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Recreational activity and interactions with birds within the SSSIs on the North-West coast of England

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Summary

This report has been commissioned by Natural England to assess levels of recreational disturbance to overwintering birds across a range of estuary sites in North-west England. All the sites are designated as nationally and internationally important for over-wintering birds. Fieldwork included ornithological work (counts of birds and people combined with behavioural observations of the responses of birds) and visitor surveys (involving interviews with a random sample of visitors). Fieldwork was focussed at specific survey locations (spread around the coast from the Dee Estuary to the Solway); locations selected as ones where birds and access were thought to coincide and where there could be issues from disturbance. Both visitor and bird data were collected at each location, usually with the visitor data collected from an access point or car-park and the bird data from a suitable vantage point nearby.

Key findings included:

Bird Disturbance Fieldwork

- 4,608 events (e.g. groups of people) were recorded across all locations during 315 hours of fieldwork (fieldwork involving 10 visits spread over the winter, each visit 1 hour and 45 minutes).
- At all but two survey locations dog walking was the most frequently recorded activity and across all locations combined, dog walking accounted for 53% of the events observed.
- Walking was the second most common activity (35% of events) across all locations combined and was the commonest activity at two locations (Church Scar and Fairhaven).
- The number of dogs observed across all locations over the 315 hours was 3,704, of which 85% were observed to be off a lead. The proportion of dogs on a lead was significantly different across survey locations, and locations with high proportions of dogs on lead included the very busy survey locations but also the one with the lowest level of access.
- 47 species of bird were recorded across the survey points (the majority were waders, counts also included wildfowl, gulls and other species such as grebes, divers and herons).
- There was no significant correlation between bird densities (maximum counts of birds at each location) and the mean level of access at each location, suggesting disturbance is not necessarily having a chronic effect on bird distributions.
- There was some evidence of a more temporary effect of disturbance such that wildfowl numbers were significantly lower on individual counts where there were more people. A similar effect was found for waders, but only when two sites (Church Scar and Fairhaven), were removed. These sites were atypical in that they had very high levels of access which mostly involved walkers.

- Of the 4,608 events, 2,058 (45%) were potential disturbance events in that they coincided with birds present within the recording areas and were either within 200m of the birds (or triggered in a behavioural response from the birds).
- From these 2,058 potential disturbance events, 5,156 different observations relating to a single bird species and an individual event were compiled. Of these (species-specific) observations, 4,065 (79%) resulted in no visible change in behaviour or any kind of response from the birds. 21% of observations resulted in a behavioural response from a given species, with 591 observations (11%) involving birds undertaking a major flight (i.e. moving more than 50m).
- Comparing between activities, the proportion of cycling, jogging and walking events that resulted in any behavioural response was very low.
- Dog walking was the activity that particularly resulted in a behavioural response: for example, dog walking caused 77% of the major flights and flushed 89% of the birds seen flushed.
- There were significant differences between dog walkers comparing dog(s) off leads to dogs on leads, for example only 5% of dog walking events with all dog(s) on leads resulted in a major flight whereas 18% of events with dogs off lead resulted in a major flight.
- There were differences between sites in the proportions of observations resulting in a behavioural response. Leasowe Breakwater was the location with the highest rate of flushing events while Hoylake was the location with the highest number of individual birds flushed. Hale Head was the location with the lowest rate of flushing events.
- Birds typically responded to the presence of people when they were in close proximity, with birds tending to take flight when people were around 50m away or closer.

Visitor Survey Results

- Visitor surveys involved 16 hours of survey work at each location, spread evenly across daylight and split between weekend days and weekdays. A random sample of people were interviewed and counts were made of all people and dogs passing the surveyor.
- 1,435 groups, totalling 4,689 people and 1,310 dogs were counted across 288 hours of survey.
- Visit rates (people per hour) ranged from less than 2 people per hour (Barwise Brow, Grune Point) to 23 people per hour (Formby).
- In total 741 interviews were conducted.
- 97% of interviewees were visiting on a short trip and had travelled directly from home (i.e. local residents). Some 2% of interviewees were staying in a second home/mobile home and 1% were on a short trip and staying with friends/family.
- Dog walking was the most frequently recorded main activity, cited by 64% of interviewees. Other frequently cited activities included walking (21%) and family outing (5%). Dog walking was the most frequent main activity among interviewees at all locations except Grune Point (where bird watching was the most frequently recorded main activity).
- Most interviewees were visiting for less than an hour, with 16% visiting for less than 30 minutes and 46% of interviewees visiting for between 30 mins and 1 hour.

- Interviewees were typically frequent visitors to the survey locations, e.g. 33% of interviewees visited at least daily, 17% most days and 23% 1-3 times per week. Askam Pier, Ainsdale and West Kirby had particularly high frequencies of daily visitors.
- Interviewees tended to visit all year (88% of those interviewed stating that they visited equally all year round). For those that indicated a preferred time of day to visit, mornings seemed to be favoured, with 25% indicating they tended to visit before 9am.
- The majority of interviewees arrived at sites by car (65%), with 33% arriving on foot. Sites with relatively high proportions of visitors arriving on foot included Hoylake, Church Scar, Lytham and Fairhaven.
- Interviewees visiting directly from home typically lived within a short radius of the survey point (mean, 5.3 km. 699 interviewees), half of these interviewees lived within 1.9 km (median value) and three quarters within 5.2km (Q3 value). Most of these lived along the coast, within easy access of the coast (e.g. clear line along the A595) or within highly populated areas (e.g. Liverpool).
- Relatively few (14%) interviewees indicated that they had used or referred to any information sources in order to plan their visit.
- For dog owners who indicated having a dog off lead was an important factor in their visit, under a third (31%) indicated they would put their dog on a lead if there was a flock of birds ahead of them.
- Awareness of designations and nature conservation importance was relatively low, with 60% of interviewees indicating they were not aware of any designations or environmental protection applying to the stretch of coast they were visiting. Awareness seemed particularly low at the Ribble, the Sefton coast and the North Wirral survey locations.

Implications of the results are discussed in terms of measures to reduce disturbance impacts and future monitoring. We highlight Dubmill Point, Leasehowe Breakwater and Thurstaston Country Park as survey locations where disturbance levels seemed the highest and these represent the locations where any interventions are best focussed.

Contents

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We are grateful to all the landowners who provided access for the survey work to take place and our thanks also to all the people who gave up their time to be interviewed.

1. Introduction

Overview

1.1 This report has been commissioned by Natural England to assess levels of recreational disturbance to overwintering birds across a range of estuary sites in North-west England. Alongside bird fieldwork, visitor surveys have been commissioned to understand more about visitor behaviour and use of sites.

Context

1.2 A challenging issue for UK nature conservation is how to accommodate increasing demand for access without compromising the integrity of protected wildlife sites. With a rising human population, often focussed in the coastal zone, areas that are important for nature conservation often fulfil a range of other services, including providing space for recreation (ranging from the daily dog walk to extreme sports).

1.3 There is now a strong body of evidence showing how increasing levels of access can have negative impacts on wildlife. The issues are particularly acute in coastal sites (for general reviews see Saunders et al. 2000; Lowen et al. 2008; Liley et al. 2010) including estuaries (Ross et al. 2014). The issues are not however straight forward. It is now increasingly recognised that access to the countryside is crucial to the long term success of nature conservation projects and has wider benefits such as increasing public awareness of the natural world and health benefits (Alessa, Bennett & Kliskey 2003; Pretty et al. 2005; Moss 2012) or economic benefits (Bennett, Tranter & Blaney 2003; Downward & Lumsdon 2004). Nature conservation bodies are trying to encourage people to spend more time outside and government policy (for example through enhanced coastal access) is promoting access to the coast. Furthermore, access to many sites is a legal right, with an extensive Public Rights of Way network and open access to many sites through the Countryside and Rights of Way Act (2000). There is therefore a difficult balancing act required to resolve impacts associated with recreation without compromising the ability of people to be outside and enjoying the green spaces near their homes.

Impacts of Disturbance

1.4 This report focusses on impacts to wintering birds from recreational disturbance. Such disturbance has the potential to affect birds in a range of different ways, for example:

- Redistribution of birds in response to the presence of people. Redistribution can be short-term - response to individual disturbance events - or more chronic, with birds simply avoiding using otherwise suitable habitat for breeding or nesting

(Cryer et al. 1987; Gill 1996; Burton et al. 2002; Burton, Rehfisch & Clark 2002; Liley & Sutherland 2007).

- Reduced intake-rate of food as a response to disturbance, with birds feeding in areas with poorer available food resources (Fitzpatrick & Bouchez 1998; Stillman & Goss-Custard 2002; Bright et al. 2003; Thomas, Kvitek & Bretz 2003; Yasué 2005).
- Increased energy expenditure as a result of birds reacting to disturbance by flying to different areas to feed and being flushed while feeding and roosting (Stock & Hofeditz 1997; Nolet et al. 2002).
- Physiological impacts, such as increased stress (Regel & Putz 1997; Weimerskirch et al. 2002; Walker, Dee Boersma & Wingfield 2006; Thiel et al. 2011). Increased stress levels/heart rate etc. may also have consequences for energy expenditure.
- Direct mortality, such as predation from domestic dogs (Pienkowski 1984; Liley & Sutherland 2007), predators exploiting disturbance events (e.g. Brambilla, Rubolini & Guidali 2004) or nests being trampled (Liley 1999).

1.5 On a single site, localised disturbance in a small part of the site for a small amount of time is unlikely to result in a likely significant effect, as birds are highly mobile, and on a large site there will be nearby options where birds can feed or roost. A single event for a short time period is unlikely to have implications. For non-breeding birds, switching to alternative locations within a site might take seconds, and the impact from a single brief event will therefore be negligible.

1.6 However, more chronic disturbance, regularly affecting larger parts of sites, will have more serious effects. Notably, disturbance can be considered as equivalent to habitat loss (Sutherland 1996) or even worse because repeated flushing has energetic costs that would not be incurred if the habitat was simply not available to the birds at all (West et al. 2002). Considering disturbance purely in terms of habitat loss, it follows that if the area available to the birds is reduced, birds are forced to redistribute and it is possible they will end up feeding in locations with less food and possibly more interference from other birds due to the reduced amount of space. They may also be forced to forage in areas which are more exposed to the weather, where they are at greater risk from predators, or where they are further from roost sites. The ability of the site to support a given number of birds is therefore compromised.

1.7 The impact of disturbance is not necessarily easy to quantify, as most sites in the UK have a long history of public access, with recreation pressure increasing gradually over time. Bird numbers at sites will fluctuate for a range of reasons besides disturbance, and increased mortality as a result of disturbance or a marked drop in numbers (that can be linked directly to disturbance) may be difficult to detect. Of course, individual birds may well be able to compensate by modifying their behaviour (Swennen, Leopold & Bruijn 1989), for example feeding for longer (Urfi, Goss-Custard & Lev. Dit Durell 1996), feeding at night (Burger & Gochfeld 1991; McNeil, Drapeau & Goss-Custard 1992) or temporarily switching to other sites. In such cases the birds may still survive, but with increased pressure put on the system it is likely to be more vulnerable in the

long-term, and the 'slack' in the system greatly reduced. There is evidence that bird breeding success and migration patterns are linked to the quality of the wintering sites (Gill et al. 2001) so gradual deterioration on wintering sites might link to reduced breeding success, or even to reduced numbers of birds able to migrate back to the breeding grounds at the end of each winter. Such changes will only be apparent over long time periods and may not necessarily be apparent if other factors are also suppressing bird numbers at a site. Changes in access levels at sites will usually be gradual, and there is unlikely to be any sudden influx of visitors at a given moment in time.

The north-west coast

1.8 This report focusses on the north-west coast of England, from the Dee to the Solway. This coastline includes several coastal Sites of Special Scientific Interest (SSSIs) and Special Protection Areas (SPAs) where bird disturbance is of potential concern. Key sites are shown in Map 1 and include 12 SSSIs, virtually all of which are also SPA and designated for their wintering bird interest. The SSSIs include (from north to south): the Upper Solway Flats and Marshes SSSI; the Duddon Estuary; Morecambe Bay; South Walney Island and Piel Flats SSSI; the Lune Estuary SSSI; the Wyre Estuary SSSI; the Ribble Estuary SSSI; the Sefton Coast SSSI; the Mersey Narrows SSSI; the North Wirral Foreshore SSSI; the Dee Estuary SSSI and the Mersey Estuary SSSI.

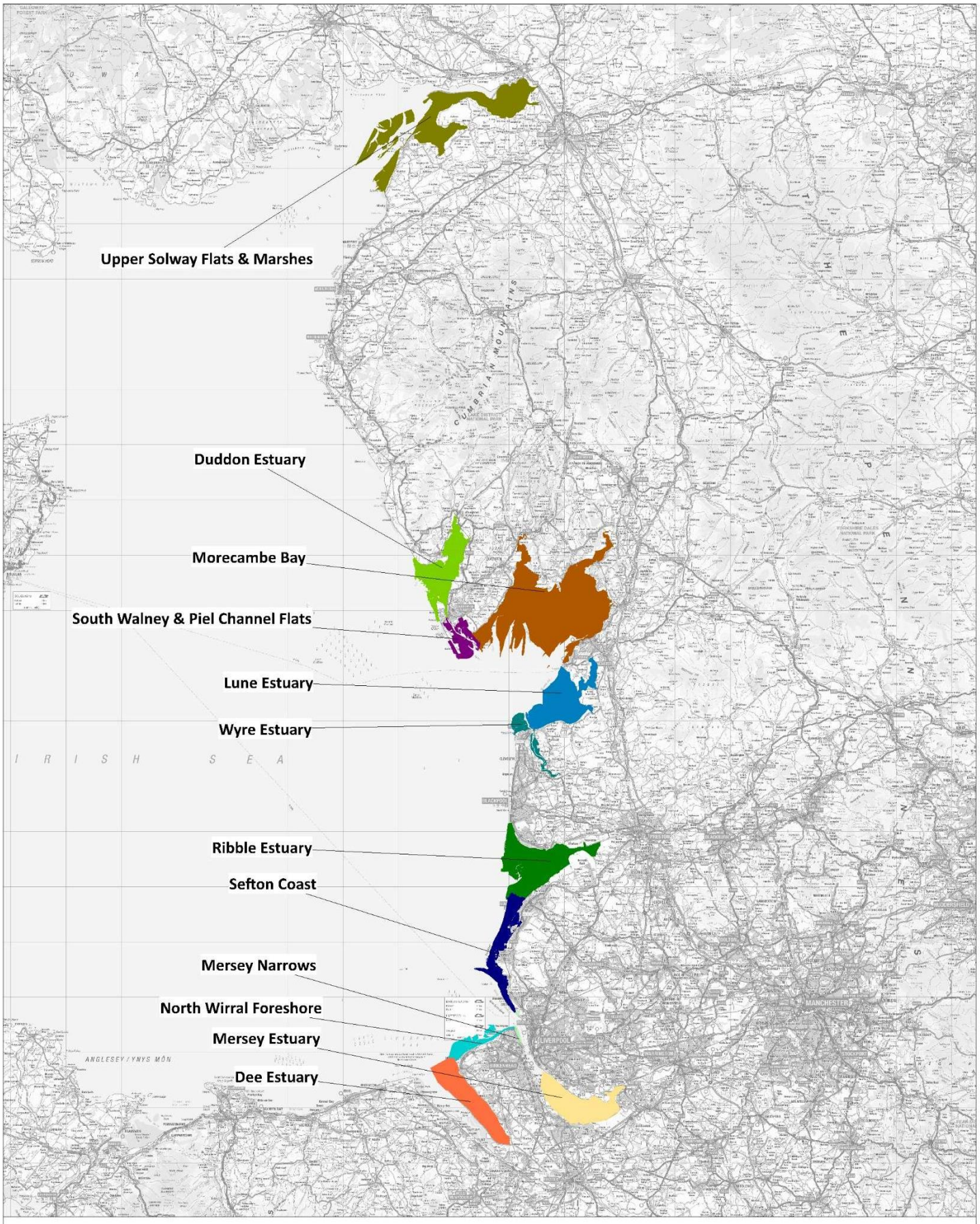
1.9 The coastline stretches over 1,400km and includes a wide range of habitats. A range of previous studies have raised concern relating to declines in bird numbers and disturbance impacts. Looking at all English SPA estuary sites, Ross et al. (2014) identified which are under the most current pressure from recreation. Sites were compared based on the amount of housing (weighted according to how far people tend to travel to visit estuary sites for recreation) and a range of other metrics such as the shape of the estuary, extent of mudflats that are close to paths, habitats present, access infrastructure etc.

1.10 The report highlighted the Mersey Narrows and North Wirral Foreshore SPA as of particular concern, ranked second most vulnerable out of all 39 sites included in the report. Most of the Mersey Narrows and North Wirral Foreshore's shoreline has current access and there are a relatively high number of car-parks per km of shoreline. Furthermore, the site has a relatively high percentage of sand in the sediment which may facilitate foot access onto intertidal areas. Other north-west SPA sites were ranked of less concern, however the work also highlighted the high proportion of WeBS alerts at many of the sites, reflecting marked declines for many species.

1.11 Analyses of these declines (Ross-Smith et al. 2015; Still, Calbrade & Holt C.A. 2015) have highlighted that the declines are in some cases site specific, reflecting issues at individual sites. In recent years, bird disturbance fieldwork has been conducted at Morecambe Bay (Liley et al. 2015b) and also on the Mersey Narrows and North Wirral

Foreshore SPA (Watola & Heard 2015). Both studies highlighted a range of recreation activities taking place but in particular highlighted dog walking as a particular issue.

Map 1: Key sites, showing different SSSIs



The need for a better understanding

1.13 The Morecambe Bay work (Liley et al. 2015b) considered the range of potential solutions to ensure nature conservation impacts could be avoided or reduced while potentially also enhancing access. There were clear challenges. In many areas access is relatively informal, with little infrastructure and little to convey to visitors that they are visiting an area that is of nature conservation importance. Most visitors will be unaware they are having an impact or causing a problem, and with growing recreation use, increasing population and changes in local housing, the issues are likely to continue to grow. Measures that restrict access to sites are likely to be unpopular and antagonise visitors, particularly if they appear to come out of the blue. Positive solutions, such as increasing the amount of recreation space, providing information, interpretation and guidance, creating new routes (potentially away from sensitive areas) and directly working with local groups are often complex to set up, costly or require long-term investment. Detailed information is necessary to guide such decisions and provide the foundation for design and implementation.

1.14 Good information can also help to inform the dialogue with visitors and other stakeholders; demonstrating the links between particular activities (dogs off leads for example) and changes in bird behaviour, or putting numbers on the overall levels of recreational use, ensure that a well-informed discussion can take place. Decisions can be based on evidence and the best solutions found.

1.15 As such Natural England require information on bird disturbance and visitor use. Such work would fit with similar work undertaken at other sites around the country. The work needs to involve data collection in a standardised fashion across multiple locations, carefully selected to focus on sensitive locations and representative areas (i.e. providing the potential to draw conclusions that would be relevant to other locations, for example adjacent areas of coast). By undertaking bird disturbance work and visitor surveys alongside each other the results will provide information to inform long term visitor management and the results will be relevant for site management, strategic planning policy advice, response to planning applications and securing funding.

3. Methods

3.1 In this section, we set out the approaches used. This includes the selection of survey points. The fieldwork involved two major, but separate, components: bird disturbance fieldwork (recording the interactions between people and birds) and visitor survey work (involving face-face interviews with visitors).

Selection of Survey Points

3.2 Broad areas to focus on were initially identified by Natural England staff. Locations were then selected following initial site visits, discussion with Natural England site leads and reference to BTO WeBS data (both core and low tide count data). The final selection of survey points ensured survey effort was targeted to areas that:

- Are important to birds (e.g. areas used for roosting or feeding),
- Have public access to the shoreline,
- Are thought to have existing issues or threats from access, e.g. anecdotal evidence of birds being repeatedly flushed or areas where there are high levels of access,
- Provide a good geographical spread across the area.

3.3 Areas where there were existing data (e.g. parts of Morecambe Bay and parts of the North Wirral Foreshore had targeted fieldwork in 2015[1]) were not targeted. Eighteen survey points were selected (Map 2-3, Table 1). Bird disturbance and visitor surveys were conducted at each of the 18 locations, in most cases from the same place but in some instances the locations were slightly different, to ensure a good vantage point for the bird fieldwork and a good location to intercept people for the visitor survey.

[1] See Liley et al. (2015c) and Watola & Heard (2015)

Map 2: Survey locations

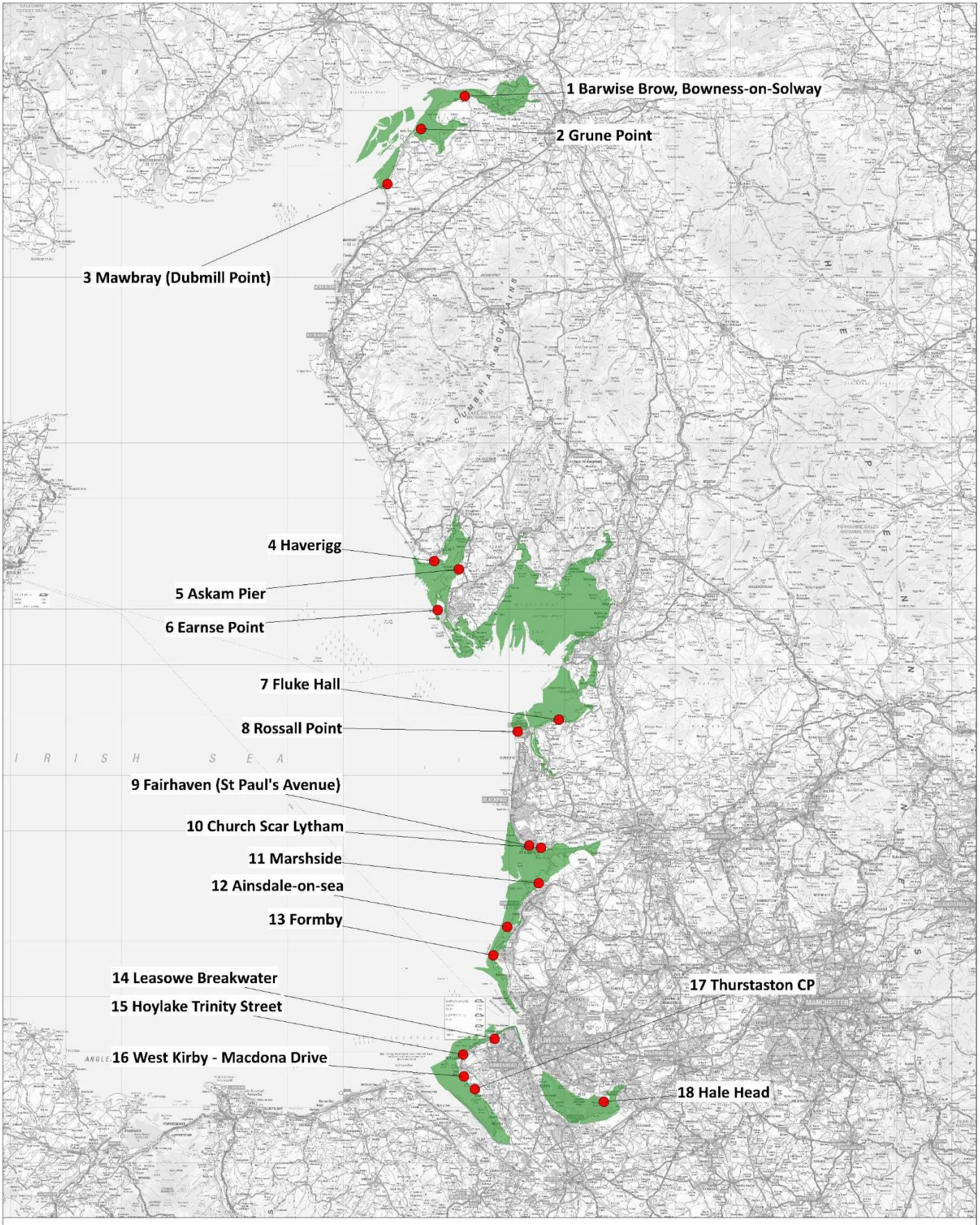


Table 1: Summary of survey points

Map Ref	Estuary	Location	Description	Relevant tide state	Grid Reference for bird survey	Grid Reference for visitor survey
1	Solway	Barwise Brow, Bowness-on-Solway	Layby with access to shore	Low tide or lower tides	NY21966263	NY21966262
2	Solway	Grune Point	Saltmarsh, wide creek	Around high tide avoiding spring tides when the access track is cut off?	NY14075668	NY14075667
3	Solway	Mawbray (Dubmill Point)	Shingle beach	Around high tide	NY07654609	NY08234692
4	Duddon	Haverigg	From car park (room for 20 cars) located near the entrance to Port Haverigg Marina Village	Incoming tide	SD16387870	SD16387870
5	Duddon	Askam Pier	Road at end of Parklands Drive	Rising or dropping tide	SD20837725	SD20837725
6	Duddon	Earnse Point	Sea defence groyne	Rising and dropping tide/around high tide	SD17016990	SD17016990
7	Morecambe Bay	Fluke Hall	Small car-park at end of road, with vehicle access onto mudflats	Rising or falling tide, avoiding full low	SD38935002	SD38935002
8	Morecambe Bay	Rossall Point	Tower near point	Rising or falling tide, avoiding full low	SD31494791	SD31494791
9	Ribble	Fairhaven (St Paul's Avenue)	Car-park at St. Paul's Avenue. Vantage point from seawall at western corner of Fairhaven Lake	Either side of high tide, feeding/gathering and roosting birds	SD33592730	SD33592730
10	Ribble	Church Scar Lytham	Sea wall	7.5m (low high tides) best	SD35702690	SD35702690

Map Ref	Estuary	Location	Description	Relevant tide state	Grid Reference for bird survey	Grid Reference for visitor survey
11	Ribble	Marshside	From car park	Spring tides (tide too far out otherwise)	SD35262051	SD35262051
12	Sefton Coast	Ainsdale-on-sea	To south-west of Discovery Centre	Rising or falling tide, avoiding full low	SD29591262	SD29721279
13	Sefton Coast	Formby	Formby National Trust, vantage point in dunes south of car-park	Rising or falling tide, avoiding full low	SD27070750	SD27390825
14	North Wirral	Leasowe Breakwater	Vantage point on dune along from end of car-park	Avoid very high/very low tides	SJ27309241	SJ27309241
15	North Wirral	Hoylake Trinity Street	End of trinity road.	Either side of high tide	SJ21618953	SJ21618953
16	Dee Estuary	West Kirby - Macdona Drive	Above old culvert to south of Marine Lake	Rising or falling tide, avoiding full low	SJ21808559	SJ21838550
17	Dee Estuary	Thurstaston CP	Near end of Station Road, on cliff top	Avoiding high tide	SJ23768332	SJ23628346
18	Mersey	Hale Head	End of Lighthouse Road	All tide states	SJ47088104	SJ47178092

Bird Disturbance Fieldwork

Survey visits and effort

3.4 Survey visits were spread across the period late November 2016 – mid February 2017 and ten visits were made to each location. Fieldwork avoided the Christmas period (Dec 20th – Jan 5th), as during this period it was assumed that access would be variable and atypical compared to the rest of the winter. Visits were be targeted to ensure, as far as possible, survey effort coincided with times and conditions where there may be issues, i.e. particular tide states (see Table 1).

3.5 Each visit to a survey point lasted around two hours and each count involved the following elements:

- Two counts of birds, one count at the start and one at the end of the survey period.
- A diary of all potential disturbance events observed during the 1 hour and 45 minutes following the first count.
- A record of the response of selected bird species to each of the potential disturbance events recorded in the 'diary', including counts of birds present and the number of birds flushed etc.
- Additional information.

3.6 These different elements are described in more detail below.

Bird count

3.7 At the start of each two-hour survey, a count of the birds was conducted. The count included all waders, gulls, terns, wildfowl and herons/egrets. The count only recorded the birds present within a pre-defined survey area that extended to a maximum of 500m from the watch point. This area was carefully mapped for each location, using aerial photographs. The mapped area only included areas where there was a clear sight line and all areas (within 500m) were visible to the recorder from the fixed watch point. Each fixed watch point was also selected to be at a point where any disturbance caused by the presence of the surveyor could be minimised/avoided, yet a good vantage point for both birds and people obtained. At each location, the survey area varied in size, and the aerial photos were printed for field use, providing surveyors with a clear map of landmarks and the recording area, with distances to key features/landmarked labelled.

3.8 For all species, the count was the total number of birds within the survey area (as defined above). The count was repeated at the end of each visit.

Diary

3.9 All events during the following 1 hour and 45 minutes were recorded in a diary form. This diary logged all events that were relevant to the survey area, with events encompassing any group undertaking recreation (dog walkers, families, watersports etc.) but also aircraft, trains, military activity, commercial activity, shellfishing etc. Birds of prey were also logged, allowing a comparison of the amount of disturbance caused by natural events as opposed to human-related ones.

3.10 Events logged in the diary could include those well outside the survey area, as events outside the recording area could disturb birds within it. In general, all events that occurred within a 200m radius of the survey area were logged, where they were relevant to the survey area. If an event occurred at a distance greater than 200m, but still resulted in a behavioural response from the birds, this was also logged.

3.11 Which events were logged was, to some extent, location-specific as landscape features affect visibility and the potential for disturbance. For example, on an open shoreline with expansive saltmarsh or similar open habitats, all events within a 200m radius of the survey area were logged; yet where dunes, cliffs, seawalls or other features provide screening, recording was slightly different. At such locations, access events would not necessarily be visible to the birds or surveyors, and were only logged when they had the potential to cause disturbance, e.g. came above the seawall.

3.12 All events were recorded in the diary, regardless of whether birds were present or not, allowing direct comparison of levels of human activity between survey points.

3.13 Each event in the diary was given a unique reference, allowing cross-reference with other data recorded. In general, events were only entered onto the diary form once, but occasionally the same event might warrant recording more than once, for example a walker that passed the survey area and disappeared from sight and then returned after a prolonged interval would be logged twice if the surveyors judged the time interval such that any disturbance caused would be equivalent to a separate event. For each entry in the diary, details were recorded that included activity (categorised to standard codes), group size, zone (intertidal, on water or above MHWM), length of time present in area and notes relating to behaviour.

Disturbance

3.14 Events recorded in the diary were classified as 'potential disturbance events' if:

- The event coincided with birds being present within the count area and
- The event occurred within 200m of birds within the recording area or
- Birds were disturbed (i.e. a behavioural response: seen to become alert, change behaviour or move away).

3.15 For each potential disturbance event, the response of birds was recorded on a separate recording form. This approach meant we could ensure that events that resulted in no response were also recorded – i.e. if the birds were not disturbed. The recording system therefore documented for each event what birds were present and ensured that events where no birds were present could be separated from events where birds were present but not disturbed.

3.16 The disturbance data recorded the number of birds within 200m of the potential source of disturbance and the behaviour. Behaviour was categorised simply as feeding or roosting/preening/loafing. The response of the birds was recorded using simple categories:

- No Response: no visible change in behaviour
- Alert: birds do not move position, but change behaviour (stopping feeding, looking up) and becoming alert
- Walk/Swim: birds change position without taking flight, walking or swimming away from the source of disturbance
- Minor Flight: birds are flushed and take flight, but land within 50m from their original position
- Major Flight: birds are flushed and displaced from the area first recorded, moving at least 50m

3.17 For each individual bird the ultimate response was recorded: as a person approaches a bird, that bird is likely to become alert, perhaps walk away and then take flight, depending on how close the person comes. A single category was only assigned to each bird.

3.18 For each category of response and for each species, the number of birds was recorded, for example if a flock of 100 birds became alert at the approach of a person and then 10 undertook a major flight, for that observation and that species there would be a record of 90 birds becoming alert and 10 birds undertaking major flight. For 10% of potential disturbance events, multiple responses were recorded in this fashion (i.e. not all birds responded in the same way). In some analyses, tables and figures we simplified the data to a single response per observation, taking the most extreme response observed (i.e. the

single response in the above example would be major flight). Where we summarise data in such a way it is made clear in the text/captions, as using single codes only.

3.19 For each activity/event where disturbance occurred the maximum distance from the birds to the event was recorded, as the straight-line distance from the source of disturbance to the birds. If there was no response from the birds, then the minimum distance from each species present to the disturbance event was recorded (i.e. how close the disturbance event was to the birds). In the case of a single individual bird or a tight flock, then this distance was relatively easy to estimate. If the birds were scattered over a wide area and all were disturbed, then the distance recorded was the distance at which the closest bird responded. To ensure consistency in recording distances we:

- Ensured accurate aerial photographs, annotated with distances from the vantage point to key landmarks/features were available for each location.
- Used laser rangefinders to determine the distance to key landmarks/features and the birds.
- Triangulated or paced out some of the distances at the end of the survey – this was helpful where the distances were hard to estimate during the survey period (for example due to the angles between the observer, source of disturbance and the birds).
- Ensured observers were trained and occasionally counts were undertaken together to check that the data were collected in a standard fashion.

Additional Information

3.20 Information relating to each visit, such as tide coverage, weather and any details specific to the visit (e.g. events going on) are important. These were recorded on the same sheet as the bird count.

Visitor Surveys

3.21 Each of the 18 survey points was surveyed for a total of 16 hours, with survey effort split equally over a weekday and a weekend day. Survey work was undertaken in two-hour time slots (0730-0930; 1000-1200; 1230-1430; 1500-1700) to ensure good coverage across daylight hours. All survey slots were covered on a weekday and weekend day to give the sixteen hours.

3.22 As with the bird disturbance fieldwork, survey visits were spread across the period late November 2016 – mid February 2017. Fieldwork avoided the Christmas period (Dec 20th – Jan 5th), as during this period it was assumed that access would be variable and atypical compared to the rest of the winter. As far

as possible surveys avoided particularly inclement weather. Survey effort was spread across different weekends and dates to ensure any effects of weather or local events affecting access were minimised.

3.23 Single survey days could be halved such that the two, morning sessions (0730-1200) were conducted on one day and the two afternoon sessions (1230-1700) conducted on another day. This helped to mitigate against periods of bad weather in short fine weather periods, or allow visitor and bird disturbance surveys to be conducted on a single day. Because of this, the break in surveying over the Christmas period, and large distance between sites, many visitor survey start and end dates covered a wide period (average of 12 days, maximum of 52 days).

3.24 Weather conditions during surveys were very favourable, reflecting the national and local pattern for the winter. The winter of 2016/17 was overall milder and drier than typical for the time of year, with any stormy periods generally brief, especially in northern areas [2]. Roughly a third of visitor surveys were conducted with any rain (29% of two hour sessions), although cloud cover was usually very high (on average 6/8ths).

3.25 Dates and weather conditions by survey point are summarised in Appendix 1.

Interviews

3.26 A random sample of people was interviewed, with the random sample achieved through surveyors approaching the next person seen (if not already interviewing). At busy locations/sessions surveyors focused only on those leaving the site (for example returning to their car) to ensure accurate information about the person's visit (i.e. what the interviewee did rather than what they intended to do). At quiet locations/survey sessions anyone entering or leaving was included. Interviews were conducted only during the survey windows. The questionnaire (Appendix 2) was conducted using tablet computers and gathered information that included activity undertaken, frequency of visit, mode of transport, route taken, factors influencing the route taken, reasons for choice of site, other sites visited, views on management etc. Route data within the site were plotted in the field as part of the questionnaire process, using paper maps. Additional information recorded alongside each survey included direct observation as to the number of people (and dogs) in the party and whether dogs were off lead.

[2] http://www.metoffice.gov.uk/climate/uk/summaries/2017/winter

3.27 No unaccompanied minors were approached or interviewed and only one interview was conducted per party or group.

Counts of visitors ('tallies')

3.28 Surveyors counted all visitors entering/leaving during each survey period. This tally data provided basic information on visitor flows (number of people, groups, dogs and numbers) passing each point.

Analysis and data presentation

3.29 We used a generalized linear mixed model (GLMM) with a poisson error and logarithm function, including location and tide as random factors, to test whether the number of birds counted at the end of each survey was related to the level of disturbance recorded during the survey (i.e. the previous 1 hour and 45 minutes). We used the total number of people (log transformed) recorded during the count (i.e. the diary data) as a measure of disturbance. Models were run using R statistical software and run separately for wildfowl (ducks, geese and swans), waders and other birds (cormorants, herons, divers, grebes etc. but excluding gulls).

3.30 With the response data, the probabilities of a flight taking place were modelled using logistic regression (Hosmer & Lemeshow 2000) with the flush response (i.e. major or minor flight taking place) being the dependent variable. The data were complex in that a range of variables were likely to relate to the response of the birds. These variables related to the potential disturbance event (distance from the birds, number of people, type of activity, whether on the mud/water/shore, presence/absence of dog, number of dogs off lead); the survey (location, month) or the birds (species, flock size, whether foraging or roosting). Variables were tested individually, rather than as a maximal model including all individual variables and meaningful interactions. This was because the range of potential variables was too broad to include simultaneously.

3.31 We use box plots in a number of places within the report to compare sample distributions. In these plots the lower limit of the box is the first quartile (Q1), i.e. 25% of the data values are less than or equal to this value. Similarly the upper limit of the box is the third quartile (Q3), i.e. 75% of the data are less than or equal to this value. The horizontal line in the middle of the box shows the median, i.e. half of the data values are less than or equal to this value. The vertical lines ('whiskers') extend to the upper and lower limits[3] of the data and

[3] The upper limit =Q3+1.5 (Q3-Q1); the lower limit=Q1-1.5(Q3-Q1).

outlying values that fall beyond the upper or lower limits are denoted with an asterisk.

4. Results: bird disturbance fieldwork

Levels of human activity

4.1 Overall, across all survey points, 4,608 diary events were logged. Church Scar, Lytham and Fairhaven were by far the busiest survey locations (with 27% and 17% of all events respectively).

4.2 Dog walking was the most frequently recorded activity, accounting for just over half (53%) of all events across all survey locations. Walking was the second most commonly recorded activity (35% of events). Dog walking was the most commonly recorded activity at most locations, Church Scar Lytham and Fairhaven were the only exceptions; at these two locations more walkers than dog walkers were recorded and in fact the majority of walkers were at these two sites.

4.3 Data are summarised by location and activity in Map 3 and also in Figure 1

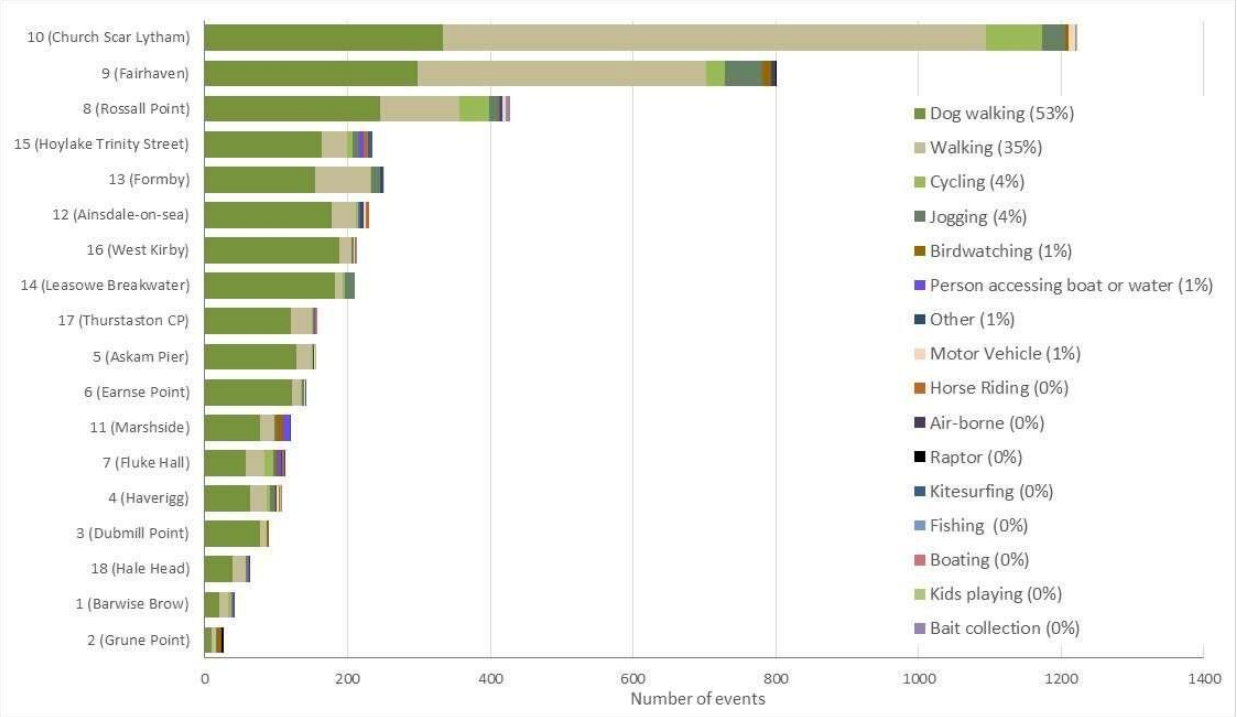


Figure 1: Numbers of events at each location, from diary data. Green and brown shading reflects land-based activities. Percentages reflect overall values across all survey points combined.

4.4 Group size ranged from 1 to 294 (this exceptionally large group was an organised race, at Church Scar, Lytham); across all sites the median group size was 1. The number of dogs recorded with the dog walkers was 3,704, of which

3,151 (85% of dogs) were noted as off-lead. There were significant differences between survey locations in the proportions of dogs off lead (χ215=346.288, p<0.001; test excluded Barwise Brow and Grune point due to small sample sizes at these locations). At all sites, the majority of dogs were off lead, however Grune Point (46% of dogs on lead), Church Scar, Lytham (40%) and Hoylake (25%) stand out as having a relatively high proportion of dogs observed on lead.

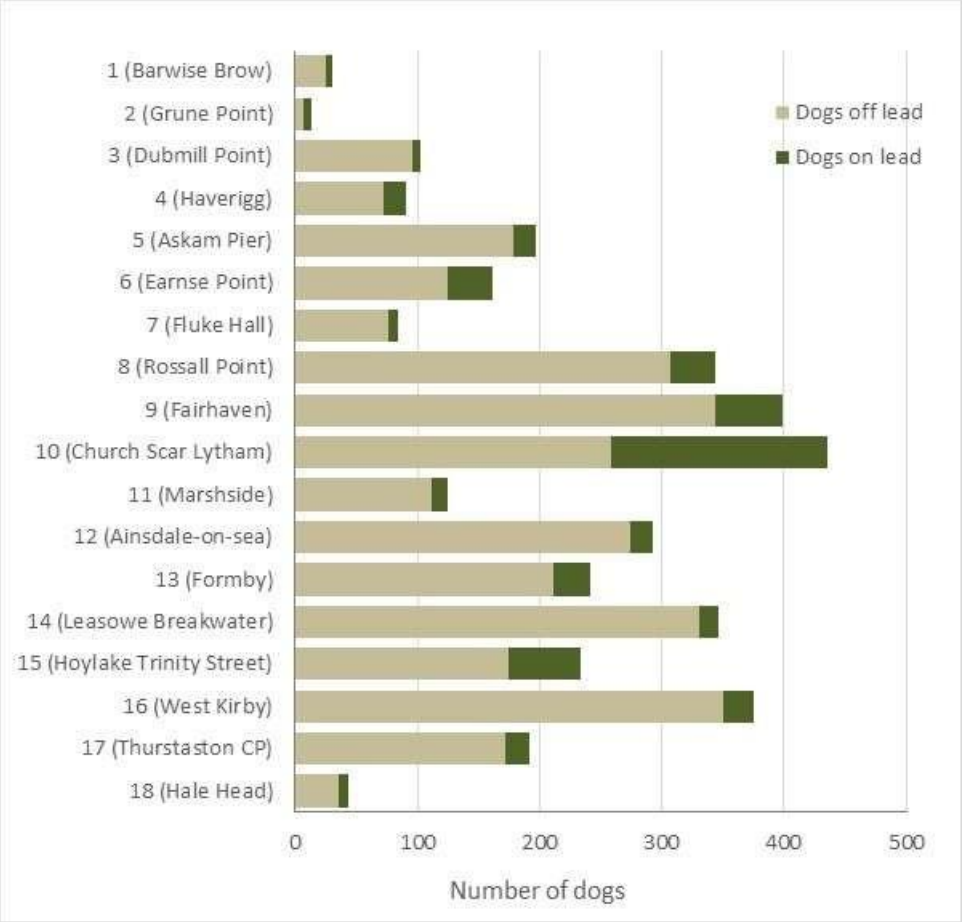
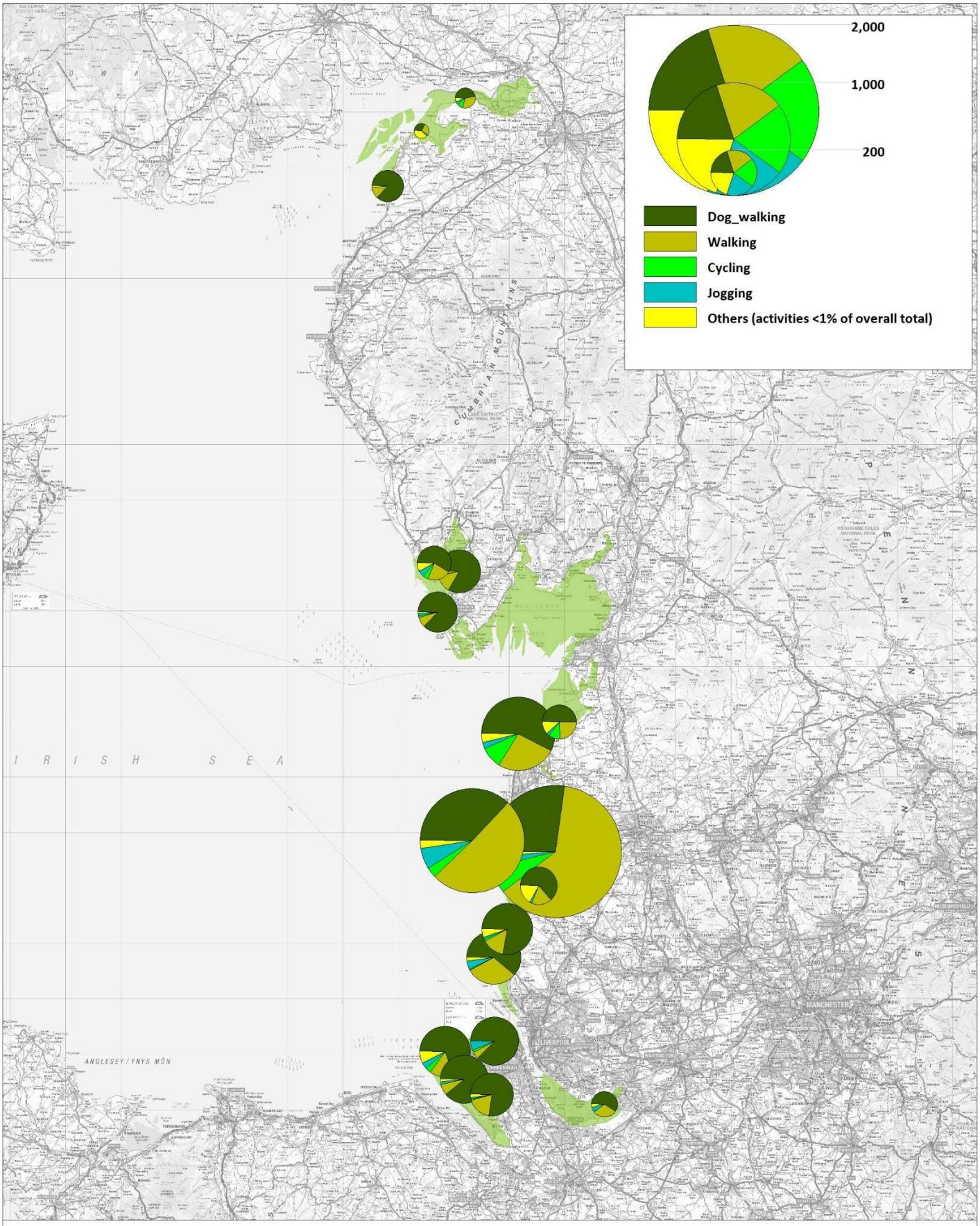


Figure 2: Number of dogs on and off lead, as observed during the disturbance fieldwork.

Map 3: Visitor numbers by activity, from diary data

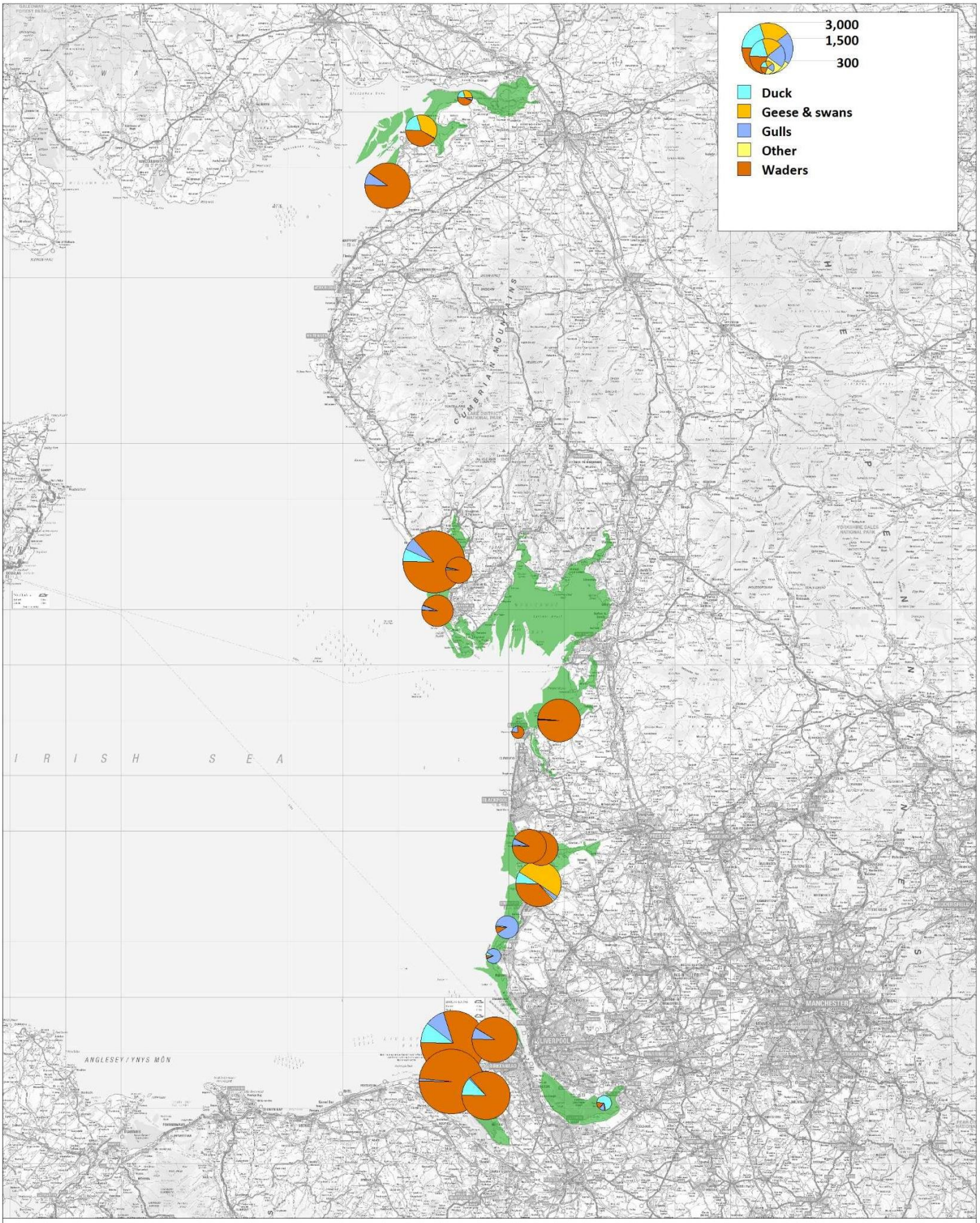


Bird counts

4.5 Forty-seven species were recorded during the bird counts. We grouped these into geese and swans; duck, waders, gulls and other (cormorants, herons, grebes and divers). Some particularly high counts (over 1,000 birds) included Barnacle Goose (max 2,460 at Grune Point on 21/1/17), Black-headed Gull (max 2,300 at Hoylake on 21/1/17), Black-tailed Godwit (max 2,200 at Thurstaston on 3/12/16), Dunlin (max 4,015 at West Kirby on 3/12/16), Herring Gull (max 4,950 at Hoylake on 14/1/17), Knot (max 8,350 at Fluke Hall on 11/1/17), Oystercatcher (max 4,100 at Hoylake on 2/2/17) and Pink-footed Goose (max 1,060 at Marshside on 30/11/16).

4.6 Data are summarised in Map 4 by species group, with maximum counts for individual species at the end of each visit at each location shown. Waders accounted for the most individuals at most survey points and Haverigg, the Dee and Dubmill Point had some relatively high counts. Data are broken down by species and location in Appendix 3, which gives the maximum count and number of counts where each species was present at each location.

Map 4: Bird numbers (maximum counts, for individual species, summed for species groups)



Effect of people on bird numbers and distribution

4.7 If disturbance were affecting the general distribution of birds it might be expected that the survey points that were busiest (i.e. from the diary data) might also tend to have lower bird counts. We took the maximum bird count for each species at each survey point (excluding gulls) and summed these at each survey point to give a maximum total for each location. We then converted these to densities (based on the focal area at each survey point), to allow direct comparison across survey points. These summed maximum bird densities are shown in relation to the visitor data in Figure 3. The three plots show the mean number of groups per location (a), the mean number of people (b) and the mean number of dogs off lead (c). The plots for the mean number of groups and mean number of people are similar, suggesting relatively consistent group size across sites. The error bars show the standard error and therefore give an indication of variability in the levels of use at each location.

4.8 Were disturbance to have a general effect whereby birds avoided areas with consistent high levels of access, we would expect lower densities of birds at locations with high levels of access and small error bars. There is no significant correlation in any the plots (Pearson correlation coefficients: a) -0.209; b) -0.206; c) -0.126; in all cases $p>0.05$).

4.9 In each plot, Fluke Hall is notable in that it has consistently low levels of access and high bird numbers. Fairhaven and Church Scar (the two outlying points in plots a and b) have particularly high levels of access (in terms of numbers of people) but not particularly high numbers of dogs off leads. Bird densities at these two sites are relatively low, but not as low as some of the other sites with much lower access levels.

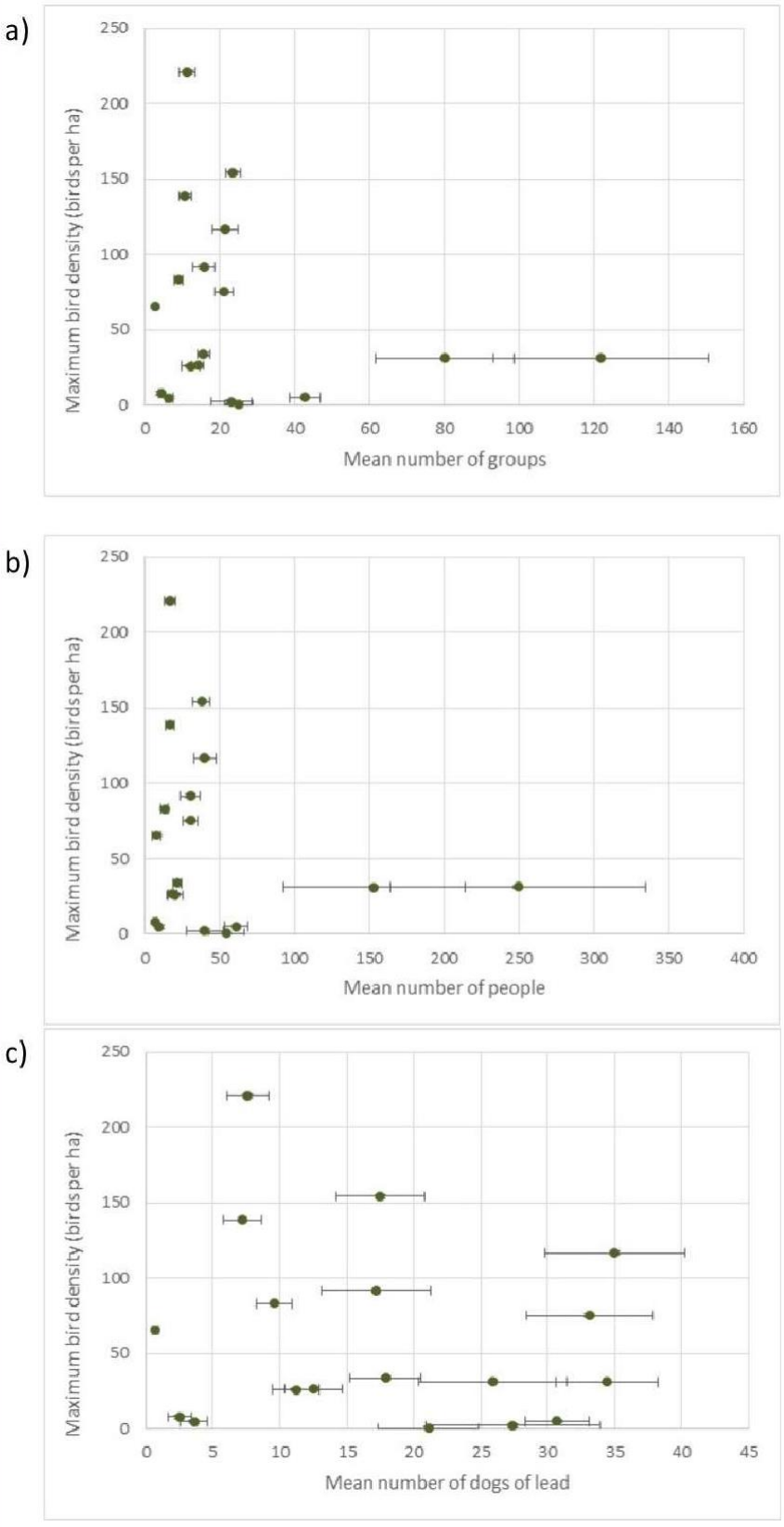


Figure 3: Maximum bird density and access levels per survey point. Maximum bird density is the maximum count for each species (excluding gulls) at each location summed. Three different mean values for access data are used. Error bars show 1 SE.

4.10 There was some variation in access levels between visits, even at the same location, and disturbance effects on bird distribution may therefore be more temporary, i.e. birds not avoiding areas completely and instead shifting distribution in response to access levels at the time. By looking at different visits, any more temporary pattern in terms of disturbance effects should be evident. We have taken the bird count data from the end of each survey visit and plotted these bird data against access levels during the visit (i.e. the previous 1 hour and 45 minutes). The plots (Figure 4) show the data for the waders and wildfowl, the main groups in terms of number of birds and species. Were birds to show a temporary avoidance of areas where access is high, we would expect evidence of a pattern whereby high counts of birds occurred when visitor numbers were low and/or low counts of birds when visitor numbers were high. For most locations, the number of people is relatively low and there is some variation in bird numbers, potentially linked to tide (reflected in the coloured symbols) or other factors.

4.11 We used a generalized linear mixed model with a poisson error and logarithm function, including location and tide as random factors, to test whether the number of birds was related to the number of people, using the total number of people (log transformed) recorded during the same count as a measure of disturbance. This analysis therefore tests whether bird numbers vary in relation to disturbance in the short term – i.e. whether birds will try to use areas and then vacate them if disturbed (rather than simply avoid the areas with high disturbance levels altogether).

4.12 Results are summarised in Table 2 and show a significant effect of visitor numbers on the numbers of waders and wildfowl but not other species (other species being herons, cormorants, divers and grebes, excluding gulls). The coefficients are however weak, indicating the effect is not strong and for waders the effect is positive, i.e. indicating more birds when more people are present. However, if the two sites with very high numbers of people are removed from the analysis (the two sites being Church Scar and Fairhaven, see lower half of Table 2) then the effect for waders (and wildfowl) is negative and significant. The relatively small coefficient for waders suggests a relatively weak effect, whereby fewer birds occur when more people are present, once Church Scar and Fairhaven are excluded. The analysis of the data is made complex with the very high visitor numbers at Church Scar and Fairhaven; we also know that at these sites the diary data show a different pattern of access (for example a lower proportion of dog walkers).

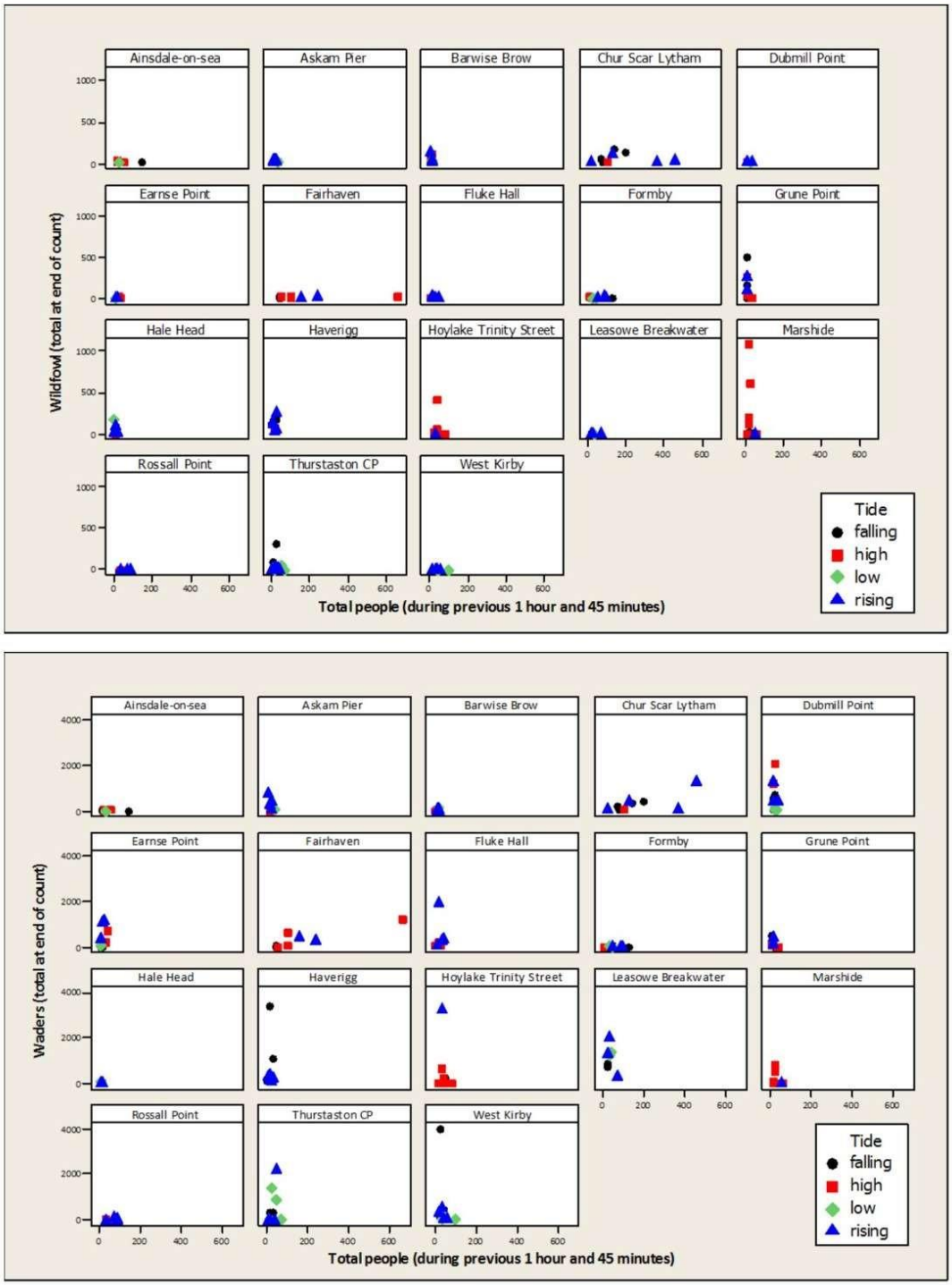


Figure 4: Numbers of birds (at end of each visit) and number of people recorded during the survey visit (i.e. preceding 1 hour and 45 minutes). Top plot is for wildfowl (ducks, geese and swans) and lower plot for waders. The x axis has been constrained at 700, omitting one point at Church Scar, Lytham with 914 people and no birds counted. Symbols reflect the main tide state for the count.

Table 2: Generalized linear mixed model results testing the effect of numbers of people during a count on the number of birds present during the count. Models with poission error and logarithm function and including both tide (four categories) and location (18 sites) as random factors. Separate models for waders, wildfowl (i.e. ducks, geese and swans) and other species (cormorants, divers, grebes etc., excluding gulls). Asterisks for the R2 values indicate values where R2 potentially unreliable.

ID	Effect	F	df	p	R2
Waders	location =2.31±1.52. tide =0.08±0.28				
constant	4.39±0.39				
Log Total people	0.37±0.02	505.3	176	<0.001	33
Wildfowl	location =8.46±2.90. tide =0.05±0.23				
constant	2.02±0.71				
Log Total people	-0.38±0.03	113.3	176	<0.001	53*
Other	location =1.73±1.31. tide =0.50±0.71				
constant	-1.17±0.61				
Log Total people	-0.12±0.24	0.25	176	0.607	40*
Church scar & Fairhaven removed					
Waders	location =2.54±1.60. tide =0.08±0.29				
constant	4.95±0.43				
Log Total people	-0.07±0.02	17.92	156	<0.001	37
Wildfowl	location =9.41±3.06. tide =0.06±0.24				
constant	1.85±0.80				
Log Total people	-0.42±0.04	125.5	156	<0.001	56*
Other	location =1.97±1.40. tide =0.61±0.78				
constant	-1.36±0.66				
Log Total people	-0.04±0.26	0.02	156	0.881	0.4*

Behavioural Responses

4.13 During each survey visit the diary element essentially recorded all human activities and potential disturbance events that might affect birds within the focal recording area. This diary was maintained even when no birds were present within the recording area (for example some prior disturbance or changes in the tide might have pushed birds out of the recording area). Some of the diary events could also result in different disturbance events, involving multiple species specific observations: a single person might disturb different birds in different parts of the survey area and different species may respond differently (e.g. some might take flight, while others show no response). The data therefore consist of a number of unique diary entries, some of which could result in multiple potential disturbance events, each of which we treat as a unique observation. We use the term potential disturbance event throughout this report to highlight those diary entries that resulted in people/activities occurring within 200m of birds within the study area. Each of these potential disturbance events could be associated with multiple observations.

4.14 Across all sites there were 4,608 diary entries. Of these 2,058 (45%) occurred when birds were present in the focal area and either caused disturbance or were within 200m of the birds (Table 3). There were therefore 2,058 different potential disturbance events. These potential disturbance events generated a total of 5,156 species specific observations (Table 4). Of these (species-specific) observations, 4,065 (79%) resulted in no visible change in behaviour or any kind of response from the birds. 21% of observations resulted in a behavioural response from a given species, with 591 observations (11%) involving birds undertaking a major flight.

Table 3: Number (%) of diary observations at each survey point broken down by whether within 200m of birds within study area/birds disturbed or not.

Location	within 200m of birds within study area/birds disturbed	not within 200m of birds within study area	Total
1 (Barwise Brow)	18 (43)	24 (57)	42 (100)
2 (Grune Point)	22 (81)	5 (19)	27 (100)
3 (Dubmill Point)	46 (52)	43 (48)	89 (100)
4 (Haverigg)	32 (30)	75 (70)	107 (100)
5 (Askam Pier)	42 (27)	114 (73)	156 (100)
6 (Earnse Point)	59 (42)	82 (58)	141 (100)
7 (Fluke Hall)	81 (72)	32 (28)	113 (100)
8 (Rossall Point)	126 (30)	301 (70)	427 (100)
9 (Fairhaven)	546 (68)	255 (32)	801 (100)
10 (Church Scar Lytham)	297 (24)	926 (76)	1223 (100)
11 (Marshside)	64 (53)	57 (47)	121 (100)
12 (Ainsdale-on-sea)	72 (31)	158 (69)	230 (100)
13 (Formby)	86 (34)	166 (66)	252 (100)
14 (Leasowe Breakwater)	126 (60)	84 (40)	210 (100)
15 (Hoylake Trinity Street)	127 (54)	108 (46)	235 (100)
16 (West Kirby)	167 (78)	46 (22)	213 (100)
17 (Thurstaston CP)	93 (59)	64 (41)	157 (100)
18 (Hale Head)	54 (84)	10 (16)	64 (100)
Total	2058 (45)	2550 (55)	4608 (100)

Table 4: Number (%) of observations and different categories of behavioural response. Each observation involved a potential disturbance event and a single species.

No Response	Alert	Walk/Swim	Minor Flight	Major Flight	Total
4,065 (79)	137 (3)	119 (2)	244 (5)	591 (11)	5,156 (100)

Types of activity and response of birds

4.15 Responses by activity are summarised in Figure 5, which includes all those activities where there were at least 10 observations involving the activity and birds present. Cycling, jogging and walking were the activities with the lowest proportion of events that involved a behavioural response from birds.

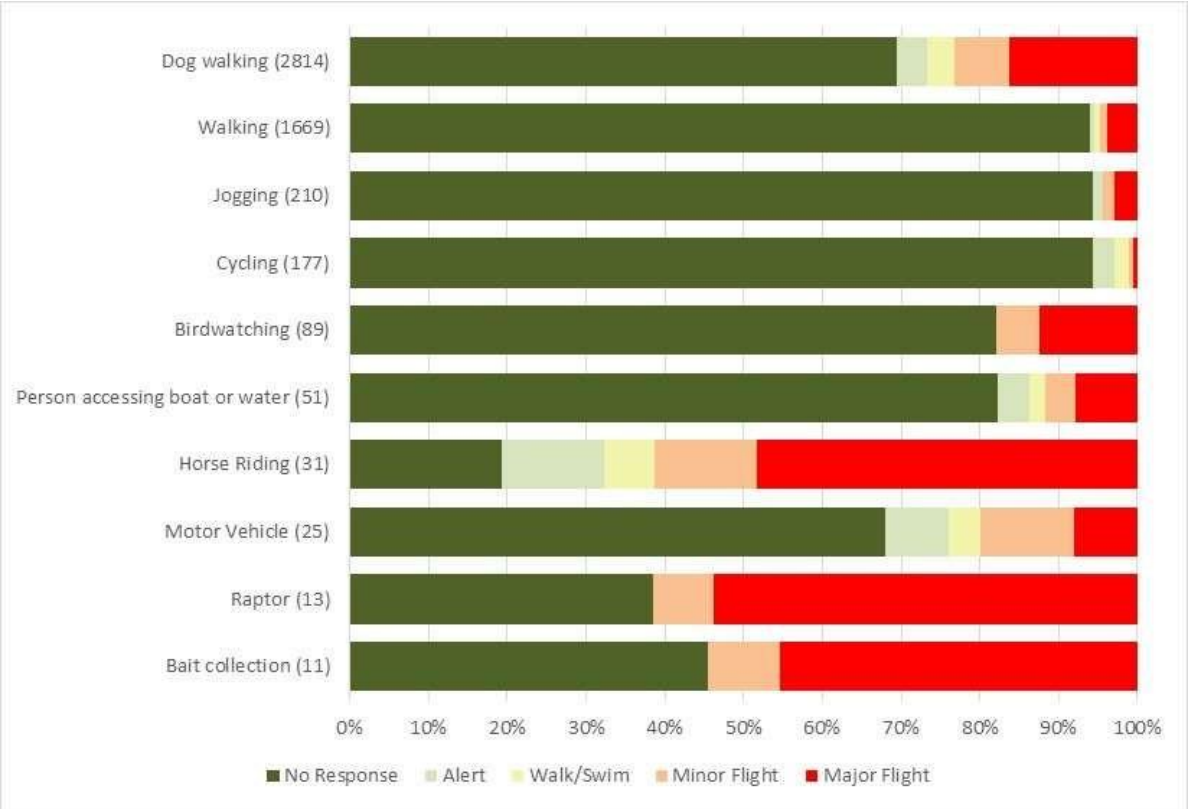


Figure 5: Responses by activity. Only activities with at least 10 observations are recorded. Activities are listed in order of frequency (i.e. the number of observations) which are given in brackets. Responses are classified using single response codes.

4.16 In Figure 5 dog walking is treated as a single activity, however there were marked differences in the response of birds depending whether the dog walker had dog(s) off lead or not (Table 5). For those dog walkers with at least one dog off a lead, 67% of observations involved no response and for 33% there was a behavioural response recorded. By contrast for dog walkers with all dogs on a lead, 90% of observations involved no disturbance and 10% involved a behavioural response. The proportions of birds responding are significantly different between the two groups (χ^2 =81.77; $p<0.001$).

Table 5: Number (%) of potential disturbance events and the response of birds present for dog walkers with dogs on lead compared to dogs off lead. Responses categorised using single response codes.

	No response	Alert	Walk/swim	Minor flight	Major flight	Total
All dog(s) on a lead	319 (90)	9 (3)	5 (1)	4 (1)	16 (5)	353 (100)
1 or more dogs off lead	1635 (67)	96 (4)	93 (4)	189 (8)	438 (18)	2451 (100)
Total	1954 (70)	105 (4)	98 (3)	193 (7)	454 (16)	2804 (100)

4.17 If activities had a similar likelihood of causing a behavioural response, we would expect the proportion of disturbance events to be broadly similar to the level of access. We summarise responses by activity in Table 6 , with the percentages calculated for each column. It can be seen that dog walking accounted for 55% of the observations (i.e. around 55% of the access) and caused 77% of the major flights recorded. By contrast, walking without a dog accounted for 32% of the access and 11% of the major flights.

Table 6: Number (%) of observations by response and activity. Percentages are calculated for each column. Responses categorised using single response codes.

Activity	No Response	Alert	Walk/Swim	Minor Flight	Major Flight	Total
Dog walking	1956 (48)	105 (77)	100 (84)	195 (80)	458 (77)	2814 (55)
Walking	1567 (39)	12 (9)	11 (9)	16 (7)	63 (11)	1669 (32)
Jogging	198 (5)	3 (2)	0 (0)	3 (1)	6 (1)	210 (4)
Cycling	167 (4)	5 (4)	3 (3)	1 (0)	1 (0)	177 (3)
Birdwatching	73 (2)	0 (0)	0 (0)	5 (2)	11 (2)	89 (2)
Person accessing boat or water	42 (1)	2 (1)	1 (1)	2 (1)	4 (1)	51 (1)
Horse Riding	6 (0)	4 (3)	2 (2)	4 (2)	15 (3)	31 (1)
Motor Vehicle	17 (0)	2 (1)	1 (1)	3 (1)	2 (0)	25 (0)
Raptor	5 (0)	0 (0)	0 (0)	1 (0)	7 (1)	13 (0)
Bait collection	5 (0)	0 (0)	0 (0)	1 (0)	5 (1)	11 (0)
Kitesurfing	2 (0)	0 (0)	0 (0)	2 (1)	5 (1)	9 (0)
Air-borne	2 (0)	2 (1)	0 (0)	3 (1)	1 (0)	8 (0)
Kids playing	3 (0)	0 (0)	0 (0)	2 (1)	2 (0)	7 (0)
Boating	1 (0)	1 (1)	0 (0)	0 (0)	4 (1)	6 (0)
Fishing	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)	1 (0)
Other	21 (1)	1 (1)	1 (1)	6 (2)	6 (1)	35 (1)
Total	4065 (100)	137 (100)	119 (100)	244 (100)	591 (100)	5156 (100)

4.18 In Table 7 we summarise the number of birds observed flushed by different activities. The table also summarises the number of potential disturbance events for each activity. It can be seen that dog walking stands out from the other activities in that it is the most frequent type of potential disturbance event (57% of events), and was attributed as the cause of roughly a similar proportion of flight events (55% of both major and minor flights). The activity did however result in a disproportionate amount of birds flushed, for example 89% of the birds flushed in major flight events were flushed by dog walking events.

Table 7: Number (%) of birds flushed by different activities

Activity	Major Flight		Minor Flight		Number of potential disturbance events
	Number of flights	Number of birds flushed	Number of flights	Number of birds flushed	
Air-borne	8 (0)	6 (0)	8 (0)	88 (0)	2 (0)
Bait collection	11 (0)	227 (0)	11 (0)	82 (0)	2 (0)
Birdwatching	89 (2)	264 (0)	89 (2)	2587 (14)	28 (1)
Boating	6 (0)	24 (0)	6 (0)	0 (0)	3 (0)
Cycling	177 (3)	19 (0)	177 (3)	3 (0)	73 (4)
Dog walking	2814 (55)	51,886 (89)	2814 (55)	14,103 (77)	1183 (57)
Fishing	1 (0)	15 (0)	1 (0)	0 (0)	1 (0)
Horse Riding	31 (1)	1,820 (3)	31 (1)	215 (1)	9 (0)
Jogging	210 (4)	23 (0)	210 (4)	21 (0)	91 (4)
Kids playing	7 (0)	56 (0)	7 (0)	4 (0)	2 (0)
Kitesurfing	9 (0)	1,058 (2)	9 (0)	21 (0)	4 (0)
Motor Vehicle	25 (0)	31 (0)	25 (0)	10 (0)	9 (0)
Other	35 (1)	678 (1)	35 (1)	317 (2)	12 (1)
Person accessing boat/water	51 (1)	141 (0)	51 (1)	7 (0)	20 (1)
Raptor	13 (0)	1,158 (2)	13 (0)	445 (2)	6 (0)
Walking	1669 (32)	1127 (2)	1669 (32)	483 (3)	613 (30)
Total	5156 (100)	58533 (100)	5156 (100)	18386 (100)	2058 (100)

Variation between sites

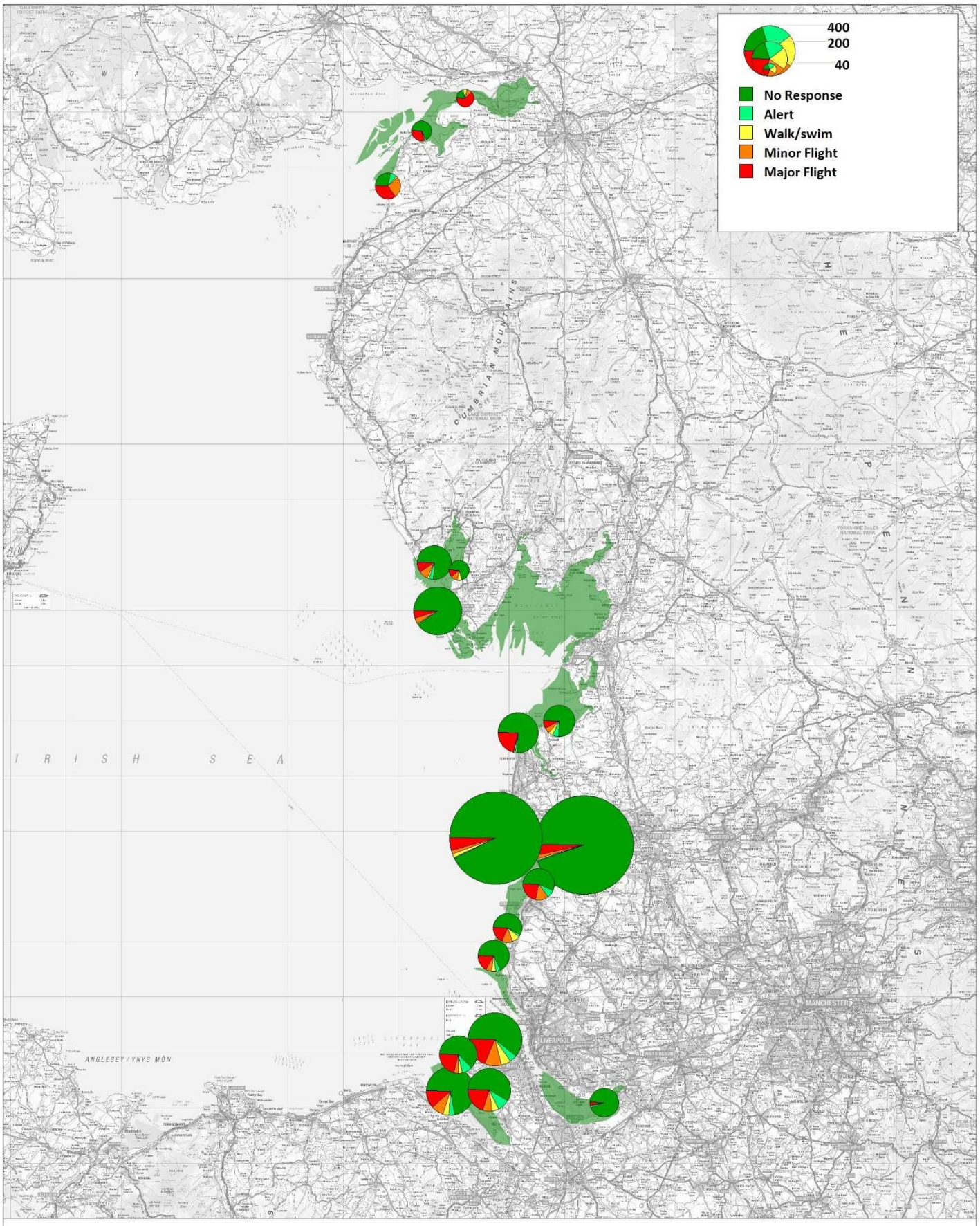
4.19 There were significant differences between sites in the proportions of observations that results in no response or some kind of response from birds present (χ^2_{17}=898.30, p<0.001). Responses of birds by site are summarised in Table 8 and also in Map 5.

4.20 In Table 8 locations are ranked based on the number of flights (i.e. no of observations resulting in major or minor flights) per hour. It can be seen that Leasowe Breakwater is the location with the highest rate, with an average of 6.6 flight events per hour. Other sites with comparatively high rates were Thurstaston CP, West Kirby and Dubmill Point. Hale Head was the only location with a rate well below 1 per hour; at this location some 94% of observations resulted in no response from birds present.

Table 8: Responses of birds by site. Table gives numbers (%) of observations at each site and the response of birds. Responses categorised using single response codes. Flights per hour is the number of minor and major flights combined and expressed per hour of fieldwork. Sites are ranked according to the flights per hour.

Location	No Response	Alert	Walk/swim	Minor Flight	Major Flight	Total Observ-ations	Flights per hour
14 (Leasowe Breakwater)	239 (61)	17 (4)	22 (6)	40 (10)	75 (19)	393 (100)	6.6
17 (Thurstaston CP)	150 (58)	24 (9)	13 (5)	18 (7)	52 (20)	257 (100)	4
16 (West Kirby)	233 (72)	13 (4)	13 (4)	27 (8)	39 (12)	325 (100)	3.8
3 (Dubmill Point)	31 (29)	9 (8)	2 (2)	28 (26)	38 (35)	108 (100)	3.8
9 (Fairhaven)	977 (93)	3 (0)	15 (1)	12 (1)	49 (5)	1056 (100)	3.5
11 (Marshside)	90 (57)	12 (8)	0 (0)	21 (13)	35 (22)	158 (100)	3.2
10 (Church Scar Lytham)	1091 (94)	4 (0)	5 (0)	13 (1)	42 (4)	1155 (100)	3.1
15 (Hoylake Trinity Street)	135 (63)	19 (9)	7 (3)	8 (4)	47 (22)	216 (100)	3.1
8 (Rossall Point)	169 (75)	4 (2)	2 (1)	1 (0)	48 (21)	224 (100)	2.8
12 (Ainsdale-on-sea)	77 (58)	3 (2)	11 (8)	16 (12)	25 (19)	132 (100)	2.3
1 (Barwise Brow)	9 (17)	2 (4)	4 (8)	5 (10)	32 (62)	52 (100)	2.1
13 (Formby)	105 (68)	7 (5)	7 (5)	9 (6)	27 (17)	155 (100)	2.1
4 (Haverigg)	132 (75)	7 (4)	3 (2)	15 (9)	18 (10)	175 (100)	1.9
6 (Earnse Point)	282 (90)	0 (0)	2 (1)	12 (4)	17 (5)	313 (100)	1.7
7 (Fluke Hall)	118 (75)	10 (6)	7 (4)	9 (6)	13 (8)	157 (100)	1.3
2 (Grune Point)	45 (67)	0 (0)	1 (1)	1 (1)	20 (30)	67 (100)	1.2
5 (Askam Pier)	52 (70)	0 (0)	5 (7)	8 (11)	9 (12)	74 (100)	1
18 (Hale Head)	130 (94)	3 (2)	0 (0)	1 (1)	5 (4)	139 (100)	0.3
Total	4065 (79)	137 (3)	119 (2)	244 (5)	591 (11)	5156 (100)	

Map 5: Number of observations by response (single codes) and location



4.21 Looking across sites in more detail, we show the number of observations which resulted in disturbance (i.e. birds became alert or moved away from people) in relation to the total number of observations at each location. It can be seen that Fairhaven and Church Scar are clearly different from the other locations in that there is a high level of access and high numbers of observations of people and birds together, yet the proportion resulting in disturbance is relatively low. The other sites show a different pattern whereby the number of observations involving disturbance (a behavioural response) increases with the number of observations. For these other sites Dubmill Point, Thurstaston and Leasowe Breakwater appear to have particularly high levels of disturbance, given the number of observations. This would suggest that at these sites, when people and birds coincide, disturbance is more frequent. Conversely at Hale Head and Earnse Point the level of disturbance is low for the number of observations.

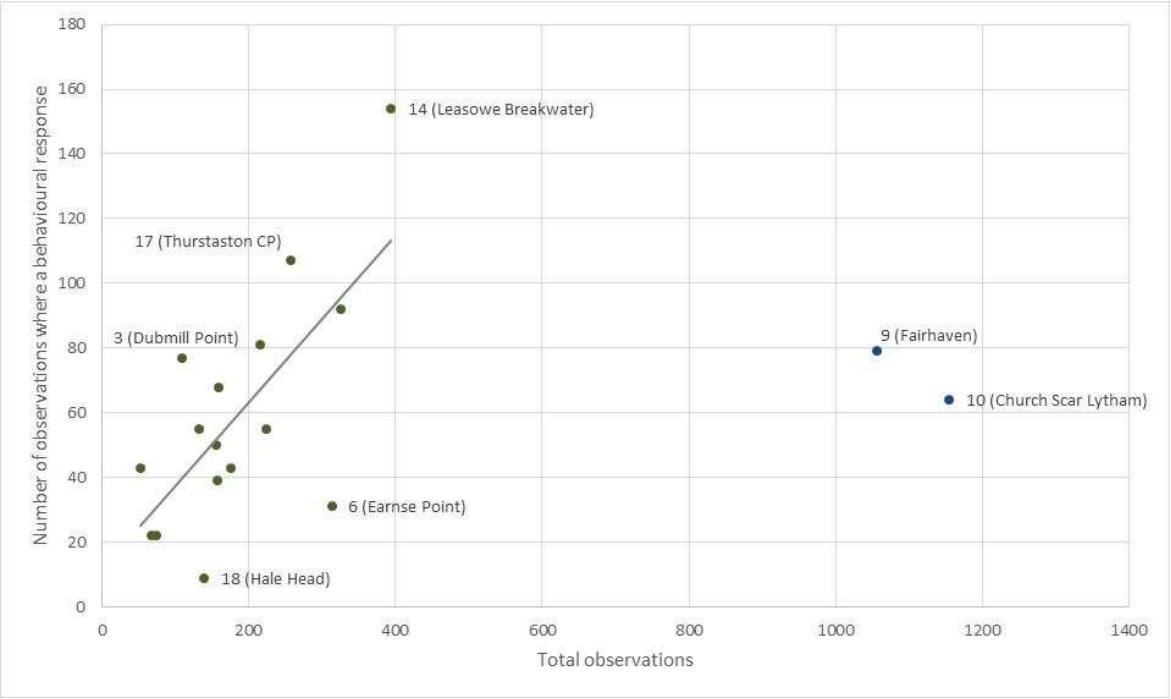


Figure 6: Number of observations with a behavioural response (i.e. events where birds became alert, walked/swam or took flight) and the total number of observations at each location. Selected (outlying) sites labelled. Trendline plotted excluding Fairhaven and Church Scar, Lytham. $Y=11.7+0.258x$; $r^2=43.5$.

4.22 In Figure 7, sites are ranked according to the number of birds flushed. The rankings are similar, with Hoylake Trinity Street, Leasowe Breakwater, Dubmill Point, Thurstaston CP and West Kirby the sites with the most birds flushed. At all the other sites the numbers of birds observed flushed was considerably

below 5,000, and the numbers of birds flushed at Hale Head, Formby, Askam Pier and Fluke Hall were particularly low.

4.23 At most sites the proportion of major flights compared to minor flights was much higher, however at Dubmill Point most of the flight events involved minor flights.

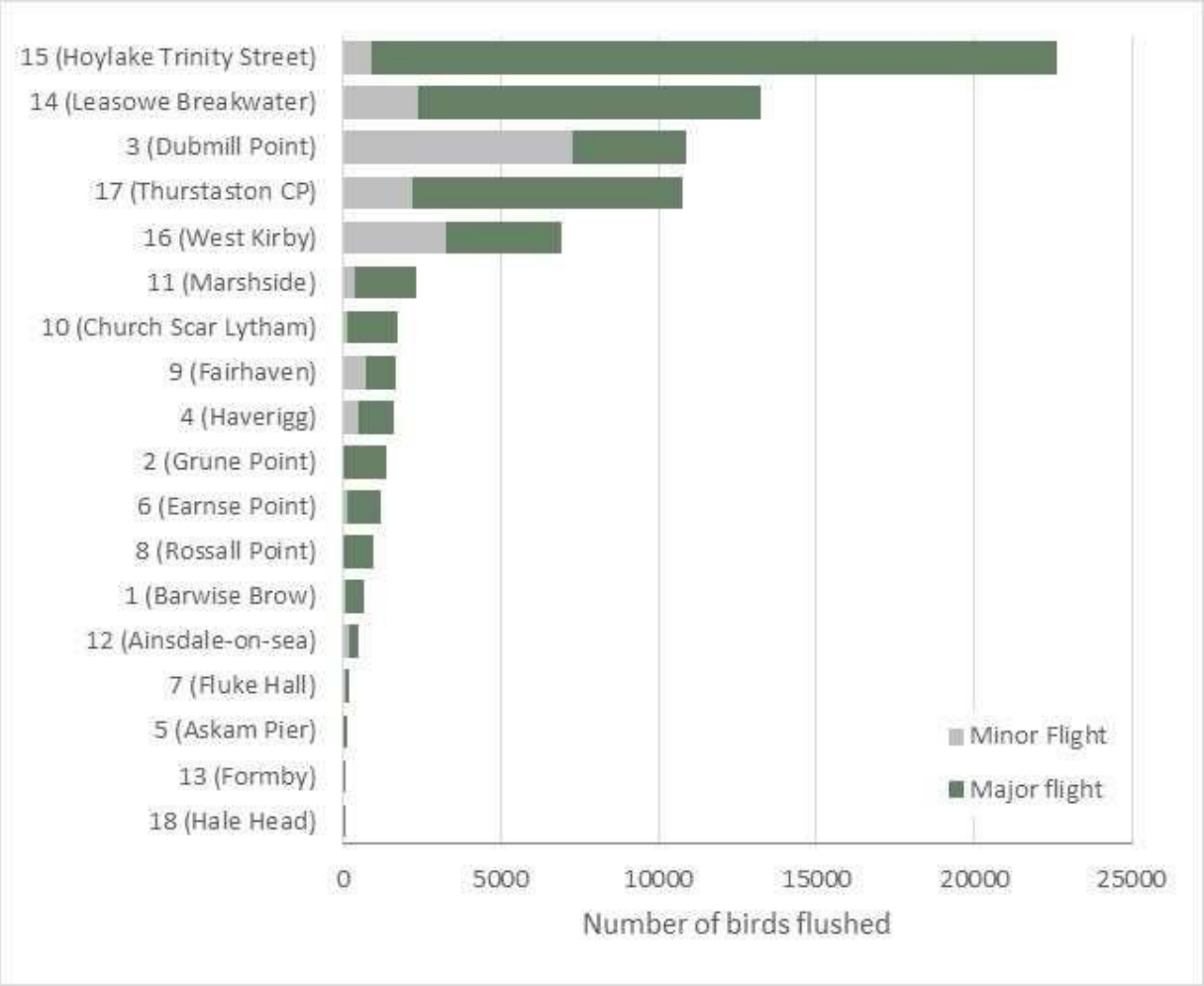


Figure 7: Numbers of birds flushed per location, with shading reflecting minor and major flights.

4.24 There was some variation between sites as to the behaviour of the birds when flushed. It should be noted that visits at each site were targeted when access and birds were thought to coincide, and therefore at some locations survey effort was focussed at low tide, when birds were foraging while, at others visits were at high tide (see Table 1). The number of birds foraging and roosting was recorded for each potential disturbance event. Comparing these proportions for the events where major or minor flights were recorded indicates that at Thurstaston, Church Scar Lytham and Leasowe both roosting and foraging birds were flushed (i.e. major and minor flights combined) in roughly equal proportions. At Dubmill Point and Hoylake the birds flushed were

predominantly roosting while at West Kirby and to some extent Marshside it was predominantly foraging birds that were flushed.

Responses by species

4.25 Observations included 39 different species, but for many of these species sample sizes were very low. Data are summarised in Figure 8 for those species with at least 15 observations. For species such as Mallard, Purple Sandpiper and Great-crested Grebe very few (or even zero for Purple Sandpiper and Great-crested Grebe) observations resulted in any disturbance recorded at all. Pink-footed Goose was the species with the highest proportion of observations resulting in disturbance.

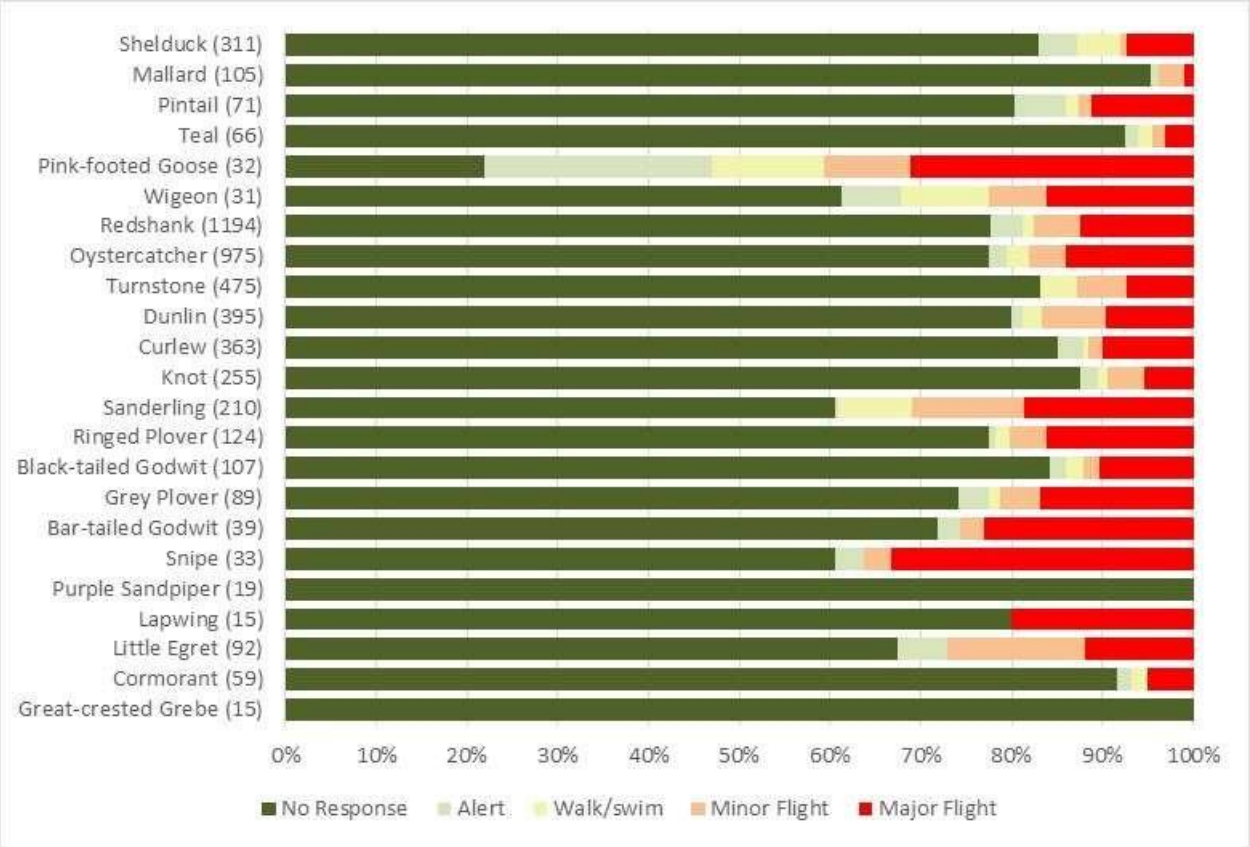


Figure 8: Responses by species (only species with at least 15 observations included). Sample size (number of observations) is given in brackets. Species are grouped into wildfowl, waders and other species and within each group ranked according to sample size. Responses are classified using single response codes.

Response Distances

4.26 Distances between the birds and the people or event were recorded for most observations (there were 39 observations where the distance was not recorded because the surveyor could not estimate the distance with confidence, for

example airborne events or sudden noises). Data are summarised by species group in Figure 9, which shows a general pattern (with much variation) whereby responses occur when the event is closer to the birds and birds tending to be flushed when the event was around 50m from the birds. In Appendix 4 we summarise response data by species.

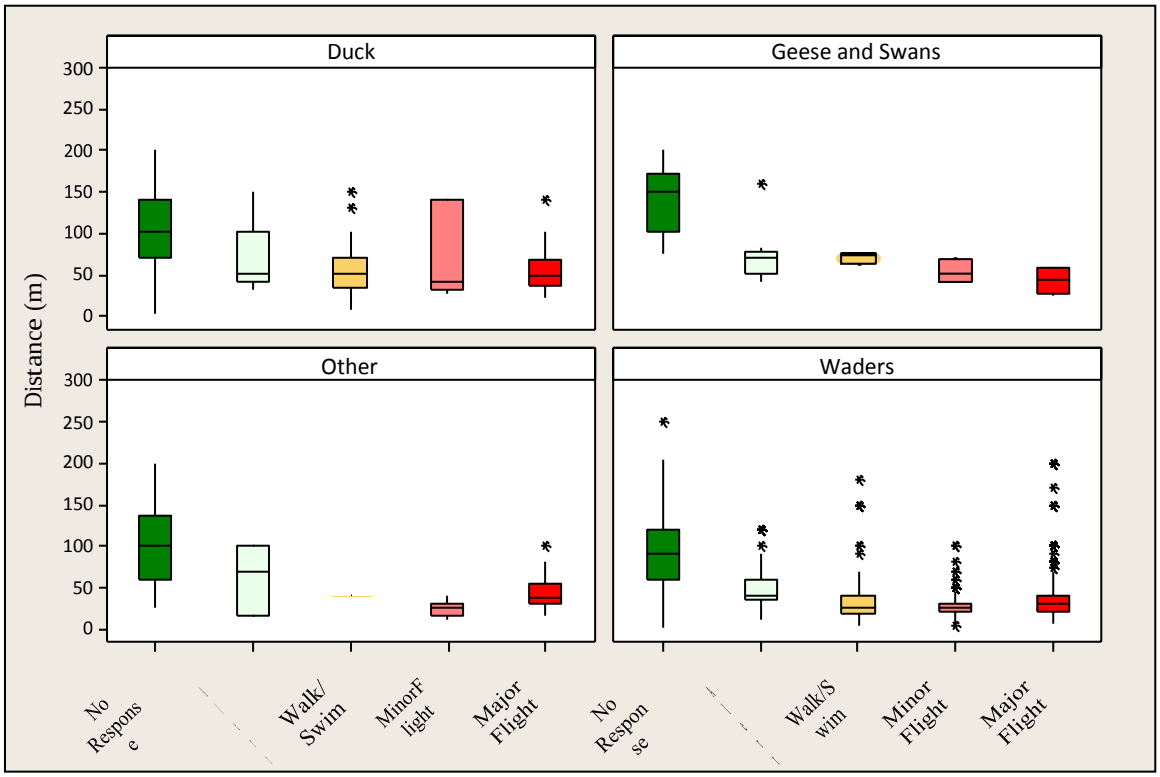


Figure 9: Boxplot showing response distances for different species groups and types of response. Responses are classified using single response codes. For No Response the distance recorded is the closest distance between the event and the birds while for other responses the distance recorded was the maximum distance. Y axis is clipped to 300m, 7 outlier data points fell beyond 300m.

4.27 There was little evidence that, after controlling for activity and species, birds responded to the presence of people at different distances. In Figure 10 we show the distances at which Oystercatchers (top) and Redshank (lower) took flight. These species are selected as they are the ones with most observations. Similarly, the plots show responses for one activity (dog walking, the most common) and show the distances by site at which birds were recorded taking flight. It can be seen there is relatively little difference between locations. For Oystercatchers, 4 locations had more than 10 observations and at these sites the median distance at which birds took flight ranged from 30m to 40m. For Redshank there were six locations with at least one observation and the median distance for these ranged from 20m to 30m, again a relatively narrow range.

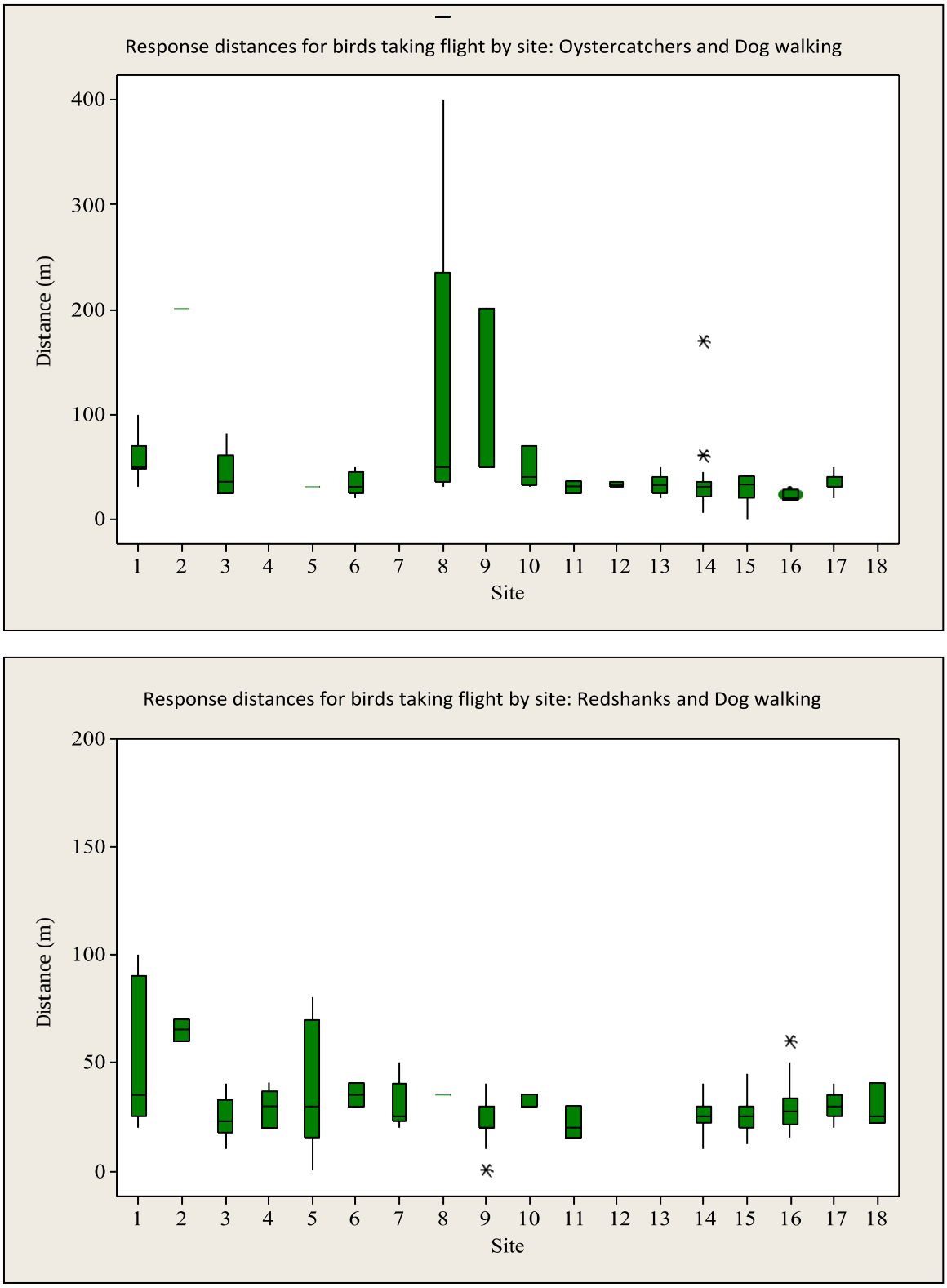


Figure 10: Boxplots comparing distances at which birds took flight. Plots are for the two species with the most observations (Oystercatcher, top and Redshank bottom). Flight response is both major and minor flight. Data for the most common activity type (dog walking).

Factors influencing flight response

4.28 In order to explore which factors were linked to birds taking flight we tested a range of variables using logistic regression to determine which were potentially significant in relation to whether a flight event occurred (i.e. flight 1 or 0 was the response variable). We filtered the dataset to give a selection of wildfowl and wader species (Bar-tailed Godwit, Curlew, Dunlin, Grey Plover, Knot, Lapwing, Oystercatcher, Pink-footed Goose, Pintail, Redshank, Ringed Plover, Sanderling, Shelduck, Teal, Turnstone and Wigeon) which were key components of the waterbird assemblage of the various sites and for which there were reasonable sample sizes. The species selected were also likely to be relatively similar in their response to disturbance (i.e. omitting species such as Mallard and Mute Swan which may be positively drawn to people, or species associated with particular habitats that are not widespread, such as Snipe or Purple Sandpiper). A wide range of potential explanatory variables were initially tested individually, as there were too many too build an initial maximal model.

4.29 Distance (and the square root of distance) were significant ($p<0.01$), with the probability of flight occurring decreasing with distance (i.e. when people were close to the birds, the probability of major flight increased).

4.30 There were some differences between species, with high coefficient values indicting a higher probability of flight for Pink-footed Goose, Sanderling, Bar-tailed Godwit and Wigeon and low coefficient values indicating a low probability of flight for Teal and Shelduck.

4.31 Flock size (number of individuals of given species) was significant ($p<0.001$), the low, positive coefficient indicating a weak effect whereby major flight was more likely to occur when more birds were present. There was no significant effect of behaviour, indicating no difference in probability of flight whether birds were roosting or foraging.

4.32 There were significant differences between location, with low probability of birds being flushed at Hale Head, Church Scar Lytham and Fairhaven and conversely a higher probability of flushing at Barwise Brow and Dubmill Point.

4.33 Where the activity took place was highly significant: activities on the shore (i.e. above the high water mark) had a low probability of causing birds to take flight ($p<0.001$) compared to those on the water or on the intertidal. Events categorised as taking place on the water had a significantly higher probability of flushing birds ($p=0.004$) and events on the intertidal (i.e. where people were walking on sandflats or mudflats) had the highest probability of flushing birds ($p<0.001$).

4.34 There were many different activities (many of which had relatively low sample sizes) and the model fit using all activities was poor, however cycling, jogging and walking all had very low coefficients and were significantly different to the reference activity (air-born) to indicate these activities had a low probability of flushing birds. There was no significant effect of group size (which ranged from 1 – 81 people), suggesting that bigger groups do not necessarily have a greater probability of flushing birds compared to smaller groups. There was, however, a significant effect of the number of dogs ($p<0.001$); events with more dogs had a higher probability of flushing birds. Similarly, groups with at least one dog off lead were more likely to flush birds compared to groups with no dog or dog(s) on leads ($p<0.001$).

4.35 Temperature was significant ($p<0.001$), with a higher probability of flight in warmer temperatures. There were also significant effects of tide, with the highest probability of birds being flushed at low tide.

5. Results: visitor survey

Tally count data

5.1 In total, we counted 4,689 people, of which 554 were minors, during the 288 hours of survey. These people were from 1,435 identified groups and therefore we calculated an overall average group size of 1.7 people per group. We also observed 1,310 dogs at sites, and therefore an average of 0.9 dogs per group.

5.2 There were some extreme differences between survey locations in the number of people recorded, as indicated in Figure 11. Figure 11 suggests a number of sites were very quiet, particularly those in the north, such as Barwise Brow, and Grune Point with less than 2 people per hour entering. The survey point at the National Trust's Formby dunes stands out as the highest, with approximately 23 people per hour entering on average. Unsurprisingly, differences in people entering per two hour session were highly significant (KW, h=58.57, df =17, p<0.001).

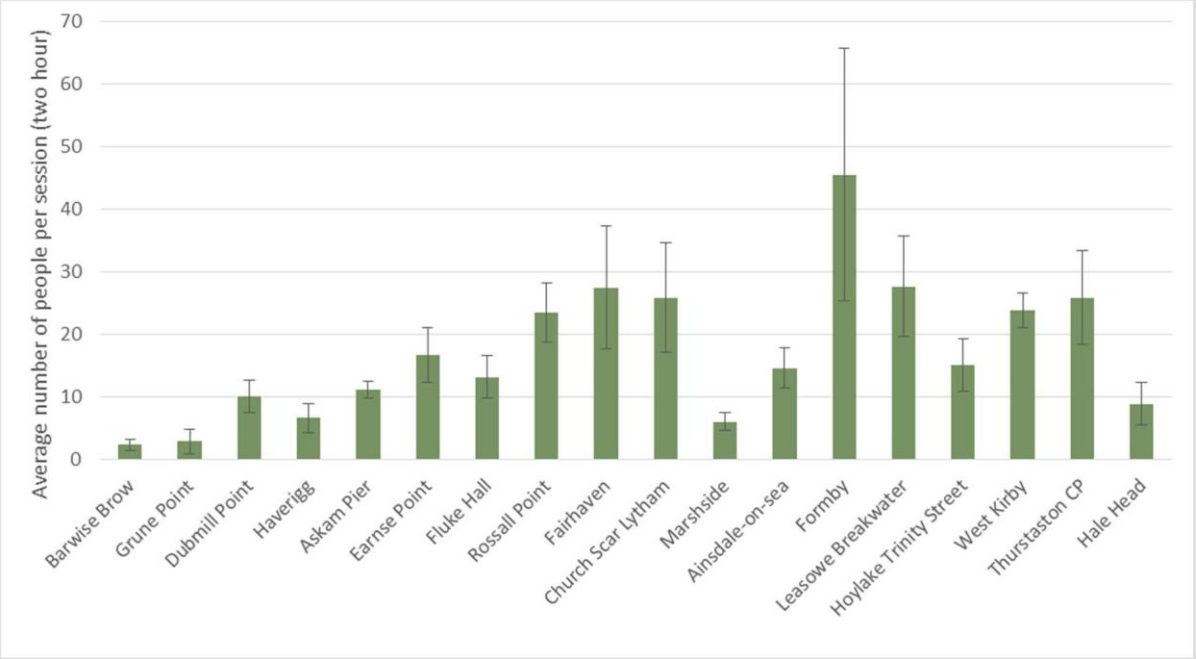


Figure 11: The mean number of people entering per two hour session (error bars indicate standard error) for each survey point location. Locations sorted from north to south (by ID).

5.3 Results of the tally data are summarised for each survey point in Table 9. This shows Formby also had the highest overall total of people recorded. This was despite one session (the weekday final session; 1500-1700) in which no people were recorded entering and only 10 people leaving (this was due to the car park closing early as a result of bad weather).

5.4 The highest number of people counted in a single two-hour session was recorded at Formby (274 people passing in two hours). Away from Formby the next two highest values of people entering or leaving in a two-hour session were at Fairhaven and Church Scar Lytham (149 and 137 respectively). Grune Point was the only location with no people recorded entering or leaving during a session, and this occurred on three occasions.

5.5 The total number of people entering as recorded in tallies (over the 16 hours) was also converted to the average number of people per hour (shown in Table 9). These values, averaged for each estuary, are shown in Figure 12. While Figure 12 shows there was a pattern of busier sites in the central areas, it is important to note there were a range of values at most estuaries. Only the two survey points on the Dee estuary showed very little range in values; all other estuaries included a wide range of values.

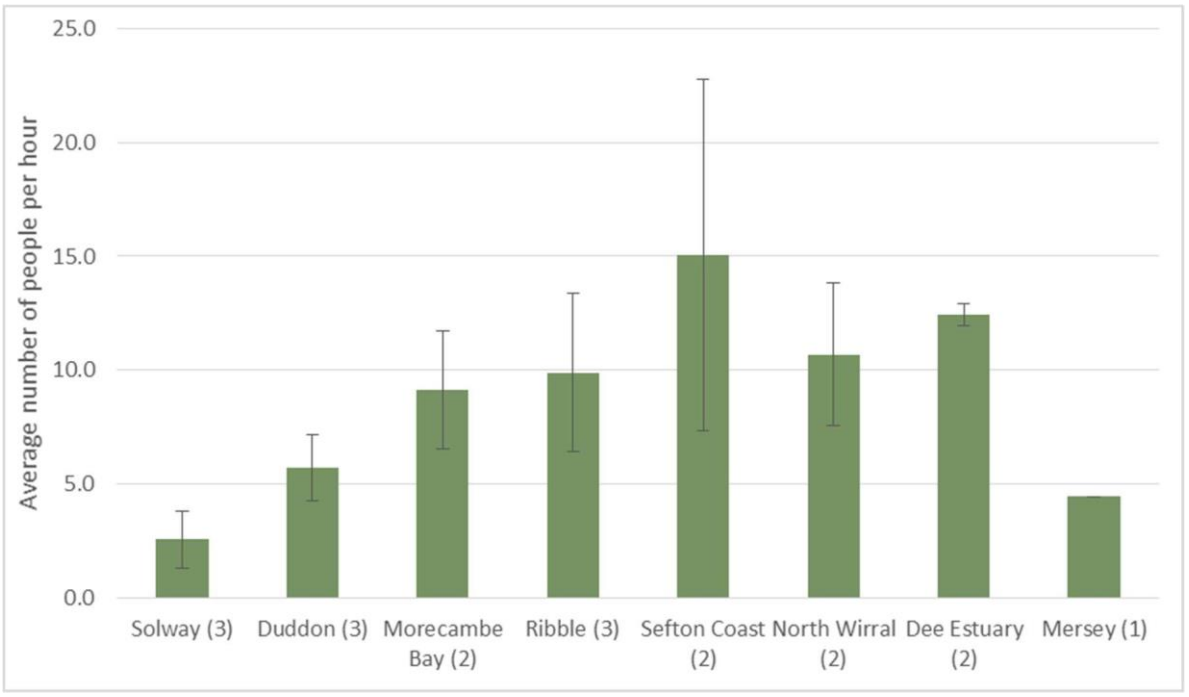


Figure 12: The overall number of people entering per hour for survey points averaged for each survey estuary shown as average values (standard error bars shown). Numbers in brackets indicate the number of survey points for each estuary. Estuaries are sorted north to south.

5.6 Averaged group size was also different between survey locations (see Table 9). The overall group size was 1.7 people per group (including minors), and most sites fall within this approximate region (range, 1.4-1.8). Exceptions to this were; Hale Head (2.0), Thurstaston CP (2.1), Formby (2.6) and Grune Point (3.3). The value for Grune Point was considered atypical for the site; the site typically had few visitors and the average is heavily influenced by a single large group (14 people, from RSPB Carlisle).

5.7 Tally counts also recorded the numbers of dogs and minors for each survey location. Map 6 presents the relative composition of adults, minors and dogs recorded for each survey location.

5.8 The average number of dogs per group ranged from 0.5 dogs per group (Church Scar Lytham and Formby) to 1.3 (Dubmill Point, Askam Pier and Ainsdale-on-sea). Average number of minors ranged from virtually no minors per group (0.0, Barwise Brow, Grune Point, Earnse Point and Fluke Hall) to every other group including 1 minor (0.5 minors per group, at Formby). We noted a significant negative correlation between the number of minors per group and the number of dogs per group at survey points (Pearson's =-0.514, p=0.029).

5.9 There were also differences between weekday and weekend days in the number of people entering at some survey points (as shown in Figure 13). At all locations, except for Rossall Point, numbers at weekends were greater than weekdays. Survey conditions at Rossall Point were less favourable at the weekend than on the weekday and this may have been an important contributing factor.

5.10 Sites with much higher numbers of people at weekends relative to the weekdays were often associated with sites popular with family groups, such as National Trust locations or Country Parks (Formby and Thurstaston). This is indicated by a significant correlation between the proportion of total people recorded on a weekend compared to the average number of minors per group for each survey point (Pearson's = 0.544, p=0.020). It should be noted that these survey periods were outside of the school holidays, and the numbers of family groups on weekdays will be noticeably different during school holiday[4].

[4] Initial site visits to locations were made during October half term, and Formby in particularly was very busy with family groups at this time.

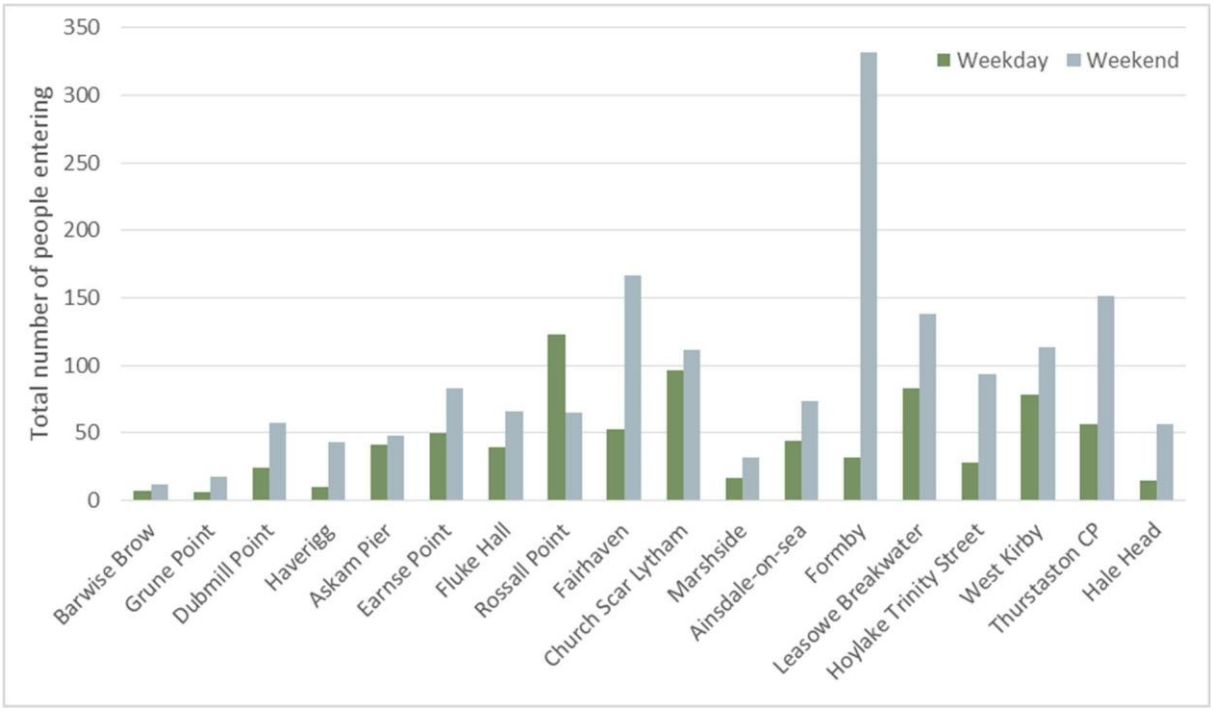


Figure 13: The number of people entering in a single survey day, shown separately for weekdays and weekend days.

Table 9: Summary by survey point of the number of people, minors, and dogs recorded entering at each survey point.

ID	Location Name	Total number of people passing	Total number of groups entering	Total number of people (inc. minors) entering	Total number of minors entering	Total number of dogs entering	People per group	Dogs per group	Minors per group	People per hour
1	Barwise Brow	35	14	19	0	15	1.4	1.1	0.0	1.2
2	Grune Point	35	7	23	0	6	3.3	0.9	0.0	1.4
3	Dubmill Point	168	53	81	4	71	1.5	1.3	0.1	5.1
4	Haverigg	100	36	53	7	35	1.5	1.0	0.2	3.3
5	Askam Pier	155	65	89	11	84	1.4	1.3	0.2	5.6
6	Earnse Point	280	94	133	3	117	1.4	1.2	0.0	8.3
7	Fluke Hall	183	68	105	2	79	1.5	1.2	0.0	6.6
8	Rossall Point	286	129	188	10	104	1.5	0.8	0.1	11.8
9	Fairhaven	398	134	220	26	82	1.6	0.6	0.2	13.8
10	Church Scar Lytham	441	112	207	22	55	1.8	0.5	0.2	12.9
11	Marshside	87	33	48	4	30	1.5	0.9	0.1	3.0
12	Ainsdale-on-sea	220	80	117	21	105	1.5	1.3	0.3	7.3
13	Formby	771	140	364	74	74	2.6	0.5	0.5	22.8
14	Leasowe Breakwater	401	134	221	24	162	1.6	1.2	0.2	13.8
15	Hoylake Trinity Street	231	81	121	30	49	1.5	0.6	0.4	7.6
16	West Kirby	368	121	191	18	119	1.6	1.0	0.1	11.9
17	Thurstaston CP	408	99	207	24	100	2.1	1.0	0.2	12.9
18	Hale Head	122	35	71	11	23	2.0	0.7	0.3	4.4
Total		4,689	1,435	2,458	291	1,310	1.7	0.9	0.2	8.5

Map 6: Pie charts at survey points to indicate the proportions of adults, minors and dogs recorded passing.

Questionnaire data

Interview data collected

5.11 In total, 741 interviews were conducted with groups of one or more person during the surveying. The numbers for each survey point are given in Table 10 and were driven by the number of people on site and therefore able to be interviewed. The fewest interviews were conducted at Grune Point with only 9 interviews, compared to 73 at West Kirby. West Kirby was not the busiest location, but had a steady stream of a reasonable number of people and therefore yielded the highest number of interviews.

5.12 Group size (i.e. the number of people with the interviewee, including the interviewee) was on average 1.8 people, with 56% lone individuals. In addition, there was a fairly even split between genders (48:52, % female: male).

5.13 Table 10 also details the number of refusals recorded during the surveys. Overall, 6% of those approached refused to participate in the survey. The highest proportion of refusals was recorded at Askam Pier and Earnse Point (16% refusals). Reasons for this were uncertain; weather was not unfavourable compared to the other survey locations and only a single interviewee mentioned conflicts over access, which can lead to a lack of engagement in a survey.

5.14 We also examined the number of people approached but had already been interviewed (see Table 10). Those groups who had already been interviewed were not asked to participate again, but the number of these were recorded. Repeat approaching of people already interviewed can occur by chance. However, a high number of people already interviewed reoccurring does indicate a regular, often small, user group at the site. Highest proportions of groups approached but already interviewed were recorded at Hale Head (28%), Leasowe Breakwater and Fairhaven (both 27%).

Table 10: Summary of the number of people interviewed, refusing to be interviewed and approached but already interviewed at each survey point.

ID	Location Name	Total number of interviews	Total number of refusals (% of those approached who refused)	Already interviewed after day 1	Already interviewed after 2 days (% of those approached already intervieweed)
1	Barwise Brow	10	0 (0)	1	3 (23)
2	Grune Point	9	0 (0)	0	1 (10)
3	Dubmill Point	38	1 (2)	3	5 (11)
4	Haverigg	23	1 (3)	3	5 (17)
5	Askam Pier	45	10 (16)	3	6 (10)
6	Earnse Point	40	9 (16)	3	9 (16)
7	Fluke Hall	37	3 (7)	0	3 (7)
8	Rossall Point	49	8 (13)	2	3 (5)
9	Fairhaven	54	3 (4)	7	21 (27)
10	Church Scar Lytham	48	4 (6)	3	11 (17)
11	Marshside	26	2 (6)	2	5 (15)
12	Ainsdale-on-sea	48	9 (13)	6	15 (21)
13	Formby	56	1 (1)	4	14 (20)
14	Leasowe Breakwater	49	0 (0)	7	18 (27)
15	Hoylake Trinity Street	44	1 (2)	4	11 (20)
16	West Kirby	73	5 (5)	8	18 (19)
17	Thurstaston CP	61	2 (3)	2	5 (7)
18	Hale Head	31	0 (0)	5	12 (28)
	Total	741	59 (6)	63	165 (17)

Visit type

5.15 Interviewees were asked to describe the nature of their visit on the site today (Q1). Of the 741 interviewees, 717 (96.7%) were visiting on a short trip having travelled directly from home. Remaining interviewees were usually either on holiday, 17 interviewees (2.3%, including those at a second home/owned mobile home), or on a short trip but staying with friends/family, 8 interviewees (1%).

5.16 The dominance of local visitors, travelling directly from home, was fairly consistent at all locations during surveys. Of the eighteen survey points, eight had no interviewees on holiday or staying with friends/family recorded during the surveys (Barwise Brow, Fluke Hall, Fairhaven, Marshside, Ainsdale-on-sea, Leasowe Breakwater, Thurstaston CP, Hale Head).

5.17 The survey point with the smallest proportion of interviewees travelling directly from home was Dubmill Point (78%). At this location, 4 interviewees were staying away from home (17%) and a single interviewee staying with family/friends (4%). At Haverigg, a single interviewee from France was recorded, but otherwise all those on holiday were from the UK, and often local to the North West or Midlands (examined in more detail in postcode analysis).

5.18 At the West Kirby survey point, all interviewees who were not travelling directly from home were staying with family/friends. All other interviewees who were staying away from home were more evenly spread and included; hotels/motels (7 interviewees), caravan sites/campsites (3), bed and breakfast (2) and self catering (2). A single interviewee was staying in a second home.

Activity

5.19 Surveyors asked the interviewees to describe the main activity they were conducting on the site today. These responses were categorised by the surveyors, and are listed by each survey point in Table 11 and shown in Map 7.

5.20 Overall, dog walking was the most popular main activity recorded, conducted by 472 interviewees, approximately 64% of interviewees. The next most common activity was walking (21% of interviewees), followed by groups on an outing with the family (5%). All other activities amounted to the remaining 11% of interviewees, and no single activity group was more than 5% of the overall total interviewees. These smaller groups are listed in Table 11 and includes a grouped class of 'other' consisting of four single interviewees who were conducting the following; drone flying, horse riding, fishing, and a teacher scoping prior to a school trip.

5.21 Dog walking was also the highest ranked activity at each of the survey points, with the exception of Grune Point, where bird watchers were more frequent (4 interviewees, 44%), followed by dog walking (3 interviewees, 33%). Otherwise the relative abundance of different activities could differ markedly, see Map 7. Formby had the lowest percentage of dog walkers, with 30% conducting this activity, and overall had a diverse range of other activities, including 29% walking and 25% on a family outing. Conversely, three of the survey points, Dubmill Point, West Kirby and Ainsdale-on-sea, recorded more than three quarters of interviewees dog walking (79%, 86%, 88% respectively). Other locations of note were Hoylake Trinity Street, were a quarter of interviewees were jogging/power walking, and Hale Head which had the largest proportion of cyclists (10% of interviewees).

5.22 The relative abundance of different activities are summarised by estuary in Figure 14. This again shows dog walking as the most common activity, but there

are some suggested patterns across the different estuaries. Greater numbers of bird/wildlife watchers were noted on some of the more northerly estuaries, and greater number of families at some of the more popular areas (e.g. Sefton Coast) or those closer to urban areas (e.g. Ribble and North Wirral).

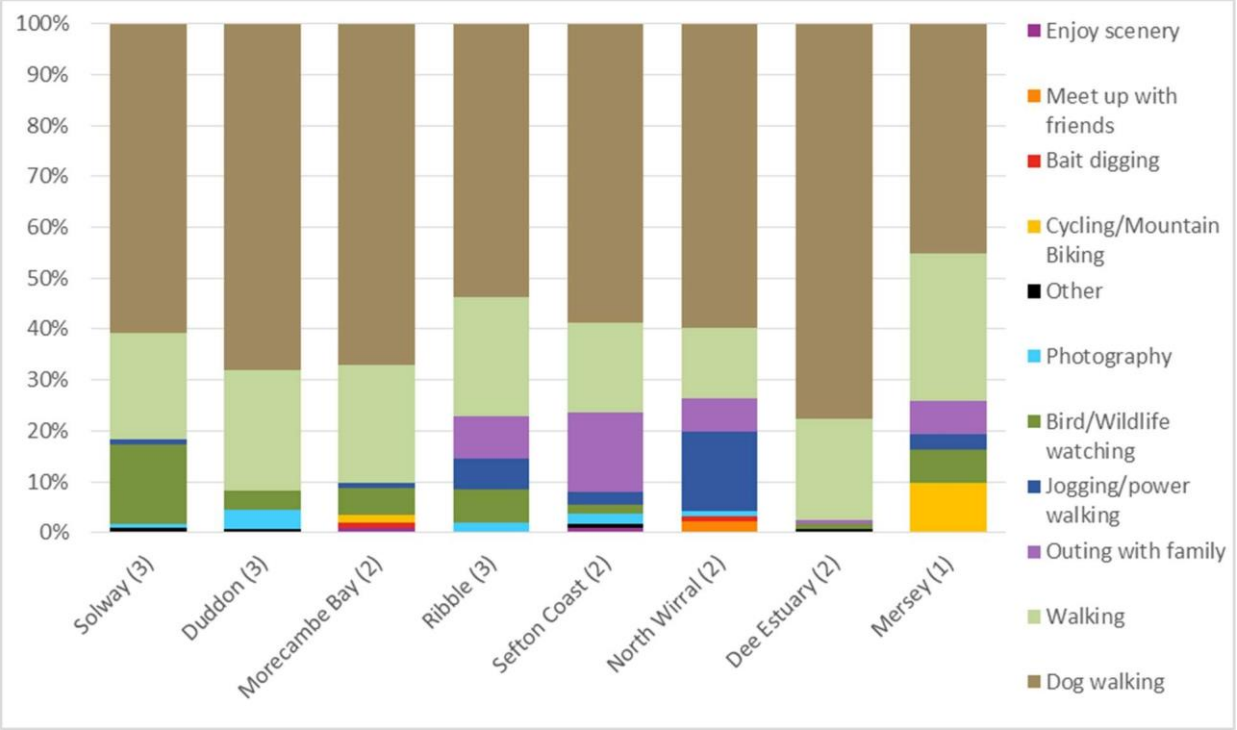


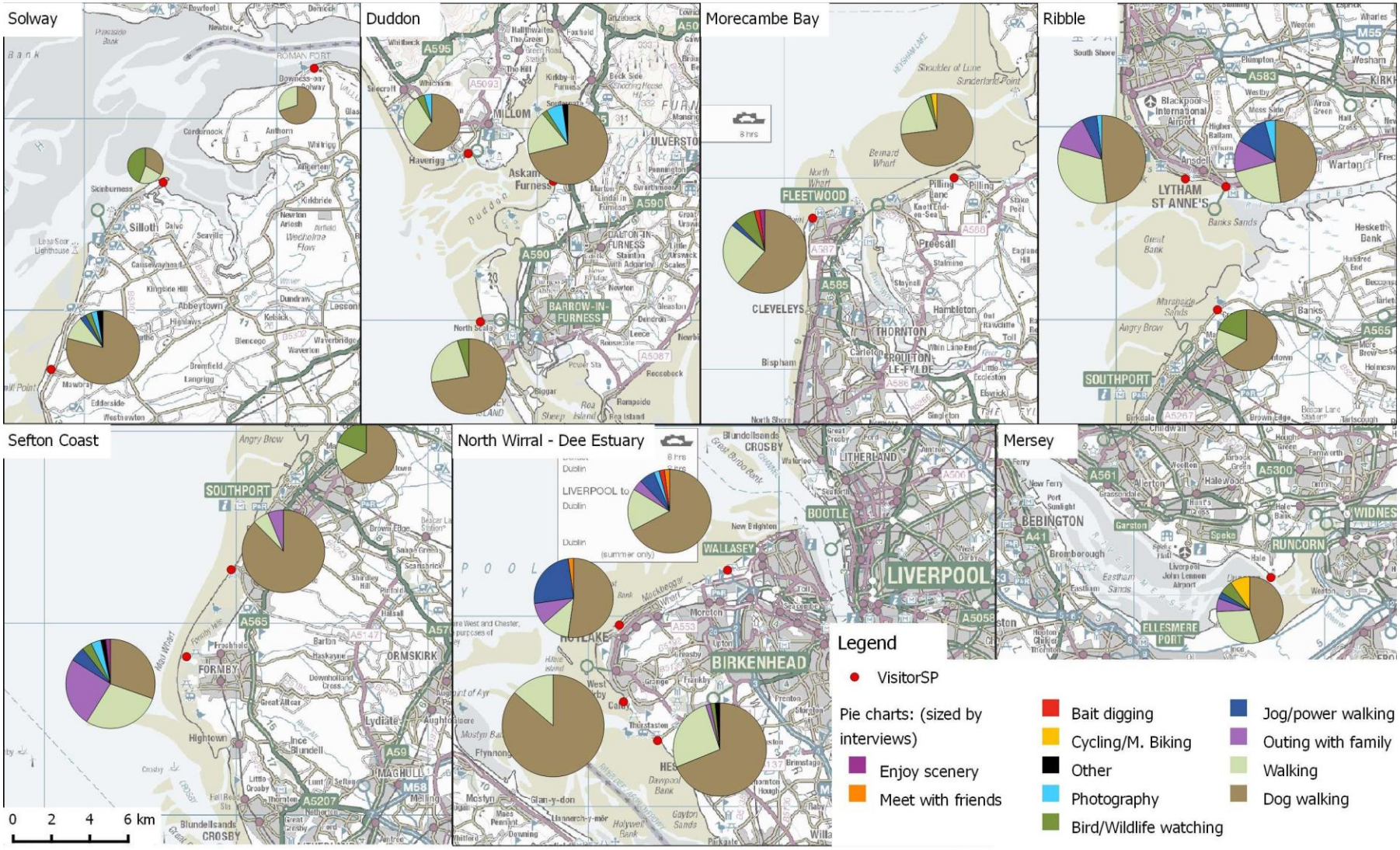
Figure 14: The proportion of activities recorded at each estuary from interviews (Q3). Proportions were calculated for each survey point, then averaged across survey points for individual estuaries such that these were weighted by the number of survey points and not influenced by differences in the number of interviewees between survey points.

5.23 Dog walkers had on average 1.5 dogs per group of dog walkers interviewed. However, dogs recorded within groups were not restricted to those describing their main activity as dog walkers. Dogs were present amongst all other groups with the exception of the following activities; photography, cycling/ mountain biking and the pooled 'other' group. Surveyors also recorded whether dogs were off lead at the time of the interviewing, and at that moment 77% of the dogs were off lead.

Table 11: Percentage of interviewees by activity and survey point, with number of interviewees in brackets (Q3).

ID	Survey Point	Dog walking	Walking	Outing with family	Jog/power walking	Bird/Wildlife watching	Photography	Cycling/M. Biking	Bait digging	Meet up with friends	Enjoy scenery	Other
1	Barwise Brow	70 (7)	30 (3)	0	0	0	0	0	0	0	0	0
2	Grune Point	33 (3)	22 (2)	0	0	44 (4)	0	0	0	0	0	0
3	Dubmill Point	79 (30)	11 (4)	0	3 (1)	3 (1)	3 (1)	0	0	0	0	3 (1)
4	Haverigg	61 (14)	30 (7)	0	0	4 (1)	4 (1)	0	0	0	0	0
5	Askam Pier	71 (32)	18 (8)	0	0	2 (1)	7 (3)	0	0	0	0	2 (1)
6	Earnse Point	73 (29)	23 (9)	0	0	5 (2)	0	0	0	0	0	0
7	Fluke Hall	73 (27)	22 (8)	0	0	3 (1)	0	3 (1)	0	0	0	0
8	Rossall Point	61 (30)	24 (12)	0	2 (1)	8 (4)	0	0	2 (1)	0	2 (1)	0
9	Fairhaven	48 (26)	31 (17)	13 (7)	6 (3)	0	2 (1)	0	0	0	0	0
10	Church Scar Lytham	48 (23)	23 (11)	13 (6)	13 (6)	0	4 (2)	0	0	0	0	0
11	Marshside	65 (17)	15 (4)	0	0	19 (5)	0	0	0	0	0	0
12	Ainsdale-on-sea	88 (42)	6 (3)	6 (3)	0	0	0	0	0	0	0	0
13	Formby	30 (17)	29 (16)	25 (14)	5 (3)	4 (2)	4 (2)	0	0	0	2 (1)	2 (1)
14	Leasowe Breakwater	67 (33)	16 (8)	4 (2)	6 (3)	0	2 (1)	0	2 (1)	2 (1)	0	0
15	Hoylake Trinity Street	52 (23)	11 (5)	9 (4)	25 (11)	0	0	0	0	2 (1)	0	0
16	West Kirby	86 (63)	14 (10)	0	0	0	0	0	0	0	0	0
17	Thurstaston CP	69 (42)	26 (16)	2 (1)	0	2 (1)	0	0	0	0	0	2 (1)
18	Hale Head	45 (14)	29 (9)	6 (2)	3 (1)	6 (2)	0	10 (3)	0	0	0	0
Total		64 (472)	21 (152)	5 (39)	4 (29)	3 (24)	1 (11)	1 (4)	0 (2)	0 (2)	0 (2)	1 (4)

Map 7: Pie charts at survey points to indicate the proportions of activities recorded from interviews.



Visit duration

5.24 Interviewees were asked to describe how long they had spent/would spend at the site on their visit, and the responses were categorised by the surveyor to set classes.

5.25 Overall, we observed that just under half of interviewees (46%) were visiting for between 30 minutes and 1 hour. Around 30% of interviewees were visiting for 1 to 2 hours and 16% for less than 30 minutes. Very few interviewees were conducting long visits, with only 8% visiting for more than 2 hours, including only 2.5% (19 interviewees) visiting more than 3 hours.

5.26 However, there were some notable differences between survey points, as shown in Figure 15. The highest number of short visits of less than 30 minutes were recorded at Barwise Brow (50% of interviewees), although this site did include some long visits and was based on only 10 interviewees.

5.27 Figure 15 ranks sites by conducting a rudimentary calculation of the average time spent on site for each survey point. The classes used to categorise responses can be converted to approximate duration in minutes and averaged across interviewees (Values used; 'Less than 30 minutes' =20 mins, 'Between 30 minutes and 1 hour' = 45 mins, '1-2 hours' = 1.5 hrs, '2-3 hours' = 2.5 hrs, '3-4 hours' = 3.5 hrs and '4 hours +' = 4 hrs).

5.28 Sites such as Askam Pier, Ainsdale-on-sea, Earnse Point and Fluke Hall ranked high in their averaged estimated duration (see Figure 15), with short visits typical, with at least 80% of interviewees visiting for less than 1 hour. Conversely Grune Point, Formby and Hale Head, which were ranked lowest (Figure 15), had no interviewees visiting for less than 30 minutes and the vast majority of interviewees visiting for 1 or more hours.

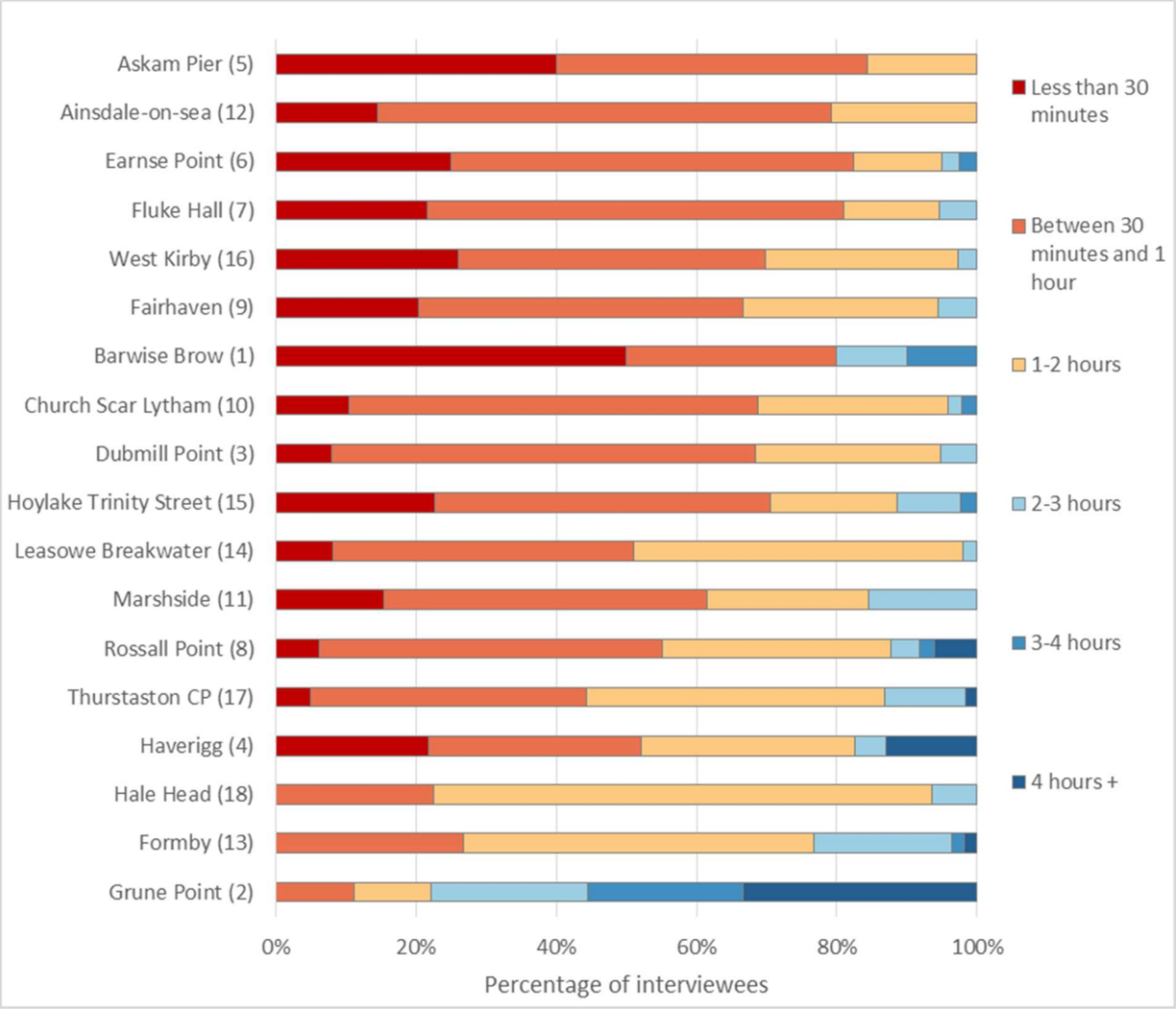


Figure 15: Interviewees' responses to the question 'how long have you spent' at each site, shown as percentage of interviewees for each site. Locations sorted by estimated average time spent, sorted from shortest average visit (top) to longest (bottom). Numbers in brackets show the survey location ID.

5.29 Considering the data grouped by estuary the differences were subtler. Visits on the Duddon were usually quite short including the highest proportion of very short visits (31% of interviewees, less than 30 minutes). From the estimated average durations we observed that visits to the Duddon were the shortest, lasting on average around 50 minutes. Averaged visit times for the Dee Estuary, North Wirral, Ribble and Morecambe Bay were all estimated to be around 60 minutes, around 70 minutes on the Sefton Coast and Solway, and the longest, around 80 minutes, on the Mersey.

5.30 Differences in the visit times are driven by a number of factors, such as the size of the site, facilities available and also the activities being conducted. Dog walkers and joggers/power walkers most frequently spent 30 mins to 1 hour on

the site, whereas walkers and family groups were typically visiting for 1-2 hrs. and bird/wildlife watchers 2-3 hours.

Visit frequency

5.31 Surveyors also asked interviewees to think about how frequently they visited the site. Responses were categorised with reference to the approximate number of visits annually (e.g. '2 to 3 times a month' estimated as c.15-40 visits a year). For comparison, we again calculated estimated averages by assigning values to the visit frequency classes ('Daily' =365 visits per year, 'Most days' = 200, '1 to 3 times a week' = 110, '2 to 3 times per month' =27.5, 'Once a month' =10.5, 'Less than once a month' =3.5, 'First visit' =1). This is a rudimentary estimation and is used with caution, but helps to give a feel for the likely number of visits per year.

5.32 Most interviewees suggested they visited at least daily, with overall 33% of all interviewees falling into this category. It should be noted that this could include those individuals who visited more than once a day. The next highest proportion of interviewees was those categorised as visiting 1 to 3 times a week, (23% of interviewees), followed by those visiting 'most days' (17% of interviewees). The remaining one quarter of interviewees visited infrequently, ranging from those visiting 2 to 3 times per month, to those on their first visit to the site. Just 4% of the interviewees were on their first visit to the site.

5.33 There were no strong differences between estuaries, as most differences were between the individual survey points, as shown in Figure 16. The top three ranked sites in Figure 16, Askam Pier, Ainsdale-on-sea and West Kirby, had over 50% of interviewees visiting at least daily, and it was estimated that an interviewee made on average around 250 visits per year to the three locations. All other survey locations had relatively few very frequent visitors and a greater relative number of regular (e.g. 1-3 times a week) or infrequent (e.g. once a month or less) visitors. At most survey points the average interviewee's visit frequency was estimated at around 100- 200 visits per year. Only at the lowest ranked site, Grune Point, was this radically different with an estimated average of around 10 visits per year by an interviewee. At this location there was an even split with one third of the nine interviewees each visiting for '2 to 3 times per month', 'less than once a month' and on their 'first visit'.

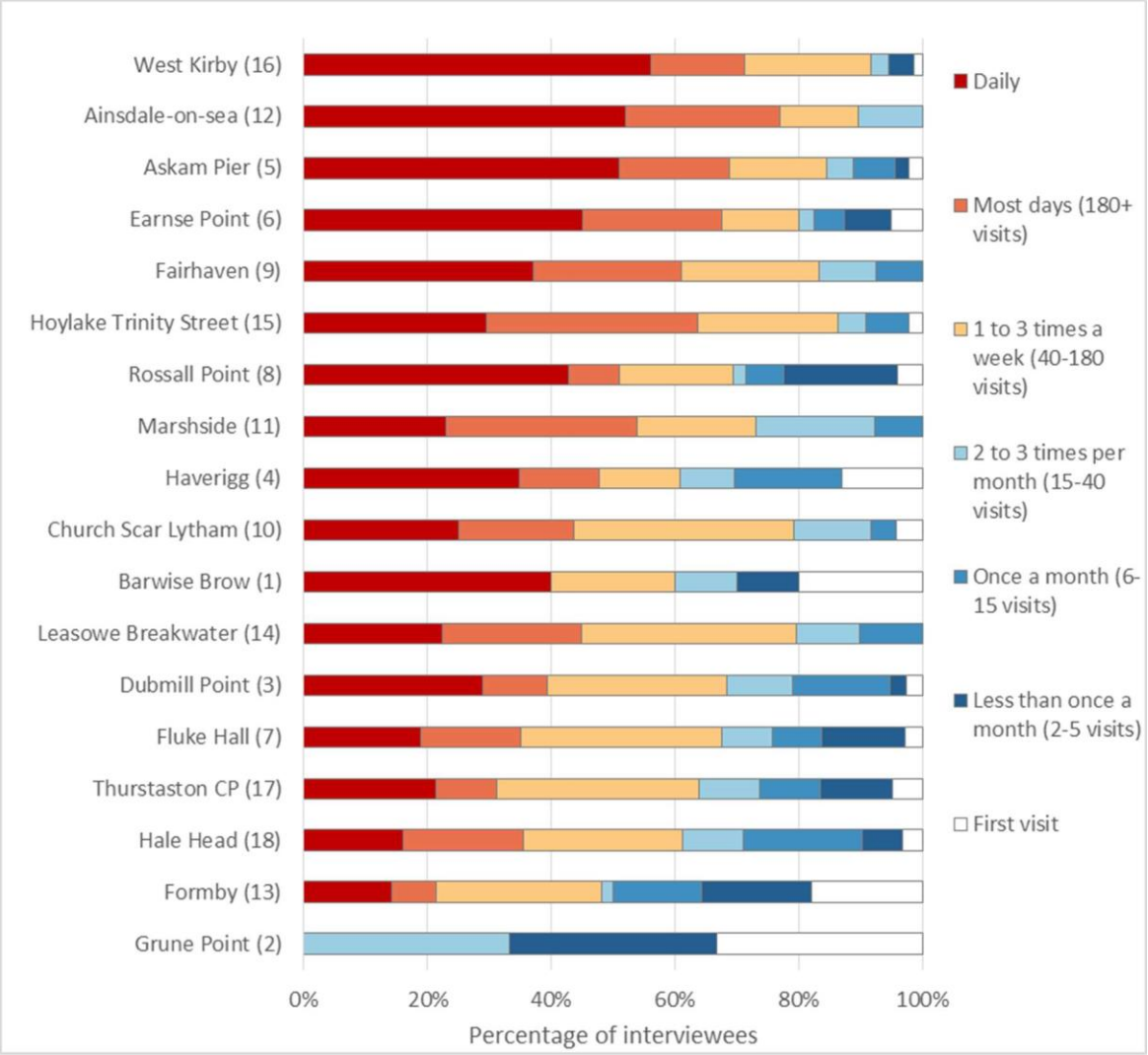


Figure 16: Interviewees' responses to how frequently they visited each site, shown as percentage of interviewees for each site. Locations sorted by estimated average visit frequency, sorted from sites with frequent visitors (top) to those with most infrequent (bottom).

5.34 As noted for visit duration, one of the key factors in this will be the different activities being conducted. Dog walkers were the most regularly visiting group with 50% visiting daily and an estimated average of around 240 visits per year for each interviewee. This compared to walkers where the largest class (32%) was those visiting 1 to 3 times a week and an estimated average of 85 visits per year. Those on a family outings were estimated to be making 40 visits per year.

Pattern of visit

5.35 Interviewees were asked if there were any particular times of day or certain times of the year at which they visited more. For both of these separate questions (Q6 and Q7), multiple times of day or year could be selected. Across all survey locations, 88% of the interviewees responded that they visited equally

across the whole year. Of those who did select a season, winter and summer were the most popular (5% and 3% respectively).

5.36 There was greater variation in the times of day selected, as shown in Figure 17. Figure 17 shows that mornings were the most commonly selected times of day, with most interviewees visiting in early morning, before 9 am, (25%) or late mornings, between 9 am and 12 noon (23%). Although it should be noted that from tally data, that there was little indication that this was as overwhelmingly the case on the survey days. Also, around a third (32%) of respondents, indicated that this varied, or they did not know.

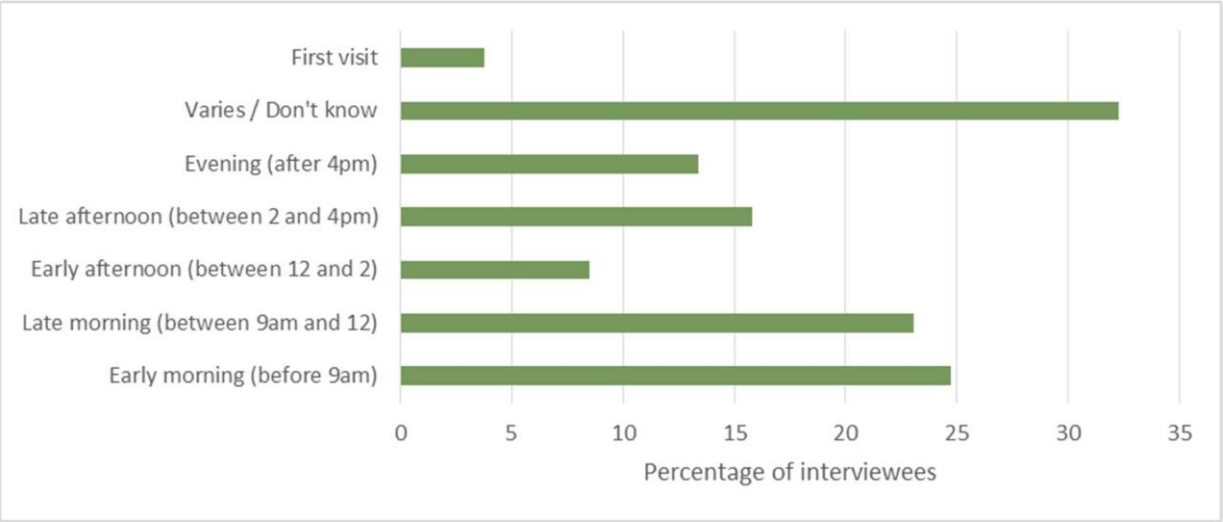


Figure 17: The percentage of interviewees selecting particularly times of the day during which they most visit. Note that multiple categories could be selected.

Transport

5.37 The majority of interviewees, 65%, arrived by car, compared to 33% on foot and the remaining 2% by bicycle or public transport. Locations where the percentage on foot exceeded the percentage by car were Barwise Brow (60% on foot), Haverigg (57%), Askam Pier (78%), Fairhaven (54%), Church Scar Lytham (71%) and Hoylake Trinity Street (68%).

Postcodes

5.38 As part of the surveying, interviewees were asked for their full home postcode. Of the 741 interviewees, 723 (98%) gave a full, valid postcode which could be matched to a database[5], allowing linear (Euclidean) distances to be extracted between the home postcode and the survey location.

[5] National postcode data, Postzon from Royal Mail.

5.39 The distribution of all postcodes is shown in Map 8, and show the difference in the distances travelled by those visiting from home and those staying away from home. Interviewees visiting directly from home typically lived within a short radius of the survey point (mean, 5.3 km, 699 interviewees), half of these interviewees lived within 1.9 km (median value) and three quarters within 5.2 km (Q3 value). Most of these lived along the coast, within easy access of the coast (e.g. clear line along the A595) or within highly populated areas (e.g. Liverpool).

5.40 For those on holiday in the area or alternatively staying with friends/family this distance was much greater (mean 160.3, 128.7, holiday and friends/family respectively), with half living within 123 km and 103 km for holiday makers and those staying with friends/family respectively. These individuals often lived in the Midlands and in the south of Northern England (see Map 8). Statistical tests highlight the clear difference in the distances between the different visitor types ($KW, H=66.79, df=2, p<0.001$).

Map 8: The distribution of all postcodes (a) and at a smaller scale along the coastline.

5.41 The differences in distances travelled are also shown separately for individual survey point locations in Table 13. This showed largest distances were taken by interviewees at Grune Point of whom half lived within 31 km of the survey point (median value). This compares to just 0.3 km for those interviewees at Askam Pier. The median values presented for each survey point in Table 13 were significantly different when considering both all interviewees (n=723. KW, H=220.76, df=17, p<0.001) and those travelling from home only (n=699. KW, H=240.32, df=17, p<0.001).

5.42 Map 9 and 10 graphically show the geographic areas covered using convex hulls around the 75% nearest home postcodes for interviewees who were travelling from home (e.g. excluding those on holiday/visiting family or friends). It should be noted these are roughly approximate to 3rd Quartiles, but where samples are small these can be different (e.g. Barwise Brow).

5.43 The most unusual of all the convex hulls is Grune Point, which shows no interviewee home postcodes in close proximity to the survey point. All other convex hulls covered areas in close proximity to the survey location and then varied in their distance beyond the survey location (note varying scales in maps 9 and 10). Largest distances away from the survey point shown in Maps 9 and 10 were recorded at Grune Point and Dubmill Point (points 2 and 3). These cover some large rural areas and therefore can have wider 'catchments' than more urban areas (e.g. Fairhaven and Church Scar Lytham around Lytham St Anne's; and Leasowe Breakwater, Hoylake Trinity Street and West Kirby on the Wirral). Other sites can have much wider draws, such as Formby, as would be expected for a well promoted part of the coastline.

5.44 Summarising sites into the eight estuaries showed significant differences in the distances between estuaries (n=723. KW, H=134.67, df=7, p<0.001). (Median values as follows: Dee Estuary 2.9 km, Duddon 0.5 km, Mersey 5.2km, Morecambe Bay 3.3 km, North Wirral 1.5 km, Ribble 1.3 km, Sefton Coast 2.5 km, Solway 12 km).

5.45 One of the factors regarding this will be the kinds of activities being conducted and how far individuals are likely to travel to the coast for respective activities. Table 12 shows a summary table of the distances between the survey point and home postcode separated by the activity of interviewees. Bait diggers and joggers/power walkers often lived within close proximity to the survey point, with half within 2.8 and 1.4 km respectively. Largest distances were typical for those enjoying scenery (median, 95.7 km) and bird/wildlife watching (13.1 km). Dog walkers typically lived within 1.7 km. Again this showed significant differences (n=699. KW, H=74.11, df=10, p<0.001).

5.46 The distance to the survey point is also an important factor in how frequently interviewees visit the location. Daily visitors lived in close proximity, with half within 1 km and three quarters within 1.9 km.

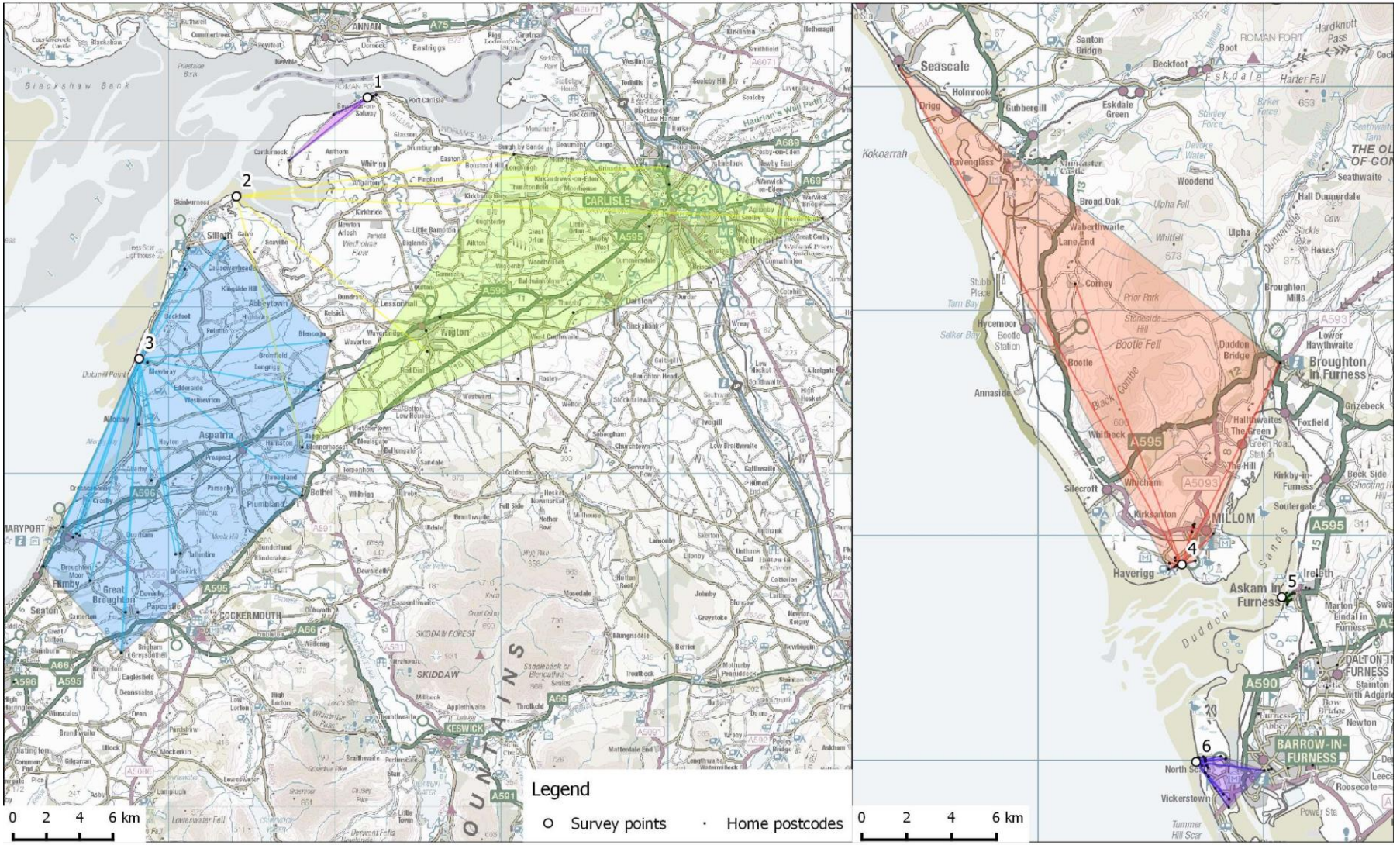
Table 12: Summary of the distances (km) from home postcode to survey point recorded for each activity. Table sorted by the mean value.

Activity	n	Mean (±SE)	Median	Maximum
Jogging/power walking	29	2.2 (0.6)	1.4	16.5
Bait digging	2	2.8 (1.2)	2.8	4.0
Cycling/Mountain biking	3	6.5 (1.0)	6.1	8.3
Dog walking	460	6.6 (1.2)	1.7	341.5
Outing with family	39	7.2 (1.1)	3.4	28.5
Other	4	10.3 (3.4)	9.7	19.1
Meet up with friends	2	11.6 (2.9)	11.6	14.5
Walking	148	18.6 (4.1)	3.5	363.4
Photography	11	25.4 (13.4)	2.7	125.4
Bird/Wildlife watching	23	27.1 (10.1)	13.1	235.8
Enjoy scenery	2	95.7 (79.8)	95.7	175.5
Total	723	10.1 (1.2)	2.1	363.4

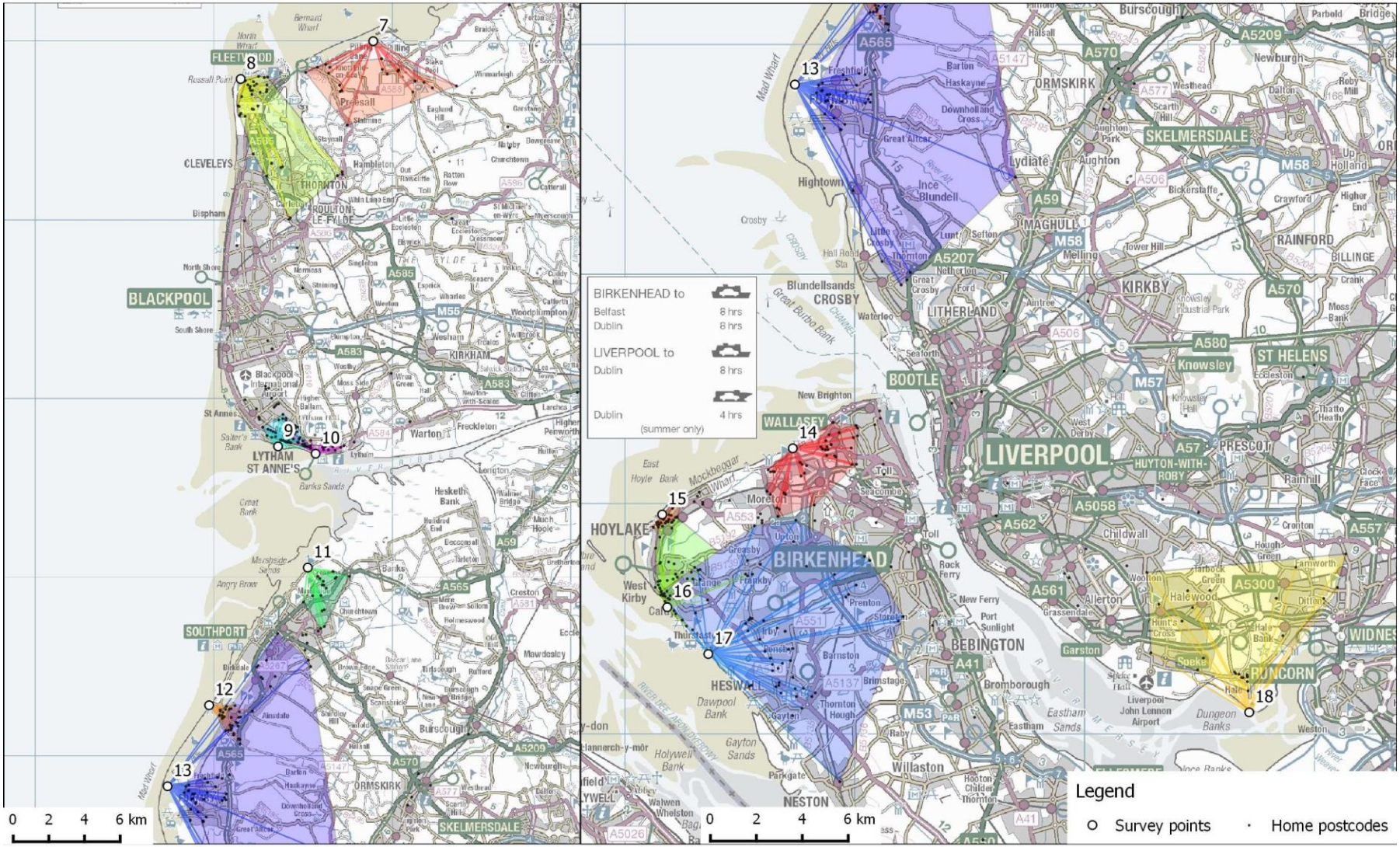
Table 13: Summary of distances (km) between interviewee's home postcode and the survey location for each survey point. Top and bottom three values for each column of distances are highlighted in bold.

ID	Survey Point Name	All interviewees (723)				Interviewees from home only (699)			
		n	Mean (±SE)	Median	3rd Quartile	n	Mean (±SE)	Median	3rd Quartile
1	Barwise Brow	9	8.5 (3.9)	2.3	16.2	9	8.5 (3.9)	2.3	16.2
2	Grune Point	8	56.1 (26.3)	30.7	54.9	7	30.4 (6.4)	26.0	46.7
3	Dubmill Point	37	19.4 (6.7)	11.5	19.0	36	12.9 (2.0)	11.3	18.1
4	Haverigg	22	31.9 (16.4)	1.7	16.4	18	3.5 (1.5)	0.6	1.9
5	Askam Pier	43	9.7 (8.4)	0.3	0.6	42	1.3 (0.5)	0.3	0.6
6	Earnse Point	40	13.1 (8.9)	0.7	3.5	38	4.2 (1.5)	0.6	3.3
7	Fluke Hall	33	5.7 (1.2)	3.5	7.7	33	5.7 (1.2)	3.5	7.7
8	Rossall Point	48	17.7 (4.9)	2.0	23.6	45	11.0 (2.6)	1.9	8.8
9	Fairhaven	54	1.7 (0.3)	1.0	1.9	54	1.7 (0.3)	1.0	1.9
10	Church Scar Lytham	48	6.1 (2.9)	1.0	2.2	46	2.1 (0.5)	1.0	1.8
11	Marshside	25	4.6 (1.2)	2.0	4.4	25	4.6 (1.2)	2.0	4.4
12	Ainsdale-on-sea	48	2.2 (0.2)	1.8	2.7	48	2.2 (0.2)	1.8	2.7
13	Formby	56	18.6 (5.1)	3.9	15.3	51	7.8 (1.2)	3.3	11.4
14	Leasowe Breakwater	49	2.6 (0.2)	2.2	3.3	49	2.6 (0.2)	2.2	3.3
15	Hoylake Trinity Street	44	3 (1.1)	0.6	1.4	43	2.1 (0.7)	0.6	1.1
16	West Kirby	70	9.8 (3.9)	1.8	5.3	66	2.7 (0.3)	1.7	4.4
17	Thurstaston CP	58	10.5 (2.5)	4.5	8.8	58	10.5 (2.5)	4.5	8.8
18	Hale Head	31	5.4 (0.6)	5.2	8.3	31	5.4 (0.6)	5.2	8.3

Map 9: Distribution of postcodes in northern areas, convex hulls indicate 75% nearest postcodes for interviewees visiting from home.



Map 10: Distribution of postcodes in southern areas, convex hulls indicate 75% nearest postcodes for interviewees visiting from home.



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Choice of site

5.47 Interviewees were asked to think about the reasons they chose to visit this site rather than another local site. All given responses were categorised by the surveyor, with multiple reasons accepted. From these multiple reasons the surveyor followed up this question by asking the respondent to select a single main reason which had the most influence on their site choice.

5.48 Figure 18 shows the most commonly selected main reason was that the site was 'close to home' (184 interviewees, 25%), followed by the site being 'near the coast/water' (13%), the 'scenery/views' (10%) and 'good for dog/dog enjoys it' (8%). The other reasons given largely reflected the frequency of main reasons (see Figure 18), with the highest percentage of interviewees (25%) listing the 'scenery/views' in these multiple reasons, followed by 'near coast/water' (23%).

5.49 The pooled class of 'other' ranks relatively high in Figure 18, and suggests reasons were quite diverse. Many of these reasons related to the site being close to other locations (e.g. friends/family or shops) and the desire for a change of scenery. They also highlighted the importance of the areas often being large open spaces, especially for useful for dog owners (e.g. allows dogs to run, but can still be seen, doesn't have to interact with other dogs and few animals, such as sheep, to chase).

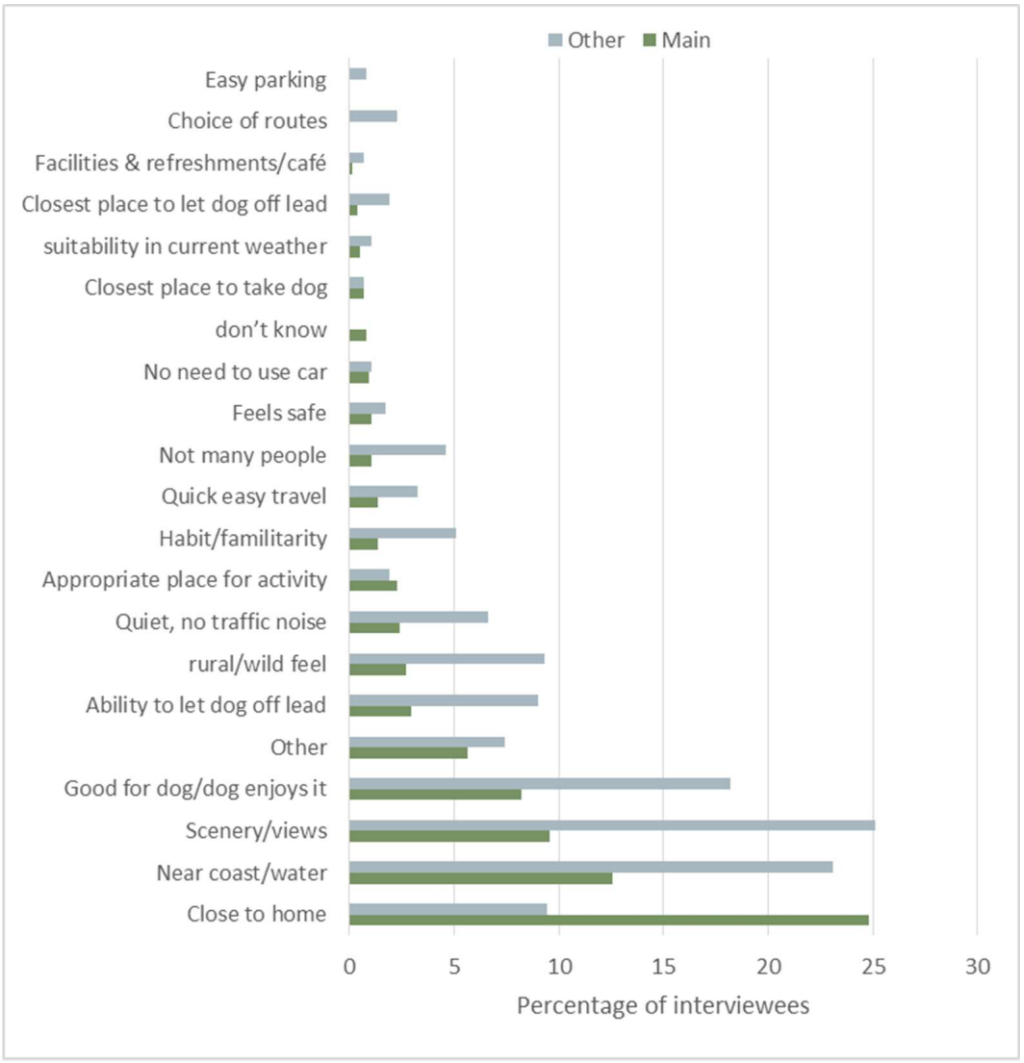


Figure 18: Reasons for interviewees visiting the site, categorised with main reasons (single choice per interviewee) and other reasons (multiple reasons per interviewees allowed) shown as percentages of all interviewees

Routes

5.50 As part of the questionnaire process surveyors asked interviewees to indicate the route they had taken (or would take) for their visit on a paper map. These were then digitised in GIS and allowed route lengths to be calculated and these to be visualised, as shown in Maps 11 and 12.

5.51 Route lengths were significantly different between the individual survey points (KW, $H=176.96$, $df=17$, $p<0.001$), with the three longest median route lengths at Grune Point (5.5km), Haverigg (5.2 km) and Thurstaston Country Park (4.6 km). Shortest route lengths were typical at Barwise Brow (median, 1.4 km) Askam Pier (2.1 km) and Fairhaven (2.2 km). Summarising route lengths by estuary rather

than survey point also showed significant differences (KW, H=57.41, df=7, p<0.001), as shown in Table 14.

Table 14: Summary of the route lengths (km) recorded at each estuary.

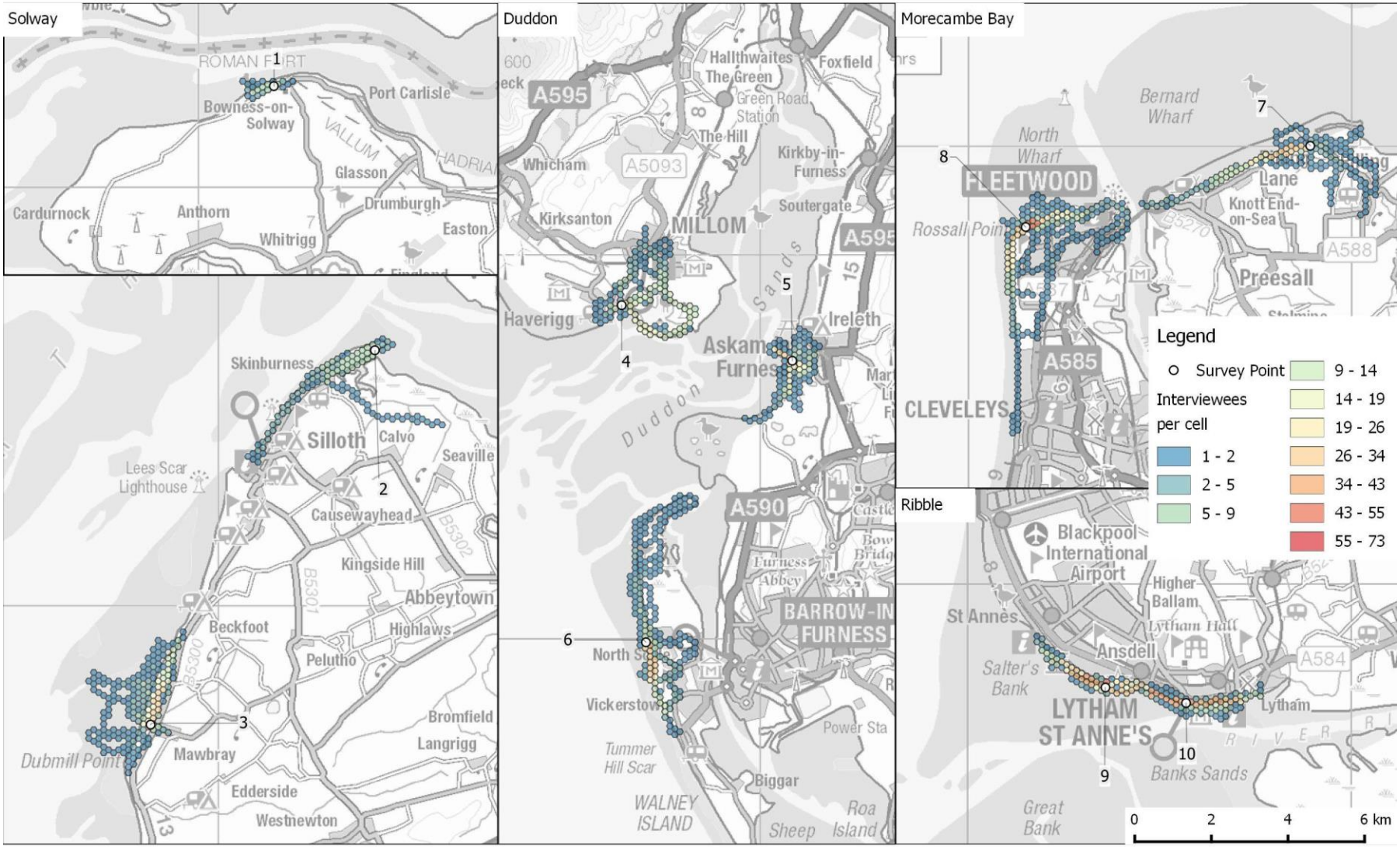
Estuary	n	Average route length	Median route length	Miminum route length	Maximum route length
Solway	57	3.7	3.3	0.2	9.8
Duddon	108	3.2	2.6	0.4	9.6
Morecambe Bay	86	3.7	3.2	0.7	12.2
Ribble	128	3.5	2.8	0.4	11.9
Sefton Coast	104	4.2	3.8	1.3	12.6
North Wirral	93	2.4	2.2	0.4	8.7
Dee Estuary	134	3.8	3.4	0.4	13.2
Mersey	31	3.3	2.8	1.7	7.0
Total	741	3.5	3.0	0.2	13.2

5.52 To confirm the accuracy of the results we asked interviewees if the route was fairly typical of their usual visit. Of the 741 interviewees, 79% said their route was of normal length, and around10% suggesting it was shorter than normal (compared to only 1% longer than normal). Most interviewees' routes were not affected by anything, but around 21% suggested their route was adapted because of the activity being undertaken (e.g. presence/absence of dog or family). Weather and tide were also considerations and influenced around 11% and 4% of interviewees (almost always to shorten routes).

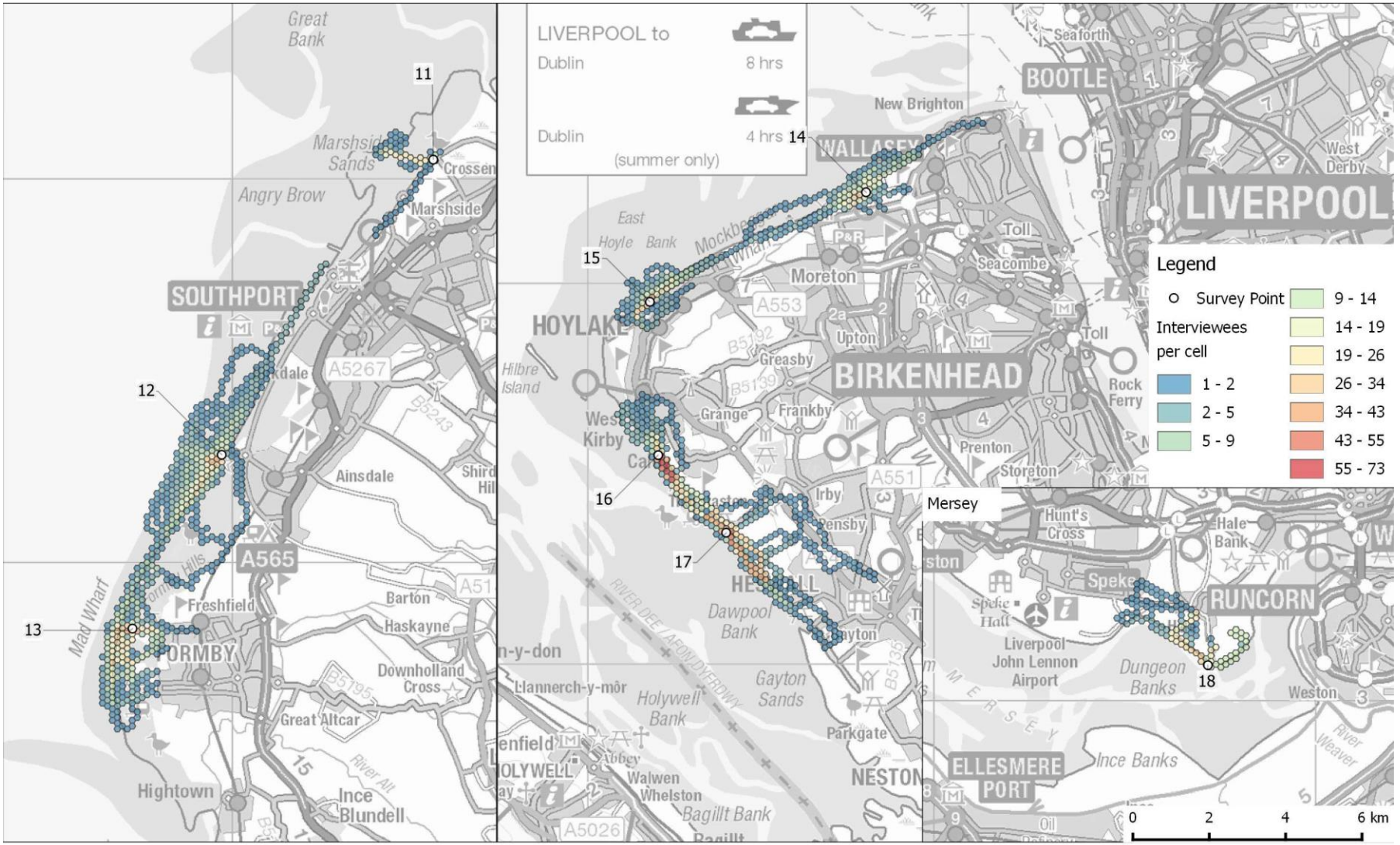
5.53 Route lengths are driven by a range of factors, including the length of coast accessible, but also how this joins up with other accessible areas. For example at Haverigg and Thurstaston the coastline was only part of the route, and interviewees routes often included walking into towns/villages or around the country park in these two examples.

5.54 Survey points on the North Wirral, Southport and Dubmill Point show many interviewees' routes recorded walking out onto the intertidal sand/mud. However, this may also be the case at other locations and will be highly dependent on the tide state during surveying.

Map 11: Density of interviewees routes mapped for northern survey points. Maps show a 150m hexagonal grid and all on the same scale.



Map 12: Density of interviewees routes mapped for southern survey points. Maps show a 150m hexagonal grid and all on the same scale.



Planning visits

5.55 Interviewees were asked about what information sources they used to plan their visit. Just 14% of (107 interviewees) suggested they accessed some form of information before their visit.

5.56 Websites were the most common resource used and 38 interviewees (35% of those accessing information and 5% of the overall interviewees) stated they looked up information on a website before visiting. Other common resources included smartphone apps, (30 interviewees), maps (17 interviewees), word of mouth (10 interviewees) and leaflets (9). A single interviewee used social media (in this case Facebook) to check for information before visiting.

5.57 Interviewees staying away from home were more likely to be checking these resources. Just under a third of all interviewees staying away from home checked websites (29%) or maps (29%), compared to less than one in twenty for websites (5%) or maps (2%). Those interviewees staying with friends or family were the only group most likely to use word of mouth as their information source (2 interviewees, 25%).

5.58 Most people accessing information were looking up weather or tide information (62% of the information being sought), and there was a fairly even split between those using a website or smartphone app for this information (Table 15). Table 15 also shows that for general site information most people were using websites (e.g. googling the site name, National Trust website, Visit Cumbria) and occasionally leaflets.

Table 15: The number of interviewees accessing different types of information before visiting and the sources used for this information

Information type	Information medium		
	Website	Apps	Leaflets
Bird information/ID	3	1	1
General site information	13	2	3
Weather information	10	11	0
Tide information	12	13	2
Suggested walks	-	2	2
Personal tracking	-	2	0

Awareness and behaviours

5.59 The questionnaire asked interviewees if they were aware of any designations or environmental protection that applied to the stretch of coast. Overall 38% of

interviewees answered that they were aware (278 interviewees), and 60% that they were not aware (442). However, there were large differences between locations, and there seemed a pattern across estuaries, as shown in Figure 19.

5.60 The awareness was highest on the Solway, Dee and Duddon, with around three quarters of interviewees answering 'yes', that they were aware (Figure 19). Lowest awareness was at the Ribble, Sefton Coast and North Wirral survey locations. However, for those who suggested they were aware of designations/ environmental protection, almost half (49%, 136 out of the 278 interviewees) were not able to give a clear response as to what the designation was.

5.61 When asked to think about the species or habitats present on the site which were vulnerable to impacts of recreation most interviewees, 63%, were unable to name any. Interviewees who did suggest a species/habitat were allowed to suggest multiple species or habitats and most suggested breeding birds (41%) or wintering birds (42%) as vulnerable.

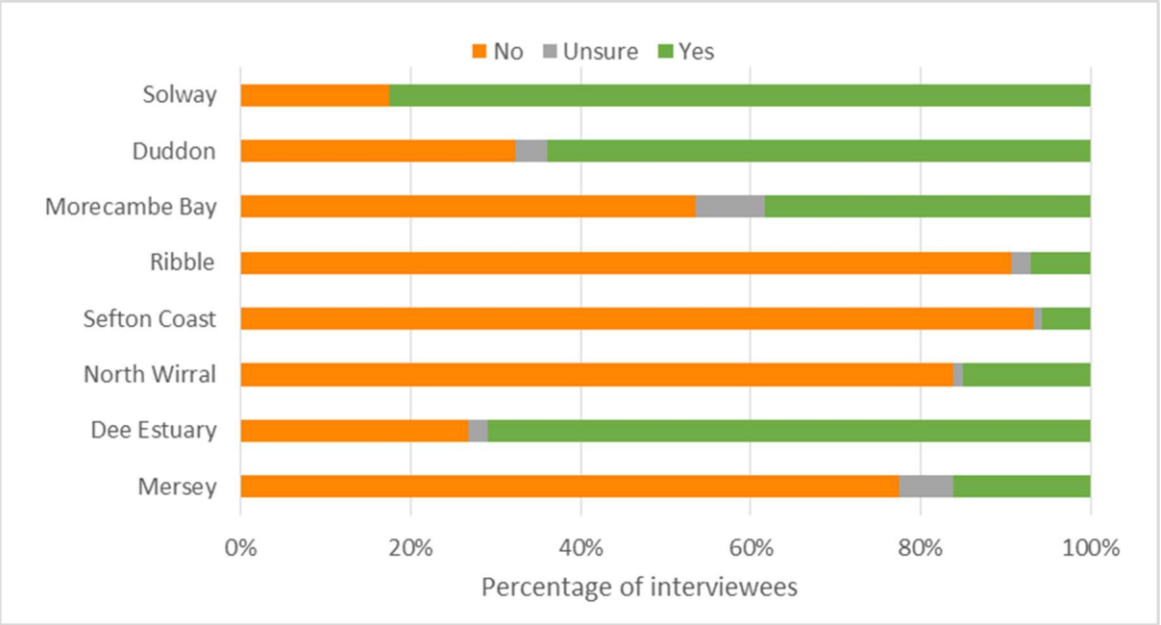


Figure 19: The percentage of interviewees' responses to the question "are you aware of any designations or environmental protection that apply to this part of the coast?" shown separately for each estuary.

5.62 For a subset of interviewees, who had indicated having their dog off lead was important to them (Q11), we asked under what circumstances they would put a dog on a lead. This question was therefore only asked of a total of 88 interviewees and responses are summarised in Table 16.

5.63 The majority of interviewees indicated that they would put their dog on a lead if a horse rider were approaching (83%, Table 16). In addition, most interviewees would also put their dog on a lead if a cyclist or family/children were approaching (63% and 65% of interviewees). If another off-lead dog was

approaching or a flock of birds was ahead around a third of interviewees said they would put their dog on a lead (30% and 31%). However, for this question regarding a flock of birds ahead, the largest proportion (17%) were unsure or did not know. This suggests this was the most variable response and perhaps is dependent on a wide range of factors about the situation.

Table 16: The percentage of interviewees who were asked whether they would or would not put their dog on a lead in response to the listed events. This question was asked of 88 interviewees, selected as those for whom the dog being off lead was important. Events are sorted by the order they were asked. Note that percentages do not always add up to 100%, as those who were unsure/did not know are not shown, but included in the calculation.

Event	% of interviewees asked would put dog on lead	% of interviewees asked would not put dog on lead
Horse rider approaching	83	9
Family/children approaching	65	31
Cyclist approaching	63	31
Flock of birds ahead	31	52
Another dog off lead approaching	30	57

6. Discussion

6.1 In this section, we provide context for the results and consider the limitations in terms of the findings. Implications of the results are discussed in section 7.

Limitations

6.2 Impacts of disturbance to birds are complex and it is often difficult to understand the implications in terms of population consequences (Gill, Norris & Sutherland 2001; Beale & Monaghan 2004a). While behavioural responses can be extreme, for example when large flocks of birds are flushed, a range of studies have shown that such responses may not necessarily reflect the true impact of disturbance, for example birds that are well-fed may be more likely to leave an area when disturbed than those less well fed (Beale & Monaghan 2004b). While behavioural responses (such as taking flight) have consequences for the birds (West et al. 2002), disturbance can have a range of other impacts. For example, birds may avoid areas with high levels of access, such that the effect is similar to habitat loss (Summers, McFarlane & Pearce-Higgins 2007) and a range of studies have shown physiological effects of disturbance, even when no behavioural response is apparent (Weimerskirch et al. 2002; Beale & Monaghan 2005; Walker, Boersma & Wingfield 2005; Thiel et al. 2008).

6.3 In this study, we have focussed on the effects of disturbance on bird distribution and on the behavioural response of birds to the presence of people. We have not collected data on physiological effects, nor have we tried to predict the impacts of disturbance in terms of population effects. As such the full scale of disturbance impacts have not been presented. In terms of the behavioural response, it is important to note that birds may avoid areas with high disturbance levels or perceived risk (for example in the Pink-footed Geese studied by Gill 1996), and the level of behavioural response needs to be considered in the light that birds are potentially already distributed so as to avoid disturbance.

6.4 Around three survey points were selected for most estuary sites and as such the data do not provide comprehensive coverage of each estuary. The survey points were however selected to represent locations where access and birds coincide and, through discussion with local Natural England staff, the locations were chosen to provide information on locations where there are concerns regarding recreation impacts. Locations that have not been included are not, however, necessarily ones without issues, as the number of survey points was constrained by budget. As such the results should be considered to provide a snapshot from selected locations where disturbance issues are perhaps particularly acute.

6.5 Survey visits were timed to coincide with times when birds and people were thought most likely to coincide. As such the samples are not random samples and do not necessarily provide a truly representative account of the access at the particular survey point. For example, some activities may be tide dependent and therefore not necessarily captured in our surveys. Furthermore, with ten visits for the bird survey work and a focus on a survey area based on a 500m arc, rare or sporadic activities may not necessarily be recorded. Some activities – such as wildfowling, beach buggies, land yachts, paragliding etc. – are likely to be relatively uncommon, at low densities and patchy in their distribution. Such activities may not necessarily be picked up with our survey methodology. At Thurstaston, for example, disturbance from hang-gliding and parachutes occurs in particular conditions, at low tide with light winds from the south-west (Matthew Thomas pers comm.) and yet has not been picked up in this survey.

6.6 There were some differences between the visitor data and the bird data, for example Formby was the visitor survey point with the highest level of access whereas the bird disturbance work recorded the highest access levels at Church Scar, Lytham and Fairhaven. These differences relate to slightly different survey points and also the weather. The bird survey points were located where there was a good vantage point and clear sight of the areas used by birds. Visitor survey locations tended to be at access points, car-parks or major path junctions where it is easy to intercept people. At Formby, the visitor survey work was conducted by the car-park whereas the bird survey work was conducted a little away from the car-park, at a location where visitor levels had clearly dispersed. Visitor survey work at both Church Scar and Fairhaven did include some sessions with rain which may also have resulted in lower visitor numbers on those dates.

6.7 A further point is that our fieldwork was focussed on the midwinter period and therefore does not take into account the periods in the late summer, autumn and spring when high numbers of birds can be present at a time when access is potentially different. For example, in milder weather visitors would be expected to perhaps spend longer on-site, potentially access different areas and undertake different activities (such as watersports).

7. Implications for visitor management & future monitoring

7.1 In this section, we consider the implications of the results. We provide an overview of key metrics for each survey point, and then consider at which sites disturbance is potentially an issue. We then consider possible options for management and future monitoring.

Overview of results by site

7.2 We summarise the key metrics gathered in the bird disturbance fieldwork and visitor surveys in Table 17. This is intended to provide a site-by-site overview, bringing results from the two surveys (bird disturbance and visitors) together and allowing selected metrics from the two surveys to be compared across sites.

7.3 The shading in the table reflects the values, with the red shading indicating values that potentially indicate more disturbance or impacts from disturbance, for example red indicates sites with more people or sites with fewer birds.

Table 17: Overview of data by survey point. Red shading indicates values in each column that may indicate more disturbance or disturbance impacts, i.e. higher numbers of people, more dogs off leads, low numbers of birds etc.

Survey Point		Bird disturbance fieldwork results							Visitor Survey results			
		Total birds (all sp., all counts)	Total people	% people on intertidal	No. dogs off lead	% dogs off lead	% observations within 200m of birds	Total birds flushed (major and minor flight)	Total number of groups entering	People per hour	% interviewees dog walking	median distance home postcode to survey point, visitors from home only (km)
1 (Barwise Brow)	Upper Solway Flats & Marshes	2495	65	45	25	83	43	659	14	1.2	70	2.3
2 (Grune Point)	Upper Solway Flats & Marshes	11241	77	66	7	54	81	1385	7	1.4	33	26
3 (Dubmill Point)	Upper Solway Flats & Marshes	29266	129	61	96	94	52	10864	53	5.1	79	11.3
4 (Haverigg)	Duddon Estuary	20674	167	16	72	80	30	1606	36	3.3	61	0.6
5 (Askam Pier)	Duddon Estuary	3797	216	13	179	91	27	1755	65	5.6	71	0.3
6 (Earnse Point)	Duddon Estuary	10288	183	15	125	77	42	2326	94	8.3	73	0.6
7 (Fluke Hall)	Lune Estuary	16961	163	18	76	90	72	473	68	6.6	73	3.5
8 (Rossall Point)	Wyre Estuary	1281	610	32	307	89	30	104	129	11.8	61	1.9
9 (Fairhaven)	Ribble Estuary	7876	1528	34	344	86	68	13218	134	13.8	48	1
10 (Church Scar Lytham)	Ribble Estuary	8129	2492	10	259	60	24	22604	112	12.9	48	1
11 (Marshside)	Ribble Estuary	8021	201	88	112	90	53	6897	33	3	65	2
12 (Ainsdale-on-sea)	Sefton Coast	4436	397	77	274	94	31	10764	80	7.3	88	1.8
13 (Formby)	Sefton Coast	1727	543	55	211	88	34	97	140	22.8	30	3.3

Survey Point		Bird disturbance fieldwork results							Visitor Survey results			
		Total birds (all sp., all counts)	Total people	% people on intertidal	No. dogs off lead	% dogs off lead	% observations within 200m of birds	Total birds flushed (major and minor flight)	Total number of groups entering	People per hour	% interviewees dog walking	median distance home postcode to survey point, visitors from home only (km)
14 (Leasowe Breakwater)	North Wirral Foreshore	35402	302	47	331	95	60	109	134	13.8	67	2.2
15 (Hoylake Trinity Street)	North Wirral Foreshore	36105	377	31	175	75	54	1226	81	7.6	52	0.6
16 (West Kirby)	Dee Estuary	10182	398	31	350	93	78	197	121	11.9	86	1.7
17 (Thurstaston CP)	Dee Estuary	27605	302	26	172	90	59	989	99	12.9	69	4.5
18 (Hale Head)	Mersey Estuary	1914	94	11	36	82	84	1646	35	4.4	45	5.2

Identifying sites where disturbance is an issue

7.4 Birds were recorded being flushed by people at all locations and the results suggest a general effect of access on bird distribution across all locations. From the data collected we can however highlight sites where there are the most observations resulting in a behavioural response from the birds. In Table 18 we rank sites based on several different metrics collected during fieldwork. Dubmill Point, Leasowe Breakwater and Thurstaston Breakwater potentially stand out in that there was a high flush rate (major/minor flights per hour), the total number of birds flushed was relatively high (above 10,000 at all three sites) and there was a high proportion of events resulting in disturbance. We would also highlight Hoylake, where there were particularly high numbers of birds flushed.

7.5 At Askam Pier, Earnse Point, Fluke Hall and Hale Head the number of flights per hour was very low (less than 2 events per hour) and we would suggest disturbance is of relatively little concern at these locations. At Grune Point, the number of flights per hour is also very low, but at this location there was a relatively high proportion of observations that resulted in disturbance of some kind, hence Grune Point appearing higher in the table.

7.6 Church Scar, Lytham and Fairhaven are interesting in the high volume of access recorded here and the relatively low levels of birds responding, these sites are clearly different (e.g. see Figure 6). The extent to which these differences relate to a segregation of access and birds, the species present, the way people behave (linear routes along promenade with high proportion of dogs on leads) or the extent to which there is any habituation is difficult to determine. It is notable that at Church Scar a high proportion of the access was well away from the birds (i.e. no birds within 200m).

Table 18: Summary metrics relating to behavioural responses at different locations. Data are drawn primarily from Table 8; sites are ordered based on the average rank of the four data columns.

Location	% of observations resulting in a response of some kind	% observations resulting in major flight	Total birds flushed	Flights per hour
3 (Dubmill Point)	71	35	10864	3.8
14 (Leasowe Breakwater)	39	19	13218	6.6
17 (Thurstaston CP)	42	20	10764	4
11 (Marshside)	43	22	2326	3.2
15 (Hoylake Trinity Street)	38	22	22604	3.1

Location	% of observations resulting in a response of some kind	% observations resulting in major flight	Total birds flushed	Flights per hour
1 (Barwise Brow)	83	62	659	2.1
16 (West Kirby)	28	12	6897	3.8
12 (Ainsdale-on-sea)	42	19	473	2.3
2 (Grune Point)	33	30	1385	1.2
8 (Rossall Point)	25	21	989	2.8
9 (Fairhaven)	7	5	1646	3.5
13 (Formby)	32	17	104	2.1
4 (Haverigg)	25	10	1606	1.9
10 (Church Scar Lytham)	6	4	1755	3.1
5 (Askam Pier)	30	12	109	1
6 (Earnse Point)	10	5	1226	1.7
7 (Fluke Hall)	25	8	197	1.3
18 (Hale Head)	6	4	97	0.3

7.7 We can refer to other studies to highlight areas where there are particular concerns. Ross-Smith et al. (2015) used WeBS data to assess population trends of waterbird species in different parts of the Ribble & Alt Estuaries SPA, Mersey Estuary SPA, Dee Estuary SPA and the Mersey Narrows & North Wirral Foreshore SPA. They highlighted marked declines of waders and to a lesser extent wildfowl, on the Mersey Estuary SPA. Their results indicate also indicated that there have been relatively marked declines in the WeBS count sectors that include (or are adjacent to) Marshside (on the Ribble & Alt Estuaries SPA) and Leasowe, (on the Mersey Narrows & North Wirral Foreshore SPA), both locations that are relatively high in our ranked table (above).

7.8 Holt et al. (2016) provide a review and analysis of wintering waterbird abundance and distribution on estuaries in the north west, building on the work by Ross-Smith et al. (2015). Holt et al. also highlights marked declines on the Mersey Estuary SPA, they also identified marked short term declines in waders on the Dee Estuary SPA compared to other estuaries in the north west and highlighted site specific issues at the Morecambe Bay SPA and Upper Solway Flats and Marshes SPA. On the Ribble-Alt Estuaries SPA and on the Duddon Estuary SPA, waterbirds are generally showing more positive trends than the wider region (with some exceptions). Local issues of disturbance are identified by Holt et al. for the southern shore of the Solway, for Morecambe Bay and for the Ribble-Alt. Stakeholder consultations undertaken by Holt et al. suggested changes in human disturbance were an issue for all sites apart from the Duddon.

7.9 Using the combined results from Holt et al. (2016) and Ross-Smith et al. (2015) we can extract data for each WeBS sector corresponding to our survey points and check to see the proportion of species where the WeBS data suggests marked declines. Data are summarised in Figure 20. For each species in each WeBS sector, Holt et al. give trends over the short, medium and long term, with trends categorised as high/red (>50%); medium/amber (25-50%) etc. In the top two plots, we show the number of species with a particular trend. Where a species had different trends over different time periods (e.g. red over the short term and amber over the medium term), we used the most severe category (i.e. red). In the lower two plots we show the number of trends of a particular category, so in the lower plot if a given species was assigned a trend of red in the short term, red in the medium term and white in the long term, then the total trends would be 2 red and 1 white). Sites with no columns are ones where there were not enough data to assess trends. The order of the sites from left to right reflects the order in Table 18, such that the points to the left of the plots are ones with the most observations of behavioural response.

7.10 A range of factors are likely to account for species trends at a given location, and some of those trends may be specific to the location or relate more to estuary or even regional factors. It is therefore to be expected that an overall pattern with disturbance may be difficult to pick out. Nonetheless, for the waders at least, it does appear that the sectors where we have recorded some of the most behavioural responses are also those with more red towards the left, i.e. high rates of decline. Equally for waders some of the sites with more green appear towards the right, i.e., locations where we have recorded less behavioural response. Some sites appear to stand out, for example the Hale was a location where we recorded very low levels of birds being flushed, yet there have been some marked declines in WeBS data from this location. Dubmill Point is also interesting in that we have ranked it highly in terms of the responses from birds, and there are high flush rates and high numbers of birds flushed here, yet comparatively the proportion of marked declines here is low compared to other sites. Clearly other factors besides disturbance are likely to be driving bird declines at some of these locations.

7.11 With such data, it could be possible to try to highlight locations where the bird trends for a species buck the regional trend or the site trend and then look to see whether these are locations with more disturbance, for example more birds flushed. A challenge in looking this way is that it is hard to be confident that disturbance is a local issue. Access has increased over time across the UK as the population has increased, and therefore it would be expected that most if not all locations around our coast have seen changing numbers of visitors.

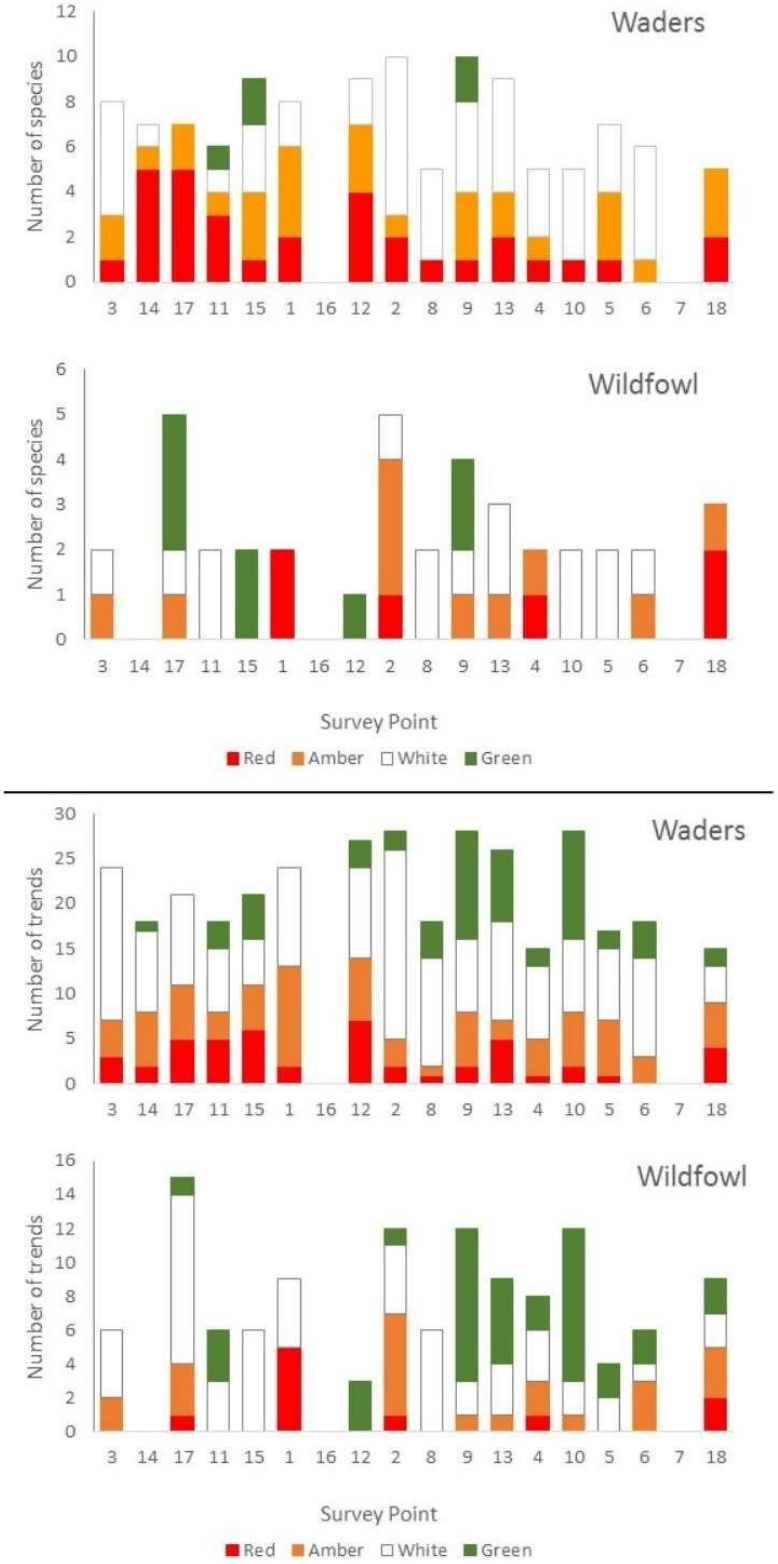


Figure 20: Numbers of species and trend by survey point. Data and colours extracted from Holt et al. (2015): Red – a decline in numbers of at least 50%; Amber – a decline in numbers of at least 25% but less than 50%; White – a decline in numbers of less than 25% or an increase of less than 33%; Green – an increase in numbers of at least 33%. In the top 2 graphs, data for short, medium and long term combined such that the most severe decline used for each species (e.g. if a species was red for short term and amber for other terms, it is assigned red in the plots). In the lower 2 plots we have counted the number of trends across all species. Following Holt et al. (2016) wildfowl includes Cormorant and Great-crested Grebe.

7.12 At an estuary level, Ross et al. (2014) compared all SPA intertidal sites around England using a range of metrics relevant to bird disturbance. Some key metrics, from Ross et al. for relevant north-west estuary sites, are summarised in Figure 21. The three metrics are:

- The mean amount of housing around the shoreline of the estuary (shoreline with access), weighted by typical travel distances. This essentially provides an approximate measure of how many people live around the estuary (within the kind of distances people travel to visit such sites).
- The percentage of the shoreline with access. This is derived from GIS data on paths.
- The proportion of mudflats within 60m of the path network. Sixty metres was taken as an approximate distance within which a behavioural response might occur and fits well with the results here (see Figure 9).

7.13 It can be seen that the Solway has very low levels of surrounding housing, indicating that this site has few people living nearby. Access levels from local people is therefore expected to be low (at an estuary level) compared to some other English sites. The Mersey Narrows and North Wirral Foreshore by contrast has comparatively very high levels of local housing and access would be expected to be high here. Our highest visitor counts were on the Ribble (Church Scar and Fairhaven), highlighting that at a specific location there can be variation, however the Mersey Narrows and North Wirral Foreshore sites did have relatively high access. Most of the Mersey Narrows shoreline has access (plot b) whereas on the Ribble there is a relatively low proportion of the SPA with access, indicating that over half of the estuary shoreline is likely to be relatively undisturbed. The shape of the individual estuaries and the area designated influences the proportion of the mudflats that lie within 60m. It can be seen from plot c) that the Duddon stands out as having a relatively high proportion of the site's mudflats within our 60m radius. Note however that this proportion is still relatively low (equivalent to around 6%) of the site's overall mudflat area. These data suggest – at a site level – that the Mersey Narrows and North Wirral foreshore are likely to have the most current pressure from access and are therefore potentially the most vulnerable.

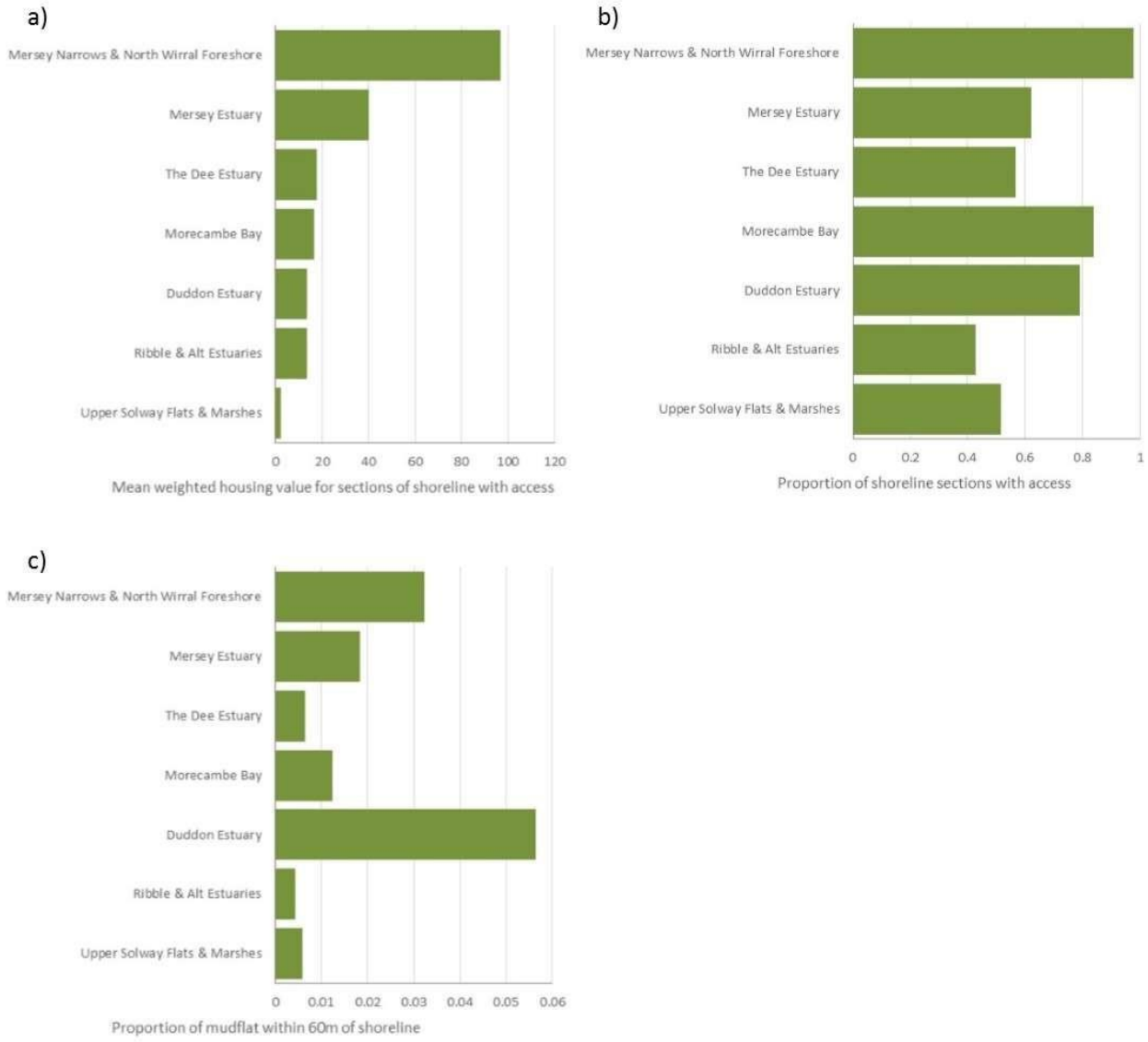


Figure 21: Data for selected NW estuary sites, after Ross et al (2014). See original report for full details of how each metric is derived.

Recommendations for management of disturbance

7.14 An overview of management options to reduce disturbance is summarised in Appendix 5. In this section, we consider the need for management and then draw from the list in Appendix 5 to make a series of recommendations. All recommendations are based on the results in this report and have not involved any direct contact or liaison with landowners or other stakeholders or detailed site visits to include areas beyond those where the data collection has taken place. We have not undertaken any audits of current infrastructure and visitor engagement, not discussed how access is currently managed at the relevant sites with site managers/stakeholders. Furthermore, survey work has been focussed in the winter months when visitor access patterns may be different from the summer, yet any management of access should consider year-round use. As such our recommendations simply represent ideas and suggestions for further consideration.

The need for management of disturbance

7.15 Our results do not provide a clear indication of population-level impacts, as complex and detailed modelling or long-term monitoring over many years would be necessary for this. However, placed in context with larger, complex studies at other sites (e.g. Stillman et al. 2012) they indicate that disturbance is currently causing some redistribution of birds, at least at the surveyed locations.

7.16 Disturbance issues are likely to become greater in the long term. The UK human population is increasing and monitoring of access at a national level indicates access to the countryside is increasing too (TNS 2015). Habitat change will influence the potential for disturbance impacts; 'coastal squeeze' resulting in the loss of saltmarsh habitats will mean there are fewer locations for birds to roost and will concentrate access onto smaller areas too. Government policy is to enhance access around the coast and this is likely in the long term to increase visitors' expectations of easy access to coastal areas and 'spreading room' that allows access to the water's edge/shoreline from the coastal path. In combination, these factors could result in disturbance levels gradually increasing over time.

7.17 Management interventions have the potential to improve the experience for visitors and enhance access, as well as reducing disturbance. Most of the locations surveyed are not existing nature reserves and it is not clear to visitors that they are important sites for nature conservation. All sites have a legal right of access and are popular destinations for visitors. In general, there is a lack of information for visitors, relatively little engagement and relatively little access infrastructure designed to focus or manage access (such as marked paths,

formalised parking, gates, interpretation etc.). The lack of current management at some sites has been highlighted by others (Watola & Heard 2015).

7.18 There is scope to improve access facilities and infrastructure. Many visitors choose sites because they are close to home and other factors such as good for the dog are important. There is the potential to enhance sites such that these requirements can potentially be better met while also ensuring disturbance is minimised. Improvements have the potential to draw more users and increase awareness of the local environment. There is a growing awareness of the benefits for society of access to the countryside and the importance of good access (Pretty et al. 2005, 2007; Lee & Maheswaran 2011; Moss 2012; Wolch, Byrne & Newell 2014).

General recommendations

7.19 The visitor survey results indicate a generally low level of awareness about the nature conservation importance of sites. This is particularly the case at the Ribble, the North Wirral, the Mersey and the Sefton Coast (Figure 19). Many visitors may assume that sites important for wildlife are those where access is restricted, wardens are in place and the sites managed with facilities such as hides in place – i.e. 'Nature Reserves'. Various awareness raising approaches are possible to change perceptions and highlight the issues and importance at these sites. Such approaches could include a combination of:

- Interpretation
- Signage
- Face-face contact, e.g. wardening
- Events
- Local publicity/media

7.20 Such approaches are already in place some locations, such as the RSPB's Marshside Reserve, but there is the scope to extend more widely with the aim of raising people's understanding of the nature conservation importance and how to behave. As necessary such approaches should direct visitors to different locations that are more suitable for their activity (such as dogs off leads).

7.21 Face-face wardening is likely to be the best approach and has been established at other European sites such as around the Solent as a mitigation approach where new development has been identified as having a likely significant effect on the European site interest. Wardens can speak to visitors, show them birds, highlight disturbance concerns and suggest how the visitors might minimise

their impact. Wardening has the potential to work well in that messages can be tailored to particular groups and face-face contact is harder for visitors to ignore (as opposed to signs etc.). Wardens can target particular groups (such as those with dogs off lead) and target locations and times when birds are particularly vulnerable. In general, there are few published studies on the success of different interventions, but face-face wardening has been scored highly in a survey involving expert scoring (Ross et al. 2014), and there are some published studies that show the effectiveness of wardening in reducing disturbance, at least when combined with other measures (e.g. Medeiros et al. 2007; Weston et al. 2012). It is important that wardens are well briefed and clear about what they can ask people to do and the messages that are being conveyed, for example how firmly they can request people to put dogs on leads and which sites they redirect people too. Furthermore, if wardens have a clear branding and identity, they are likely to appear more official and potentially be more effective.

7.22 Wardens can be professional employees, for example as on the Solent[6], or can be voluntary. There is an existing scheme involving volunteers on the Dee that has been running for many years and was established by Wirral Borough Council[7]. Two to five Wardens are scheduled to be on West Kirby beach for about three hours each time the height of the tide is above 8.6 metres at high water during daylight hours between September and March.

7.23 The regular visiting pattern of many visitors and in particular the high proportion of daily visitors who live in close proximity at locations such as Ainsdale, Askham and West Kirby should mean that engagement soon reaches the target audience.

7.24 Wardening should be combined with other approaches to maximise effectiveness. Use of social media and the internet, signs, interpretation, access restrictions and promotion of other sites/greenspaces can be part of a package of measures work alongside face-face wardening. Signage and access restrictions can be effective (Williams et al. 2017). Restrictions are most likely to work where there are roost sites on spits or other locations that can be easily fenced or access set-back. Restrictions can be more costly in terms of warden time, as there has to be enforcement to ensure these are heeded and therefore effective.

7.25 Interpretation is cost effective, with little upkeep cost, and there is already a range of interpretation in place, for example Wirral Council has recently installed

[6] See http://www.birdaware.org/article/28063/About-us

[7] See http://www.deeestuary.co.uk/warden.htm

interpretation boards between West Kirby and Meols. Current interpretation in this stretch details cultural and historical information and gives clear warnings and instructions on safety along the shore.

7.26 Provision of greenspace for access, such as local dog walking, may provide an alternative destination for some dog walkers. This may particularly work if sites are promoted where dogs are welcome off-lead at the same time as initiatives are in place to keep dogs on leads to reduce disturbance at the coast. Visitor data shows close to home and good for dog are key elements of site choice (see Figure 18) and these may be easy to replicate at alternative sites. The coast is likely to always remain a draw and scenery and proximity to water may be harder to replicate. The route data from this survey (see Table 14) would suggest that any site would need to provide routes of around 3km to accommodate the walks undertaken by the people interviewed.

7.27 While provision of new greenspace is likely to be costly and potentially hard to achieve, improvements to inland sites or coastal ones where disturbance is not an issue may work to draw access. There may also be options to create routes or redirect access away from sensitive locations, for example by setting paths back from the shore. Existing greenspaces along the coast may be particularly useful to provide environments, which are still coastal in the feel, where dogs can roam and then access on the shoreline itself be more careful managed (for example at Thurstaston Country Park).

7.28 There is a need for coordination across sites, at least at an estuary level. Piecemeal measures at individual sites are unlikely to be effective and without coordination, issues may be deflected to neighbouring shorelines. Coordination will help reduce costs while consistency in branding, messages and communication will help ensure visitors recognise the importance of the area and take notice.

More site-specific measures

7.29 Potential measures worthy of further consideration at each location include:

7.30 Barwise Brow: access levels were low and the main issues at this site appeared to be at or near high tide, involving dog walkers coming from the village and walking across the saltmarsh to the west between the car-park and the Herdhill Scar old railway jetty. 70% of the interviewees here were dog walkers and a high proportion were on short visits. Signage and perhaps some occasional wardening visits could potentially reduce the amount of disturbance observed.

7.31 Grune Point: access levels here were also low. There is scope to improve the path network here and reduce disturbance to the Oystercatcher roost on the shingle beach. The footpath to the north/west currently disappears around

NY131564 and people therefore end up on the shingle beach. The fencing that has been washed away could also be replaced, again helping to direct people.

7.32 Dubmill Point: the coastal footpath to the south here is an ill-defined track alongside a stock fence, and it appeared that some visitors were not clear which routes to take The track crosses a stream on a narrow bridge. There is also a rough vehicle track heading straight out onto the beach at the access point and this seemed to draw walkers and other users rather than the coastal footpath. Visitors that came out on the beach here were more likely to flush birds, however crossing the stream on this route is difficult and perhaps limits some of the issues. Signage and other measures to direct people along the main footpath if they heading south would reduce disturbance and help people find the best route. Disturbance would be reduced if dog walkers used the area to the north (where the sand is firmer) and as such directing visitor flows should reduce some of the issues here. For visitors coming along the beach heading north, via parking at Allonby or various pull-ins along the road, directing access to the top of the beach would help reduce disturbance issues. There may be options to close some of the parking locations. The end of the bridge would be an excellent location for wardens to directly engage with visitors, and such effort should be focussed around spring high tides.

7.33 Haverigg: the site was most notable for significant numbers of wildfowl (Teal and Wigeon in particular) at low/neap high tides. The only issue here related to a small number of people accessing the intertidal via the steps at SD161786, along to Haverigg Pool, a route that appears to be mostly used by boat owners. Signage here could direct access along the easier route west along Haverigg beach which would be less likely to cause disturbance.

7.34 Askam Pier: there was little evidence from the survey visits of access onto the mudflats and the sediment here is very soft. All visitors using the Cumbrian Coastal Way path were accessing it via a steep and rough track running down from the pier. It would be possible to enhance access, for example steps and handrail, without impacts to birds.

7.35 Earnse Point: there appears to be some beach access by 4x4 vehicles just to the north of the survey area and many interviewees complained about vehicles here. Some vehicle access appeared to be visitors reducing the walking distance to various desire lines through the gorse between the airfield fence and the beach. Limiting vehicle access, for example through rocks or metal barriers and focussing parking to the main car-park would help focus access and ensure signage etc. is likely to be more effective.

7.36 Fluke Hall: disturbance here was associated with the route between Piling Lane Ends and the Fluke Hall slipway. Access along this route could instead be

directed along the existing access road through Fluke Hall and not on the seaward side of the woodland. Casual access to the shore via the slipway could be reduced by improving access onto the west/southbound seawall, for example through provision of steps and signage to draw visitors in this direction. This location could work well for face-face engagement.

7.37 Rossall Point: two sections of the beach here were regularly used by roosting birds: by the coastguard station (SD 314479) and 350m to the west, where a shingle beach was used by Ringed Plover, Turnstone and Sanderling. These sections could be zoned off and access directed around the roosts on the seawall path. Any such approach would need to be backed up with face-face engagement, publicity etc. to ensure effectiveness.

7.38 Fairhaven: the saltmarsh here acts as a natural barrier between birds and people on most tides. Disturbance is most likely on spring tides which can almost reach the footpath, pushing the birds and access in close proximity. Clear, bold and simple signage at the steps (SD335272) and face-face engagement could work here, with the aim of directing people to keep dogs on leads if the tide is high or to walk well inshore, near the dunes.

7.39 Church Scar: high levels of access here (and at Fairhaven) provide good opportunities to show people birds and perhaps raise awareness of the conservation importance of the area. The high volumes of people here included a relatively high proportion of walkers and there was a relatively steady stream of walkers moving reasonably quickly along the promenade. Most access on the beach was a minor detour heading parallel to the promenade from the Church Scar slipway heading east (rather than west where there is no easy access back to the promenade). Signage on the slipway asking people to keep to the top of the beach and to stick to the promenade at high tide could reduce some disturbance.

7.40 Marshside: there is a well-used path across the marsh that provides access to the water's edge. People using the path included a number of birdwatchers (including an organised group) as well as a dog-walkers etc. This was the main area where any disturbance was recorded, with birds such as Pink-footed Geese flushed when visitors strayed from the path. Measures to focus access along the path could be beneficial.

7.41 Ainsdale and Formby: visitors staying near the dunes and on the drier sand seemed to have little impact, while those straying to the water's edge were more likely to flush oystercatchers, sanderling etc. Direct engagement through wardening and perhaps signage etc. is likely to be the best way to reduce disturbance issues at these sites. The National Trust help to promote access on the dunes and woodland/fields behind these with set walks rather than along

the shore. However, there is little mention of disturbance to birds along the shore and people are likely to be always drawn to the water's edge.

7.42 Leasowe: This site held some large concentrations of waders and the potential conflicts between access and birds resulted from people and dogs near the water's edge. Wardening and direct public engagement are likely to be the most effective approaches to minimise impacts. At this point of the coast many were arriving by car and the large car parks provide an opportunity to engage with people on arrival.

7.43 Hoylake: few birds were recorded here during low or neap-tide survey visits but there were some very large concentrations of birds on spring or wind driven tides. Birds seemed to show relatively little response to activity along the promenade but access events on the sea-ward side of the railings were much more likely to flush birds. Measures to focus access along the promenade, potentially closing some of the access onto the beach during the winter, could be beneficial. Engagement with dog walkers to limit or reduce dogs off-leads on the intertidal would reduce disturbance. Direct engagement with activities such as kitesurfing, working to focus access in particular areas could also reduce disturbance.

7.44 West Kirby: disturbance issues at this survey point seemed focussed around rising, falling and low tides. At high tide sections of concrete reinforcement and rock armour at the sailing club end were usually used by roosting waders, including Turnstone, Redshank and Dunlin. At high tides these areas were inaccessible to people and therefore disturbance at high tide was minimal. When birds were feeding, access by people and dogs on the wetter/muddier areas of intertidal habitat tended to result in a behavioural response. Measures that would be beneficial here would keep access to the top of the beach – signage and face-face contact may work in this regard.

7.45 Thurstaston: on incoming tides, large numbers of Oystercatchers, Pintail and other species were present here. Access events that involved people straying onto the intertidal tended to result in the most observed disturbance, and signage or other measures to keep people to the upper beach would reduce disturbance. The country park provides adjoining greenspace which can provide alternative routes, while still being at a coastal site. Improvements which increase the amount of time spent in the park are likely to reduce time spent on the shoreline. Furthermore, the centre at the country park provides some engagement, and is an opportunity to help strengthen messages.

7.46 Hale Head: while disturbance was relatively infrequent here, disturbance events seem to be particularly linked to access events that strayed from the top path

(on a bluff) onto the saltmarsh/intertidal habitats lower down. Low fencing, signage and/or temporary closure of steps/desire lines could limit impacts.

Approaches to future monitoring relating to visitor management measures

7.47 Some recommendations for future monitoring are made by Watola & Heard (Watola & Heard 2015). Key recommendations in that report include:

- A full coast survey mapping and counting visitor levels
- Collection of detailed data to allow modelling of population consequences of disturbance (after Stillman et al. 2012).

7.48 The geographical range covered in this report, and the number of sites, means that the collection of detailed data to allow individual-based models to be constructed would be very expensive and time-consuming. Data such as prey abundance will be particularly difficult to collect. While there may be options for such an approach on parts of sites or individual estuaries (building on existing models), we suggest such modelling at a strategic, NW coast scale is not feasible or necessary. Such models, particularly for estuaries such as the Solway where access levels appear very low, are unlikely to show any impact of disturbance at an estuary level and would be highly costly to undertake.

7.49 Nonetheless, data collection is important and monitoring is essential to pick up changes in access and behaviour and identify issues at particular locations.

7.50 We suggest the following as key approaches to future monitoring and data collection:

Systematic visitor counts

7.51 Systematic counts should be established for key stretches of coast and estuaries and repeated regularly to indicate what types of access are occurring, how access is changing over time and to record visitor behaviour. The simplest way of achieving this would be counts of parked cars along stretches of coast, with the count data collected as transects whereby the surveyor drives along the coast and counts cars in car-parks. Such surveys need to include lay-bys and roadside parking. In order to establish such monitoring, an initial audit of all parking locations is required, and this is a useful output in itself and can include a record of signs, interpretation, parking capacity etc. at each location.

7.52 The approach is cost-effective and is used at a range of European sites (such as the Dorset Heaths, Thames Basin Heaths, the Solent) as a means of collecting standard data. Counts are repeated at set dates each year and cover a range of different types of day (weekends, weekdays etc.) and times of day. Counts can be coordinated such that multiple surveyors cover different areas at the same time.

7.53 On the Humber (see Ross & Liley 2014) and on the Solent (Liley et al. 2015a) the approach also included vantage point counts, whereby the surveyor quickly records the number of people visible (looking out onto the intertidal/beach areas from the car-park) and the activities being undertaken (e.g. different watersports, dog off leads etc.) as part of the driving transect. These snapshot counts are undertaken at a sub-sample of the surveyed car-parks and allow information on actual beach use to be collected.

Bird Counts

7.54 Understanding the distribution of birds and how bird numbers are changing is fundamental. The WeBS (Wetland Bird Survey) data provides this information. The survey covers the UK and is run by the BTO and the data are used by the statutory agencies to inform site condition and designation. WeBS has been running for decades and the data are used to highlight where species numbers are changing at a particular site and whether such changes are specific to that site or consistent with widespread changes at other sites in the region or nationally.

7.55 WeBS counts provide data for both high tide and low tide through two separate monitoring schemes both undertaken by volunteer counters coordinated by a local organiser. Low-tide counts provide data on feeding birds and this is when many species will be particularly sensitive to disturbance. By contrast the high tide counts provide data on the total number of birds present and highlight roost sites, which can also be vulnerable. WeBS data should continue to provide the bird monitoring data and as necessary counts should be boosted using professional fieldworkers to plug any large gaps in volunteer coverage. The mid-winter period is when bird numbers tend to peak overall, but other months can be particularly important for some species at some sites. During the mid-winter period birds are likely to be particularly vulnerable to disturbance as there is more competition (higher numbers of birds overall) and cold weather can make particular demands. Over the winter depletion can mean food is particularly limited. Conversely, during the summer months, access levels may peak, and as such some coverage of birds during the shoulder periods (April and August) would seem justified.

Record of interventions

7.56 Any measures relating to the management of access should be carefully recorded in a systematic way. Data on face-face engagement, interpretation, parking provision, signage and other measures are rarely collated at an estuary level, yet are important to provide an overview of current measures. Given the range of organisations and stakeholders often involved on a single estuary, even a simple record of all signage in place at a given time may be difficult to generate. Ensuring a standard, partnership approach to recording such work provides an opportunity to identify gaps and cross-reference to changes in bird numbers or visitor flows.

Effectiveness of mitigation approaches and targeted recording

7.57 The visitor counts should allow any changes in access in terms of visitor numbers and behaviour to be picked up. Data on the effectiveness of different interventions would be useful in addition, to help hone approaches and maximise their effectiveness. Ad hoc work could therefore be targeted where there were issues and a need for more information. We suggest that visitor surveys (i.e. interviews with visitors), and direct observation (using the approaches set out here for disturbance monitoring) could be targeted in the future to locations where:

- There is uncertainty whether disturbance is an issue,
- Where measures have been put in place for the first time (e.g. fencing around roost sites) and there is a need to check the effectiveness and whether additional measures (such as face-face engagement) are required,
- Where there have been marked declines in bird numbers or marked changes in access.

7.58 Data collection could compare times with and without interventions (e.g. when wardens are present to when they are absent) and compare over time. Survey work could be targeted as necessary to particular questions such as the optimal level of wardening effort required for long-lasting behaviour change; the approaches that work to best communicate bird conservation issues to visitors and what further measures are necessary to promote behaviour change and responsible access.

References

Alessa, L., Bennett, S.M. & Kliskey, A.D. (2003) Effects of knowledge, personal attribution and perception of ecosystem health on depreciative behaviors in the intertidal zone of Pacific Rim National Park and Reserve. Journal of Environmental Management, 68, 207–218.

Beale, C.M. & Monaghan, P. (2004a) Human disturbance: people as predation-free predators? Journal of Applied Ecology, 41, 335–343.

Beale, C.M. & Monaghan, P. (2004b) Behavioural responses to human disturbance: a matter of choice? Anim. Behav., 68, 1065–1069.

Beale, C.M. & Monaghan, P. (2005) Modeling the Effects of Limiting the Number of Visitors on Failure Rates of Seabird Nests. Conservation Biology, 19, 2015–2019.

Bennett, R.M., Tranter, R.B. & Blaney, R.J.P. (2003) The Value of Countryside Access: A Contingent Valuation Survey of Visitors to the Ridgeway National Trail in the United Kingdom. Journal of Environmental Planning and Management, 46, 659–671.

Brambilla, M., Rubolini, D. & Guidali, F. (2004) Rock climbing and Raven Corvus corax occurrence depress breeding success of cliff-nesting Peregrines Falco peregrinus. Ardeola, 51, 425–430.

Bright, A., Reynolds, G.R., Innes, J. & Waas, J.R. (2003) Effects of motorised boat passes on the time budgets of New Zealand dabchick, Poliocephalus rufopectus. Wildl. Res., 30, 237–244.

Burger, J. & Gochfeld, M. (1991) Human Activity Influence and Diurnal and Nocturnal Foraging of Sanderlings (Calidris alba). Condor, 93, 259–265.

Burton, N.H.K., Armitage, M.J.S., Musgrove, A.J. & Rehfisch, M.M. (2002) Impacts of man-made landscape features on numbers of estuarine waterbirds at low tide. Environ. Manage., 30, 857–864.

Burton, N.H., Rehfisch, M.M. & Clark, N.A. (2002) Impacts of disturbance from construction work on the densities and feeding behavior of waterbirds using the intertidal mudflats of Cardiff Bay, UK. Environ Manage, 30, 865–71.

Cryer, M., Linley, N.W., Ward, R.M., Stratford, J.O. & Randerson, P.F. (1987) Disturbance of overwintering wildfowl by anglers at two reservoir sites in South Wales. Bird Study, 34, 191–199.

Downward, P. & Lumsdon, L. (2004) Tourism Transport and Visitor Spending: A Study in the North York Moors National Park, UK. Journal of Travel Research, 42, 415–420.

Fitzpatrick, S. & Bouchez, B. (1998) Effects of recreational disturbance on the foraging behaviour of waders on a rocky beach. Bird Study, 45, 157–171.

Gill, J.A. (1996) Habitat choice in wintering pink-footed geese:quantifying the constraints determining winter site use. Journal of Applied Ecology, 33, 884–892.

Gill, J.A., Norris, K., Potts, P.M., Gunnarsson, T.G., Atkinson, P.W. & Sutherland, W.J. (2001) The buffer effect and large-scale population regulation in migratory birds. Nature, 412, 436–438.

Gill, J.A., Norris, K. & Sutherland, W.J. (2001) Why behavioural responses may not reflect the population consequences of human disturbance. Biological Conservation, 97, 265–268.

Holt, C.A., Bull, A.J. & Frost, B. (2016) Desk-Based Review and Analysis of Changes in Non-Breeding Bird Populations on the SSSI Estuaries of North West England. Unpublished report by RPS ltd. for Natural England.

Hosmer, D.W. & Lemeshow, S. (2000) Applied Logistic Regression. John Wiley and Sons.

Lee, A.C.K. & Maheswaran, R. (2011) The health benefits of urban green spaces: a review of the evidence. Journal of Public Health, 33, 212–222.

Liley, D. (1999) Predicting the Consequences of Human Disturbance, Predation and Sea-Level Rise for Ringed Plover Population Size. University of East Anglia, School of Biological Sciences, Norwich.

Liley, D., Lake, S., Underhill-Day, J., Sharp, J., White, J., Hoskin, R., Cruickshanks, K. & Fearnley, H. (2010) Welsh Seasonal Habitat Vulnerability Review. Footprint Ecology / CCW.

Liley, D., Stillman, R., Austin, G. & Panter, C. (2015a) Advice on How to Monitor the Effectiveness of the Solent Recreation Mitigation Strategy. Footprint Ecology / Bournemouth University / BTO / Solent Recreation Mitigation Partnership.

Liley, D. & Sutherland, W.J. (2007) Predicting the population consequences of human disturbance for Ringed Plovers Charadrius hiaticula: a game theory approach. Ibis, 149, 82–94.

Liley, D., Underhill-Day, J., Panter, C., Marsh, P. & Roberts, J. (2015b) Morecambe Bay Bird Disturbance and Access Management Report. Unpublished report by Footprint Ecology for the Morecambe Bay Partnership.

Liley, D., Underhill-Day, J., Panter, C., Marsh, P. & Roberts, J. (2015c) Morecambe Bay Bird Disturbance and Access Management Report. Footprint Ecology/Morecambe Bay Partnership.

Lowen, J., Liley, D., Underhill-Day, J. & Whitehouse, A.T. (2008) Access and Nature Conservation Reconciliation: supplementary guidance for England.

McNeil, R., Drapeau, P. & Goss-Custard, J.D. (1992) The occurrence and adaptive significance of nocturnal habitats in waterfowl. Biological Reviews, 67, 381–419.

Medeiros, R., Ramosa, J.A., Paivaa, V.H., Almeidac, A., Pedroa, P. & Antunes, S. (2007) Signage reduces the impact of human disturbance on little tern nesting success in Portugal. Biological Conservation, 135, 99–106.

Moss, S. (2012) Natural Childhood. National Trust.

Nolet, B.A., Bevan, R.M., Klaassen, M., Langevoord, O. & Van der Heijden, Y. (2002) Habitat switching by Bewick's swans: maximization of average long-term energy gain? J. Anim. Ecol., 71, 979–993.

Pienkowski, M.W. (1984) Behaviour of young Ringed Plovers Charadrius hiaticula and its relationship to growth and survival to reproductive age. Ibis, 126, 133–155.

Pretty, J., Griffin, M., Peacock, J., Hine, R., Selens, M. & South, N. (2005) A countryside for health and well-being: the physical and mental health benefits of green exercise. Countryside Recreation, 13, 2–7.

Pretty, J., Peacock, J., Hine, R., Sellens, M., South, N. & Griffin, M. (2007) Green exercise in the UK - countryside: Effects on health and psychological well-being, and implications for policy and planning. Journal of Environmental Planning and Management, 50, 211.

Regel, J. & Putz, K. (1997) Effect of human disturbance on body temperature and energy expenditure in penguins. Polar Biology, 18, 246–253.

Ross, K. & Liley, D. (2014) Humber Winter Bird Disturbance Study. Footprint Ecology.

Ross, K., Liley, D., Austin, G., Burton, N., Stillman, R., Cruickshanks, K. & Underhill-Day, J. (2014) Housing Development and Estuaries in England: Developing Methodologies for Assessing the Impacts of Disturbance to Non-Breeding Waterfowl.

Ross-Smith, V.H., Calbrade, N.A., Wright, L.J. & Austin, G.E. (2015) Waterbird Population Trend Analysis of the Mersey Narrows SPA, Mersey Narrows & North Wirral Foreshore pSPA and Ribble & Alt Estuaries SPA. Natural England Commissioned Report.

Saunders, C., Selwyn, J., Richardson, S., May, V. & Heeps, C. (2000) A Review of the Effects of Recreational Interactions within UK European Marine Sites. UK CEED & Bournemouth University.

Still, D.A., Calbrade, N.A. & Holt C.A. (2015) Review and Analysis of Changes in Water-Bird Use of the Mersey Estuary SPA, Mersey Narrows & North Wirral Foreshore SPA and Ribble & Alt Estuaries SPA. Natural England Commissioned Report.

Stillman, R.A. & Goss-Custard, J.D. (2002) Seasonal changes in the response of oystercatchers Haematopus ostralegus to human disturbance. J. Avian Biol., 33, 358–365.

Stillman, R.A., West, A.D., Clarke, R.T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the Impact of Human Disturbance on Overwintering Birds in the Solent. Solent Forum / Bourneouth University / Footprint Ecology.

Stock, M. & Hofeditz, F. (1997) Compensatory limits: energy budgets of Brent Geese, Branta b- bernicla, the influence of human disturbance. Journal Fur Ornithologie, 138, 387–411.

Summers, R.W., McFarlane, J. & Pearce-Higgins, J.W. (2007) Measuring Avoidance by Capercaillies Tetrao Urogallus of Woodland Close to Tracks. Wildlife Biology, 13, 19–27.

Swennen, C., Leopold, F. & Bruijn, L.M. (1989) Time-stressed Oystercatchers Haematopus ostralegus, can increase their intake rate. Animal Behaviour, 38, 8–22.

Thiel, D., Jenni-Eiermann, S., Braunisch, V., Palme, R. & Jenni, L. (2008) Ski tourism affects habitat use and evokes a physiological stress response in capercaillie Tetrao urogallus: a new methodological approach. Journal of Applied Ecology, 45, 845–853.

Thiel, D., Jenni-Eiermann, S., Palme, R. & Jenni, L. (2011) Winter tourism increases stress hormone levels in the Capercaillie Tetrao urogallus. Ibis, 153, 122–133.

Thomas, K., Kvitek, R.G. & Bretz, C. (2003) Effects of human activity on the foraging behavior of sanderlings Calidris alba. Biological Conservation, 109, 67–71.

TNS. (2015) Monitor of Engagement with the Natural Environment Technical Report from the 2013-14 Survey. Natural England Joint Report.

Urfi, A.J., Goss-Custard, J.D. & Lev. Dit Durell, S.E.A. (1996) The Ability of Oystercatchers Haematopus ostralegus to Compensate for Lost Feeding Time: Field Studies on Individually Marked Birds. Journal of Applied Ecology, 33, 873–883.

Walker, B.G., Boersma, P.D. & Wingfield, J.C. (2005) Physiological and Behavioral Differences in Magellanic Penguin Chicks in Undisturbed and Tourist-Visited Locations of a Colony. Conservation Biology, 19, 1571–1577.

Walker, B.G., Dee Boersma, P. & Wingfield, J.C. (2006) Habituation of Adult Magellanic Penguins to Human Visitation as Expressed through Behavior and Corticosterone Secretion. Conservation Biology, 20, 146–154.

Watola, G. & Heard, V. (2015) Mersey Narrows and North Wirral Foreshore Sites of Special Scientific Interest - Investigation into the Impacts of Recreational Disturbance on Bird Declines. Natural England Commissioned Report, Natural England.

Weimerskirch, H., Shaffer, S.A., Mabille, G., Martin, J., Boutard, O. & Rouanet, J.L. (2002) Heart rate and energy expenditure of incubating wandering albatrosses: basal

levels, natural variation, and the effects of human disturbance. J Exp Biol, 205, 475–83.

West, A.D., Goss-Custard, J.D., Stillman, R.A., Caldow, R.W.G., Durell, S. & McGrorty, S. (2002) Predicting the impacts of disturbance on shorebird mortality using a behaviour-based model. Biol. Conserv., 106, 319–328.

Weston, M.A., Dodge, F., Bunce, A., Nimmo, D.G. & Miller, K.K. (2012) Do temporary beach closures assist in the conservation of breeding shorebirds on recreational beaches? Pacific Conservation Biology, 18, 47–55.

Williams, D.., Child, M.F., Dicks, L.V., Okendon, N., Pople, R.G., Showler, D.A., Walsh, J.C., zu Ermgassen, E. & Sutherland, W.J. (2017) Bird Conservation. What Works in Conservation 2017 (eds W.J. Sutherland, L.V. Dicks, N. Okendon, & R.K. Smith), p. Open Book Publishers, Cambridge.

Wolch, J.R., Byrne, J. & Newell, J.P. (2014) Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. Landscape and Urban Planning, 125, 234–244.

Yasué, M. (2005) The effects of human presence, flock size and prey density on shorebird foraging rates. Journal of Ethology, 23, 199–204.

Appendix 1: Dates and weather conditions for visitor survey fieldwork

Summary of the date ranges of visitor survey fieldwork.

Survey point	Location Name	Number of separate survey dates	First date	Last date
1	Barwise Brow	3	30/11/2016	21/01/2017
2	Grune Point	3	29/11/2016	11/12/2016
3	Dubmill Point	5	01/12/2016	22/01/2017
4	Haverigg	3	08/12/2016	10/12/2016
5	Askam Pier	2	27/11/2016	06/12/2016
6	Earnse Point	3	28/11/2016	07/01/2017
7	Fluke Hall	4	25/11/2016	14/01/2017
8	Rossall Point	4	19/12/2016	15/01/2017
9	Fairhaven	4	05/01/2017	08/01/2017
10	Church Scar Lytham	4	05/01/2017	08/01/2017
11	Marshside	4	27/01/2017	30/01/2017
12	Ainsdale-on-sea	4	27/01/2017	30/01/2017
13	Formby	2	03/02/2017	04/02/2017
14	Leasowe Breakwater	2	09/12/2016	11/12/2016
15	Hoylake Trinity Street	2	10/12/2016	12/12/2016
16	West Kirby	2	08/12/2016	10/12/2016
17	Thurstaston CP	2	09/12/2016	11/12/2016
18	Hale Head	2	05/02/2017	06/02/2017

Summary of weather conditions at survey points during visitor surveys.

Survey Point ID	Location Name	Cold sessions	Mild sessions	Average cloud cover (8ths)	% of sessions with rain
1	Barwise Brow	3	5	7.1	25
2	Grune Point	2	6	6.0	0
3	Dubmill Point	1	7	4.5	0
4	Haverigg	4	4	5.8	38
5	Askam Pier	5	3	7.0	0
6	Earnse Point	1	7	6.3	50
7	Fluke Hall	6	2	4.6	25
8	Rossall Point	2	6	6.4	25
9	Fairhaven	8	0	6.0	50
10	Church Scar Lytham	8	0	6.1	50
11	Marshside	8	0	7.3	38
12	Ainsdale-on-sea	8	0	6.5	25
13	Formby	8	0	4.5	13
14	Leasowe Breakwater	6	2	6.7	50
15	Hoylake Trinity Street	6	2	7.5	63
16	West Kirby	5	4	5.7	38
17	Thurstaston CP	5	3	5.9	25
18	Hale Head	8	0	5.6	13

Appendix 2: Visitor Survey Questionnaire

Good morning/afternoon. I am conducting a visitor survey on behalf of Natural England. The survey is to find out more about access along this area of coastline. Can you spare me a few minutes please?

Q1 ...

- ○ **Are you on a day trip/short visit and travelled directly from your home** ... *if no*
- ○ **Are you on a short trip/short visit & staying away from home with friends or family** ... *if no*
- ○ **Staying away from home, e.g. second home, mobile home or on holiday**
- ○ If none of the above, **How would you describe your visit today?**

Further details

Q2 *if staying away from home:* **What type of accomodation are you staying in?** *Tick closest answer. Do not prompt. Single response only.*

- ○ Hotel/Motel
- ○ Bed & Breakfast
- ○ Pub/Inn/Guesthouse
- ○ Self-catering
- ○ Second home
- ○ Campervan/campsite
- ○ Home of friend/relative
- ○ Other, please detail:

Further details

Q3 **What is the main activity you are undertaking today?** *Tick closest answer. Do not prompt. Single response only.*

- ○ Dog walking
- ○ Walking
- ○ Jogging/power walking
- ○ Outing with family
- ○ Beach Activity (sunbathing, bucket/spade etc)
- ○ Cycling/Mountain Biking
- ○ Bird/Wildlife watching
- ○ Fishing
- ○ Enjoy scenery
- ○ Photography
- ○ Meet up with friends
- ○ Horse Riding
- ○ Kitesurfing/Windsurfing
- ○ Jetski
- ○ Canoe/kayak/Surfing/Paddleboarding
- ○ Sailing (non-motorised)
- ○ Boating (motorised - RIB etc)
- ○ Organised boat trip
- ○ Drone Flying
- ○ Other, please detail:

Further details

Q4 **How long have you spent / will you spend in the area today?** *Single response only.*

- ◯ Less than 30 minutes
- ◯ Between 30 minutes and 1 hour
- ◯ 1-2 hours
- ◯ 2-3 hours
- ◯ 3-4 hours
- ◯ 4 hours +

Q5 **Over the past year, roughly how often have you visited this site?** *Tick closest answer, single response only. Only prompt if interviewee struggles.*

- ◯ Daily
- ◯ Most days (180+ visits)
- ◯ 1 to 3 times a week (40-180 visits)
- ◯ 2 to 3 times per month (15-40 visits)
- ◯ Once a month (6-15 visits)
- ◯ Less than once a month (2-5 visits)
- ◯ Don't know
- ◯ First visit
- ◯ Other, please detail

Further details:

Q6 **Do you tend to visit this area at a certain time of day?** *Tick closest answers. Multiple answers ok.*

- ☐ Early morning (before 9am)
- ☐ Late morning (between 9am and 12)
- ☐ Early afternoon (between 12 and 2)
- ☐ Late afternoon (between 2 and 4pm)
- ☐ Evening (after 4pm)
- ☐ Varies / Don't know
- ☐ First visit

Q7 **Do you tend to visit this area more at a particular time of year for [***insert given activity***]?** *Multiple answers ok.*

- ☐ Spring (Mar-May)
- ☐ Summer (Jun-Aug)
- ☐ Autumn (Sept-Nov)
- ☐ Winter (Dec-Feb)
- ☐ Equally all year
- ☐ Don't know
- ☐ First visit

Q8 **How did you get here today?** *What form of transport did you use? Single response only.*

- ◯ Car / van
- ◯ On foot
- ◯ Public transport
- ◯ Bicycle
- ◯ Other, please detail

Further details:

Now I'd like to ask you about your route today. looking at the area shown on this map, can you show me where you started your visit today, the finish point and your route please. Probe to ensure route is accurately documented. *Use **P** to indicate where the visitor parked, **E** to indicate the start point and **X** to indicate the exit. Mark the route with a line; a solid line for the actual route and a dotted line for the expected or remaining route.*

Q9 **Is / was your route today the normal length when you visit here for [***insert given activity***]?** *Tick closest answer, do not prompt. Single response only.*

- ○ Yes, normal
- ○ Much longer than normal
- ○ Much shorter than normal
- ○ Not sure / no typical visit
- ○ First visit

Q10 **What, if anything, influenced your choice of route here today?** *Tick closest answers, do not prompt. Multiple responses ok.*

- ☐ Weather
- ☐ Daylight
- ☐ Time
- ☐ Other users (avoiding crowds etc)
- ☐ Group members (eg kids, less able)
- ☐ Muddy tracks / paths
- ☐ Followed a marked trail
- ☐ Previous knowledge of area / experience
- ☐ Activity undertaken (eg presence of dog)
- ☐ Interpretation / leaflets / promotion
- ☐ Wanting to be near water
- ☐ Viewpoint/Headland/Feature
- ☐ Tide
- ☐ Other, please detail

Further details:

Q11 **Why did you choose to visit here, rather than another local site?** *Tick all responses given by visitor in the 'other' column. Do not prompt, tick closest answers. Then ask* **Which single reason would you say had the most influence over your choice of site to visit today?** *Tick only one main reason. Use text box for answers that cannot be categorised and for further information.*

	Other	Main
Don't know / others in party chose	○	○
Close to home	○	○
No need to use car	○	○
Quick & easy travel route	○	○
Good / easy parking	○	○
Particular facilities	○	○
Refreshments / cafe/ pub	○	○
Choice of routes	○	○
Feels safe here	○	○
Quiet, with no traffic noise	○	○
Not many people	○	○
Scenery / variety of views	○	○
Rural feel / wild landscape	○	○
Particular wildlife interest	○	○
Habit/familiarity	○	○
Good for dog / dog enjoys it	○	○
Ability to let dog off lead	○	○
Closest place to take dog	○	○
Closest place to let dog safely off lead	○	○
Appropriate place for activity	○	○
Suitability of area in given weather conditions	○	○
Near coast / water	○	○
Other, please detail	○	○

Further details:

Q12 You have indicated that the ability to let your dog off the lead is important to you. Which of the following would trigger you to put your dog on a lead during your walk? Would you put your dog on a lead if there was: ***read out each of following. If necessary ask with each, if there was ...., would you put your dog on a lead?***

	Would put dog on lead	Would not put dog on lead	Not/sure
A family/small children approaching	○	○	○
A cyclist approaching	○	○	○
A horse rider approaching	○	○	○
An other dog approaching off lead	○	○	○
A flock of birds ahead	○	○	○

I'd now like to ask about how you plan where you go on the coast.

Q13 **We'd like to know which information sources you use to plan your visit. Thinking of your visit today:**

	Yes	No	Don't know/unsure
Did any particular website influence your choice to come here today?	○	○	○
Did any social media influence your choice to come here today?	○	○	○
Did any smartphone app influence your choice to come here today?	○	○	○
Did any maps (online or paper) influence your choice to come here today?	○	○	○
Did any leaflets influence your choice to come here today	○	○	○
Did word of mouth influence your choice to come here today	○	○	○

Q14 **You indicated that a website influenced your visit today, which websites did you use?**

Q15 **You indicated that social media influenced your visit today, which social media did you use?**

- ☐ Twitter
- ☐ Facebook
- ☐ Instagram
- ☐ Other

Other

Q16 **You indicated that you have used a smartphone app specifically relating to your activity. Which apps do you use?**

Q17 **You indicated that leaflets influenced your visit. Which leaflet did you mean?**

Q18 **You indicated that word of mouth influenced your visit today. Who did you speak too?**

- ☐ Family
- ☐ Friend
- ☐ Other (give details):

Further details:

Q19 **Are you aware of any designations or environmental protection that apply to this part of the coast.** *Single response only.*

- ◯ Yes
- ◯ No
- ◯ Unsure

Q20 **If yes, can you name the designation?** *Do not prompt. Multiple responses ok.*

- ☐ SSSI mentioned
- ☐ SPA/SAC/European site mentioned
- ☐ AONB mentioned
- ☐ General comment about importance for birds
- ☐ No clear response / not able to name

Other/further details:

Q21 **Are you aware of any habitats or species that occur here and are vulnerable to impacts from recreation? Can you name them?** *Do not prompt. Tick any groups mentioned. Use Further details box for any additional species/habitats mentioned.*

- ☐ No/none/can't name
- ☐ Breeding terns/waders on the beaches
- ☐ Wintering waterbirds (e.g. wildfowl, waders, geese)
- ☐ Reptiles/Sand Lizard
- ☐ Plants
- ☐ Sand Dune
- ☐ Salt Marsh
- ☐ Other (give details)

Further details:

Q22 **Are there any changes you would like to see here with regards to how this area is managed for access?**

Q23 **What is your full home postcode?** *This is an important piece of information, please make every effort to record correctly.*

Q24 *If visitor is unable or refuses to give postcode:* **What is the name of the town or village where you live?**

Q25 *If visitor is on holiday ask:* **Which town / village are you staying in?**

Q26 **Do you have any further comments or general feedback about your visit and access to this area?**

That is the end. Thank you very much indeed for your time.

Q27 TO BE COMPLETED AFTER INTERVIEW FINISHED.

Surveyor initials	
Survey location code	
Map Reference Number	
Gender of respondent	
Total number in interviewed group	
Total males	
Total females	
Total minors	
Number of dogs	
Number of dogs off lead	

Q28 Surveyor comments. ***Note anything that may be relevant to the survey, including any changes to the survey entry that are necessary, eg typos/mistakes/changes to answers/additional information.***

Appendix 3: Bird Count Data, summary by location species

Table 19: Maximum number of each species counted at each location and (in brackets) the number of counts the species was recorded from at each location. There were two counts undertaken during each visit. Blank cells indicate counts with no birds.

	1 (Barwise Brow)	2 (Grune Point)	3 (Dubmill Point)	4 (Haverigg)	5 (Askam Pier)	6 (Earnse Point)	7 (Fluke Hall)	8 (Rossall Point)	9 (Fairhaven)	10 (Church Scar Lytham)	11 (Marshside)	12 (Ainsdale-on-sea)	13 (Formby)	14 (Leasowe B'water)	15 (Hoylake Trinity St.)	16 (West Kirby)	17 (Thurstaston CP)	18 (Hale Head)	Max across all locs
Duck																			
Common Scoter												16 (2)	22 (3)						22 (5)
Eider				5 (2)	1 (1)														5 (3)
Goosander	5 (4)																		5 (4)
Long-tailed Duck		4 (12)																	4 (12)
Mallard	12 (5)	51 (10)		34 (12)	15 (1)					4 (3)	24 (5)						6 (1)	179 (16)	179 (53)
Pintail		249 (6)							12 (4)	220 (10)							645 (14)		645 (34)
Red-breasted Merganser	5 (3)	9 (14)				6 (2)			26 (1)			4 (1)	3 (1)				4 (1)		26 (23)
Scaup		1 (2)		18 (1)															18 (3)
Shelduck	19 (2)	23 (5)		19 (15)	19 (8)		81 (9)		30 (8)	10 (7)	64 (5)				476 (12)	17 (5)	163 (16)	2 (3)	476 (96)
Shoveler	6 (1)																		6 (1)
Teal	70 (4)	53 (5)		260 (18)						11 (1)	27 (3)						16 (5)	72 (15)	260 (51)

	1 (Barwise Brow)	2 (Grune Point)	3 (Dubmill Point)	4 (Haverigg)	5 (Askam Pier)	6 (Earnse Point)	7 (Fluke Hall)	8 (Rossall Point)	9 (Fairhaven)	10 (Church Scar Lytham)	11 (Marshside)	12 (Ainsdale-on-sea)	13 (Formby	14 (Leasowe B'water)	15 (Hoylake Trinity St.)	16 (West Kirby)	17 (Thurstaston CP)	18 (Hale Head)	Max across all locs
Wigeon	79 (13)	250 (14)		225 (20)	6 (1)					12 (3)	186 (3)								250 (54)
Geese and Swans																			
Barnacle Goose	96 (4)	2460 (5)																	2460 (9)
Canada Goose											1 (1)							36 (3)	36 (4)
Greylag Goose											8 (2)								8 (2)
Mute Swan		1 (1)																	1 (1)
Pale-bellied Brent Goose															9 (1)		6 (1)		9 (2)
Pink-footed Goose		50 (3)					310 (1)				1060 (14)								1060 (18)
Whooper Swan							4 (2)											16 (1)	16 (3)
Gulls																			
Black-headed Gull	27 (9)	1 (1)	51 (11)	26 (18)	5 (2)	61 (6)	20 (2)	70 (4)	177 (8)	5 (7)	68 (10)	570 (20)	250 (18)	290 (16)	2300 (20)	33 (12)	28 (15)	31 (10)	2300 (191)
Common Gull	17 (7)		220 (13)	320 (10)	32 (3)	5 (3)	11 (2)	14 (2)		1 (1)	30 (2)	400 (12)	42 (8)	116 (7)	116 (19))	1 (1)	4 (3)	2 (1)	400 (95)
Great Black-backed Gull	4 (4)	1 (1)	9 (10)		1 (1)	12 (4)	1 (1)	5 (4)		1 (3)		4 (1)	4 (3)		17 (3)	1 (1)	2 (3)	3 (4)	17 (43)
Herring Gull	9 (6)	4 (3)	325 (12)	29 (10)	1 (1)	32 (15)		49 (6)	5 (5)	7 (9)	4 (3)	270 (18)	144 (19)	100 (8)	4950 (15)	125 (5)	26 (6)	30 (5)	4950 (148)
Lesser Black-backed Gull	2 (2)		1 (1)	1 (2)		3 (2)		3 (1)	1 (4)	1 (1)	4 (1)	22 (14)	26 (10)	14 (4)	160 (11)	3 (2)	4 (2)	10 (5)	160 (62)
Mediterranean Gull												15 (1)	4 (2)		1 (1)				15 (4)

	1 (Barwise Brow)	2 (Grune Point)	3 (Dubmill Point)	4 (Haverigg)	5 (Askam Pier)	6 (Earnse Point)	7 (Fluke Hall)	8 (Rossall Point)	9 (Fairhaven)	10 (Church Scar Lytham)	11 (Marshside)	12 (Ainsdale-on-sea)	13 (Formby	14 (Leasowe B'water)	15 (Hoylake Trinity St.)	16 (West Kirby)	17 (Thurstaston CP)	18 (Hale Head)	Max across all locs
Other																			
Cormorant	2 (2)		36 (3)		2 (1)	2 (5)				3 (2)	8 (1)	4 (7)	4 (12)	1 (3)	1 (1)		2 (4)	3 (5)	36 (46)
Great-crested Grebe		1 (2)										2 (3)	5 (5)	1 (1)					5 (11)
Grey Heron	4 (3)	1 (3)				2 (4)			1 (1)	1 (3)	1 (2)			1 (1)					4 (17)
Little Egret	3 (7)			1 (3)	1 (3)		2 (3)		14 (6)		24 (19)						1 (1)	1 (1)	24 (43)
Red-throated Diver												2 (1)	2 (4)						2 (5)
Waders																			
Bar-tailed Godwit		450 (9)	250 (16)	43 (3)			140 (3)		1 (1)	19 (3)	2 (2)			2 (1)		13 (5)	19 (4)		450 (48)
Black-tailed Godwit				41 (14)						35 (2)				1 (2)	38 (1)	76 (4)	2200 (11)		2200 (34)
Curlew	33 (14)	68 (16)	376 (16)	22 (15)	62 (6)	19 (9)	93 (15)		47 (15)	5 (6)	305 (7)		1 (1)	17 (5)	86 (2)	178 (11)	46 (9)	26 (10)	376 (159)
Dunlin	263 (4)	215 (5)	270 (12)	3350 (18)	71 (5)	1150 (15)	1960 (12)	1 (1)	50 (3)	124 (14)	764 (3)	2 (2)		716 (15)	730 (8)	4015 (10)	450 (5)	2 (1)	4015 (133)
Golden Plover		45 (1)	2 (2)											1 (1)					45 (4)
Grey Plover	2 (4)		80 (10)	3 (4)	2 (2)	46 (15)	31 (8)		1 (2)			19 (4)	3 (4)	14 (3)	1 (1)	4 (2)	4 (6)	4 (2)	80 (67)
Jack Snipe				1 (1)															1 (1)
Knot		500 (7)	2100 (9)	7 (4)		720 (6)	8350 (7)		650 (3)	1250 (7)	207 (2)			1325 (9)	5630 (4)	850 (5)	1460 (7)	2 (1)	8350 (71)
Lapwing	69 (3)	170 (5)		12 (4)		19 (6)	128 (7)							4 (1)					170 (26)

	1 (Barwise Brow)	2 (Grune Point)	3 (Dubmill Point)	4 (Haverigg)	5 (Askam Pier)	6 (Earnse Point)	7 (Fluke Hall)	8 (Rossall Point)	9 (Fairhaven)	10 (Church Scar Lytham)	11 (Marshside)	12 (Ainsdale-on-sea)	13 (Formby	14 (Leasowe B'water)	15 (Hoylake Trinity St.)	16 (West Kirby)	17 (Thurstaston CP)	18 (Hale Head)	Max across all locs
Oystercatcher	140 (17)	400 (13)	3250 (20)	61 (18)	800 (15)	1090 (19)	1050 (15)	220 (8)	1232 (12)	490 (15)	320 (5)	16 (7)	14 (9)	2820 (20)	4100 (9)	362 (9)	3100 (16)	11 (3)	4100 (231)
Purple Sandpiper						2 (5)													2 (5)
Redshank	37 (13)	115 (19)	25 (12)	368 (18)	192 (17)	195 (17)	225 (19)	2 (1)	67 (15)	70 (15)	60 (12)			347 (14)	104 (13)	194 (15)	96 (17)	35 (19)	368 (238)
Ringed Plover			4 (3)	32 (16)	1 (2)	2 (3)		49 (8)						1 (3)	1 (3)	1 (1)	1 (1)	2 (3)	49 (43)
Ruff				1 (2)															1 (2)
Sanderling			80 (4)	2 (1)		22 (7)	26 (3)	131 (8)			6 (1)	89 (12)	19 (10)	74 (10)	240 (2)		1 (1)		240 (59)
Snipe	2 (1)	1 (1)		93 (12)		3 (2)	2 (2)												93 (18)
Turnstone			8 (8)	22 (13)		27 (16)		10 (6)	4 (6)	102 (18)		3 (1)		58 (7)	1 (1)	12 (4)		1 (1)	102 (83)

Appendix 4: Response distances summarised by response and species

Data are summarised here by species and by type of response, for those species with at least 15 observations.

Species	Response	Mean (+SE)	Median	Minimum	Maximum	n
Bar-tailed Godwit	No Response	107.1 (10.4)	100	15	200	28
Bar-tailed Godwit	Alert	40		40	40	1
Bar-tailed Godwit	Walk/Swim					0
Bar-tailed Godwit	Minor Flight	40		40	40	1
Bar-tailed Godwit	Major Flight	78.1 (20.3)	65	15	200	8
Black-tailed Godwit	No Response	106.4 (4.4)	120	35	180	90
Black-tailed Godwit	Alert	250 (200)	250	50	450	2
Black-tailed Godwit	Walk/Swim	45 (5)	45	40	50	2
Black-tailed Godwit	Minor Flight	45 (15)	45	30	60	2
Black-tailed Godwit	Major Flight	29.5 (2.4)	27.5	20	40	10
Cormorant	No Response	120.5 (5.3)	110	50	200	54
Cormorant	Alert	70		70	70	1
Cormorant	Walk/Swim	40		40	40	1
Cormorant	Minor Flight					0
Cormorant	Major Flight	43.3 (4.4)	45	35	50	3
Curlew	No Response	98 (2)	100	35	200	309
Curlew	Alert	56 (8.8)	45	30	120	10
Curlew	Walk/Swim	33.5 (11.5)	33.5	22	45	2
Curlew	Minor Flight	33.7 (2.7)	33.5	25	45	6
Curlew	Major Flight	73.5 (13.8)	50	22	500	35
Dunlin	No Response	100.2 (2.2)	100	10	200	316
Dunlin	Alert	37 (5.6)	35	25	50	5
Dunlin	Walk/Swim	13.7 (3.4)	18	3	25	7
Dunlin	Minor Flight	44 (17)	25	5	500	28
Dunlin	Major Flight	30 (2.7)	25	15	100	37
Grey Plover	No Response	112.6 (3.9)	100	35	200	65
Grey Plover	Alert	63.3 (13.3)	50	50	90	3
Grey Plover	Walk/Swim	40		40	40	1
Grey Plover	Minor Flight	37 (2.4)	39	30	40	4
Grey Plover	Major Flight	31.8 (2.1)	30	15	45	15
Knot	No Response	97 (2.4)	100	12	200	220
Knot	Alert	32 (6.8)	35	10	50	5
Knot	Walk/Swim	28.3 (7.3)	30	15	40	3
Knot	Minor Flight	33 (7)	35	5	80	10
Knot	Major Flight	37.9 (3.5)	40	15	50	12

Species	Response	Mean (+SE)	Median	Minimum	Maximum	n
Little Egret	No Response	68.8 (4.8)	50	25	180	53
Little Egret	Alert	66 (20.8)	100	15	100	5
Little Egret	Walk/Swim					0
Little Egret	Minor Flight	23.7 (2.2)	25	10	40	14
Little Egret	Major Flight	45 (8.2)	30	15	100	11
Mallard	No Response	133.2 (7.5)	120	2	500	100
Mallard	Alert	75		75	75	1
Mallard	Walk/Swim					0
Mallard	Minor Flight	31.7 (4.4)	30	25	40	3
Mallard	Major Flight	20		20	20	1
Oystercatcher	No Response	102.7 (1.6)	100	5	250	750
Oystercatcher	Alert	54.2 (4.7)	50	25	100	19
Oystercatcher	Walk/Swim	49 (8.8)	30	8	180	23
Oystercatcher	Minor Flight	29.9 (1.9)	30	8	70	38
Oystercatcher	Major Flight	45.2 (3.7)	35	5	400	136
Pink-footed Goose	No Response	123.6 (16.9)	100	75	200	7
Pink-footed Goose	Alert	61.3 (4.7)	65	40	75	8
Pink-footed Goose	Walk/Swim	70 (3.5)	72.5	60	75	4
Pink-footed Goose	Minor Flight	50 (10)	40	40	70	3
Pink-footed Goose	Major Flight	42.2 (6.7)	35	22	80	10
Pintail	No Response	110 (5.5)	100	60	190	57
Pintail	Alert	107.5 (11.1)	100	90	140	4
Pintail	Walk/Swim	20		20	20	1
Pintail	Minor Flight	50		50	50	1
Pintail	Major Flight	58.8 (8.2)	57.5	20	100	8
Purple Sandpiper	No Response	90.8 (3.6)	100	65	100	19
Purple Sandpiper	Alert					0
Purple Sandpiper	Walk/Swim					0
Purple Sandpiper	Minor Flight					0
Purple Sandpiper	Major Flight					0
Redshank	No Response	88.3 (1.4)	80	9	200	907
Redshank	Alert	45.3 (3.7)	40	10	120	42
Redshank	Walk/Swim	53.8 (10.9)	37.5	10	150	16
Redshank	Minor Flight	29.2 (1.7)	30	10	100	58
Redshank	Major Flight	34.8 (3.4)	30	10	500	148
Ringed Plover	No Response	60.7 (3.2)	50	4	180	96
Ringed Plover	Alert	90		90	90	1
Ringed Plover	Walk/Swim	32.5 (7.5)	32.5	25	40	2
Ringed Plover	Minor Flight	25 (2.2)	25	20	30	5
Ringed Plover	Major Flight	32.5 (3.5)	30	20	70	20
Sanderling	No Response	72.1 (3.6)	60	25	200	127
Sanderling	Alert	40		40	40	1
Sanderling	Walk/Swim	20.1 (1.4)	20	15	35	16

Species	Response	Mean (+SE)	Median	Minimum	Maximum	n
Sanderling	Minor Flight	22 (3.5)	19	8	100	26
Sanderling	Major Flight	25.4 (1.9)	20	12	70	39
Shelduck	No Response	99.9 (2.2)	100	35	200	257
Shelduck	Alert	61.2 (10.5)	45	30	150	13
Shelduck	Walk/Swim	50.7 (5.9)	50	5	100	15
Shelduck	Minor Flight	29 (1)	29	28	30	2
Shelduck	Major Flight	42.6 (3.5)	40	25	90	22
Snipe	No Response	100 (0)	100	100	100	20
Snipe	Alert	20		20	20	1
Snipe	Walk/Swim					0
Snipe	Minor Flight	50		50	50	1
Snipe	Major Flight	10 (1.1)	10	5	15	10
Teal	No Response	109.3 (6.8)	100	35	200	61
Teal	Alert	100		100	100	1
Teal	Walk/Swim	40		40	40	1
Teal	Minor Flight	40		40	40	1
Teal	Major Flight	50 (10)	50	40	60	2
Turnstone	No Response	67.1 (2.5)	50	2	180	392
Turnstone	Alert					0
Turnstone	Walk/Swim	15.6 (1.6)	20	4	30	19
Turnstone	Minor Flight	19.1 (1.6)	20	3	30	26
Turnstone	Major Flight	25.2 (2.4)	20	10	70	33
Wigeon	No Response	74.5 (14.6)	35	35	200	19
Wigeon	Alert	42.5 (7.5)	42.5	35	50	2
Wigeon	Walk/Swim	106.7 (33.8)	130	40	150	3
Wigeon	Minor Flight	270 (230)	270	40	500	2
Wigeon	Major Flight	90 (14.8)	90	60	140	5

Appendix 5: Overview of measures to manage or mitigate disturbance

The following table is reproduced from Ross et al. (2014) and summarises the range of management options available to mitigate for disturbance impacts. DCOs is used as an abbreviation for Dog Control Orders which have now been replaced by Public Space Protection Orders.

Key:	Measures most relevant to estuary wide approaches	Complex measures potentially difficult to deliver; Estuary-wide strategic schemes only/careful consideration necessary	More localised measures, relevant within estuary wide schemes or for localised mitigation

Measure	Type of activity measure relates to			Spatial scale		Can be off-site	Very Site Specific	Temporal scale		
	Shore-based	Water-based	Dogs	Local	Strategic			Short term measures: can be established quickly and likely to be effective quickly	Medium term measures	Major long-term projects/ large infrastructure
Lagoon and wetland creation	□	□	□	□	(□)	□				□
Hides	□			□				□	□	
On-site visitor engagement	□	□	□	□	(□)			(□)	□	
Screening	□		□	□				□	□	

Measure	Type of activity measure relates to			Spatial scale		Can be off-site	Very Site Specific	Temporal scale		
	Shore-based	Water-based	Dogs	Local	Strategic			Short term measures: can be established quickly and likely to be effective quickly	Medium term measures	Major long-term projects/ large infrastructure
Development exclusion zones	□	□	□		□	□			□	
Artificial roosts	□	□	□	□		□			□	□
Closing car parks	□	□	□	□	(□)			□	□	
Re-siting/relocating of car parks	□	□	□	□	(□)				□	□
Path improvement	□			□				□		
Permits / licences	□	□		□	□			□	□	
Path closure	□		□	□				□		
Path diversion	□		□	□				□		
Vehicle restrictions/barriers	□	□	□	□				□		
Direct contact with local clubs/user groups	□	□	(□)	□	□	□	□		□	
Alternative routes	□		□	□				□		
Temporary exclusion fencing	□		□	□				□		
Managed retreat	□	□	□	□		□				□
Watersports zones		□			□				□	
Alternative sites	□	□	□		□				□	□
DCOs to ban dogs entirely			□	□					□	

Measure	Type of activity measure relates to			Spatial scale		Can be off-site	Very Site Specific	Temporal scale		
	Shore-based	Water-based	Dogs	Local	Strategic			Short term measures: can be established quickly and likely to be effective quickly	Medium term measures	Major long-term projects/ large infrastructure
Dedicated routes	□		□	□					□	□
Limiting/reducing parking provision	□	□	□	□	□				□	
Dog-fenced areas			□	□				(□)	□	
Planning conditions	□	□	□	□	□	□		□	□	
Other byelaws (e.g. fishing, kite surfing, etc.)	□	□	□	□	□		□		□	
DCOs/byelaws to keep dogs on a lead			□	□					□	
Signs	□	□	□	□					□	
Information materials (leaflets, interpretation)	□	□	□	□	□				□	
Codes of conduct	□	□	□		□	□			□	
General off-site information provision	□	□	□		□	□			□	
DCOs to put dogs on a lead when asked			□	□					□	
Changing parking charges	□	□	□	□	□	□			□	
DCOs to limit the number of dogs per walker			□	□					□	
DCOs to pick up dog fouling			□	□					□	

Further information

Natural England evidence can be downloaded from our **Access to Evidence Catalogue**. For more information about Natural England and our work see **Gov.UK**. For any queries contact the Natural England Enquiry Service on 0300 060 3900 or e-mail **enquiries@naturalengland.org.uk**.

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