Low tide waterbird surveys:

survey methods and guidance notes

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Low tide waterbird surveys: survey methods and guidance notes

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Executive Summary

Ireland's coastal wetlands support thousands of migratory waterbirds each winter that either use them as wintering grounds or as stop-over places along migratory pathways to wintering areas further south. The conservation value of Ireland's coastal wetlands is informed through regular waterbird monitoring. Data collected though the Irish Wetland Bird Survey (I-WeBS) enables the production of waterbird population estimates and trends at the site level and at the national level.

I-WeBS surveys are undertaken primarily on a rising tide, when birds, being pushed closer to shore by the rising water or gathering at roost sites, are easier to count. As a primary focus of waterbirds during winter is to feed, it is therefore important to understand how waterbirds are distributed across a site when they are feeding. For many species feeding is concentrated around the low water stage of the tidal cycle, when tidal flats are exposed. The collection and analyses of low tide data, in addition to I-WeBS data, therefore promotes a better understanding of how these species use sites, and are important in informing the conservation management of these important areas.

The National Parks and Wildlife Service (NPWS) of the Department of Arts, Heritage and the Gaeltacht undertook a programme of low tide waterbird surveys across 33 coastal Special Protection Areas (SPAs) over the three winters of 2009/10, 2010/11 and 2011/12. The resulting low tide data are currently presented within SPA Conservation Objectives Supporting Documents and summary data are available from NPWS, on request.

This report presents the methodology used to collect these low tide data and gives guidance on data interpretation and use. It is intended that the information presented here on low tide survey design and its execution will inform future survey work on non-breeding waterbirds at coastal sites in Ireland.

Acknowledgements

1.0 Introduction

In the winter of 2009/10, the National Parks and Wildlife Service (NPWS) initiated a programme of low tide waterbird surveys across a series of coastal Special Protection Areas (SPAs). In 2009/10, and the following two winters (2010/11 and 2011/12), these surveys were undertaken across a total of 33 coastal SPAs. The primary aim of the surveys was to gain an understanding of how waterbird species use these sites during the low tide period and to identify important foraging areas; key information that was often lacking previously for some of these wetland sites.

The analyses of data from the NPWS low tide Waterbird Survey Programme 2009 – 12 are presented within the various SPA Conservation Objectives Supporting Documents and summary data are available from NPWS on request. This report presents the methodology used to collect these low tide data and gives guidance on data interpretation and use. It is intended that the information presented here on low tide survey design and its execution will inform future survey work on non-breeding waterbirds at coastal sites in Ireland.

1.1 Waterbird surveys in Ireland

Ireland's coastal wetlands[1] are important for thousands of migratory waterbirds that either use them as wintering grounds or as stop-over places as they journey to wintering grounds further south. The majority of these birds have spent the summer months at arctic and boreal breeding grounds and migrate south in autumn to avail of the relatively mild and ice-free conditions at our estuaries and coastal bays and to exploit the abundant prey resource that these habitats support.

The importance of Ireland's coastal and inland wetlands for non-breeding waterbirds has long been recognised. Waterbird surveys over limited years were carried out in Ireland during the decades 1940s to 1980s (see a review in Crowe, 2005). Since the winter of 1994/95 an annual waterbird monitoring scheme has been established, which is known as the Irish Wetland Bird Survey (I-WeBS). The primary aim of I-WeBS is to monitor the numbers and distribution of non-breeding waterbird populations during winter. The data collected have been used to provide the basis for site selection and designation of SPAs, and have enabled the estimation of population size and trends of many waterbird species to be calculated.

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[1] It should be acknowledged that inland (non-coastal) wetlands also contribute to the total wetland resource utilised by migratory waterbirds each winter, but this document relates specifically to coastal wetland sites.

1.2 The need for a low tide waterbird survey programme

I-WeBS Core counts are undertaken at monthly intervals during the period September – March inclusive (for further details please refer to Crowe, 2005; Boland & Crowe, 2012). This timeframe covers the main winter period when many species occur in their largest concentrations, but also overlaps with the autumn and spring passage periods when total waterbird numbers at sites may be enhanced by staging/stopover birds[2].

I-WeBS surveys are undertaken primarily on a rising tide, when birds are pushed closer to shore and are easier to count. At high tide, I-WeBS can also record the positions of roost sites and the numbers and species of waterbirds that use them.

During the non-breeding period, waterbirds must achieve a sufficient energy intake through feeding in order to reduce the risks of overwinter mortality but also to enable the successful return migration to the breeding grounds in good condition to breed. Therefore it is important to understand how waterbirds are distributed across a site when they are feeding, and for many species feeding is concentrated around the low water stage of the tidal cycle, when tidal flats are exposed. Detailed knowledge of low tide feeding grounds and their use, in addition to I-WeBS data, therefore provide a more complete understanding of how species use sites, which is important to inform the conservation management of these important areas.

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[2] The terms 'stopover' and 'staging' are often used interchangeably. A stopover site can be defined as any place where a bird takes a break during migration. Staging areas are stopover sites that attract large numbers of individuals and play an important part in re-fuelling the birds before their onward migration (e.g. Warnock, 2010).

2.0 Background to the low tide survey programme

2.1 Survey coverage of coastal SPAs

The NPWS low tide Waterbird Survey Programme commenced in the season 2009/10. By the end of the winter 2011/12, thirty-three coastal SPAs were surveyed across Ireland. A list of sites surveyed to date is provided in Appendix 1.

The primary focus during low tide surveys was often on wading birds that specialise in feeding across exposed tidal flats. But coastal SPAs are often 'site complexes' and may cover large areas and include a range of intertidal and coastal habitats across which waterbirds may range, including saltmarsh, coastal grassland, lagoons, reedswamps and freshwater lakes. Therefore the waterbird survey programme often extended beyond the SPA boundaries and included other associated wetland areas.

Complete coverage of wetlands was achieved for a majority of sites with some notable exceptions; an example being the River Shannon & Fergus Estuaries SPA (Site code 4077) which at 32,261ha in size, is not only challenging in terms of accessibility, visibility and the distances over which birds range, but also in terms of the time and number of fieldworkers that would be required to achieve full count coverage. For such sites the primary aim was therefore to complete good count coverage across key areas of the site.

A single wetland site can rarely meet all the ecological requirements of a diverse assemblage of waterbirds (Ma et al. 2010); so while a count site may satisfy the ecological requirements (e.g. feeding, roosting, loafing) for some species, it may not for others. To address this monitoring issue, a series of additional surveys are undertaken periodically to complement I-WeBS; these are discussed in Crowe (2005) and Boland & Crowe (2012).

2.2 Species coverage

Waterbirds are defined as '*"birds that are ecologically dependent on wetlands"*' (Ramsar Convention, 1971). Although linked by their dependence on water, different species can vary considerably in aspects of their ecology due to many evolutionary adaptations and specialisations to different wetland habitats. Species or groups of species may therefore utilise wetland habitats in very different ways which relates to how species are distributed across a site as a whole.

The following waterbirds as defined by the Ramsar Convention (1971) were included in the survey programme: Gaviidae (divers), Podicipedidae (grebes), Anatidae (swans, geese and ducks), Rallidae

(Water Rail, Moorhen & Coot), Haematopodidae (oystercatchers), Charadriidae (plovers and lapwings), Scolopacidae (sandpipers and allies) and Laridae (gulls and terns). In line with I-WeBS methodology, Cormorant (*Phalacrocorax carbo*), Shag (*Phalacrocorax aristotelis*), Little Egret (*Egretta garzetta*), Grey Heron (*Ardea cinerea*) and Kingfisher (*Alcedo atthis*) were also included.

2.3 Fieldworkers

Fieldwork for the three survey seasons was primarily undertaken by staff of BirdWatch Ireland under contract to the National Parks & Wildlife Service. Teams of fieldworkers were assigned to each site and an overall Team Leader was appointed to coordinate the teams and data entry, data storage/filing and delivery. Low tide surveys at several sites were completed by the regional staff of NPWS.

2.4 The survey programme

To maximise data collection, four low tide counts were completed each season. A single low-tide count was undertaken in each of the months October, November, December and February. It was recommended that no count should be undertaken within ten days of a previous count.

Low tide surveys were standardised by being undertaken during the two-hour period either side of low-tide. In a semi-diurnal system, each low tide cycle lasts approximately six hours, and an estuarine system is constantly in flux as the tide ebbs slowly towards the time of low water, and then floods gradually to the time of high water. While it is recognised that waterbird distribution varies across the tidal cycle, and like the tidal cycle itself, is constantly in flux, previous studies suggest that standardisation of counts to the period before and after low tide provides a good representation of the average usage of study areas in 75% of cases (Burton et al. 2004).

Clearly 'through-the-tide counts' would be advantageous to obtain the most complete understanding of foraging distribution across a site but these were beyond the scope of this broad-scale monitoring programme. However such approaches would be very useful for detailed studies as part of, for example, ecological impact assessments (EcIA).

3.0 Survey methodology

3.1 Survey planning and site/subsite determination

As noted above, a key requirement of the survey programme was to achieve, wherever practicable, count coverage of each wetland site in its entirety. Therefore an important early step in survey planning is to define the total extent of the wetland site and the total count area of that site (i.e. the area that can be covered practicably). The total count area is then divided into subsites. The publication *Ireland's Wetlands and their waterbirds: status and distribution* (Crowe, 2005) is a key reference containing site descriptions and details of I-WeBS boundaries and coverage, while SPA boundaries are available to view and download on www.npws.ie.

The identification of count subsites should begin with a review of I-WeBS boundaries because these are defined with mapped boundaries and known and workable vantage points. The use of I-WeBS subsites also enables comparison of low tide data with I-WeBS data. However, as I-WeBS is undertaken on a rising or at high tide, the subsites are sometimes inappropriate for the low-tide programme when a larger area of tidal flat is exposed. The subdivision of I-WeBS subsites is therefore recommended, leaving the outer boundaries intact to allow comparison of data collected with existing datasets. Subsites are subdivided using identifiable features (e.g. man-made features such as piers, slips or roads) and using natural divisions between habitat types (e.g. upper estuarine mudflats, outer estuarine sandflats, open sea). A site visit is necessary to confirm subsite boundaries; this is undertaken during the low tide period when all broad habitats can be viewed. Count subsites are chosen on the basis that:

(1) complete coverage by *n* number of fieldworkers is possible within a four-hour period;

(2) there is no overlap of areas counted and no areas were missed;

(3) they are appropriate (in terms of size/habitat type etc) for low-tide surveys (see above);

(4) they can be clearly identified in the field and on a 6-inch map (to allow accurate digitisation within GIS); and

(5) they are repeatable.

For the 33 SPAs covered, low tide site boundaries and subsite boundaries have been determined and digitised within ARC GIS. These boundaries can be used in future low tide monitoring programmes and subsite boundary shapefiles are available on request from NPWS.

Wherever possible, survey dates should be chosen so that the time of low tide (or high tide) is close to midday thus maximising the time available before and after the survey period, facilitating fieldworker travel, and access to and from vantage points in daylight. Flexibility with regards survey dates is required to be able to respond to weather conditions therefore the identification of 'back-up' dates is advisable.

3.2 Field survey methods

Pre-survey

Each fieldworker was assigned a number of count subsites for which they are responsible during the survey programme. Repeat counts by the same fieldworker are advantageous so that they become familiar with access routes between vantage points as well as boundary lines between subsites. Repeat surveys by the same person also maximises knowledge gained of bird behaviour, patterns and distribution in their survey areas.

Fieldworkers were provided with field maps (Ordnance Survey Ireland (OSI) 6''or 1:5000 maps) showing subsite boundaries plus count forms for recording count data (shown in Appendix 2). Aerial photographs with subsite boundaries superimposed may also be useful. Target Note Sheets are used for the recording of additional observations as required. In practice, hand-written count forms have become almost obsolete because Excel data entry is quicker. Fieldworkers record count data using a method familiar to them (e.g. field notebook) and transfer these data to the Excel data entry sheet after the survey. Printed count forms remain useful however as a check-list in the field providing summary instructions on the various categories of data that need to be recorded.

Before starting a count, the following data is recorded for each subsite:

1. **Counter Code**: a unique code assigned to each fieldworker.

2. **Survey type:** i.e. low tide.

3. **Site/Subsite Details**: the code and name of the site and subsite being counted.

4. **Date and count start and end time.**

5. **Tidal State**: as per the following categories 1= **Rising** (3-hour period after LT); 2 = **High** (3-hour period with HT in the middle); 3 = **Falling** (3-hour period after HT) and 4=**Low** (3-hour period with LT in the middle).

6. **Ice Cover:** this refers to areas of frozen mudflat, saltmarsh or even frozen sea surface and was recorded in the following categories 0-33%, 33-66% and 66-100%.

7. **Weather Conditions**: attributed to the following categories: cloud cover (0-33%, 33-66% and 66-100%), rain (none, showers or drizzle), wind (calm, light or breezy) and visibility (good, moderate or poor).

Note that poor weather conditions can seriously affect visibility and the accuracy of counts. Surveys should therefore not proceed in conditions of heavy rain, poor visibility or strong wind. Despite surveys being planned for days with suitable weather, conditions can sometimes deteriorate during a survey. In extreme cases surveys may need to be abandoned and re-scheduled.

Bird Counts

Waterbird counts are conducted on the 'look-see' basis (Bibby et al. 2000) which involves scanning across the survey area and counting all birds seen. Birds are recorded (and listed on the count form) according to their species code following the two-letter coding system used by I-WeBS and developed by the British Trust for Ornithology. The codes for common species are shown in Appendix 3.

The position and behaviour of the birds counted is assigned to the categories outlined below:

Position - waterbirds are assigned to one of five broad habitats (1) intertidal (area between mean low water and mean high water); (2) subtidal (area below mean low water) (3) supratidal (area above mean high water); (4) terrestrial and (5) terrestrial – aquatic. Further guidance on the use of these broad habitats is given in Appendix 4.

Only waterbirds that occur within count subsites are recorded in the standard manner. However, as with any mobile species, waterbirds sometimes occur outside of the delineated subsites (e.g. flocks feeding in nearby fields). In these cases it is advantageous to record this information on additional datasheets or using the Target Note Sheet.

Behaviour – waterbird behaviour is assigned to one of two categories: (1) **foraging** or (2) **roosting/other.** Further guidance on this topic is given in Appendix 5.

Recording numbers of waterbirds and count accuracy - count accuracy should be recorded as follows:

- Count number only - denotes that a count is considered accurate to within 10% of the total number present;

- Count number in square brackets e.g. [540] - denotes a count that is an underestimation of the total number present;

- Count number within a circle - denotes a count that is not considered accurate or has not been obtained in the standard manner (e.g. a crude estimate when birds fly off mid-count);

- 'NC' (no count) written in the appropriate species box - indicates that a species is present but is not counted for some reason (e.g. flock flew off just as you were about to count it).
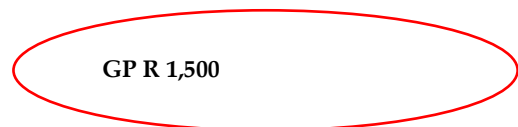
Mapping flock positions

In addition to counting waterbirds within subsites, the position of major flocks of foraging and/or roosting birds is drawn onto field maps ('flock maps'). The interpretation of what is a 'major' flocks is subjective and best judgement is used to determine which flocks to map (e.g. the difference between a flock of 10 Wigeon and 10 Greenshank; with the latter being more significant).

Species that are widely distributed as many small flocks, or are widely dispersed across a subsite are difficult to map and in these cases a simple written note onto a flock map or Target Note Sheet can aid the understanding of distribution at a later date. Appendix 6 shows some examples of flock maps.

Flock positions are recorded by drawing a shape onto the field map that illustrates the <u>estimated</u> location and extent of the flock. The species (codes), their numbers and an indication of behaviour (foraging (F) or roosting/other (R) are written inside or alongside the shape, clearly linked with an arrow.

For example: a flock of roosting Golden Plover upon sandflats at low-tide:-

GP R 1,500

A mixed flock of 980 foraging Black-tailed Godwits and 50 foraging Dunlin - counts for both species are considered to underestimate the true flock size:-

BW F [980]

DN F [50]

When it was not clear on the field map as to which broad habitat the birds are in (e.g. intertidal vs subtidal) then the broad habitat (Int, Sub, Supra, Terr or Terr (aq) as appropriate) should also be written alongside the species code and number. Flocks that occur across two different broad habitats are labelled with both (e.g. Int/Sub).

Overlapping count sections: when a flock occurs on the boundaries of separate count subsites then only birds that occur inside the subsite being counted are recorded. However it is useful to note on the field map or Target Note Sheet that the flock overlaps with another subsite.

Subsite

boundary

WN R 320

T. R 180
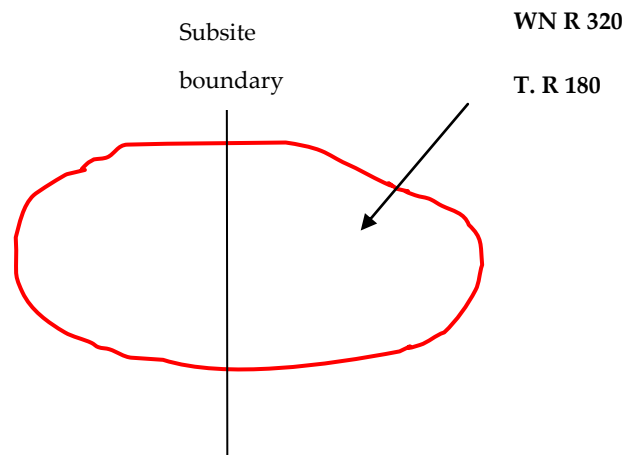
Overlapping flocks: when it is possible to distinguish two distinct flocks that overlap each other they can be mapped to indicate this. The example below shows a flock of roosting Black-tailed Godwits and Knot, where the Knot are located in a linear strip overlapping the Black-tailed Godwits. (Note that the Knot are distributed across both intertidal and subtidal habitat i.e. some birds have their feet in water although it is not possible to make an accurate count of each so a total count is given).

BW R 180 (Int)

KN   R   220

(Int/Sub)
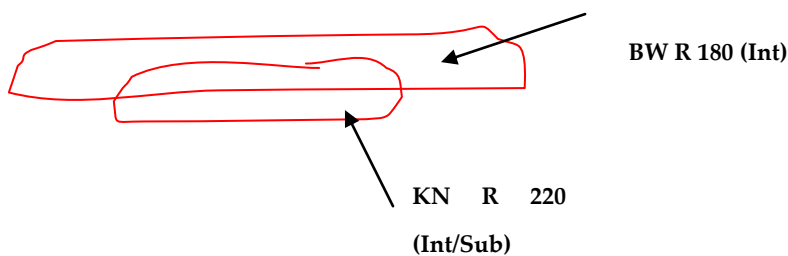
Disturbed flocks: if a flock flies away prior to its mapping, where possible the flock position and number of birds are estimated (circled number to denote inaccurate).

Moving flocks: some flocks of birds regularly take to the air and then settle again in a slightly different position. These movements can be recorded by marking the general position of the flock and indicating its transient nature on the Target Note Sheet. If necessary, map several positions and link them with an arrow.

Recording accessory information

Fieldworkers spend a considerable amount of time in the field and the recording of accessory information is advantageous, especially when this information can aid the understanding of the distribution or behaviour of the waterbirds present.

Recording of activities/events: this refers to activities that occur at the site that are, or have the potential to cause disturbance to waterbirds. All activities are recorded, regardless of whether they are causing a noticeable disturbance to birds at the time of observation, or not. Each activity is recorded separately. Although the method of recording appears complex it is easily accomplished in practice.

A circled number is used to identify the activity type and this number is crossed if the activity is affecting birds. Activity types are categorized as follows:

(1) human, on-foot - shoreline (2) human, on foot – intertidal aquaculture, (3) bait-diggers (4) non-powered watercraft (5) powered watercraft, (6) water-based recreation (e.g. wind-surfers) (7) horse-riding (8) dogs (9) aircraft (10) shooting (11) other (12) winkle pickers (13) aquaculture machinery (14) other vehicles.

Note that (8) dogs, refers to dogs with or without accompanying humans, to distinguish between humans that are walking along a shore without dogs (1).

The circled number is recorded onto the count form/data sheet and onto a field map. In the case of the latter, the circled number is drawn to show the general location of the activity and the map can also be annotated to indicate e.g. routes traversed by boats or people.

When an activity is observed to cause a disturbance, the waterbird species affected are recorded by writing the species code in the space provided on the count form/data sheet. In brackets following the species code, a letter is used to indicate the bird's response to the activity as follows:-

W - Weak response, waterbirds move slightly away from the source of the disturbance.

M - Moderate response, waterbirds move away from the source of the disturbance to another part of your subsite; they may return to their original position once the activity ceases.

H - High response, waterbirds fly away to areas outside of your subsite and do not return during the current count session.

The length of the activity is recorded by adding by the codes **A – D** (see below). The addition of a star * (e.g. A*) represents an activity that was already occurring within the subsite when the count started.

A – short/discrete event.

B – activity occurs for up to 50% of the count period.

C – activity length estimated at >50% but < 100% of the count period.

D – activity continues after the count period has ended.

Best judgement should be used when recording activities. Although it is important to record individual activities and how waterbirds respond to them, individual detail is not always needed. For example, several people walking along a beach with their dogs can be recorded as one event if it occurs in the same general location. Likewise, several small fishing boats in one area of a harbour can be counted as one event; but if one boat takes a different path across a new area then this would be recorded separately.

Recording the presence of raptors - the presence of raptors during a count session is recorded by circling the species code on the count form. A crossed circle represents a raptor that is causing disturbance to waterbirds. Alternatively this data is entered into the data sheet.

4.0 Data handling and use

4.1 SPA Conservation Objectives

Low tide data from the NPWS low tide Waterbird Survey Programme 2009 – 12 are analysed and presented within the various SPA Conservation Objectives Supporting Documents (see examples on www.npws.ie).

How the data are handled

Raw data are received from fieldworkers either on count forms or, for the majority, on specifically designed MS Excel data sheets. Data are compiled and quality checked then entered into an MS Access database, from which summary datasheets can be produced.

For each survey undertaken and for each species, subsite totals are obtained by summing the individuals counted across each behaviour and broad habitat type within each subsite. When a subsite was counted by more than one fieldworker, (e.g. large subsites that required fieldworkers at more than one vantage point), the count data are added together to form a total subsite count.

GIS mapping

Low tide site boundaries and subsite boundaries are mapped within GIS. This allows the determination of site and subsite areas. Broad habitats are mapped using OSI Discovery Series mapping and the areas of broad habitats determined at site and subsite level.

Low tide data analyses and presentation

The aim of data analyses is to help understand how waterbirds are distributed across a site during the survey period. By assessing patterns of waterbird distribution at low tide, together with examination of data on sediment and invertebrate distribution and abundance[3], areas (subsites) within the site that are important for foraging (and roosting) are identified on a species by species basis.

For each coastal SPA site, data analyses determine the proportional use of subsites by each species relative to the whole area surveyed on each survey occasion. These analyses are undertaken for total bird numbers, and for subsets of these data, for example, species foraging (intertidally or subtidally). For each survey date, subsites are ranked in succession from the highest to the lowest in terms of their

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[3] Data from surveys undertaken by NPWS and the Marine Institute.

relative contribution to each species' distribution. The rank positions are then converted to categories as follows:

- **Very High (V)** - Any section ranked as 1.

- **High** - Top third of ranking placings (where n = total number of count sections species was observed in);

- **Moderate (M)** - Mid third of ranking placings (where n = total number of count sections species was observed in)

- **Low (L**) - Lower third of ranking placings (where n = total number of count sections species was observed in).

This approach, rather than averaging across all surveys, means that more than one subsite can be ranked within the same category. This equal weighting allows for temporal differences e.g. concentrations of foraging birds in different subsites at different times, reflecting natural pattern of distribution across time.

Intertidal foraging density is calculated for selected species and for each low tide survey, by dividing the number of the species within a subsite by the area of intertidal habitat within the same subsite. Whole site intertidal foraging density is calculated by summing the mean subsite counts for each species and dividing by the total area of intertidal habitat within the count area.

Waterbird count data for low tide surveys are also presented as species distribution maps ('dot density maps'). Dot-density maps show waterbird species distribution, divided into 'foraging' birds and 'roosting/other' birds, an example shown in Figure 1. The abundances of birds are represented by dots; each dot representing one, or a pre-determined number of birds. As the dots are randomly placed within the appropriate subsites and broad habitat types for the birds counted, the resulting map presents numbers and densities in an efficient and effective manner in order to assess a species' distribution.

Figure 1. Example dot density map

Summary low tide data are available on request from NPWS, and take the form of totals (e.g. site totals, subsite totals) and summaries (e.g. data divided by behaviour or position).

4.2 Data interpretation, limitations and guidance notes

While low tide data can provide important information on the distribution of waterbirds during the low tide period, there are several points to consider when interpreting these data.

Based on previous experience (e.g. Musgrove et al. 2003; Lewis & Kelly, 2012), it is considered that broad-scale low tide distributions recorded in a single winter are a reasonably reliable predictor of longer-term distributions, so long as major changes do not take place such as marked shifts in invertebrate distribution/abundance or increases in external pressures (e.g. human activities). However each site should be considered on an individual basis because some sites have more external pressures that might affect waterbird distributional patterns, than others.

In order to assess species' distribution over time, repeat surveys using similar methods and count sites would be required (e.g. Lewis & Kelly, 2012).

A species' distribution at a point in time may be influenced by one or more factors. A notable example is weather. The NPWS low tide Waterbird Survey Programme 2009 – 12 coincided with two relatively severe cold winters (i.e. 2009/10 and 2010/11) which undoubtedly affected waterbird distribution patterns across Ireland and Europe (Crowe & Boland, 2011). Other influencing factors include tide (e.g. differences in exposure of tidal flats between spring and neap tides), temperature, direction of prevailing winds, changing prey densities/availabilities and degree of human activity across the site, all of which could lead to changing patterns across months and years.

As described previously, low tide surveys are standardised by being undertaken during the period two hours before, to two hours after, the time of low water. While this period provides a good representation of the average usage of study areas (Burton et al. 2004) it should be recognised that waterbird feeding distribution changes throughout the tidal cycle. For example, low tide counts are likely to underestimate the usage of upper shore areas, these areas often utilised for a brief but important period as the tide ebbs. Low tide surveys are ideally suited to collecting data on the distribution of wading birds. While all waterbird species were counted during the NPWS low tide survey programme, it should be borne in mind that other states of the tide may be more appropriate for some other species, and notably waterfowl that forage preferentially on ebbing or flood tides. While the low tide survey period is deemed suitable for broad-scale surveys, in some cases, and where specific detail is required, 'through the tide counts' may need to be employed.

Dot-density maps do not show the actual position of birds; the dots are placed randomly within subsites so no conclusions can be made at a scale finer than subsite. Although the dots are placed in the appropriate subsites and broad habitats for the birds counted, the broad habitats are based on OSI mapping, and cannot represent the finer-scale habitat complexities that occur across a site, for

example, in the case of waterbirds associated with freshwater flows, or small creeks, that are 'subtidal' in terms of broad habitat definition, but are not shown on OSI maps.

While field maps (flock position maps or roost location maps) can be very valuable in clarifying details of finer-scale distribution, some limitations of use apply. In general it is very difficult to accurately determine the position of birds when viewing over large distances; the inherent error in this will vary for different sites. Flock or roost position maps are best viewed as indicative only.

The NPWS low tide Waterbird Survey Programme 2009 – 12 was based on surveys that were largely undertaken during the days Monday to Friday. In many sites the levels of human recreational activities are much reduced on weekdays as opposed to weekend days, and hence waterbird distribution may differ between them. The significance of this will vary on a site by site basis.

Additional pointers are given below to guide the careful use of low tide (and other) waterbird data.

- I-WeBS is the principal source of data that inform the calculation of population estimates both at site level and national level. Analyses of I-WeBS data also lead to the production of trends of waterbird numbers and distribution. Low tide data surveys are primarily intended to provide details of waterbird spatial distribution. As already noted above however, these patterns of distribution should not be considered absolute as waterbirds by their nature are highly mobile and various factors will lead to variation across both space and time.

- I-WeBS data are generally examined in five-year periods (five-year peak mean). The mean is used to dampen annual fluctuations in numbers, and as a way of compensating for missing counts (Boland & Crowe, 2012). It is important to consider that low tide data at the site level from the NPWS low tide Waterbird Survey Programme 2009 – 12 refers to one single season. When examining this limited dataset, site and subsite peak numbers, rather than average numbers, are therefore most appropriate for use because they give a better reflection of the totals of birds using the area.

- Density is an important calculation as seemingly low numbers of birds in an area can, depending on area counted, equate to a high density area of particular significance.

- Data for individual subsites should not be considered in isolation. As subsites are subdivided units of the 'entire' wetland, subsite data should always be viewed in the context of the site as a whole.

- It should be borne in mind that the standard low tide survey programme encompassing the months October to February inclusive, does not provide any detail on birds that may occur at a site during the important periods of passage (i.e. August- September, March-April).

5.0 Bibliography & Relevant Literature

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Appendices

Appendix 1 21

Coastal SPAs included in the NPWS low tide Waterbird Survey Programme 2009 – 12

2009/10	2010/11	2011/12
Dundalk Bay (Co Louth) (SPA 4026)	Drumcliff Bay (Co Sligo) (SPA 4013)	North Bull Island & South Dublin Bay & River Tolka Estuary (Co. Dublin) (SPA 4006 & 4024)
Blackwater Estuary (Co Waterford/Cork) (SPA 4028)	Ballycotton Bay (Co Cork) (SPA 4022)	Rogerstown Estuary (Co Dublin) (SPA 4015)
Castlemaine Harbour (Co Kerry) (SPA 4029)	Ballymacoda Bay (Co Cork) (SPA 4023)	Baldoyle Bay (Co Dublin) (SPA 4016)
Inner Galway Bay (Co Galway) (SPA 4031)	Tramore Bay (Co Waterford) (SPA 4027)	Ballyteige Burrow (Co. Wexford) (SPA 4020)
Dungarvan Harbour (CO Waterford) (SPA 4032)	Cork Harbour (SPA 4030)	Malahide Estuary (Co Dublin) (SPA 4025)
Bannow Bay (Co Wexford) (SPA 4033)	Cumeen Strand (Co Sligo) (SPA 4035)	Boyne Estuary (Co. Louth) (SPA 4080)
Trawbreaga Bay (CO Donegal) (SPA 4034)	Killala Bay/Moy Estuary (Co Sligo) (SPA 4036)	Lough Foyle (4087)
Donegal Bay (Co Donegal) (SPA 4151)	River Shannon & Fergus Estuaries (Co Clare, Limerick, Kerry) (SPA 4077)	River Nanny Estuary & Shore (Co. Meath) (SPA 4158)
Blacksod/Broadhaven Bay (Co Mayo) (SPA 4037)	Clonakilty Bay (Co Cork) (SPA 4081)	
Lough Swilly (Co Donegal) (SPA 4075)	Courtmacsherry Estuary (Co Cork) (SPA 4219)	
Wexford Harbour, Slobs (incl. The Raven SPA) (Co Wexford) (SPA 4076 and 4019)	Mid Clare Coast (Co Clare) (SPA 4182)	
Tralee Bay Complex (Co Kerry) (SPA 4188)		

Appendix 2

Example count form

Baseline Waterbird Surveys within Irish Coastal Special Protection Areas 2011/12

WATERBIRD COUNT FORM

Guidelines for Data Entry

Brief guidelines for data entry are given below. The numbers refer to sections in the following pages. Please also refer to the detailed methodology within 'Baseline waterbird surveys within Irish Coastal SPAs - survey methods and guidance notes.'

(1) **Counter Code**: Please enter this code in the box provided.

(2) **Survey type**: Please mark whether this data form refers to a low-tide or high-tide count.

(3) **Site Details**: Please enter the site code and name, followed by the count unit code and count unit name.

(4) **Date and Time**: Please enter the date in the section provided (dd/mm/yyyy) and the start and finish times of your count in the appropriate boxes – please use 24hour clock (e.g. 11:45).

(5) **Tidal State**: Record the tidal state that best represents the time period during which you conduct the survey:- 1= **Rising** (3-hour period after LT); 2 = **High** (3-hour period with HT in the middle); 3 = **Falling** (3-hour period after HT) and 4 = **Low** (3-hour period with LT in the middle). **Ice Cover**: please circle the percentage cover of ice as appropriate.

(6) **Weather Conditions**: Please record weather conditions in the boxes provided, referring to the conditions/categories outlined. If weather conditions change during the survey please select a category based upon the one which best represents the overall conditions.

(7) **Bird Counts**: Please enter the numbers of each waterbird species counted in the appropriate columns with regards their location (**intertidal, subtidal, supratidal, terrestrial** and **terrestrial (aquatic)**) and behaviour (**foraging** or **roosting/other**). Blank lines are provided to record additional species not listed on the form.
For all counts, please:
- Use square brackets around a count number e.g. [540] to denote a count that is considered to underestimate the total number present;
- Put a circle around a count number to denote a count that is not considered to be accurate or which was not taken in the standard manner e.g. when you have not had time to count a large flock because the birds fly off mid-count and a crude estimate is therefore provided.
- Write 'NC' (no count) in the appropriate box if a species was present but you were not able to count it (e.g. flock flew off).
- An empty box for a species represents a nil-record i.e. the species was not present during the count session.

(8) **Records of disturbance events**:

Spaces are provided to record each disturbance event that occurs during your count period. Please use circled numbers that correspond to disturbances type e.g ② and cross if the disturbance is affecting birds, e.g. ②̸

In the additional space provided, please indicate:
- the main species affected by the disturbance (species code).
- species response: weak (W), moderate (M) or high (H), and
- the duration of disturbance events: (A) short, (B) 50% of count, (C) more than 50% of count or (D) continuing after the count has ended,
- a star * (e.g. A*) to represent an activity that was already occurring within the subsite when you started the count of that subsite.

(9) **Raptors** - Please record the presence of raptor species during your count session by circling the species code. Indicate if the raptor is causing a disturbance (e.g. attack) by crossing the circle.

MAP PRODUCTION – For each subsite (and for each survey date) please provide (1) a flock map and (2) an activity/events map.

| (1) COUNTER CODE: | | | | | | - | | | | | | (4) Date / / | Start Time: | Finish Time: |

| (2) Survey Type: Circle appropriate | Low tide | High tide |

(5)Tidal State circle appropriate	1 rising	2 high	3 falling	4 low
Ice Cover circle appropriate	1 0 – 33%	2 30 – 66%		3 66 – 100%

(3)
SITE CODE: _____
SITE NAME: _____
COUNT UNIT CODE: _____
COUNT UNIT NAME: _____

(6) Weather circle appropriate

	1	2	3
Cloud cover:	0 – 33%	33 – 66%	66 – 100%
Rain:	1 none	2 showers	3 drizzle
Wind:	1 calm	2 light	3 breezy
Visibility:	1 good	2 moderate	3 poor

(7) Waterbird counts

	Code	Intertidal	Intertidal	Subtidal	Subtidal	Supratidal	Supratidal	Terrestrial	Terrestrial	Terrestrial aquatic	Terrestrial aquatic
		F	R	F	R	F	R	F	R	F	R
Red Throated Diver	RH										
Black-throated Diver	BV										
Great Northern Diver	ND										
Little Grebe	LG										
Great Crested Grebe	GG										
Slavonian Grebe	SZ										
Cormorant	CA										
Shag	SA										
Little Egret	ET										
Grey Heron	H.										
Mute Swan	MS										
Bewick's Swan	BS										
Whooper Swan	WS										
Pink-footed Goose	PG										
Greenland White-fronted Goose	NW										
Greylag Goose	GJ										
Canada Goose	CG										
Barnacle Goose	BY										
Light-bellied Brent Goose	PB										
Shelduck	SU										
Wigeon	WN										
Gadwall	GA										
Teal	T.										
Mallard	MA										
Pintail	PT										

	Code	Intertidal F	Intertidal R	Subtidal F	Subtidal R	Supratidal F	Supratidal R	Terrestrial F	Terrestrial R	Terrestrial aquatic F	Terrestrial aquatic R
Shoveler	SV										
Pochard	PO										
Tufted Duck	TU										
Scaup	SP										
Long-tailed Duck	LN										
Common Eider	E.										
Common Scoter	CX										
Goldeneye	GN										
Smew	SY										
Red-breasted Merganser	RM										
Goosander	GD										
Ruddy Duck	RY										
Water Rail	WA										
Moorhen	MH										
Coot	CO										
Oystercatcher	OC										
Ringed Plover	RP										
Golden Plover	GP										
Grey Plover	GV										
Lapwing	L										
Knot	KN										
Sanderling	SS										
Little Stint	LX										
Curlew Sandpiper	CV										
Purple Sandpiper	PS										
Dunlin	DN										
Ruff	RU										
Jack Snipe	JS										
Snipe	SN										
Woodcock	WK										
Black-tailed Godwit	BW										
Bar-tailed Godwit	BA										
Whimbrel	WM										
Curlew	CU										
Spotted Redshank	DR										
Redshank	RK										
Greenshank	GK										
Green Sandpiper	GE										
Wood Sandpiper	OD										
Common Sandpiper	CS										
Turnstone	TT										

	Code	Intertidal F	Intertidal R	Subtidal F	Subtidal R	Supratidal F	Supratidal R	Terrestrial F	Terrestrial R	Terrestrial aquatic F	Terrestrial aquatic R
Kingfisher	KF										
Black-headed Gull	BH										
Common Gull	CM										
Lesser Black-backed Gull	LB										
Herring Gull	HG										
Great Black-backed Gull	GB										
Mediterranean Gull	MU										
Sandwich Tern	TE										
Common Tern	CN										
Arctic Tern	AE										
Little Tern	AF										

(8) DISTURBANCE

Please record each disturbance event in a separate space below. Please use circled numbers that correspond to disturbances type e.g. ② and cross if the disturbance is affecting birds, e.g. ⊗

In the additional space provided please indicate the main species affected by the disturbance (species code), whether their response was weak (W), moderate (M) or high (H) **and** the duration of disturbance events: short (A), 50% of count (B), more than 50% of count (C) or continuing after the count has ended (D) plus the addition of a star * (e.g. A*) to represent an activity that was already occurring within the subsite when you started the count of that subsite.

There is space for 5 disturbance events; please use an additional sheet if necessary thereafter.

Example ②				
CU/RK (M, B)				

1 human, on-foot - shoreline 2 human, on foot – intertidal aquaculture, 3 bait-diggers 4 non-powered watercraft 5 powered watercraft, 6 water-based recreation (e.g. jet-skis, wind-surfers) 7 horse-riding 8 dogs 9 aircraft 10 shooting 11 other 12 winkle pickers 13 Aquaculture machinery 14 other vehicles

(9) BIRDS OF PREY

Circle species codes for the birds of prey present during your count session; indicate which were causing a disturbance with a crossed circle :-

SPECIES:	MR	HH	SH	K.	ML	PE	BZ	SE	O.

MR Marsh Harrier; HH Hen Harrier; SH Sparrowhawk; K Kestrel; ML Merlin; PE Peregrine; BZ Buzzard; SE Short-eared Owl O. Other (please specify)

Appendix 3

Waterbird Species Codes

(for additional waterbird species not shown here please refer to I-WeBS (2008))

AE	Arctic Tern	*Sterna paradisaea*
BY	Barnacle Goose	*Branta leucopsis*
BA	Bar-tailed Godwit	*Limosa lapponica*
BE	Bean Goose	*Anser fabalis*
BS	Bewick's Swan	*Cygnus columbianus*
AS	Black Swan	*Cygnus atratus*
BH	Black-headed Gull	*Chroicocephalus ridibundus*
BN	Black-necked Grebe	*Podiceps nigricollis*
BW	Black-tailed Godwit	*Limosa limosa*
BV	Black-throated Diver	*Gavia arctica*
DB	Brent Goose (dark-bellied)	*Branta bernicla bernicla*
PB	Brent Goose (Light-bellied)	*Branta bernicla hrotra*
CG	Canada Goose	*Branta canadensis*
CM	Common Gull	*Larus canus*
CS	Common Sandpiper	*Actitis hypoleucos*
CX	Common Scoter	*Melanitta nigra*
CN	Common Tern	*Sterna hirundo*
CO	Coot	*Fulica atra*
CA	Cormorant	*Phalacrocorax carbo*
CU	Curlew	*Numenius arquata*
CV	Curlew Sandpiper	*Calidris ferruginea*
DN	Dunlin	*Calidris alpina*
E.	Eider	*Somateria mollissima*
GA	Gadwall	*Anas strepera*
GP	Golden Plover	*Pluvialis apricaria*

GN	Goldeneye	*Bucephala clangula*
GD	Goosander	*Mergus merganser*
GB	Great Black-backed Gull	*Larus marinus*
GG	Great Crested Grebe	*Podiceps cristatus*
ND	Great Northern Diver	*Gavia immer*
NW	Greenland White-fronted Goose	*Anser albifrons flavirostris*
GK	Greenshank	*Tringa nebularia*
H.	Grey Heron	*Ardea cinerea*
GV	Grey Plover	*Pluvialis squatarola*
GJ	Greylag Goose	*Anser anser*
HG	Herring Gull	*Larus argentatus*
IG	Iceland Gull	*Larus glaucoides*
JS	Jack Snipe	*Lymnocryptes minimus*
KF	Kingfisher	*Alcedo atthis*
KN	Knot	*Calidris canutus*
L.	Lapwing	*Vanellus vanellus*
LB	Lesser Black-backed Gull	*Larus fuscus*
ET	Little Egret	*Egretta garzetta*
LG	Little Grebe	*Tachybaptus ruficollis*
LU	Little Gull	*Hydrocoloeus minutus*
AF	Little Tern	*Sterna albifrons*
MA	Mallard	*Anas platyrhynchos*
MU	Mediterranean Gull	*Larus melanocephalus*
MH	Moorhen	*Gallinula chloropus*
MS	Mute Swan	*Cygnus olor*
OC	Oystercatcher	*Haematopus ostralegus*
PG	Pink-footed Goose	*Anser brachyrhynchus*
PT	Pintail	*Anas acuta*
PO	Pochard	*Aythya ferina*
PS	Purple Sandpiper	*Calidris maritima*

RM	Red-breasted Merganser	*Mergus serrator*
RH	Red-throated Diver	*Gavia stellata*
RK	Redshank	*Tringa totanus*
RP	Ringed Plover	*Charadrius hiaticula*
RS	Roseate Tern	*Sterna dougallii*
RY	Ruddy Duck	*Oxyura jamaicensis*
RU	Ruff	*Philomachus pugnax*
SS	Sanderling	*Calidris alba*
TE	Sandwich Tern	*Sterna sandvicensis*
SP	Scaup	*Aythya marila*
SU	Shelduck	*Tadorna tadorna*
SV	Shoveler	*Anas clypeata*
SY	Smew	*Mergus albellus*
SN	Snipe	*Gallinago gallinago*
NB	Spoonbill	*Platalea leucorodia*
DR	Spotted Redshank	*Tringa erythropus*
T.	Teal	*Anas crecca*
TU	Tufted Duck	*Aythya fuligula*
TT	Turnstone	*Arenaria interpres*
WA	Water Rail	*Rallus aquaticus*
WM	Whimbrel	*Numenius phaeopus*
WG	White-fronted Goose	*Anser albifrons*
WS	Whooper Swan	*Cygnus Cygnus*
WN	Wigeon	*Anas penelope*
WK	Woodcock	*Scolopax rusticola*

Appendix 4

Further guidance on assigning waterbirds to 'location'

Categories	Troubleshooter
Intertidal Assigning waterbirds to the category 'intertidal' should be relatively straightforward. This category refers to the area uncovered by the tide and most likely dominated by mudflats and sandflats but it may also include areas of rocky shoreline, areas of mixed sediment and grave/pebbles or shingle and gravel shores.	**Piers and jetties** – parts of these structures will be covered at high water and uncovered at low water. Because they are man-made, unnatural habitats and linked to land, please record waterbirds that occur upon these structures within the 'terrestrial' category. **Man-made structures** - e.g. buoys/rafts if the structures are entirely surrounded by intertidal habitat please record the waterbirds that are standing on them within the intertidal category regardless of whether it is a low-tide or high-tide count. **Saltmarsh** – in theory all saltmarshes are subject to some degree of tidal inundation, the classification of upper and lower saltmarsh heavily dependent on shore height and the associated degree of submersion. However for the purpose of assigning waterbird location and to facilitate field recording, saltmarsh that is contiguous with coastal habitats lying above should be assigned to the supratidal category. However if discrete stands of e.g. Glassworts (*Salicornia* sp) or Common Cord-grass *Spartina* sp. occur as patches surrounded by mud/sand flat then this can be viewed as intertidal. **Algal mats** – mats of green algae Sea Lettuce (*Ulva sp.*) (formerly classified as *Enteromorpha spp.*) that occur on tidal flats should be included within the intertidal category. **Mussel beds** - should be included within this category. **Note the difference in birds wading in water** - wading birds that are observed wading through water at the incoming tide edge (during HT counts) should be classed as intertidal as this habitat would be uncovered by the tide at low-tide. Where water cover remains upon the mudflat surface during low-tide counts (e.g. within shallow dips or depressions) is also classed as intertidal habitat. However, birds wading in channels, creeks or the open sea during low-tide counts should be recorded as within subtidal habitat.

Subtidal

The category 'subtidal' refers to areas that are covered by seawater during your counts. During low-tide counts it will include offshore water, tidal channels and creeks.

Tidal rivers – the lower sections (estuarine) that occur within your count section are included here. Also include freshwater streams, tidal channels and creeks that are found across intertidal habitats at low-tide.

Man-made structures - if the structures are entirely surrounded by subtidal habitat please record the waterbirds that are standing on them within the subtidal category. Structures may include buoys, rafts, poles/masts associated with e.g. aquaculture or shipping etc.

Supratidal

The category 'supratidal' relates to the shore area and habitats immediately above the high-tide mark. Unlike the terrestrial category however, the supratidal section is an integral part of the shoreline.

Supratidal vs terrestrial? – the difference between these two is the marine influence; whereas supratidal areas have a strong marine influence, terrestrial areas do not.

Saltmarsh – included here, see explanation in intertidal section above.

Reedbed – please include within the supratidal category if it occurs immediately above tidal flat habitat (e.g. in association with a tidal river and mudflats within an upper estuary). If separated from the intertidal/supratidal area then please regard as terrestrial (e.g. in association with a freshwater lagoon).

Terrestrial

The category 'terrestrial' should be used where birds are recorded within habitats close to the shoreline but which are above the intertidal and supratidal levels. The terrestrial category is regarded as having no, or only a weak, coastal influence. Examples include coastal grassland and marsh and agricultural grassland.

Machair and sand dunes - please include within this category.

Reedbed – please include within the supratidal category if it occurs immediately above tidal flat habitat (e.g. in association with a tidal river and mudflats within an upper estuary). If separated from the intertidal area then please regard as terrestrial.

Piers and jetties – parts of these structures will be covered at high water and hence uncovered at low water. Because they are man-made, unnatural habitats and linked to land, please record waterbirds that occur upon these structures within the 'terrestrial' category.

Terrestrial - Aquatic

This category refers to non-marine water bodies that are included within the site complex, predominantly **lagoons/lakes** because they are wholly or partially separated from the sea. These may be freshwater or brackish in nature. This category would also include **Drainage ditches** e.g. man-made wet channels/ditches that discharge to an intertidal habitat (for example may occur within a coastal marsh) but are non-tidal.

If you are unsure as to the category to assign to observed waterbirds, use your best judgement to assign them to a given category and make a note on your Target Note Sheet as to the species code, count number and brief description of habitat/area encountered. Please then discuss with the Team Leader to obtain clarification before further surveys.

Appendix 5

Guidance on assigning waterbird 'behaviour'

Wherever possible waterbirds should also be recorded as either 'feeding' (F) or 'roosting/other' (R). These categories are given for each habitat type. We recognise that distinguishing between different behaviours may be difficult and that at some sites, and for a variety of reasons, this task may be difficult to achieve with sufficient accuracy. However, we ask you to undertake this task wherever possible and for as many species as you can.

Please use your best judgement when assigning birds to behaviour; we do not expect you to spend long in the decision-making process, but rather, to make a 'snap-shot' decision based on your best judgement at the time. For instance, when counting a large flock, assigning each and every bird to a behavioural category may take too long. So it will be sufficient to either mark behaviour based on your judgement as to the proportion of birds within the two categories or, place all birds under the behavioural category that best describes what the majority of birds are doing.

On the data sheet, when you count a species but do not assign its behaviour, please record the count number in the foraging (F) column but underline the counts given. Where none of the species during your count were assigned to behaviour, please record the count numbers in the foraging (F) column but circle the letter F at the top of the columns used.

A section of a data sheet is given below as an example: Mallard and Teal were counted and assigned to location and behaviour. In the case of Wigeon however, although counts were recorded for different habitats, behaviour was not assigned so the counts were underlined.

	Code	Intertidal F	Intertidal R	Subtidal F	Subtidal R	Supratidal F	Supratidal R	Terrestrial F	Terrestrial R	Terrestrial aquatic F	Terrestrial aquatic R
Wigeon	**WN**	<u>220</u>		<u>550</u>							
Gadwall	**GA**										
Teal	**T.**		50	80							
Mallard	**MA**			160							

Difficulties may arise with split location/behaviour records – you may record a waterbird species within different habitats and based on e.g. observation distance, be only able to assign behaviour to waterbirds within one of the locations. In this case, and as shown in the example below, please record the count where behaviour was not assigned in the foraging (F) column and underline that count to indicate this.

		Intertidal	Intertidal	Subtidal	Subtidal	Supratidal	Supratidal	Terrestrial	Terrestrial	Terrestrial aquatic	Terrestrial aquatic
	Code	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**	**F**	**R**
Wigeon	WN	<u>220</u>	120	<u>1000</u>							
Gadwall	GA										
Teal	T.										
Mallard	MA										

Further guidance on assigning waterbirds to 'behaviour'

Categories	Troubleshooter
Foraging Waders at low-tide will be the easiest to assign to this behaviour, particularly flocks foraging across a tidal flat.	**Walking** – in the main, walking wading birds should be assigned to 'foraging' when walking across tidal flats because even if you do not observe a foraging action, the bird may be scanning for visual signs of prey (e.g. Plover foraging behaviour). There are, of course, various exceptions to this e.g. when birds are involved in territorial behaviour (e.g. Curlew), but please use your best judgement.
Ducks and divers will be more difficult to assign to this behaviour when they occur on water.	Use your knowledge and best judgement in terms of ducks walking across tidal flats e.g. Shelduck may forage within mud, Wigeon within saltmarsh/surface vegetation but dabbling ducks are less likely to do so, although they may be seen walking across flats e.g. Wigeon often fly from saltmarsh foraging areas (perhaps as a result of some unseen disturbance) to water, then walk back across an intervening mudflat to the saltmarsh to resume feeding. **Ducks and divers on water** – <u>use your best judgement</u> in terms of assigning behaviour. Distinguishing between foraging and loafing birds may be difficult and several species have varied foraging strategies. It may help to think about foraging strategies and the factors that determine where different species feed (e.g. water depth, tidal regime, substrate, presence of vegetation etc.) thereby linking species with the habitats. If in doubt, rapidly scan a flock and if any of the birds show signs of upending/submerged head or neck or diving etc and therefore foraging might be taking place – then assign all birds to the foraging category. If after a rapid scan no birds show signs of foraging and your judgement tells you that the habitat may not be ideal, then assign all to roosting/other.
Roosting/Other This category is used for all other behaviours that you do not assign to foraging.	This category includes roosting, standing, preening, loafing, aggression and others.

Appendix 6

Examples of flock maps

Appendix 7

Recording activities/disturbance events - example data entry:

Example 1 – Curlew and Redshank were disturbed by people walking across an intertidal area (humans on foot - intertidal aquaculture). The bird's response was moderate and the activity lasted for up to 50% of the count period.

Example 2 – Bar-tailed Godwit and Oystercatchers were disturbed by people walking across an intertidal area (humans on foot - intertidal aquaculture). The bird's response was moderate. The activity was a short/discrete event (the people walked off the shore) but as the activity was already occurring when the survey started a star (*) is also shown.

Example 3 - people were observed walking across an intertidal area (humans on foot - intertidal aquaculture). No response was observed from the waterbirds present but as the activity was already occurring when the survey started a star (*) is also shown.

(8) ACTIVITIES CAUSING DISTURBANCE					
Please record each activities event in a separate space below. *There is space for 5 activities; please use an additional sheet thereafter.*					
Example 1 ②	Example 2 ②	Example 3 ②			
CU/RK (M, B)	*BA/OC (M, A*)*	*			
1 human, on-foot - shoreline 2 human, on foot – intertidal aquaculture, 3 bait-diggers 4 non-powered watercraft 5 powered watercraft, 6 water-based recreation (e.g. jet-skis, wind-surfers) 7 horse-riding 8 dogs 9 aircraft 10 shooting 11 other 12 winkle pickers 13 aquaculture machinery 14 other vehicles					