# Malahide Estuary
# Special Protection Area

## (Site Code 4025)

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# Conservation Objectives
# Supporting Document

## VERSION 1

National Parks & Wildlife Service

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SUMMARY

This document presents conservation objectives for the Special Conservation Interests of Malahide Estuary Special Protection Area, designated under Directive 2009/147/EC on the conservation of wild birds (Birds Directive).

Part One presents an introduction to the Special Protection Area (SPA) designation process and to the site designated as Malahide Estuary Special Protection Area, as well as introducing the concept of conservation objectives and their formulation.

Part Two provides site designation information for Malahide Estuary SPA and Part Three presents the conservation objectives for this site.

Part Four reviews the conservation condition of the site Special Conservation Interest (SCI) species including analysis of wintering (non-breeding) population trends, assignment of site conservation condition, and examination of site trends in light of all-Ireland and international status and trends. Importantly, this section states the current conservation condition of each of the SCI species.

Part Five provides supporting information that will assist the interpretation of the site-specific conservation objectives. This section includes a review of the ecological characteristics of the SCI species and examines waterbird distribution recorded during the 2011/12 Waterbird Survey Programme, drawing also on data from NPWS monitoring programmes (e.g. benthic surveys) and the Irish Wetland Bird Survey (I-WeBS). Part Five concludes with information on activities and events that occur in and around the site which may interact with waterbirds during the non-breeding season and includes an assessment of those activities that were recorded to cause disturbance to waterbirds during the 2011/12 Waterbird Survey Programme.

# PART ONE - INTRODUCTION

## 1.1 Introduction to the designation of Special Protection Areas

The over-arching framework for the conservation of wild birds within Ireland and across Europe is provided by Directive 2009/147/EC on the conservation of wild birds (the codified version of Council Directive 79/409/EEC as amended) (Birds Directive). Together with the EU Habitats Directive (Council Directive 92/43/EEC), these legislative measures provide for wild bird protection via a network of protected sites across Europe known as Natura 2000 sites, of which the overriding conservation objective is the maintenance (or restoration) of 'favourable conservation status' of habitats and species.

Under Article 4 of Directive 2009/147/EC, Ireland, along with other Member States, is required to classify the most suitable territories in number and size as Special Protection Areas (SPAs) for the conservation of certain wild bird species, which are:

- species listed in Annex I of the directive
- regularly occurring migratory species

Also under Article 4, Member States are required to pay particular attention to the protection of wetlands, especially those of international importance.

The National Parks & Wildlife Service (NPWS), part of the Department of the Arts, Heritage and the Gaeltacht, is responsible for the selection and designation of SPAs in the Republic of Ireland. NPWS has developed a set of criteria, incorporating information relating to the selection of wetland sites developed under the Ramsar Convention, which are used to identify and designate SPAs. Sites that meet any of the following criteria may be selected as SPAs:

- A site regularly supporting 20,000 waterbirds or 10,000 pairs of seabirds;
- A site regularly supporting 1% or more of the all-Ireland population of an Annex I species;
- A site regularly supporting 1% or more of the biogeographical population of a migratory species;
- A site that is one of the 'n' most suitable sites in Ireland for an Annex I species or a migratory species (where 'n' is a variable which is related to the proportion of the total biogeographic population of a species held by Ireland).

The biogeographic population estimates and the recommended 1% thresholds for wildfowl and waders are taken from Wetlands International (Wetlands International, 2002); thresholds reflecting the baseline data period used. The all-Ireland populations for the majority of wintering waterbirds are taken from Crowe et al. (2008).

Site specific information relevant to the selection and designation of a SPA is collated from a range of sources including the Irish Wetland Bird Survey (I-WeBS), The Wetland Bird Survey (WeBS) in Northern Ireland, species specific reports and a wide range of scientific publications, reports and other surveys. If, following collation of all the available scientific data, a site meets the relevant criteria for designation and is selected as an SPA, a list of species for which the site is nationally and internationally important is compiled. These species are known as **Special Conservation Interests** and may be one of the following:

- An Annex I species that occurs at the site in numbers that exceed the all-Ireland 1% population threshold;
- A migratory species that occurs at the site in numbers that exceed the biogeographic 1% population threshold (referred to as a species that occurs in numbers of 'international importance');
- A migratory species that occurs at the site in numbers that exceed the all-Ireland 1% threshold (referred to as a species that occurs in numbers of 'all-Ireland importance');

- A species for which the site is considered to be one of the *'n'* most suitable sites in Ireland for the conservation of that species (where *n* is a variable that is related to the proportion of the total biogeographic population held by Ireland).

Wetlands and waterbirds: the wetlands of northwest Europe are a vital resource for millions of northern and boreal nesting waterbird species that overwinter on these wetlands or visit them when migrating further south. To acknowledge the importance of Ireland's wetlands to wintering waterbirds the term Wetland & Waterbirds can be included as a Special Conservation Interest for a Special Protection Area that has been designated for wintering waterbirds, and is or contains a wetland site of significant importance to one or more of the species of Special Conservation Interest.

### 1.2 Introduction to Malahide Estuary Special Protection Area

Malahide Estuary is situated in north Co. Dublin, between the towns of Malahide and Swords. The estuary is bisected by a railway viaduct, built in the 1800s, which creates an inner and outer site. The Broadmeadow M1 motorway bridge crosses the inner estuary and covers some saltmarsh habitat.

The outer estuary empties almost completely at low tide. The intertidal area is sheltered from the sea by a large sand spit, known as "the Island" which is now mostly converted to golf-course. The site also includes a shallow subtidal area at the estuary mouth.

Water levels of the inner estuary drop very little because the viaduct has effectively created an artificial brackish lagoon. At low tide only a thin shingle edge is exposed together with habitats in the very inner estuary.

Salt marshes, which provide important roosts during high tide, occur in parts of the outer estuary, the extreme inner part of the inner estuary, and are well developed at the end of the spit (also known as Malahide Island).

The intertidal seagrass *Zostera noltii* is recorded in two discrete areas to the north of the site, on Burrow Strand at Corballis and along the shore to the east of Kilcrea (NPWS, 2013). Green algae, mostly *Ulva* spp. (formerly *Enteromorpha*)[1] are frequent on the sheltered flats. Common Cord-grass (*Spartina anglica*) is well established in the outer estuary as well as the innermost part of the site.

This site is of high importance for wintering waterfowl and supports a particularly good diversity of species, including two, Light-bellied Brent Goose (*Branta bernicla hrota*) and Black-tailed Godwit (*Limosa limosa*) that occur in numbers of international importance.

The Site Synopsis for Malahide Estuary SPA and a map showing the SPA boundary are given in Appendix 1.

### 1.3 Introduction to Conservation Objectives

The overriding objective of the Habitats Directive is to ensure that the habitats and species covered achieve '*favourable conservation status'* and that their long-term survival is secured across their entire natural range within the EU (EU Commission, 2010). In its broadest sense, favourable conservation status means that an ecological feature is being maintained in a satisfactory condition, and that this status is likely to continue into the future. Definitions as per the EU Habitats Directive are given in Box 1.

[1] Hayden et al. (2003), using genetic information, reassigned the genus *Enteromorpha* to the genus *Ulva.*

**Box 1**

**Favourable Conservation Status as defined by Articles 1 (e) and 1(i) of the Habitats Directive**

*The conservation status of a natural habitat is the sum of the influences acting on it and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species. The conservation status of a natural habitat will be taken as favourable when:*

- *its natural range and areas it covers within that range are stable or increasing; and*
- *the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and*
- *the conservation status of its typical species is favourable'.*

*The conservation status of a species is the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' when:*

- *the population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; and*
- *the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and*
- *there is, and will probably continue to be, a sufficiently large habitat to maintain its populations*

Site-specific conservation objectives define the desired condition or range of conditions that a habitat or species should be in, in order for these selected features within the site to be judged as favourable. At site level, this state is termed 'favourable conservation condition.' Site conservation objectives also contribute to the achievement of the wider goal of biodiversity conservation at other geographic scales, and to the achievement of favourable conservation status at national level and across the Natura 2000 network[2].

Where relevant, conservation objectives are defined for attributes[3] relating to bird species populations, and for attributes related to the maintenance and protection of habitats that support them. These attributes are:

- Population trend;
- Population distribution;
- Habitat range and area (extent).

Further guidance is given in Section 3.1 (Conservation Objectives for the Special Conservation Interests of Malahide Estuary Special Protection Area).

[2] Note that the terms 'conservation condition' and 'conservation status' are used to distinguish between site and the national level objectives respectively.

[2]Attribute can be defined as: 'a characteristic of a habitat, biotope, community or population of a species which most economically provides an indication of the condition of the interest feature to which it applies' (JNCC, 1998).

## PART TWO – SITE DESIGNATION INFORMATION

### 2.1 Special Conservation Interests of Malahide Estuary Special Protection Area

The **Special Conservation Interest Species** for Malahide Estuary SPA are listed below and summarised in Table 2.1. This table also shows the importance of Malahide Estuary for SCI species, relative to the importance of other sites within Ireland and within the Dublin region.

The Special Conservation Interest Species are as follows:-

1. During winter the site regularly supports 1% or more of the biogeographic population of Light-bellied Brent Geese (*Branta bernicla hrota*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 1,104 individuals.

2. During winter the site regularly supports 1% or more of the all-Ireland population of Shelduck (*Tadorna tadorna*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 439 individuals.

3. During winter the site regularly supports 1% or more of the all-Ireland population of Pintail (*Anas acuta*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 58 individuals.

4. During winter the site regularly supports 1% or more of the all-Ireland population of Goldeneye (*Bucephala clangula*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 215 individuals.

5. During winter the site regularly supports 1% or more of the all-Ireland population of Red-breasted Merganser (*Mergus serrator*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 99 individuals.

6. During winter the site regularly supports 1% or more of the all-Ireland population of Great Crested Grebe (*Podiceps cristatus*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 63 individuals.

7. During winter the site regularly supports 1% or more of the all-Ireland population of Oystercatcher (*Haematopus ostralegus*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 1,360 individuals.

8. During winter the site regularly supports 1% or more of the all-Ireland population of the Annex I species Golden Plover (*Pluvialis apricaria*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 1,843 individuals.

9. During winter the site regularly supports 1% or more of the all-Ireland population of Grey Plover (*Pluvialis squatarola*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 201 individuals.

10. During winter the site regularly supports 1% or more of the all-Ireland population of Knot (*Calidris canutus*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 915 individuals.

11. During winter the site regularly supports 1% or more of the all-Ireland population of Dunlin (*Calidris alpina*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 1,594 individuals.

12. During winter the site regularly supports 1% or more of the biogeographic population of Black-tailed Godwit (*Limosa limosa*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 409 individuals.

13. During winter the site regularly supports 1% or more of the all-Ireland population of the Annex I species Bar-tailed Godwit (*Limosa lapponica*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 156 individuals.

14. During winter the site regularly supports 1% or more of the all-Ireland population of Redshank (*Tringa totanus*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 581 individuals.

15. The wetland habitats contained within Malahide Estuary SPA are identified of conservation importance for non-breeding (wintering) migratory waterbirds. Therefore the wetland habitats are considered to be an additional Special Conservation Interest.

**Table 2.1 Designation Summary: species listed for Malahide Estuary Special Protection Area, plus site importance (national and regional)**

| Special Conservation Interests | Annex I species | Baseline Population[a] | Population status at baseline | National Importance Rank[1] | Regional Importance Rank[2] |
|---|---|---|---|---|---|
| Light-bellied Brent Goose (*Branta bernicla hrota*) | | 1,104 | International Importance | 4 | 2 |
| Shelduck (*Tadorna tadorna*) | | 439 | All-Ireland Importance | 11 | 3 |
| Pintail (*Anas acuta*) | | 58 | All-Ireland Importance | 9 | 2 |
| Goldeneye (*Bucephala clangula*) | | 215 | All-Ireland Importance | 2 | 1 |
| Red-breasted Merganser (M*ergus serrator*) | | 99 | All-Ireland Importance | 5 | 1 |
| Great Crested Grebe (*Podiceps cristatus*) | | 63 | All-Ireland Importance | 8 | 1 |
| Oystercatcher (*Haematopus ostralegus*) | | 1,360 | All-Ireland Importance | 9 | 3 |
| Golden Plover (*Pluvialis apricaria*) | Yes | 1,843 | All-Ireland Importance | 30 | 3 |
| Grey Plover (*Pluvialis squatarola*) | | 201 | All-Ireland Importance | 10 | 3 |
| Knot (*Calidris canutus*) | | 915 | All-Ireland Importance | 8 | 4 |
| Dunlin (*Calidris alpina*) | | 1,594 | All-Ireland Importance | 20 | 4 |
| Black-tailed Godwit (*Limosa limosa*) | | 409 | International Importance | 16 | 1 |
| Bar-tailed Godwit (*Limosa lapponica*) | Yes | 156 | All-Ireland Importance | 24 | 4 |
| Redshank (*Tringa totanus*) | | 581 | All-Ireland Importance | 13 | 3 |

| SAC | RAMSAR SITE | IMPORTANT BIRD AREA | WILDFOWL SANCTUARY | OTHER | OTHER | OTHER |
|---|---|---|---|---|---|---|
| SAC 00205 | Yes | - | - | Nature Reserve | pNHA | - |

[a] Baseline data are the 5-year mean peak counts for the period 1995/96 – 1999/00 (I-WeBS) with the exception of Light-bellied Brent Goose (Robinson et al. 2004).
[b] Note that other designations associated with Malahide Estuary may relate to different areas and/or some of these areas may extend outside the SPA boundary.
[1]National importance rank – the number given relates to the importance of the site for the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to other sites in Ireland.
[2]Regional importance rank – the number given relates to the importance of the site for the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to other sites within the Dublin region.

## PART THREE – CONSERVATION OBJECTIVES FOR MALAHIDE ESTUARY SPA

### 3.1 Conservation Objectives for the Special Conservation Interests of Malahide Estuary SPA

The overarching Conservation Objective for Malahide Estuary Special Protection Area is to ensure that waterbird populations and their wetland habitats are maintained at, or restored to, favourable conservation condition. This includes, as an integral part, the need to avoid deterioration of habitats and significant disturbance; thereby ensuring the persistence of site integrity.

The site should contribute to the maintenance and improvement where necessary, of the overall favourable status of the national resource of waterbird species, and continuation of their long-term survival across their natural range.

Conservation Objectives for Malahide Estuary Special Protection Area, based on the principles of favourable conservation status, are described below and summarised in Table 3.1. Note that these objectives should be read and interpreted in the context of information and advice provided in additional sections of this report.

***Objective 1:*** *To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Malahide Estuary SPA.*

This objective is defined by the following attributes and targets:-

- To be favourable, the long term **population trend** for each waterbird Special Conservation Interest species should be stable or increasing.[4] Waterbird populations are deemed to be unfavourable when they have declined by 25% or more, as assessed by the most recent population trend analysis.[5]

- To be favourable, there should be no significant decrease in the range, timing or intensity of use of areas by the waterbird species of Special Conservation Interest, other than that occurring from natural patterns of variation.[6]

Factors that can adversely affect the achievement of Objective 1 include:

- ❖ Habitat modification: activities that modify discrete areas or the overall habitat(s) within the SPA in terms of how one or more of the listed species use the site (e.g. as a feeding resource) could result in the displacement of these species from areas within the SPA and/or a reduction in their numbers (for further discussion on this topic please refer to Section 5.4).

- ❖ Disturbance: anthropogenic disturbance that occurs in or near the site and is either singular or cumulative in nature could result in the displacement of one or more of the listed waterbird species from areas within the SPA, and/or a reduction in their numbers (for further discussion on this topic please refer to Section 5.4).

[4] Note that 'population' refers to site population (numbers wintering at the site) rather than the species biogeographic population.

[5] Population trend analysis is presented in Section 4.

[6] Waterbird distribution from the 2011/2012 waterbird survey programme is examined in Section 5.

- ❖ Ex-situ factors: several of the listed waterbird species may at times use habitats situated within the immediate hinterland of the SPA or in areas ecologically connected to it. The reliance on these habitats will vary from species to species and from site to site. Significant habitat change or increased levels of disturbance within these areas could result in the displacement of one or more of the listed waterbird species from areas within the SPA, and/or a reduction in their numbers (for further information on this topic please refer to Section 5.2).

***Objective 2:*** *To maintain the favourable conservation condition of the wetland habitat at Malahide Estuary SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.*

This objective is defined by the following attributes and targets:-

- To be favourable, the permanent **area** occupied by the wetland habitat should be stable and not significantly less than the area of **765 ha**, other than that occurring from natural patterns of variation.

The boundary of Malahide Estuary SPA was defined to include the primary wetland habitats of this site. Objective 2 seeks to maintain the permanent extent of these wetland habitats, which constitute an important resource for regularly-occurring migratory waterbirds. The wetland habitats can be categorised into three broad types: subtidal; intertidal; and supratidal. Over time and through natural variation these subcomponents of the overall wetland complex may vary due to factors such as changing rates of sedimentation, erosion etc. Waterbird species may use more than one of the habitat types for different reasons (behaviours) throughout the tidal cycle.

Subtidal areas refer to those areas contained within the SPA that lie below the mean low water mark and are predominantly covered by marine water. Tidal rivers, creeks and channels are included in this category. For Malahide Estuary SPA this broad category is estimated to be **388 ha**. Subtidal areas are continuously available for benthic and surface feeding ducks (e.g. Pintail, Goldeneye) and piscivorous/other waterbirds. Various waterbirds roost in subtidal areas.

The intertidal area is defined, in this context, as the area contained between the mean high water mark and the mean low water mark. For Malahide Estuary SPA this is estimated to be **284 ha**. When exposed or partially exposed by the tide, intertidal habitats provide important foraging areas for many species of waterbirds, especially wading birds, as well as providing roosting/loafing[7] areas. When the intertidal area is inundated by the tide it becomes available for benthic and surface feeding ducks and piscivorous/other waterbirds. During this tidal state this area can be used by various waterbirds as a loafing/roosting resource.

The supratidal category refers to areas that are not frequently inundated by the tide (i.e. occurring above the mean high watermark) but contain shoreline and coastal habitats and can be regarded as an integral part of the shoreline. For Malahide Estuary SPA this is estimated to be **93 ha**. Supratidal areas are used by a range of waterbird species as a roosting resource as well as providing feeding opportunities for some species.

The maintenance of the 'quality' of wetland habitat lies outside the scope of Objective 2. However, for the species of Special Conservation Interest, the scope of Objective 1 covers the need to maintain, or improve where appropriate, the different properties of the wetland habitats contained within the SPA.

[7] Loafing can be described as any behaviour not connected with breeding or feeding, and includes preening and resting.

**Table 3.1 Conservation Objectives for the waterbird Special Conservation Interests of Malahide Estuary SPA.**

| **Objective 1:**<br><br>*To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Malahide Estuary SPA, which is defined by the following list of attributes and targets:* | | | | |
|---|---|---|---|---|
| **Parameter** | **Attribute** | **Measure** | **Target** | **Notes** |
| Population | Population trend | Percentage change as per population trend assessment using waterbird count data collected through the Irish Wetland Bird Survey and other surveys. | The long term population trend should be stable or increasing | Waterbird population trends are presented in Part Four of this document. |
| Range | Distribution | Range, timing or intensity of use of areas used by waterbirds, as determined by regular low tide and other waterbird surveys. | There should be no significant decrease in the range, timing or intensity of use of areas by the waterbird species of Special Conservation Interest other than that occurring from natural patterns of variation. | Waterbird distribution from the 2011/12 waterbird survey programme is reviewed in Part Five of this document. |
| **Objective 2:**<br><br>*To maintain the favourable conservation condition of the wetland habitat at Malahide Estuary SPA as a resource for the regularly-occurring migratory waterbirds that utilise it. This is defined by the following attributes and targets:* | | | | |
| **Parameter** | **Attribute** | **Measure** | **Target** | **Notes** |
| Area | Wetland habitat | Area (ha) | The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 765 ha, other than that occurring from natural patterns of variation. | The wetland habitat area was estimated as 765 ha using OSI data and relevant orthophotographs. |

## PART FOUR – REVIEW OF THE CONSERVATION CONDITION OF WATERBIRD SPECIAL CONSERVATION INTERESTS

### 4.1 Population data for waterbird SCI species of Malahide Estuary SPA

Wintering waterbirds have been counted regularly at Malahide Estuary as part of the Irish Wetland Bird Survey (I-WeBS) since the survey commenced in 1994 (Crowe, 2005). With the exception of the very first season (1994/95) the site has been counted across a six or seven month period in each season, covering the months September to March inclusive. This is known as the core count period of I-WeBS and this timeframe not only covers the main winter period when many species occur in their largest concentrations, but also the autumn and spring passage periods when total waterbird numbers may be enhanced by staging/stopover birds[8]. Light-bellied Brent Goose is also the subject of an additional species-specific survey; further information about I-WeBS and other waterbird surveys is given in Appendix 2.

The I-WeBS count area is divided into a number of count units (subsites) and the total count area is approximately 940 ha (Crowe, 2005). Note that the SPA area and the I-WeBS count area are not coincident, the latter being slightly larger.

Table 4.1 presents population[9] data for non-breeding waterbirds of Malahide Estuary. Annual maxima were identified and used to calculate the five-year mean peak for each species. The baseline period was 1995/96 – 1999/00 and the most recent five-year average is for 2006/07 – 2010/11.

When examining waterbird data, it is standard practice to use the mean of peak counts because they reflect more accurately the importance of a site for a particular species. The assessment of five-year periods helps to account for fluctuations in numbers or cases where there are inconsistencies in data gathering (e.g. incomplete coverage, bad weather). In general and taking into account all potential sources of error in counting wetland birds, resulting data are regarded to be underestimates of population size (Underhill & Prŷs-Jones, 1994).

Table 4.1 highlights where the numbers shown surpass thresholds of International or all-Ireland importance. These thresholds are different for the baseline and recent time periods used; international thresholds are outlined in Wetlands International (2002) and Wetlands International (2012) for the baseline and recent site data respectively, while all-Ireland thresholds are presented within Crowe et al. (2008).

[8] 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).

[9] Note that 'population' refers to site population (numbers wintering at the site) rather than a species' biogeographic population.

**Table 4.1 Population data for waterbird Special Conservation Interest Species of Malahide Estuary SPA**

| Site Special Conservation Interests (SCIs) | Baseline Period[1] (1995/96 – 1999/00) | Recent Site Data[2] (2006/07 – 2010/11) |
|---|---|---|
| Light-bellied Brent Goose | 1,104 (i) | 1,675 (i) |
| Shelduck | 439 (n) | 317 (n) |
| Pintail | 58 (n) | 65 (n) |
| Goldeneye | 215 (n) | 122 (n) |
| Red-breasted Merganser | 99 (n) | 85 (n) |
| Great Crested Grebe | 63 (n) | 70 (n) |
| Oystercatcher | 1,360 (n) | 1,381 (n) |
| Golden Plover | 1,843 (n) | 2,865 (n) |
| Grey Plover | 201 (n) | 155 (n) |
| Knot | 915 (n) | 401 (n) |
| Dunlin | 1,594 (n) | 751 |
| Black-tailed Godwit | 409 (i) | 427 (n) |
| Bar-tailed Godwit | 156 (n) | 243 (n) |
| Redshank | 581 (n) | 561 (n) |

Baseline data is the 5-year mean peak count for the period 1995/96 – 1999/00;
[2]recent site data is the 5-year mean peak count for the period 2006/07 – 2010/11 (I-WeBS).
(i) denotes numbers of international importance; (n) denotes numbers of all-Ireland importance.

### 4.2 Waterbird population trends for Malahide Estuary SPA

The calculation and assessment of waterbird population trends at Irish coastal SPA sites follows the UK Wetland Bird Survey 'Alerts System' which provides a standardised technique for monitoring changes in the numbers of non-breeding waterbirds over a range of spatial scales and time periods. The methods include the calculation of annual indices using a standard set of months which excludes passage periods unlike the mean peaks shown in Section 4.1 which include data across a longer time period; so it should be borne in mind that waterbird population data presented in Section 4.1 and 4.2 are not directly comparable. A detailed methodology for the trend analysis is provided in Appendix 3.

Annual population indices were calculated for waterbird SCI species for the data period 1994/95 to 2010/11. Trends are given for the 'long-term' 14-year period (1995/96–2009/10) and the recent ('short-term') five-year period (2004/05 – 2009/10) (Table 4.2). The values given represent the percentage change in index (population) values across the specified time period. Positive values equate to increases in population size while negative values reflect a decrease in population size.

Waterbirds are relatively long-lived birds and changes in population size can take several years to become evident. The short-term trend can be useful to assess whether species numbers at the site are remaining stable, showing increase or signs of recovery, or are continuing to decline. For example, although a species' long-term trend may be negative, the short-term trend could be positive if numbers have increased during the recent five year period being assessed. Importantly, the short-term trend may detect more rapidly where a species population is beginning to decline.

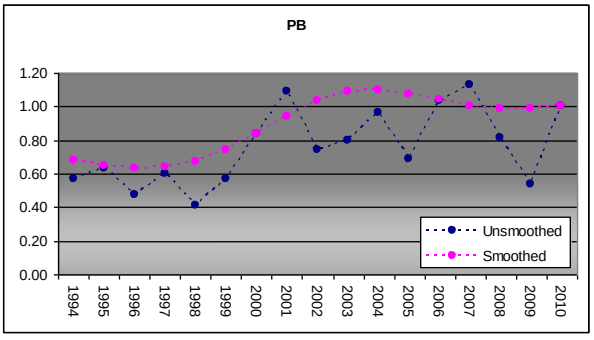
**Table 4.2 Site Population Trends for Waterbird Special Conservation Interest species of Malahide Estuary SPA**

| Site Special Conservation Interests (SCIs) | Site Population Trend[1] 14 Yr | Site Population Trend[2] 5 Yr |
|---|---|---|
| Light-bellied Brent Goose | + 52.8 | - 9.9 |
| Shelduck | +1.0 | - 13.6 |
| Pintail | + 49.9 | - 17.9 |
| Goldeneye | - 49.6 | + 2.4 |
| Red-breasted Merganser | + 5.9 | + 59.7 |
| Great Crested Grebe | + 21.9 | + 12.9 |
| Oystercatcher | + 34.0 | + 30.1 |
| Golden Plover | - 76.6 | - 84.5 |
| Grey Plover | - 1.9 | + 7.7 |
| Knot | - 33.0 | + 25.8 |
| Dunlin | - 53.2 | - 13.1 |
| Black-tailed Godwit | - 16.6 | - 6.5 |
| Bar-tailed Godwit | + 178.8 | + 16.2 |
| Redshank | + 15.9 | - 15.7 |

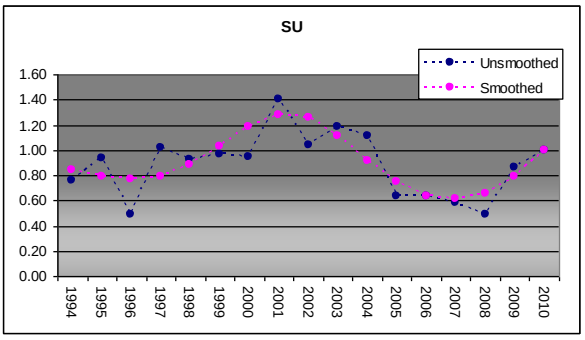
[1]Site population trend analysis: 14-year period = 1995/96–2009/10
[2]Site population trend analysis: 5 yr = 2004/05 – 2009/10.

For selected species, explanatory notes are given below to aid the interpretation of trends. Smoothed and unsmoothed indices are shown graphically. Site trends are compared with national trends (Boland & Crowe, 2012[10]); all-Ireland trends (Crowe et al. 2008) and British trends (Holt et al. 2011). Graph headings use waterbird species codes and a list of these is provided in Appendix 4.

**Light-bellied Brent Goose –** the long-term trend is for increasing numbers at Malahide Estuary, although this increase was most dramatic in the early part of the dataset. The short-term trend for decline reflects lower numbers in recent seasons although numbers returned to a near previous level in the final season 2010/11. Nationally, numbers increased at an annual rate of 5.1% over the period 1994/95 to 2008/09.

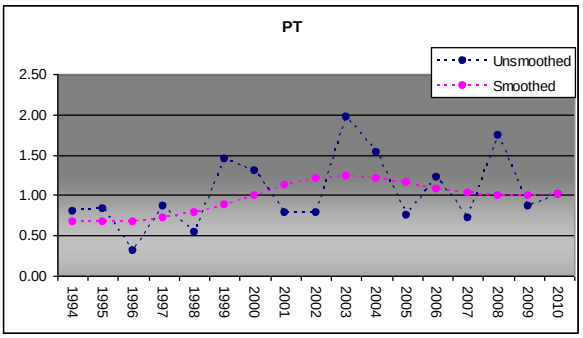



**Shelduck** – the long-term trend, based on a comparison of the indices for 2009/10 and 1995/96, indicates stable numbers at Malahide Estuary. However during this period, numbers have exhibited a period of increase (1996/97 to 2001/02) followed by a period of decrease (to 2008/09), with a subsequent return to numbers that are on a par with those recorded during early seasons. Nationally, numbers have shown a slight but steady decline since the mid 1990's, consistent with the trend observed in Britain.

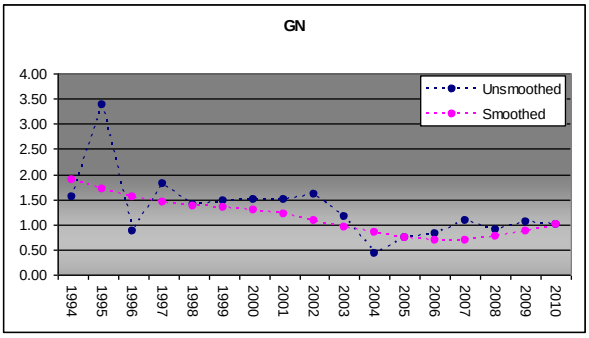



[10] National trends presented in Boland & Crowe (2012) update those previously shown in Crowe (2005).

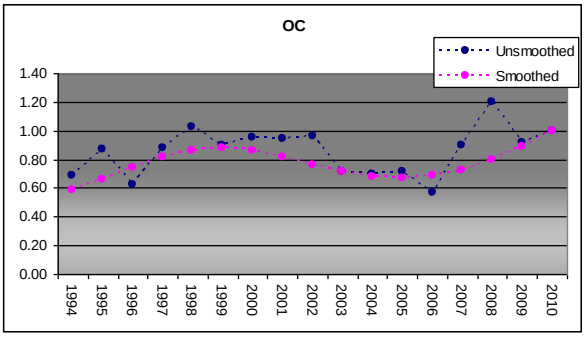
**Pintail** – has shown a trend for increasing numbers at Malahide Estuary over the long-term although numbers in recent seasons have declined slightly. Nationally, numbers of Pintail declined during the late 1990's but subsequently recovered to former levels, while in Britain increasing numbers up to 2005/06 have been followed by a declining index.



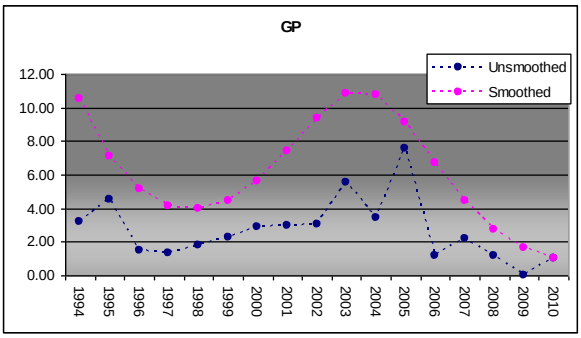

**Goldeneye** – the long-term trend is for declining numbers at Malahide Estuary. Numbers reached a low point in the season 2004/05 and have since increased slightly to result in a short-term trend for increase. However recent numbers are still considerably lower than those recorded during the late 1990's and early 2000's.



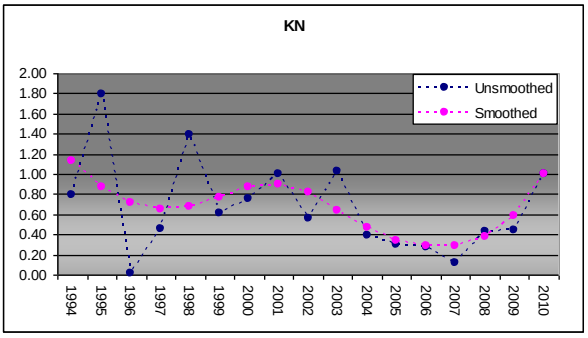

**Oystercatcher** – a gradual increase in numbers up to the late 1990's was followed by a decline to 2006/07, then further increase. Nationally, numbers of Oystercatcher have shown an overall increase since 1994, and have been relatively stable since the early 2000's.



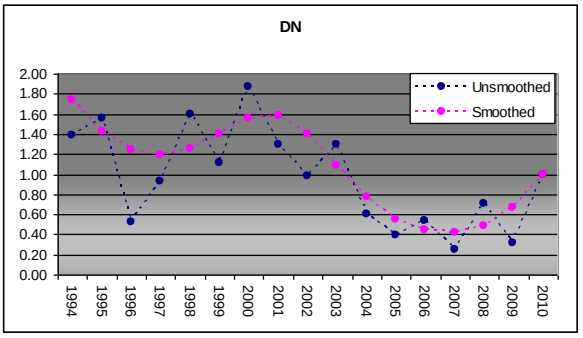

**Golden Plover –** despite a period of increasing numbers during the late 1990's to mid 2000's, numbers of Golden Plover at Malahide Estuary have declined sharply across the long-term. Numbers in recent seasons have been particularly low with none recorded at the site during the core winter months of the 2009/10 season; likely due to the birds moving in response to the cold weather that winter (e.g. Crowe et al. 2011). Nationally numbers of Golden Plover have been relatively stable since the mid 1990's



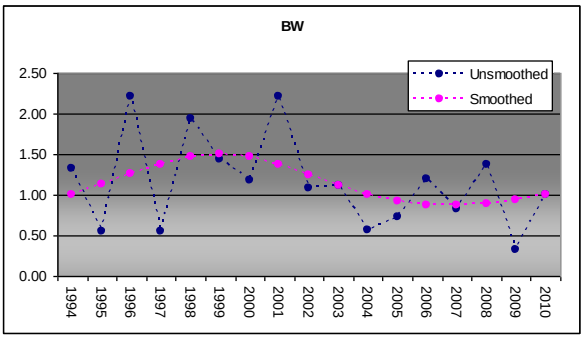
**Knot –** numbers fluctuated greatly especially in the early seasons. Overall numbers have decreased over time and were particularly low during the period 2005/06 to 2007/08. Since then however, numbers have increased, as reflected by the short-term trend. Nationally, numbers were broadly stable until 2005/06 and have increased since.



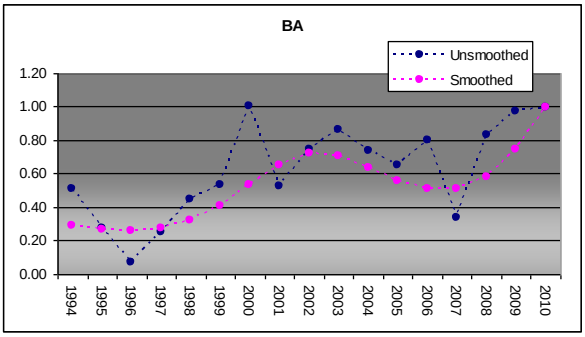

**Dunlin** – the graph highlights that numbers of Dunlin at Malahide Estuary were higher in the late 1990's than those recorded from 2004 onwards; a substantial overall long-term trend for decline. This trend for decline is consistent with that observed at national level, in Britain and in Northern Ireland.




**Black-tailed Godwit** – despite fluctuating greatly at times, numbers have declined at the site over the long-term. This contrasts with the national trend and that observed in the UK where a long-term increase has been evident.




**Bar-tailed Godwit** – this wader exhibits a long- and short-term trend for increase at Malahide Estuary. Nationally numbers have remained largely stable throughout I-WeBS while in Britain numbers have increased in recent seasons following a drop in numbers during the mid 2000's.



### 4.3 Malahide Estuary SPA – site conservation condition of waterbird SCI species

Conservation condition of waterbird species is determined using the long-term site population trend and is assigned using the following criteria:

**Favourable population =** population is stable/increasing.

**Intermediate (unfavourable) =** Population decline in the range 1.0 – 24.9%.

**Unfavourable population =** populations that have declined between 25.0 – 49.9% from the baseline reference value.

**Highly Unfavourable population =** populations that have declined > 50.0% from the baseline reference value.

The threshold levels of >25.0% and >50.0% follows standard convention used for waterbirds (e.g. Lynas et al. 2007; Leech et al. 2002). The 'Intermediate' range (1.0% - 24.9% decline) allows for natural fluctuations and represents a range within which relatively small population declines have the potential to be reversible and less likely to influence conservation status in the long-term (Leech et al. 2002). Declines of more than 25.0% are deemed of greater ecological significance for the long-term.

With regards the 14 waterbird species of Special Conservation Interest listed for Malahide Estuary SPA, and based on the long-term population trend for the site, it has been determined that (Table 4.3):-

1. 2 species are currently considered as **Highly Unfavourable** (Golden Plover & Dunlin);

2. 2 species are considered as **Unfavourable** (Goldeneye & Knot)

3. 2 species are considered as **Intermediate unfavourable** (Grey Plover & Black-tailed Godwit)

4. 8 species are currently considered as **Favourable** (Light-bellied Brent Goose, Shelduck, Pintail, Red-breasted Merganser, Great Crested Grebe, Oystercatcher, Bar-tailed Godwit & Redshank).

Site conservation condition and population trends were also reviewed in light of species' national and international trends (Table 4.3). National trends were provided by the I-WeBS Office while International trends follow Wetlands International (2012).

**Table 4.3 SCI species of Malahide Estuary SPA – Current Site Conservation Condition**

| Special Conservation Interests | BoCCI Category[a] | Site Population Trend[b] | Site Conservation Condition | Recent National Trend[c] | Current International Trend[d] |
|---|---|---|---|---|---|
| Light-bellied Brent Goose | Amber | + 52.8 | Favourable | + 62.3 | Increase |
| Shelduck | Amber | +1.0 | Favourable | - 25.1 | Increase |
| Pintail | Red | + 49.9 | Favourable | - 10.8 | Increase |
| Goldeneye | Amber | - 49.6 | Unfavourable | - 31.4 | Stable |
| Red-breasted Merganser | Green | + 5.9 | Favourable | - 16.7 | Unknown |
| Great Crested Grebe | Amber | + 21.9 | Favourable | + 4.2 | Decline? |
| Oystercatcher | Amber | + 34.0 | Favourable | + 14.5 | Decline |
| Golden Plover | Red | - 76.6 | Highly Unfavourable | - 65.6 | Decline |
| Grey Plover | Amber | - 1.9 | Intermediate (Unfavourable) | - 22.3 | Decline? |
| Knot | Red | - 33.0 | Unfavourable | + 83.0 | Fluctuating |
| Dunlin | Amber | - 53.2 | Highly Unfavourable | - 43.4 | Stable |
| Black-tailed Godwit | Amber | - 16.6 | Intermediate (Unfavourable) | + 67.7 | Increase |
| Bar-tailed Godwit | Amber | + 178.8 | Favourable | + 35.0 | Increase |
| Redshank | Red | + 15.9 | Favourable | - 4.8 | Stable/Increase |

[a]After Lynas *et al.* (2007); [b] Site population trend analysis; see Table 4.2; [c]national trend is for the 12 year period 1998/99 to 2010/11; [d]international trend after Wetland International (2012).

Table 4.3 also shows the relationship between a species' long-term site trend and the current national trend. The colour coding used represents the following cases:-

- Green – species whose populations are stable or increasing at both site level and national level.
- Beige – species whose populations are declining at both site level and national level. Therefore there is a potential for factors at a larger spatial scale to be influencing the observed trend at site level.
- Orange - species whose populations are exhibiting a 1 – 24.9% decline at site level but are stable or increasing at national level.
- Pink - species whose populations are exhibiting a 25.0 – 49.9% decline at site level but are stable or increasing at national level.
- Red - species whose populations are exhibiting a decline of >50.0% at site level but are stable or increasing at national level.

The pink and red categories listed above highlight where populations are stable at national level, but where significant declines are seen at site level. In these cases it would be reasonable to suggest that site-based management issues may be responsible for the observed declining site population trends (Leech et al. 2002).

## PART FIVE – SUPPORTING INFORMATION

### 5.1 Introduction

Part Five of this report is based around the need to review, collate and disseminate site-specific information relating to the Special Conservation Interests of Malahide Estuary SPA.

Section 5.2 provides selected ecological summary information for the non-breeding waterbirds of the site. Section 5.3 presents results from the 2011/12 Waterbird Survey Programme. Finally, Section 5.4 provides summary information on the activities and events that occur in and around Malahide Estuary that may either act upon the habitats within the site, or may interact with waterbirds using the site.

The information provided is intended to:-

- provide information to assist the interpretation and understanding of the site-specific conservation objectives;
- facilitate the identification of conservation priorities and direct site management measures;
- inform the scope and nature of Appropriate Assessments in applying the provisions of Article 6 of the Habitats Directive.

Note however, that the information does not aim to provide a comprehensive assessment on which to assess plans and projects as required under the Habitats Directive, but rather should inform the scope of these assessments and help direct where further detailed examinations are required. The information presented in this report was compiled in January 2013.

### 5.2 Waterbird species – Ecological characteristics, requirements and specialities – summary information

Waterbirds, defined as *''birds that are ecologically dependent on wetlands''* (Ramsar Convention, 1971), are a diverse group that includes divers, grebes, swans, geese and ducks, gulls, terns and wading birds. During the data period 1994/95 – 2010/11, I-WeBS recorded a total of 69 waterbird species within the Malahide Estuary count area. These species represent eleven waterbird families: *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) plus *Phalacrocoracidae* (Cormorants), *Ardeidae* (Herons) and *Alcedinidae* (Kingfisher).

As described in Section 1.1, the wetland habitats contained within this SPA are considered to be a Special Conservation Interest in their own right. The wetland habitat is an important resource for listed SCI species and for other waterbird species included in the total waterbird assemblage. These species may include those that utilise the site during passage, those that are present in months of the year outside of the non-breeding season[11] or species that use the site at certain times only (e.g. as a cold weather refuge).

33 waterbird species occurred on a regular basis within the Malahide Estuary I-WeBS count area during the period 1994/95 – 2010/11.[12] Fourteen of these species are listed as SCIs for the SPA, and the additional 19 non-SCI species are listed in Table 5.1 (note that baseline data (1994/95 – 199/00) are not shown for gull species).

[11] Non-breeding season is defined as September – March inclusive

[12] Regular is defined as a species that has occurred in 14 out of the 17-year data period.

**Table 5.1 Regularly-occurring non SCI waterbird species that occur at Malahide Estuary during the non-breeding season**

| | Baseline Data Period[1] (1995/96 – 1999/00) | Recent Site Average[2] (2005/06 – 2009/10) |
|---|---|---|
| Mute Swan (*Cygnus olor*) | 40 | 115 (n) |
| Wigeon (*Anas penelope*) | 76 | 160 |
| Teal (*Anas crecca*) | 78 | 230 |
| Mallard (*Anas platyrhynchos*) | 44 | 260 |
| Pochard (*Aythya ferina*) | 53 | 36 |
| Little Grebe (*Tachybaptus ruficollis*) | 5 | 12 |
| Cormorant (*Phalacrocorax carbo*) | 33 | 84 |
| Grey Heron (*Ardea cinerea*) | 19 | 38 |
| Moorhen (*Gallinula gallinula*) | 6 | 7 |
| Ringed Plover (*Charadrius hiaticula*) | 90 | 33 |
| Lapwing (*Vanellus vanellus*) | 1,378 | 741 |
| Snipe (*Gallinago gallinago*) | 30 | 27 |
| Curlew (*Numenius arquata*) | 524 | 368 |
| Greenshank (*Tringa nebularia*) | 34 (n) | 39 (n) |
| Turnstone (*Arenaria interpres*) | 98 | 170 (n) |
| Black-headed Gull (*Chroicocephalus ridibundus*) | - | 824 |
| Common Gull (*Larus canus*) | - | 177 |
| Herring Gull (*Larus argentatus*) | - | 102 |
| Great Black-backed Gull (*Larus marinus*) | - | 20 |

[1] Baseline data is the 5-year mean peak for the period 1995/96 – 1999/00 (I-WeBS); [2] Recent site data is the five-year mean peak for 2005/06 – 2009/10 (I-WeBS); (n) denotes numbers of all-Ireland importance; n/c = not assessed.

Although waterbirds may be linked by their dependence on water, different species vary considerably in aspects of their ecology due to many evolutionary adaptations and specialisations to their wetland habitats. Different 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.

Table 5.2 provides selected ecological information for waterbird SCI species of Malahide Estuary SPA. Information is provided for the following categories[13]:-

- waterbird family (group);
- winter distribution – species distribution range during winter (based on the period 2001/02 – 2008/09 (after Boland & Crowe, 2012);
- trophic (foraging) guild (after Weller, 1999; see Appendix 5);
- food/prey requirements;
- principal supporting habitat within the site;
- ability to utilise other/alternative habitat in/around the site;
- site fidelity (species 'faithfulness' to wintering sites).

It should be borne in mind that a single wetland site is unlikely to meet all of the ecological requirements of a diverse assemblage of waterbirds (Ma et al. 2010). Although some waterbird species will be faithful to specific habitats within the SPA, many will at times also use habitats situated within the immediate hinterland of the site or in areas ecologically connected to the SPA. These areas may be used as alternative high tide roosts, as a foraging resource or, be simply flown over, either on migration or on a more frequent basis throughout the non-breeding season as waterbirds move between different areas used (e.g. commuting corridors between feeding and roosting areas).

Reliance on alternative habitats will vary from site to site, and between species. Use of alternative habitats is also likely to vary through time, from seasonally through to daily, and different habitats may be used by day and night (Shepherd et al. 2003). Different waterbirds

[13] Notes to aid the understanding of categories and codes used in Table 5.2 are provided in the table sub text.

may utilise wetland habitats in different ways. For example, while the majority of wading birds forage across exposed tidal flats, species such as Lapwing and Golden Plover are considered to be 'terrestrial waders' typically foraging across grassland and using tidal flats for roosting. When tidal flats are covered at high water, intertidally-foraging waterbirds are excluded and many species then move to nearby fields to feed. Terrestrial foraging is also important when environmental factors (e.g. low temperature) reduce the profitability of intertidal foraging (e.g. Zwarts & Wanink, 1993). Some waterbird species are simply generalists, and make use of a range of habitats, for example the Black-tailed Godwit that forages across intertidal mudflats and grassland habitats. Other waterbird species such as Greenland White-fronted Goose (*Anser albifrons flavirostris*) or Bewick's Swan (*Cygnus columbianus bewickii*) are herbivores and are reliant on terrestrial areas, often outside of the SPA boundary, and use the wetland site primarily for roosting. Some species switch their habitat preference as food supplies become depleted; for example Light-bellied Brent Geese exploit grasslands increasingly when intertidal seagrass and algae become depleted.

The topic of alternative habitat use is also applicable to benthic-foraging seaducks and divers whose foraging distribution is highly influenced by water depth and tidal conditions. Many of these species however (e.g. Great Northern Diver, Common Scoter) exhibit a widespread coastal distribution during winter utilising shallow nearshore waters to a greater degree at certain times (e.g. storms, driving onshore winds).

Thus the area designated as a SPA can represent a variable portion of the overall range of the listed waterbird species. To this end, data on waterbird use of areas adjacent to or ecologically connected to the SPA are often collected. Indeed for some species a mix of site-related and wider countryside measures are needed to ensure their effective conservation management (Kushlan, 2006). Furthermore, it is recommended that assessments that are examining factors that have the potential to affect the achievement of the site's conservation objectives should also consider the use of these '*ex-situ'* habitats, and their significance to the listed bird species.

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**Table 5.2** Waterbirds – Ecological characteristics, requirements & specialities

| | Family (group) | Winter distribution[A] | Trophic Guild[B] | Food/Prey Requirements[C] | Principal supporting habitat within site[D] | Ability to utilise other/alternative habitats[E] | Site Fidelity[F] |
|---|---|---|---|---|---|---|---|
| Light-bellied Brent Goose *Branta bernicla hrota* | Anatidae (geese) | Localised | 1, 5 | Highly specialised | Intertidal mud and sand flats, *Zostera* beds | 2 | High |
| Shelduck *Tadorna tadorna* | Anatidae (shelducks) | Localised | 1, 5 | Wide | Intertidal mud and sand flats; shallow subtidal | 3 | High |
| Pintail *Anas acuta* | Anatidae (dabbling ducks) | Localised | 1 | Wide | Intertidal mud and sand flats; shallow subtidal | 1 | Weak |
| Goldeneye *Bucephala clangula* | Anatidae (diving ducks) | Intermediate | 2 | Wide | Shallow subtidal (impounded area) | 3 | Unknown |
| Red-breasted Merganser *Mergus serrator* | Anatidae (sea ducks) | Localised | 2 | Highly specialised | Sheltered & shallow subtidal & impounded area | 1 | Unknown |
| Great Crested Grebe *Podiceps cristatus* | Podicipedidae (grebes) | Intermediate | 2/3 | Narrower | Shallow subtidal (impounded area) | 2 | High |
| Oystercatcher *Haematopus ostralegus* | Haematopodidae (wading birds) | Intermediate | 4 | Narrower | Intertidal mud and sand flats | 2 | High |
| Golden Plover *Pluvialis apricaria* | Charadriidae (wading birds) | Intermediate | 4 | Wide | Intertidal mud and sand flats | 2 | Moderate |
| Grey Plover *Pluvialis squatarola* | Charadriidae (wading birds) | Localised | 4 | Wide | Intertidal mud and sand flats | 3 | High |
| Knot *Calidris canutus* | Scolopacidae (wading birds) | Localised | 4 | Narrower | Intertidal mud and sand flats | 3 | Moderate |
| Dunlin *Calidris alpina* | Scolopacidae (wading birds) | Intermediate | 4 | Wide | Intertidal mud and sand flats | 3 | High |
| Black-tailed Godwit *Limosa limosa* | Scolopacidae (wading birds) | Localised | 4 | Wide | Intertidal mud and sand flats | 2 | High |
| Bar-tailed Godwit *Limosa lapponica* | Scolopacidae (wading birds) | Localised | 4 | Wide | Intertidal mud and sand flats | 2 | Moderate |
| Redshank *Tringa totanus* | Scolopacidae (wading birds) | Intermediate | 4 | Wide | Intertidal mud and sand flats | 2 | Moderate |

[A] Winter distribution: Very widespread (>300 sites); Widespread (200 – 300 sites); Intermediate (100 – 200 sites); Localised (50-100 sites); Highly restricted (<50 sites) (based on Boland & Crowe, 2012).
[B] Waterbird foraging guilds. 1 = Surface swimmer, 2 = water column diver (shallow), 3 = water column diver (deeper), 4/5 = intertidal walker (out of water), 6 = intertidal walker (in water), 7 = terrestrial walker. Further details are given within Appendix 5.
[C] Food/prey requirements - species with a wide prey/food range; species with a narrower prey range (e.g. species that forage upon a few species/taxa only), and species with highly specialised foraging requirements (e.g. piscivores).
[D] Principal supporting habitat present within Malahide Estuary. This is the main habitat used when foraging with the exception of Golden Plover (roosting).
[E] Ability to utilise alternative habitats refers to the species ability to utilise other habitats adjacent to the site. 1 = wide-ranging species with requirement to utilise the site as and when required; 2 = reliant on site but highly likely to utilise alternative habitats at certain times (e.g. high tide); 3 = considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
[F] Site fidelity on non-breeding grounds: Unknown; Weak; Moderate; or High (based on published literature).

## 5.3 The 2011/12 waterbird survey programme

### 5.3.1 Introduction

The 2011/12 waterbird survey programme was designed to investigate how waterbirds are distributed across coastal wetland sites during the low tide period. The surveys ran alongside and are complementary to the Irish Wetland Bird Survey (I-WeBS) which is a nationwide survey undertaken primarily on a rising tide or at high tide.

At Malahide Estuary, a standard survey programme of four low tide counts (October, November & December 2011 and February 2012) and a high tide count (January 2012) were completed across the site.[14] Waterbirds were counted within a series of 14 count sections (subsites) (Appendix 6). These subsites were based on I-WeBS subsites and while covering the SPA in its entirety, are not exactly coincident with its boundary. Therefore, from here on in this section, the site referred to as Malahide Estuary refers to the count area rather than the SPA area.

The behaviour of waterbirds during counts was attributed to one of two categories (foraging or roosting/other) while the position of birds was recorded in relation to one of four broad habitat types (intertidal, subtidal, supratidal and terrestrial). Note that these broad habitats (Table 5.3) were defined specifically for the survey programme and do not follow strict habitat-based definitions for these areas, nor follow the definitions used in relation to conservation objectives outlined in Section 3.1. For a detailed survey methodology, please refer to NPWS (2011).

**Table 5.3 Definition of broad habitat types used**

| Broad Habitat Type | Broad Habitat Description |
|---|---|
| Intertidal (area between mean high water and mean low water) | Refers to the area uncovered by the tide and most likely dominated by mudflats and sandflats. It may also include areas of rocky shoreline, areas of mixed sediment and grave/pebbles or shingle and gravel shores. |
| Subtidal (area that lies below mean low water) | Refers to areas that are covered by seawater during counts. During low-tide counts it will include offshore water, tidal channels and creeks as well as tidal rivers. |
| Supratidal | This category pertains to the shore area and habitats immediately marginal to and above the mean high-water mark. The supratidal section is an integral part of the shoreline. This broad habitat also includes areas of saltmarsh where the saltmarsh is contiguous with coastal habitats lying above. Note that patches of lower saltmarsh (e.g. *Spartina* sp.) surrounded by intertidal flats, were included in the intertidal category. |
| Terrestrial | Used where birds were recorded within habitats close to the shoreline but were above the intertidal and supratidal levels. |

In addition to the main survey programme described above, two high tide roost surveys were completed on 26th November 2011 and 7th February 2012. These dates were chosen to reflect roosting distribution during a spring tide and neap tide (4.6m and 3.9m respectively). During these surveys waterbird roost sites were located, species and numbers of waterbirds counted and the position of the roosts marked onto field maps.

### 5.3.2 Waterbird data, analyses and presentation

The aim of data analyses was to understand how waterbirds are distributed across the site of Malahide Estuary during the autumn and winter months. By assessing patterns of waterbird distribution at low and high tide, together with examination of data on sediment and

[14] Low tide surveys: 04/10/11, 03/11/11, 06/12/11 & 03/02/12 plus a high tide survey on 09/01/12.

invertebrate distribution and abundance, we aimed to identify areas (subsites) within the site that are the most important for foraging and roosting on a species by species basis.

Data analyses were undertaken to determine the proportional use of subsites by each Special Conservation Interest (SCI) species, relative to the whole area surveyed on each survey occasion. Analyses were undertaken on datasets as follows:

- Total numbers (low tide surveys);
- Total numbers (high tide survey);
- Total numbers of foraging birds (low tide surveys);
- Total numbers of roosting birds (low tide and high tide surveys).
- Foraging densities (low tide surveys).

For each of the analyses listed above and for each survey date completed, subsites were ranked in succession from the highest to the lowest in terms of their relative contribution to each species' distribution across all subsites surveyed. Rank positions were then converted to categories (see below) with the exception of those relating to the high tide survey that are presented simply as rank numbers. The highest rank position/category for each subsite across any of the low tide count dates is presented in a subsite by species matrix.

**Subsite Rank Position - Categories**

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

Intertidal foraging density was 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. Subsites were ranked based on the peak foraging density recorded. Whole site intertidal foraging density was calculated by summing the mean subsite counts for each species and dividing by the total area of intertidal habitat.

Waterbird count data for low tide surveys are also presented as species distribution maps ('dot density maps'). Dot-density maps show waterbird species distribution within intertidal or subtidal habitat[15] divided into 'foraging' birds and 'roosting/other' birds. These maps show the number of birds represented by dots; each dot representing one, or a pre-determined number of birds. As the dots are placed in the appropriate subsites and broad habitat types for the birds counted, the resulting map is equivalent to presenting numbers and densities and provides a relatively quick way of assessing species distribution.

In contrast to dot-density maps, roost maps produced from roost survey data show the mapped locations of waterbird roosts, but note the limitations in relation to field mapping discussed below.

**Notes on data interpretation and methodological limitations**

Subsite rankings and dot-density maps relate to the distribution of waterbirds at subsite level as recorded within the survey area during the 2011/12 waterbird survey programme. Care

[15] Note that birds within supratidal or terrestrial habitat are not included within these maps.

must be taken in the interpretation of these data, and subsite rankings in isolation should not be used to infer a higher level of conservation importance to one area over another without a detailed examination of data and understanding of each species' ecology. For instance, while some species are known to be highly site-faithful, both at site level and within-site level (e.g. Dunlin), other species may range more widely across a site(s). While some species by their nature may aggregate in high numbers, others such as Greenshank or Grey Heron may not. It is also important to consider that distribution maps and data refer to a single season of low tide surveys. Although important patterns of distribution will emerge, these distributions should not be considered absolute; waterbirds by their nature are highly mobile and various factors including tide (e.g. spring/neap), temperature, direction of prevailing winds, changing prey densities/availabilities and degree of human activity across the site, could lead to patterns that may change in different months and years.

Dot-density maps are not intended to show the actual position of each bird; the dots are placed randomly within subsites so no conclusions can be made at a scale finer than subsite. Dots are placed in the appropriate subsites and broad habitat types for the birds counted but given that the broad habitats are based on OS mapping, there are various cases where the mapping does not accurately portray where a bird was, e.g. in the case of birds associated with freshwater flows, or small creeks that are not shown on OS maps. These associations are discussed as necessary in the individual species text tables.

The mapping of flock positions or roost locations over large distances in intertidal habitats (i.e. mapping by eye) is inherently difficult and prone to error. Flock or roost positions should therefore be viewed as indicative only.

### 5.3.3 Summary Results

A total of 41 waterbird species were recorded during the 2011/12 survey programme at Malahide Estuary (see Appendix 6 for a map of subsites). Cummins and Crowe (2012) provide a summary of waterbird data collected.

All SCI species were recorded within all counts undertaken with the exception of Pintail (one low tide and high tide survey only), Goldeneye (two low tide surveys plus the high tide survey) and Great Crested Grebe and Knot that were present in three and two low tide surveys respectively, plus the high tide survey.

Table 5.4 shows peak numbers (whole site) for SCI species recorded during the low tide (LT) and high tide (HT) surveys.

Average percentage occupancy (Table 5.4) defined as the average proportion of subsites in which a species occurred during low tide counts, varied greatly amongst species. It was lowest for Goldeneye (recorded in one subsite only) and highest for Oystercatcher (52%); the latter was the only species to occur, on average, in over half of the count subsites.

Average percentage area occupancy is defined as the average proportion of the total count area that a species occurred in during low tide counts. Although this is a broad calculation across all habitat zones it presents some indication of the range of a species across the site as a whole. The lowest occupancy was recorded for Golden Plover (12%) while only two species occurred, on average, across 50% or more of the area surveyed (Oystercatcher and Redshank) (Table 5.4).

**Table 5.4 Malahide Estuary 2011/2012 waterbird surveys – summary data**

| Site Special Conservation Interests (SCIs) | Peak number - LT surveys[I] | Peak number - HT survey[II] | Average subsite % occupancy [III] | Average % area occupancy [III] |
|---|---|---|---|---|
| Light-bellied Brent Goose | 1,105 (i) | 1,350 (i) | 30 (16) | 44 (22) |
| Shelduck | 280 (n) | 173 (n) | 16 (4) | 19 (1) |
| Pintail | 36 (n) | 11 | 14 (0) | 18 (0) |
| Goldeneye | 58 | 44 | 7 (0) | 29 (0) |
| Red-breasted Merganser | 137 (n) | 54 (n) | 16 (4) | 46 (1) |
| Great Crested Grebe | 29 | 51 | 10 (4) | 31 (3) |
| Oystercatcher | 905 (n) | 1,699 (n) | 52 (7) | 84 (9) |
| Golden Plover | 1,900 (n) | 1,305 | 10 (4) | 12 (7) |
| Grey Plover | 62 | 71 (n) | 21 (12) | 38 (24) |
| Knot | 74 | 80 | 14 (0) | 26 (10) |
| Dunlin | 381 | 6 | 13 (4) | 25 (9) |
| Black-tailed Godwit | 404 (n) | 205 (n) | 29 (8) | 47 (8) |
| Bar-tailed Godwit | 108 | 28 | 14 (6) | 36 (19) |
| Redshank | 390 (n) | 366 (n) | 48 (7) | 72 (15) |

(n) denotes numbers of all-Ireland importance (1% thresholds; 1999/00 – 2003/04 Crowe et al. 2008); (i) denotes numbers of international importance (Wetlands International, 2012); [I] four low-tide counts undertaken on 04/10/11, 03/11/11, 06/12/11 & 03/02/12; [II] High-tide count undertaken on 09/01/12; [III] Mean (± s.d.) averaged across the low tide surveys in which the species occurred.

Species richness (total number of species) across the whole site varied between 30 species (04/10/11) and 36 species (03/02/12) during low tide counts, with 34 species recorded during the high tide survey.

During low tide surveys, subsite species richness ranged from zero (subsites 0UL20, 0UL21) and one species (0UL22, 0UL50), to an average 23 species (0UL24 Burrow Strand) which never recorded less than 20 species during any of the low tide surveys. Six of the total 14 subsites supported on average, ten species or more. Eight subsites supported a greater number of species during low tide surveys, as opposed to the high tide survey.

**Table 5.5 Subsite species richness**

| Subsite | Subsite Name | Mean (±S.D) LT Survey | HT Survey | Peak Overall |
|---|---|---|---|---|
| 0UL16 | Balheary Bridge | 4 (3) | 4 | 8 (LT) |
| 0UL17 | Seatown West | 12 (8) | 22 | 22 (HT) |
| 0UL18 | Prospect Point | 17 (2) | 19 | 19 (LT & HT) |
| 0UL19 | Seatown East | 2 (2) | 3 | 4 (LT) |
| 0UL20 | Yellow Walls | 0 (0) | 4 | 4 (HT) |
| 0UL21 | Kilcrea East | 0 (1) | 2 | 2 (HT) |
| 0UL22 | Mullan intake | 1 (2) | 0 | 3 (LT) |
| 0UL23 | Corballis House Marsh | 11 (3) | 9 | 14 (LT) |
| 0UL24 | Burrow Strand | 23 (2) | 15 | 24 (LT) |
| 0UL25 | Malahide Point | 11 (3) | 15 | 15 (HT) |
| 0UL26 | Malahide Strand South | 13 (8) | 6 | 24 (LT) |
| 0UL27 | Malahide Strand North | 4 (1) | 8 | 8 (HT) |
| 0UL28 | Malahide Martello Tower | 6 (2) | 7 | 9 (LT) |
| 0UL50 | Kilcrea Field | 1 (1) | 0 | 2 (LT) |

### 5.3.4 Waterbird distribution

Data analyses determined the proportional use of subsites by each Special Conservation Interest (SCI) species, relative to the site as a whole during both low tide and high tide surveys. Selected results from these 'subsite assessments' are shown in Tables 5.6 (a–f). The relative importance of each subsite is based on the final rank positions (see 5.3.2 for methodology). Where a box is left blank, it simply means that a species was not recorded in that subsite.

The fact that different subsites may be ranked as 'Very High' for the same species highlights the fact that several subsites may be equally important for the species being analysed. This approach, rather than averaging across all surveys, allows for equal weightings to be given for temporal differences – e.g. concentrations of foraging birds in different subsites at different times reflecting the natural pattern of distribution across time as species move in response to changing prey densities or availabilities.

Tables 5.6 (a–f) are followed by species discussion notes which provide additional information on the distribution of each SCI species, drawing upon the full extent of the data collected and analysed for Malahide Estuary. Waterbird distribution dot-density maps are provided in Appendix 7; summary roost data are presented in Appendix 8.

**Table 5.6 (a) Malahide Estuary Subsite assessment – total numbers during LT surveys (across all behaviours and habitats)** (L Low, M Moderate; H High V Very high; please see Section 5.3.2 for methods).

| Species ► / Subsites ▼ | PB | SU | PT | GN | RM | GG | OC | GP | GV | KN | DN | BW | BA | RK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0UL16 | | | | | | | | | | | | | | |
| 0UL17 | H | M | | | M | | L | H | H | | | V | V | V |
| 0UL18 | M | | | V | V | V | H | | H | | | M | V | V |
| 0UL19 | | | | | | | M | | | | | V | | M |
| 0UL20 | | | | | | | | | | | | | | |
| 0UL21 | H | | | | | | | | | | | | | |
| 0UL22 | | | | | | | | | | | | | | |
| 0UL23 | M | V | V | | | | H | V | M | | H | H | | V |
| 0UL24 | V | V | H | | V | | V | V | V | V | V | H | V | H |
| 0UL25 | M | | | | | | L | | H | H | | L | | M |
| 0UL26 | V | | | | | | H | V | H | V | H | V | V | V |
| 0UL27 | | | | | | | M | | | | | | | L |
| 0UL28 | L | | | | | H | H | | | | | | | L |
| 0UL50 | | | | | | | | | | | | | | L |

**Table 5.6 (b) Malahide Estuary Subsite assessment – ranked total numbers HT Survey (across all habitats)**

| Species ► / Subsites ▼ | PB | SU | PT | GN | RM | GG | OC | GP | GV | KN | DN | BW | BA | RK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0UL16 | | | | | | | | | | | | | | |
| 0UL17 | 7 | | | | 1 | | 3 | 1 | 1 | | | 1 | | 5 |
| 0UL18 | 4 | | | 1 | 2 | 2 | 6 | | 2 | | | 2 | 1 | 4 |
| 0UL19 | 5 | | | | | | 1 | | | | | | | |
| 0UL20 | 2 | | | | | | 2 | | | | | | | |
| 0UL21 | 8 | | | | | | | | | | | | | |
| 0UL22 | | | | | | | | | | | | | | |
| 0UL23 | 1 | 1 | | | | | | | | | | | | 3 |
| 0UL24 | 6 | 2 | 2 | | | | 3 | | | | | | | 6 |
| 0UL25 | 3 | | 1 | | | | 8 | | | 1 | | | | 7 |
| 0UL26 | | | | | | | | | 3 | | | | | 1 |
| 0UL27 | | | | | | 3 | 7 | | | | | | | 2 |
| 0UL28 | | | | | | 1 | 5 | | | | | | | |
| 0UL50 | | | | | | | | | | | | | | |

**Table 5.6 (c) Malahide Estuary Subsite assessment – total numbers foraging intertidally[I] and subtidally[II] (LT surveys)** Low, M Moderate; H High V Very high; please see Section 5.3.2 for methods)

| Species ► Subsites ▼ | PB[I] | PB[II] | SU[I] | SU[II] | PT[I] | GN[II] | RM[II] | GG[II] | OC[I] | GP[I] | GV[I] | KN[I] | DN[I] | BW[I] | BA[I] | RK[I] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0UL16 | | | | | | | | | | | | | | | | |
| 0UL17 | | | | V | | | | | L | H | H | | | V | H | V |
| 0UL18 | | | | | | V | V | V | H | | H | | | V | V | V |
| 0UL19 | | | | | | | | | | | | | | | | |
| 0UL20 | | | | | | | | | | | | | | | | |
| 0UL21 | | | | | | | | | | | | | | | | |
| 0UL22 | | | | | | | | | | | | | | | | |
| 0UL23 | M | | V | | V | | | | H | V | | | H | H | | H |
| 0UL24 | V | V | V | V | | | V | | V | V | H | V | V | V | V | V |
| 0UL25 | H | | | | | | | | M | | V | | | L | | M |
| 0UL26 | H | | | | | | | | H | | H | | H | V | V | M |
| 0UL27 | | | | | | | | | M | | | | | | | L |
| 0UL28 | | | | | | | | V | H | | | | | | | L |
| 0UL50 | | | | | | | | | | | | | | | | L |

**Table 5.6 (d) Malahide Estuary Subsite assessment – ranked peak intertidal foraging density (LT surveys)**

| Species ► Subsites ▼ | PB | SU | OC | GV | DN | BW | BA | RK |
|---|---|---|---|---|---|---|---|---|
| 0UL16 | | | | | | | | |
| 0UL17 | | | 6 | 3 | 4 | 1 | 4 | 1 |
| 0UL18 | | | 5 | 5 | | 3 | 3 | 3 |
| 0UL19 | | | | | | | | |
| 0UL20 | | | | | | | | |
| 0UL21 | | | | | | | | |
| 0UL22 | | | | | | | | |
| 0UL23 | 2 | 1 | 2 | | 1 | 2 | | 2 |
| 0UL24 | 1 | 2 | 3 | 2 | 2 | 5 | 2 | 6 |
| 0UL25 | 3 | | 7 | 1 | | 6 | | 4 |
| 0UL26 | 4 | | 8 | 4 | 3 | 4 | 1 | 7 |
| 0UL27 | | | 4 | | | | | 8 |
| 0UL28 | | | 1 | | | | | 5 |
| 0UL50 | | | | | | | | |

**Table 5.6 (e) Malahide Estuary Subsite assessment – total numbers (roosting/other behaviour) intertidally[I] and subtidally[II] during LT surveys** Low, M Moderate; H High V Very high; please see Section 5.3.2 for methods).

| Species ► Subsites ▼ | PB[I] | PB[II] | SU[I] | SU[II] | PT[I] | GN | RM[II] | GG[I] | OC[I] | GP[I] | GV[I] | KN[I] | DN[I] | BW[I] | BA[I] | RK[I] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0UL16 | | | | | | not recorded | | | | | | | not recorded | | | |
| 0UL17 | V | V | | H | | | H | | | V | | | | V | V | V |
| 0UL18 | | V | | | | | V | V | H | | V | | | L | H | V |
| 0UL19 | | | | | | | | | | | | | | | | |
| 0UL20 | | | | | | | | | | | | | | | | |
| 0UL21 | | | | | | | | | | | | | | | | |
| 0UL22 | | | | | | | | | | | | | | | | |
| 0UL23 | V | | H | | V | | | | | | H | | | V | | |
| 0UL24 | V | V | V | V | H | | V | | V | V | V | H | | H | V | V |
| 0UL25 | | H | | | | | | | | | | V | | | | |
| 0UL26 | | V | | | | | | | V | V | | V | | H | V | |
| 0UL27 | | | | | | | | | | | | | | | | |
| 0UL28 | | M | | | | | | H | H | | | | | | | |
| 0UL50 | | | | | | | | | | | | | | | | |

**Table 5.6 (f) Malahide Estuary Subsite assessment – ranked total numbers (roosting/other behaviour) during HT survey (Intertidal,[I] Subtidal,[II] and intertidal/subtidal combined[III]).**

| Species ► Subsites ▼ | PB[I] | PB[II] | SU[II] | PT[II] | GN[II] | RM[II] | GG[II] | OC[III] | GP[I] | GV[I] | KN | DN | BW[III] | BA[III] | RK[III] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0UL16 | | | | | | | | | | | not recorded | not recorded | | | |
| 0UL17 | | 1 | | | | 2 | | 2 | 1 | 1 | | | 2 | | 2 |
| 0UL18 | 1 | 2 | | | 1 | 1 | 1 | 1 | | | | | 1 | 1 | 2 |
| 0UL19 | | | | | | | | | | | | | | | |
| 0UL20 | | | | | | | | | | | | | | | |
| 0UL21 | | | | | | | | | | | | | | | |
| 0UL22 | | | | | | | | | | | | | | | |
| 0UL23 | | 3 | 1 | | | | | | | | | | | | |
| 0UL24 | | 4 | 2 | 1 | | | | 3 | | | | | | | 1 |
| 0UL25 | | | | 2 | | | | | | | | | | | |
| 0UL26 | | | | | | | | | | | | | | | |
| 0UL27 | | | | | | | | | | | | | | | |
| 0UL28 | | | | | | | | | | | | | | | |
| 0UL50 | | | | | | | | | | | | | | | |

## Malahide Estuary - Waterbird Survey Programme 2011/12

## Waterbird distribution - discussion notes

Where mentioned, information on benthic communities or sediment is from the intertidal and subtidal sampling programme commissioned by the National Parks & Wildlife Service (NPWS) and Marine Institute and reported in NPWS (2013) and ASU (2011).

'I-WeBS' refers to count data recorded at Malahide Estuary as part of the Irish Wetland Bird Survey.

Where mentioned, all-Ireland and international population thresholds follow Crowe et al. (2008) and Wetlands International (2012) respectively.

## Light-bellied Brent Goose *Branta bernicla hrota* - Family (group): Anatidae (geese)

Migratory Light-bellied Brent Geese (hereafter called 'Brent Geese') that spend winter within Ireland belong to the East Canadian High Arctic population. Almost all of this population spends winter within Ireland.

Brent Geese begin to arrive in Ireland in late August when almost three-quarters of the biogeographic population congregate at Strangford Lough in Northern Ireland before dispersing to other sites (Robinson et al. 2004).

**Numbers**

Numbers of Brent Geese peaked in November 2011 when a site count of 1,105 was recorded. Numbers in other low tide surveys ranged from 91 (04/10/11) to 606 (03/02/12). A count of 1,350 was recorded during the high tide survey (09/01/12). All counts except that in October 2011 surpassed the threshold of international importance.

Separate survey work undertaken at Malahide Estuary during 2011/12 recorded a site peak count of 1,971 Brent Geese (24/01/2012) of which 1,098 were in the inner estuary (west of the viaduct) and 873 were in the outer estuary (Creagh House Environmental, 2012). (Note that the total count area for this survey was different (smaller) than that surveyed for the 2011/12 NPWS Waterbird Survey Programme).

Roe & Lovatt (2009) documented the extensive use of terrestrial lands around the SPA. As the geese are highly mobile between the estuary and surrounding lands, total numbers actually associated with the estuary could be much higher than recorded by counts that survey only the estuary and immediate hinterland.

During the 2011/12 NPWS Waterbird Survey Programme, Brent Geese were recorded in ten subsites across the survey period; eight during low tide surveys and eight (but different subsites) during the high tide survey. They were recorded regularly (three surveys or more) within five subsites (0UL17, 0UL18, 0UL23, 0UL24, 0UL25). 0UL24 (Burrow Strand) was notable for supporting peak numbers in three low tide surveys and the subsite peak count of 915 Brent Geese on 03/11/11.

**Foraging Distribution**

Brent Geese are grazers and are known for their preference for foraging in intertidal areas with the Eelgrass *Zostera* sp. (Robinson et al. 2004). Where this food source is absent or becomes depleted, the birds feed upon algae species, saltmarsh plants and may also undertake terrestrial grazing.

Across the survey period Brent Geese were recorded foraging intertidally across a total four subsites: 0UL23 (Corballis House Marsh), 0UL24 (Burrow Strand), 0UL25 (Malahide Point) and 0UL26 (Malahide Strand South). 0UL24 (Burrow Strand) held peak numbers in all four low tide surveys with numbers ranging from 41% to 100% of the geese recorded on survey days. 0UL24 was the only subsite to support foraging individuals in all four low tide surveys.

The intertidal benthic community of 0UL24 (Burrow Strand) is classified as 'sand to muddy sand with *Peringia ulvae* (*Hydrobia ulvae*), *Tubificoides benedii* and *Cerastoderma edule*.' Two discrete areas of *Zostera noltii* occur in the north of the subsite, on Burrow Strand at Corballis, and along the shore to the east of Kilcrea. Coverage of the two beds range from 62% to 80% for the two beds respectively. These beds are monitored by a national monitoring programme undertaken by the Environmental Protection Agency (http://www.epa.ie/whatwedo/wfd/monitoring/). An examination of flock maps reveals that all recorded Brent Geese on 04/10/11 were within the eastern *Zostera* bed (near Corballis) while on other survey days the geese were distributed more widely across the subsite and outside of the main areas of *Zostera*. They were often associated with Mussel (*Mytilus edulis*) beds, likely foraging on seaweed species (e.g. *Ulva* spp.) that are afforded attachment by the hard structures of the mussel beds. Indeed, seaweed species form an integral part of the species list for the benthic community 'Mussel-dominated community complex' recorded at this site.

Subtidal foraging was recorded exclusively within 0UL24 (Burrow Strand); peak numbers of 258 individuals on 03/02/12.

Terrestrial foraging was recorded widely. Terrestrial subsite 0UL21 (Kilcrea East) (outside of SPA boundary) was utilised during both low and high tide surveys with a peak number of 578 individuals during the January 2012 high tide survey. 0UL19 (Seatown East) and 0UL20 (Yellow Walls) (both outside SPA boundary) recorded foraging individuals during the high tide survey (peak number 142). Terrestrial foraging was also recorded adjacent 0UL17 and 0UL26. Roe & Lovatt (2009) described the use of lands adjacent to the estuary by Brent Geese during the period January to March 2009, and found that flocks were highly mobile between the estuary and terrestrial areas during the course of a day. The geese were found to utilise all suitable grasslands over the surrounding lands and at all states of the tide. One survey area (equivalent to subsite 0UL21) recorded a peak number of 1,370 Brent Geese in February 2009.

The highest intertidal foraging density within a single subsite was recorded for 0UL24 (Burrow Strand) (6.5 Brent Geese $ha^{-1}$). The average whole site foraging density was 0.8 individuals $ha^{-1}$.

**Roosting Distribution**

Relatively little roosting/other behaviour was recorded in intertidal habitat during low or high tide surveys with the exception of 03/02/12 when 100 Brent Geese were recorded roosting within 0UL17 (Seatown West). Occasional records were made of small numbers resting within 0UL23 and 0UL24. Subtidal roosting/other behaviour was recorded more widely, a peak number of 50 individuals within 0UL26 (Malahide Strand South) on 06/12/11. However subtidal roosting was most frequently recorded in association with 0UL24 (Burrow Strand) that recorded the majority of geese.

During the high tide survey (09/01/12), Brent Geese were recorded roosting/other across four subsites (0Ul17, 0UL18, 0UL23 and 0UL24); the majority (200 (78%)) within the very inner subsite 0UL17 (Seatown West).

0UL17 (Seatown West) also held peak numbers of roosting birds during the November 2011 roost survey (spring tide) when a flock of 800 were recorded roosting subtidally. 0UL23 (Corballis House Marsh) held a flock of 600 roosting individuals (subtidal). 0UL24 and 0UL25 recorded smaller numbers (subtidal/supratidal habitat).

The largest single roost recorded during the February 2012 roost survey (neap tide) was located subtidally within 0UL18 (Prospect Point). 0UL17 (Seatown West) supported a flock of 243 individuals, also subtidal. Smaller numbers were recorded in 0UL23, 0UL24 and 0UL25; 50 geese in the latter subsite roosting supratidally and a further 148 also foraging intertidally within the same subsite.

Saltmarsh and creek habitat at Malahide Point (0UL25) has been documented previously as an important roost site for Brent Geese, amongst other species (NPWS, 2000). An overnight roost site was identified at the north western corner of the outer estuary at Corballis (Roe & Lovatt, 2009).

## Shelduck *Tadorna tadorna* - Family (group): Anatidae (ducks)

*Tadorna tadorna* has five known populations which breed across temperate Eurasia. The northwest Europe population breeds and winters along coasts of Britain, Ireland, Scandinavia, the Baltic and continental Europe. Although a breeding species in Ireland, Shelducks undertake a moult migration each autumn. Large moult gatherings occur along traditionally used areas of the north German coast of the Wadden Sea although several sites in Britain have also become recognised as important moulting areas such as Bridgewater Bay (Severn Estuary), the Humber Estuary, the Wash, and the Firth of Forth. Following the moult, the ducks then migrate to wintering areas.

**Numbers**

Numbers of Shelduck rose from 70 in October 2011 to a low tide peak count of 280 on 03/02/12. A total 173 Shelduck were counted during the high tide survey (09/01/12). All site counts, except those in October and December 2011, surpassed the threshold of all-Ireland importance.

Shelduck were recorded in three subsites overall (0UL17, 0UL23 and 0UL24). Peak numbers were supported by 0UL23 and 0UL24; 0UL17 recorded five individuals on one occasion only. The subsite peak count of 158 Shelduck was recorded for 0UL24 (Burrow Strand) on 03/02/12.

**Foraging Distribution**

Shelducks can forage in a variety of ways from scything their bill through wet mud on exposed tidal flats, to dabbling and scything in shallow water and up-ending in deeper waters. They can therefore forage throughout the tidal cycle.

Shelduck were recorded foraging intertidally in 0UL23 (Corballis House Marsh) and 0UL24 (Burrow Strand). They were present in all four low tide surveys. 0UL23 held peak numbers on 03/11/11, 06/12/11 and 03/02/12, while 0UL24 held peak numbers on 04/10/11.

In intertidal areas, Shelduck forage by sieving the upper layers of sediment for small invertebrates, particularly the small mollusc *Peringia ulvae* (*Hydrobia ulvae*) (Olney, 1965; Bryant & Leng, 1975). The intertidal benthic community of 0UL23 (Corballis House Marsh) and 0UL24 (Burrow Strand) is classified as 'sand to muddy sand with *Peringia ulvae* (*Hydrobia ulvae*), *Tubificoides benedii* and *Cerastoderma edule*.' *Peringia ulvae* (*Hydrobia ulvae*) was widely recorded during intertidal benthic sampling and particularly abundant in cores taken from the north of subsite 0UL24.

Subtidal foraging was recorded rarely, two and one individuals respectively recorded in 0UL17 and 0UL24 on 03/02/12 and 06/12/11.

The highest intertidal foraging density within a single subsite was recorded for 0UL23 (Corballis House Marsh) (7.5 Shelduck $ha^{-1}$). The average whole site foraging density was 1.1 individuals $ha^{-1}$.

**Roosting Distribution**

Good numbers of Shelduck roosted intertidally during low tide surveys but this activity was confined to the same two subsites that recorded foraging individuals (0UL23 and 0UL24). 0UL24 (Burrow Strand) held peak numbers in all four low tide surveys with proportions ranging from 58% to 100% of all individuals recorded in this behaviour.

Subtidal roosting/other behaviour was a rare occurrence during low tide surveys and recorded in three subsites (0UL17, 0UL23 and 0UL24). The high tide survey recorded no intertidally roosting individuals although 69 Shelduck roosted subtidally within 0UL23 (Corballis House Marsh); a further two individuals within 0UL24 (Burrow Strand).

During the November 2011 roost survey (spring tide), Shelduck roosted in three subsites: 0UL23, 0UL24 and 0UL25. The largest flock (152) was recorded in 0UL24 (Burrow Strand) (subtidal). All other birds roosted subtidally with the exception of two individuals that roosted supratidally within 0UL25.

0UL24 again supported the largest roosting flock (112 individuals) during the February 2012 high tide roost survey. These birds roosted supratidally (upper shore) along the shoreline of 0UL50 (Kilcrea Field) (but within 0UL24). All other birds roosted subtidally, the largest flock comprising 40 individuals (0UL24) followed by 24 individuals (0UL23).

| Pintail *Anas acuta* - Family (group): Anatidae (ducks) |
|---|
| The Pintail has a Holarctic distribution breeding widely over northern temperate and arctic zones. Although there is a small population breeding within Ireland, the main numbers that winter in Ireland come from breeding grounds from Iceland eastwards through Fennoscandia to western Russia (Wernham et al. 2002). The species is highly migratory, in north-west Europe is strikingly coastal in distribution during winter, and is amongst the most concentrated of all wintering waterfowl species (EU Commission, 2007). Cold weather movements are common within northwest Europe (Scott & Rose, 1996). Wintering habitats comprise largely estuaries, coastal brackish lagoons or inland lakes. |
| **Numbers** |
| Pintail were recorded once during the low tide survey programme (36 on 03/02/12) and during the high tide survey (11 on 09/01/12). They were recorded in two subsites during low tide surveys: 0UL23 (Corballis House Marsh) and 0UL24 (Burrow Strand). Malahide Point (0UL25) recorded the species during the high tide survey. The subsite peak count was 32 Pintail within 0UL23 (Corballis House Marsh) on 03/02/12. |
| **Foraging Distribution** |
| 15 Pintail foraged intertidally within 0UL23 (Corballis House Marsh) on 03/02/12, these birds foraging (dabbling) close to the low tide channel. No other foraging individuals were recorded.<br><br>Pintail are omnivorous, taking aquatic invertebrates plus plant material, including tubers, seeds, and vegetative parts. The mollusc *Peringia ulvae* (*Hydrobia ulvae*), a dominant part of the invertebrate fauna at Malahide Estuary, may be an important part of the Pintail diet (Olney, 1965). |
| **Roosting Distribution** |
| 21 Pintail roosted intertidally within two subsites during the low tide survey on 03/02/12; the majority (17) within 0UL23 (Corballis House Marsh).<br><br>The high tide survey (09/01/12) recorded 11 Pintail roosting/other subtidally within two subsites 0UL24 (Burrow Strand) (6) and 0UL25 (Malahide Point) (5).<br><br>0UL23 and 0UL25 recorded roosting Pintail in the November 2011 roost survey; 14 individuals within 0UL23 (subtidal) and eight within 0UL25, these latter birds roosting supratidally (upper shoreline) in a mixed-species roost also comprising 105 Knot and 60 Black-tailed Godwits, amongst other species. Ten Pintail roosted subtidally within 0UL23 during the February 2012 roost survey. |

| Goldeneye *Bucephala clangula* - Family (group): Anatidae (diving ducks) |
|---|
| Six populations are described for this migratory species. The population that breeds within north and northwest Europe winters in northwest and central Europe (Wetlands International, 2006). The wintering population in Ireland is about 9,600 individuals (Crowe et al. 2008). |
| **Numbers** |
| Goldeneye were recorded in the December 2011 and February 2012 low tide surveys, and during the high tide survey (09/01/12). The maximum site count of 58 was recorded on 03/02/12. Goldeneye were recorded from one subsite only - 0UL18 (Prospect Point). |
| **Foraging Distribution** |
| Wintering Goldeneye inhabit both coastal and inland freshwater habitats (Crowe, 2005). When foraging they make shallow-water dives for their prey which may comprise molluscs, crustaceans and insect larvae, although the species has a wide and varied diet.<br><br>At Malahide Estuary, foraging was recorded during two low tide surveys only; 14 and 58 individuals recorded foraging subtidally within 0UL18 (Prospect Point) on 06/12/11 and 03/02/12 respectively. 0UL18 is an impounded area, cut-off from the outer intertidal area by the railway viaduct. With limited tidal exchange, there is a relatively small difference in water depth between periods of high water and low water.<br><br>Goldeneye foraged within the inner part of 0UL18 on 06/12/11, but were more widely distributed across open water on 03/02/12. |
| **Roosting Distribution** |
| 44 Goldeneye were recorded roosting subtidally within 0UL18 (Prospect Point) during the high tide survey (09/01/12).<br>Goldeneye were not recorded during either the November 2011 or February 2012 roost surveys. |

| Red-breasted Merganser *Mergus serrator* - Family (group): Anatidae (sea ducks) |
|---|
| Red-breasted Mergansers have a wide breeding range which spans northern Europe, Russia, Siberia and North America. The Irish breeding population is thought to be sedentary. Large flocks of moulting birds congregate at several sites in Ireland and numbers remain relatively stable throughout the wintering season apart from some peaks possibly reflecting passage populations or cold weather movements (Crowe, 2005).<br>The wintering population is thought to be increased to some extent by the addition of birds from central Europe, eastern Greenland (Robinson, 1999) and Iceland (Scott & Rose, 1996). |
| **Numbers** |
| Red-breasted Mergansers were present in all five surveys of the main survey programme and numbers peaked in October 2011 when 137 were counted across the whole site. 54 were recorded during the high tide survey (09/01/12).<br><br>Red-breasted Mergansers were recorded in three subsites overall 0UL17 (Seatown West), 0UL18 (Prospect Point) and 0UL24 (Burrow Strand). The two main subsites for the species however were 0UL18 and 0UL24 which both held peak numbers on two low tide occasions. 0UL18 recorded peak numbers during the high tide survey. |
| **Foraging Distribution** |
| Red-breasted Mergansers are sea ducks that feed on fish, obtained by frequent dives from the surface. They prefer shallow waters (range 3 – 6m) (BWPi, 2004).<br><br>The majority of Red-breasted Mergansers recorded were foraging (as opposed to roosting/other). All foraging was undertaken subtidally and in two subsites - 0UL18 (Prospect Point) held peak numbers on 03/11/11 and 03/02/12 and 0UL24 (Burrow Strand) on 04/10/11 and 06/12/11.<br><br>0UL18 is an impounded area, cut-off from the outer intertidal area by the railway viaduct. With limited tidal exchange, there is a relatively small difference in water depth between periods of high water and low water. Red-breasted Mergansers in this subsite foraged in the inner western part of the subsite on 04/10/11. The following month a main loose flock of 89 individuals drifted from the south of the subsite towards the northern shore, while several smaller groupings foraged along the southern shore. On 06/12/11, the birds foraged in the inner western part of the subsite in two flocks (14 with a further four roosting/other nearby), while on 03/02/12 they foraged in open water in two main groups in the centre of the subsite.<br><br>Red-breasted Mergansers recorded in 0UL24 foraged in tidal channels, predominantly in the southern section of the subsite.<br><br>Creagh House Environmental (2012) reported nationally-important numbers of Red-breasted Merganser within the inner estuary during the 2011/12 season with a peak count of 71 individuals. |
| **Roosting Distribution** |
| Red-breasted Mergansers were recorded in roosting/other behaviour in three subsites during low tide surveys: 0UL17 (Seatown West), 0UL18 (Prospect Point) and 0UL24 (Burrow Strand). 0UL17 and 0UL18 also recorded roosting/other individuals during the high tide survey (two and 47 individuals respectively).<br>The November spring tide roost survey recorded just four roosting/other Red-breasted Mergansers; three in 0UL18 and one in 0UL25 (Malahide Point). A further 101 were recorded foraging; 100 in 0UL18. No roosting individuals were recorded during the February 2012 roost survey; although 38 were recorded foraging in 0UL18 (18) and 0UL24 (20). |

| Great Crested Grebe *Podiceps cristatus* - Family (group): Podicipedidae (grebes) |
|---|
| Great Crested Grebes are a widespread breeding species; one population of the nominate subspecies breeds and winters in north and west Europe (Wetlands International, 2006). It is thought likely that the majority that breed within Ireland are resident, with individuals breeding at inland wetlands (lakes) moving to coastal sites for the winter period. Some immigration of individuals due to cold weather movements is likely (Crowe, 2005) but the true nature of this species' movements is poorly known (Wernham et al. 2002). |
| **Numbers** |
| The peak number (whole site) of Great Crested Grebes was recorded during the January 2012 high tide survey (51 individuals); this count close to the threshold of all-Ireland importance (55). Low tide counts ranged from 25-29 and none were recorded during the February 2012 low tide survey.<br><br>Great Crested Grebes were recorded within just three subsites (0UL18, 0UL27 and 0UL28). 0UL18 (Prospect Point) was the only subsite to record the species during low tide surveys and recorded a peak number of 29 (03/11/11). 0UL27 (Malahide Strand North) only recorded the species during the high tide survey. |
| **Foraging Distribution** |
| Great Crested Grebes are largely piscivorous and make short dives for their prey in the depth range of 2-4m.<br><br>Great Crested Grebes foraged almost exclusively within 0UL18 (Prospect Point) during low tide surveys with a peak number of 29 recorded on 03/11/11. Four individuals foraged within 0UL28 (Malahide Martello Tower) on 06/12/11.<br><br>0UL18 is an impounded area, cut-off from the outer intertidal area by the railway viaduct. With limited tidal exchange, there is a relatively small difference in water depth between periods of high water and low water.<br><br>A total of 47 Great Crested Grebes were recorded foraging during the high tide survey (09/01/12), the majority of these (60%) within 0UL27 (Malahide Strand North). |
| **Roosting Distribution** |
| Relatively few Great Crested Grebes were recorded in roosting/other behaviour during low tide counts the exception being on 06/12/11 when 14 roosted/other within 0UL18 (Prospect Point) and three within 0UL28 (Malahide Martello Tower). Four Great Crested Grebes were recorded in roosting/other behaviour during the high tide survey on 09/01/12.<br><br>The November 2011 roost survey recorded subtidally roosting Great Crested Grebes in three subsites: 0UL18, 0UL27 and 0UL28. The largest flock size was 13 individuals (0UL27); this subsite also recorded the species at the greatest number of locations (five).<br><br>The February 2012 roost survey (7/02/12) did not record any Great Crested Grebes but as many return to breeding grounds in mid-February this result is perhaps not unexpected. |

## Oystercatcher *Haematopus ostralegus* - Family (group): Haematopodidae (wading birds)

*Haematopus ostralegus* is polytypic; four subspecies are recognised of which only two occur within western Europe and Africa (Delaney et al. 2009). The nominate race breeds in western and northern Europe as far as Iceland, Norway and Finland and includes those birds that breed within Ireland. Irish-breeding birds are partial migrants, some moving south during winter while others remain on the Irish coast. Wintering birds are supplemented by breeding birds from Iceland and the Faeroe Islands (Wernham et al. 2002).

**Numbers**

Whole-site numbers ranged from 611 (06/12/11) to 905 (04/10/11) during low tide surveys and 1,699 were recorded during the January 2012 high tide survey. With the exception of 06/12/11, all counts exceeded the threshold of all-Ireland importance.

Oystercatchers were relatively widespread and occurred in 10 subsites overall and within nine subsites during all four low tide surveys: 0UL17, 0UL18, 0UL19, 0UL23, 0UL24, 0UL25, 0UL26, 0UL27 and 0UL28. Highest numbers were recorded in Burrow Strand (0UL24) in all four low tide surveys and numbers peaked at 648 on 04/10/11. 0UL26 (Malahide Strand South) and 0UL28 (Malahide Martello Tower) were notable in supporting numbers always ranked in the top four.

**Foraging Distribution**

Oystercatchers are large wading birds that forage primarily on tidal flats although the species can be found foraging along non-estuarine coastline or terrestrially for earthworms. On tidal flats their food consists of Cockles (*Cerastoderma edule*), Mussels (*Mytilus edulis*) and to a lesser degree other bivalve molluscs such as *Macoma balthica*, *Scrobicularia plana* and *Mya arenaria* as well as larger polychaetes such as *Arenicola marina* and *Hediste diversicolor.* Cockles and Mussels are favoured prey items and '*universally important during winter*' (Zwarts et al. 1996) because these bivalves live in the upper sediment and are nearly always accessible, although it is known that individual birds are specialised by way of their morphology with regards choosing one or the other of these prey items, and their means of handling them.

Between 65% and 85% of all Oystercatchers recorded during low tide surveys were foraging. Peak numbers were recorded in Burrow Strand (0UL24) in all four low tide surveys with numbers that represented between 48 and 82% of all recorded foraging individuals. 0UL23 (Corballis House Marsh), 0UL26 (Malahide Strand South) and 0UL28 (Malahide Martello Tower) recorded numbers ranked second highest on one or more low tide survey occasions.

Based on these results, foraging distribution is therefore confined largely to the outer estuary (east of the causeway) although up to 52 individuals were recorded in the rather limited intertidal habitat of 0UL18 (Prospect Point) and 12 Oystercatchers foraged in 0UL17 (Seatown West) on 03/02/12. A preference for foraging in the outer estuary was also noted by Creagh House Environmental (2012).

The intertidal benthic community of 0UL23, 0UL24 and part of 0UL25 is classified as 'sand to muddy sand with *Peringia ulvae* (*Hydrobia ulvae*), *Tubificoides benedii* and *Cerastoderma edule.*' The Cockle (*Cerastoderma edule*) was recorded at 13 out of 20 sampling sites during recent intertidal sampling (ASU, 2011) and was most abundant in the north of subsite 0UL24. In addition, there are several Mussel beds (*Mytilus edulis*) within subsite 0UL24, located in the centre and south of the subsite and classified as the intertidal benthic community '*Mytilus* dominated community complex.' It is therefore not surprising that flock maps show foraging Oystercatchers to be associated with either areas of Cockle or Mussel beds.

0UL26 (Malahide Strand South) and 0UL28 (Malahide Martello Tower) are outer site (open shore) subsites that are classified as the intertidal benthic community 'fine sand with oligochaetes, amphipods, bivalves and polychaetes. Species such as the bivalve *Angulus tenuis* and the polychaetes *Nephtys cirrosa*, *Hediste diversicolor*, *Scoloplos armiger* and *Scolelepis squamata* all occur in moderate abundances.

The highest average intertidal foraging density within a single subsite was recorded for 0UL28 (Malahide Martello Tower) (15.6 Oystercatchers $ha^{-1}$). 0UL24 (Corballis House Marsh) supported good densities of foraging individuals in all low tide surveys and peaked at 8 Oystercatchers $ha^{-1}$. The average whole site foraging density was 1.6 individuals $ha^{-1}$.

Oystercatchers regularly forage terrestrially for prey such as earthworms, and foraging individuals were recorded in the terrestrial subsites 0UL19 and 0UL20 (outside of the SPA). This activity is likely to take place regularly around Malahide Estuary and outside of the SPA boundary. Roe & Lovatt (2009) reported that Oystercatchers favoured terrestrial foraging within amenity lands to the south of the estuary.

**Roosting Distribution**

Oystercatchers were recorded roosting/other during low tide surveys in four subsites: 0UL18, 0UL24, 0UL26 and 0UL28. Peak numbers were recorded in Burrow Strand (0UL24) in three low tide surveys and in 0UL26 (Malahide Strand South) on one occasion (06/12/11). Low tide roosting in Burrow Strand (0UL24) was often observed alongside the tidal channel.

61 Oystercatchers roosted intertidally during the high tide survey (09/01/12) with more than half of these within 0UL18 (Prospect Point). These birds roosted in various places including intertidal habitat, rock armour and the slip off Malahide Yacht club. By far the largest roost was 1,500 individuals that roosted as part of a mixed-species roost on the upper shore (northern shoreline of subsite backed by dunes) of 0UL25 (Malahide Point).

During the November roost survey, Oystercatchers were recorded roosting within four subsites; 0UL18, 0UL25, 0UL26 and 0UL28. Again the largest flock was recorded in 0UL25 (Malahide Point) where 650 roosted close to the position noted above.

The February neap high tide survey recorded roosting individuals in five subsites: 0UL18, 0UL24, 0UL25, 0UL27 and 0UL28. The largest flock (1,270 Oystercatchers) was again recorded in 0UL25 (Malahide Point) and these birds were in a similar position to those documented above. With the exception of six Oystercatchers in 0UL18, all other roosts were located in the outer estuary, east of the causeway.

The importance of the roost at Malahide Point for Oystercatchers has been documented previously (NPWS, 2000).

| Golden Plover *Pluvialis apricaria* - Family (group): Charadridae (wading birds) |
|---|
| The Eurasian Golden Plover is a Palearctic species, occurring mainly at higher latitudes of Western Europe to north-central Siberia and wintering south in Europe, north Africa and parts of Asia. Two subspecies are currently described. *P. a. altifrons* is the 'northern' form and breeds at high latitudes in Western Eurasia from Iceland and the Faeroes across northern Scandinavia to 125$^0$E in the north Siberia lowlands south of Taymyr (Delaney et al. 2009). The nominate *P. a apricaria* breeds at more southerly latitudes including Ireland and Britain and migrates south for winter. Golden Plovers that winter in Ireland are thought to be mostly Icelandic-breeding birds *P. a. altifrons* (Wernham et al. 2002). |
| **Numbers** |
| Numbers of Golden Plover ranged from zero in October 2011 to a site peak of 1,900 on 06/12/11; the only count to exceed the all-Ireland threshold. 1,305 were recorded during the January 2012 high tide survey.<br><br>Golden Plovers were recorded in four subsites overall (0UL17 (Seatown West), 0UL23 (Corballis House Marsh), 0UL24 (Burrow Strand) and 0UL26 (Malahide Strand South)); on one occasion in each. The peak count of 1,900 was counted in 0UL26 on 06/12/11. |
| **Foraging Distribution** |
| During winter, Golden Plovers feed primarily within agricultural grassland and arable land. Tidal flats are used as a roosting/resting habitat and the birds tend to favour large, open tidal flats. As a consequence, Golden Plovers tend to be in large aggregations when observed upon tidal flats.<br><br>Limited intertidal feeding was recorded and comprised 80 individuals in 0UL24 (Burrow Strand) on 03/11/11, and 134 individuals in 0UL23 (Corballis House Marsh) plus a further two in 0UL17 on 03/02/12. Intertidal feeding is observed to a greater degree during cold weather periods when grassland feeding areas are frozen over. Although Golden Plovers eat a wide range of invertebrate species, relatively little is known about intertidal feeding patterns (Gillings et al. 2006).<br><br>No terrestrial foraging was recorded during the surveys although it is likely to occur regularly around the site (outside the SPA). Roe & Lovatt (2009) found that Golden Plovers make good use of ploughed lands at Seatown East (south of the estuary). |
| **Roosting Distribution** |
| Intertidally-roosting Golden Plovers were recorded within 0UL17, 0UL24 and 0UL26. Each held peak numbers (03/02/12, 03/11/11 and 06/12/11 respectively) and the peak number was 1,900 within 0UL26 (Malahide Strand South) on 06/12/11.<br><br>1,305 Golden Plovers roosted intertidally within 0UL17 (Seatown West) during the high tide survey. This area was also identified as key for this species by Roe & Lovatt (2009).<br><br>No Golden Plovers were recorded during the November roost survey. The February neap high tide survey recorded a flock of 3,685 roosting individuals in 0UL17. A further flock of 470 roosted nearby. The total count of 4,155 was the largest number counted during the entire survey programme and far exceeds recent I-WeBS counts. The birds roosted intertidally with their feet in water. |

| Grey Plover *Pluvialis squatarola* - Family (group): Charadriidae (wading birds) |
|---|
| The Grey Plover is generally considered a monotypic species and has a holarctic breeding distribution across the tundra of Eurasia and North America (Delaney et al. 2009). The species migrates from breeding areas to a very wide wintering range extending to the coastlines of Africa, south and east Asia, Australasia and South America (BWPi, 2004). In Ireland, Grey Plovers occur as both passage and wintering birds and are thought to originate from Russian breeding populations (Wernham et al. 2002). |
| **Numbers** |
| Grey Plovers were recorded in all five surveys. Low tide numbers rose from 25 in October 2011 to a low tide peak count of 62 on 06/12/11. 71 individuals were counted during the high tide survey and only this count surpassed the threshold of all-Ireland importance.<br><br>Grey Plovers were recorded in a total six subsites throughout the entire survey programme (0UL17, 0UL18, 0UL23, 0UL24, 0UL25 and 0UL26). 0UL24 (Burrow Strand) was the only subsite to record this wader in all four low tide surveys and it recorded peak numbers in all with substantially fewer numbers in all other subsites. |
| **Foraging Distribution** |
| During winter Grey Plovers mainly forage intertidally and have a characteristic mode of foraging whereby they stand motionless watching the mudflat surface before snatching a prey item (often a worm) from the sediment surface. Grey Plovers take a wide range of prey species including Lugworms (*Arenicola marina*), Ragworms (*Hediste diversicolor*), amphipod crustaceans and small bivalves (e.g. *Macoma balthica and Scrobicularia plana*) (Dit Durrell & Kelly, 1990).<br><br>Peak numbers of Grey Plovers foraged in 0UL24 (Burrow Strand) during all four low tide surveys (25, 32, 34 and 21 individuals respectively). Other subsites (0UL17 (Seatown West), 0UL18 (Prospect Point) and 0UL25 (Malahide Point)) recorded solitary individuals on one or two occasions only while 0UL26 (Malahide Strand South) supported nine individuals on one occasion.<br><br>The intertidal benthic community of 0UL24 (Burrow Strand) is classified as 'sand to muddy sand with *Peringia ulvae* (*Hydrobia ulvae*), *Tubificoides benedii* and *Cerastoderma edule*.' The gastropod *Peringia (Hydrobia) ulvae*, the oligochaete *Tubificoides benedii* and the bivalve *Cerastoderma edule* all occur in moderate abundances within this complex while the polychaete *Hediste diversicolor* and the bivalve *Scrobicularia plana* have a patchy distribution, having their highest abundances near Malahide Point. The polychaetes *Scoloplos armiger, Pygospio elegans* and *Nephtys hombergii* are also recorded. Flock maps reveal that these waders tended to occur in the open central part of the subsite; often dispersed in small flocks, and often close to a water channel.<br><br>The peak intertidal foraging density was 0.2 Grey Plover $ha^{-1}$ recorded for 0UL25 (Malahide Point). The whole site average intertidal foraging density was 0.1 Grey Plover $ha^{-1}$. |
| **Roosting Distribution** |
| During low tide surveys, relatively few Grey Plovers were recorded in roosting/other behaviour. Less than five individuals were recorded on single occasions roosting intertidally within 0UL18 and 0UL23. 12 Grey Plover roosted intertidally within 0UL24 (Burrow Strand) on 06/12/11. During the high tide survey, 17 Grey Plovers roosted intertidally within 0UL18 and a 53 further roosted supratidally within 0UL26 (Malahide Strand South).<br><br>During the November 2011 roost survey (spring tide), 11 Grey Plover roosted within 0UL26 (Malahide Strand South) and a further two in 0UL18 (Prospect Point). Both roosts were positioned intertidally and the flock of 11 in 0UL26 were positioned, together with 55 Sanderling and six Dunlin, on a sand bar just north of where the estuary mouth opens out to sea.<br><br>22 Grey Plover roosted (intertidally within 0UL26 (Malahide Strand South) during the February 2012 neap high tide survey in a similar place to the roost recorded in November 2011. 252 Dunlin were also part of this roosting flock. Single birds were observed in 0UL17 and 0UL18. |

| Knot *Calidris canutus* - Family (group): Scolopacidae (wading birds) |
|---|
| Knot are a high Arctic breeding species. Two populations are recognised in Western Eurasia and Africa - *C. c canutus* and *C. c. islandica*. The latter breeds in north and east Greenland and northern Canada and winters in north-west Europe. Knot that winter in Ireland are almost entirely from the *islandica* population. The Wadden Sea is an important staging ground for the species after a non-stop flight from the breeding grounds (van der Kam, 2004). |
| **Numbers** |
| Knot were present in two low tide surveys (06/12/11 and 03/02/12) and the high tide survey (09/01/12). 73, three and 80 Knot were counted on these respective dates across the entire count area.<br>This wader was recorded from three subsites only: 0UL24 (Burrow Strand), 0UL25 (Malahide Point) and 0UL26 (Malahide Strand South).<br><br>0UL24 (Burrow Strand) recorded Knot during two low tide surveys: 12 and two individuals on 06/12/11 and 03/02/12, while 0UL26 (Malahide Strand South) recorded 62 Knot on 06/12/11. 0UL25 (Malahide Point) recorded a single individual only on 03/02/12. |
| **Foraging Distribution** |
| Knot are specialist intertidal foragers; pecking visible items off the sediment surface or probing to the depth that their bill (3.5cm) allows. The preferred prey items are bivalve molluscs including *Scrobicularia plana, Macoma balthica* and *Mytilus edulis* of smaller size-classes (shell length in the range 6 – 16mm depending on bivalve species and shape of shell) (Dekinga & Piersma, 1993).<br><br>Only two knot were recorded foraging during the survey programme and these were observed in 0UL24 (Burrow Strand) on 03/02/12.<br><br>The intertidal benthic community of 0UL24 (Burrow Strand) and the outer estuarine subsites 0UL23 and parts of 0UL25 are classified as 'sand to muddy sand with *Peringia ulvae* (*Hydrobia ulvae*), *Tubificoides benedii* and *Cerastoderma edule.*' The gastropod *Peringia (Hydrobia) ulvae*, the oligochaete *Tubificoides benedii* and the bivalve *Cerastoderma edule* all occur in moderate abundances within this complex while the polychaete *Hediste diversicolor* and the bivalve *Scrobicularia plana* have a patchy distribution, having their highest abundances near Malahide Point. The polychaetes *Scoloplos armiger, Pygospio elegans* and *Nephtys hombergii* are also recorded. Knot are likely to avail of foraging opportunities across these subsites. |
| **Roosting Distribution** |
| The majority of Knot recorded were roosting. 0UL24 (Burrow Strand) supported 12 individuals on 06/12/11 while 0UL26 (Malahide Strand South) recorded 62 roosting Knot on 06/12/11. 80 Knot roosted supratidally within 0UL25 (Malahide Point) during the high tide survey. These birds roosted alongside 1,500 Oystercatchers as part of a mixed-species roost on the upper shore (northern shoreline of subsite backed by dunes).<br><br>The November 2011 spring high tide survey recorded 105 Knot roosting within 0UL25 (Malahide Point). These birds were positioned again as a large mixed-species roost (dominated by Oystercatchers) on the upper shore of the northern shoreline of the subsite (backed by dunes). The same position was favoured again in February 2012 when 100 Knot roosted along with 1,270 Oystercatchers. A further 60 Knot roosted intertidally (feet in water) within 0UL17 (Seatown West), the birds this time flocking with Dunlin. These results suggest a good degree of roost site fidelity at this site. |

| Dunlin *Calidris alpina* - Family (group): Scolopacidae (wading birds) |
|---|
| The Dunlin is a Holarctic and highly migratory wader, breeding widely in Arctic zones across Europe, Asia and North America. The nominate form *alpina* breeds from northern Scandinavia eastwards across European Russia and western Siberia to $85^0$ E (Delaney et al. 2009). This race migrates southwest to winter along the coasts of Western Europe, south to Iberia, western Mediterranean and beyond.<br><br>The majority of Dunlin wintering in Ireland are *C. a. alpina* that originate from the western part of their breeding range and moult mainly in the Wadden Sea before starting to arrive in Ireland during October (Crowe, 2005). Ireland has a small and declining breeding population of *Calidris alpina schinzii* which are believed to winter mainly in west Africa (Delaney et al. 2009). |
| **Numbers** |
| Dunlin were recorded in all five surveys. Numbers rose from 53 in October 2011 to a low tide peak of 381 on 03/02/12. No count surpassed the threshold for all-Ireland importance. Only six Dunlin were recorded during the high tide survey (10/01/12).<br><br>Overall, Dunlin were recorded within four subsites: 0UL17 (Seatown West), 0UL23 (Corballis House Marsh), 0UL24 (Burrow Strand) and 0UL26 (Malahide Strand South). 0UL17 (Seatown West)) recorded this wader during the high tide survey only.<br><br>Only 0UL24 (Burrow Strand) recorded this wader in all four low tide surveys and it also held peak numbers in all of these; the subsite peak count of 381 recorded on 03/02/12. |
| **Foraging Distribution** |
| Between 60% and 100% of all foraging Dunlin were recorded within 0UL24 (Burrow Strand) and this was the only subsite to recorded foraging individuals in all four low tide surveys. Smaller and irregular numbers were counted in 0UL23 (once) and 0UL26 (twice). A preference for foraging in the outer estuary was noted by Creagh House Environmental (2012).<br><br>The intertidal benthic community of 0UL24 (Burrow Strand) (and 0UL23) are classified as 'sand to muddy sand with *Peringia ulvae* (*Hydrobia ulvae*), *Tubificoides benedii* and *Cerastoderma edule.*' The gastropod *Peringia (Hydrobia) ulvae*, the oligochaete *Tubificoides benedii* and the bivalve *Cerastoderma edule* all occur in moderate abundances within this complex while the polychaete *Hediste diversicolor* and the bivalve *Scrobicularia plana* have a patchy distribution, having their highest abundances near Malahide Point. The polychaetes *Scoloplos armiger, Pygospio elegans* and *Nephtys hombergii* are also recorded. Dunlin have a reasonably varied diet and may take Scrobicularia bivalves and the gastropod *Peringia (Hydrobia) ulvae*, as well as many polychaete worms and insects (e.g. Santos et al. 2005).<br><br>The peak intertidal foraging density was 4 Dunlin $ha^{-1}$ recorded for 0UL23 (Corballis House Marsh); however this subsite recorded foraging individuals only once. 0UL24 (Burrow Strand) recorded a peak density of 2.7 individuals $ha^{-1}$. The whole site average intertidal foraging density was 0.6 Dunlin $ha^{-1}$. These densities are considered low. |
| **Roosting Distribution** |
| All Dunlin recorded during low tide surveys and the high tide survey were foraging.<br><br>The November spring high tide roost survey recorded roosting individuals in five subsites (0UL18, 0UL24, 0UL25, 0UL26 and 0UL28). The largest flock of 200 Dunlin was recorded in 0UL26; these birds on shingle in the south of the subsite. A flock of 130 also roosted on shingle in 0UL28 (Malahide Martello Tower). 31 roosted in 0UL18 (count underestimated); these birds part of a large mixed-species roost at the mouth of the Yellow Walls river along the southern shore of the subsite. Ten Dunlin roosted in 0UL25 and a single individual was recorded roosting in 0UL24.<br><br>The February neap tide roost survey recorded larger numbers. The largest flock of 278 Dunlin roosted in 0UL28, a large mixed-species roost on rock. 252 roosted intertidally (sand bar) just north of where the estuary mouth opens out to sea. This roost also comprised Grey Plover (22) and gulls. A further 250 Dunlin roosted in 0UL17 (intertidally, feet in water) and 62 were recorded in 0UL18, again at the mouth of Yellow Walls.<br><br>Saltmarsh at Malahide Point (0UL25) has been documented previously as an important roosting site for Dunlin, amongst other species (NPWS, 2000). |

## Black-tailed Godwit *Limosa limosa* - Family (group): Scolopacidae (wading birds)

Black-tailed Godwits *Limosa limosa* have a widespread Palearctic breeding distribution. Four populations are recognised – three populations of the nominate *L. l. limosa* and one *L. l. islandica*, the latter of which breeds almost exclusively in Iceland and winters in Britain, Ireland, Spain, Portugal and Morocco (Delaney et al. 1999). Recoveries and sightings confirm that Black-tailed Godwits wintering in Ireland are of the *islandica* race, whereas further south (e.g. Spain and Portugal) some mixing of *limosa and islandica* occurs in the non-breeding season (Wernham et al. 2002).

**Numbers**

Numbers of Black-tailed Godwits of all-Ireland importance were recorded during all surveys and ranged from 188 (06/12/11) to 404 (03/11/11) during low tide surveys, with 205 counted during the high tide survey.

Black-tailed Godwits were recorded in seven subsites overall (0UL17, 0UL18, 0UL19, 0UL23, 0UL24, 0UL25 and 0UL26). Peak numbers were recorded in 0UL17 (Seatown West), 0UL19 (Seatown East), 0UL26 (Malahide Strand South) and 0UL17 for the four low tide surveys respectively. The subsite peak of 282 individuals was recorded within 0UL19 on 03/11/11.

**Foraging Distribution**

Black-tailed Godwits are relatively large long-billed wading birds that forage within intertidal flats for their preferred prey of bivalves such as *Macoma balthica*, *Scrobicularia plana* and *Mya arenaria*. At some sites, polychaete worms may form a larger proportion of the diet and the species is relatively adaptable, utilising other habitats for foraging where available, such as terrestrial grassland, coastal marshes or freshwater callows.

Black-tailed Godwits foraged in six subsites overall: 0UL17, 0UL18, 0UL23, 0UL24, 0UL25 and 0UL26. Peak numbers were held by 0UL18 (17), 0UL24 (27), 0UL26 (114) and 0UL17 (142) for the four low tide counts respectively. 0UL24 (Burrow Strand) is perhaps most notable for supporting high numbers in all four low tide surveys.

Black-tailed Godwits therefore distributed across both the inner and outer estuarine subsites of Malahide Estuary. The benthic community of the inner estuarine subsites of Malahide Estuary, and most prominent in 0UL17, is 'estuarine sandy mud with Chironomidae and *Hediste diversicolor*. The large polychaete *Hediste diversicolor* (Ragworm) can occur in moderate to high abundances and is likely to form part of the godwit diet.

The intertidal benthic community of 0UL24 (Burrow Strand) is classified as 'sand to muddy sand with *Peringia ulvae* (*Hydrobia ulvae*), *Tubificoides benedii* and *Cerastoderma edule*.' The godwits tended to forage in the north of the subsite where ASU (2011) report a marine biotope dominated by *Hediste diversicolor*, *Macoma balthica* and *Scrobicularia plana*; all of which are prey items of Black-tailed Godwit; or in the south-east of the subsite (near Malahide Point) where a similar biotope occurred.

Terrestrial foraging was recorded within 0UL19 (Seatown East) and Black-tailed Godwits are likely to regularly use this and other grass fields around the site for foraging (outside the SPA boundary). Roe & Lovatt (2009) reported terrestrial foraging at several areas to the north of the estuary e.g. Kilcrea and Corballis.

The peak intertidal foraging density was 17 Black-tailed Godwits $ha^{-1}$ recorded for 0UL17 (Seatown West) although this subsite held foraging individuals only once. 0UL23 (Corballis House Marsh) supported 4.4 individuals $ha^{-1}$ on 03/02/12. The whole site average intertidal foraging density was 0.3 Black-tailed Godwits $ha^{-1}$.

**Roosting Distribution**

Black-tailed Godwits were recorded in roosting/other behaviour in five subsites during low tide surveys (0UL17, 0UL18, 0UL23, 0UL24 and 0UL26) and most regularly within 0UL17 (Seatown West) which supported a peak number of 199 individuals on 04/10/11.

During the high tide survey a total 179 Black-tailed Godwits were recorded in roosting/other behaviour in two subsites: 146 in 0UL18 (Prospect Point) and 33 within 0UL17 (Seatown West).

The November 2011 spring high tide roost survey recorded roosting individuals in three subsites: 0UL17, 0UL18 and 0UL25. These held single flocks of 6, 11 and 60 individuals respectively, the latter birds roosting supratidally (upper shoreline) in a mixed-species roost also comprising 105 Knot amongst other species.

The February neap high tide survey recorded roosting individuals in 0UL18, 0UL23 and 0UL25, with peak roost sizes of 49, 6 and 19 individuals respectively. A total 56 Black-tailed Godwits roosted within 0UL18 at the tip of a shingle bar at the mouth of the yellow walls stream (southern shore of subsite 0UL18). This appears to be an important roosting area; other species forming the large-mixed species roost included Oystercatcher, Dunlin and Light-bellied Brent Goose. The 19 Black-tailed Godwits roosting in 0UL25 were part of a mixed-species roost that was transient (observed for *c.* 30 minutes); birds later pushed up or moved on by the tide.

| **Bar-tailed Godwit *Limosa lapponica* - Family (group): Scolopacidae (wading birds)** |
|---|
| The Bar-tailed Godwit has a widespread breeding distribution across the sub-arctic and low Arctic zones of the Palearctic and extending into western Alaska (Delaney et al. 2009). The taxonomy of the species is complex but five subspecies are generally recognised. The nominate subspecies *L. l. lapponica* breeds in northern Fennoscandia and Northern European Russia, east to the Kanin Peninsula, and winters mainly in Western Europe, including Ireland. The Wadden Sea is used by *L. l. lapponica* and other populations as a staging and moulting area in autumn and spring. |
| **Numbers** |
| Numbers of Bar-tailed Godwits rose from just one on 04/10/11 to a low tide site peak count of 108 on 06/12/11; 28 individuals were recorded during the high tide survey (09/01/12). No count surpassed the threshold for all-Ireland importance.<br><br>Across the entire survey period, Bar-tailed Godwits were recorded in four subsites: 0UL17 (Seatown West), 0UL18 (Prospect Point), 0UL24 (Burrow Strand) and 0UL26 (Malahide Strand South). Each of these held peak numbers (03/02/12, 04/10/11, 03/11/11 and 06/12/11 respectively). The overall subsite peak number (64) was recorded within 0UL17 on 03/02/12. |
| **Foraging Distribution** |
| Bar-tailed Godwits are a wader species considered characteristic of coastal wetland sites dominated by sand (e.g. Hill et al. 1993). The birds forage by probing within intertidal sediment for invertebrate species, of which polychaete worms such as Lugworm *Arenicola marina* and *Nepthys* sp. are the most favoured.<br><br>Bar-tailed Godwits foraged in greatest numbers and regularity within 0UL24 (Burrow Strand) and 0UL26 (Malahide Strand South). Very low numbers (<3) were recorded irregularly within 0UL17 and 0UL18.<br><br>The intertidal benthic community of 0UL24 (Burrow Strand) is classified as 'sand to muddy sand with *Peringia ulvae* (*Hydrobia ulvae*), *Tubificoides benedii* and *Cerastoderma edule*.' The gastropod *Peringia ulvae* (*Hydrobia ulvae*), the oligochaete *Tubificoides benedii* and the bivalve *Cerastoderma edule* all occur in moderate abundances within this complex while the polychaete *Hediste diversicolor* and the bivalve *Scrobicularia plana* have a patchy distribution, and occur in highest abundances near Malahide Point. The polychaetes *Scoloplos armiger, Pygospio elegans* and *Nephtys hombergii* are also recorded. 0UL26 (Malahide Strand South) has a sandier substratum and is classified as the intertidal benthic community 'fine sand with oligochaetes, amphipods, bivalves and polychaetes. Species such as the bivalve *Angulus tenuis* and the polychaetes *Nephtys cirrosa*, *Hediste diversicolor*, *Scoloplos armiger* and *Scolelepis squamata*, all occur in moderate abundances. These four aforementioned polychaetes may be taken as prey by Bar-tailed godwits in addition to small-sized bivalves of the species *Angulus tenuis, Cerastoderma edule* and *Scrobicularia plana* (e.g. Scheiffarth, 2001).<br><br>The peak intertidal foraging density was 0.5 Bar-tailed Godwits $ha^{-1}$ recorded for 0UL26 (Malahide Strand south) on 06/12/11. The whole site average intertidal foraging density was 0.07 Bar-tailed Godwits $ha^{-1}$. |
| **Roosting Distribution** |
| During low tide surveys, irregular records were made of Bar-tailed Godwits roosting/other, the majority of the birds foraging. An exception was 63 roosting individuals in 0UL17 (Seatown West) on 03/02/12.<br><br>The November spring high tide roost survey recorded 43 roosting individuals in 0UL18; these birds part of a large mixed-species roost at the mouth of the Yellow Walls river (along the southern shore of the subsite). The February neap tide roost survey recorded just four roosting Bar-tailed Godwits, again in 0UL18 at the mouth of the Yellow Walls river.<br><br>Saltmarsh at Malahide Point (0UL25) has been documented previously as an important roosting site for Bar-tailed Godwits amongst other species (NPWS, 2000). |

## Redshank *Tringa totanus* - Family (group): Scolopacidae (wading birds)

*Tringa totanus* breeds widely across the Palearctic in a band that extends both into the low arctic and Mediterranean zones, from Iceland through continental Europe and Russia to eastern Siberia, China and Mongolia. The taxonomy of the species has proved complex but five populations are recognised currently including *T. t. britannica,* a small and declining population that breeds in Britain and Ireland, and *T. t. robusta* which breeds in Iceland and the Faeroes and winters in Britain, Ireland and the North Sea area (Delaney et al. 2009).

**Numbers**

Redshank were recorded in all five surveys. Low tide numbers ranged from 236 (06/12/11) to a site peak of 390 (04/10/11). Only the December low tide count failed to exceed the threshold of all-Ireland importance. 366 Redshanks were recorded during the high tide survey (09/01/12).

Redshanks were widespread and recorded within 10 subsites overall: 0UL17, 0UL18, 0UL19, 0UL23, 0UL24, 0UL25, 0UL26, 0UL27, 0UL28 and 0UL50.

Peak numbers were recorded by 0UL17 (Seatown West), 0UL23 (Corballis House Marsh), 0UL26 (Malahide Strand South) and 0UL18 (Prospect Point) for the four low tide surveys respectively. The peak subsite count of 166 Redshank was recorded for 0UL23 on 03/11/11.

**Foraging Distribution**

Redshanks forage mainly by pecking at the surface or probing within intertidal mudflats; favouring the muddier sections of sites (e.g. Rehfisch et al. 2000) where they prey upon species such as the Ragworm *Hediste diversicolor* or Mud Snail *Peringia ulvae* (*Hydrobia ulvae*). A particularly favoured prey is the burrowing amphipod *Corophium volutator.*

Redshanks foraged widely across the site and within nine subsites overall (all listed above except 0UL19). Three subsites recorded foraging individuals in all four low tide surveys: 0UL18, 0UL23 and 0UL24. Peak numbers were recorded by 0UL17 (Seatown West), 0UL24 (Burrow Strand), 0UL24 and 0UL18 (Prospect Point) for the four low tide surveys respectively. 0UL23 (Corballis House Marsh) was notable in supporting numbers of foraging Redshank ranked in the top three in all four low tide surveys.

Although Redshank can vary their diet to suit local conditions, it is interesting that a major prey of this wader *Peringia ulvae* (*Hydrobia ulvae*), is a characteristic component of the invertebrate community at this site; indeed a characterising species of the communities assigned to both 0UL24 and 0UL26. These subsites also support a range of polychaetes that may form part of the Redshank diet such as *Scoloplos armiger or Pygospio elegans.* 0UL17 (Seatown West) is an inner estuarine subsite typically muddier in nature and classified as 'estuarine sandy mud with Chironomidae and *Hediste diversicolor*.' Both aforementioned species/taxa are also likely to form part of the Redshank diet.

The peak intertidal foraging density was 16 Redshank $ha^{-1}$ recorded for 0UL17 (Seatown West) on 04/10/11. 0UL23 (Corballis House Marsh) held densities of over 10 Redshank $ha^{-1}$ on two survey occasions. The whole site average intertidal foraging density was 0.8 Redshank $ha^{-1}$.

**Roosting Distribution**

Records of roosting Redshank were relatively irregular and concerned small numbers (0UL17, 0UL18, 0UL24). 87 Redshank roosted intertidally during the high tide survey; 47 in 0UL24 (Burrow Strand) and 20 in both 0UL17 (Seatown West) and 0UL18 (Prospect Point).

The November spring high tide roost survey recorded roosting Redshank across seven subsites: 0UL17, 0UL18, 0UL23, 0UL24, 0UL25, 0UL26 and 0UL28. The largest roost (26 individuals) was in 0UL24 roosting on the upper shore (backed by dunes) in the east of the subsite. 25 and 23 Redshank roosted within 0UL28 and 0UL26 respectively. Overall 11 separate roost positions were recorded.

The largest flock of 42 individuals roosted within 0UL17 during the February neap tide roost survey, positioned in the northeast of the subsite. A flock of 32 Redshank roosted in 0UL24, in the north of the subsite along the boundary with 0UL50 (Kilcrea Field); this subsite also supported two further roosts of one and 19 individuals. A further 23 Redshank roosted within 0UL28; these birds part of a large mixed-species roost on rock, other species included Dunlin (278), Oystercatcher (78) and Ringed Plover (27).

## 5.4 Malahide Estuary - Activities and Events

### 5.4.1 Introduction

The overriding objective of the Habitats Directive is to ensure that the habitats and species covered achieve '*favourable conservation status'* and that their long-term survival is secured across their entire natural range within the EU (EU Commission, 2010). In its broadest sense, favourable conservation status means that an ecological feature is in a satisfactory condition, and that this status is likely to continue into the future.

At site level, the concept of 'favourable status' is referred to as 'conservation condition.' This can relate to not only species numbers, but importantly, to factors that influence a species abundance and distribution at a site. The identification of activities and events that occur at a designated site is therefore important, as is an assessment of how these might impact upon the waterbird species and their habitats, and thus influence the achievement of favourable condition. Site-based management and the control of factors that impact upon species or habitats of conservation importance are fundamental to the achievement of site conservation objectives.

Section 5.4 provides information on activities and events that occur in and around Malahide Estuary that may either act upon the habitats within the site, or may interact with the Special Conservation Interest species and other waterbirds using the site.

### 5.4.2 Assessment Methods

Information on 'activities' and 'events' across the site was collected during a desk-top review which included NPWS site reporting files, County Development and other plans (e.g. Fingal County Council, 2011a; 2011b), Eastern River Basin District documents (e.g. ERBD, 20010a, b) and other available documents relevant to the ecology of the site.

In addition, information was collected during the 2011/12 waterbird survey programme (NPWS, 2011) as field workers recorded activities or events that occurred at the site during their survey work. This information, together with results from a 'site activity questionnaire' provides valuable information gained from 70+ hours of surveyor effort across the site. All data collected were entered into a database but as the dataset will be subject to change over time, the assessment should be viewed as a working and evolving process.

The 'activities' and 'events' information collected were categorised using the standard EU list of pressures and threats as used in Article 12 reporting under the EU Birds Directive. Only factors likely to directly or indirectly affect waterbirds were included but the resulting list is broad and includes built elements (e.g. man-made structures such as roads and bridges that are adjacent to the site), factors associated with pollution (e.g. discharges from waste water treatment plants), various recreational and non-recreational activities as well as biological factors such as the growth of the invasive plant species *Spartina anglica*.

Data are presented in three ways:-

1. Activities and events identified as occurring in and around Malahide Estuary (through either the desk-top review or field survey programme) are listed in relation to the subsite within which they were observed or are known to occur. The activities/events are classified as follows:

   **O** observed or known to occur within Malahide Estuary;
   **U** known to occur but unknown spatial area hence all potential subsites are included (e.g. fisheries activities);
   **H** historic, known to have occurred in the past.
   **P** potential to occur in the future.

2. Of the activities and events identified to occur in and around Malahide Estuary, those that have the potential to cause disturbance to waterbird species are highlighted.

3. Data from the 2011/12 waterbird survey programme were used to inform an assessment which examined the level of disturbance caused by activities recorded during field surveys. The methodology was adapted from that used for monitoring Important Bird Areas (IBAs) (Birdlife International, 2006) and involved assigning scores which ranged between 0 and 3, to three selected attributes of each disturbance event (1) frequency/duration; (2) intensity and (3) likely response of waterbirds (after Hill et al. 1997) (Table 5.7). The rationale for scoring is provided in Appendix 10.

**Table 5.7 Scoring system for disturbance assessment**

| Frequency/Duration | (A) Timing Score | Intensity | (B) Scope Score | Response | (C) Severity Score | TOTAL SCORE A + B + C |
|---|---|---|---|---|---|---|
| Continuous | 3 | Active, high-level | 3 | Most birds disturbed all of the time | 3 | 9 |
| Frequent | 2 | Medium level | 2 | Most birds displaced for short periods | 2 | 6 |
| Infrequent | 1 | Low-level | 1 | Most species tolerate disturbance | 1 | 3 |
| Rare | 0 | Very low-level | 0 | Most birds successfully habituate to the disturbance | 0 | 0 |

The scores assigned to the three attributes were then added together to give an overall 'disturbance score' which is used to define the extent of the impact as follows:-

Scores 0 – 3 = Low
Scores 4 – 6 = Moderate
Scores 7 – 9 = High

The attributes (1) frequency/duration and (3) response were scored based on field survey observations. Attribute (2) intensity was scored based on a combination of field survey observations and best expert opinion.

### 5.4.3 Overview of activities at the Malahide Estuary

Activities and events identified to occur in and around Malahide Estuary are shown in Appendix 9, listed in terms of the subsites surveyed during the 2011/12 Waterbird Survey Programme. Activities highlighted in grey are those that have the potential to cause disturbance to waterbirds (see Section 5.4.4). For a map of count subsites, please refer to Appendix 6.

The following pages outline the range of activities and events that occur across the site using the following headings: (1) adjacent landuse, habitat loss and modification; (2) water quality; (3) fisheries and aquaculture; (4) recreational disturbance; and (5) others.

Adjacent landuse, habitat loss and modification

Malahide Estuary (also known as Broadmeadow or Swords Estuary) is located immediately north of Malahide and east of Swords (15 km north of Dublin). The estuary is bisected by a railway causeway which restricts the tidal flow between the inner and outer estuary thus

creating an artificial brackish 'lagoon' west of the railway. The sand dunes and spit (Malahide Island) at the estuary mouth are dominant adjacent features; much of the natural dune habitat has been taken over by a Golf Course. The eastern shoreline comprises a sandy beach (Donabate beach) while Martello Towers mark both the northern and southern extent of the survey areas used during the 2011/12 Waterbird Survey Programme.

The estuary receives the waters of the Broadmeadow and Ward rivers, both of which flow through intensive agricultural catchments, although the catchments are becoming increasingly urbanised (CRFB, 2008). The estuary is surrounded by low-lying land that is mainly agricultural along the northern side and mainly urban along the southern and western sides (McCorry & Ryle, 2009).

The Broadmeadow Viaduct carries the Dublin-Belfast railway line. The first timber structure built in 1844 suffered from stability problems and was replaced by a wrought iron structure in 1860. The structure then underwent regular strengthening and maintenance works until it was replaced by a concrete structure in the mid 1960's. More recently, in August 2009, part of the viaduct collapsed; it was subsequently repaired and re-opened in November of that year. Remedial works on the viaduct and weir following the collapse resulted in some changes in water levels in the inner estuary. In 2011, water levels were observed to be higher than prior to the 2009 collapse and works were undertaken in December 2011 to return them to former levels (Creagh House Environmental, 2012). In line with these remedial works are proposals to create a walkway/cyclepath on the western margin of the railway embankment that would extend from Bissett's Strand in Malahide to the local access road (coast road) and onwards to the Newbridge Demesne at Donabate; a total length of approximately 3km (Creagh House Environmental, 2012).

Saltmarsh occurs in the inner estuary (0UL17) and at Yellow Walls (0UL18) as well as in the inner margins of the outer estuary; 0UL23, around 0UL50 and in the north-eastern corner of 0UL24. However, saltmarsh is most developed at the end of the sand spit (Malahide Island) where it has been shown to be an important roosting habitat. Cord-grass (*Spartina anglica)* occurs in 0UL17, 0UL23 and 0UL24 with only a small area at Malahide Point. It is most developed in the north-west corner of the outer estuary (0UL23) (McCorry & Ryle, 2009). McCorry & Ryle (2009) compared aerial photos from 1995 and 2000 and suggest that Common Cordgrass has not spread significantly on mudflats of the inner or outer estuaries during this period. There have been some minor losses of saltmarsh along the southern shoreline of the inner estuary, which were probably infillled (McCorry & Ryle, 2009).

Malahide and Swords are the two largest settlements adjacent to the site (south and west respectively) while Donabate lies to the north. Numerous roads lead to the edge of the site and much of the remainder is bordered by roads. The Broadmeadow M1 motorway bridge crosses the inner estuary and covers some saltmarsh. McCorry & Ryle (2009) stated that there were no signs of any major physical damage to the saltmarsh due to the construction of the bridge. Mitigation undertaken by Fingal County Council during the construction of the bridge aiming to reduce impacts on saltmarsh and brackish habitats appears to have been quite successful.

Some historical land claim has taken place at the site evidenced by comparing current OS maps with historic 6'' maps. Of note is a large area in the north-western corner of the outer estuary. This probably occurred in the 19$^{th}$ century and was facilitated by the construction of the viaduct across the estuary. The area claimed was behind the viaduct in Mullan Intake (McCorry & Ryle, 2009). A further area of claimed land occurs along the southern shore at Malahide Marina and also likely associated with the viaduct construction.

Water quality

Malahide Estuary is part of the Eastern River Basin District (ERBD, 2010a). The water quality of Malahide Estuary (called Broadmeadow Water in ERBD report) has been classified as

moderate for transitional waters (i.e. substandard) (ERBD, 2010c); the largest contributory factor identified as wastewater. Physical modifications and dangerous substances (physico-chemical) such as run-off are also identified as pressures on the system, as well as agricultural inputs (ERBD, 2010c). Coastal waters are categorised as part of the Northwestern Irish Sea (HA 08) water management unit (ERBD, 2010b) which has a current status of 'high' with an undetermined chemical status.

The Environmental Protection Agency (EPA) monitors the status of estuarine and coastal water bodies using their Trophic Status Assessment Scheme (TSAS), a requirement under the Urban Waste Water Treatment Directive (UWWT) (91/271/EEC)[16] and Nitrates Directive (91/676/EEC). Following assessment, waterbodies are classified as eutrophic, potentially eutrophic, intermediate, or unpolluted (O'Boyle et al. 2010). For the most recent period 2007-2009, the EPA reported eutrophic conditions for Broadmeadow water (inner estuary) and potentially eutrophic conditions for Malahide Bay (outer estuary) representing a decline in status since earlier assessments, although the deterioration in status for Malahide Bay was due to the presence of green opportunistic macroalgae, which, while previously observed in the bay, had not been formally assessed (O'Boyle et al. 2010). Monitoring of Nitrogen and Phosphorous levels, key limiting nutrients in coastal waters, showed that Malahide Bay failed to comply with the environmental quality standard (EQS) for dissolved inorganic nitrogen (DIN) (S.I. No. 272 of 2009) while Broadmeadow water (inner estuary) had high levels of phosphorus (molybdate reactive phosphorus (MRP)) and breached the summer environmental quality standard (EQS) (O'Boyle et al. 2010). Elevated Biological Oxygen Demand (BOD) also indicated eutrophic conditions in the inner estuary.

Malahide Estuary has been designated as a 'nutrient sensitive area' under the Urban Waste Water Treatment Regulations (EU Council Directive 91/271/EEC, as transposed by S.I. No. 254 of 2001 as amended by S.I. 48 of 2010).

A purpose built 60,000 PE (population equivalent) Waste Water Treatment Plant (WWTP) was opened at Swords in 2004. This plant is located on the Spittal Hill road adjacent to Malahide Estuary. Malahide WWTP also opened in 2004, built on reclaimed land. Proposals to provide necessary upgrades to these schemes have been in place for several years. Combined sewer overflows are also a documented pressure upon water quality (DoEHLG, 2009). They can contain a wide range of potentially polluting components originating from households, industry and urban areas and receive no treatment before being discharged to the receiving waterbody. On-site wastewater treatment systems also pose a threat to surface and grounds waters.

While improvements in WWTP treatment and cessation of point discharges are aimed at meeting objectives of the Urban Waste Water Treatment Regulations (EU Council Directive 91/271/EEC, as transposed by S.I. No. 254 of 2001 as amended by S.I. 48 of 2010) and the Water Framework Directive (2000/20/EC as transposed by the European Communities (Water Policy) (Amendment) Regulations, 2010)), it should be borne in mind that there may be various consequences for the ecology of the estuarine system with knock-on effects upon waterbirds. For example, a reduction in organic and nutrient loading to an estuary could lead to reduced abundances of benthic invertebrate prey species (e.g. Burton et al. 2002) particularly those invertebrates that thrive (proliferate) in organically-enriched sediments. This could have effects upon waterbird foraging distribution, prey intake rates, and ultimately upon survival and fitness[17].

[16] Transposed by the Urban Waste Water Treatment Regulations S. I. No 254 of 2001, as amended by S.I. No 48 of 2010.

[17] Fitness can be defined as the contribution of individuals to future generations; a combination of survival and reproduction.

Although a natural component of shallow estuarine communities, proliferations of macroalgal mats of species such as *Ulva* spp[18] have long been considered a consequence of organic enrichment. However, their presence can have both negative and positive effects upon waterbird foraging ecology; some species avoiding them or being negatively affected by lowered invertebrate abundances beneath them (Lewis & Kelly, 2001), while herbivores such as Light-bellied Brent Geese and Wigeon benefit from the algae as a source of food. Given the link with organic enrichment, there is therefore a potential for changes in macroalgal abundance as a result of future improvements in wastewater discharges with subsequent negative and positive consequences.

In addition to nutrient enrichment, other pressures such as hazardous substances and morphological alterations can also impact on the quality of aquatic systems (EPA, 2010). Classification schemes have been developed that use the characteristics of different biological communities, together with information on the physico-chemical environment to define ecological status. Under this assessment, Malahide Estuary was assigned a moderate to high status for the period 2007-2009 (O'Boyle et al. 2010).

Fisheries & aquaculture

Malahide Harbour has a long history and has supported a substantial trade in fishing. By the 1850's the harbour supported local fishing boats but also exported grain, meal and flour and took import of coal. At this time the fishing was of two distinct types. One was for oysters, as extensive oyster beds occurred in the vicinity of the railway arches; these are no longer present. The other was a cod fishery although there are also historical records of fishermen landing substantial catches of herring and whitefish (www.malahideheritage.com). Today the harbour is home to Malahide Marina which has 350 fully serviced berths with associated service buildings plus a boatyard.

Fish recorded in Malahide Estuary include Sprat (*Sprattus sprattus*) and Flounder (*Platichthys flesus*); both widespread during sampling for Water Framework Directive monitoring (CRFB, 2008). A total of 13 species were recorded including Sea Bass (*Dicentrarchus labrax*) and Eel (*Anguilla anguilla*). The presence of juvenile Mullet (*Chelon labrosus*) highlights that the estuary is an important nursery area although older age-classes were also present.

An area of 36.3 $km^2$ to the south-east of Malahide Estuary (coastal waters from Lambay Island to Portmarnock) is designated as a Shellfish Water under the EU Shellfish Waters Directive[19] (No. 32) (DoEHLG, 2009). This is known as the Malahide Shellfish Area and the designation relates to the cultivation of Razor Clams (*Ensis siliqua*). The Sea Fisheries Protection Authority (SFPA) is responsible for classifying shellfish production areas and the current classification of the Malahide Bivalve Mollusc Production Area is Class B, as of 20th July 2012 (www.sfpa.ie). This means that shellfish may be placed on the market for human consumption only after treatment in a purification centre or after relaying, so as to meet the health standards for live bivalve molluscs laid down in EC Regulations on food safety[20].

Various inshore fishing activities occur adjacent to the site (detail and spatial scale unknown) including hydraulic dredges, otter trawls, line fishing and the use of pots; while line fishing (static fishing gear) occurs within the SPA itself (DoEHLG, 2009). There are three active fishing harbours in the area: Howth, Balbriggan and Skerries Harbour.

[18] includes species formerly classified as *Enteromoropha* (Hayden, 2003).

[19] European Communities (Quality of Shellfish Waters) (Amendment) Regulation 2009 (SI 55 of 2009).

[20] Criteria for the classification of bivalve mollusc harvesting areas under Regulation (EC) No 854/2004, Regulation (EC) 853/2004 and Regulation (EC) 2073/2005.

Recreational disturbance

Walking is a popular recreational pastime and was widely recorded in and around Malahide Estuary during the 2011/12 Waterbird Survey programme (13 subsites). Several areas have footpaths directly adjacent to the estuary while Malahide Point is less accessible as it involves a long walk on the beach or on the shoreline east of the golf club.

Malahide Marina is a source of much water-based activity. There are two sailing clubs situated on the estuary: Swords Sailing & Boating Club and Malahide Yacht Club; the latter has a dinghy club house in the inner estuary (0UL18) at Broadmeadows. Demand is increasing for further marinas and jetties in Malahide Estuary as well as nearby Rogerstown Estuary (Fingal County Council, 2001b). Sailing is popular in the outer estuary and open water between Howth and Lambay Island.

Donabate beach to the east of Malahide Island is a popular bathing beach and achieved Blue Flag status in 2012 (www.beachawards.ie). Since 2009, cars have been prohibited on the beach under Bye-laws introduced by Fingal County Council. Further restrictions apply to the exercising of dogs and horses, especially within the SPA. Jet Skis and Fast Power Boats are prohibited within the SPA or Special Area of Conservation (SAC) (Fingal County Council, 2006).

Particularly where population densities are high, the coastline is viewed as an important amenity for recreation and tourism. Recreational use is likely to increase in the future. One objective of the Fingal County Development Plan (Fingal County Council, 2011a) is to '*develop a continuous network of signed pathways around Donabate Peninsula and linking the Peninsula to Malahide and Rush via the Rogerstown and Malahide estuaries whilst ensuring the protection of designated sites'*….(through Appropriate Assessment); while another is to '*facilitate water-based leisure activities*.'

Malahide Harbour facilitates sea-anglers (recreational fishing); two slipways adjacent to the marina give access to the main channel. Bottom fishing in the channel from boat or shore is for flounder (ERFB, 2009). Shore-angling occurs on Donabate Strand while the inner impounded estuary is also a favoured fishing area.

Other

Activity questionnaires reported wildfowling from five subsites; in most cases not directly observed but known to have occurred. The majority of shooting activity recorded during surveys was adjacent to the site (e.g. pigeon shooting). Crop protection bangers ('crow bangers') were also heard close to the site.

### 5.4.4 Disturbance Assessment

Seven activities were recorded during 2011/12 survey work that caused disturbance to waterbirds. These activities were: aircraft, sailing, walking (including with dogs), motorised vehicles, horse-riding, shooting, and bait-digging (Table 5.8).

Walking was the most regular and widespread activity, occurring in 13 subsites. In five subsites (0UL19, 0UL20, 0UL24, 0UL26 and 0UL27) the frequency and regular presence of dogs resulted in an overall '*high*' peak disturbance score being assigned. In 67% of all observations of dogs, the dogs were already present when the count commenced therefore any disturbance effect (i.e. birds flying off) may have already occurred before the count started. This factor should be borne in mind when examining count data.

Shooting that occurred close to the site was often recorded to have a noticeable effect on waterbirds, especially for 0UL22 and 0UL24 where the activity occurred regularly.

Full results of the disturbance assessment are shown in Appendix 10. Individual activities/events are scored separately and there has been no attempt to produce cumulative scores for different activities occurring at the same time, although cumulative effects are likely. As a final review, Table 5.9 shows the peak disturbance scores overlaid on the subsite assessment table (total waterbird numbers, LT surveys).

**Table 5.8 Disturbance Assessment – Summary Table**

Number of activities recorded during field surveys (2011/12 waterbird survey programme) observed to cause disturbance to waterbirds. The calculated peak disturbance score is shown (see text for explanation).
Scores 0 – 3 = Low Scores 4 – 6 = Moderate Scores 7 – 9 = High. Grey shading = no activity recorded.

| Subsite Code | Subsite Name | Number of Activities | Peak Disturbance Score | Activity Responsible |
|---|---|---|---|---|
| 0UL16 | Balheary Bridge | 1 | 5 | • Walking (incl. dogs) |
| 0UL17 | Seatown West | 1 | 5 | • Walking (incl. dogs) |
| 0UL18 | Prospect Point | 2 | 6 | • Sailing |
| 0UL19 | Seatown East | 2 | 7 | • Walking (incl. dogs) |
| 0UL20 | Yellow Walls | 1 | 7 | • Walking (incl. dogs) |
| 0UL21 | Kilcrea East | - | - | |
| 0UL22 | Mullan intake | 2 | 7 | • Shooting |
| 0UL23 | Corballis House Marsh | 2 | 6 | • Walking (incl. dogs)<br>• Shooting |
| 0UL24 | Burrow Strand | 6 | 7 | • Walking (incl. dogs)<br>• Shooting |
| 0UL25 | Malahide Point | 1 | 6 | • Walking (incl. dogs) |
| 0UL26 | Malahide Strand South | 1 | 7 | • Walking (incl. dogs) |
| 0UL27 | Malahide Strand North | 3 | 7 | • Walking (incl. dogs) |
| 0UL28 | Malahide Martello Tower | 1 | 6 | • Walking (incl. dogs) |
| 0UL50 | Kilcrea Field | 2 | 7 | • Walking (incl. dogs) |

**Table 5.9 Malahide Estuary -** subsite rankings based on total numbers of waterbirds (LT surveys) by peak disturbance score

| Species ► / Subsites ▼ | PB | GN | BW | GG | SU | PT | RM | OC | GP | GV | KN | DN | BA | RK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0UL16 | | | | | | | | | | | | | | |
| 0UL17 | H | | V | | M | | M | L | H | H | | | V | V |
| 0UL18 | M | V | M | V | | | V | H | | H | | | V | V |
| 0UL19 | | | V | | | | | M | | | | | | M |
| 0UL20 | | | | | | | | | | | | | | |
| 0UL21 | H | | | | | | | | | | | | | |
| 0UL22 | | | | | | | | | | | | | | |
| 0UL23 | M | | H | | V | V | | H | V | M | | H | | V |
| 0UL24 | V | | H | | V | H | V | V | V | V | V | V | V | H |
| 0UL25 | M | | L | | | | | L | | H | H | | | M |
| 0UL26 | V | | V | | | | | H | V | H | V | H | V | V |
| 0UL27 | | | | | | | | M | | | | | | L |
| 0UL28 | L | | | H | | | | H | | | | | | L |
| 0UL50 | | | | | | | | | | | | | | L |

### 5.4.5 Discussion

This review has highlighted that many 'activities and events' occur across the site, while the disturbance assessment represents a 'snap-shot' record of the level of disturbance-causing activities that can occur during the non-breeding season.

Many of the 'activities' identified may act so as to modify wetland habitats of the site. While physical loss might be considered more historic in nature (e.g. land claim, the construction of viaduct, piers etc.), on-going modifications to intertidal habitats may occur due to changes in natural processes (e.g. sedimentation or erosion rates) as a result of former physical events.

The most obvious on-going activity at this site is human recreational disturbance in the form of walking, with or without dogs. It is clear that this activity is displacing waterbirds. The significance of the impact that results from even a short-term displacement should not be underestimated. In terms of foraging habitat, displacement from feeding opportunities not only reduces a bird's energy intake but also leads to an increase in energy expenditure as a result of the energetic costs of flying to an alternative foraging area. Displacement also has knock-on ecological effects such as increased competition within and/or between different species for a common food source. In areas subject to heavy or on-going disturbance, waterbirds may be disturbed so frequently that their displacement is equivalent to habitat loss. When disturbance effects reduce species fitness[21] (reduced survival or reproductive success) consequences at population level may result.

Whilst the nature and the frequency of disturbance-causing activities are key factors when assessing likely impacts, many aspects of waterbird behaviour and ecology will influence a species response. Waterbird responses are likely to vary with each individual event and to be species-specific. The significance of a disturbance event upon waterbirds will vary according to a range of factors including:-

[21] defined as a measure of the relative contribution of an individual to the gene pool of the next generation.

- Frequency/duration of disturbance event;
- Intensity of activity;
- Response of waterbirds.

and be influenced by:-

- Temporal availability – whether waterbirds have the opportunity to exploit the food resources in a disturbed area at times when the disturbance does not occur;
- Availability of compensatory habitat - whether there is suitable alternative habitat to move to during disturbance events;
- Behavioural changes as a result of a disturbance - e.g. degree of habituation;
- Time available for acclimatisation - whether there is time available for habituation to the disturbance. (there may be a lack of time for waterbirds during the staging period);
- Age - for example when feeding, immature ($1^{st}$ winter birds) may be marginalised by older more dominant flocks so that their access to the optimal prey resources is limited. These individuals may already therefore be under pressure to gain their required daily energy intake before the effects of any disturbance event are taken into account;
- Timing/seasonality - birds may be more vulnerable at certain times e.g. pre- and post-migration, at the end of the winter when food resources are lower;
- Weather - birds are more vulnerable during periods of severe cold weather or strong winds;
- Site fidelity – some species are highly site faithful at site or within-site level and will therefore be affected to a greater degree than species that range more widely;
- Predation and competition – a knock-on effect of disturbance is that waterbirds may move into areas where they are subject to increased competition for prey resources, or increased predation – i.e. the disturbance results in an indirect impact which is an increased predation risk.

Knowledge of site activities and events is important when examining waterbird distribution and understanding the many factors that might influence a species' distribution across a site. The above points also highlight the complex nature of waterbird behaviour and species specificity, as well as the need for careful consideration of the impacts of disturbance upon waterbird species when undertaking Appropriate Assessments or other environmental assessments. This review could therefore form the starting point for any future study aiming to quantify the effects of activities/disturbance events across the site, as well as to help identify the extent to which existing use and management of the site are consistent with the achievement of the conservation objectives described in Part Three of this document.

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## APPENDIX 1

**SITE NAME: MALAHIDE ESTUARY SPA**

**SITE CODE: 004025**

Malahide Estuary is situated in north Co. Dublin, between the towns of Malahide and Swords. The site encompasses the estuary, saltmarsh habitats and shallow subtidal areas at the mouth of the estuary. A railway viaduct, built in the 1800s, crosses the site and has led to the inner estuary becoming lagoonal in character and only partly tidal. Much of the outer part of the estuary is well-sheltered from the sea by a large sand spit, known as "The Island". This spit is now mostly converted to golf-course. The outer part empties almost completely at low tide and there are extensive intertidal flats exposed. Substantial stands of eelgrass (both *Zostera noltii* and *Z. angustifolia*) occur in the sheltered part of the outer estuary, along with Tasselweed (*Ruppia maritima*). Green algae, mostly *Enteromorpha* spp. and *Ulva lactuca,* are frequent on the sheltered flats. Common Cord-grass (*Spartina anglica*) is well established in the outer estuary and also in the innermost part of the site. The intertidal flats support a typical macro-invertebrate fauna, with polychaete worms (*Arenicola marina* and *Hediste diversicolor*), bivalves such as *Cerastoderma edule, Macoma balthica* and *Scrobicularia plana*, the small gastropod *Hydrobia ulvae* and the crustacean *Corophium volutator*. Salt marshes, which provide important roosts during high tide, occur in parts of the outer estuary and in the extreme inner part of the inner estuary. These are characterised by such species as Sea Purslane (*Halimione portulacoides*), Sea Aster (*Aster tripolium*), Thrift (*Armeria maritima*), Sea Arrowgrass (*Triglochin maritima*) and Common Saltmarsh-grass (*Puccinellia maritima*).

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Great Crested Grebe, Light-bellied Brent Goose, Shelduck, Pintail, Goldeneye, Red-breasted Merganser, Oystercatcher, Golden Plover, Grey Plover, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit and Redshank. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

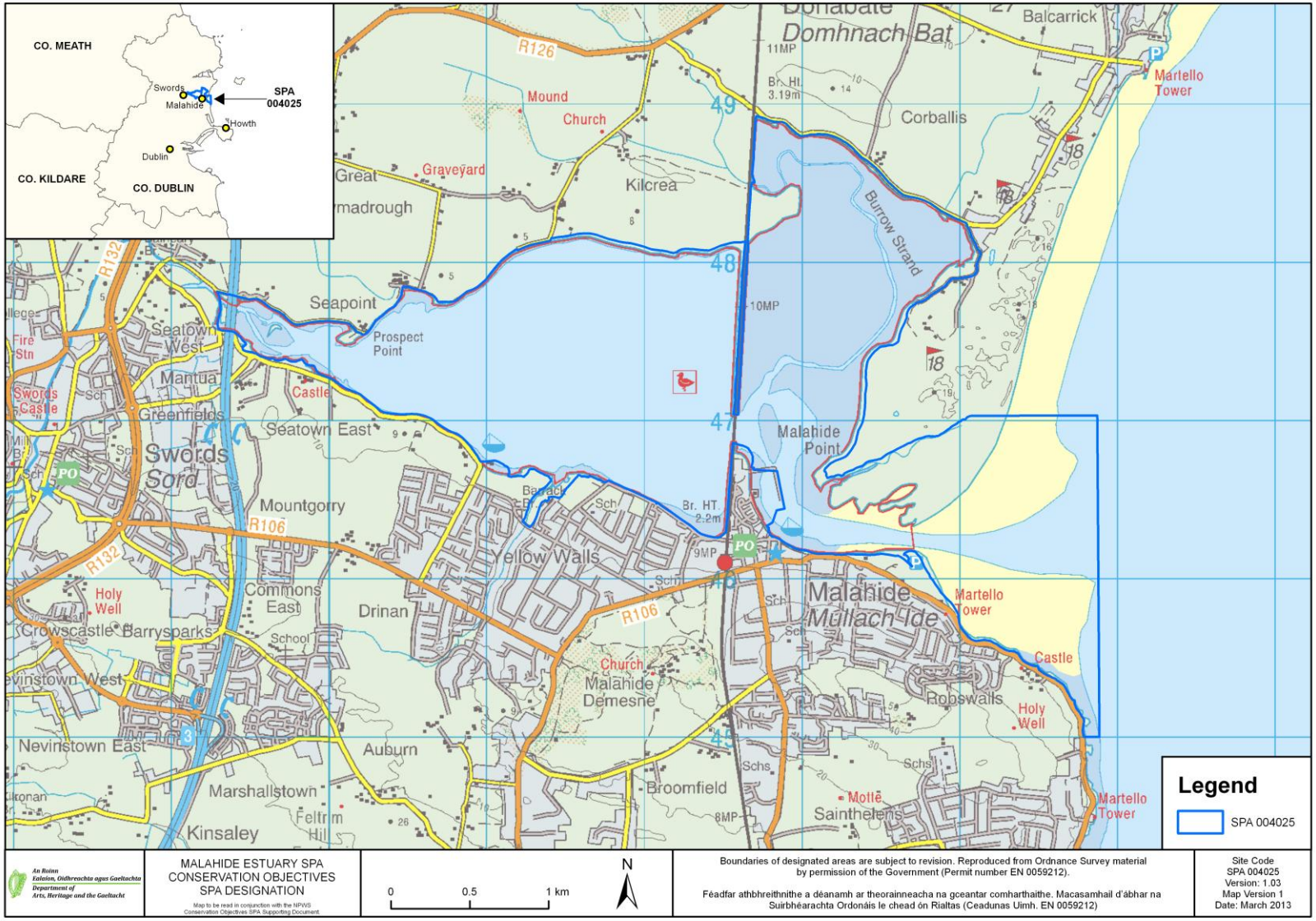
This site is of high importance for wintering waterfowl and supports a particularly good diversity of species. It has internationally important populations of Light-bellied Brent Goose (1,104 individuals or 5% of the all-Ireland total) and Black-tailed Godwit (409 individuals or 2.9% of the all-Ireland total) - figures given here and below are mean peaks for the five winters 1995/96-1999/2000. Furthermore, the site supports nationally important populations of an additional 12 species: Great Crested Grebe (63), Shelduck (439), Pintail (58), Goldeneye (215), Red-breasted Merganser (99), Oystercatcher (1,360), Golden Plover (1,843), Grey Plover (201), Knot (915), Dunlin (1,594), Bar-tailed Godwit (156) and Redshank (581). The high numbers of diving ducks reflects the lagoon-type nature of the inner estuary, and this is one of the few sites in eastern Ireland where substantial numbers of Goldeneye can be found.

A range of other species occurs, including Mute Swan (37), Pochard (36), Ringed Plover (86), Lapwing (1,542), Curlew (548), Greenshank (38) and Turnstone (112).

The estuary also attracts other migrant wader species such as Ruff, Curlew Sandpiper, Spotted Redshank and Little Stint. These occur mainly in autumn, though occasionally in spring and winter.

Breeding birds of the site include Ringed Plover, Shelduck and Mallard. Up to the 1950s there was a major tern colony at the southern end of Malahide Island. Grey Herons breed nearby and feed regularly within the site.

Malahide Estuary SPA is a fine example of an estuarine system, providing both feeding and roosting areas for a range of wintering waterfowl. The lagoonal nature of the inner estuary is of particular value as it increases the diversity of birds which occur. The site is of high conservation importance, with internationally important populations of Light-bellied Brent Goose and Black-tailed Godwit, and nationally important populations of a further 12 species. Two of the species which occur regularly (Golden Plover and Bar-tailed Godwit) are listed on Annex I of the E.U. Birds Directive.


CO. MEATH
Swords
Malahide
Howth
SPA 004025
Dublin
CO. KILDARE
CO. DUBLIN
Donabate
Domhnach Bat
Balcarrick
Martello Tower
R126
Mound
Church
Graveyard
Great
Kilcrea
Corballis
Burrow Strand
Seapoint
Prospect Point
Seatown West
Mantua
Castle
Greenfields
Seatown East
Swords
Sord
Malahide Point
Mountgorry
R106
R132
Yellow Walls
Commons East
Drinan
Holy Well
Crowscastle
Barrysparks
School
Malahide
Mullach Ide
Castle
Church
Malahide Demesne
Robswalls
Holy Well
Nevinstown West
Nevinstown East
Auburn
Marshallstown
Broomfield
Motte
Sainthelens
Feltrim Hill
Kinsaley
Legend
SPA 004025
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
SPA DESIGNATION
0
0.5
1 km
N
Site Code
SPA 004025
Version: 1.03
Map Version 1
Date: March 2013

## APPENDIX 2

## Waterbird data sources

Irish Wetland Bird Survey (I-WeBS)
I-WeBS began in the Republic of Ireland in 1994/95 and aims to monitor wintering (non-breeding) waterbird populations at the wetland sites upon which they rely. Counts are carried out by volunteers and professional staff of the partner organisations across the months September to March of each year. I-WeBS counts take place on a rising tide or close to high tide. For further information please refer to Crowe (2005).

The I-WeBS Programme monitors the larger coastal wetland sites together with inland lakes, turloughs, rivers and callows. However the resulting dataset is incomplete for some waterbird species that utilise other habitats such as non-wetland habitat (e.g. grassland used by many species and particularly foraging geese, and swans), non-estuarine coastline, small and ephemeral wetlands and the open sea; the latter of which is obviously difficult to monitor from land-based surveys (Crowe, 2005).

A number of additional and special surveys are therefore conducted on an annual or regular basis and data collected are, where appropriate, integrated into the I-WeBS database. These surveys include those undertaken for swan and geese species that forage typically during daylight hours across terrestrial habitats (e.g. grassland, arable fields) using coastal wetlands sites at night when they congregate to roost. Some of the additional surveys are carried out at certain times, aimed at providing a better estimate of numbers (e.g. Greylag Geese) and for some species an assessment of breeding success during the previous summer (e.g. Light-bellied Brent Geese). These surveys are introduced briefly below and more information is provided in Crowe (2005).

- Swan Surveys

Coordinated international censuses are carried out of the wintering populations of Whooper Swan (*Cygnus cygnus*) and Bewick's Swan (*Cygnus columbianus bewickii*) at four or five-yearly intervals. The surveys are organised by I-WeBS, the Irish Whooper Swan Study group (IWSSG) and WWT.

- Greenland White-fronted Goose

Greenland White-fronted Geese are concentrated at relatively few sites during winter, many of which are non-wetland habitats. The species is therefore not covered adequately by the I-WeBS programme. The Greenland White-fronted Goose census was initiated in the late 1970's and is carried out by NPWS in Ireland and by JNCC and Scottish Natural Heritage (SNH) in Scotland.

- Greylag Geese

Data for the Icelandic breeding population of Greylag Goose that winters in Ireland are taken from special surveys organised through I-WeBS and undertaken during November each year. The surveys aim to assess the distribution and status of the migratory flocks wintering in Ireland and focus on known feeding areas (grassland & agricultural land). When calculating population estimates of the Icelandic birds, data collected are adjusted to account for feral flocks that also occur within Ireland.

- Barnacle Goose (*Branta leucopsis*)

A wintering population from the northeast Greenland breeding population winters mainly on offshore islands along the west coast of Ireland. An aerial survey is conducted of the principal wintering areas every four to five years.

- Light-bellied Brent Geese

Special autumn surveys of this species have been conducted since 1996 and organised in the Republic of Ireland by the Irish Brent Goose Research Group (IBGRG). The survey is currently conducted on a bi-annual basis during the month of October which coincides with the autumn arrival of the species. Data collected are integrated into the I-WeBS database.

## APPENDIX 3

Analysing population trends: a synopsis

Monitoring of non-breeding waterbirds has been undertaken by the Irish Wetland Bird Survey (I-WeBS) and its partner, WeBS in Northern Ireland, since the mid 1990's. For such long-term count data, there is clearly a need to assess long-term trends in a consistent and objective manner (Atkinson et al. 2006).

The first stage in the analytical process involves the use of the Underhill Program (Underhill & Prŷs-Jones, 1994) which models the raw monthly counts using a Generalised Linear Model (GLM). As part of this process, it accounts for changes in numbers at the site and the timing of the count (month, year) while also taking into account completed counts and trends at other sites. When counts at a site are flagged as poor quality (e.g. due to poor visibility) or where there are missing values in a given month, then the modelled values are used. This imputation process is used widely to replace missing data points (e.g. Houlahan et al. 2000; Atkinson et al. 2006; Leech et al. 2002; Gregory et al. 2005; Crowe et al. 2008). The resulting dataset is therefore complete for all months and seasons and comprises a combination of actual count data and imputed count data.

This complete dataset is then modelled using a Generalised Additive Models (GAM) which fits a smoothed curve to the counts. GAMs are non-parametric and flexible extensions of the generalised linear model where the linear predictor of the GLM is replaced by a general additive predictor which allows mean abundance to vary as a smooth function of time. Count data are assumed to follow independent Poisson distribution with 0.3T degrees of freedom (e.g. after Atkinson et al. 2006). The application of GAMs to analyse population trends was applied to UK farmland birds by Fewster et al. (2000) and has since been adopted for modelling waterbird trends elsewhere, for example, the UK WeBS Alert system (Leech et al. 2002).

Smoothed count data for a site are then indexed to assess population trends over time. An index number can be defined as a measure of population size in one year expressed in relation to the size of the population in another selected year (Leech et al. 2002). Changes in the index numbers can therefore explain the pattern of population change over time (Underhill & Prŷs-Jones, 1994).

Annual indices are calculated separately for each species at a site. For each year included in an analysis, a total is obtained by summing the number of birds present in a predetermined number of months. The final year in the series of totals is then scaled to equal 100 (please see example in table). Index values in any given year therefore represent the number of individuals relative to those present in the final year. As this process is the same across all species and all sites analysed it allows for some useful comparisons.

| Count Data | Index |
|---|---|
| 264.41 | 128.11 |
| 262.21 | 127.04 |
| 234.0 | 113.37 |
| 126.0 | 61.05 |
| 197.23 | 95.56 |
| 206.4 | 100.00 |

Un-smoothed indices are also calculated and provide a means of examining ('eye-balling') the variation across time and can also be used to provide a measure of the mean annual change over the entire period. However, the GAM extension to the methodology and resultant smoothed indices allows for the calculation of proportional change in population size between one season and another. This latter calculation is used in Section 4.2 whereby trends are calculated for the 'long-term' 12-year period (1995–2007) and the recent five-year period (2002-2007). The values given represent the percentage change in index (population) values across the specified time period, calculated by subtracting the smoothed index value at the start of the time-frame (1995) from the smoothed index value in the reference year (2007):-

$$\text{Change} = ((I_y - I_x) / I_x) \times 100$$

where $I_y$ is the index from the current year and $I_x$ is the index value at the start of the selected time period (see example below)

The reference year is the penultimate year in the time series because, when smoothing, the GAM takes into account values from both the preceding and following year. The last value in the smoothed dataset (2008) is therefore likely to be the least robust because it has no following year.

The final result is therefore % change in population size across a specified time period. Larger values indicate larger proportional changes in population size; positive values indicating relative increases while negative values indicate relative decreases over the specified time period.

Worked example

| Year | Unsmoothed Index | Smoothed Index |
|---|---|---|
| 1994 | 0.715 | 0.753 |
| 1995 | 0.604 | 0.804 |
| 1996 | 0.739 | 0.835 |
| 1997 | 0.594 | 0.826 |
| 1998 | 0.711 | 0.782 |
| 1999 | 0.745 | 0.727 |
| 2000 | 0.618 | 0.691 |
| 2001 | 0.694 | 0.692 |
| 2002 | 0.300 | 0.739 |
| 2003 | 0.530 | 0.827 |
| 2004 | 1.348 | 0.936 |
| 2005 | 0.836 | 1.028 |
| 2006 | 0.773 | 1.069 |
| 2007 | 0.734 | 1.051 |
| 2008 | 1 | 1.000 |

| Term | Change |
|---|---|
| **5YR** | **+ 42.80** |
| **10YR** | **+ 27.24** |
| **ALL YR** | **+ 30.72** |

Further information on population indexing and trend analysis can be found in various references; for particular reference to waterbirds see Leech et al (2002) and Atkinson et al. (2006). For information on the UK WeBS Alerts system, please see Thaxter et al. (2010).

Limitations

The months chosen for the calculation of population indices aim to reflect the months when the populations at a site are the most stable, excluding months when there may be fluctuations due to passage populations. Despite this, some datasets still present a high degree of variability or fluctuation both within and between years. Because of this, we assess each species separately and take into account where a species shows a history of wide fluctuations between years (within national dataset), or where a species naturally exhibits within-season fluctuations (e.g. species considered to have weak site faithfulness). Where necessary the results of the trend analysis are assigned necessary caution.

A high proportion of imputed counts can limit the effectiveness of the analysis to aid in the interpretation of the dataset. Species for which 50% or more of the monthly count values are imputed are excluded from analysis. But sometimes the calculation of population change may involve a comparison between winters where, at least one has a value based on a high proportion of imputed data. Where data for adjacent winters are relatively complete this is not a serious concern because of the smoothing technique used. However, where data for a number of consecutive winters rely heavily on imputed data then the resulting result is considered less reliable (Thaxter et al. 2010). Where necessary the results of the trend analysis are assigned necessary caution.

Despite the smoothing effects of the GAM analysis, interpretation of population trends may sometimes still be difficult. Therefore we calculate proportional change in the population across differing time periods (e.g. 12-year, 10-year and 5-year periods) to assess more effectively how the population has fared over time.

## APPENDIX 4

**Waterbird species codes**

| | | |
|---|---|---|
| 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* |
| BG | Brent Goose | *Branta bernicla* |
| 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 alpine* |
| 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* |
| JS | Jack Snipe | *Lymnocryptes minimus* |
| KF | Kingfisher | *Alcedo atthis* |
| KN | Knot | *Calidris canutus* |
| L. | Lapwing | *Vanellus vanellus* |
| LB | Lesser Black-backed Gull | *Larus fuscus* |
| PB | Light-bellied Brent Goose | *Branta bernicla hrotra* |
| ET | Little Egret | *Egretta garzetta* |

| | | |
|---|---|---|
| LG | Little Grebe | *Tachybaptus ruficollis* |
| 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 maritime* |
| RM | Red-breasted Merganser | *Mergus serrator* |
| RH | Red-throated Diver | *Gavia stellata* |
| RK | Redshank | *Tringa tetanus* |
| RP | Ringed Plover | *Charadrius hiaticula* |
| 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 5

Waterbird foraging guilds (after Weller, 1999)

| Guild | Foods | Tactics | Examples… |
|---|---|---|---|
| (1) Surface swimmer | Invertebrates, vegetation & seeds | Strain/sieve/sweep/dabble/grab/up-ending | 'Dabbling ducks'; e.g. Shoveler, Teal, Mallard, Pintail, Wigeon, Gadwall |
| (2) Water column diver – shallow[a] | Fish & Invertebrates; | Search/grab | 'Diving ducks' e.g. Pochard, Tufted Duck, Scaup, Eider, |
| (3) Water column diver – greater depths | Fish & Invertebrates | Search/grab | Common Scoter, divers, grebes, Cormorant |
| (4) Intertidal walker, out of water | Invertebrates | Search (probe)/grab | Sandpipers, plovers |
| (5) Intertidal walker, out of water | Invertebrates, vegetation | Sieve/grab/graze | Shelduck, Avocet, Spoonbill, Wigeon, Light-Bellied Brent Goose, |
| (6) Intertidal walker, in water | Fish | Search/strike | Grey Heron |
| | Fish, Invertebrates | Probe, scythe, sweep/grab | Spoonbill, Greenshank |
| | Fish | Stalk | Little Egret |
| | Invertebrates | Probe | Several sandpiper species |
| (7) Terrestrial, walker (e.g. grassland/marsh) | Vegetation (inc. roots, tubers & seeds) | Graze, peck, probe | Many geese species |

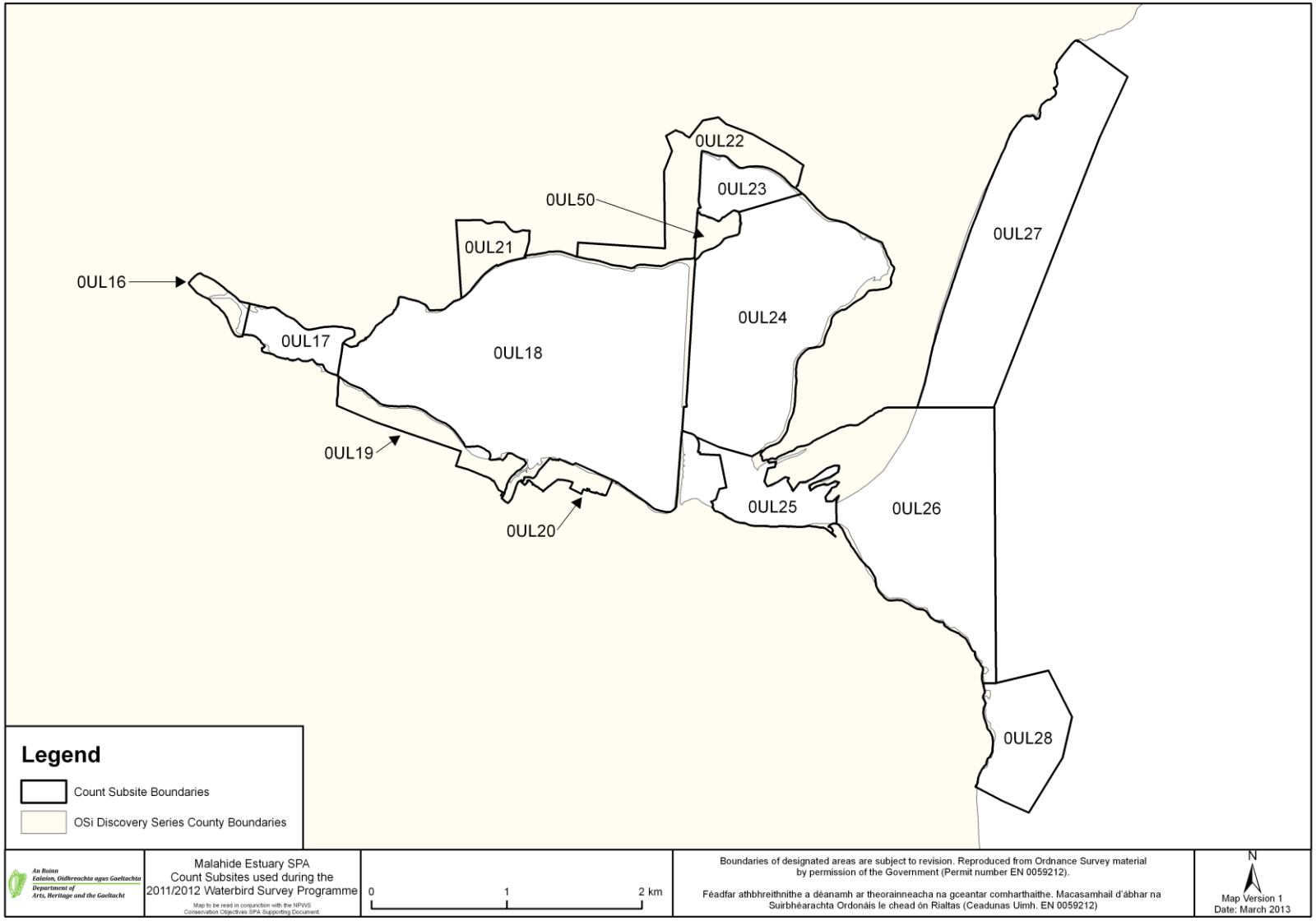
[a] dives <3m.

Please note that this table refers to generalised foraging strategies and is meant as a guide only. There is a great deal of variation between sites, seasons, tidal states and indeed, individual birds themselves. For example, some waterbird species may deploy several of the methods, e.g. Shelduck may forage by sieving intertidal mud (5) or by up-ending (1) and Pintail, although generally known as a 'dabbling' duck, does occasionally dive for food.

## APPENDIX 6

### Malahide Estuary – Waterbird Survey Programme 2011/12 – Count Subsites

| Subsite Code | Subsite Name | Area (ha) |
|---|---|---|
| 0UL16 | Balheary Bridge | 7.9 |
| 0UL17 | Seatown West | 21.3 |
| 0UL18 | Prospect Point | 319.5 |
| 0UL19 | Seatown East | 24.9 |
| 0UL20 | Yellow Walls | 9.1 |
| 0UL21 | Kilcrea East | 18.2 |
| 0UL22 | Mullan intake | 48.5 |
| 0UL23 | Corballis House Marsh | 22.6 |
| 0UL24 | Burrow Strand | 176.4 |
| 0UL25 | Malahide Point | 36.2 |
| 0UL26 | Malahide Strand South | 182.9 |
| 0UL27 | Malahide Strand North | 162.9 |
| 0UL28 | Malahide Martello Tower | 50.4 |
| 0UL50 | Kilcrea Field | 7.0 |
| | **TOTAL** | **1087.7** |

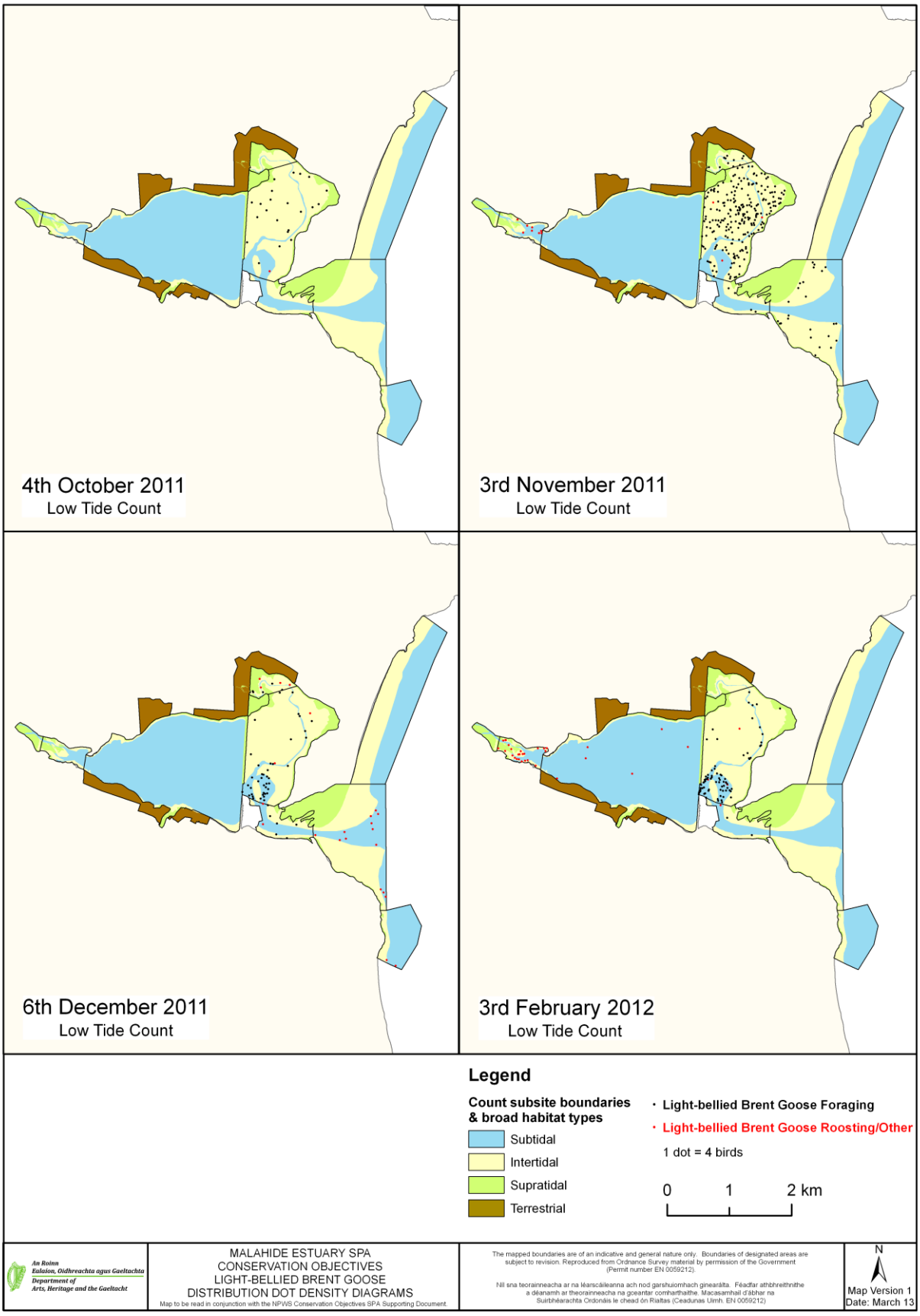

0UL22
0UL23
0UL50
0UL21
0UL27
0UL16
0UL24
0UL17
0UL18
0UL19
0UL25
0UL26
0UL20
0UL28
Legend
Count Subsite Boundaries
OSi Discovery Series County Boundaries
An Roinn Ealaíon, Oidhreachta agus Gaeltachta Department of Arts, Heritage and the Gaeltacht
Malahide Estuary SPA
Count Subsites used during the
2011/2012 Waterbird Survey Programme
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document
0
1
2 km
Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 2013

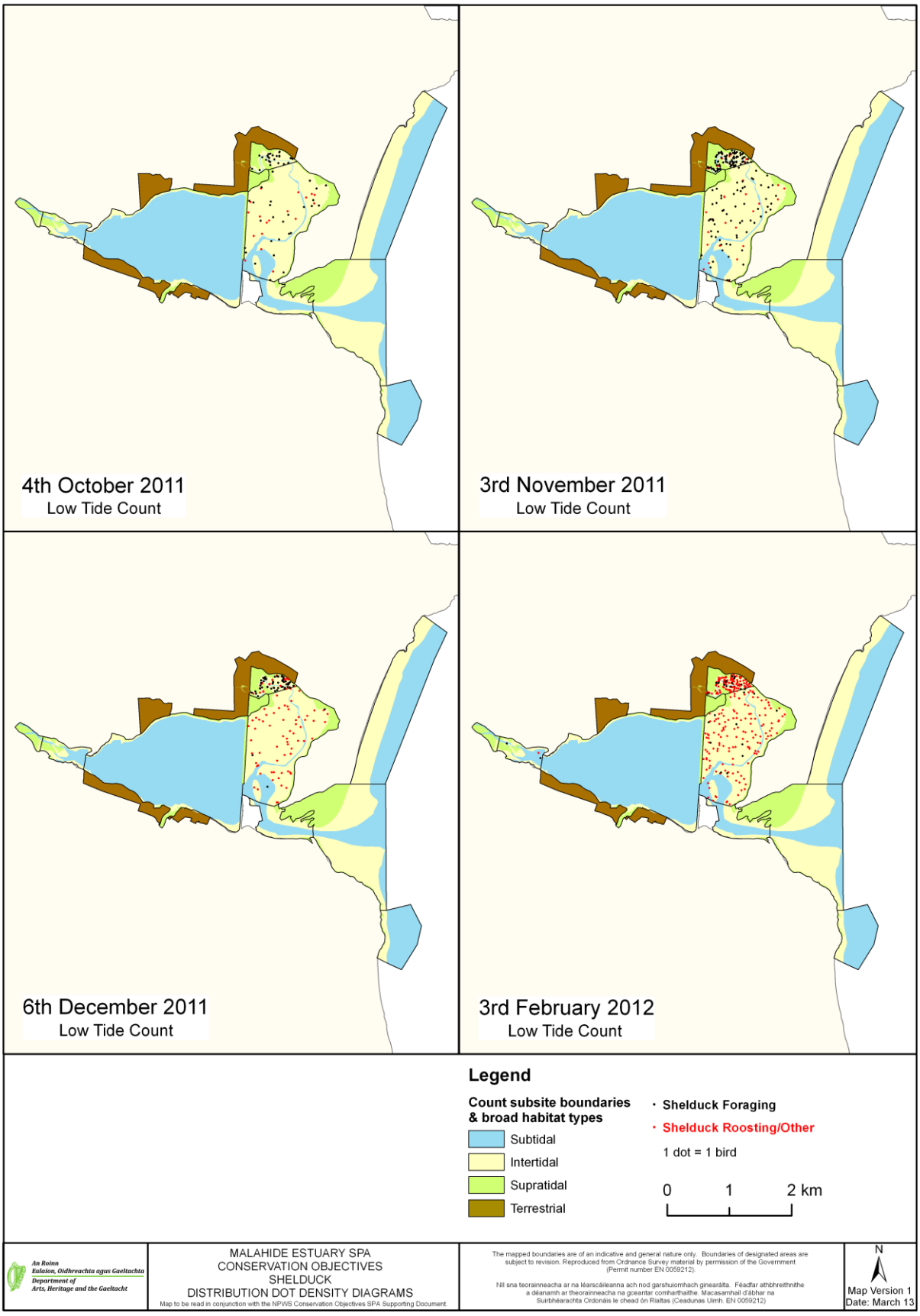
## APPENDIX 7

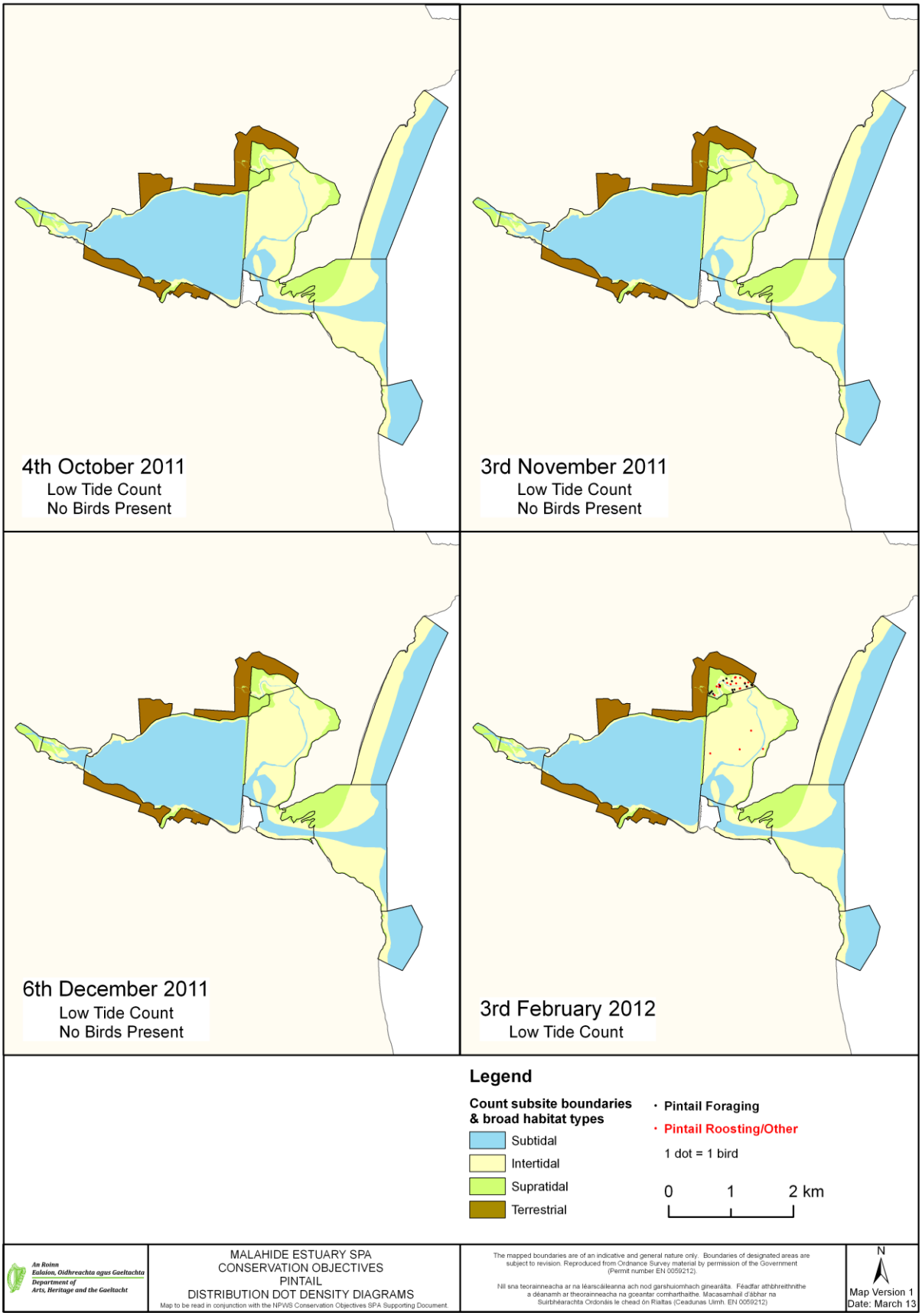
**Malahide Estuary**

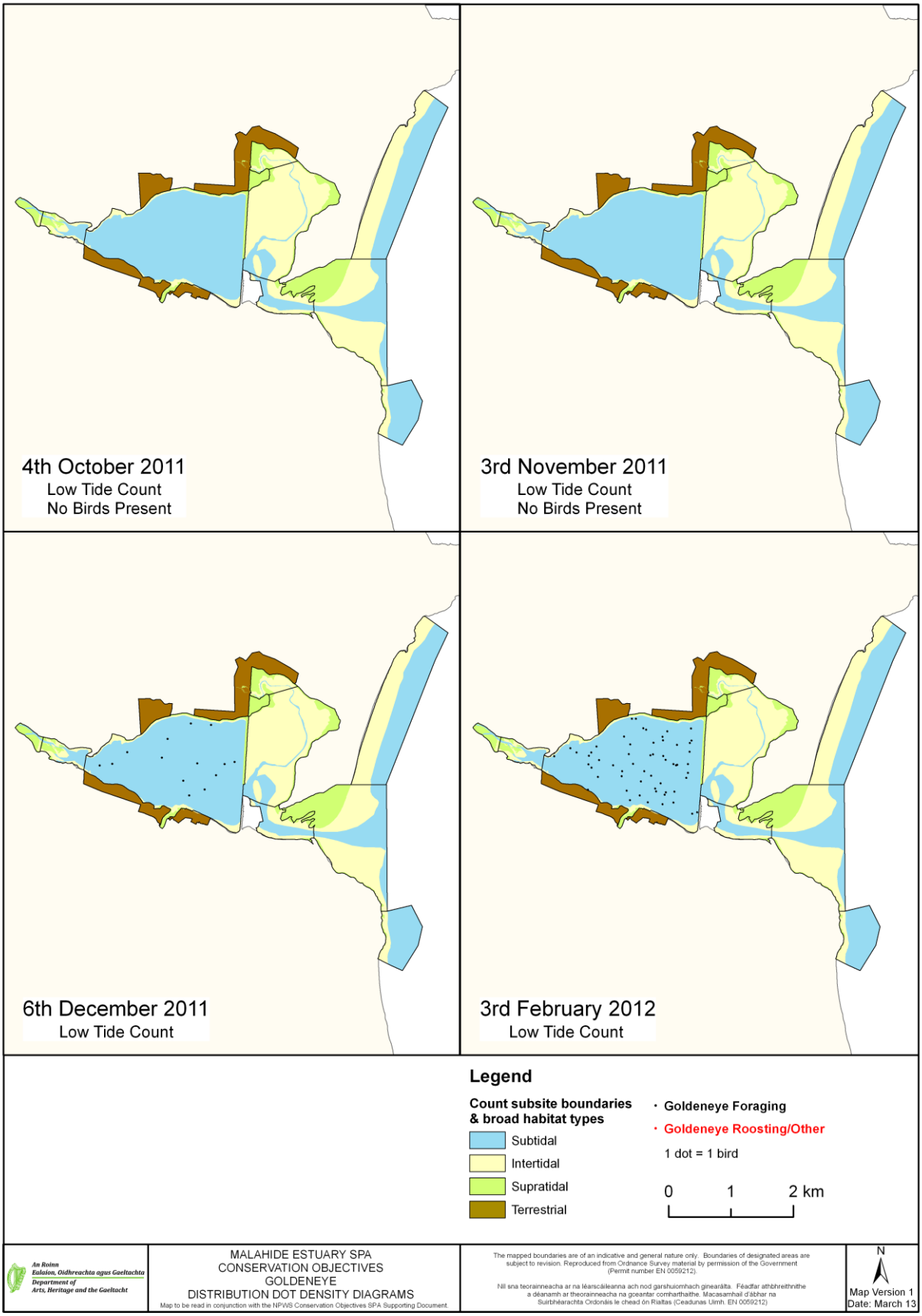
**Waterbird distribution (dot-density diagrams) recorded during low tide surveys (October 2011 – February 2012)**

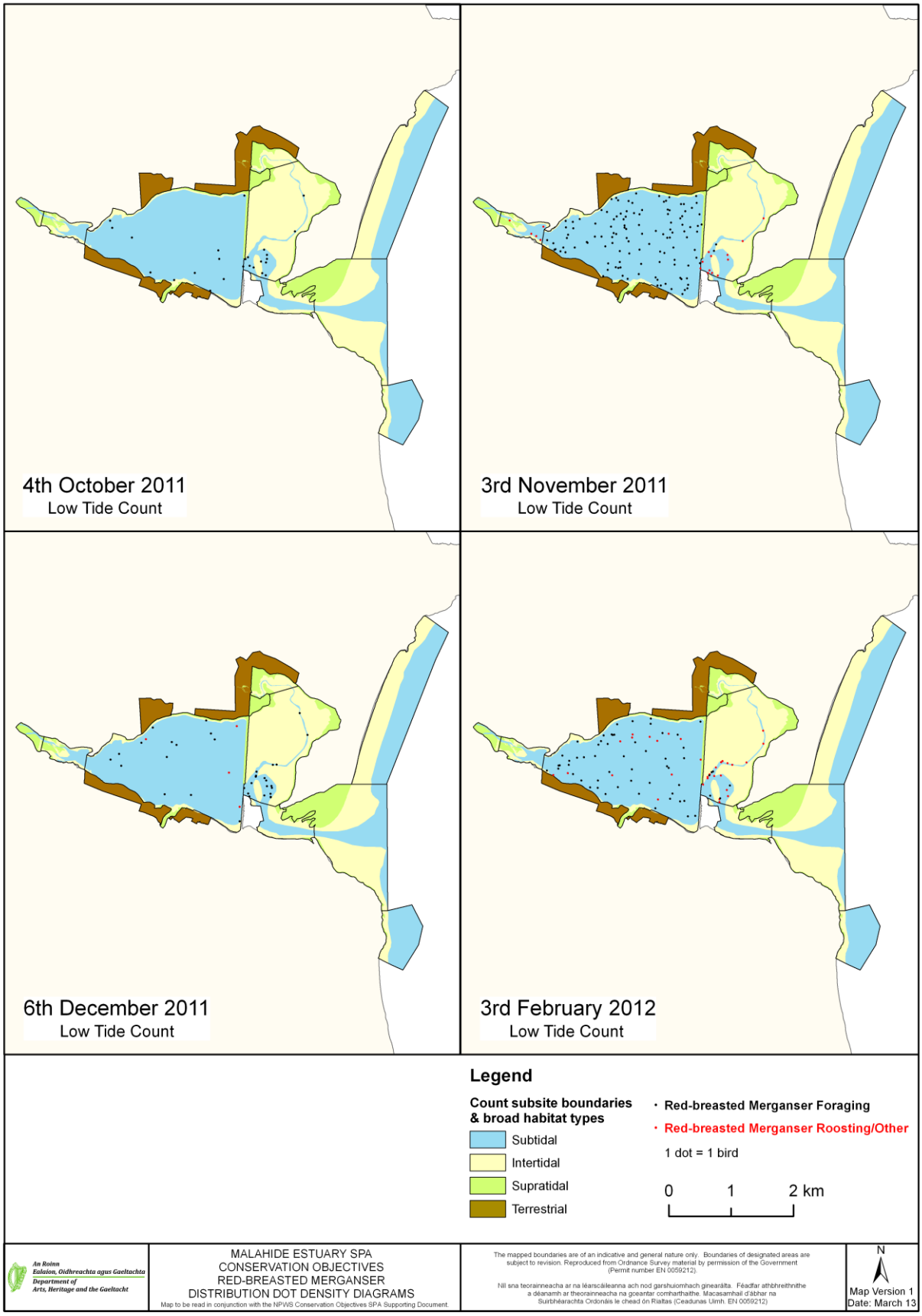
**(data are presented for birds located in intertidal and subtidal habitats only)**

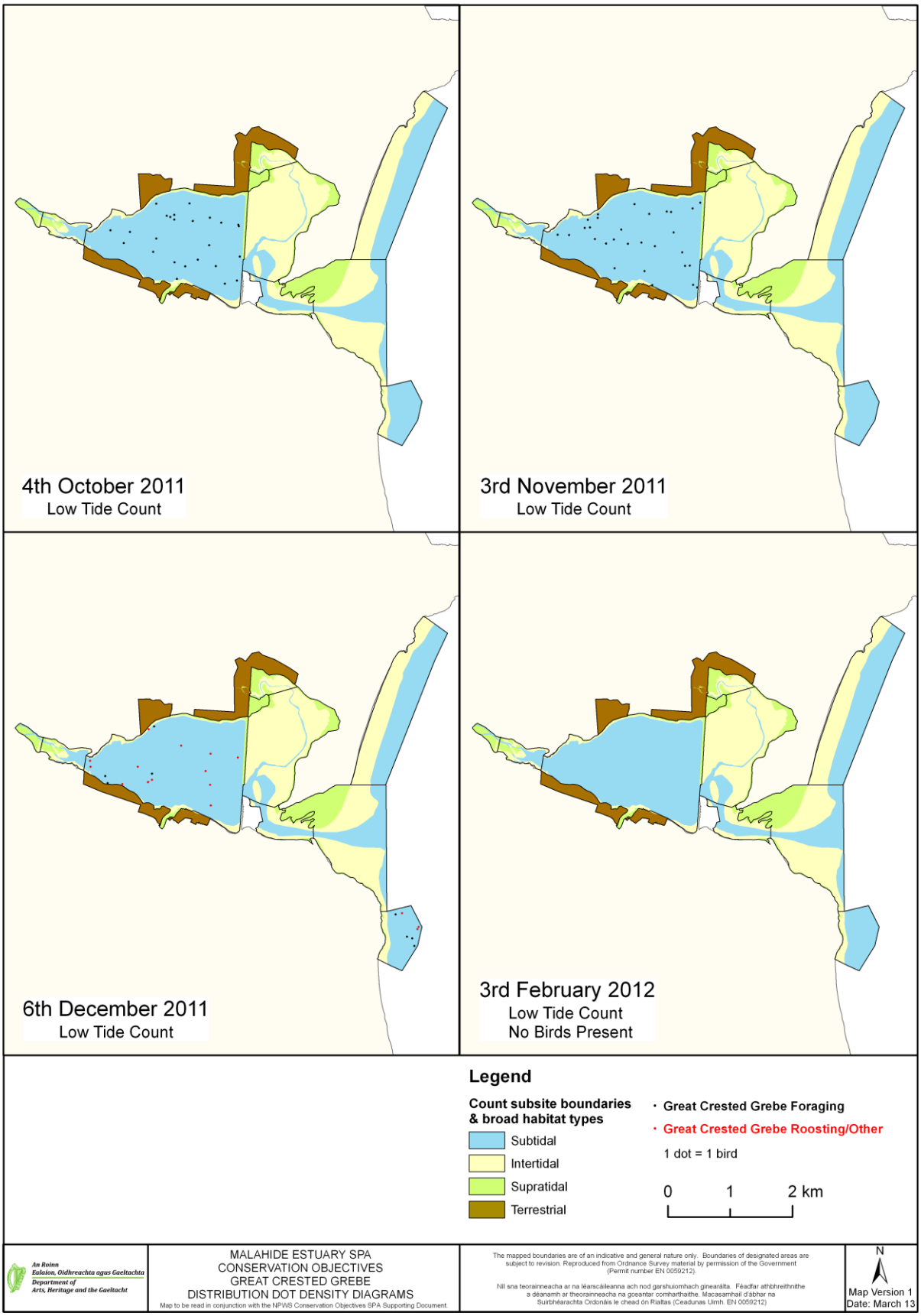

4th October 2011
Low Tide Count
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Light-bellied Brent Goose Foraging
Light-bellied Brent Goose Roosting/Other
1 dot = 4 birds
0 1 2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
LIGHT-BELLIED BRENT GOOSE
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059212)
N
Map Version 1
Date: March 13

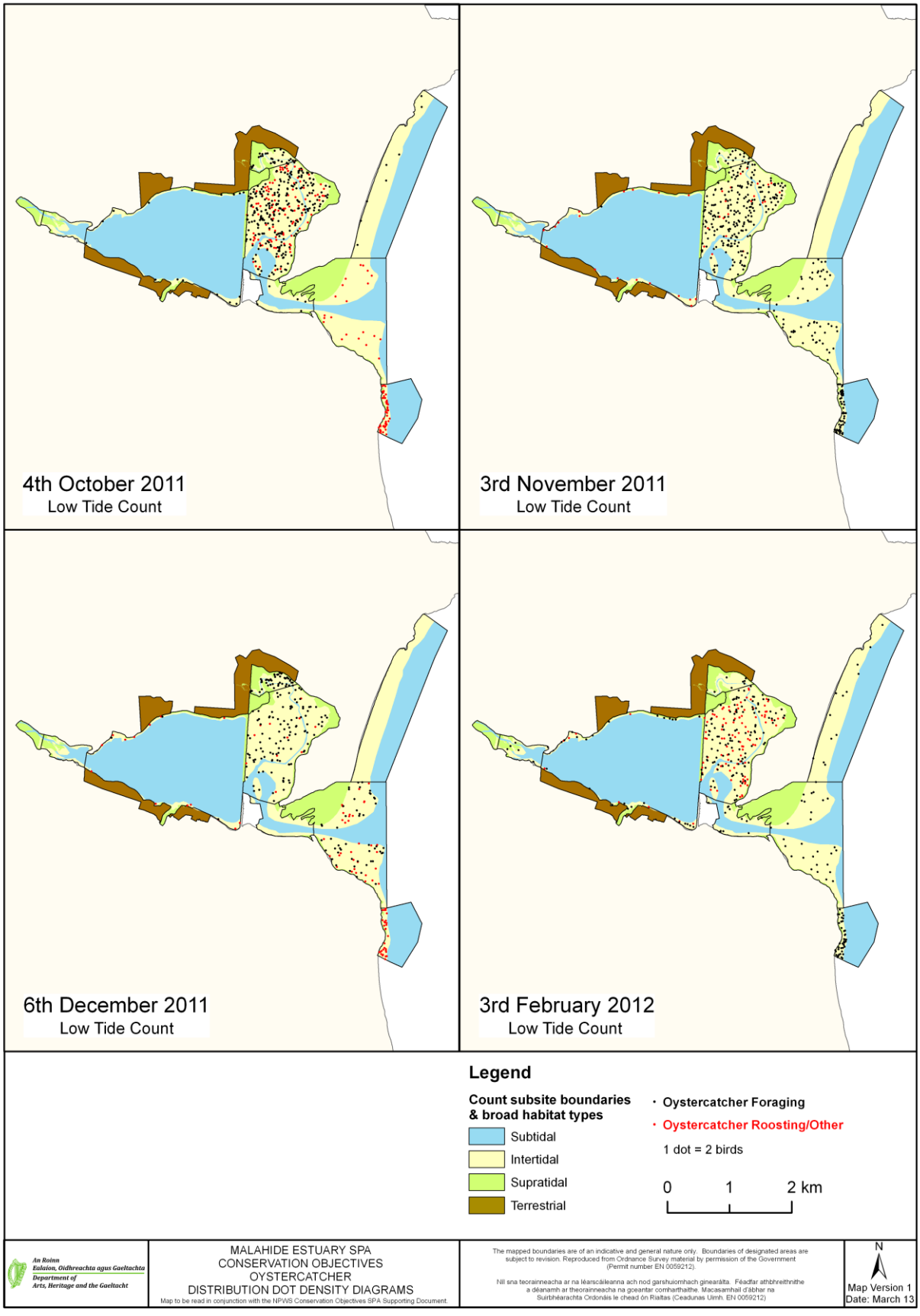

4th October 2011
Low Tide Count
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Shelduck Foraging
Shelduck Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
SHELDUCK
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059212)
N
Map Version 1
Date: March 13

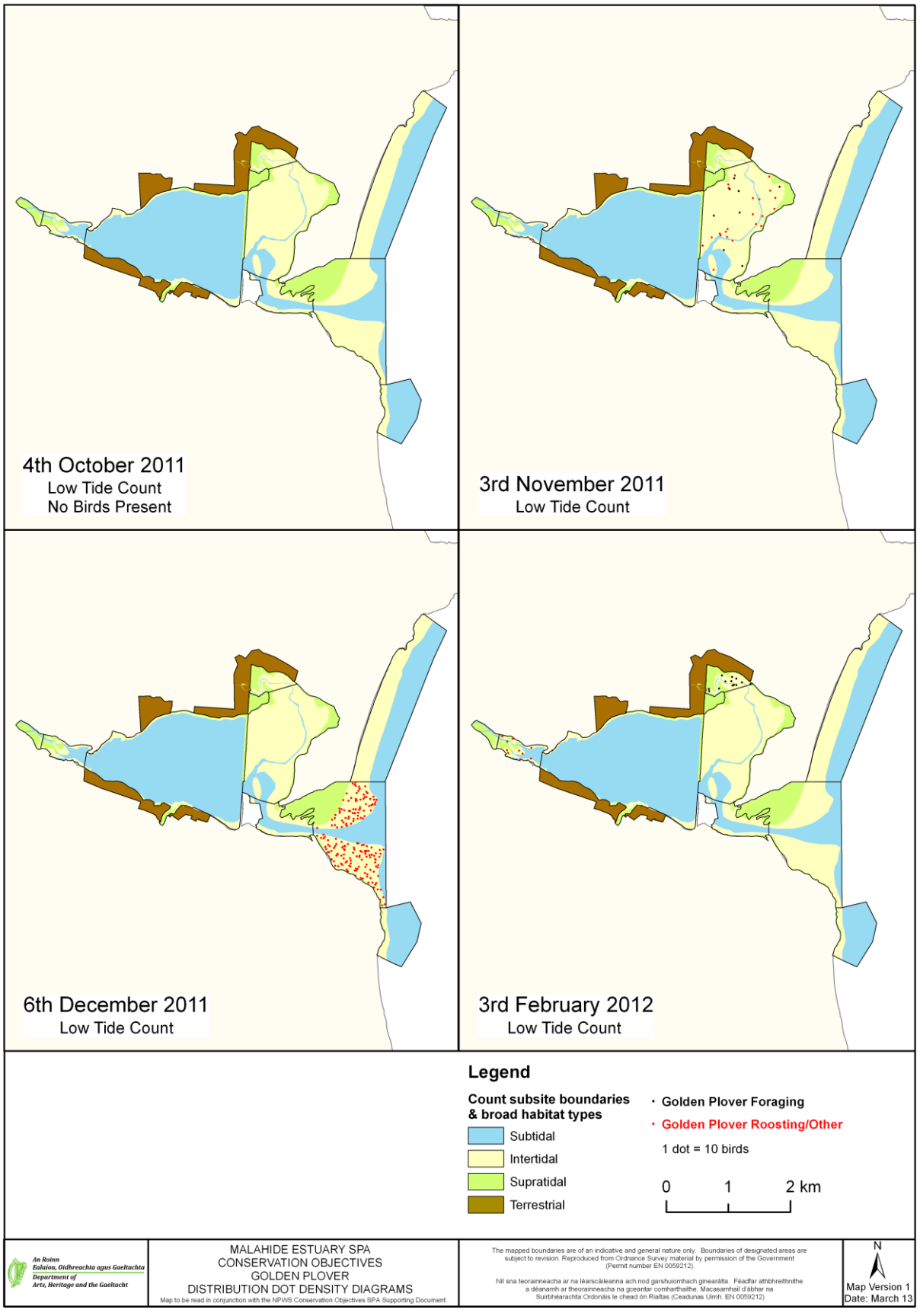

4th October 2011
Low Tide Count
No Birds Present
3rd November 2011
Low Tide Count
No Birds Present
6th December 2011
Low Tide Count
No Birds Present
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Pintail Foraging
Pintail Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
PINTAIL
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 13

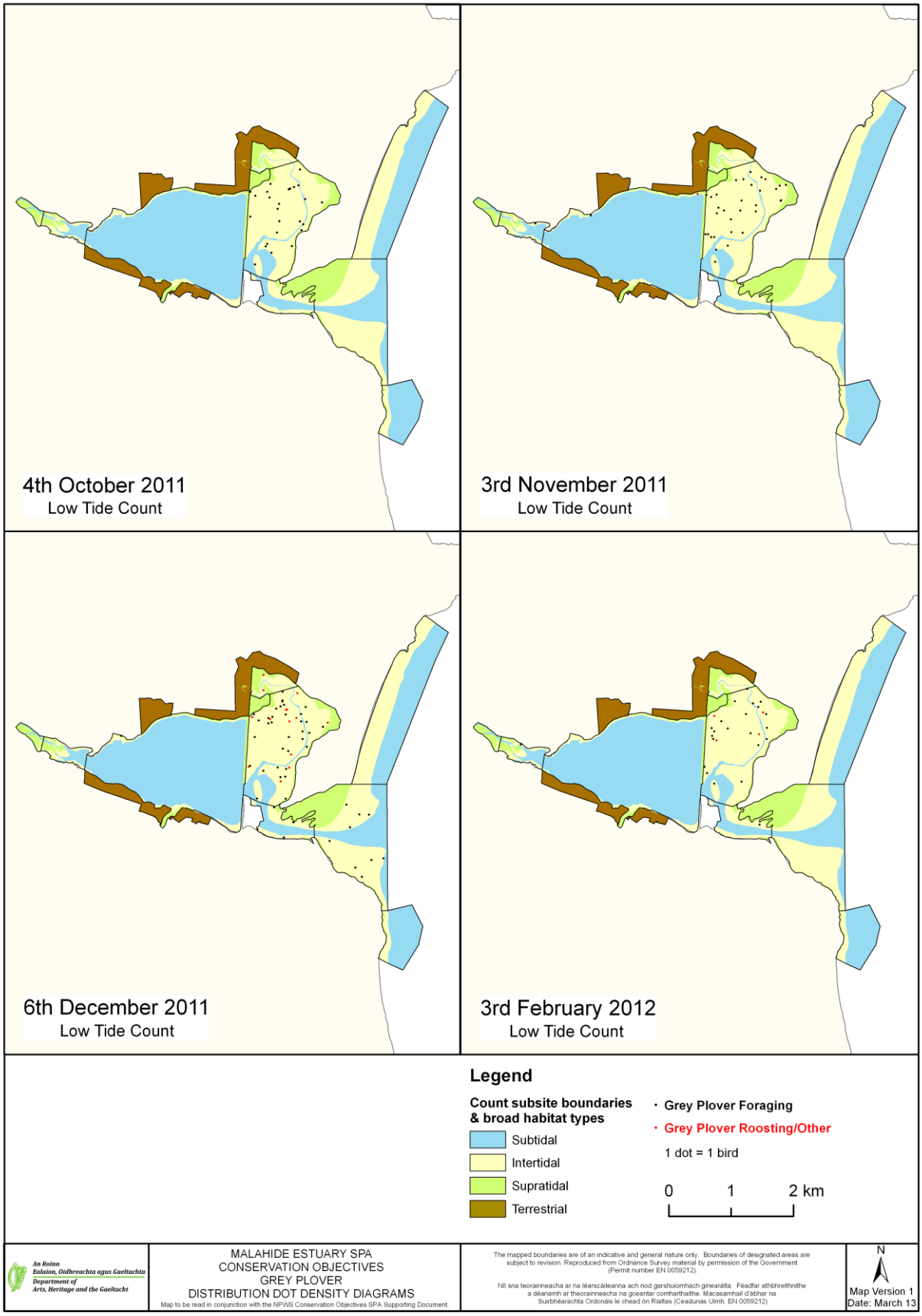

4th October 2011
Low Tide Count
No Birds Present
3rd November 2011
Low Tide Count
No Birds Present
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Goldeneye Foraging
Goldeneye Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
GOLDENEYE
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 13

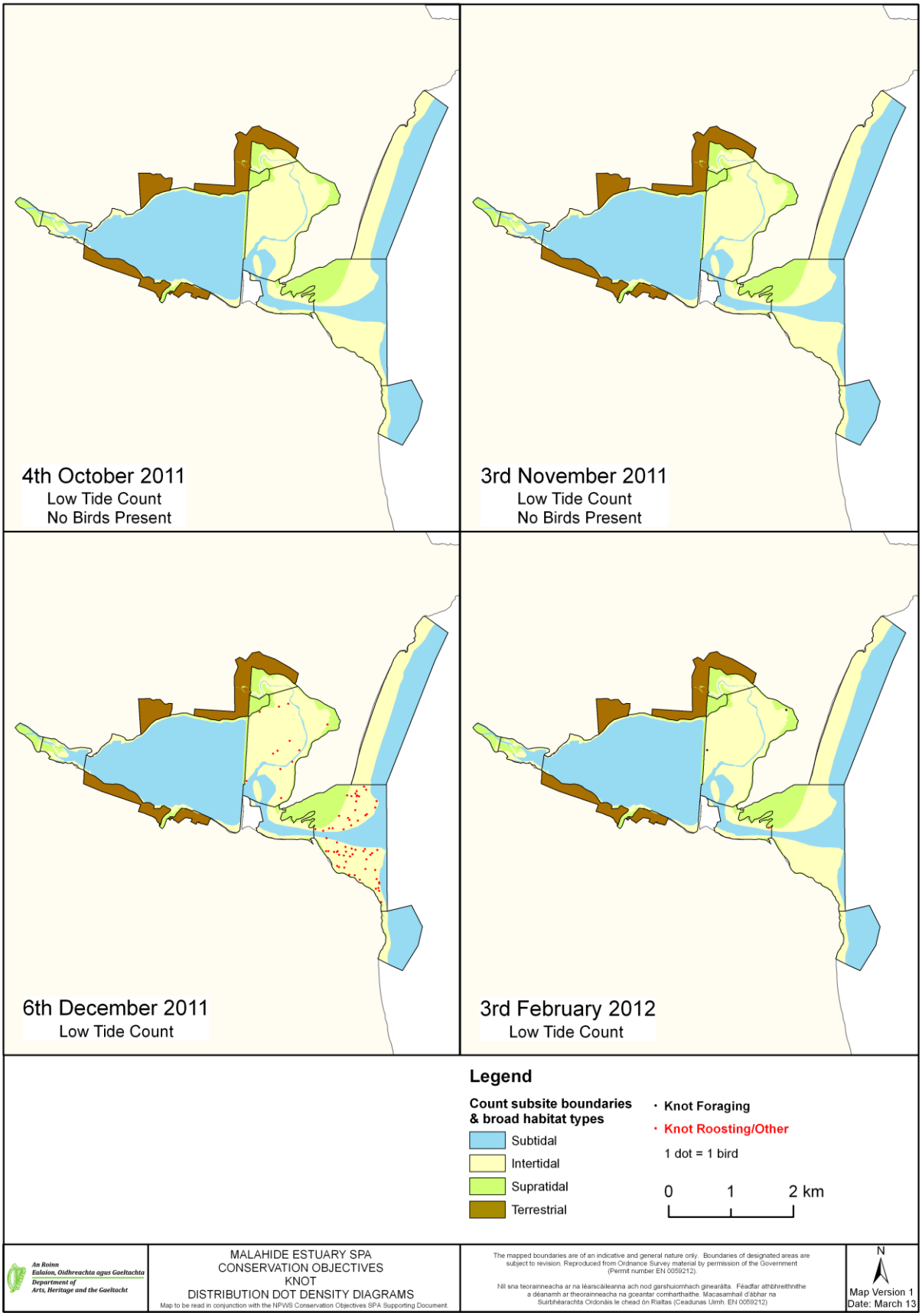

4th October 2011
Low Tide Count
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Red-breasted Merganser Foraging
Red-breasted Merganser Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
RED-BREASTED MERGANSER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 13

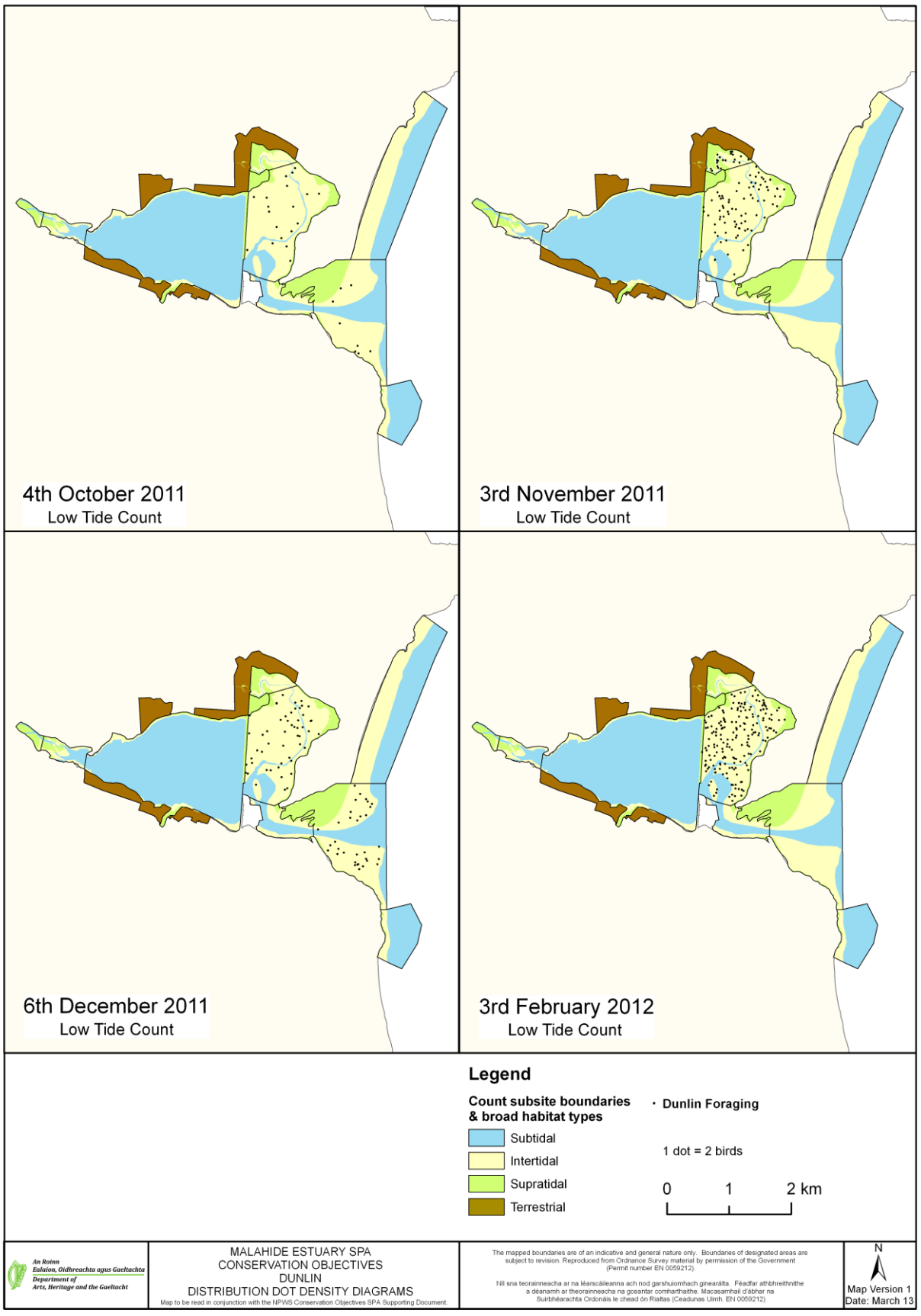

4th October 2011
Low Tide Count
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
No Birds Present
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Great Crested Grebe Foraging
Great Crested Grebe Roosting/Other
1 dot = 1 bird
0 1 2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
GREAT CRESTED GREBE
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead on Rialtas (Ceadúnas Uimh. EN 0059212)
N
Map Version 1
Date: March 13

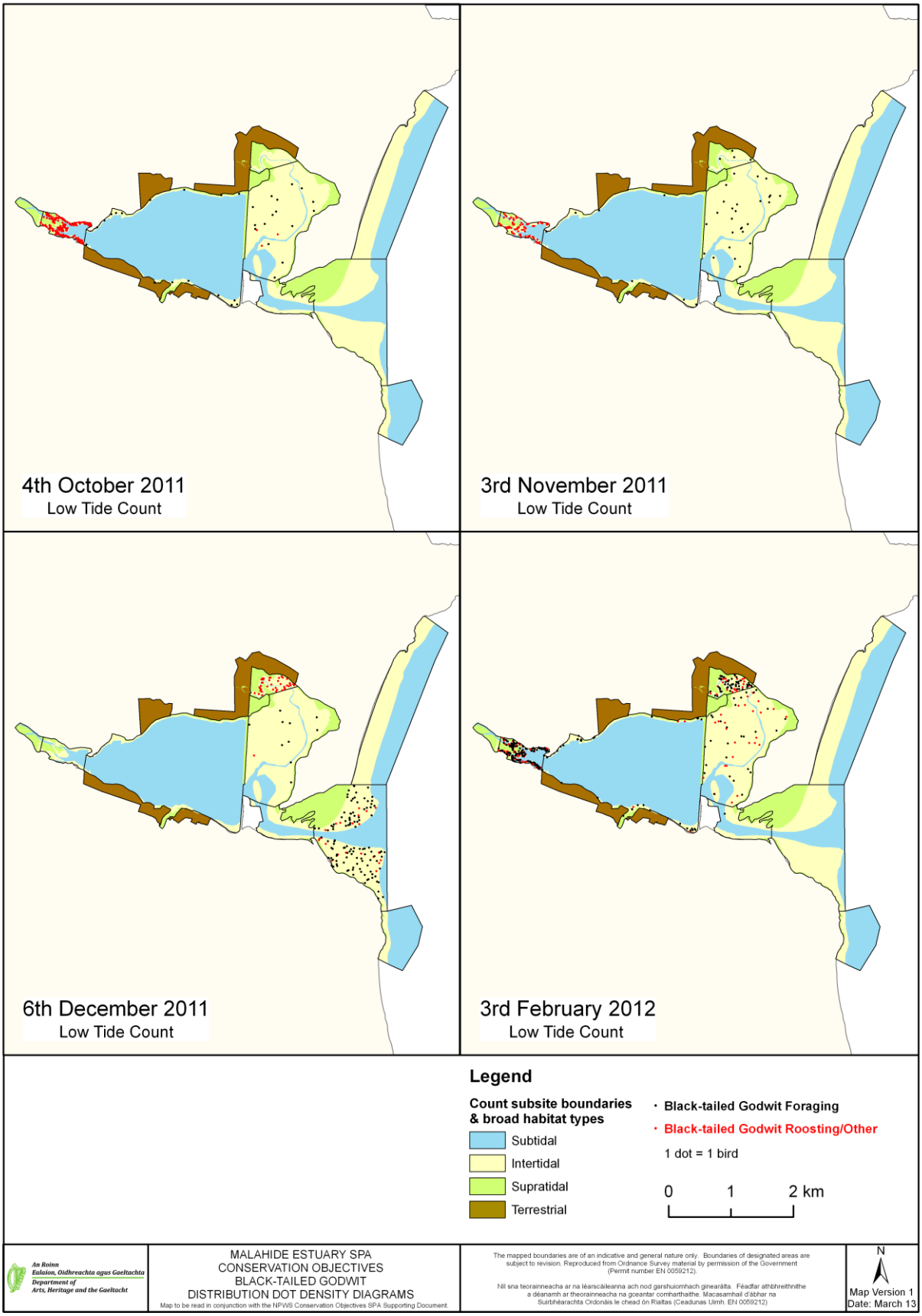

4th October 2011
Low Tide Count
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Oystercatcher Foraging
Oystercatcher Roosting/Other
1 dot = 2 birds
0 1 2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
OYSTERCATCHER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordanáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 13

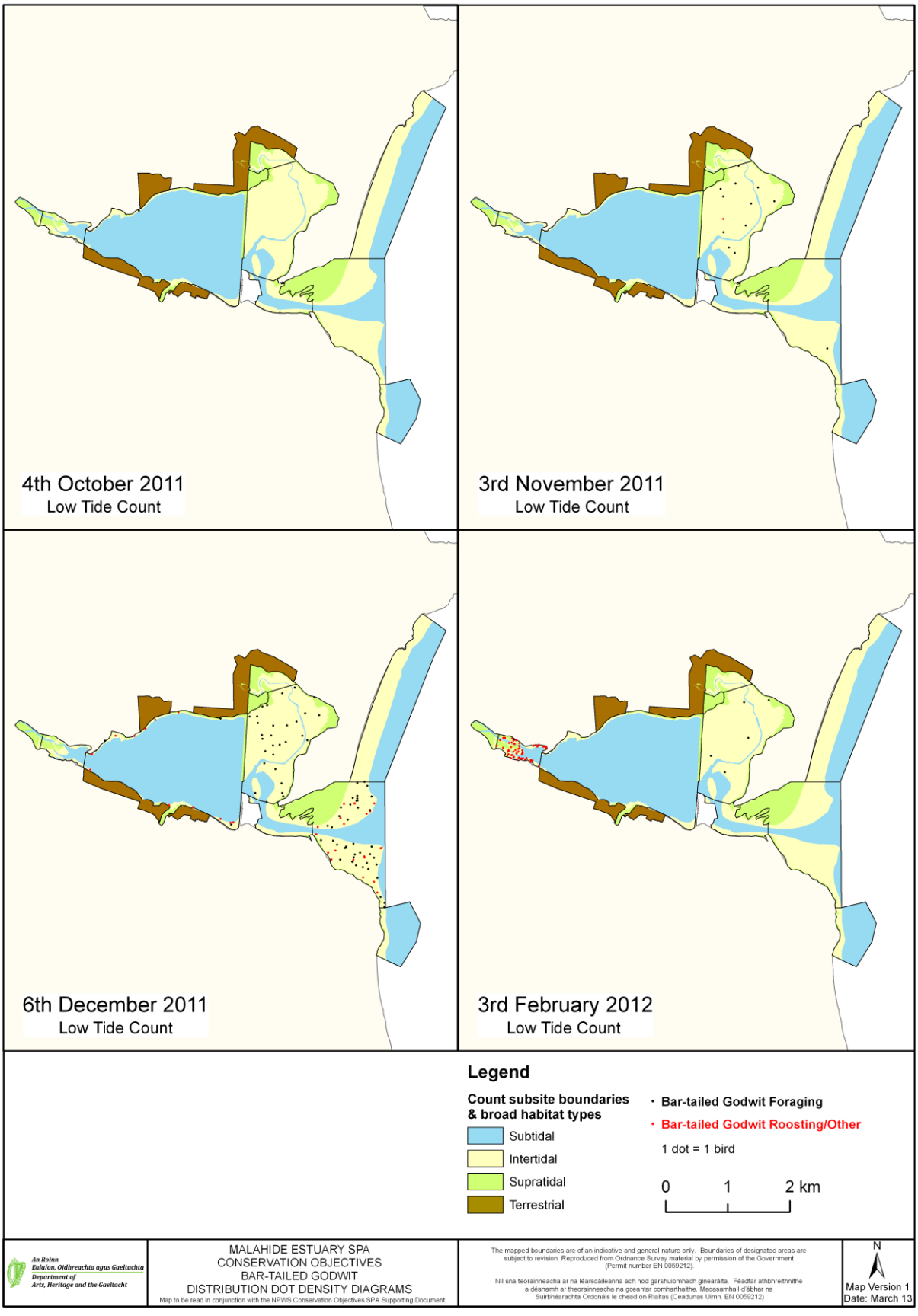

4th October 2011
Low Tide Count
No Birds Present
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Golden Plover Foraging
Golden Plover Roosting/Other
1 dot = 10 birds
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
GOLDEN PLOVER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059212)
N
Map Version 1
Date: March 13

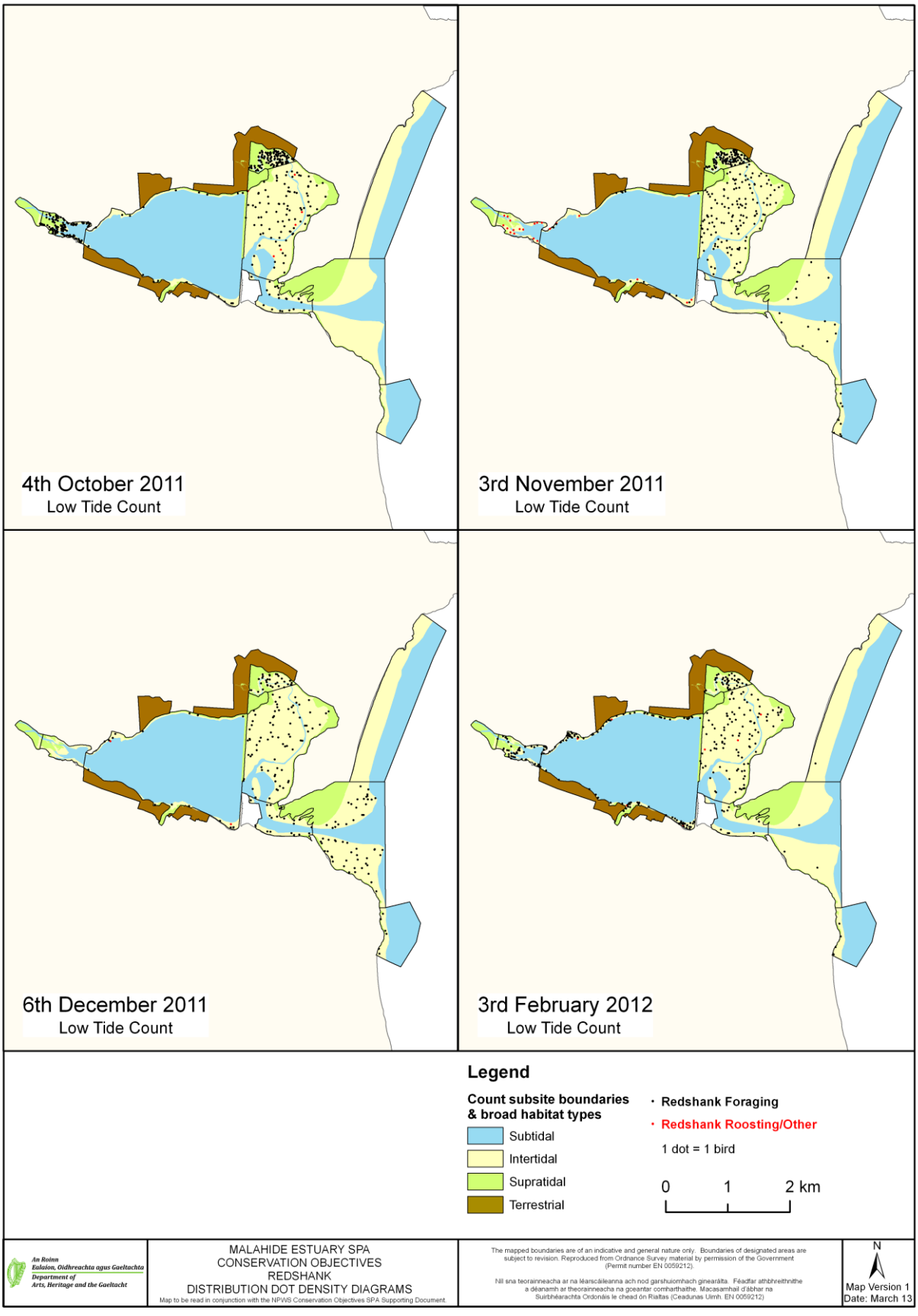

4th October 2011
Low Tide Count
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Grey Plover Foraging
Grey Plover Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
GREY PLOVER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comhaltaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 13


4th October 2011
Low Tide Count
No Birds Present
3rd November 2011
Low Tide Count
No Birds Present
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Knot Foraging
Knot Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
KNOT
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 13


4th October 2011
Low Tide Count
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Dunlin Foraging
1 dot = 2 birds
0 1 2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
DUNLIN
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar na teorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 13


4th October 2011
Low Tide Count
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Black-tailed Godwit Foraging
Black-tailed Godwit Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
BLACK-TAILED GODWIT
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 13


4th October 2011
Low Tide Count
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Bar-tailed Godwit Foraging
Bar-tailed Godwit Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
BAR-TAILED GODWIT
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordanáis le chead ón Rialtas (Ceadúnas Uimh. EN 0059212)
N
Map Version 1
Date: March 13


4th October 2011
Low Tide Count
3rd November 2011
Low Tide Count
6th December 2011
Low Tide Count
3rd February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Redshank Foraging
Redshank Roosting/Other
1 dot = 1 bird
0 1 2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
REDSHANK
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 13

## APPENDIX 8

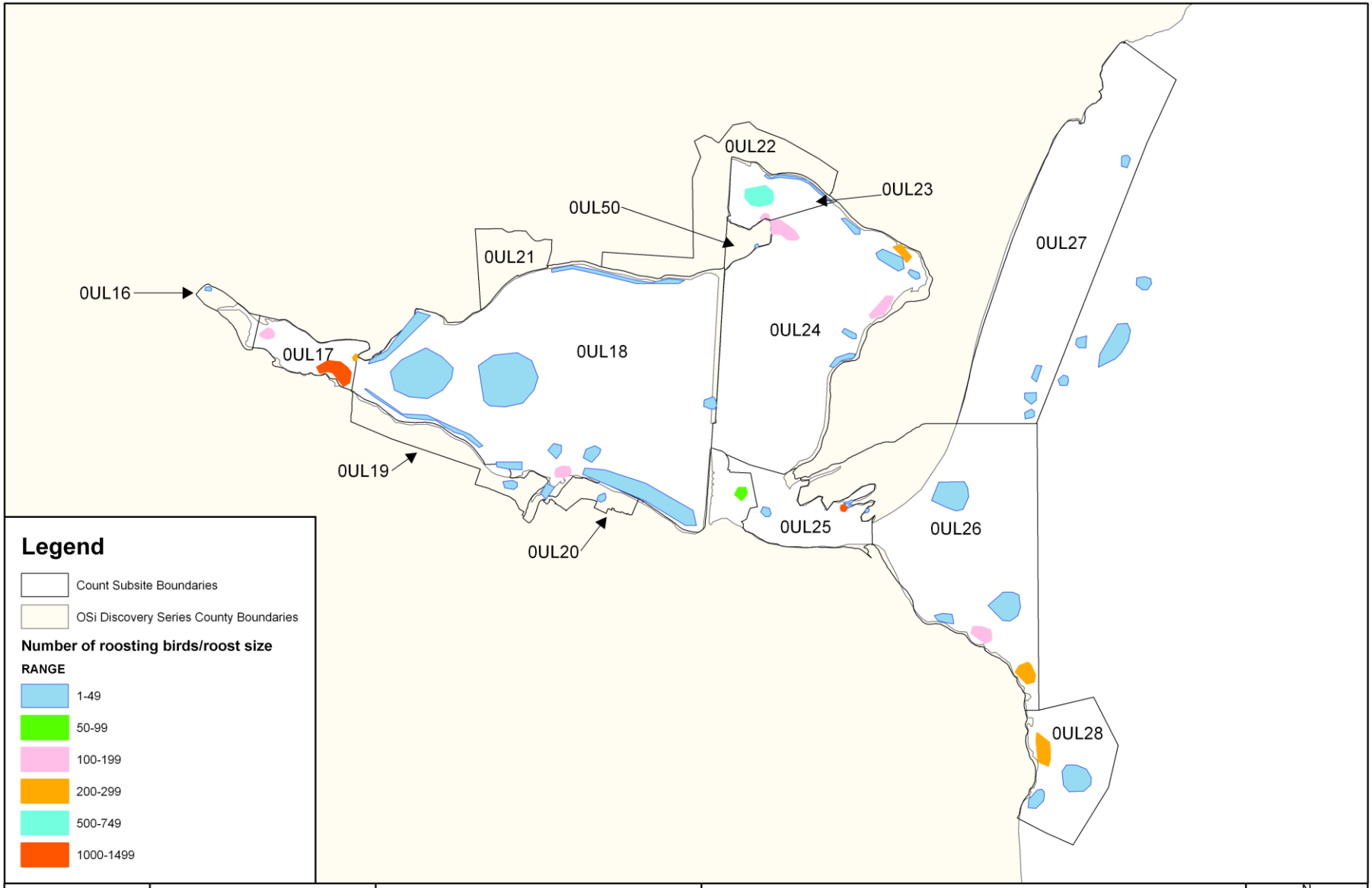
## Malahide Estuary

**(1a) Summary data and roost location maps from the roost survey 26th November 2011**
(Please see Sections 5.3.1 and 5.3.2 for further details on methods/limitations)

| Subsite | Subsite Name | Number individual roost locations | No. Species | Species (alphabetical order) |
|---|---|---|---|---|
| 0UL16 | Balheary Bridge | 1 | 1 | MA |
| 0UL17 | Seatown West | 3 | 13 | BH, BW, CA, CM, GB, GK, L., MA, PB, RK, T., WS, WN |
| 0UL18 | Prospect Point | 12 | 16 | BA, BH, BW, DN, GB, GG,GV, H., HG, LG, MA, MS, OC, RM, RK, TT |
| 0UL19 | Seatown East | 1 | 2 | BH, HG |
| 0UL20 | Yellow Walls | 1 | 1 | BH |
| 0UL21 | Kilcrea East | - | - | |
| 0UL22 | Mullan intake | - | - | |
| 0UL23 | Corballis House Marsh | 3 | 8 | BH, GB, GK, MA, PT, PB, RK, SU |
| 0UL24 | Burrow Strand | 8 | 10 | BH, CU, DN, HG, MA, PB, RK, SU, TT, WN |
| 0UL25 | Malahide Point | 6 | 21 | BH, BW, CA, CM, CU, DN, GB, GK, H., HG, KN, MA, ND, OC, PB, PT, RK, RM, SA, SU, TT |
| 0UL26 | Malahide Strand South | 5 | 9 | DN, GV, HG, OC, RK, RP, SA, SS, TT |
| 0UL27 | Malahide Strand North | 8 | 4 | CX, GG, LB, SA |
| 0UL28 | Malahide Martello Tower | 3 | 11 | CA, CM, DN, GB, GG, HG, OC, RH, RK, SA, TT |
| 0UL50 | Kilcrea Field | 1 | 1 | H. |

**(1b) Malahide Estuary SPA (4025) SCI species and recorded roosts 26/11/11: shows number of roost locations within the subsite and in brackets, the peak number recorded at a single roost location**

| Subsite Code | PB | SU | PT | GN | RM | GG | OC | GP | GV | KN | DN | BW | BA | RK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0UL16 | | | | Not recorded | | | | Not recorded | | | | | | |
| 0UL17 | 2 (800) | | | | | | | | | | | 1 (6) | | 2 (11) |
| 0UL18 | | | | | 1 (3) | 1 (4) | 2 (2) | | 1 (2) | | 1 (31) | 1 (11) | 1 (43) | 3 (3) |
| 0UL19 | | | | | | | | | | | | | | |
| 0UL20 | | | | | | | | | | | | | | |
| 0UL21 | | | | | | | | | | | | | | |
| 0UL22 | | | | | | | | | | | | | | |
| 0UL23 | 2 (600) | 1 (13) | 1 (14) | | | | | | | | | | | 1 (5) |
| 0UL24 | 5 (250) | 3 (152) | | | | | | | | | 1 (1) | | | 2 (26) |
| 0UL25 | 3 (80) | 1 (2) | 1 (8) | | 1 (1) | | 1 (650) | | | 1 (105) | 1 (10) | 1 (60) | | 1 (5) |
| 0UL26 | | | | | | | 2 (12) | | 1 (11) | | 4 (200) | | | 1 (23) |
| 0UL27 | | | | | | 5 (13) | | | | | | | | |
| 0UL28 | | | | | | 1 (10) | 2 (29) | | | | 1 (130) | | | 1 (25) |
| 0UL50 | | | | | | | | | | | | | | |

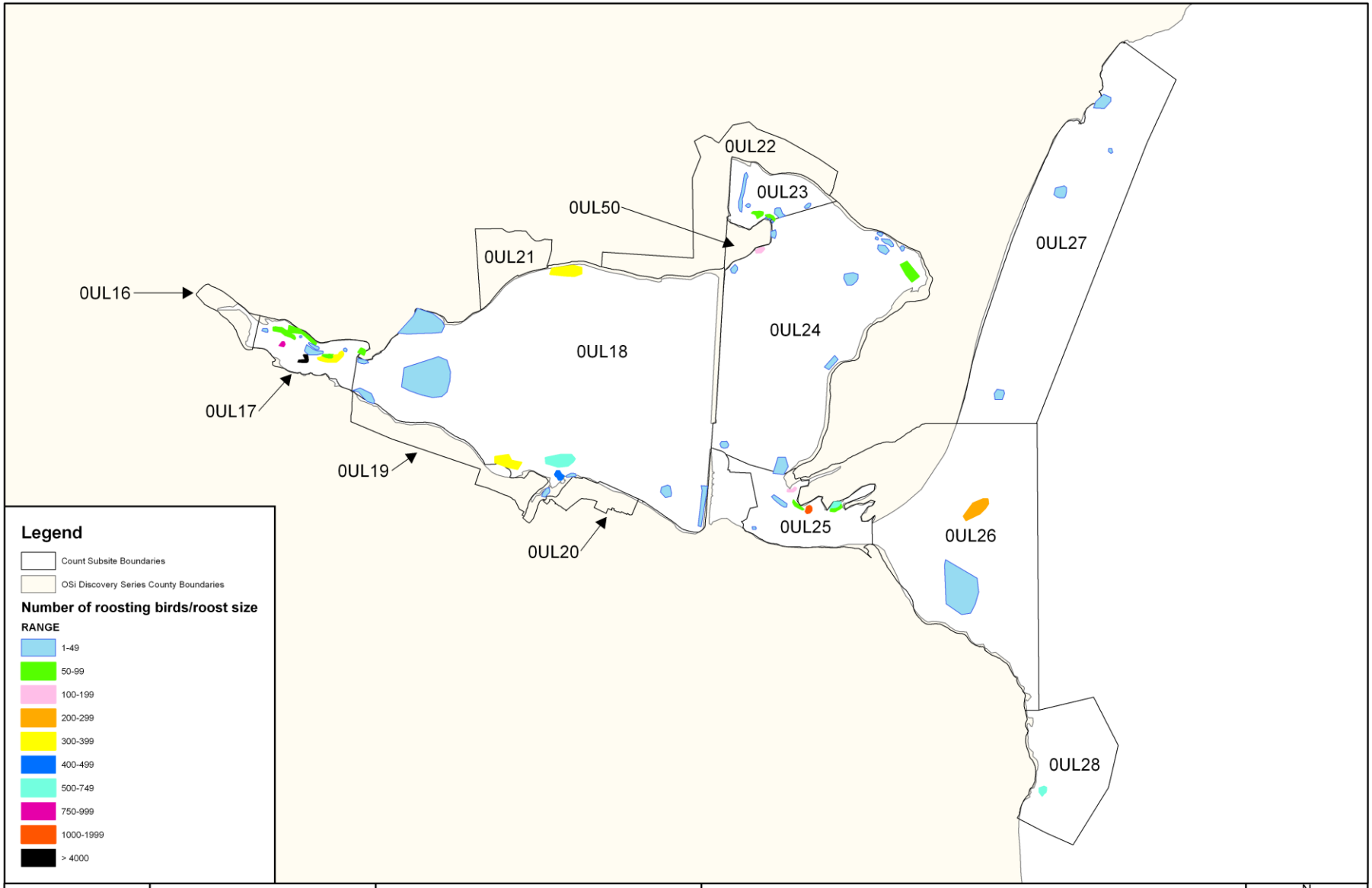

0UL16
0UL17
0UL18
0UL19
0UL20
0UL21
0UL22
0UL23
0UL24
0UL25
0UL26
0UL27
0UL28
0UL50
Legend
Count Subsite Boundaries
OSi Discovery Series County Boundaries
Number of roosting birds/roost size
RANGE
1-49
50-99
100-199
200-299
500-749
1000-1499
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Malahide Estuary SPA
Roost Location Map
Data collected during
the roost survey on 26/11/2011
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
0
1
2 km
Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 2013

**(2a) Summary data and roost location maps from the roost survey 7th February 2012**
(Please see Sections 5.3.1 and 5.3.2 for further details on methods/limitations)

| Subsite | Subsite Name | Number individual roost locations | No. Species | Species (alphabetical order) |
|---|---|---|---|---|
| 0UL16 | Balheary Bridge | - | - | |
| 0UL17 | Seatown West | 12 | 15 | BH, CM, DN, GP, GK, GV, H., KN, L., MA, MS, PB, RK, SU, TT |
| 0UL18 | Prospect Point | 12 | 13 | BA, BH, BW, CM, DN, GK, GV, HG, MA, MS, OC, PB, RK |
| 0UL19 | Seatown East | - | - | |
| 0UL20 | Yellow Walls | - | - | |
| 0UL21 | Kilcrea East | - | - | |
| 0UL22 | Mullan intake | - | - | |
| 0UL23 | Corballis House Marsh | 9 | 13 | BH, BW, CU, L., MA, PB, PT, RK, RU, SU, SV, T., WN |
| 0UL24 | Burrow Strand | 13 | 9 | BH, CM, CU, MA, OC, PB, RK, SU, WN |
| 0UL25 | Malahide Point | 7 | 10 | BH, BW, CM, CU, GB, HG, KN, OC, PB, RK |
| 0UL26 | Malahide Strand South | 2 | 6 | BH, CM, DN, GB, GV, HG |
| 0UL27 | Malahide Strand North | 4 | 3 | BH, OC, RH |
| 0UL28 | Malahide Martello Tower | 1 | 6 | DN, HG, OC, RK, RP, TT |
| 0UL50 | Kilcrea Field | - | - | |

**(2b) Malahide Estuary SPA (4015) SCI species and recorded roosts 07/02/12: shows number of roost locations within the subsite and in brackets, the peak number recorded at a single roost location**

| Subsite Code | PB | SU | PT | GN | RM | GG | OC | GP | GV | KN | DN | BW | BA | RK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0UL16 | | | | Not recorded | Not recorded | Not recorded | | | | | | | | |
| 0UL17 | 3 (243) | 2 (7) | | | | | | 2 (3685) | 1 (1) | 1 (60) | 1 (250) | | | 2 (42) |
| 0UL18 | 4 (670) | | | | | | 2 (6) | | 1 (1) | | 1 (62) | 1 (49) | 1 (4) | 4 (4) |
| 0UL19 | | | | | | | | | | | | | | |
| 0UL20 | | | | | | | | | | | | | | |
| 0UL21 | | | | | | | | | | | | | | |
| 0UL22 | | | | | | | | | | | | | | |
| 0UL23 | 1 (1) | 3 (24) | 2 (9) | | | | | | | | | 2 (6) | | 4 (12) |
| 0UL24 | 2 (42) | 3 (112) | | | | | 1 (6) | | | | | | | 3 (32) |
| 0UL25 | 1 (50) | | | | | | 1 (1270) | | | 2 (100) | | 1 (19) | | 1 (1) |
| 0UL26 | | | | | | | | | 1 (22) | | 1 (252) | | | |
| 0UL27 | | | | | | | 2 (41) | | | | | | | |
| 0UL28 | | | | | | | 1 (78) | | | | 1 (278) | | | 1 (23) |
| 0UL50 | | | | | | | | | | | | | | |


0UL16
0UL17
0UL18
0UL19
0UL20
0UL21
0UL22
0UL23
0UL24
0UL25
0UL26
0UL27
0UL28
0UL50
Legend
Count Subsite Boundaries
OSi Discovery Series County Boundaries
Number of roosting birds/roost size
RANGE
1-49
50-99
100-199
200-299
300-399
400-499
500-749
750-999
1000-1999
> 4000
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Malahide Estuary SPA
Roost Location Map
Data collected during
the roost survey on 07/02/2012
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
0
1
2 km
Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).
Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: March 2013

## APPENDIX 9

### Malahide Estuary - Activities & Events

Please note that this list is based on the current review process and is not exhaustive.

| Legend: | |
|---|---|
| **O** | observed or known to occur in or around Malahide Estuary. |
| **U** | known to occur but unknown area (subsites)/spatial extent; hence all potential subsites are included (e.g. fisheries activities). |
| **H** | historic, known to have occurred in the past. |
| **P** | potential to occur in the future. |
| | Grey highlighting refers to activities that have the potential to cause disturbance to waterbirds. |

| Activity/event | 0UL16 | 0UL17 | 0UL18 | 0UL19 | 0UL20 | 0UL21 | 0UL22 | 0UL23 | 0UL24 | 0UL25 | 0UL26 | 0UL27 | 0UL28 | 0UL50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Coastal protection, sea defences & stabilisation** | | | | | | | | | | | | | | |
| 1.1 Linear defences | | | O | | | | | O | O | | | | | |
| 1.4 *Spartina anglica* | | O | | | | | | O | O | O | | | | |
| 1.5 Marram grass | | | | | | | | | | | | O | | |
| **2. Barrage schemes/drainage** | | | | | | | | | | | | | | |
| 2.3 Other channel modifications | | | | | | | | H | | | | | | |
| 2.4 Tidal barrages | | | O | | | | | | O | | | | | |
| **4. Industrial, port & related development** | | | | | | | | | | | | | | |
| 4.2 Fishing harbour | | | | | | | | | | O | O | | | |
| 4.3 Slipway | | | O | | | | | | | O | | | | |
| 4.7 Ship & boat building/repair | | | | | | | | | | O | | | | |
| **6. Pollution** | | | | | | | | | | | | | | |
| 6.1 Domestic & urban waste water | O | | O | | | | | | | | | | | |
| **8. Transport & communications** | | | | | | | | | | | | | | |
| 8.2 Flight path | | | | | | | | | O | | | | | |
| 8.3 Bridges & aqueducts | O | O | O | | | | | | O | | | | | |
| 8.5 Road schemes | O | O | O | O | O | | O | O | O | O | O | | O | |
| 8.6 Car parks | | | | | | | | | O | O | O | O | O | |
| 8.8 Rail lines | | | O | | | | O | O | O | O | | | | O |
| **9. Urbanisation** | | | | | | | | | | | | | | |
| 9.1 Urbanised areas, housing | O | O | O | O | O | | | | O | O | O | | O | |
| 9.2 Commercial & industrial areas | O | | | | | | | | | O | O | | O | |
| **12. Tourism & recreation** | | | | | | | | | | | | | | |
| 12.1 Marinas | | | | | | | | | O | O | | | | |
| 12.3 Dinghy & boat parks | | | O | | | | | | | | | | | |
| 12.5 Leisure centres, sports ground | | | | O | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.6 Power boating & water-skiing | | | O | | | | | | | | | | | |
| 12.8 Sailing | | | O | | | | | | | O | O | | | |
| 12.9 Sailboarding & wind-surfing | | | O | | | | | | | | | | | |
| 12.11Canoeing | O | | O | | | | | | | | | | | |
| 12.15 Angling | | | | O | | | | | | | | | | |
| 12.17 Bathing & general beach recreation | | | | | | | | | | | O | O | O | |
| 12.18 Walking, incl. dog walking | O | O | O | O | O | | O | O | O | O | O | O | O | O |
| 12.19 Birdwatching | O | O | O | | | | | | | O | O | | O | |
| 12.21 4WD, trial & quad bikes | | | O | | | | | | | | | | | |
| 12.22 Motorised vehicles | | | O | | | | | | O | | | | | |
| 12.23 Horse-riding | | | | | | | | | O | | | O | | |
| 12.25 Golf courses | | | | | | | | | O | O | O | O | | |
| 12.27 Others | | | | | | | | | O | | | O | O | |
| **13. Wildfowl & hunting** | | | | | | | | | | | | | | |
| 13.1 Wildfowling | | | O | | | | O | O | O | | | | | O |
| 13.2 Other hunting-related activities | | | | O | | | O | O | O | | | | | O |
| **14. Bait-collecting** | | | | | | | | | | | | | | |
| 14.1 Digging for lugworms/ragworms | | | | | | | | | O | O | | O | | |
| **15. Fisheries & Aquaculture** | | | | | | | | | | | | | | |
| 15.1 Professional passive fishing (e.g. longlining) | | | | | | | | | U | U | U | U | U | |
| 15.2 Professional active fishing | | | | | | | | | U | U | U | U | U | |
| 15.5 Leisure fishing | | | O | | | | | | | | O | O | O | |
| **16. Agriculture & forestry** | | | | | | | | | | | | | | |
| 16.2 Grazing: intensive (terrestrial) | | | | O | | O | | | | | | | | |
| 16.3 Grazing: non-intensive (terrestrial) | | | | O | | | O | | | | | | | |
| 16.6 Crop production: intensive | | | | O | | | O | | | | | | | |
| 16.9 Removal of hedges, scrub | | | | H | | | H | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16.10 Mowing/grassland cutting | | | | O | O | O | | | | | | | | O |
| 16.13 Land-claim (agricultural & other) | | | H | H | | | H | H | | H | | | | H |
| 16.14 In-filling of ditches, pools, marshes/pits | | | H | H | | | H | | | | | | | H |
| 16.15 Removal of stone walls/embankments | | | | H | | | H | | | | | | | H |
| 16.16 Other - crop scarers | | | O | | | | O | O | | | | | | O |
| 16.18 Forest/plantation management & use | | | | | | | O | | | | | | | |
| **19. Natural events** | | | | | | | | | | | | | | |
| 19.3 Eutrophication | | | O | | | | | | | | | | | |

## APPENDIX 10

## Disturbance Assessment

### Scoring system - definitions & rationale

| Frequency/Duration | Score | Rationale |
|---|---|---|
| Continuous | 3 | Continuous motion or noise; not necessarily 24-hours per day but zones of fairly continuous activity such as a port or marina. |
| Frequent | 2 | Frequently observed during the survey programme, can be up to several times per 6 hour tidal cycle; and/or known to occur on a frequent basis. |
| Infrequent | 1 | Observed only once or twice during the survey programme and known/considered likely to be infrequent. |
| Rare | 0 | Known to occur but not observed during the survey programme and considered likely to be rare in occurrence. |
| **Intensity** | **Score** | **Rationale** |
| Active, high-level | 3 | Would indicate an active event that is likely to displace waterbirds during its presence e.g. active shipping channel, speed boats, quad bikes, loose dogs. |
| Medium-level | 2 | Lower intensity events such as non-powered watercraft, vehicles, people walking along a shoreline (without dogs) – that are likely to result in waterbirds moving but birds will be less 'alarmed' than (1) and response will be species-specific. |
| Low-level | 1 | Although activity may be of a nature to displace waterbirds, birds move only slightly, resume normal behaviour quickly or show no determinable response at all; e.g. solitary walkers close to site but not impacting on waterbirds' immediate location; cars passing on an adjacent road… |
| Very low-level | 0 | Any activities considered to impart little effect upon waterbirds. |
| **Response** | **Score** | **Rationale** |
| Most birds disturbed all of the time | 3 | Birds do not return - therefore equivalent to habitat loss. |
| Most birds displaced for short periods | 2 | Birds return once disturbance has ceased. |
| Most species tolerate disturbance | 1 | Weak response, birds may move slightly away from disturbance source. |
| Most birds successfully habituate to the disturbance | 0 | Little determinable effects. |

The scores assigned to the three attributes were then added together to give an overall 'disturbance score' which is used to define the extent of the impact as follows:-

Scores 0 – 3 = Low
Scores 4 – 6 = Moderate
Scores 7 – 9 = High

### Scoring system – worked example

| **Disturbance event** – humans walking along a beach; the beach is a popular recreational area and this activity was recorded frequently during surveys. | | |
|---|---|---|
| **Attribute** | **Score** | **Rationale** |
| Frequency/Duration | 2 | Recorded frequently during the survey period; known area of beach recreation. |
| Intensity | 2 | Medium level - considered likely to result in waterbirds moving away from the source of disturbance although response will be species-specific and some species may even habituate to the activity. |
| Response | 2 | Most birds are displaced for short periods and therefore will resume their previous behaviour in the area when the activity ceases. |
| **TOTAL SCORE** | **6** | **MODERATE** |

Results - based on data from the 2011/12 Waterbird Survey Programme

| Activity/event | 0UL16 | 0UL17 | 0UL18 | 0UL19 | 0UL20 | 0UL22 | 0UL23 | 0UL24 | 0UL25 | 0UL26 | 0UL27 | 0UL28 | 0UL50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **8. Transport & communications** | | | | | | | | | | | | | |
| 8.2 Flight path | | | | | | | | 6 | | | | | |
| **12. Tourism & recreation** | | | | | | | | | | | | | |
| 12.8 Sailing | | | 6 | | | | | | | | | | |
| 12.18 Walking, incl. dog walking | 5 | 5 | 6 | 7 | 7 | 5 | 6 | 7 | 6 | 7 | 7 | 6 | 7 |
| 12.22 Motorised vehicles | | | | | | | | 5 | | | | | |
| 12.23 Horse-riding | | | | | | | | 6 | | | 5 | | |
| **13. Wildfowl & hunting** | | | | | | | | | | | | | |
| 13.2 Other hunting-related activities | | | | 6 | | 7 | 6 | 7 | | | | | 6 |
| **14. Bait-collecting** | | | | | | | | | | | | | |
| 14.1 Digging for lugworms/ragworms | | | | | | | | 3 | | | 3 | | |