

# Assessing the habitat use of Lesser Black-backed Gulls (*Larus fuscus*) From the Bowland Fells SPA

Clewley, G.D., Scragg, E.S., Thaxter, C.B. & Burton, N.H.K.





**BTO Research Report No. 694**

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**Authors**

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on behalf of Natural England**

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**British Trust for Ornithology**

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## CONTENTS

	Page No.
List of Tables .....	3
List of Figures .....	5
List of Appendices .....	7
<b>EXECUTIVE SUMMARY .....</b>	<b>9</b>
<b>1. INTRODUCTION .....</b>	<b>11</b>
1.1 Background .....	11
1.2 Project Objectives .....	11
<b>2. METHODS .....</b>	<b>13</b>
2.1 Focal Species .....	13
2.2 Field Sites .....	13
2.3 Capture and Attachment Methods .....	14
2.4 The GPS System .....	15
2.5 Data .....	16
2.6 Analyses .....	18
2.6.1 Spatial analyses .....	18
2.6.2 Temporal analyses .....	18
<b>3. RESULTS .....</b>	<b>19</b>
3.1 Overview of Tracks .....	19
3.2 Home Range .....	19
3.2.1 Day-time home ranges .....	19
3.2.2 Night-time home ranges .....	22
3.2.3 Individual home ranges in the day .....	23
3.3 Maximum Foraging Distance .....	29
3.4 Time Spent in Bowland Fells SPA .....	30
<b>4. DISCUSSION .....</b>	<b>33</b>
4.1 Spatial Assessment .....	33
4.2 Temporal Assessment .....	33
4.3 Conclusions .....	34
<b>Acknowledgements .....</b>	<b>35</b>
<b>References .....</b>	<b>37</b>
<b>Appendices .....</b>	<b>41</b>



## LIST OF TABLES

	<b>Page No.</b>
<b>Table 2.1</b>	
Overview of data collected from GPS-GSM tags on Lesser Black-Backed Gulls over the summer period .....	17
<b>Table 3.1</b>	
Summary of spatial extent and overlap between kernel density estimate utilisation distributions for movements during the day of individual Lesser Black-backed Gulls and the Bowland Fells SPA.....	28
<b>Table 3.2</b>	
Summary of the maximum distance from nest reached by Lesser Black-backed Gulls from the Bowland Fells SPA during each discrete trip away from the colony during the summer period.....	29
<b>Table 3.3</b>	
Summary of the temporal overlap for individual Lesser Black-backed Gulls with the Bowland Fells SPA.....	31



## LIST OF FIGURES

	<b>Page No.</b>
<b>Figure 2.1</b>	Location of each field site within the Bowland Fells SPA and the approximate boundary of the areas of colony visited.....14
<b>Figure 2.2</b>	Distribution of the nest locations of Lesser Black-backed Gulls fitted with GPS-GSM tags from the Tarnbrook colony and Langden Head colony .....15
<b>Figure 3.1</b>	Example tracks for two individual Lesser Black-backed Gulls from the Bowland Fells SPA across the entire summer period .....19
<b>Figure 3.2</b>	Kernel density estimate utilisation distributions for Lesser Black-backed Gulls from the Bowland Fells SPA for 2015 and 2016 using GPS fixes recorded during the day outside of the main colony boundary.....20
<b>Figure 3.3</b>	Examples of satellite imagery overlain with GPS points for Lesser Black-backed Gulls from the Bowland Fells SPA taken from within the main 50% utilisation distribution areas in 2016 .....21
<b>Figure 3.4</b>	Kernel density estimate utilisation distributions for Lesser Black-backed Gulls from the Bowland Fells SPA for 2016 using GPS fixes recorded during the night outside of the main colony boundary.....22
<b>Figure 3.5</b>	Kernel density estimate utilisation distribution for individual Lesser Black-backed Gulls from the Bowland Fells SPA in 2015 using GPS fixes recorded during the day outside of the main colony boundary.....23
<b>Figure 3.6</b>	Kernel density estimate utilisation distributions for individual Lesser Black-backed Gulls from the Bowland Fells SPA in 2016 using GPS fixes recorded during the day outside of the main colony boundary.....27
<b>Figure 3.7</b>	Example for one individual Lesser Black-backed Gull of the maximum distance reached from the nest on each discrete trip away from the colony in the Bowland Fells SPA.....30
<b>Figure 3.8</b>	Histogram of the estimated speed of Lesser Black-backed Gulls as recorded from the GPS-GSM devices for all GPS fixes recorded within the Bowland Fells SPA boundary but outside of the two colony areas .....32



## LIST OF APPENDICES

	<b>Page No.</b>
<b>Appendix 1.</b> Raw capture and nest monitoring data .....	41
<b>Appendix 2.</b> Plot of all GPS fixes for Lesser Black-backed Gulls from the Bowland Fells SPA which were excluded from the analyses .....	43
<b>Appendix 3.</b> Kernel density estimate utilisation distributions for individual Lesser Black-backed Gulls from the Bowland Fells SPA and all the birds combined for 2015 using all GPS fixes recorded during the day.....	45
<b>Appendix 4.</b> Details of tagged Lesser Black-backed Gulls from the Bowland Fells SPA reported as dead.....	51
<b>Appendix 5.</b> Plots of GPS tracks from individual Lesser Black-backed Gulls from the Bowland Fells SPA irrespective of data quality.....	53
<b>Appendix 6.</b> Individual plots of maximum foraging distance reached on each trip away from the colony for Lesser Black-backed Gulls fitted with GPS-GSM devices on Bowland Fells SPA.....	57



## EXECUTIVE SUMMARY

1. Findings from a GPS tracking study of Lesser Black-backed Gulls breeding in the Bowland Fells Special Protection Area (SPA) are presented in this report. The aims were to i) describe the home range of Lesser Black-backed Gulls during the breeding season and the spatial overlap with the SPA; ii) quantify the maximum foraging distances; and iii) assess the time spent by individual birds inside the SPA.
2. Twelve GPS-GSM tags (Movetech Telemetry) were deployed during 2015 but unfortunately subsequent performance was not as expected and the work was repeated in 2016, with an additional sample of tags also deployed, resulting in 22 deployments across two sites (Tarnbrook Fell and Langden Head). In total, data from 20 individuals were considered suitable for analysis (one individual from both years). Data were only analysed up until the last date that each individual was present in the SPA.
3. Home range analyses were carried out using time invariant kernel density estimate methods and were performed separately for day and night periods due to different GPS sampling rates. GPS fixes obtained from inside the colony boundary were excluded from home range analyses to give a more accurate reflection of foraging space use. Foraging distance was the maximum distance away from the nest and was calculated for each discrete trip away from the colony.
4. Tracked Lesser Black-backed Gulls from the Bowland Fells SPA likely foraged almost exclusively in terrestrial habitats. There was some individual variation in the extent and pattern of their foraging ranges, but generally the degree of overlap with the SPA was low for most birds and in total was <10%. The most frequently visited habitats tended to be urban areas and landfill sites to the south and southwest of the SPA but regular use of nearby agricultural land was also seen. Unfortunately it was not possible to tag an equal sample from each colony, and the sample from Tarnbrook was much smaller, but it appears that birds from each colony are highly segregated inside the SPA and may even have different foraging site preferences outside the SPA boundary.
5. Birds spent only a small proportion of their time – on average 12% – within the SPA during the periods that they were away from the colony. Total time within the SPA was closer to 50% when GPS data recorded from inside the colony boundary were also included, as would be expected from sharing of nest attendance by pairs during incubation and chick rearing. It was not possible to precisely know the behaviour of the Lesser Black-backed Gulls from the tracking data; however, data on estimated ground speed suggest that most fixes within the SPA but outside the colony were obtained during active flight. However, there is low certainty around this without further analyses.
6. While the SPA provides an important breeding site for the Lesser Black-backed Gulls, the tracking data indicate that it does not currently provide important foraging sites and that the gulls travel daily to other sites outside the SPA. It is likely that a small proportion of individuals spent relatively more time within the SPA and make greater use of nearby agricultural land but at present it seems profitable for most birds to continue to travel relatively long distances to forage around human occupied environments, predominantly urban areas, but also farmland.



## 1. INTRODUCTION

### 1.1 Background

The Bowland Fells Site of Special Scientific Interest (SSSI) and Special Protection Area (SPA) is located to the east of Lancaster within north Lancashire. It supports the largest area of blanket bog and heather moorland within Lancashire and provides a habitat for an internationally important upland breeding bird community. The diverse mosaic of upland habitats across the Fells contributes greatly to the ornithological interest of the site, which supports breeding Hen Harrier (*Circus cyaneus*) (at its only regular breeding site in England), Merlin (*Falco columbarius*) and one of the five largest UK breeding colonies of Lesser Black-backed Gull (*Larus fuscus*), which is a SPA review (Stroud *et al.* 2001) and pSPA (potential SPA) feature.

The Lesser Black-backed Gull breeding population has recently been growing since control measures ceased in 2009. Landowners have expressed concern that, without control, the population will reach levels which significantly impact on other birds and on vegetation communities within the Bowland Fells SSSI/SPA, as well as on the quality of water emerging from catchment land. When Lesser Black-backed Gull numbers were at their highest, it is thought (from observation and ringing studies) that a large part of their diet was sourced at landfill sites at Lancaster and Warrington. These sites have since become inaccessible and there is concern from landowners that feeding now takes place more within the Bowland Fells SSSI/SPA and on fringing in-bye land, which is important for breeding waders. This poses a largely unquantified risk to the wider bird assemblage and to landowner interests – mostly grouse shooting. An additional risk is to the Bowland Fells Hen Harrier population, which is within one mile of some parts of the colony.

### 1.2 Project Objectives

The aim of this study is to use new state-of-the-art Movetech Global Positioning System-Global System for Mobile communication ('GPS-GSM') tracking devices to:

- i. Identify potential feeding areas (both within and outside the SSSI/SPA) used by Lesser Black-backed Gulls from this breeding population; and
- ii. Quantify the amount of time spent by the gulls in these areas.

The outputs from this would help to inform understanding of the space use of Lesser Black-backed Gulls from this breeding population in comparison to birds from the colony at South Walney in the Morecambe SPA, and would also help to inform understanding of the extent of interaction of the Bowland Fells population with the breeding populations at South Walney and the Ribble Estuary. The study would provide a better evidence base to inform Natural England's discussions over the need to manage risks in the growth of the Lesser Black-backed Gull population within the Bowland Fells SSSI/SPA to ensure that favourable conservation status is maintained and sustained. Furthermore, the study would help to inform any Habitats Regulations Assessment required to assess likely significant effects of land use changes and management activities both within and outside the SPA.

Initial work was undertaken to fit 12 Lesser Black-backed Gulls with GPS-GSM tags in spring 2015. While these tags provided some useful information during the breeding season, the life-span of the tags was not as expected and thus this work was repeated in 2016 with an additional sample of 12 tags (24 in total).



## 2. METHODS

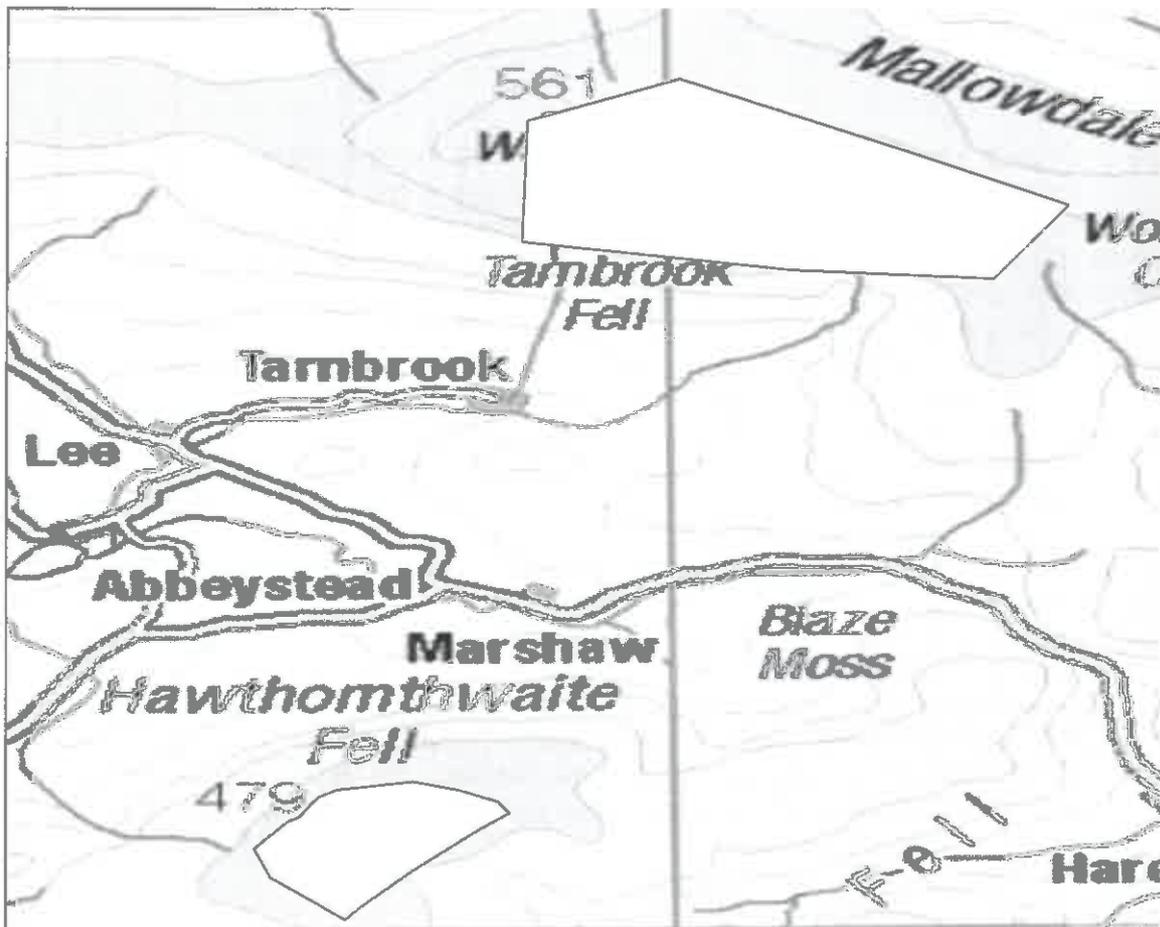
### 2.1 Focal Species

The Lesser Black-backed Gull (the UK sub-species of which is *L. fuscus graellsii*) is a qualifying feature of four breeding colony SPAs and one potential SPA in England, two in Scotland and one in Wales (SPA Review: Stroud *et al.* 2001; SNH SPA extensions). At-sea data have been used to investigate the species' distributions and habitat associations, for instance in the German North Sea (Schwemmer & Garthe 2008), and placement within multi-species feeding associations (Camphuysen & Webb 1999). Research has also focused particularly on general breeding biology, diet, and kleptoparasitism (Camphuysen 1995; Calladine 1997; Galván 2003; Kubetzki & Garthe 2003; Kim & Monaghan 2006). However, only recently has the species been tracked, e.g. in studies of birds breeding in the Netherlands (Shamoun-Baranes *et al.* 2011), Germany (Corman & Garthe 2014) and in eastern England (Thaxter *et al.* 2011, 2012a, 2013, 2014b, 2015, 2016) and hence limited data are available concerning foraging movements.

During the non-breeding season, the extent of migration varies between and within populations. Lesser Black-backed Gulls tracked from colonies in the Netherlands (sub-species *L. fuscus graellsii* and *L. fuscus intermedius*) are known to migrate initially to the UK immediately after breeding, before travelling further south to over-winter on the coasts of the Iberian Peninsula and north-west Africa (Ens *et al.* 2008). This pattern is also well-documented for other populations of the same sub-species from ringing data (Wernham *et al.* 2002). However, *L. fuscus graellsii* breeding in the UK may differ in their migratory strategy to those on the continent, and to members of the *L. fuscus intermedius* sub-species, which overlap with *L. fuscus graellsii* in their breeding range.

### 2.2 Field Sites

Fieldwork was carried out on two Lesser Black-backed Gull nesting areas within the Bowland Fells SPA. One colony on Tarnbrook Fell (54.015° N, 2.59° W) and one at Langden Head near Sykes Fell (53.95° N, -2.64° W). Gulls nest widely over both areas but catching efforts were kept within the maximum boundaries shown in Fig. 2.1. Landowners were informed of all access to both sites and visits were not made during inclement weather.



**Figure 2.1** Location of each field site within the Bowland Fells SPA and the approximate boundary of the areas of colony visited.

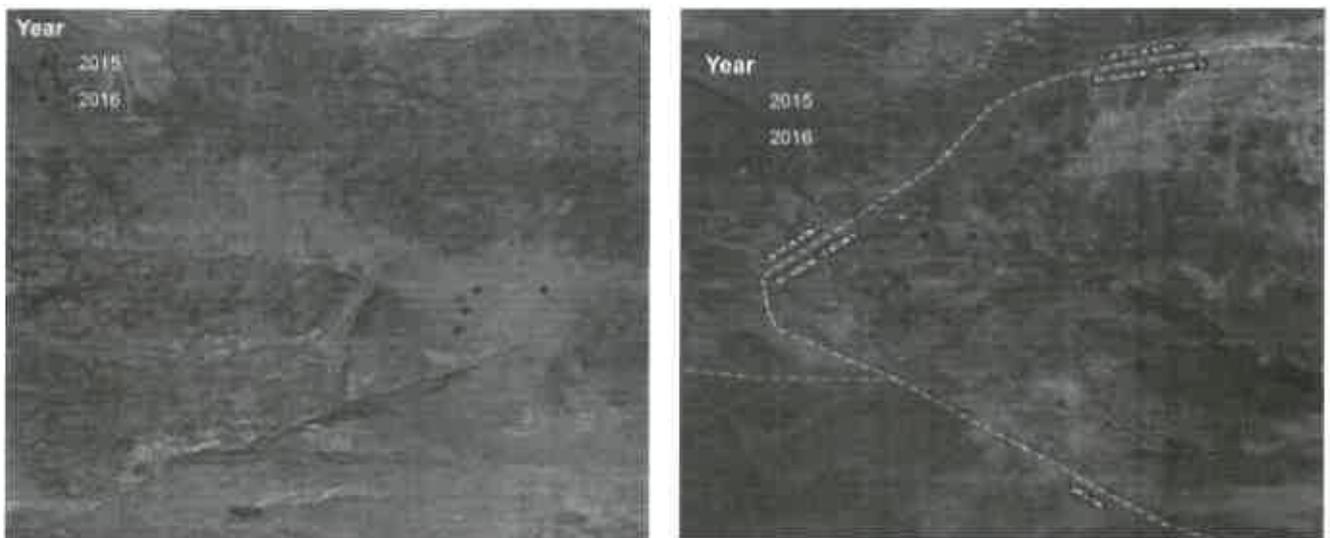
### 2.3 Capture and Attachment Methods

Breeding adult Lesser Black-backed Gulls were captured during incubation using wire mesh traps, with a single funnel entrance, placed over the nest and pegged down (Bub 1991). Where possible, traps were observed from a distance or left for up to 30 minutes and once a bird had entered and settled onto the nest, the trap could be approached and bird retrieved. Birds during late incubation with a full clutch (three) of warm eggs were targeted for improved capture efficiency but some nests with smaller clutches (one or two) or small chicks were targeted if required. Each nest targeted was marked with an individually identifiable marker placed c. 1 m away to ensure each nest was only targeted once per visit and allow subsequent nest recording (Appendix 1). Nest locations were recorded using a handheld GPS (Fig. 2.2).

Two capture visits were made to each site during 2015 and three visits to Tarnbrook and four visits to Langden Head were carried out in 2016. To comply with licensing requirements to fit the tags, birds needed to be above a minimum weight, consequently, a total of 92 individuals (Appendix 1) were captured in order to attach the majority of the requisite sample of tags (as some tags were heavier than specified, only 22 of the 24 tags were fitted in 2016). All birds were weighed and measured and fitted with a unique metal leg ring. Additionally, all birds tagged and a further sample of 19 birds was fitted with a unique engraved colour ring.

GPS tags were fitted to the birds using a permanent wing loop harness made from tubular Teflon (see Thaxter *et al.* 2014a, 2014b for detailed harness design). Tags weighed 20-25.5g, which represented < 3% body mass for the birds in this study: mean  $\pm$  SD: 788  $\pm$  90g, range: 620-1040g. During 2016, on average birds at Tarnbrook did weigh slightly less than Langden Head although this difference was not significant ( $t = -0.91$ , d.f. = 69,  $P=0.37$ ), however, capture efficiency was lower on the Tarnbrook site and an equal sample of tags at each site was not feasible. A possible sample bias was introduced as only heavier birds, which are more likely to be males, were tagged in order that the combined weight of tag and harness was below 3% of body mass.

The mean time from capture to release was 36 minutes (maximum 1 hour). After tagging, birds were released and resumed normal incubating behaviour after a period of time away from the nest area.



**Figure 2.2** Distribution of the nest locations of Lesser Black-backed Gulls fitted with GPS-GSM tags from the Tarnbrook colony (left) and Langden Head colony (right). Note that there are two separate points (2015 and 2016) at Tarnbrook for bird ID 034.

## 2.4 The GPS System

The GPS devices used in this study were developed by Movetech, a consortium of scientific partners (BTO, University of East Anglia, University of Lisbon and University of Porto). They include a GPS sensor, accelerometer, solar panel, battery, thermometer, a SIM card and flash drive.

The devices were programmed to collect GPS data every hour during daylight and every three hours during the night. Reduced sampling rates during the night are necessary to preserve battery life during periods of poor solar recharging conditions. Actual recording performance can vary depending on device power levels at any given time. More frequent GPS fixes are taken to prevent overcharging and the GPS is turned off entirely when the battery drops below a certain threshold to protect the device and allow continued data collection if conditions become suitable again.

These devices allow for continual data collection, potentially over long periods (e.g. up to 2 years). Data are communicated through the mobile phone network (GSM), and thus there is a continual live stream of data throughout the tag's life. GPS data are still collected in areas of no network coverage

and stored on the device to be transmitted at a later date whenever sufficient mobile network coverage is obtained again. All data were automatically forwarded to and stored on an online data repository for tracking information (2015; Fleetronic - <http://rd.fleetronic.net/> 2016; Movebank - <https://www.movebank.org/>).

## 2.5 Data

Data from both years were downloaded from the respective repositories in comma-separated value format and combined. Analyses were restricted to the breeding and immediate post-breeding periods (i.e. excluding migration and wintering). This period was defined from the beginning of tag deployment up until the last fix obtained inside the Bowland Fells SPA and subsequently varied for each bird. Tracking data collected after the last fix within the SPA were excluded from the analyses in this report. Plotting the excluded data validated that the birds tend not to use areas immediately adjacent to the SPA for any prolonged period after their last fix inside the protected area (Appendix 2). Any records which were duplicated, contain invalid GPS fixes or were above the 99<sup>th</sup> percentile for GPS location error were also removed from the dataset.

When tracking the movements of breeding birds, clusters of GPS fixes around nest sites can introduce bias into analyses of foraging home ranges by increasing the indication of area usage as a result of behaviour such as incubation. To avoid such bias, all home range analyses presented here used a subset of data whereby all fixes within the colony boundaries (Fig. 2.1) were excluded. Results using data from both in and away from the colony are presented in Appendix 3. Individual birds were also excluded from the analyses if there were insufficient data (Table 2.1).

**Table 2.1**

Overview of data collected from GPS-GSM tags on Lesser Black-backed Gulls over the summer period. Individuals excluded from the analyses due to insufficient or low quality data are listed at the bottom of each year and highlighted in red. Details of birds reported dead of in Appendix 4.

Bird ID	Fixes at colony	Fixes away from colony	Total GPS fixes	Tracking period	Notes
<b>2015</b>					
Langden_Head_109	256	136	392	11/06/2015 - 18/07/2015	
Tarnbrook_034	628	924	1552	08/06/2015 - 08/08/2015	
Tarnbrook_100	237	57	294	10/06/2015 - 17/06/2015	Truncated dataset
Langden_Head_28	0	0	0	NA	Wintering fixes only
Langden_Head_68	36	9	45	09/06/2015 - 10/06/2015	Truncated dataset
Langden_Head_76	30	13	43	24/06/2015 - 01/07/2015	Truncated dataset
Langden_Head_101	8	20	28	12/06/2015 - 16/06/2015	Truncated dataset
Langden_Head_107	0	10	10	27/06/2015 - 08/08/2015	Truncated dataset
Tarnbrook_41	0	0	0	NA	All excluded - Large GPS error
Tarnbrook_55	56	25	81	13/06/2015 - 21/07/2015	Truncated dataset
Tarnbrook_104	0	0	0	NA	No data transmitted
Tarnbrook_110	15	0	15	11/06/2015 - 23/06/2015	Truncated dataset
<b>2016</b>					
Langden_Head_178	577	861	1438	28/05/2016 - 07/08/2016	
Langden_Head_237	1096	1877	2973	25/05/2016 - 21/08/2016	
Langden_Head_245	156	380	536	24/05/2016 - 13/08/2016	
Langden_Head_262	139	93	232	28/05/2016 - 07/06/2016	Truncated dataset
Langden_Head_269	182	280	462	28/05/2016 - 13/08/2016	
Langden_Head_270	1005	908	1913	24/05/2016 - 14/08/2016	
Langden_Head_277	123	155	278	25/05/2016 - 29/07/2016	
Langden_Head_279	1052	1621	2673	28/05/2016 - 19/08/2016	
Langden_Head_287	628	1016	1644	28/05/2016 - 02/08/2016	
Langden_Head_454	142	389	531	28/05/2016 - 16/07/2016	
Langden_Head_457	795	900	1695	24/05/2016 - 10/08/2016	Truncated dataset
Langden_Head_459	475	936	1411	24/05/2016 - 20/08/2016	
Langden_Head_460	346	187	533	05/06/2016 - 11/08/2016	
Langden_Head_461	169	786	955	24/05/2016 - 18/08/2016	
Langden_Head_462	1023	1051	2074	24/05/2016 - 16/08/2016	Reported dead
Tarnbrook_034	825	1460	2285	14/04/2016 - 15/08/2016	
Tarnbrook_226	92	281	373	22/05/2016 - 28/07/2016	
Tarnbrook_452	195	365	560	30/05/2016 - 04/08/2016	
Tarnbrook_453	151	212	363	27/05/2016 - 31/07/2016	
Langden_Head_263	4	6	10	27/05/2016 - 11/07/2016	Truncated dataset – Reported dead
Langden_Head_284	15	27	42	24/05/2016 - 06/06/2016	Truncated dataset – Reported dead
Langden_Head_451	39	86	125	28/05/2016 - 01/08/2016	
Langden_Head_458	3	0	3	01/07/2016 - 05/07/2016	

## 2.6 Analyses

### 2.6.1 Spatial analyses

#### *Home range*

We used time-invariant Kernel Density Estimation (KDE) (Worton 1989) to estimate the home range area usage for each bird and all birds combined. The 50%, 75% and 95% KDEs of the utilisation distribution were taken to represent the core, middle, and total areas, respectively – although in line with other studies (e.g. Soanes *et al.* 2013), here we present overlaps using the core and total area usage for simplicity. KDEs were calculated following the approach of Thaxter *et al.* (2015), using fixed smoothing parameters, deemed most appropriate through visual assessment of utilisation distributions across a range of band widths ( $h = 1500$ , resolution = 500). GPS fixes collected at irregular time intervals are not suitable for time-invariant KDEs, we therefore filtered the data, for each bird, down to a common sampling rate for day (60 minutes) and night (180 minutes) separately (allowing  $\pm 20$  minutes) even though this reduced the effective sample size.

For each individual, we calculated the total area of the 95% and 50% KDEs, as well as the percentage overlap with the Bowland Fells SPA. Boundary information for the SPA was downloaded from [www.jncc.defra.gov.uk](http://www.jncc.defra.gov.uk). All kernel analyses were conducted using the 'adehabitatHR' package (Calenge 2006) in R 3.3.1 (R Core Team 2016) and spatial overlaps using ArcGIS 10.3.1 (ESRI 2015).

#### *Foraging distance*

Individual discrete trips away from the colony were defined as consecutive GPS fixes outside of the colony boundary punctuated by fixes inside. Any trips of five points or fewer were not included. For each trip the maximum distance recorded away from the individual's nest site was calculated the R package 'geosphere' (Hijmans 2016).

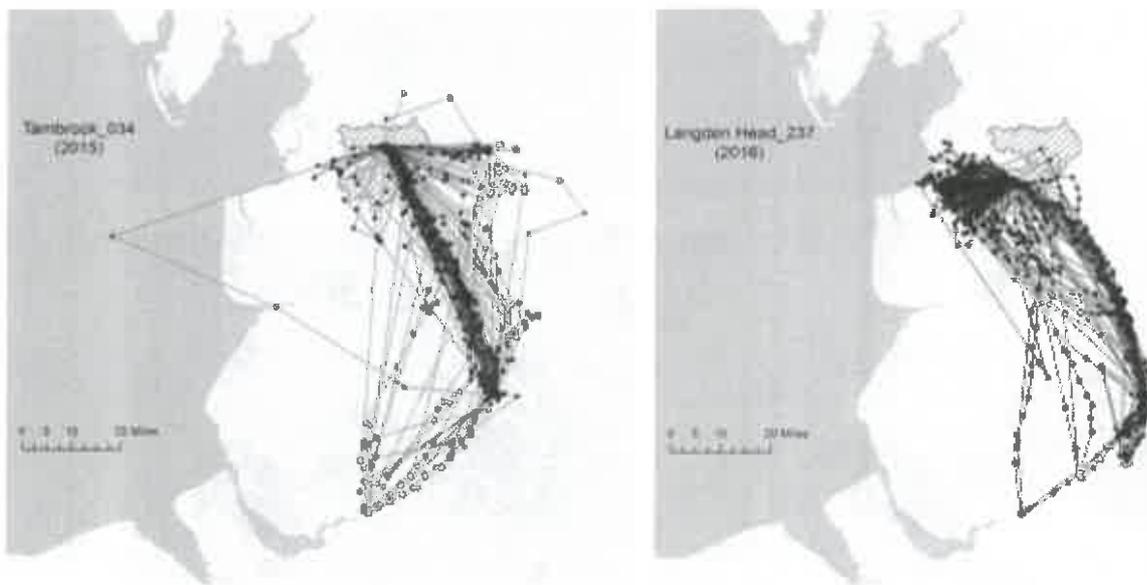
### 2.6.2 Temporal analyses

For each individual, we calculated the time spent in the Bowland Fells SPA using GPS data interpolated to 10 second intervals assuming linear and constant travel between successive locations using the 'adehabitatLT' R package (Calenge 2006). Interpolated data can then be used to identify the most probable time of transition over the SPA boundary. The total time spent inside the SPA is calculated as the sum of time spent inside the boundary for each pair of consecutive GPS fixes.

### 3 RESULTS

#### 3.1 Overview of Tracks

Plots of the raw GPS data give an indication of the geographic coverage and broad patterns of movements (Fig. 3.1). Generally, Lesser Black-backed Gulls from the Bowland Fells SPA foraged heavily in terrestrial environments with only a minority of birds visiting any marine areas. Predominantly, movements from the SPA were in a south or southwest direction. It was apparent that a number of sites were important to multiple birds for foraging (see 3.2.1) but that there was also individual variation. Birds tracked from the different colonies appear to have similar broad patterns of behaviour but there is a suggestion of some segregation with more movements in eastward or northward directions from Tarnbrook birds, albeit from a small sample. Example tracks are shown in Fig. 3.1; plots for all individuals are presented in Appendix 5.

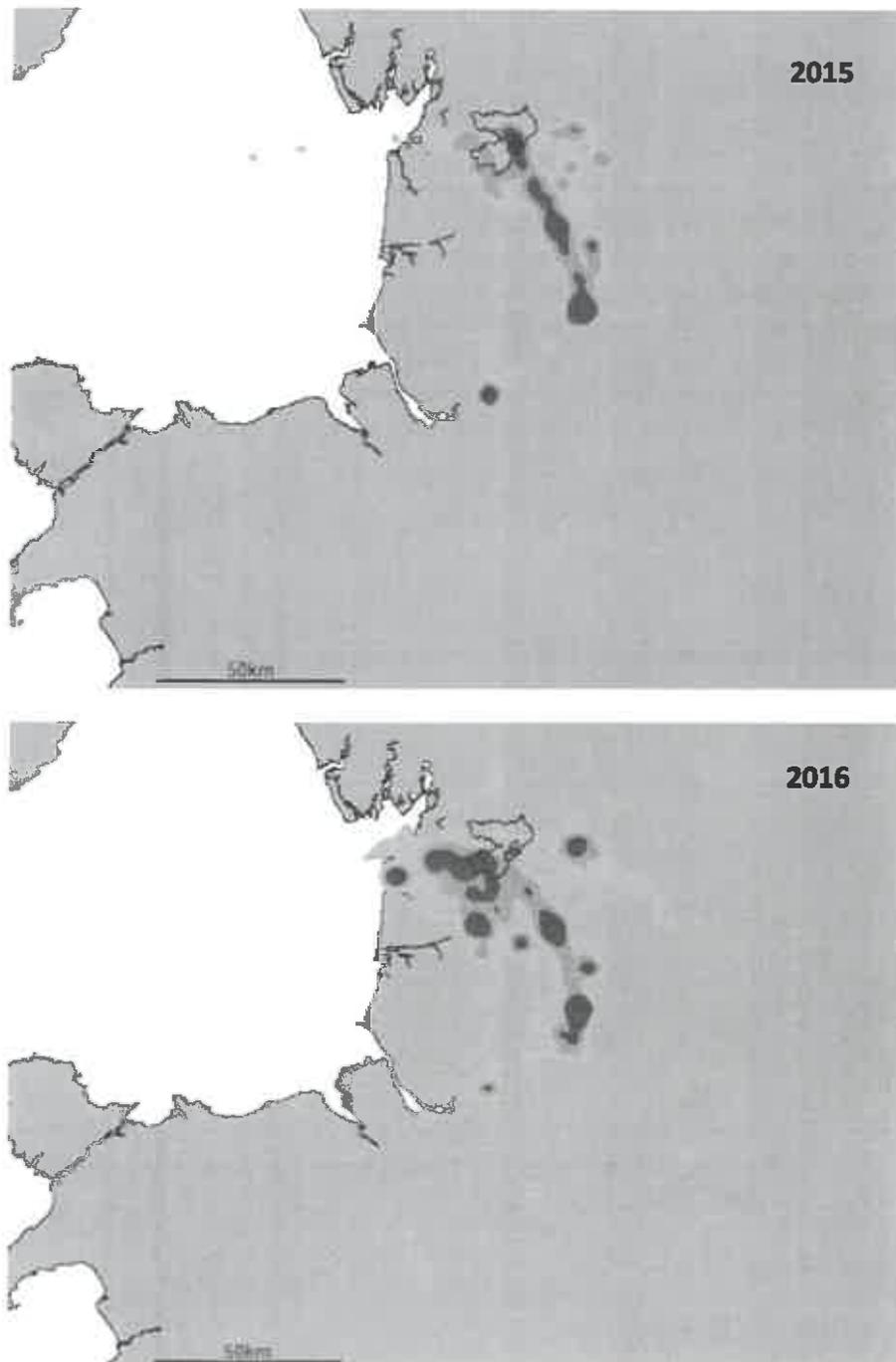


**Figure 3.1** Example tracks for two individual Lesser Black-backed Gulls from the Bowland Fells SPA across the entire summer period. The Bowland Fells SPA is indicated by the red hatched area.

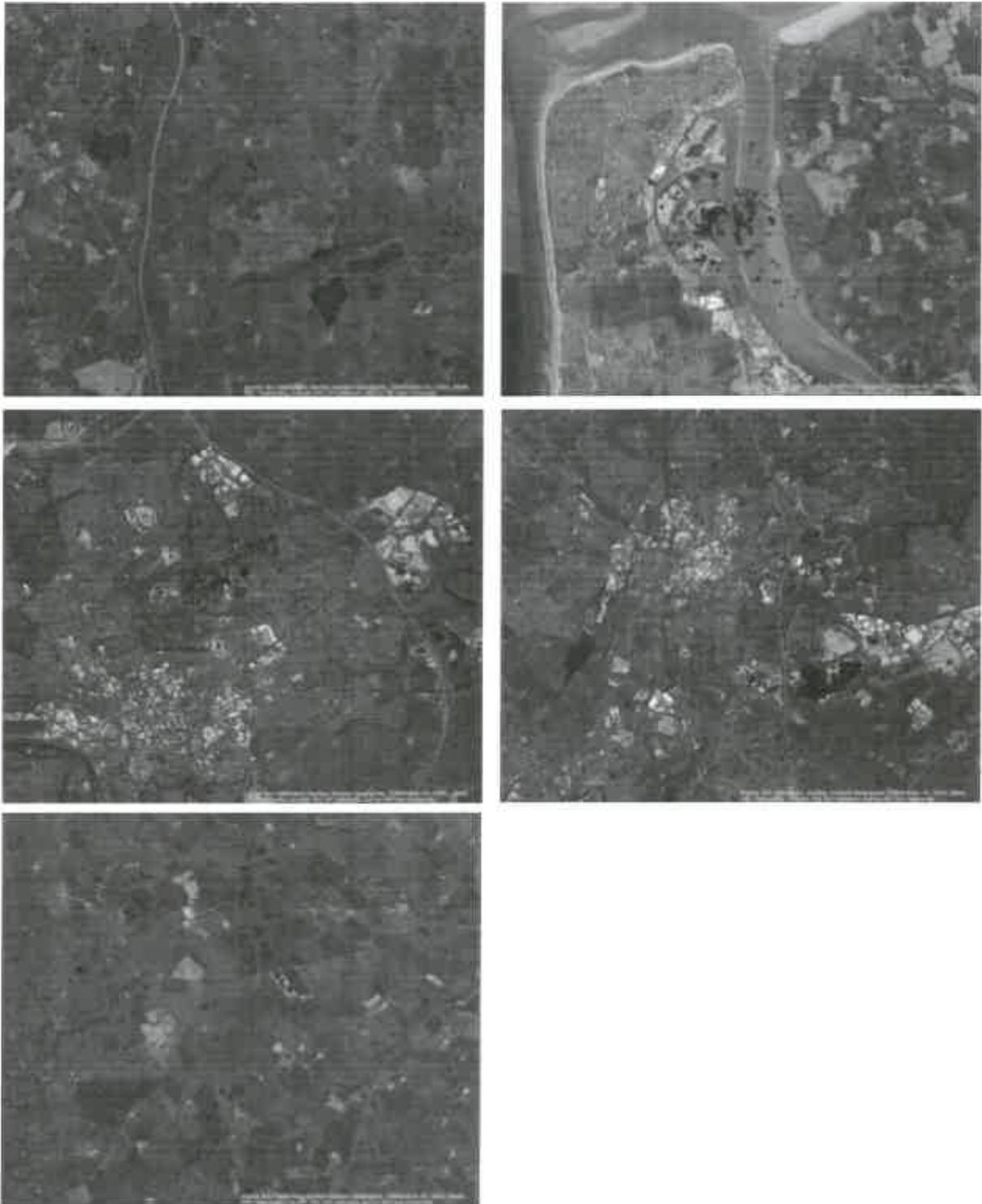
#### 3.2 Home Range

##### 3.2.1 Day-time home ranges

Home range estimates are presented for both 2015 and 2016 (Fig. 3.2) although no general conclusions should be drawn from the 2015 data as only a very small sample of birds were suitable for inclusion in the analyses. The home ranges identify the most important areas of space use, which for the day-time subset of the data, are presumed to represent key foraging locations. The core home ranges cover several landfill sites and urban areas, particularly to the south and southwest of the SPA, as well as farmland to the east. Illustrative examples of the habitats within the core home range are shown in Fig. 3.3. There was virtually no overlap with any marine environment. The extents of the estimated home ranges and overlaps with the SPA are summarised in Table 3.1.



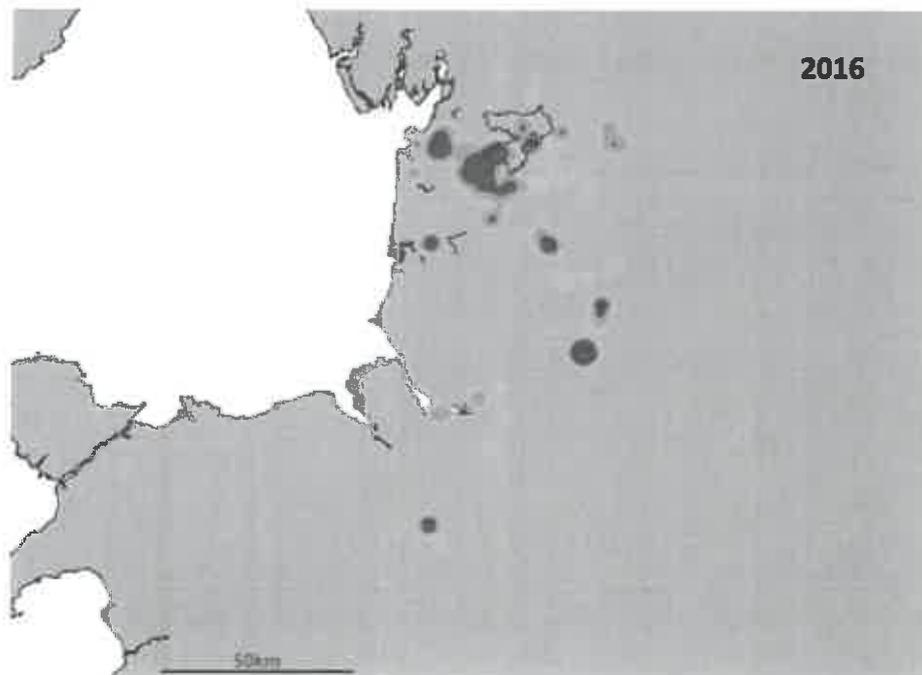
**Figure 3.2** Kernel density estimate utilisation distributions for Lesser Black-backed Gulls from the Bowland Fells SPA for 2015 (n = 2 individuals; 555 fixes) and 2016 (n = 19 individuals; 4870 fixes) using GPS fixes recorded during the day (60 minute sampling rate) outside of the main colony boundary. Red, orange and yellow illustrate the 50%, 75% and 95% utilisation distributions respectively. The Bowland Fells SPA boundary is shown in black.



**Figure 3.3** Examples of satellite imagery overlain with GPS points for Lesser Black-backed Gulls from the Bowland Fells SPA (across individuals) taken from within the main 50% utilisation distribution areas in 2016. Top left – bordering area to southwest of SPA, Top right – Fleetwood landfill site, Middle left – Preston City centre, Middle right – Bury landfill, Bottom left – farmland east of SPA.

### 3.2.2 Night-time home ranges

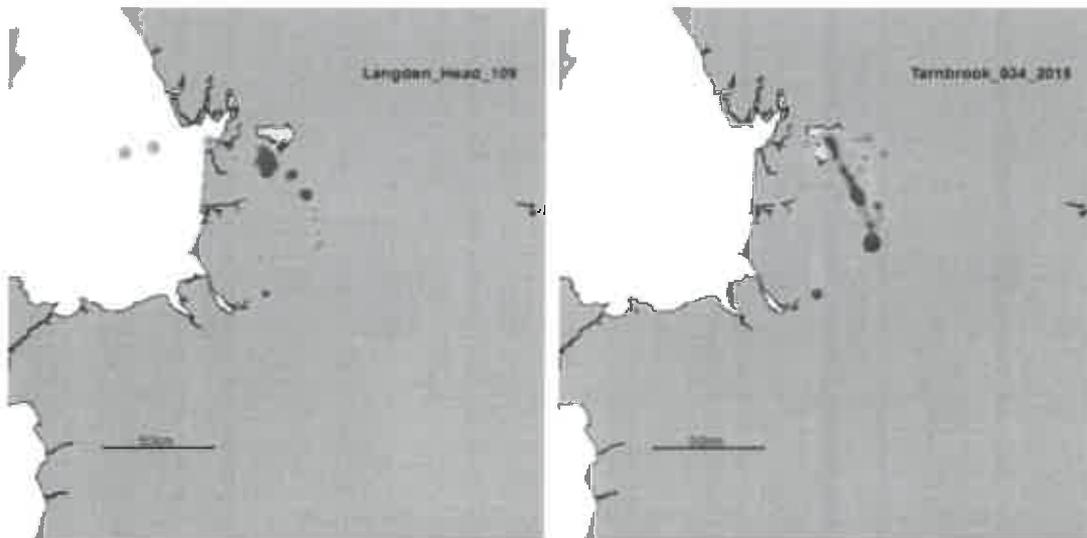
As the tags operated a reduced sampling rate during the night to prevent overuse of the battery, night-time home ranges could only be calculated from a reduced sample of points, and only from birds tagged in 2016. During 2016, an estimate of night-time home range could be derived using 295 GPS fixes recorded outside of the colony from a total of 1321 (Fig. 3.4). Some of the core home range areas coincide with the day estimates but other areas are also indicated, such as the Ribble Estuary, which were likely important roost sites for at least some individuals.



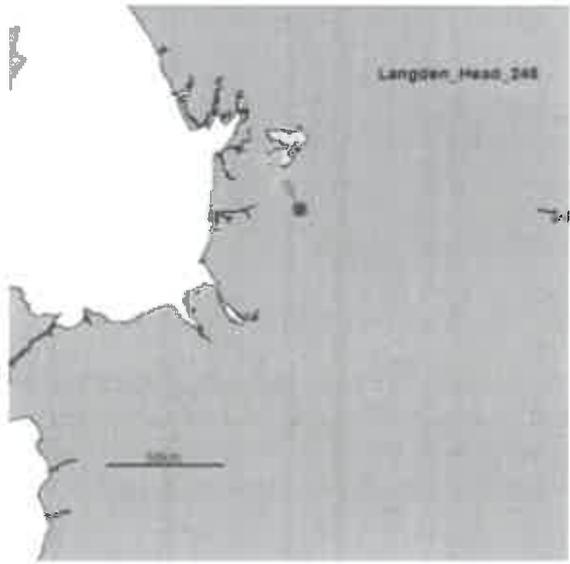
**Figure 3.4** Kernel density estimate utilisation distributions for Lesser Black-backed Gulls from the Bowland Fells SPA for 2016 ( $n = 19$  individuals; 295 fixes) using GPS fixes recorded during the night (180 minute sampling rate) outside of the main colony boundary. Red, orange and yellow illustrate the 50%, 75% and 95% utilisation distributions respectively. The Bowland Fells SPA boundary is shown in black.

### 3.2.3 Individual home ranges in the day

Data were only sufficient to consider the home ranges of individual birds during the day. Figs. 3.5 and 3.6 provide results of these analyses for 2015 and 2016 respectively. There was some individual variation between birds in the patterns of space use detected and also between years (albeit based on data for only one individual). Bird ID 034, tagged at the Tarnbrook colony, was the only individual to transmit data for both 2015 and 2016 and while this bird used some of the landfill sites south of the SPA in both years, it also made greater use of farmland in 2016. Similarly, some of the important foraging sites identified were only covered by the core range of a subset of individual birds, for example five individuals regularly visited the landfill site in Fleetwood.

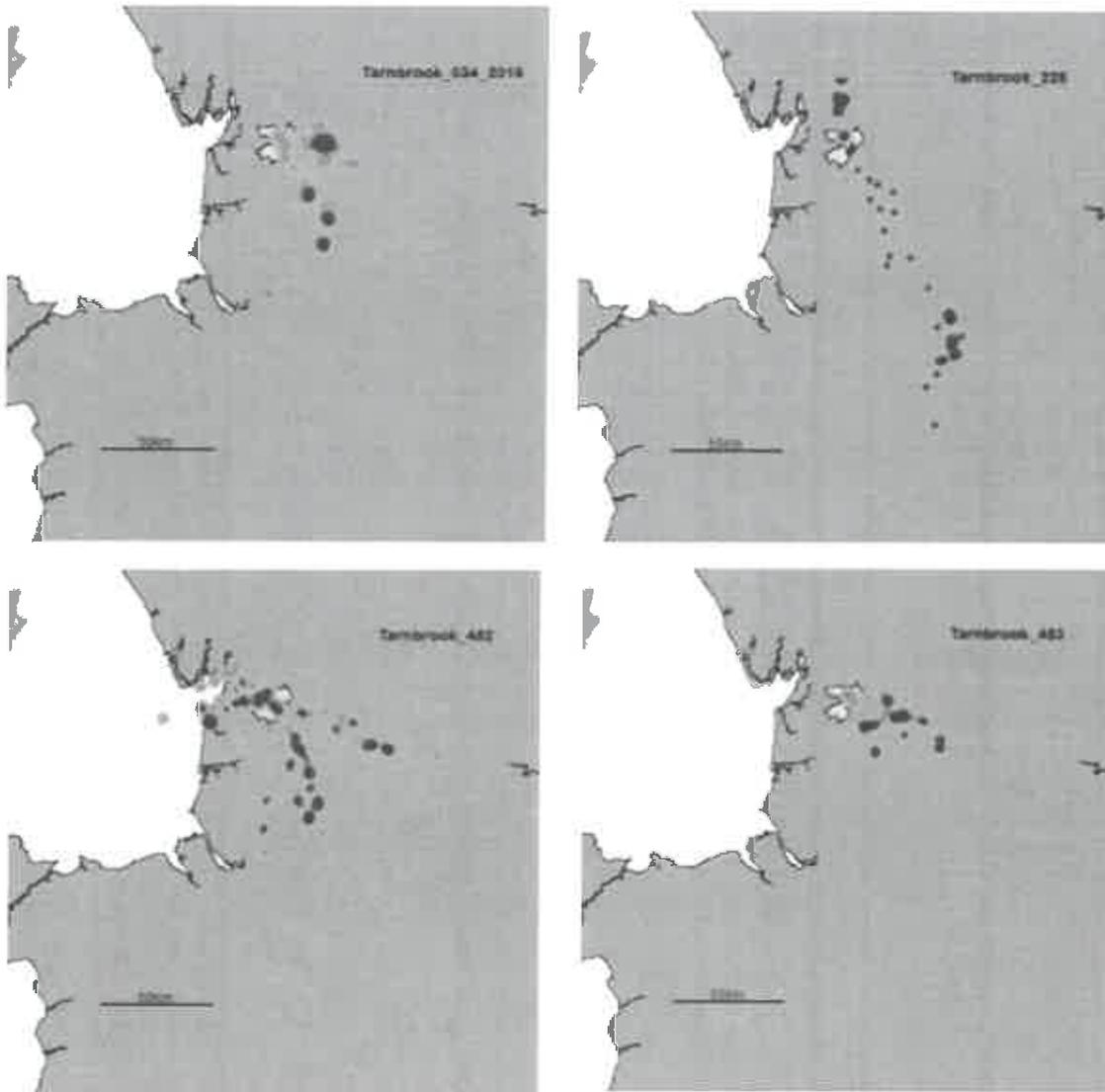


**Figure 3.5** Kernel density estimate utilisation distributions for individual Lesser Black-backed Gulls from the Bowland Fells SPA in 2015 using GPS fixes recorded during the day (60 minute sampling rate) outside of the main colony boundary. Red, orange and yellow illustrate the 50%, 75% and 95% utilisation distributions respectively. The Bowland Fells SPA indicated in blue.









**Figure 3.6** Kernel density estimate utilisation distributions for individual Lesser Black-backed Gulls from the Bowland Fells SPA in 2016 using GPS fixes recorded during the day (60 minute sampling rate) outside of the main colony boundary. Red, orange and yellow illustrate the 50%, 75% and 95% utilisation distributions respectively. The Bowland Fells SPA boundary indicated in blue.

**Table 3.1** Summary of spatial extent and overlap between kernel density estimate utilisation distributions for movements during the day of individual Lesser Black-backed Gulls and the Bowland Fells SPA.

Bird ID	N fixes	Area of KDE (km <sup>2</sup> )		Percentage overlap with SPA	
		50	95	50	95
<b>2015</b>					
Langden_Head_109	41	119.86	615.88	25.03	8.17
Tarnbrook_034	470	154.43	1275.85	8.35	7.1
TOTAL	511	274.29	1891.73	15.64	7.45
<b>2016</b>					
Langden_Head_178	352	100.87	1210.71	9.87	4.9
Langden_Head_237	542	81.20	832.13	4.73	4.33
Langden_Head_245	104	20.60	282.55	0	8.45
Langden_Head_262	33	54.88	317.24	8.97	9.65
Langden_Head_269	55	81.91	546.57	0	7.53
Langden_Head_270	343	108.04	1039.13	5.67	5.39
Langden_Head_277	59	80.87	460.78	4.92	7.1
Langden_Head_279	482	217.86	1449.51	8.23	3.77
Langden_Head_287	434	68.68	814.39	0	6.86
Langden_Head_454	105	217.10	953.41	24.57	7.05
Langden_Head_457	335	23.94	221.14	0	15.8
Langden_Head_459	297	388.54	1909.06	6.78	2.56
Langden_Head_460	44	85.39	377.80	8.84	8.23
Langden_Head_461	265	184.33	1185.20	9.73	5.31
Langden_Head_462	397	184.04	812.41	12.8	6.58
Tarnbrook_034	733	141.49	1122.66	0	7.21
Tarnbrook_226	49	251.12	1181.79	5.18	3.16
Tarnbrook_452	105	336.44	1558.06	11.77	5.39
Tarnbrook_453	51	137.85	606.66	0.8	8.73
TOTAL	4785	2765.14	16881.21	8.29	5.59

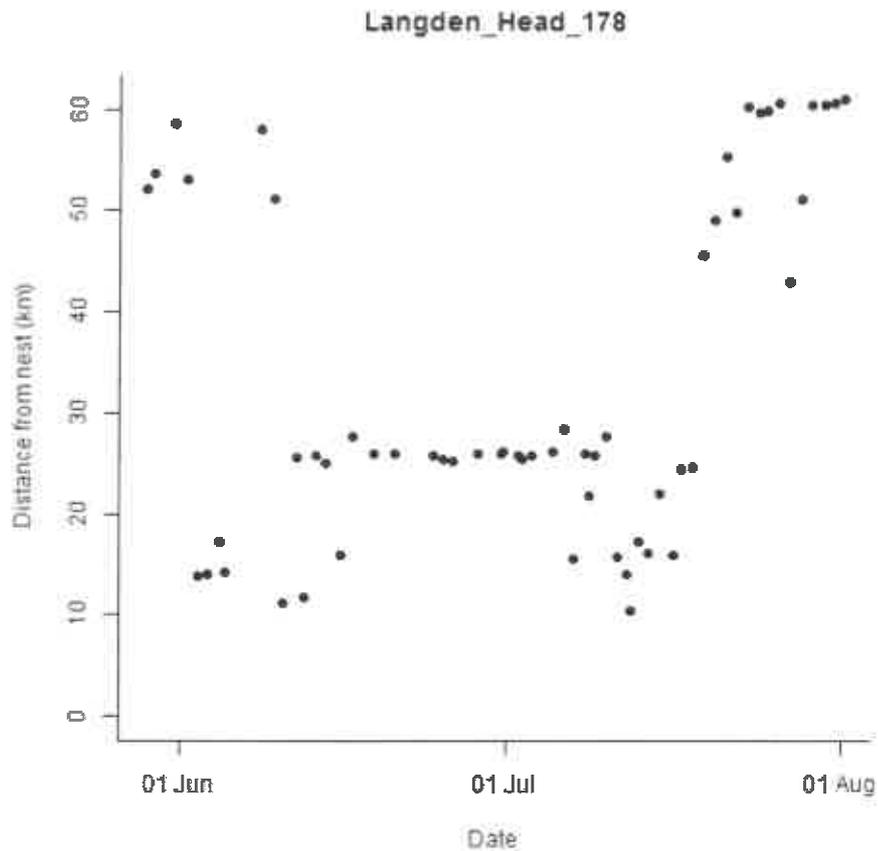
### 3.3 Maximum Foraging Distance

Individual Lesser Black-backed Gulls varied in both the number and maximum distance of foraging trips recorded away from the colony (Table 3.2). However, for some individuals (Fig. 3.7), there were periods – linked to the stage of breeding – when foraging trips were very consistent in the maximum distance travelled. Towards the end of the tracking period, birds went on longer trips away from the colony. Foraging distance plots for all individuals are included in Appendix 6.

**Table 3.2** Summary of the maximum distance from nest reached by Lesser Black-backed Gulls from the Bowland Fells SPA during each discrete trip away from the colony during the summer period.

Bird ID	Number of trips	Max distance (km)	Mean ( $\pm$ SD) maximum distance (km)
<b>2015</b>			
Langden_Head_109	7	58.94	45.76 $\pm$ 16.89
Tarnbrook_034	49	64.59	19.34 $\pm$ 17.05
<b>2016</b>			
Langden_Head_178	58	60.99	33.16 $\pm$ 17.09
Langden_Head_237	74	64.82	30.4 $\pm$ 17.33
Langden_Head_245	22	48.99	23.89 $\pm$ 15.64
Langden_Head_262	5	57.62	30.1 $\pm$ 24.27
Langden_Head_269	21	57.59	34.92 $\pm$ 22.53
Langden_Head_270	59	83.40	37.25 $\pm$ 19.98
Langden_Head_277	11	64.40	52.77 $\pm$ 4.51
Langden_Head_279	74	94.29	24.93 $\pm$ 14.49
Langden_Head_287	63	124.21	41.66 $\pm$ 33.61
Langden_Head_454	28	51.87	30.22 $\pm$ 14.32
Langden_Head_457	70	96.93	22.17 $\pm$ 17.94
Langden_Head_459	42	71.59	29.27 $\pm$ 21.26
Langden_Head_460	9	71.32	45.84 $\pm$ 18.95
Langden_Head_461	41	71.69	39.32 $\pm$ 22.93
Langden_Head_462	67	71.31	27.97 $\pm$ 19
Tarnbrook_034	65	83.34	33.29 $\pm$ 18.43
Tarnbrook_226	14	233.53 <sup>1</sup>	53.12 $\pm$ 54.06
Tarnbrook_452	26	88.09	51.82 $\pm$ 17.53
Tarnbrook_453	15	52.90	32.72 $\pm$ 13.66

<sup>1</sup>Note – Tarnbrook\_226 trip duration from which maximum foraging distance was derived was >24hrs



**Figure 3.7** Example for one individual Lesser Black-backed Gull (ID 178) of the maximum distance reached from the nest on each discrete trip away from the colony in the Bowland Fells SPA.

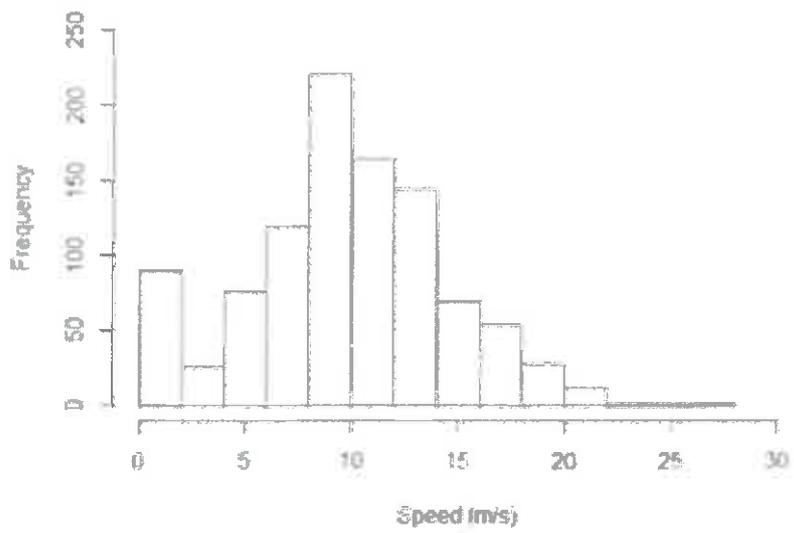
### 3.4 Time spent in Bowland Fells SPA

The estimated mean time spent inside the SPA (for both day and night periods combined but excluding time spent inside the colony boundaries) was 12% of the overall tracking period, ranging from 4 to 29% across individuals (Table 3.3). Without excluding GPS fixes recorded inside the colony the temporal overlap is much closer to 50% as would be expected from sharing of nest attendance by pairs during incubation and chick rearing.

**Table 3.3** Summary of the temporal overlap for individual Lesser Black-backed Gulls with the Bowland Fells SPA.

Bird ID	All time (incl. colony)			Away from colony		
	Total time (hrs)	Overlap (hrs)	%	Total time (hrs)	Overlap (hrs)	%
<b>2015</b>						
Langden_Head_109	895.62	201.94	23	892.82	62.67	7
Tarnbrook_034	1460.62	772.03	53	1425.45	155.33	11
<b>TOTAL</b>	<b>2356.23</b>	<b>973.97</b>	<b>41</b>	<b>2318.27</b>	<b>218.01</b>	<b>9</b>
<b>2016</b>						
Langden_Head_178	1708.30	792.54	46	1705.82	213.62	13
Langden_Head_237	2103.50	943.15	45	2088.08	207.77	10
Langden_Head_245	1951.70	612.79	31	1951.15	138.48	7
Langden_Head_262	223.88	140.34	63	204.27	15.62	8
Langden_Head_269	1854.68	714.43	39	1847.90	220.86	12
Langden_Head_270	1957.13	1187.14	61	1929.25	284.70	15
Langden_Head_277	1549.17	771.74	50	1470.37	150.52	10
Langden_Head_279	1977.77	1116.19	56	1956.33	287.00	15
Langden_Head_287	1572.53	832.16	53	1565.47	174.99	11
Langden_Head_454	1178.02	562.55	48	1152.43	337.07	29
Langden_Head_457	1857.87	955.26	51	1825.10	143.59	8
Langden_Head_459	2103.03	828.02	39	2091.88	217.96	10
Langden_Head_460	1612.30	848.28	53	1563.72	62.83	4
Langden_Head_461	2067.07	547.31	26	2050.13	181.36	9
Langden_Head_462	2006.60	1161.54	58	1999.37	287.27	14
Tarnbrook_034	2960.83	1511.79	51	2958.82	404.70	14
Tarnbrook_226	1599.87	534.49	33	1593.23	217.24	14
Tarnbrook_452	1584.53	635.44	40	1533.37	232.34	15
Tarnbrook_453	1554.62	683.98	44	1523.17	144.58	9
<b>TOTAL</b>	<b>33423.40</b>	<b>15379.12</b>	<b>46</b>	<b>33009.85</b>	<b>3922.50</b>	<b>12</b>

The results presented in this report focus on time and location information, however, some basic inferences on behaviour can also be made using the telemetry data received from the tags, even at relatively infrequent sampling rates. The tags record an estimated measure of ground speed at the time a GPS is taken. To better understand how the birds were using areas of the SPA in which GPS fixes were obtained, we also considered the distribution of estimated speed within the SPA (excluding the colonies), across all birds (Fig. 3.8). There is a high degree of uncertainty in the estimates of ground speed but they are nonetheless indicative. The majority of records indicated speeds of around 10 m/s which is consistent with flight behaviour (Shamoun-Baranes *et al.* 2011) and suggest that for the majority of time spent inside the SPA but outside of the colony, birds are commuting to other sites.



**Figure 3.8** Histogram of the estimated speed of Lesser Black-backed Gulls as recorded from the GPS-GSM devices for all GPS fixes (across individuals) recorded within the Bowland Fells SPA boundary but outside of the two colony areas.

## 4. DISCUSSION

### 4.1 Spatial assessment

Overall, the spatial overlap between day time foraging ranges of Lesser Black-backed Gulls breeding in Bowland Fells SPA and the SPA itself was low, being less than 10% for both core and total ranges in 2016 (Table 3.1). This suggests that while the SPA is clearly important as a breeding site for Lesser Black-backed Gulls, it is not important for foraging during the breeding season compared with other sites.

Nevertheless, it is important to consider the degree of individual variation in foraging strategy in assessing how representative the sample of tagged birds is of the overall population. For example, core range overlap with the SPA was highest for bird ID 454. However, when raw plotted data are viewed there is little to suggest this individual actively foraged within the SPA and the results are possible an artefact of a relatively small sample of GPS fixes. Given the total size of the colonies within the Bowland Fells SPA, if even a small percentage of the birds also adopted more local foraging then this could represent a considerable number of individuals.

In a review of previous published information, Thaxter *et al.* (2012b) reported a maximum foraging range for Lesser Black-backed Gull of 181 km. The maximum foraging distances of individual Lesser Black-backed Gulls from the Bowland colonies are typically within this range, although the maximum figure of 234 km exceeds this. However, this figure likely came after the individual's breeding attempt had finished, during the post-breeding period when birds were still attached to the colony. The studies reviewed by Thaxter *et al.* (2012b) and other recent studies (e.g. Ens *et al.* 2008, Götmark 1984, Kubetzki & Garthe 2003, Isaksson *et al.* 2016, Shamoun-Baranes *et al.* 2011) all report the importance of offshore environments during the breeding season. In contrast, the birds tracked from Bowland almost exclusively visited terrestrial sites. O'Connell (1995) highlighted the likely importance of anthropogenic food sources from landfill sites and invertebrates from agricultural areas in the diet of birds from the Tarnbrook colony, noting that earthworms were the commonest items of food fed to chicks. Use of terrestrial foraging can be expected for birds from inland colonies and there is evidence for the importance of agricultural and landfill food in urban breeding gull diet (Coulson & Coulson 2008). Future changes to current landfill regulations or urban management may influence the foraging behaviour of gulls from the Bowland Fells SPA and may affect the relative importance of use of agricultural areas near or in the SPA or the potential use of marine areas.

### 4.2 Temporal assessment

It was apparent that the tagged birds spent a small proportion of their time inside the SPA when on trips away from the main colony areas (Table 3.3) and of that time it is likely that they were mostly flying to or from other locations (Fig. 3.8). Some individuals did have higher than average temporal overlap with the SPA, for example, bird ID 454, which also showed the highest spatial overlap with the SPA. This individual was one of the few birds to make greater use of the farmland areas to the east of the SPA (Fig. 3.7) and was likely to be making use of different food resources than the majority of other birds closely linked with human environments (although it still visited urban habitat in Clitheroe on occasion).

### 4.3 Conclusions

Tracked Lesser Black-backed Gulls from the Bowland Fells SPA likely foraged almost exclusively in terrestrial habitats. Both spatial and temporal overlap with the SPA was low for most birds when away from the colony (<10% of ranges, <12% of time budgets on average). Total time within the SPA was closer to 50% when GPS data recorded from inside the colony boundary were also included, as would be expected from sharing of nest attendance by pairs during incubation and chick rearing.

It was not possible to precisely know the behaviour of the Lesser Black-backed Gulls from the tracking data; however, data on estimated ground speed suggest that most fixes within the SPA but outside the colony were obtained during active flight. It is possible to analyse telemetry data to delineate patterns of behaviour and match them to spatial use at a very fine scale, i.e. through the use of accelerometer data (Shamoun-Baranes *et al.* 2012), or at a meso-scale looking at trajectory and speed information but this was not within the scope of the present study.

The most frequently visited habitats tended to be urban areas and landfill sites to the south and southwest of the SPA but regular use of nearby agricultural land was also seen. Unfortunately it was not possible to tag an equal sample from each colony, and the sample from Tarnbrook was much smaller, but it appears that birds from each colony are highly segregated inside the SPA and may even have different foraging site preferences outside the SPA boundary.

While the SPA provides an important breeding site for the Lesser Black-backed Gulls, the tracking data indicate that it does not currently provide important foraging sites and that the gulls travel daily to other sites outside the SPA. It is likely that a small proportion of individuals spent relatively more time within the SPA and make greater use of nearby agricultural land but at present it seems profitable for most birds to continue to travel relatively long distances to forage around human occupied environments, predominantly urban areas, but also farmland.

### **Acknowledgements**

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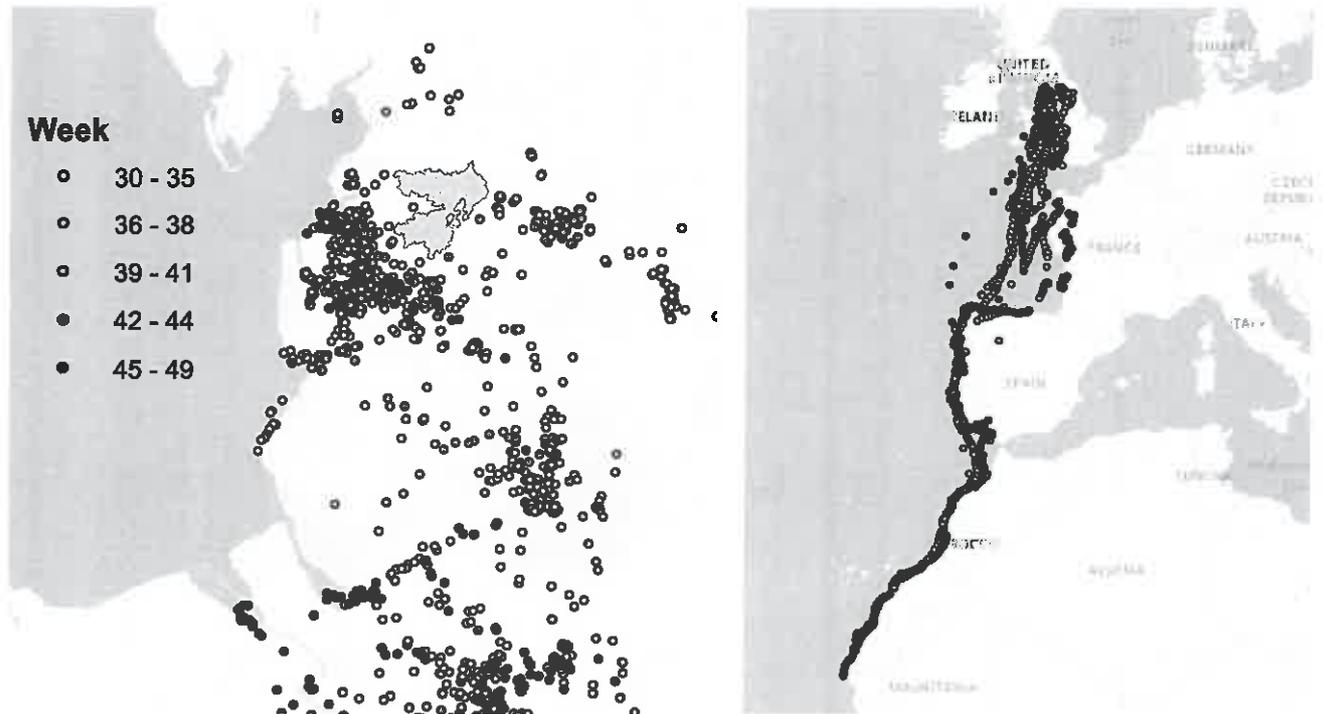


## Appendices

- Appendix 1** Raw capture and nest monitoring data – see file  
'Bowland Fells SPA\_LBBGU capture data\_BTO\_Feb 2017.xlsx'



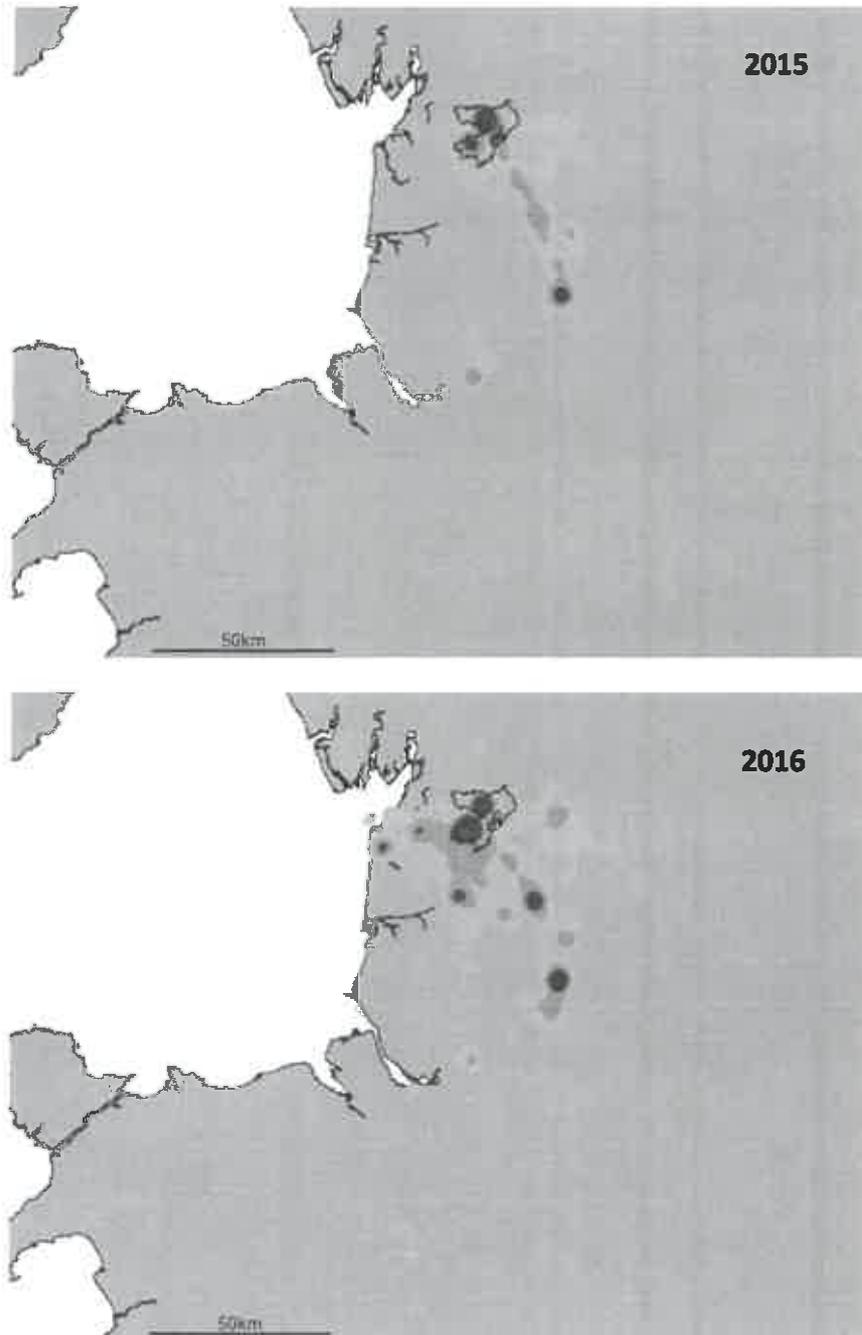
**Appendix 2** Plot of all GPS fixes for Lesser Black-backed Gulls from the Bowland Fells SPA (up until 30/11/2016) which were excluded from the analyses (after last fix was recorded inside the Bowland Fells SPA). The timing (week of year) of the GPS fix is ordered by colour with later fixes shown in darker colours.



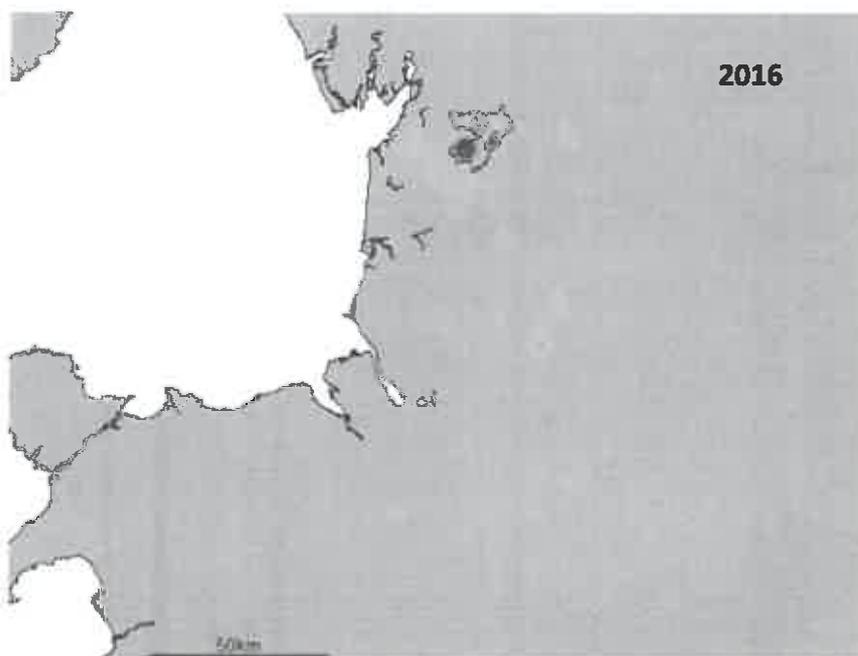


**Appendix 3** Kernel density estimate utilisation distributions for individual Lesser Black-backed Gulls from the Bowland Fells SPA and all birds combined for 2015 (n = 2 individuals) and 2016 (n = 19 individuals) using all GPS fixes (including those inside the colony) recorded during the day (60 minute sampling rate). Red, orange and yellow illustrate the 50%, 75% and 95% utilisation distributions respectively. The Bowland Fells SPA boundary is shown.

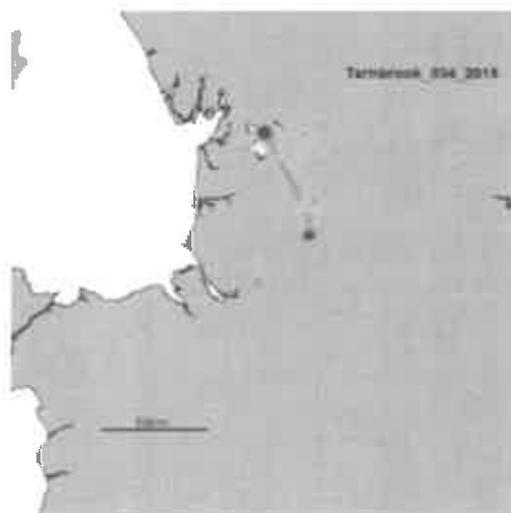
***Day foraging range***

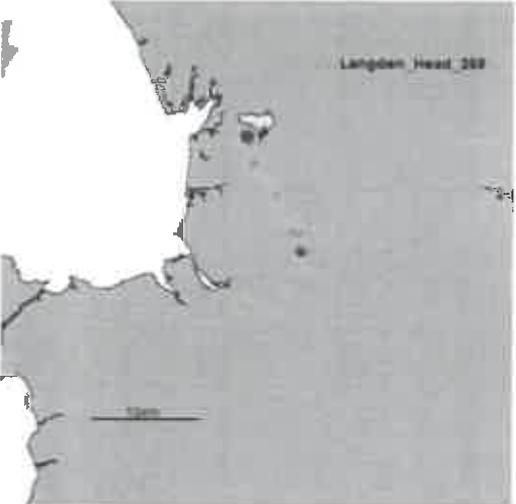
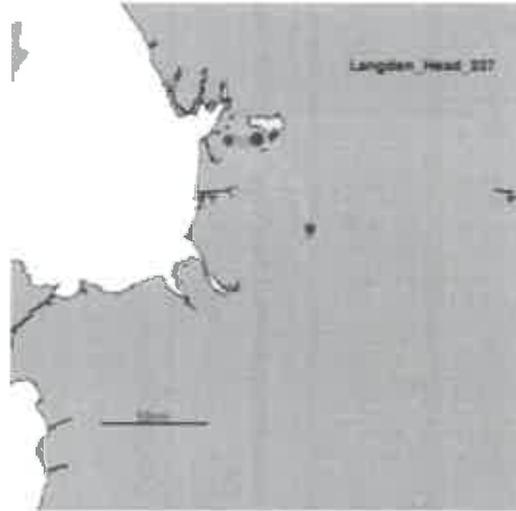


**Night foraging range**



**Individual foraging ranges**









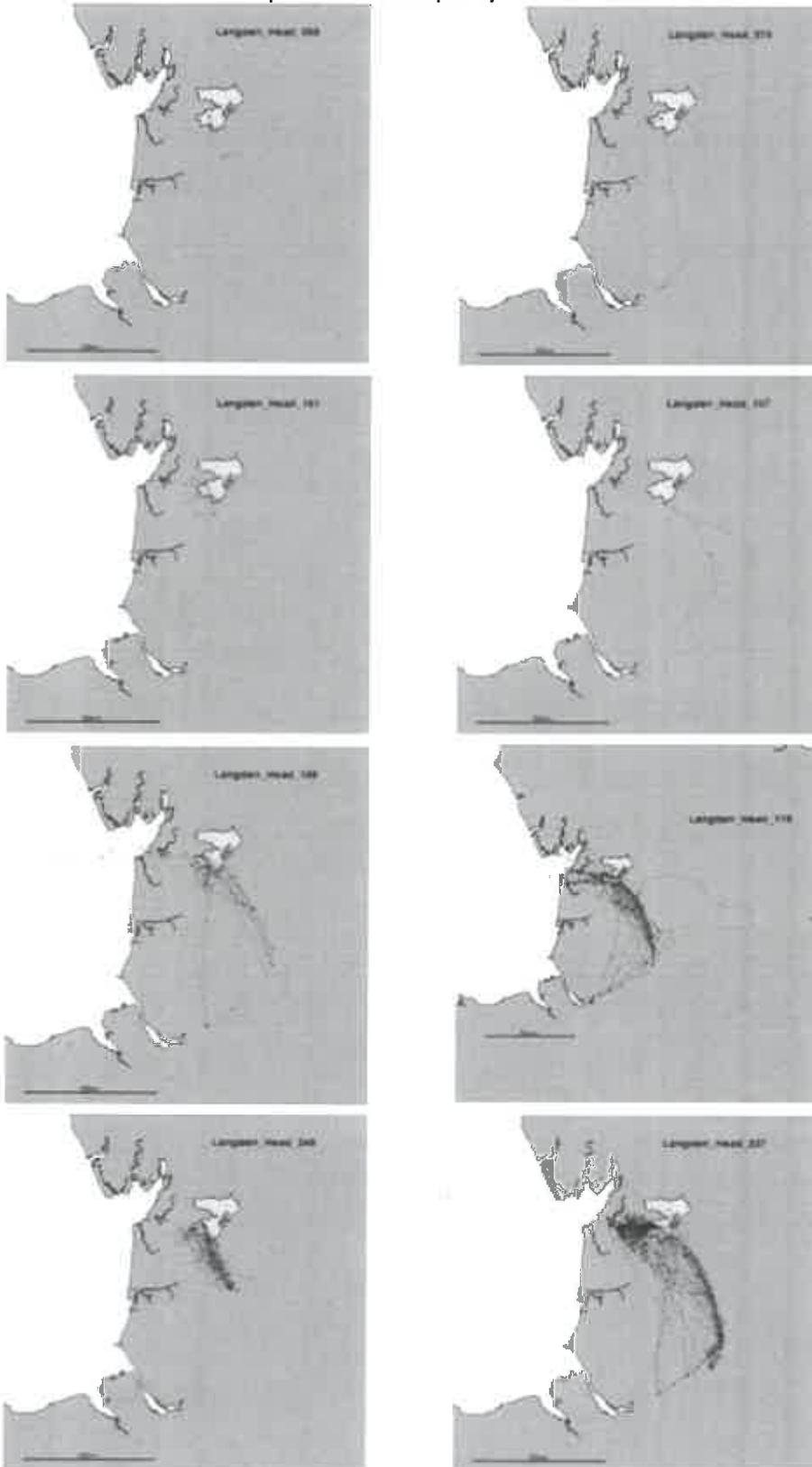


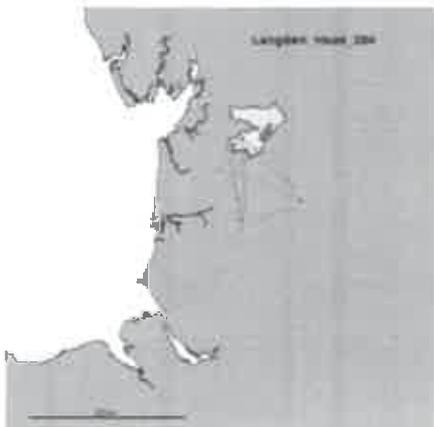
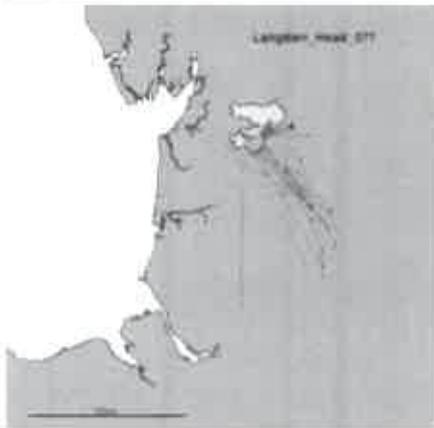
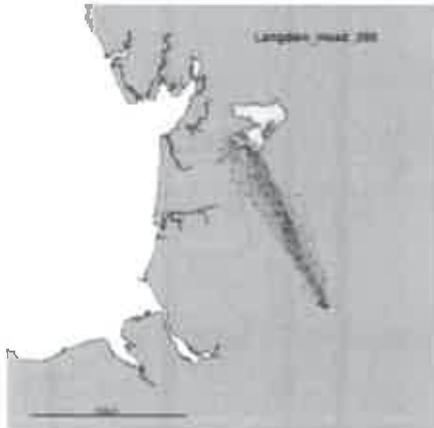
**Appendix 4** Details of tagged Lesser Black-backed Gulls from the Bowland Fells SPA reported as dead (up until 31/12/2016).

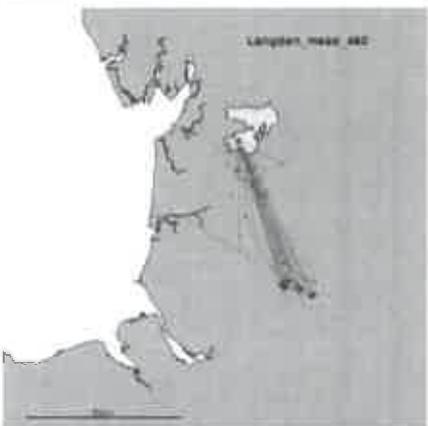
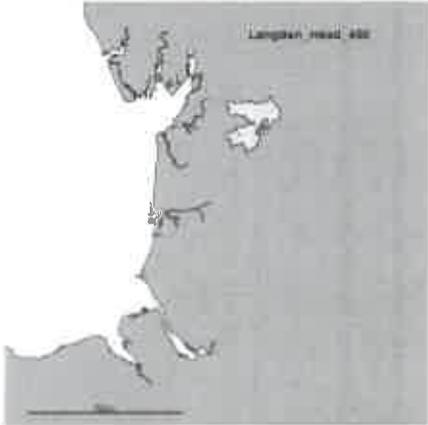
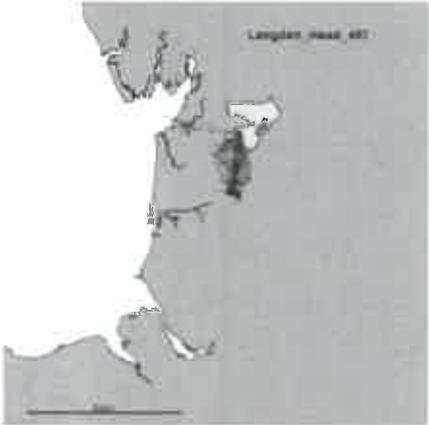
Year caught	Year found	Tag ID	Found by	Finding circumstances
2016	2016	263	Staff	Presumed death around 28/7/16 near busy road. Tag not recovered. Would not have been known about if not for tag data.
2016	2016	284	Public	Collision with power lines reported by member of public 26/8/16
2016	2016	462	Staff	Death around 25/8/16 near M1/M6 interchange. Scavengers took body but left tag, which was recovered. Would not have been known about if not for tag data.

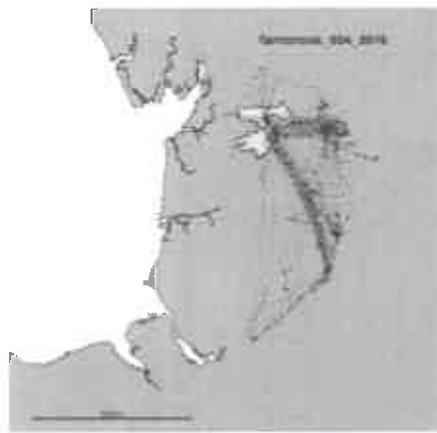


**Appendix 5** Plots of GPS tracks from individual Lesser Black-backed Gulls from the Bowland Fells SPA irrespective of data quality.

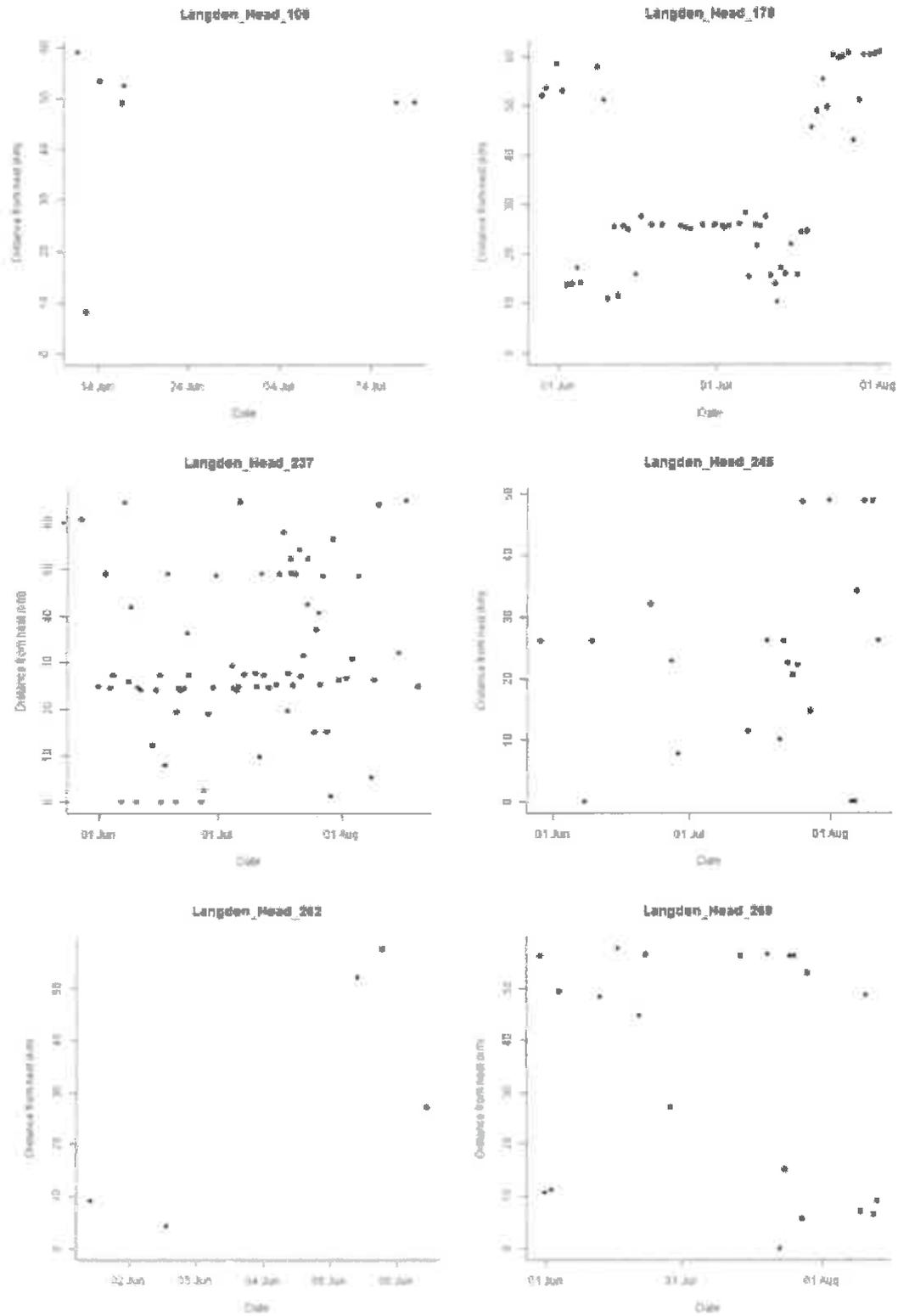


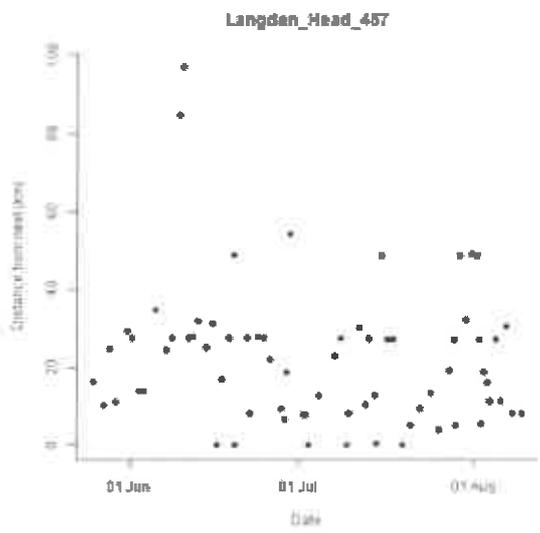
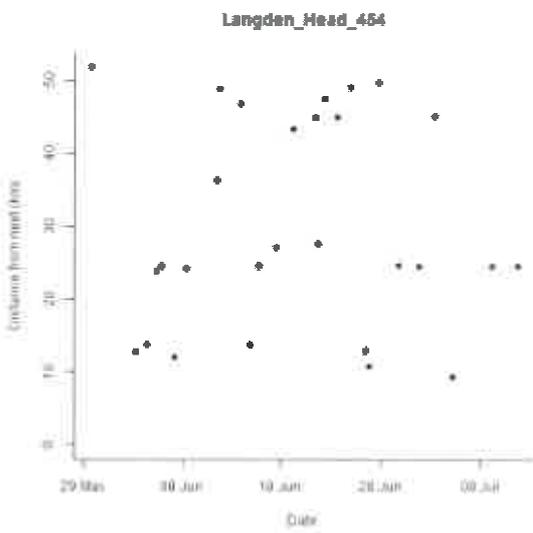
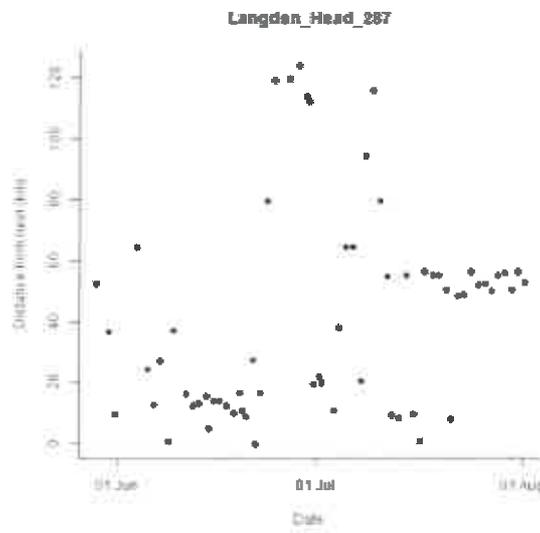
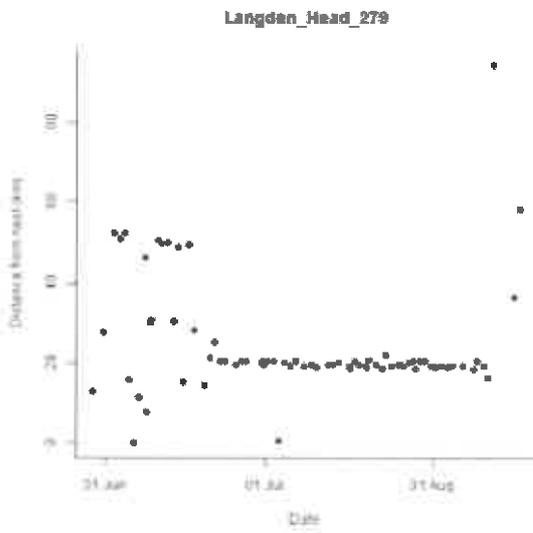
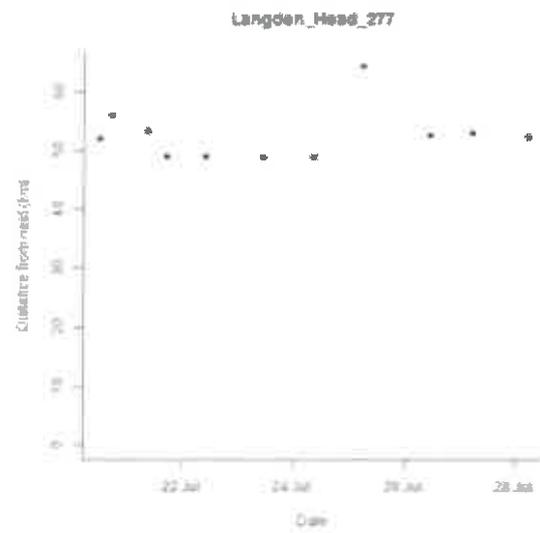
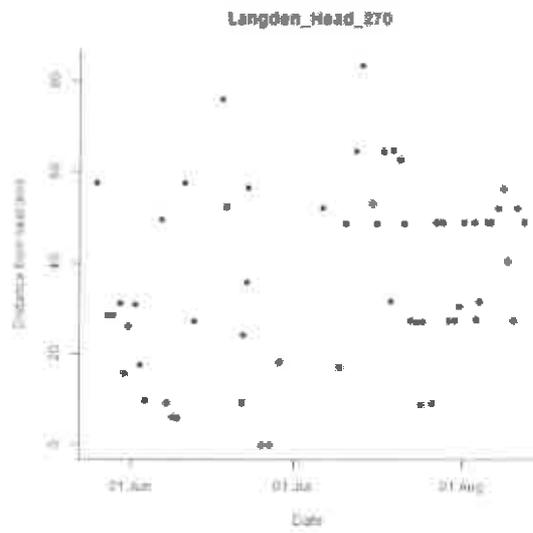


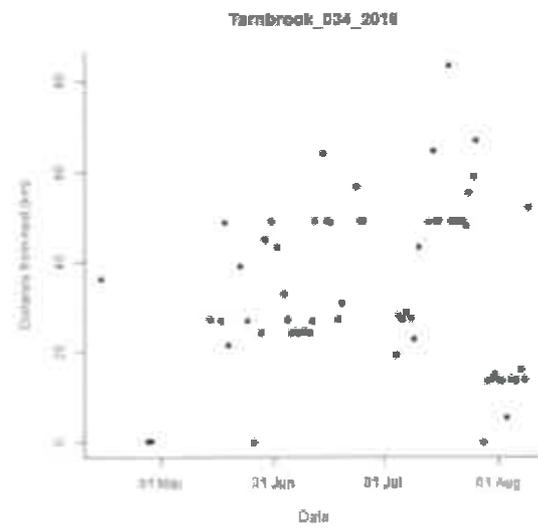
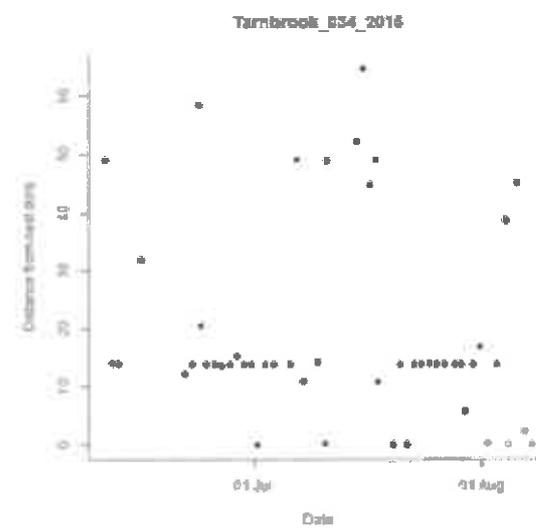
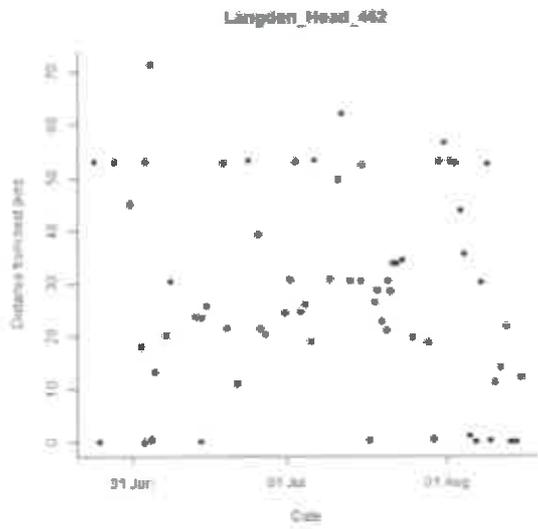
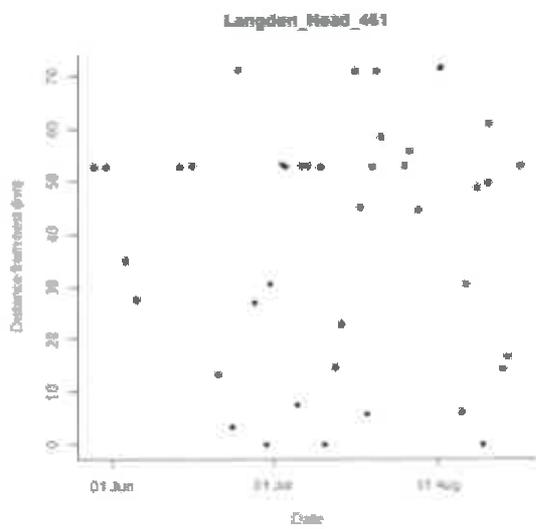
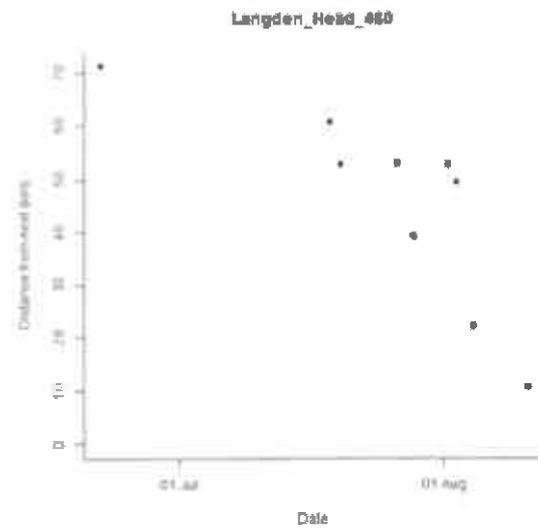
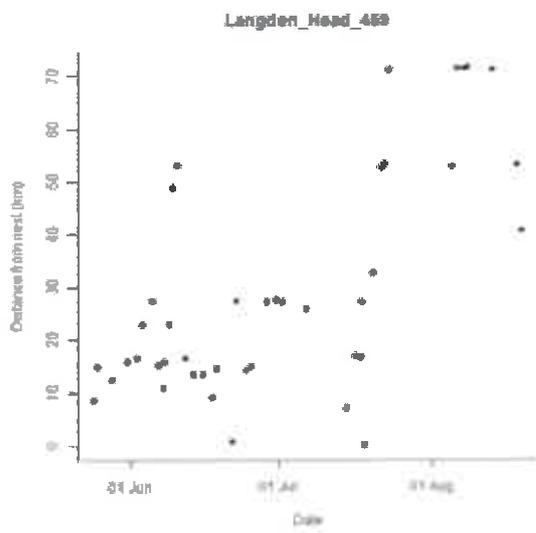




**Appendix 6** Individual plots of maximum foraging distance reached on each trip away from the colony for Lesser Black-backed Gulls fitted with GPS-GSM devices on Bowland Fells SPA.











**BTO Research Report No. 694A**

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from the Bowland Fells SPA  
ANNEX 1 – 2017 update**

Authors

**Clewley, G.D., Scragg, E.S., Thaxter, C.B. & Burton, N.H.K.**

Report of work carried out by the British Trust for Ornithology  
on behalf of Natural England

November 2017

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## CONTENTS

	<b>Page No.</b>
List of Tables .....	2
List of Figures.....	2
<b>EXECUTIVE SUMMARY .....</b>	<b>3</b>
<b>1. INTRODUCTION .....</b>	<b>4</b>
<b>2. METHODS .....</b>	<b>4</b>
<b>3. RESULTS .....</b>	<b>4</b>
<b>3.1 Overview of the Status of Tagged Birds and Data Collection Periods.....</b>	<b>4</b>
<b>3.2 Nest Monitoring .....</b>	<b>6</b>
<b>3.3 Summary of Data Collected .....</b>	<b>6</b>
<b>Reference.....</b>	<b>15</b>

## LIST OF TABLES

	<b>Page No.</b>
<b>Table 1</b>	Summary of status of all tagged birds since 2015 and summary of data transmitted for the 2017 breeding period .....5
<b>Table 2</b>	Nest outcomes for returning tagged adult Lesser Black-backed Gulls in 2017 at Langden Head in the Bowland Fells SPA, in relation to a control sample .....6

## LIST OF FIGURES

	<b>Page No.</b>
<b>Figure 1</b>	GPS tracking from tagged Lesser Black-backed Gulls from the Bowland Fells SPA for the 2017 breeding period .....14

## EXECUTIVE SUMMARY

1. This annex to BTO Research Report 694 (Clewley *et al.* 2016) presents a summary update for 2017 on the results of a GPS tracking study of Lesser Black-backed Gulls *Larus fuscus* breeding in the Bowland Fells Special Protection Area (SPA). For analyses of the data collected during the 2016 breeding season quantifying: (i) the home ranges of Lesser Black-backed Gulls during the breeding season and their spatial overlap with the SPA; (ii) maximum foraging distances; and (iii) the time spent by individual birds inside the SPA, please see the main report.
2. Twenty-two GPS-GSM tags (Movetech Telemetry) were deployed on Lesser Black-backed Gulls during 2016 across two sites (Tarnbrook Fell and Langden Head) within the Bowland Fells SPA. Fourteen of the 22 birds fitted with tags in 2016 returned and transmitted data during the 2017 breeding season. Two additional individuals were tagged in 2017 from the Tarnbrook colony to increase the sample there as birds from either main colony within Bowland can have different local space use. Many of the movements in 2017 appeared consistent with those reported for 2016 although some new behaviours, such as potential colony switching, were recorded.

## **1. INTRODUCTION**

This annex to BTO Research Report 694 (Clewley *et al.* 2016) presents a summary update for 2017 on the results of a GPS tracking study of Lesser Black-backed Gulls *Larus fuscus* breeding in the Bowland Fells Special Protection Area (SPA). The overall aims of the project were to:

- i. Identify potential feeding areas (both within and outside the SSSI/SPA) used by Lesser Black-backed Gulls from this breeding population; and
- ii. Quantify the amount of time spent by the gulls in these areas.

Twelve GPS-GSM tags (Movetech Telemetry) were deployed during 2015 but unfortunately subsequent performance was not as expected and the work was repeated in 2016, with an additional sample of tags also deployed, resulting in 22 deployments across two sites (Tarnbrook Fell and Langden Head) within the SPA. Further details on the background to the study and analyses of the data collected during the 2016 breeding season quantifying: (i) the home ranges of Lesser Black-backed Gulls during the breeding season and their spatial overlap with the SPA; (ii) maximum foraging distances; and (iii) the time spent by individual birds inside the SPA are presented in the main report.

Here, we provide an update on the status of tracked individuals and an overview of the data collected during the 2017 breeding season.

## **2. METHODS**

To add to the data from birds returning for the 2017 breeding season, two additional birds were fitted with improved GPS tags in 2017 on the Tarnbrook Fell site to replace two tags which did not function as expected during 2016. With the exception of a new style of harness designed to safely fall off the bird after the intended tracking period all methods were unchanged from the previous work.

## **3. RESULTS**

### **3.1 Overview of the Status of Tagged Birds and Data Collection Periods**

Fourteen of the 22 birds tagged in 2016 returned and continued to transmit data during the breeding period in 2017 after spending the winter months further south (at various locations between south England and West Africa). There was some attrition of the tagged cohort through both mortality and potentially tag failure (Table 1).

**Table 1** Summary of status of all tagged birds since 2015 and summary of data transmitted for the 2017 breeding period. The breeding period is defined by the first and last date in which any GPS fixes were recorded inside the Bowland Fells SPA.

Bird ID	Total GPS fixes	2017 breeding season tracking period	Notes
<b>2015</b>			
Langden_Head_28	-	NA	Did not transmit during 2017
Langden_Head_68	-	NA	Did not transmit during 2017
Langden_Head_76	-	NA	Did not transmit during 2017
Langden_Head_101	-	NA	Did not transmit during 2017
Langden_Head_107	-	NA	Did not transmit during 2017
Langden_Head_109	-	NA	Did not transmit during 2017
Tarnbrook_34	-	NA	Did not transmit during 2017
Tarnbrook_41	-	NA	Did not transmit during 2017
Tarnbrook_55	-	NA	Did not transmit during 2017
Tarnbrook_100	-	NA	Did not transmit during 2017
Tarnbrook_104	-	NA	Did not transmit during 2017
Tarnbrook_110	-	NA	Did not transmit during 2017
<b>2016</b>			
Langden_Head_178	530	31/03/2017 - 22/06/2017	Truncated dataset – presumed dead
Langden_Head_237	4994	19/03/2017 - 20/08/2017	
Langden_Head_245	3413	03/05/2017 - 20/08/2017	
Langden_Head_269	3302	18/04/2017 - 20/08/2017	
Langden_Head_270	2791	12/03/2017 - 13/07/2017	Truncated dataset – presumed dead
Langden_Head_277	1110	29/03/2017 - 07/07/2017	
Langden_Head_279	3552	03/05/2017 - 05/08/2017	
Langden_Head_287	3143	28/03/2017 - 24/07/2017	
Langden_Head_451	129	31/03/2017 - 25/05/2017	Truncated dataset – tag failed
Langden_Head_457	289	12/03/2017 - 31/05/2017	Truncated dataset – tag failed
Langden_Head_459	903	08/04/2017 - 01/08/2017	
Langden_Head_460	220	05/05/2017 - 22/06/2017	
Langden_Head_461	2304	13/03/2017 - 16/07/2017	
Tarnbrook_226	3689	07/04/2017 - 04/08/2017	
Langden_Head_262	-	NA	Reported dead in 2017
Langden_Head_263	-	NA	Presumed dead in 2016
Langden_Head_284	-	NA	Reported dead in 2016
Langden_Head_454	-	NA	Did not transmit during breeding season
Langden_Head_458	-	NA	Did not transmit during breeding season
Langden_Head_462	-	NA	Reported dead in 2016
Tarnbrook_452	-	NA	Did not transmit during breeding season
Tarnbrook_453	-	NA	Did not transmit during breeding season
<b>2017</b>			
Tarnbrook_697	896	21/05/2017 - 14/08/2017	
Tarnbrook_728	1458	21/05/2017 - 14/08/2017	

The following birds were proven (from reports) or assumed (from the data received) to have died during the study period. For those proven cases, ringing recovery reports have been submitted.

Bird 178 – Stationary GPS data transmitted from 4 July 2017 from a farm building near Preston suggesting that the bird had died. A subsequent search on 6 August 2017 recovered the tag from a well decomposed corpse.

Bird 262 – We received a report on 16 May 2017 from keepers from the Abbeystead Estate in the Bowland Fells SPA that this bird had been shot by them. Both the corpse and tag were returned to us for examination, the freshness of the corpse indicating that the bird had been shot within one or two days of the day of the report.

Bird 263 – Stationary GPS data transmitted for several days adjacent to a busy main road suggests that this bird died around the evening of 28 July 2016. A search of the area (near to the Bowland Fells SPA) was made after this period on 7 August, but no bird or tag was recovered.

Bird 270 – Stationary GPS data transmitted from 14 July 2017 suggesting that the bird had died near Cowpe Reservoir in Lancashire. A corpse and the tag were found following a search on 7 August 2017, but with no obvious cause of death.

Bird 284 – Reported to us on 26 August 2016 by a member of the public as dead and possibly collided with power lines around Chipping in Lancashire.

Bird 462 – Stationary GPS data were transmitted from 25 August 2016 from a site near the M1/M6 interchange. The bird subsequently ‘moved’ across the field, which we interpret to be a scavenger moving the body. An intensive search was made of the area on 4 October 2016 and while we did not find the corpse, we found the tag with chewed harness material suggesting that the bird was predated.

### 3.2 Nest Monitoring

Three separate nest monitoring visits were made during 2017 to locate the nests of returning tagged birds and to compare their breeding success to that of a control sample of unmarked birds. Nests of tagged birds were identified by selecting the nearest nest to the centre point of stationary GPS data collected within the breeding colony; the nearest adjacent nest served as a paired control.

It was possible to identify the likely nests of 12 returning tagged adults from 2016 at the Langden Head colony but unfortunately none at Tarnbrook Fell (there was a sampling bias in 2016 and few birds were marked at Tarnbrook Fell). Estimates of nest success (Table 2) represent a minimum as it was not always apparent whether nest had failed or whether eggs had hatched and chicks already dispersed from the nest site.

**Table 2** Nest outcomes for returning tagged adult Lesser Black-backed Gulls in 2017 at Langden Head in the Bowland Fells SPA, in relation to a control sample. Clutch size was recorded during the first monitoring visit. Minimum hatching success takes into account observed hatching during any visit and presumed nest outcomes were from the final visit.

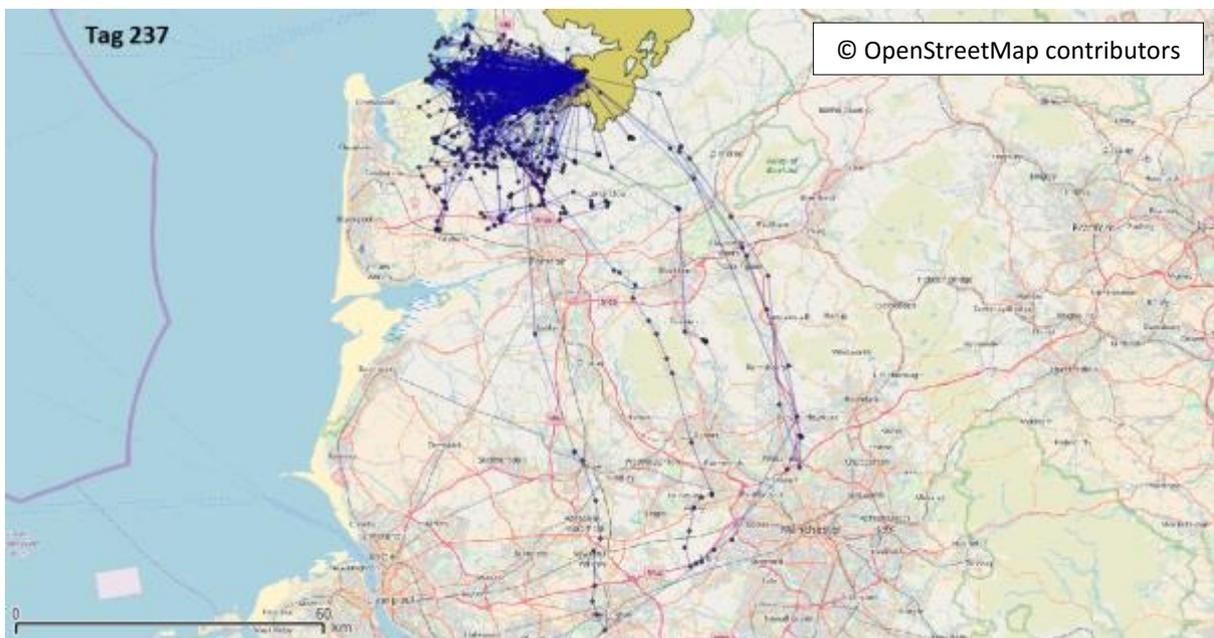
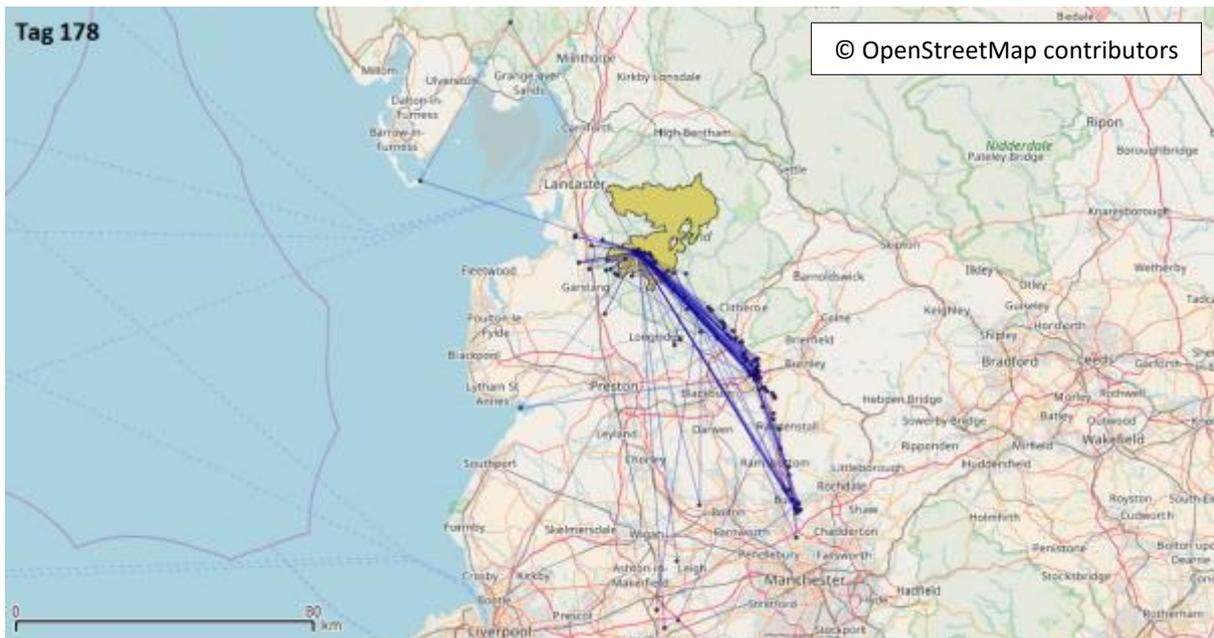
	Mean clutch size $\pm$ SD	Minimum hatching success	Presumed minimum nest success	Potential nest failure
Tagged birds’ nests	2.58 $\pm$ 0.64	0.75	0.58	0.42
Control nests	2.75 $\pm$ 0.43	0.83	0.67	0.33

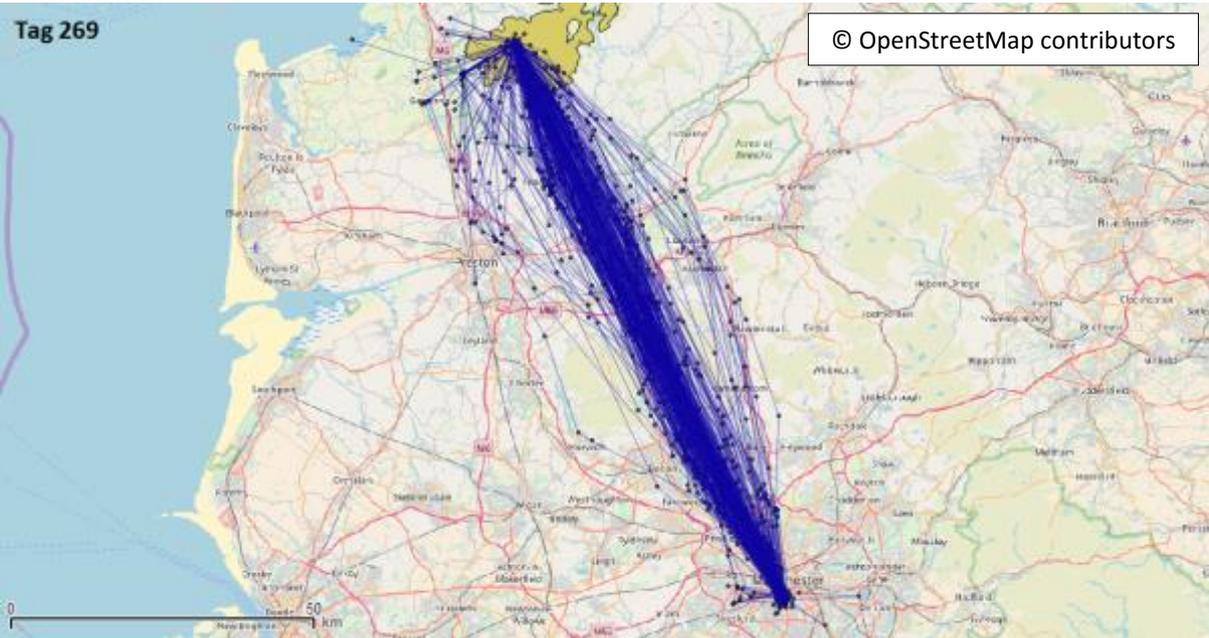
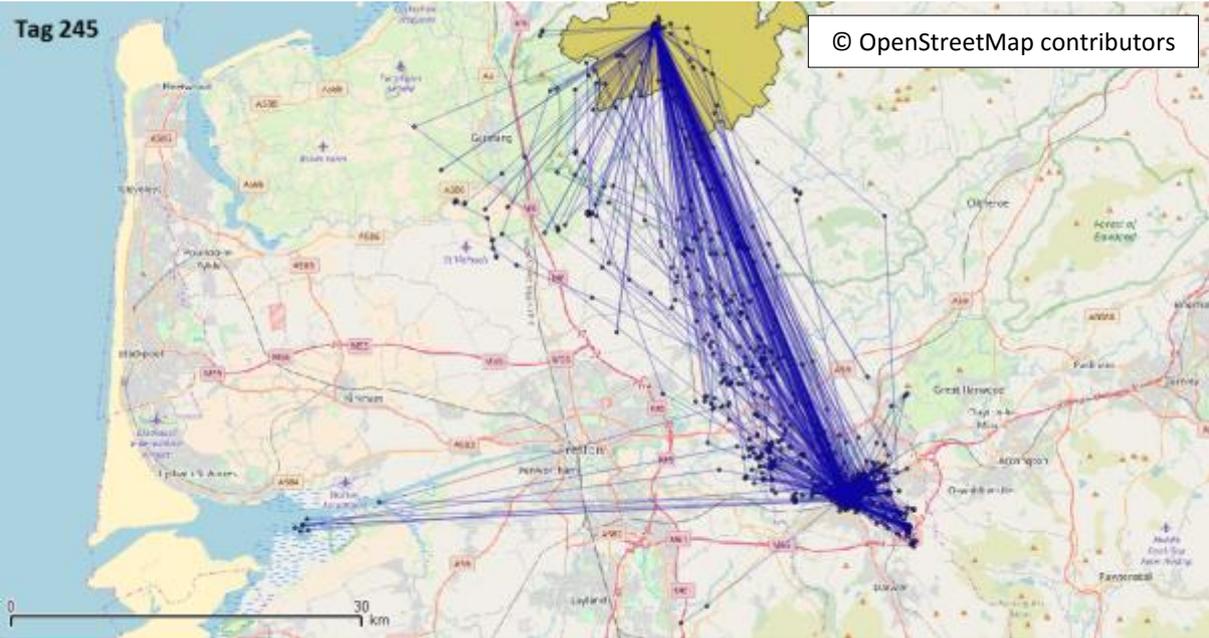
### 3.3 Summary of Data Collected

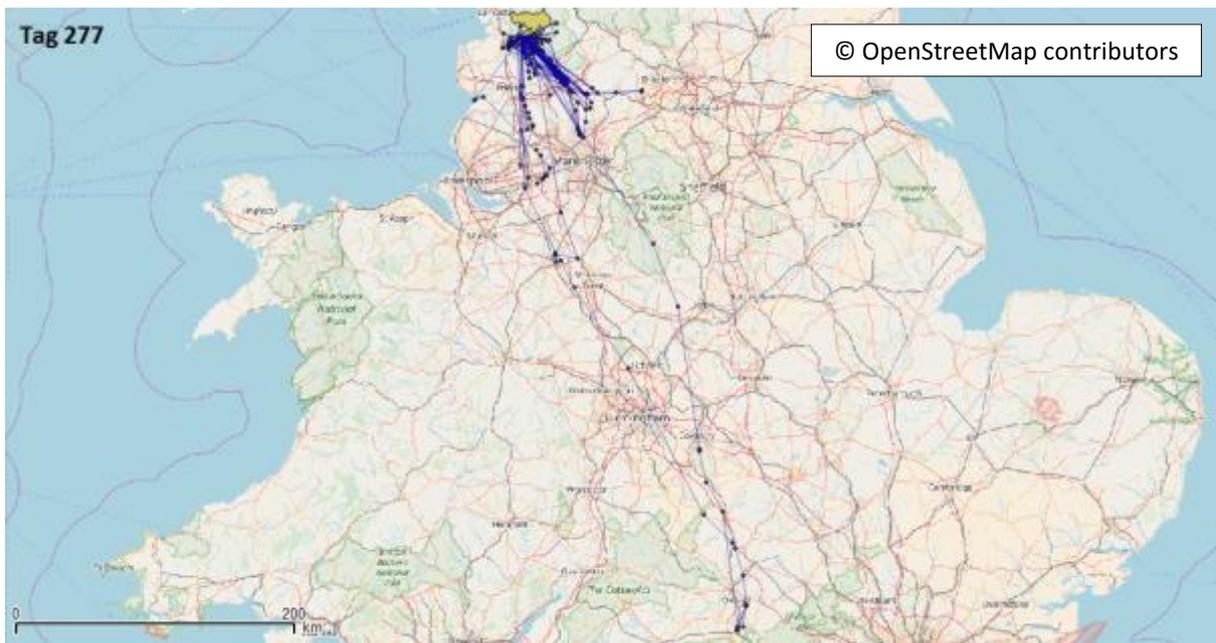
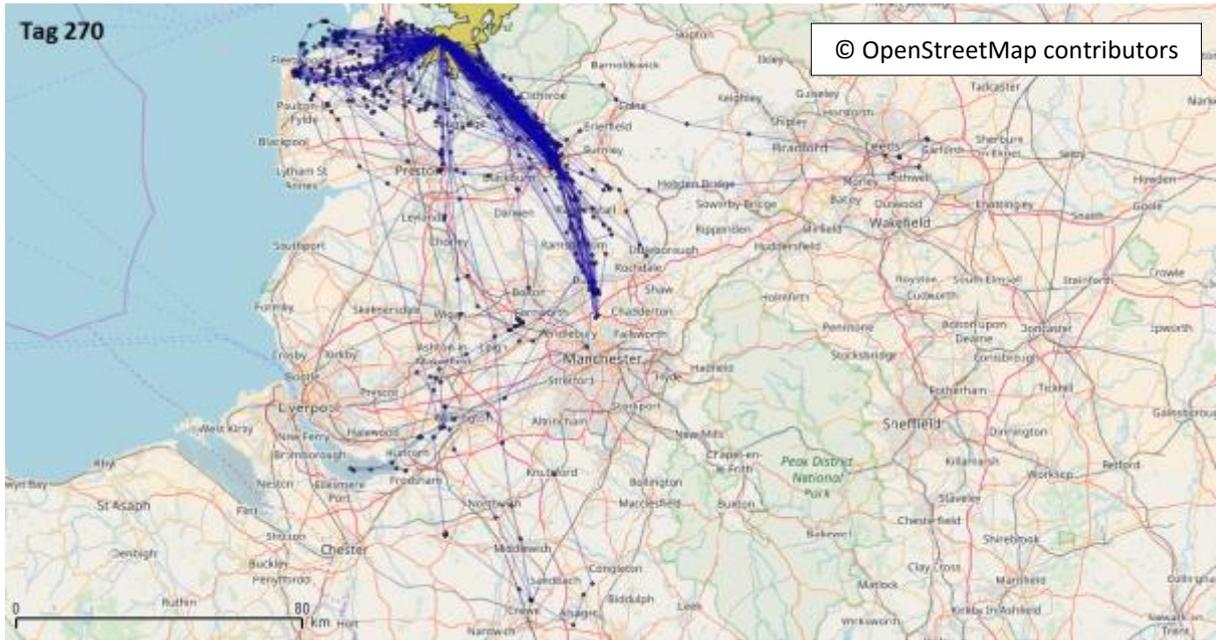
Broadly many of the movements recorded in 2017 were similar to those during 2016 (Fig. 1). Particularly, birds breeding at the Langden Head colony made extensive use of landfill and urban

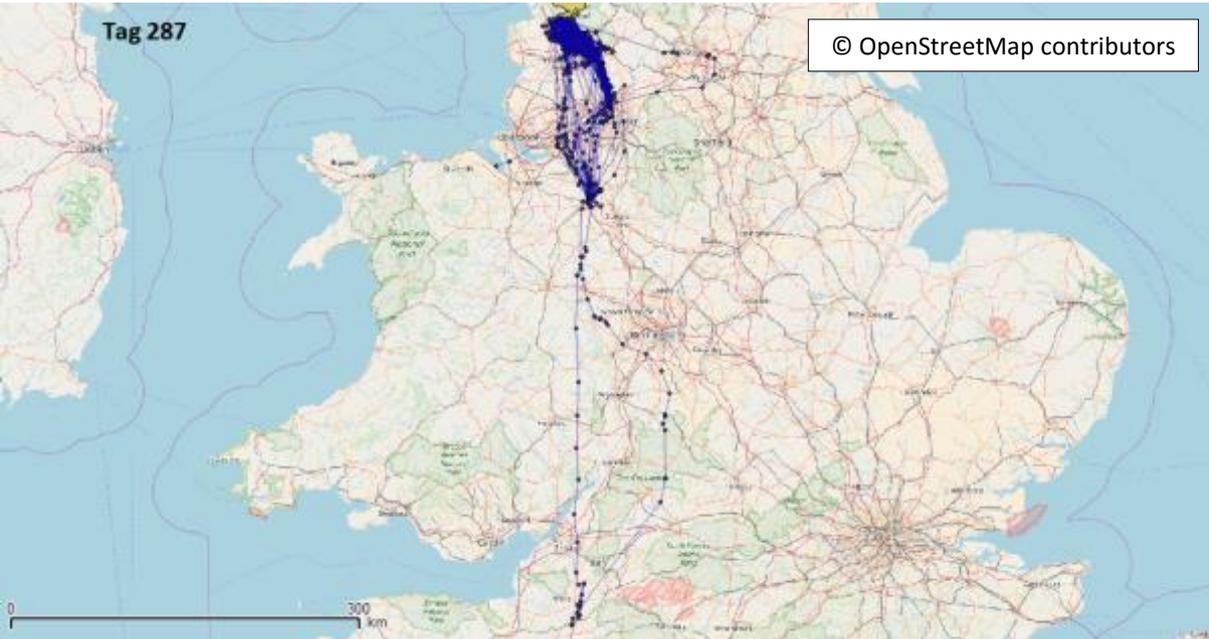
areas to the south of Bowland Fells SPA and there was a reasonably high degree of consistency in the behaviour of individuals between the two years. However, some new movement behaviours were recorded, for example, bird 461 also spent time at the South Walney colony and foraging around the Furness peninsula.

The additional tags deployed on birds at the Tarnbrook colony were beneficial as they appeared to confirm that birds from Tarnbrook utilise areas towards the north and east of the Bowland Fells SPA more than individuals from the Langden Head site.

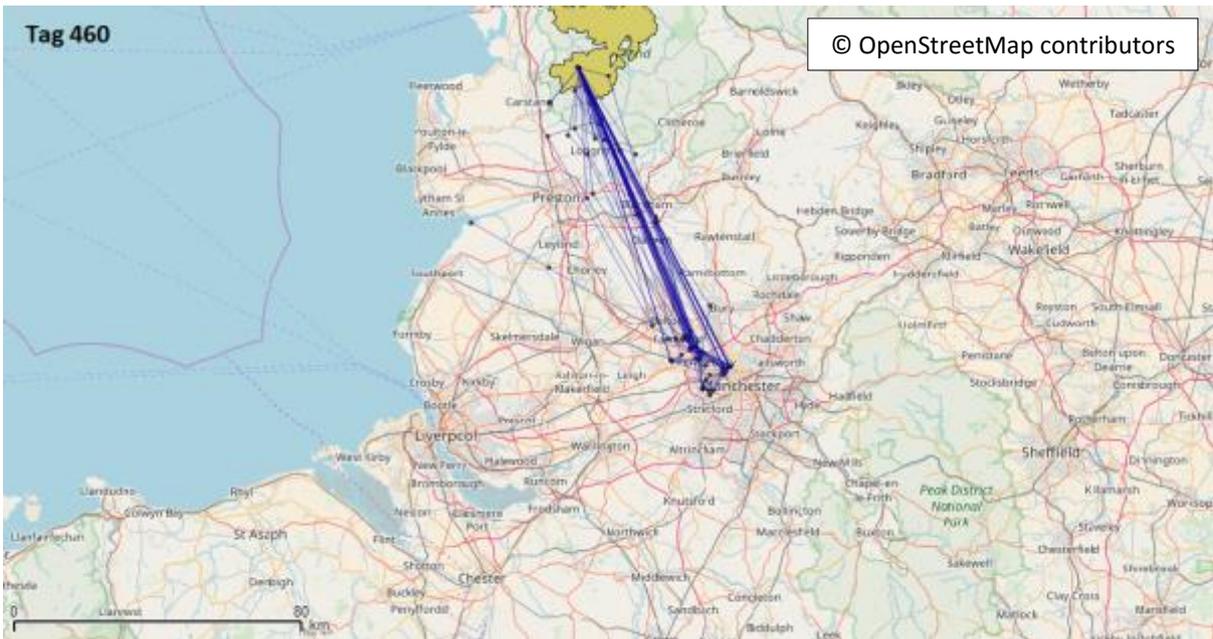
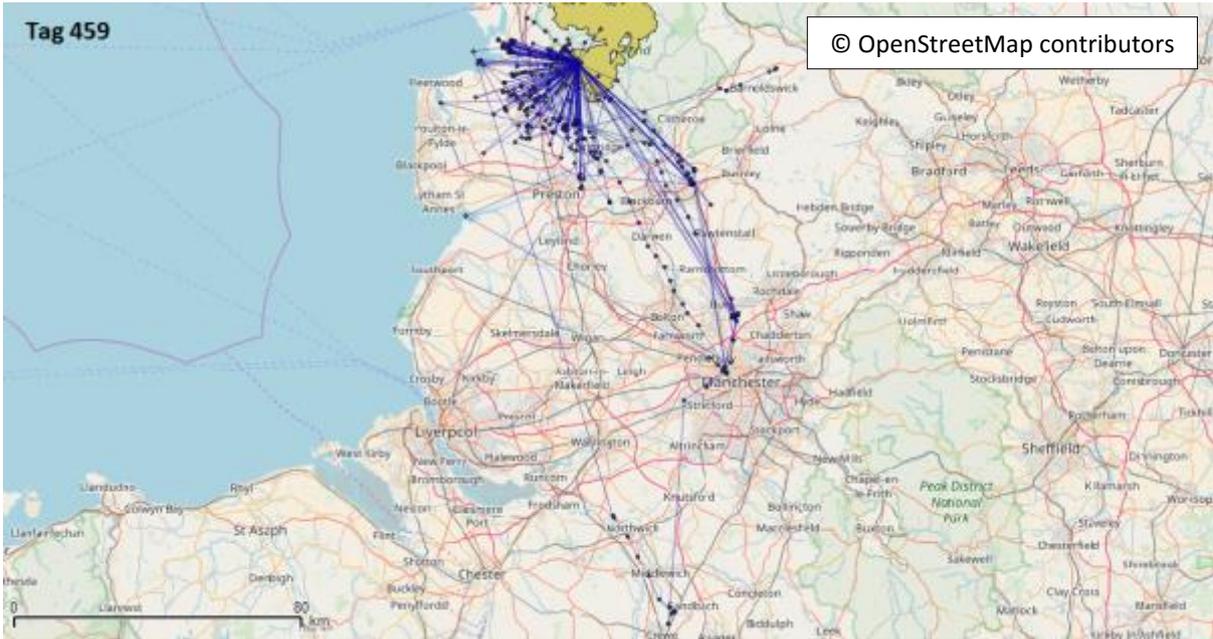


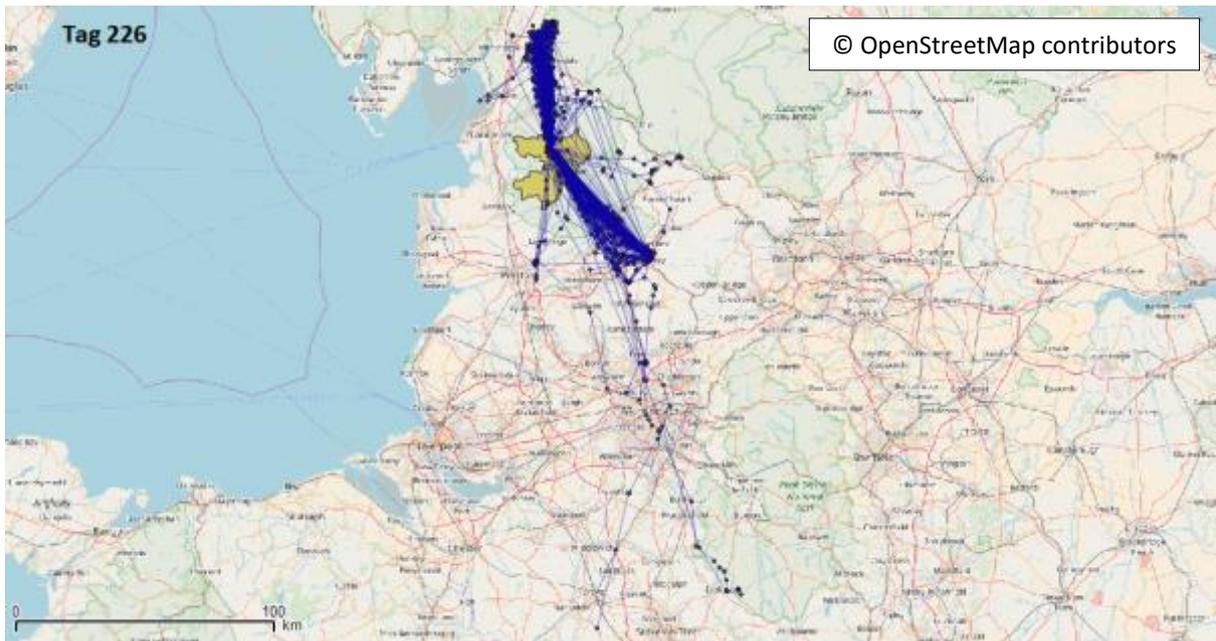
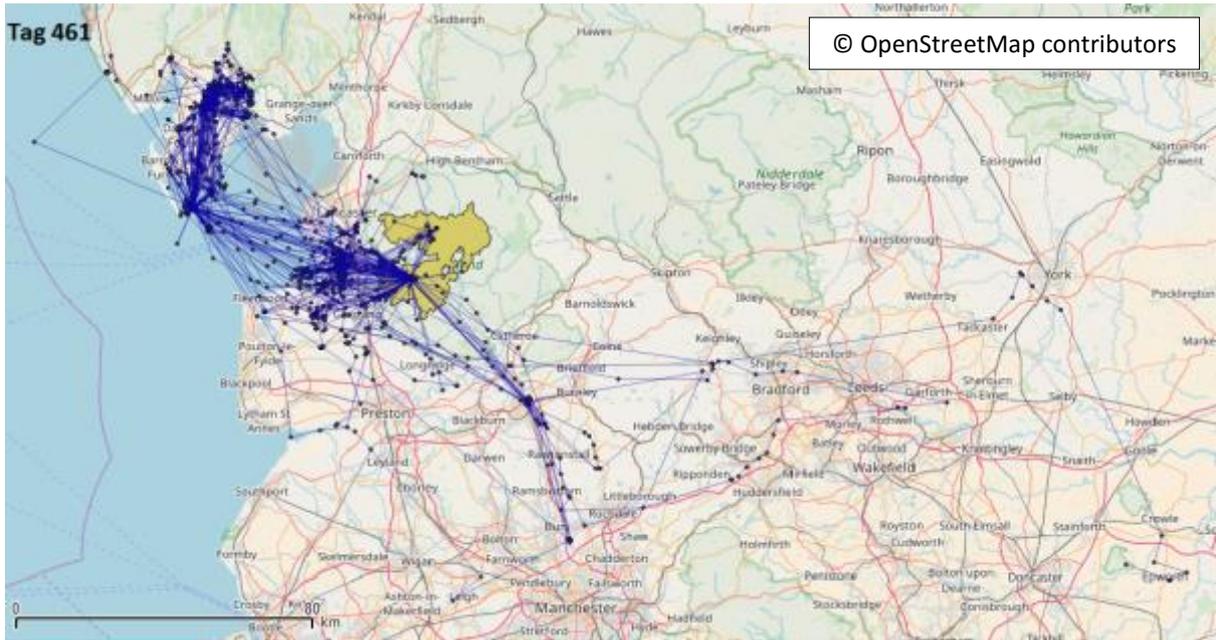


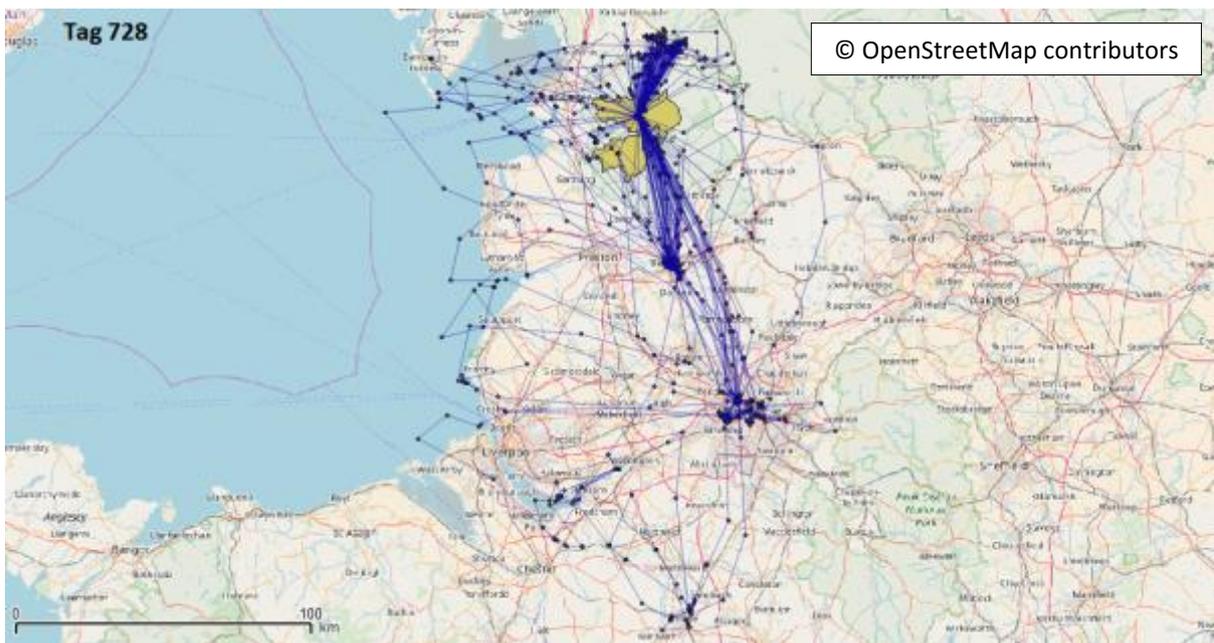
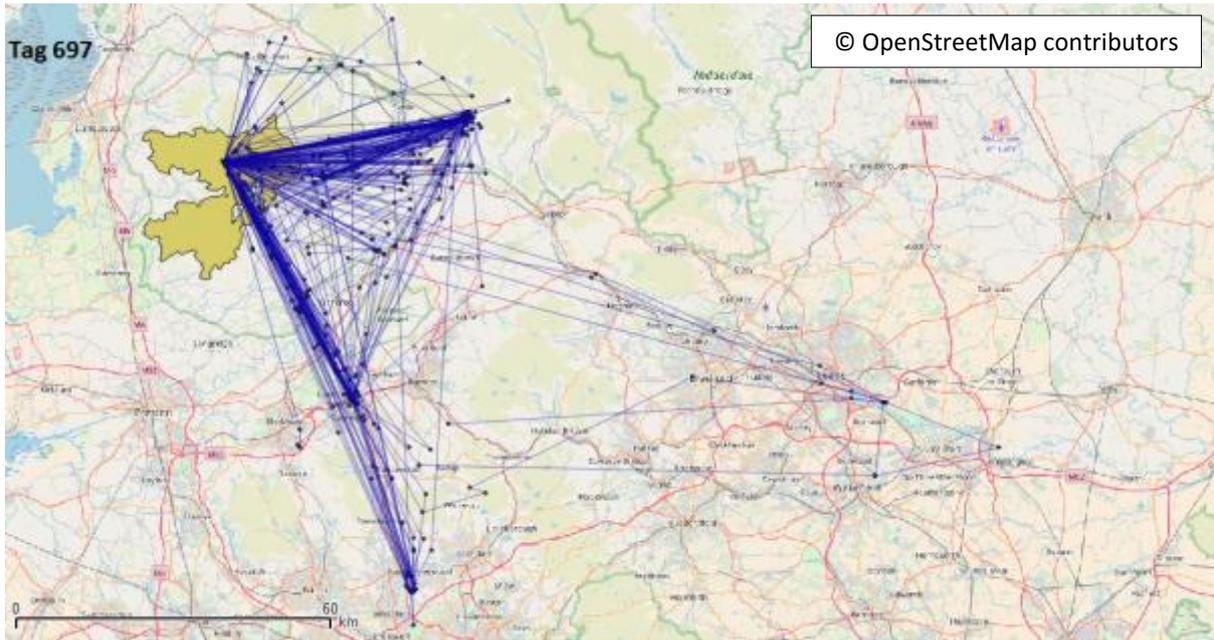












**Figure 1** GPS tracks from tagged Lesser Black-backed Gulls from the Bowland Fells SPA for the 2017 breeding period.

## REFERENCE

Clewley, G.D., Scragg, E.S., Thaxter, C.B. & Burton, N.H.K. 2016. Assessing the habitat use of Lesser Black-backed Gulls (*Larus fuscus*) From the Bowland Fells SPA. BTO Research Report No. 694 to Natural England. BTO, Thetford.