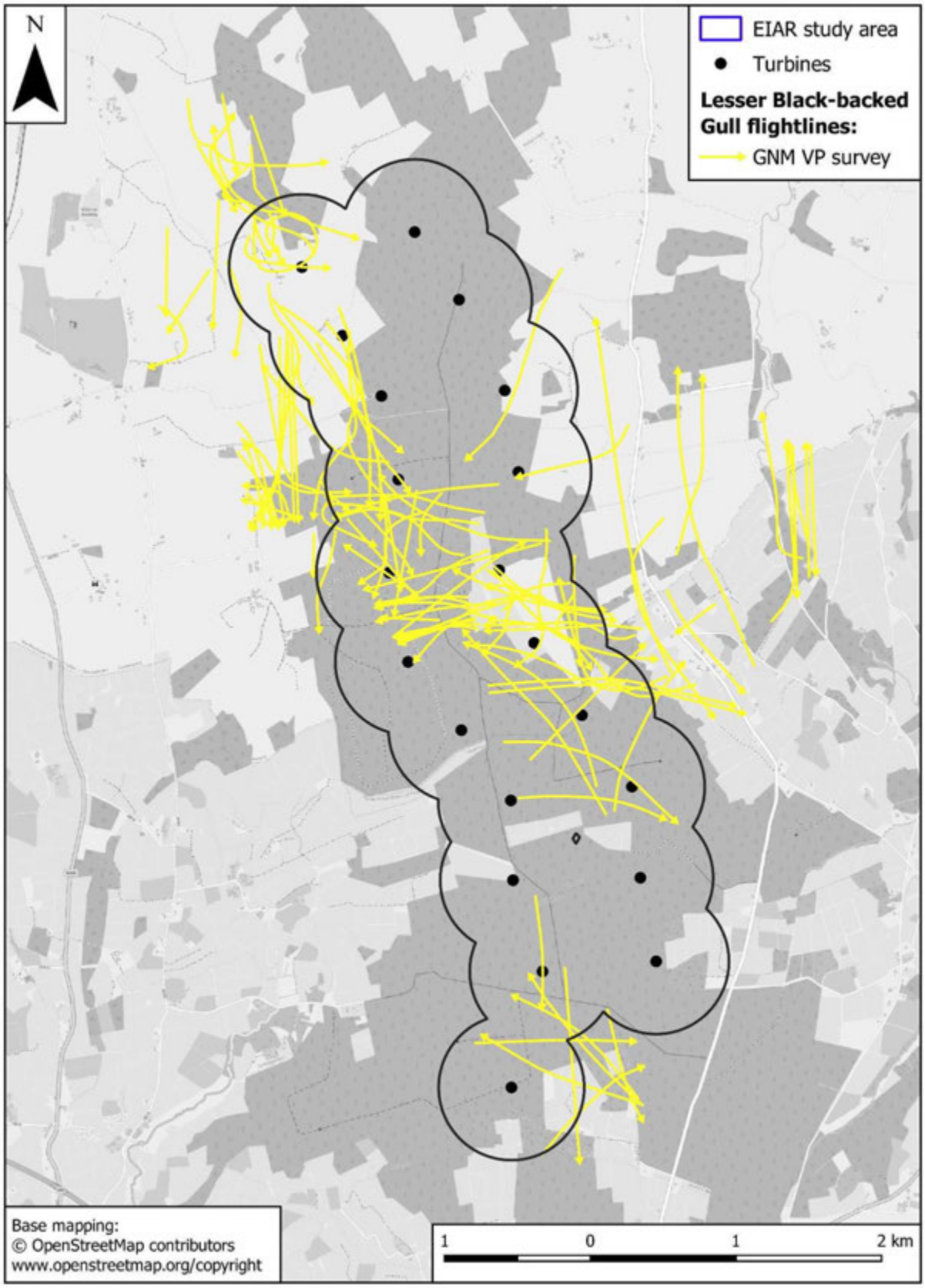

Map 1. Lesser Black-backed Gull flightlines recorded during the GNM vantage point surveys in relation to the 500 m turbine buffers.

Map 2. Lesser Black-backed Gull flightlines recorded during the MWP vantage point surveys in relation to the 500 m turbine buffers.