Killala Bay/Moy Estuary Special Protection Area

(Site Code 4036)

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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 non-breeding Special Conservation Interests of Killala Bay/Moy 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 Killala Bay/Moy Estuary Special Protection Area, as well as introducing the concept of conservation objectives and their formulation.

Part Two provides site designation information for Killala Bay/Moy 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 based on an analysis of wintering (non-breeding) population trends. Importantly, this section states the current conservation condition of each of the SCI species and examines these site trends in light of all-Ireland and international status and trends.

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 2010/11 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 non-breeding waterbirds during the 2010/11 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, are responsible for the selection and designation of SPAs in Ireland. NPWS have 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).

The wetlands of northwest Europe are a vital resource for millions of northern and boreal nesting waterbird species that over-winter 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 Killala Bay/Moy Estuary Special Protection Area

Killala Bay/Moy Estuary Special Protection Area is a large site spanning Counties Mayo and Sligo. It comprises the inner part of Killala Bay, and the estuary of the River Moy which flows into the sea via a long and narrow, funnel-shaped channel that is *c.* 7 km wide at its outer limit. The site also includes Lackan Bay and Rathfran Bay; estuaries of the Cloonalaghan and Cloonaghmore rivers respectively.

Killala Bay and the mouth of the Moy Estuary are sheltered by Bartragh Island, a long narrow barrier island that is separated from the mainland by sandflats. This island provides considerable shelter to the intertidal mud and sandflats of inner Killala Bay. The sandy peninsula that extends from Enniscrone on the eastern side provides additional shelter. Extensive intertidal sand and mud flats are exposed at low tide. These are largely unvegetated, although beds of Eelgrass (*Zostera noltii*) have been recorded at two locations and the green macroalga (*Ulva* spp.) occurs, both providing a food source for waterfowl species. Sheltered areas of shoreline including the southern side of Bartragh Island, inner Ross Bay, Rathran Bay and Lackan Bay are often fringed by saltmarsh; with the last the most developed. Sandy and shingle beaches also occur and some rocky shores occur occasionally backed by clay sea cliffs.

The site is very important for wintering waterbirds and provides excellent feeding grounds as well as sheltered and secure high-tide roosts. The Site Synopsis for Killala Bay/Moy 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.

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[1].

Where relevant, conservation objectives are defined for attributes[2] relating to non-breeding waterbird 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 Killala Bay/Moy Estuary Special Protection Area).

[1] 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 Killala Bay/Moy Estuary Special Protection Area

The **Special Conservation Interest species**[3] for Killala Bay/Moy Estuary SPA are listed below and summarised in Table 2.1. This table also shows the importance of Killala Bay/Moy Estuary SPA for its SCI species, relative to the importance of other sites within Ireland, within the Border and West regions, and within counties Sligo and Mayo[4].

The Special Conservation Interests listed for Killala Bay/Moy Estuary SPA are as follows:-

1. During winter the site regularly supports 1% or more of the all-Ireland population of Ringed Plover (*Charadrius hiaticula*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 245 individuals.

2. During winter the site regularly supports 1% or more of the all-Ireland population of Golden Plover (*Pluvialis apricaria*). The mean peak number of this Annex I species within the SPA during the baseline period (1995/96 – 1999/00) was 2,361 individuals.

3. 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 221 individuals.

4. During winter the site regularly supports 1% or more of the all-Ireland population of Sanderling (*Calidris alba*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 123 individuals.

5. 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 2,073 individuals.

6. During winter the site regularly supports 1% or more of the all-Ireland population of Bar-tailed Godwit (*Limosa lapponica*). The mean peak number of this Annex I species within the SPA during the baseline period (1995/96 – 1999/00) was 366 individuals.

7. During winter the site regularly supports 1% or more of the all-Ireland population of Curlew (*Numenius arquata*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 731 individuals.

8. 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 372 individuals.

9. The wetland habitats contained within Killala Bay/Moy 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.

[3] Special Conservation Interest species are listed in taxonomic order.

[4] The site crosses the borders of Counties Sligo and Mayo, and the borders of two Irish Regions: the Border Region and Western Region.

Table 2.1 Site Designation Summary: species listed for Killala Bay/Moy Estuary Special Protection Area, plus site importance at national, regional and county scale

Special Conservation Interests	Annex I species	Baseline Population[a]	Population status at baseline	National Importance Rank[1]	Regional Importance Rank[2]	County Importance Rank[3]
Ringed Plover (*Charadrius hiaticula*)		245	All-Ireland importance	6	2	2
Golden Plover (*Pluvialis apricaria*)	Yes	2,361	All-Ireland importance	21	3	1
Grey Plover (*Pluvialis squatarola*)		221	All-Ireland importance	14	2	1
Sanderling (*Calidris alba*)		123	All-Ireland importance	11	3	3
Dunlin (*Calidris alpina*)		2,073	All-Ireland importance	17	4	1
Bar-tailed Godwit (*Limosa lapponica*)	Yes	366	All-Ireland importance	16	3	2
Curlew (*Numenius arquata*)		731	All-Ireland importance	15	4	1
Redshank (*Tringa totanus*)		372	All-Ireland importance	18	6	2
Other conservation designations associated with the site[b]	**SAC**	**RAMSAR SITE**	**IMPORTANT BIRD AREA (IBA)**	**WILDFOWL SANCTUARY**	**OTHER**	**OTHER**
	000458 000516	Yes	Yes		pNHA	

[a] Baseline data are the 5-year mean peak counts for the period 1995/96 – 1999/00 (I-WeBS).
[b] Note that other designations associated with Killala Bay/Moy 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 Western and Border Regions (cross-region site).
[3]County 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 Counties Sligo and Mayo (cross-county site).

PART THREE – CONSERVATION OBJECTIVES FOR KILLALA BAY/MOY ESTUARY SPA

3.1 Conservation Objectives for the non-breeding Special Conservation Interests of Killala Bay/Moy Estuary SPA

The overarching Conservation Objective for Killala Bay/Moy 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 Killala Bay/Moy 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 non-breeding waterbird Special Conservation Interest species listed for Killala Bay/Moy 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.[5] Waterbird populations are deemed to be unfavourable when they have declined by 25% or more, as assessed by the most recent population trend analysis.[6]

- 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.[7]

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).

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

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

[7] Waterbird distribution from the 2010/2011 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 outside of the SPA but 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 Killala Bay/Moy 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 **3,204 ha**, other than that occurring from natural patterns of variation.

The boundary of Killala Bay/Moy 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 though 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 Killala Bay/Moy Estuary SPA this broad category is estimated to be **1,323 ha**. Subtidal areas are continuously available for benthic and surface feeding ducks (e.g. Wigeon) 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 Killala Bay/Moy Estuary SPA this is estimated to be **1,555 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[8] 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 Killala Bay/Moy Estuary SPA this is estimated to be **326 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.

[8] 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 Killala Bay/Moy Estuary SPA.

Objective 1: *To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Killala Bay/Moy 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 2010/11 waterbird survey programme is reviewed in Part Five of this document.
Objective 2: *To maintain the favourable conservation condition of the wetland habitat at Killala Bay/Moy 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 3,204 ha, other than that occurring from natural patterns of variation.	The wetland habitat area was estimated as 3,204 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 Killala Bay/Moy Estuary SPA

Non-breeding waterbirds have been counted at Killala Bay/Moy Estuary each winter as part of the Irish Wetland Bird Survey (I-WeBS) since the survey commenced in 1994/95. With the exception of 1994/95 and 1998/99, the site has been counted two or more times each season during the period September to March inclusive. This core survey period covers the main wintering 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[9]. I-WeBS and other species-specific surveys are described briefly in Appendix 2.

During I-WeBS the site is divided into several count subsites. Although the SPA area and the I-WeBS count area are similar, it should be borne in mind that they are not coincident.

Table 4.1 presents population[10] data for non-breeding waterbirds of Killala Bay/Moy 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 while the recent average relates to the five-year period 2005/06 – 2009/10. When examining waterbird data, it is standard practice to use the mean of peak counts because it reflects more accurately the importance of a site for a particular species by helping to account for inconsistencies in data gathering (i.e. differing coverage) or extraordinary fluctuations in numbers. However it is important to note that waterbird counts represent a 'snapshot' of bird numbers during a count session, so in general and taking into account all potential sources of error, resulting data are regarded to be underestimates of population size (Underhill & Prŷs-Jones, 1994).

Table 4.1 indicates where the numbers shown surpass the threshold of all-Ireland importance. These thresholds differ for the baseline and recent time periods, and are presented within Crowe et al. (2008).

Table 4.1 Population data for non-breeding waterbird Special Conservation Interest Species of Killala Bay/Moy Estuary SPA

Site Special Conservation Interests (SCIs)	Baseline Period[1] (1995/96 – 1999/00)	Recent Site Data[2] (2005/06 – 2009/10)
Ringed Plover	245 (n)	88
Golden Plover	2,361 (n)	1,058
Grey Plover	221 (n)	16
Sanderling	123 (n)	14
Dunlin	2,073 (n)	602
Bar-tailed Godwit	366 (n)	313 (n)
Curlew	731 (n)	309
Redshank	372 (n)	247

[1]Baseline data is the 5-year mean peak for the period 1995/96 – 1999/00;
[2]recent site data is the mean peak for the 5-year period 2005/06 – 2009/10 (I-WeBS).
(n) denotes numbers of all-Ireland importance.

[9] 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 can be defined as 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).

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

4.2 Waterbird population trends for Killala Bay/Moy 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 2008/09. Trends are given for the 'long-term' 12-year period (1995/96–2007/08) and the recent ('short-term') five-year period (2002/03 – 2007/08) (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.

Relatively low monthly count coverage in some of the early seasons of I-WeBS dataset, led to higher than desirable levels of imputation, therefore some caution is necessary when examining and interpreting the trends for this site.

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 Killala Bay/Moy Estuary SPA

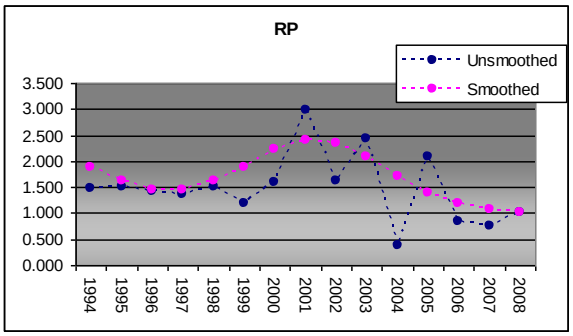
Site Special Conservation Interests (SCIs)	Site Population Trend[1] 12 Yr	Site Population Trend[2] 5 Yr
Ringed Plover	- 33.2	- 54.3
Golden Plover	- 26.7	- 44.1
Grey Plover	- 67.1	- 44.5
Sanderling	+ 23.5	- 31.9
Dunlin	- 58.0	- 50.5
Bar-tailed Godwit	- 6.9	- 42.7
Curlew	- 41.8	- 35.3
Redshank	+ 3.4	- 23.3

[1]Site population trend analysis: 12 yr = 1995/96 – 2007/08; [2]Site population trend analysis: 5 yr = 2002/03 – 2007/08.

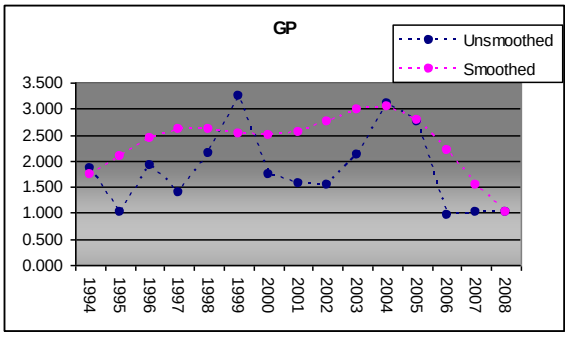
For selected species, explanatory notes are given below to aid the interpretation of trends. Smoothed and unsmoothed indices are shown graphically. Site trends are compared with all-Ireland trends (Crowe et al. 2008), national trends (Boland & Crowe, 2012[11]) and British trends (Calbrade et al. 2010); the latter two pertaining to the data period up to 2008/09 and therefore relevant to the site trends presented here. Graph headings use waterbird species codes and a list of these is provided in Appendix 4.

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

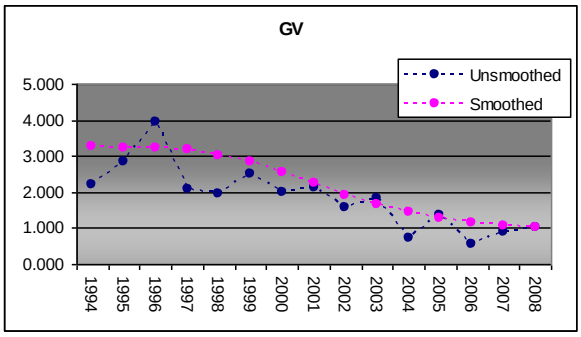
Ringed Plover – following relatively stable numbers in the early seasons of I-WeBS, and an increase to a peak in 2001, numbers then declined. Although this has levelled off in recent seasons, numbers remain lower than those recorded in the mid to late 1990's. Nationally, numbers of Ringed Plover have shown a long-term trend for increase which contrasts to the trend for decrease found in Britain and Northern Ireland.



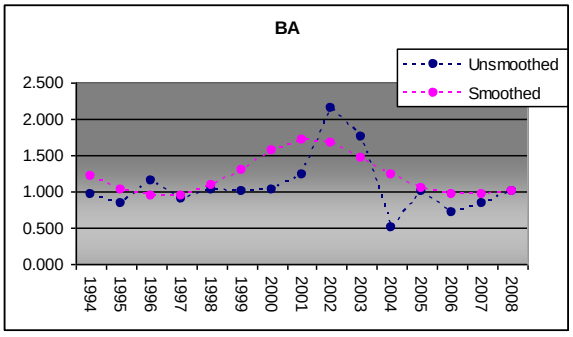
Golden Plover – the smoothed indices highlight the underlying trend for gradual increase in numbers up to 2004 which was then followed by a rather steep decline in numbers.
Nationally and across all-Ireland, numbers have been largely stable since the mid 1990's. In Britain numbers increased up to 2006/07 and have since decreased.



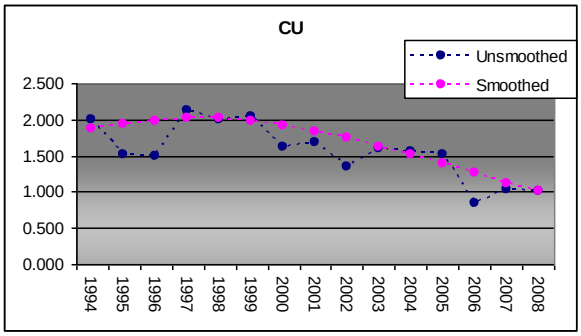
Grey Plover – numbers have progressively declined at the site; in line with a declining national and all-Ireland trend. In Britain, numbers declined steadily between the mid 1990's and mid 2000's with an apparent recovery in recent seasons.



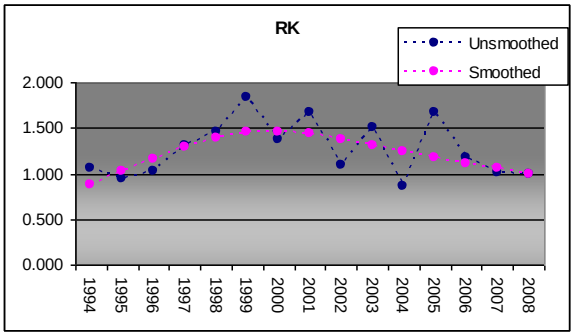
Bar-tailed Godwit – relatively stable numbers in the mid 1990's increased to a peak in the early 2000's which was followed by a subsequent decrease in numbers. This decrease has levelled off in recent seasons with numbers nearly on a par with early seasons, hence the relatively small long-term trend for decline. Nationally, numbers have remained broadly stable throughout I-WeBS, while a decline has been evident in Britain since the early 2000's with some recovery in recent seasons.



Curlew – numbers have progressively declined at the site since 1997. Nationally, numbers have declined throughout I-WeBS while in Britain numbers have declined steadily since the early 2000's.



Redshank – although the long-term site trend is for a small increase in numbers (comparison of indices 1995-2007), numbers have in fact shown a period of increase and subsequent decrease during this period. Nationally, numbers of Redshank have increased since I-WeBS began, also reflected by the all-Ireland trend. This contrasts to Britain and Northern Ireland where numbers of wintering birds have decreased in recent years.



4.3 Killala Bay/Moy 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 eight waterbird species of Special Conservation Interest listed for Killala Bay/Moy Estuary SPA, and based on the long-term population trend for the site, it has been determined that (Table 4.3):-

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

2. 3 species are currently considered as **Unfavourable** (Ringed Plover, Golden Plover & Curlew);

3. 1 species is currently considered as **Intermediate Unfavourable** (Bar-tailed Godwit);

4. 2 species are currently considered as **Favourable** (Sanderling & 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 Killala Bay/Moy Estuary SPA – Current Site Conservation Condition

Special Conservation Interests	BoCCI Category[a]	Site Population Trend[b]	Site Conservation Condition	Current National Trend[c]	Current International Trend[d]
Ringed Plover	Amber	- 33.2	Unfavourable	+ 10.5	Fluctuating
Golden Plover	Red	- 26.7	Unfavourable	- 65.6	Decreasing
Grey Plover	Amber	- 67.1	Highly Unfavourable	- 22.2	Decreasing?
Sanderling	Green	+ 23.5	Favourable	+ 125.4	Increasing?
Dunlin	Amber	- 58.0	Highly Unfavourable	- 43.4	Stable (*alpina*)
Bar-tailed Godwit	Amber	- 6.9	Intermediate (unfavourable)	+ 35.0	Increasing
Curlew	Red	- 41.8	Unfavourable	- 39.4	Decreasing
Redshank	Red	+ 3.4	Favourable	- 4.8	Stable/Increasing

[a]After Lynas *et al.* (2007); [b] Site population trend analysis; see Table 4.2; [c]recent 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 1.0 – 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 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 Killala Bay/Moy Estuary SPA.

Section 5.2 provides selected ecological summary information for non-breeding waterbirds of Killala Bay/Moy Estuary. Section 5.3 presents results from the 2010/11 Waterbird Survey Programme. Finally, Section 5.4 provides summary information on activities and events that occur in and around Killala Bay/Moy 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:-

- 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 December 2012.

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 – 2009/10 the I-WeBS database shows a total of 56 waterbird species that have been recorded within Killala Bay/Moy Estuary. These species represent 11 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[12] or species that use the site at certain times only (e.g. as a cold weather refuge).

27 waterbird species occurred on a regular basis within Killala Bay/Moy Estuary during the I-WeBS period 1994/95 – 2009/10.[13] Eight of these species are listed as SCIs for the SPA, and the additional 19 non-SCI species are listed in Table 5.1.

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

[13] Regular is defined as a species that has occurred in 12 out of the 16-year data period.

Table 5.1 Regularly-occurring non SCI waterbird species that occur at Killala Bay/Moy Estuary during the non-breeding season

Species	Baseline Data Period[1] (1995/96 – 1999/00)	Recent Site Average[2] (2005/06 – 2009/10)
Light-bellied Brent Geese (*Branta bernicla hrota*)	170	296
Shelduck (*Tadorna tadorna*)	64	40
Wigeon (*Anas penelope*)	339	233
Teal (*Anas crecca*)	236	44
Mallard (*Anas platyrhynchos*)	92	51
Red-breasted Merganser (*Mergus serrator*)	44 (n)	15
Red-throated Diver (*Gavia stellata*)	15	2
Great Northern Diver (*Gavia immer*)	13	13
Cormorant (*Phalacrocorax carbo*)	40	58
Grey Heron (*Ardea cinerea*)	21	6
Oystercatcher (*Haematopus ostralegus*)	531	248
Lapwing (*Vanellus vanellus*)	1,854	425
Knot (*Calidris canutus*)	349 (n)	155
Greenshank (*Tringa nebularia*)	24 (n)	15
Turnstone (*Arenaria interpres*)	50	17
Black-headed Gull (*Chroicocephalus ridibundus*)	338	237
Herring Gull (*Larus argentatus*)	336	50
Great Black-backed Gull (*Larus marinus*)	120	55

Grey shading denotes an Annex I species; (n) = numbers of all-Ireland importance; note that all-Ireland thresholds are different for the baseline and recent time periods used and shown in Crowe et al. (2008).
[1] Baseline data is the 5-year mean peak for the period 1995/96 – 1999/00 (I-WeBS); [2]recent site data is the 5-year mean peak for the period 2005/06 – 2009/10 (I-WeBS).

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 Killala Bay/Moy Estuary SPA. Information is provided for the following categories[14]:-

- 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 between species and from site to site. 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

[14] 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 primarily for roosting. When tidal flats are covered at high water, intertidally-foraging waterbirds are excluded and many will 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 therefore 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; an example being Light-bellied Brent Geese that 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.

Table 5.2 Waterbirds – Ecological characteristics, requirements & specialities

Special Conservation Interests	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]
Ringed Plover *Charadrius hiaticula*	Charadriidae (wading birds)	Localised	4	Wide	Intertidal mud and sand flats	3	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
Sanderling *Calidris alba*	Scolopacidae (wading birds)	Localised	4, 6	Wide	Intertidal mud and sand flats	3	High
Dunlin *Calidris alpina*	Scolopacidae (wading birds)	Intermediate	4	Wide	Intertidal mud and sand flats	3	High
Bar-tailed Godwit *Limosa lapponica*	Scolopacidae (wading birds)	Localised	4	Wide	Intertidal mud and sand flats	3	Moderate
Curlew *Numenius arquata*	Scolopacidae (wading birds)	Widespread	4	Wide	Intertidal mud and sand flats	2	High
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 Killala Bay/Moy Estuary. Note that this is the main habitat used when foraging with the exception of Golden Plover which relates to roosting habitat.
[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 2010/11 waterbird survey programme

5.3.1 Introduction

The 2010/11 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 Killala Bay/Moy Estuary SPA, a standard survey programme of four low tide counts (October, November & December 2010 and February 2011) and a high tide count (January 2011) were planned for the site but due to the extremely bad weather conditions (e.g. Met Eireann, 2010) some dates had to be rescheduled including the December low tide survey which was pushed on to January 2011.[15]

Waterbirds were counted within a series of 25 count subsites (refer to Appendix 6). It should be noted that the count boundaries and SPA boundaries are not coincident.

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 (Table 5.3). Note that these broad habitats were defined specifically for the survey programme and do not follow strict habitat-based definitions for these areas, nor follow 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 January 2011 and 1st March 2011. During these surveys waterbird roost sites were located, species and numbers of waterbirds counted and the position of 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 Killala Bay/Moy 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 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.

[15] Low tide surveys: 20/10/10, 24/11/10, 20/01/11 & 16/02/11 plus a high tide survey on 26/01/11.

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).

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 single 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 occasion, 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[16] 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

All subsites were counted from mainland vantage points. As a result, the observation of birds on Bartragh Island was difficult, especially during the high tide survey. It is therefore likely that counts of this area underestimate its use.

Weather conditions during the winter of 2010/11 proved extremely challenging for fieldworkers, December 2010 being the coldest on record (Met Éireann, 2010). It should also

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

be borne in mind that the cold weather is likely to have affected the numbers and distribution of waterbirds at the site, as well as nationally, as was the case in the previous cold winter of 2009/10 (Crowe et al. 2011).

Subsite rankings and dot-density maps relate to the distribution of waterbirds at subsite level as recorded within the survey area during the 2010/11 waterbird survey programme. Care 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, other species 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 39 waterbird species were recorded during the 2010/11 survey programme at Killala Bay/Moy Estuary. Cummins and Crowe (2011) provide a summary of waterbird data collected. Note that the total count area and SPA area are not exactly coincident; a map showing count subsites is provided in Appendix 6.

All SCI species were recorded within all counts of the main survey programme with the exception of Sanderling that were not recorded during the January 2011 low tide count. Table 5.4 shows peak numbers (whole site) for SCI species recorded during the low tide (LT) and high tide (HT) surveys.

Average subsite occupancy, the average proportion of subsites in which a species occurred during low tide counts, ranged from 13% (Sanderling) to 77% (Curlew) (Table 5.4). Five species occurred, on average, in less than 50% of subsites with only Bar-tailed Godwit, Curlew and Redshank extending their distribution over more than half of the count area.

Average percentage area occupancy is defined as the average proportion of the whole site 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 highest average percentage area occupancy was recorded for Curlew (70%); the lowest was Golden Plover (14% of count area).

Table 5.4 Killala Bay/Moy Estuary 2010/2011 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]
Ringed Plover	177 (n)	4	22 (10)	33 (8)
Golden Plover	515	100	16 (7)	14 (10)
Grey Plover	43	62	21 (9)	28 (11)
Sanderling	210 (n)	81 (n)	13 (6)	24 (14)
Dunlin	1,338 (n)	336	30 (5)	34 (4)
Bar-tailed Godwit	621 (n)	511 (n)	51 (11)	55 (15)
Curlew	1,083 (n)	941 (n)	77 (2)	70 (9)
Redshank	501 (n)	311 (n)	72 (7)	66 (2)

(n) denotes numbers of all-Ireland importance (1% thresholds; 1999/00 – 2003/04 Crowe et al. 2008); [I] 4 low-tide counts undertaken on 20/10/10, 24/11/10, 20/01/11 & 16/02/11; [II] High-tide count undertaken on 26/01/11; [III] Mean (± s.d.) averaged across low tide surveys except Sanderling that were averaged across three LT counts.

Whole site species richness (total number of species) was relatively consistent for the four low tide surveys (range 34-36 species). 34 species were recorded during the high tide survey.

During low tide surveys, average subsite species richness ranged from four (0D449 Belleek) to 21 species (0D455 Kilroe) (Table 5.5). 15 subsites (60%) supported on average, ten or more species during low tide surveys; this proportion was matched during high tide surveys. Over two-thirds of subsites recorded their peak number of species during the first two low tide surveys, which at first suggests a decline in species as the severe winter weather of the 2010/11 set in, yet 52% of subsites recorded peak or joint peak diversity in December and January 2010/11 when the cold winter weather was prevalent. Four subsites supported a greater number of species during the high tide survey (January 2011) than on average during low tide surveys.

Table 5.5 Subsite species richness

Subsite Code	Subsite name	Mean (±S.D) LT Survey	HT Survey	Peak Overall (H/L)
0C455	Inishcrone Beach (low-tide)	11 (4)	12	17 L
0C456	Barrow	14 (1)	11	15 L
0C457	Scurmore	18 (2)	12	21 L
0C481	Bartragh Island East	7 (1)	3	9 L
0D424	Croghan Bay	7 (1)	9	9 H
0D425	Ross Bay (Killala)	8 (3)	11	12 L
0D441	Killogeary	9 (1)	11	11 H
0D442	Ballysakeery	9 (5)	10	14 L
0D443	Bartragh Island northwest	12 (2)	6	14 L
0D444	Rathfran Friary	17 (2)	11	20 L
0D445	Steelaun	9 (3)	13	13 H
0D446	Lackan Bay inner	12 (2)	12	13 L
0D447	Lackan Bay outer	12 (2)	8	15 L
0D448	Quignaleka	5 (1)	4	7 L
0D449	Belleek	4 (3)	2	7 L
0D450	Garrankeel - Rathmoy	10 (4)	2	14 L
0D451	Carrowkelly	11 (2)	8	13 L
0D452	Castleconnor	11 (2)	7	12 L
0D453	Inishdugh	15 (3)	11	18 L

0D454	Killala - Rinnaun Point	17 (2)	14	19 L
0D455	Kilroe	21 (3)	16	26 L
0D457	Bartragh Is. South	18 (3)	12	20 L
0D458	Bullockpark	10 (4)	10	12 L
0D486	Rathfran Bay	5 (0)	11	11 H
0D487	Ballinlena	6 (4)	8	10 L

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.

Ranked assessments relate to the broad habitat that birds were observed in. In some cases, data for different broad habitats have been combined, for example, in the case of wading birds and intertidal/subtidal habitat which were combined in order to include those individuals that had their feet in water and were recorded as subtidal.

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 Killala Bay/Moy Estuary. Waterbird distribution dot-density maps are provided in Appendix 7; summary roost data are presented in Appendix 8.

Table 5.6 (a) Killala Bay/Moy 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 ▼	RP	GP	GV	SS	DN	BA	CU	RK
0C455	V		L		M	L	L	L
0C456		H			L	L	H	M
0C457	V		L	H	M	V	H	M
0C481							L	
0D424						L	M	M
0D425	L	V	M			M	M	M
0D441							M	M
0D442	L		V		H	M	H	H
0D443	H		H	M		H	M	L
0D444		M				M	V	M
0D445	M	M	V		L	M	H	M
0D446	H	V	M	H	H	M	H	M
0D447		L	V		L	M	L	L
0D448								L
0D449								
0D450					M	L	L	H
0D451	L				V		M	V
0D452					L	H	H	M
0D453					L	H	H	H
0D454	M		L		H	H	H	V
0D455	H	H	V	V	V	V	H	H
0D457	V	L	H	V	V	V	V	H
0D458		L	H		M	M	H	H
0D486				M				
0D487					H		V	

Table 5.6 (b) Killala Bay/Moy Estuary Subsite assessment – ranked total numbers HT Survey (across all broad habitats)

Species ► / Subsites ▼	RP	GP	GV	SS	DN	BA	CU	RK
0C455	1			1				13
0C456						6	3	12
0C457						2	8	13
0C481								
0D424					7		4	9
0D425							7	3
0D441							15	17
0D442							11	1
0D443								17
0D444							1	4
0D445					4	8	16	7
0D446		1	1	2	1	5	9	
0D447			3		3		5	
0D448								
0D449								
0D450								
0D451							18	2
0D452							14	13
0D453					5	7	12	6
0D454					2	3	13	11
0D455					8	1	2	4
0D457							6	13
0D458					9		10	9
0D486			2		6	4	17	8
0D487							18	

Table 5.6 (c) Killala Bay/Moy Estuary Subsite assessment – total numbers foraging intertidally (L Low, M Moderate; H High V Very high; please see Section 5.3.2 for methods)

Species ► / Subsites ▼	RP	GP	GV	SS	DN	BA	CU	RK
0C455	V				M	L	L	L
0C456					L	M	M	M
0C457	V		L	H	M	V	H	M
0C481							L	
0D424						L	M	M
0D425						M	H	H
0D441							L	M
0D442			V		H	M	H	H
0D443						H	M	L
0D444		V				M	H	H
0D445	H				L	L	M	M
0D446	M		M	H	H	M	H	M
0D447		V	H			M	L	L
0D448								L
0D449								
0D450					M	L	M	H
0D451	L				V		M	V
0D452					L	H	H	M
0D453					L	H	M	H
0D454	M		L		H	H	H	V
0D455	H	H	V	V	V	V	H	H
0D457	V	H	V	V	V	V	H	H
0D458			H		M	M	H	H
0D486				M				
0D487								

Table 5.6 (d) Killala Bay/Moy Estuary Subsite assessment – top ten ranked peak intertidal foraging densities for selected species - LT surveys.

Species ► / Subsites ▼	RP	GP	GV	SS	DN	BA	CU	RK
0C455	5			6	10			
0C456					7	9	8	10
0C457	3		8	3		1		
0C481								
0D424							4	5
0D425						10	2	9
0D441								
0D442	9		1		6			
0D443								
0D444		1				8	5	7
0D445	2					7	6	
0D446	6		6	5	3			
0D447		2	3					
0D448								4
0D449								2
0D450					4			
0D451	8				1		9	1
0D452						4	3	8
0D453					9	6	7	6
0D454	4		7		2	2	1	3
0D455	7	4	2	2	5	5		
0D457	1	3	4	1	8	3		
0D458			5					
0D486				4				
0D487								

Table 5.6 (e) Killala Bay/Moy Estuary Subsite assessment – total numbers (roosting/other behaviour) during LT surveys (Intertidal) Low, M Moderate; H High V Very high; please see Section 5.3.2 for methods).

Species ► Subsites ▼	RP	GP	GV	SS	DN	BA	CU	RK
0C455	V		V					
0C456		H				H	H	H
0C457							L	
0C481								
0D424							L	
0D425	M	V	H				L	
0D441							L	
0D442							H	V
0D443	H			V		L		
0D444						H	H	
0D445	V	L	V			M	H	
0D446	V	V			V	L	M	H
0D447			V		V	L		
0D448								
0D449								
0D450								
0D451					M		M	V
0D452							H	V
0D453						V	V	V
0D454							H	V
0D455	H	H				V		
0D457					V		V	
0D458		L					M	H
0D486								
0D487					V		V	

Table 5.6 (f) Killala Bay/Moy Estuary Subsite assessment – ranked total numbers (roosting/other behaviour) during HT survey (Intertidal[I], Supratidal[II])

Species ► / Subsites ▼	RP[I]	GP[I]	GV[I]	SS[I]	DN[I]	DN[II]	BA[I]	BA[II]	CU[I]	CU[II]	RK[I]	RK[II]
0C455	1			1								
0C456							5		12		8	
0C457							2		2			
0C481												
0D424										1		
0D425					6				6			
0D441										3		
0D442									11		2	
0D443											11	
0D444									3	2	9	2
0D445					4		7		9		4	
0D446			1		1		6					
0D447			3		3				4			
0D448												
0D449												
0D450												
0D451									14			1
0D452											10	
0D453						1		1	10	3	3	3
0D454					2		3		7		6	
0D455					7		1		1		1	
0D457									5			
0D458					8				8		6	
0D486			2		5		4		12		5	
0D487												

Killala Bay/Moy Estuary - Waterbird Survey Programme 2010/11

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 (2012) and ASU (2011).

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

Ringed Plover *Charadrius hiaticula* - Family (group): Charadriidae (wading birds)

The Ringed Plover is a widespread breeding bird at temperate and high latitudes in Europe, Asia, Greenland and NE Canada (Thorisson et al. 2012). Three subspecies are generally recognised. The nominate form, *C. h. hiaticula,* breeds in northern Europe (including Britain and Ireland). *C. h. psammadroma* breeds in NE Canada, Greenland, the Faeroes, Jan Mayen and Iceland, while *C. h. tundrae* breeds from N Scandinavia, Finland and N Russia, as far as the Bering Sea (Delaney et al. 2009). The nominate subspecies and the Icelandic population both winter predominantly along coasts of West Europe, NW and W Africa. The birds over-wintering in Ireland are thought to originate mainly from *C. h. hiaticula* but there is evidence that birds from both other aforementioned subspecies also occur during periods of migration (Delaney et al. 2009; Thorisson et al. 2012)

Numbers

Total site numbers of Ringed Plovers peaked in October 2010 when 177 were counted. Early season peaks are usually reported for this species and relate to the presence of passage individuals (Wernham et al. 2002). Numbers then steadily declined throughout the survey programme with just 12 individuals recorded during the final (February 2011) low tide survey, and four individuals during the January 2011 high tide survey. This drop in numbers is likely related to the cold weather, with December 2010 reported as the coldest since 1963 (Met Éireann, 2010). Only the October 2010 count surpassed the threshold of all-Ireland importance.

Ringed Plovers were recorded in a total of 11 subsites throughout the survey programme (0C455, 0C457, 0D425, 0D442, 0D443, 0D445, 0D446, 0D451, 0D454, 0D455 and 0D457). Peak numbers were recorded in 0D457 (Bartragh Is. South), 0C455 (Inishcrone Beach), 0C457 (Scurmore) and 0C455 for the four low tide counts respectively. The subsite peak count was 120 individuals recorded for 0D457 on 20/10/10.

Foraging Distribution

Ringed Plovers are 'visual foragers' searching the sediment surface for the visible signs of prey. Their diet is relatively broad and consists of small crustaceans, molluscs and polychaete worms, plus isopods, amphipods and insects (e.g. fly larvae).

All Ringed Plovers recorded foraged intertidally and the species was distributed across a total of nine subsites throughout the survey programme (0C455, 0C457, 0D442, 0D445, 0D446, 0D451, 0D454, 0D455 and 0D457). Peak numbers were recorded in 0D457 (Bartragh Is. South) on 20/10/10 and 24/11/10 and in 0C457 (Scurmore) on 24/11/10 and 20/01/11. 0C455 was the only subsite to support foraging individuals on 16/02/11.

0D457 and 0C457 represent some of the largest areas of intertidal flat available at this site and both are relatively sheltered behind Bartragh Island. On 20/10/10 and 24/11/10, 120 and 30 Ringed Plovers respectively foraged just north of the main channel alongside Dunlin, with other species such as Knot and Bar-tailed Godwit also spread out along the tide edge. The benthic community of the tidal flats is classified as 'muddy sand to fine sand dominated by *Peringia (Hydrobia*) *ulvae, Pygospio elegans* and *Tubificoides benedii.'* The gastropod *Peringia (Hydrobia*) *ulvae*, the polychaete *Pygospio elegans* and the oligochaete *Tubificoides benedii* occur in high to moderate abundances throughout this area and all could form potential prey items for the Ringed Plover.

On 20/01/11, 58 Ringed Plovers foraged in the south of 0C457, also classified as the biotope '*Hediste diversicolor, Macoma balthica* and *Eteone longa* in littoral muddy sand' by ASU (2011).

The peak intertidal foraging density was 0.6 Ringed Plover ha^{-1} recorded for 0D457 (Bartragh Is. South) on 20/10/10. 0D445 (Steelaun) recorded up to 0.5 Ringed Plover ha^{-1}. The whole site average intertidal foraging density was 0.1 Ringed Plover ha^{-1}.

Roosting Distribution

During low tide surveys relatively few Ringed Plovers were recorded in roosting/other behaviour with the exception of 45 individuals in 0C455 (Inishcrone Beach) on 20/10/10 (and smaller numbers (<5) in two other LT surveys) plus 26 individuals in 0D446 (Lackan Bay inner), also on 20/10/10.

Just four individuals roosted intertidally within 0C455 (Inishcrone Beach) during the high tide survey (26/01/11). These four roosted intertidally (littoral rock) along the eastern shore of 0C455 (Inishcrone Beach) along with 43 Sanderlings. The March 2011 roost survey recorded six individuals roosting with 35 Dunlin along the same shoreline (but slightly further north). A further 12 Ringed Plovers roosted with three Purple Sandpipers (*Calidris maritima*) slightly south along the same shoreline. Ringed Plovers are considered to be highly faithful to roost sites (e.g. Rehfisch et al. 2003). Despite the relatively small number of roosting records at Killalla Bay/Moy Estuary, the results do suggest a degree of within-site faithfulness in terms of roosting behaviour.

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 peaked in October 2010 (515) and thereafter decreased to 100 during the high tide count on 26/01/11 and just 41 during the final low tide count (16/02/11). It is likely that numbers were affected by the cold weather in December 2010, Golden Plovers being known as a species to respond to cold weather events (e.g. Crowe et al. 2011; Holt et al. 2012). Golden Plovers were recorded in nine subsites overall: 0C456, 0D425, 0D444, 0D445, 0D446, 0D447, 0D455, 0D457 and 0D458. Only 0D446 (Lackan Bay inner) supported the species during all four low tide counts and this subsite held peak numbers during the first three low tide surveys with 0D425 (Ross Bay (Killala)) supporting peak numbers on 16/02/11. The subsite peak count of 454 Golden Plovers was held by 0D446 (Lackan Bay inner) on 20/10/10.
Foraging Distribution
During winter, Golden Plovers feed primarily within agricultural grassland and arable land. Tidal flats are used more 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. Intertidal feeding is observed to a greater degree during cold weather periods when grassland feeding areas are frozen over. Terrestrially, Golden Plovers eat a wide range of invertebrate species including small earthworms, beetles and millipedes (Gillings & Sutherland, 2007), but relatively little is known about their intertidal feeding patterns (Gillings et al. 2006). Very few observations of foraging individuals were made; the exception to this general rule being 25 individuals that foraged intertidally within 0D444 (Rathran Friary) on 24/11/10. Terrestrial foraging was recorded twice, birds on both occasions outside 0D446 (Lackan Bay inner) but inside the SPA. 100 were recorded during the January 2011 high tide survey and 96 individuals during the low tide survey in the same month. Terrestrial foraging is likely to occur on a regular basis both inside and outside the SPA boundary.
Roosting Distribution
Across the survey programme, the majority of Golden Plovers were recorded roosted intertidally. Six subsites were used (0C456, 0D425, 0D445, 0D446, 0D455 and 0D458. 0D446 (Lackan Bay inner) supported roosting individuals in all four low tide surveys with a peak number of 454 on 20/10/10. 0D425 (Ross Bay), 0D455 (Kilroe) and 0C456 (Barrow) held good numbers on at least two occasions each with peak numbers of 38, 94 and 70 respectively. No roosting individuals were recorded during the January 2011 high tide survey. Golden Plovers were recorded roosting in three subsites during the March 2011 high tide survey (0D425, 0D446 & 0D454). By far the largest number was 166 that roosted upon the tidal flats of 0D446 (Lackan Bay inner).

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 peaked on 20/01/11 (43) and 62 were counted during the high tide survey (26/01/11). Grey Plovers were recorded in a total of 13 subsites throughout the entire survey programme (0C455, 0C457, 0D425, 0D442, 0D443, 0D445, 0D446, 0D447, 0D454, 0D455, 0D457, 0D458 and 0D486) but most regularly within six of these 0D442 (Ballysakeery), 0D446 (Lackan Bay inner), 0D447 (Lackan Bay outer), 0D455 (Kilroe), 0D457 (Bartragh Is. South) and 0D458 (Bullockpark). The low tide subsite peak count was 19 individuals in 0D455 (Kilroe) on 16/02/11.
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). Grey Plovers foraged intertidally with regularity in three subsites (0D442, 0D455 and 0D457); these all being in inner Killala Bay and sheltered by Bartragh Island. A further five subsites held very low numbers (<5) on one or two occasions only. 0D442 (Ballysakeery) held peak numbers on 20/10/10 and 20/01/11, 0D457 (Bartragh Is. South) held peak numbers (8) on 24/11/10 and 0D455 (Kilroe) held peak numbers on 16/02/11. The large expanses of tidal flat behind Bartragh island support the benthic community 'muddy sand to fine sand dominated by *Peringia (Hydrobia*) *ulvae, Pygospio elegans* and *Tubificoides benedii.'* The polychaetes *Hediste diversicolor* and *Arenicola marina* were recorded widely throughout the community complex, the latter reaching densities of >20m^{-2} in places. The highest intertidal foraging density recorded for a single subsite was 0.2 Grey Plover ha^{-1} (0D442 Ballysakeery), which is considered low. The whole site mean feeding density (intertidal habitat) was 0.01 Grey Plover ha^{-1}.
Roosting Distribution
During low tide surveys, relatively few Grey Plovers were recorded in roosting/other behaviour. Single roosts of 40, 16 and six individuals were recorded within 0D446 (Lackan bay inner), 0D486 (Rathran Bay) and 0D447 (Lackan Bay outer) respectively during the January 2011 high tide roost survey. The roosting individuals in both inner and outer Lacken Bay (0D446/0D447) were associated with roosting Dunlin. The 16 individuals within 0D486 (Rathran Bay) roosted upon rock in the east of the subsite along with Curlew (3), Oystercatcher (7), Redshank (8) and Dunlin (10). 0D447 and 0D457 supported 15 and seven individuals respectively during the March 2011 roost survey (intertidal).

Sanderling *Calidris alba* - Family (group): Scolopacidae (wading birds)
Sanderlings are one of the most northerly of all Arctic-breeding waders with a circumpolar breeding range that includes Alaska, Northern Canada, Greenland and Svalbard. The species is a long-distance migrant and two subspecies are described of which the nominate *Calidris alba alba* breeds in Greenland, Jan Mayen, Svalbard, and Siberia and winters along the Atlantic coast of Europe and Africa (Delaney et al. 2009). Sanderling originating from the westernmost Siberian breeding population migrate south-west along the Atlantic seaboard and form the bulk of the birds wintering in Ireland, while it was thought that birds originating from Greenland continued south to winter in West Africa. However, it is now apparent that there is overlap in the wintering ranges of the two, and that Greenland-breeding Sanderlings also occur in Ireland in winter as well as during the typical passage periods (Delaney et al., 2009; Reneerkens et al. 2009).
Numbers
Whole site numbers of Sanderling peaked in October 2010 (210 individuals) likely comprising some passage individuals. This count and the one on 24/11/10 surpassed the threshold of all-Ireland importance. Thereafter numbers dropped to 50 (20/01/11) with none present during the final low tide survey in February 2011. 81 were counted during the high tide survey (26/01/11). Numbers were likely affected by the cold weather event that saw temperatures in December 2010 plummet to a record low (Met Éireann, 2010). Overall, Sanderlings were recorded in seven subsites: 0C455, 0C457, 0D443, 0D446, 0D455, 0D457 and 0D486, although one of these (0C455) recorded the species during the high tide survey only. Peak numbers were held by 0D457 and 0D455 for the first, second and third low tide surveys respectively (no birds during the fourth low tide survey). The peak low tide count was 175 Sanderling within 0D457 (Bartragh Is. South) on 20/10/10.
Foraging Distribution
During the non-breeding season Sanderlings can be found in a variety of coastal habitats but are characteristic of sandy shorelines (strands) where they often forage along the tide line by rushing in and out with the waves searching for small prey such as sandhoppers. Significant numbers however may also be found along non-estuarine coastlines (Crowe, 2005), outer parts of estuaries (Musgrove et al., 2003) or within some sheltered bays where they may form mixed flocks with Dunlins or Ringed Plovers. Sanderlings foraged intertidally across five subsites: 0C457, 0D446, 0D455, 0D457 and 0D486. Peak numbers were held by 0D455 (Kilroe) and the adjacent 0D457 (Bartragh Is. South). 0C457 (Scurmore) held numbers ranked as second highest on two low tide survey occasions. The large expanses of tidal flat behind Bartragh island support the benthic community 'muddy sand to fine sand dominated by *Peringia (Hydrobia*) *ulvae, Pygospio elegans* and *Tubificoides benedii.'* The Sanderlings observed were nearly always foraging alongside the main tidal channel; at times close to foraging Dunlin and Ringed Plover. A total of 38 Sanderlings foraged during the January 2011 high tide survey; 20 in 0D446 and 18 in 0C455. The peak intertidal foraging density was 0.9 Sanderling ha^{-1} recorded for 0D457 (Bartragh Is. South). All other subsites recorded densities of 0.3 individuals per hectare or less. The whole site average intertidal foraging density was 0.05 Sanderling ha^{-1}.
Roosting Distribution
Five Sanderlings were recorded roosting in 0D443 (Bartragh Island northwest) during the October 2010 low tide survey. This was the only roosting record. A single roost of 43 Sanderlings was recorded roosting during the January 2011 high tide roost survey; these birds roosting together with four Ringed Plover. No roosting individuals were recorded during the March 2011 roost survey. Sanderling roosting behaviour therefore remains unknown for 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.

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

Whole-site numbers of Dunlin peaked in November 2010 when 1,338 was the only count to surpass the threshold of all-Ireland importance. 336 were recorded during the January 2011 high tide survey.

The Dunlin was a relatively widespread species and recorded in 18 subsites overall (16 during LT surveys). Seven subsites recorded the species regularly (three or more surveys): 0D446, 0D447, 0D451, 0D454, 0D455, 0D457 and 0D458. 0D457 (Bartragh Is. South) held peak numbers on 20/10/10 and 24/11/10; 0D455 (Kilroe) on 20/01/11, and 0D451 (Carrowkelly) on 16/02/11. The subsite peak count of 456 Dunlin was recorded for 0D457 (Bartragh Is. South) on 24/11/10.

Foraging Distribution

The Dunlin diet is relatively wide and although this versatile species often shows a preference for muddier areas within sites (e.g. Hill et al. 1993; Santos et al. 2005), their distribution can often be widespread with no clear patterns.

Between 70% and 99% of Dunlins counted during low tide surveys were foraging and 14 subsites were used overall. Peak numbers were held by 0D457 (Bartragh Is. South) and the adjacent 0D455 (Kilroe), two large subsites behind Bartragh Island; and by 0D451 (Carrowkelly) (twice) which is one of the lower estuarine subsites of the Moy. 0D457 and 0D455 are classified as the intertidal benthic community 'muddy sand to fine sand dominated by *Peringia (Hydrobia*) *ulvae, Pygospio elegans* and *Tubificoides benedii.'* A dominant invertebrate species is *Peringia (Hydrobia*) *ulvae*, present at 40 out of 50 intertidal sites sampled (ASU, 2011) although all three aforementioned characterising species could form prey items of Dunlin. 0D451 (Carrowkelly) is more estuarine in nature and is classified as 'estuarine muddy sand dominated by *Hediste diversicolor* and *Heterochaeta costata*.' The amphipod *Corophium volutator* is also found there.

0D454 (Killala-Rinnaun Point) supported 140 foraging individuals on two separate survey dates. 0D446 (Lackan Bay inner) held good numbers on two occasions (peak number (153). Thereafter subsites held smaller numbers on irregular occasions.

The peak intertidal foraging density was 6 Dunlin ha^{-1} recorded for 0D451 (Carrowkelly) on 24/11/10. This subsite had an average density of 3 Dunlin ha^{-1} during the survey programme. The second highest peak density recorded was 2.5 individuals per hectare (0D454 Killala-Rinnaun Point). The whole site average intertidal foraging density was 0.4 Dunlin ha^{-1}.

Roosting Distribution

Roosting/other behaviour was irregularly recorded during low tide surveys. Of note was 391 Dunlin that roosted within 0D457 (Bartragh Is. South) on 24/11/10 and 150 within 0D487 (Ballinlena) on 16/02/11.

Dunlin were recorded roosting across nine subsites during the January 2011 high tide roost survey: 0D425, 0D445, 0D446, 0D447, 0D453, 0D454, 0D455, 0D458 and 0D486. The largest roost was of 73 individuals within 0D454 (Killala - Rinnaun Point). 0D446 (Lackan Bay inner) supported two separate roosts of 55 and 60 individuals.

Fewer records were obtained during the March 2011 roost survey, roosting individuals recorded within 0C455 (35), 0D446 (87) and 0D457 (5) only.

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 across the higher latitudes of Northern Europe, Russia and Siberia and west 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

Total site numbers of Bar-tailed Godwits rose from 221 in October 2010 to a site peak of 621 during the February low tide survey. All counts surpassed the threshold of all-Ireland importance (160) including the number recorded during the January 2011 high tide survey (511).

Bar-tailed Godwits were relatively widespread and recorded in 19 subsites overall and most regularly (3 low tide surveys or more) in 11 subsites: 0C456, 0C457, 0D442, 0D443, 0D444, 0D447, 0D452, 0D453, 0D454, 0D455 and 0D457. 0D486 (Rathfran Bay) was used only during the high tide survey (35 individuals).

Peak numbers were recorded for 0D457 (Bartragh Is. South) (20/10/10), 0D455 (Kilroe) (24/11/10 & 20/01/11) and 0C457 (Scurmore) (16/02/11), the latter being the subsite peak count (205 individuals).

Foraging Distribution

Bar-tailed godwits are a wader species considered characteristic of coastal wetland sites dominated by sand. The birds forage by probing within intertidal sediment for invertebrate species, predominantly large polychaete worms such as *Arenicola marina* and *Nepthys* sp. The species is characteristic of sites with sandy substrates (e.g. Hill et al. 1993; Summers et al. 2002).

Bar-tailed Godwits were recorded foraging within 18 subsites overall but most regularly (3 or more low tide surveys) within nine subsites: 0C456, 0C457, 0D442, 0D444, 0D452, 0D453, 0D454, 0D455 and 0D457. Peak numbers foraging intertidally were recorded for 0D457 (Bartragh Is. South) (20/10/10), the adjacent 0D455 (Kilroe) (24/11/10 & 20/01/11) and 0C457 (Scurmore) (16/02/11). 0D457 and 0D455 recorded good numbers that were ranked very highly in all low tide counts and these were the two key subsites for this species. 0D454 (Killala-Rinnaun Point) was notable as supporting numbers, ranked third highest, in three low tide surveys. The large expanses of tidal flat behind Bartragh island support the benthic community 'muddy sand to fine sand dominated by *Peringia (Hydrobia) ulvae, Pygospio elegans* and *Tubificoides benedii.'* *Arenicola marina*, a large polychaete favoured by Bar-tailed Godwits (e.g. Scheiffarth, 2001) is recorded throughout the community complex and reaches highest densities of >20m^{-2}. Flock maps show that Bar-tailed Godwits within both 0D457 and 0D455 generally foraged close to or in the main channel (i.e. feet in water). The lower shore is characterised by a fine sand community with *Nephtys cirrosa*, which could explain this distributional pattern, while it is also likely that they were at times feeding upon the polychaete *Lanice conchilega* that also occurs on the lower shore at this site.

The highest intertidal foraging density recorded for a single subsite was 1.4 Bar-tailed Godwits ha^{-1} (0C457 Scurmore) on 16/02/11. Only one other subsite (0D454) recorded densities greater than 1 Bar-tailed Godwit ha^{-1}. The whole site mean feeding density (intertidal habitat) was 0.2 Bar-tailed Godwits ha^{-1}.

Roosting Distribution

During low tide surveys, Bar-tailed Godwits were rarely recorded roosting intertidally; single observations recorded for 0C456, 0D443, 0D444, 0D445, 0D446 and 0D455. 0D447 (Lackan Bay outer) and 0D453 (Inishdugh) were the exceptions supporting individuals in three and four low tide surveys respectively and with peak numbers of 10 and 47.

Bar-tailed Godwits were recorded roosting across eight subsites during the January 2011 high tide roost survey: 0C456, 0C457, 0D445, 0D446, 0D453, 0D454, 0D455 and 0D486. The largest roost was of 210 individuals within 0D455 (Kilroe), these birds part of a large, mixed-species roost in intertidal habitat.

0C457 (Scurmore) supported a single roost of 87 individuals, these birds part of a larger mixed-species roost also comprising Oystercatcher (85), Curlew (55), and Lapwing (15) amongst others. This flock was actually outside of the count subsite on the eastern side of Bird Island but inside the SPA.

Fewer records were obtained during the March 2011 roost survey, roosting individuals recorded within 0D455, 0D457 and 0D487 only; peak number of eight individuals (0D487).

Curlew *Numenius arquata* - Family (group): Scolopacidae (wading birds)

The Curlew has a widespread breeding range across temperate latitudes of the Palearctic region, occurring across Europe and Asia from Ireland in the west to northern China in the east (Delaney et al. 2009). The nominate subspecies breeds across Europe and winters in Europe. Ireland supports a small and declining population of breeding Curlew. Irish breeding Curlew are thought to make only short migrations and be mainly resident during winter. Wintering numbers are enhanced by birds moving in from breeding grounds in Fennoscandia, the Baltic and northwest Russia (Delaney et al. 2009) and Britain (Wernham et a. 2002).

Numbers

In contrast to species that decreased in number as the 2010/11 season went on, often attributed to the cold weather at the end of 2010; numbers of Curlew increased throughout the survey programme peaking at 1,083 on 16/02/11 and surpassing the threshold of all-Ireland importance. The high tide count of 941, the second highest number recorded in the survey programme also represented numbers of all-Ireland importance. The increase in numbers can perhaps be attributed to birds moving to coastal wetlands seeking unfrozen feeding opportunities as opposed to foraging terrestrially and/or at inland wetlands.

Curlews had a widespread distribution across the site, occurring in 23 subsites overall and in 19-20 subsites during individual low tide surveys. These subsites were: 0C455, 0C456, 0C457, 0C481, 0D424, 0D425, 0D441, 0D442, 0D443, 0D444, 0D445, 0D446, 0D447, 0D450, 0D451, 0D452, 0D453, 0D454, 0D455, 0D457, 0D458, 0D486 and 0D487.

Peak numbers were held by 0D444 (Rathfran Friary), 0D457 (Bartragh Is. South), 0D487 (Ballinlena) and 0D457 for the four low tide surveys respectively. The subsite peak count was 210 Curlews, supported by 0D457 (Bartragh Is. South) on 24/11/10. 0D487 (Ballinlena) recorded Curlews, and peak numbers on that date (175), once only.

Foraging Distribution

Curlews are the largest intertidal wader to spend the non-breeding season within Ireland. Within intertidal areas they seek out larger prey items such as crabs, large worms and bivalves. Their de-curved bill is ideally suited to extracting deep-living worms such as Lugworms (*Arenicola marina*). Curlews rely on large prey that takes more time to handle (long handling time) in contrast to many other wader species that swallow prey relatively quickly upon finding it (short handling time). As a consequence, Curlews are territorial foragers and tend to occur widely spaced from each other to avoid competitive conflicts.

22 subsites supported foraging Curlews overall; of these 14 supported foraging individuals in all four low tide surveys: 0C456, 0C457, 0D424, 0D442, 0D444, 0D446, 0D450, 0D451, 0D452, 0D453, 0D454, 0D455, 0D457 and 0D458 (intertidal habitat).

Peak numbers foraging intertidally were held by 0D458 (Bullockpark), 0D442 (Ballysakeery), 0D455 (Kilroe) and 0D455 for the four low tide survey dates respectively; the peak number was 91 within 0D455 on 20/01/11. These subsites are all located in inner Killala Bay behind Bartragh island, and support the benthic community 'muddy sand to fine sand dominated by *Peringia (Hydrobia*) *ulvae, Pygospio elegans* and *Tubificoides benedii.'* The polychaetes *Hediste diversicolor* and *Arenicola marina* occur widely throughout the community complex, the latter reaching densities of >20m^{-2} in places.

0C457 (Scurmore) at the mouth of the Moy was notable in supporting numbers ranked in the top five in all four low tide surveys. 72 Curlews foraged supratidally within 0D444 (Rathran Friary) during the high tide survey. Curlews will also feed amongst damp grasslands for terrestrial worms. Terrestrial foraging was recorded around the site (outside of the SPA boundary) and this activity, more common during the high tide period, is likely to play an important part in the achievement of sufficient daily energy intake. 140 Curlews foraged terrestrially adjacent to the site during the high tide survey, the largest proportion adjacent 0C456 (Barrow).

The highest intertidal foraging density recorded within a subsite was 0.9 Curlew ha^{-1} (0D454 Killala - Rinnaun Point (20/01/11) and 0D425 Ross Bay Killala (20/10/10). The whole site mean feeding density (intertidal habitat) was 0.2 Curlew ha^{-1}.

Roosting Distribution

Roosting/other behaviour was widely recorded across the site and recorded in all four low tide surveys in 0D453 (Inishdugh) which held peak numbers on one occasion and second highest on another. 0D457 (Bartragh Is. South) held peak numbers on 24/11/10 and 16/02/11. 0D487 (Ballinlena) held peak numbers (175) on 20/01/11, the only time Curlew were recorded in this subsite.

Curlews were recorded roosting across 16 subsites during the January 2011 high tide roost survey: 0C456, 0C457, 0D424, 0D425, 0D442, 0D444, 0D445, 0D447, 0D451, 0D452, 0D453, 0D454, 0D455, 0D457, 0D458 and 0D486.

0D455 (Kilroe) was notable in supporting roosting individuals at eight different positions, largely along the southern section of the subsite and the largest flock size was 50 individuals. 0C457 held the single largest roost of 55 individuals. 0C456 and 0D444 each held five different roosts with maximum flock sizes of 40 and 38 Curlews respectively.

The March 2011 roost survey recorded roosting Curlews across 11 subsites: 0C456, 0C457, 0D424, 0D442, 0D444, 0D446, 0D452, 0D453, 0D454, 0D455 and 0D458. The largest single roost was of 75 individuals in 0C456.

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

Whole site numbers of Redshanks ranged from 186 (20/01/11) to a peak of 501 on 20/10/10. 311 were counted during the high tide survey (26/01/11). All except the count of 186 surpassed the threshold of all-Ireland importance.

Redshanks were widespread and recorded within 22 subsites overall. 14 subsites recorded Redshank in all four low tide surveys: 0C456, 0C457, 0D424, 0D425, 0D444, 0D446, 0D447, 0D450, 0D451, 0D452, 0D453, 0D454, 0D455 and 0D457.

0D451 (Carrowkelly) was notable in supporting peak numbers on three low tide survey occasions and a peak number of 165 on 20/10/10. 0D454 (Killala - Rinnaun Point) held peak numbers on 20/01/11 (45). 0D453 (Inishdugh) held good numbers ranked as high on three occasions. 0D455 (Kilroe) supported a notable 71 individuals on 20/10/10 and lower numbers regularly thereafter.

Foraging Distribution

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

Redshanks foraged intertidally across 21 subsites and regularly (within all low tide surveys) within 13 subsites as follows: 0C456, 0C457, 0D424, 0D425, 0D444, 0D447, 0D450, 0D451, 0D452, 0D453, 0D454, 0D455 and 0D457.

0D451 (Carrowkelly) recorded peak numbers on 20/10/10, 24/11/10 and 16/02/11. 0D454 (Killala - Rinnaun Point) held peak numbers on 20/01/11 and good numbers in all other low tide surveys. 0D453 (Inishdugh) held good numbers ranked as high during the first three low tide surveys. 0D455 (Kilroe) supported a notable 71 individuals foraging intertidally on 20/10/10 and lower numbers regularly thereafter. These subsites are all inner sheltered areas within the site. 0D451 and 0D453 are located at the estuary mouth and classified as 'estuarine muddy sand dominated by *Hediste diversicolor* and *Heterochaeta costata*.' The amphipod *Corophium volutator* is also found there. 0D454 and 0D455 are located near Kilroe and are classified as 'muddy sand to fine sand dominated by *Peringia (Hydrobia*) *ulvae, Pygospio elegans* and *Tubificoides benedii.' Peringia (Hydrobia*) *ulvae* is dominant and was present at 40 out of 50 intertidal sites sampled (ASU, 2011) and particularly abundant within samples taken from 0D454 and 0D455 amongst others.

The peak intertidal foraging density was 2.5 Redshanks ha^{-1} recorded for 0D451 (Carrowkelly) on 20/10/10. No other subsite recorded greater than 2 Redshanks ha^{-1}. The whole site average intertidal foraging density was 0.2 Redshank ha^{-1}.

Roosting Distribution

Almost all Redshanks recorded during low tide surveys were foraging.

Redshanks were recorded roosting across 13 subsites during the January 2011 high tide roost survey: 0C456, 0C457, 0D442, 0D443, 0D444, 0D445, 0D451, 0D452, 0D453, 0D454, 0D455, 0D457 and 0D486.

0D444 (Rathfran Friary) was notable in supporting roosting individuals at eight different positions; the largest flock size being 20 individuals. The largest single roost was 50 Redshanks roosting supratidally along the western shore of 0D451 (Carrowkelly).

The March 2011 roost survey recorded roosting Redshanks across eight subsites: 0C457, 0D444, 0D448, 0D451, 0D452, 0D453, 0D454 and 0D455. The largest single roost was 17 Redshanks within 0D453 (Inishdugh).

5.4 Killala Bay/Moy 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 not only to 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 of this document provides information on activities and events that occur in and around Killala Bay/Moy 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. Mayo County Council, 2009a; Sligo County Council, 2011), Western River Basin District documents (e.g. WRBD, 2009) and other available documents relevant to the ecology of the site.

In addition, information was collected during the 2010/11 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 120+ 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' were categorised using the standard EU list of pressures and threats as used in Article 12 reporting under the EU Bird's 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 to occur in and around Killala Bay/Moy 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 Killala Bay/Moy 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 Killala Bay/Moy Estuary, those that have the potential to cause disturbance to waterbird species are highlighted.

3. Data from the 2010/11 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 Killala Bay/Moy Estuary

Activities and events identified to occur in and around Killala Bay/Moy Estuary are shown in Appendix 9, listed in terms of the subsites surveyed during the 2010/11 Waterbird Survey Programme. Activities highlighted in grey are those that have the potential to cause disturbance to waterbirds (see Section 5.4.4).

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

Habitat loss and modification and adjacent landuse

Killala Bay is the name given to the entire sea bay on the west coast of Ireland between County Mayo and County Sligo. It encompasses the estuary of the River Moy which runs through Ballina, the main town in the area, as well as smaller bays namely Lackan Bay and

Rathran Bay. The town of Killala lies adjacent, while Inishcrone is situated on the eastern side of the inner bay.

The landscape around the site is described predominantly as an area of low lying drumlins. The main agricultural activity in the surrounding area is livestock production and the region is dominated by extensive areas of pasture and some pockets of peat bog. The west of the site is characterised by the North Coast plateau, a strip of often steeply sloping terrain, which has a combination of pasture and moorland on its planar seaward slopes above sea cliffs and abrupt gullies (CAAS, 2008b).

Bartragh Island is a long, narrow barrier island dominated by a sand dune system. The island is uninhabited at present but Bartragh House is located at the eastern end and some of the land around the house has been cultivated in the past (1950s) (McCorry & Ryle, 2009). The island, accessed by boat or by crossing the intertidal flats at certain times, is used recreationally by campers and walkers, and is grazed by sheep.

There is approval for the development of a new harbour at Killala Pier with adjacent recreational park at Geyerris Point (in subsite 0D454) (source: www.killalabay.ie).

Water quality

The Western River Basin District (WRBD) River Basin Management Plan 2011 – 2015 covers the implementation of the Water Framework Directive (WFD) (2000/60/EEC) for the west coast of Ireland and covers Killala Bay and its inflowing rivers.

The current water quality status of Killala Bay is 'high' according to the Western River Basin Transitional and Coastal Waters Action Programme (WRBD, 2009). The Moy Estuary however is classified as 'moderate' and therefore unsatisfactory; one contributory factor being opportunistic macroalgae linked to inadequate wastewater treatment.

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)[17] and Nitrates Directive (91/676/EEC). Following assessment, waterbodies are classified as eutrophic, potentially eutrophic, intermediate, or unpolluted (O'Boyle et al. 2010). The most recent assessment classified Killala Bay as 'unpolluted' while the status of the Moy Estuary had deteriorated to an 'intermediate' level.

Untreated waste water is discharged into inner Killala Bay, which with narrow channels and much shelter provided by Bartragh Island, has a relatively poor dispersive capacity. This is particularly undesirable given the proximity to a Shellfish Growing Area. A licence application was made by Mayo County Council in September 2008 (registration number DC0067-01) pursuant to the requirements of the Waste Water Discharge (Authorisation) Regulations, 2007, and a new sewerage scheme proposed, incorporating a collection network, construction of a new wastewater treatment plant with tertiary treatment, and construction of two pumping stations. This scheme is currently listed as 'to commence in 2011-2012 (subject to available finances) (www.mayococo.ie).

Improvements in wastewater treatment are aimed at meeting objectives of the Urban Waste Water Treatment Regulations, as mentioned above and the Water Framework Directive (2000/20/EC as transposed by the European Communities (Water Policy) (Amendment) Regulations, 2010)), but a reduction in organic and nutrient loading to an estuary may have various consequences for the ecology of the estuarine system. For example, there could be a reduction in the abundance of benthic invertebrate prey species (e.g. Burton et al. 2002).

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

This could have knock-on effects upon waterbird foraging distribution, prey intake rates, and ultimately upon survival and fitness.

Related to this is the subject of macroalgal mats which are a common feature in Killala Bay/Moy Estuary. Macroalgal mats of species such as *Ulva* spp[18] 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; Lopes et al. 2006) while herbivores such as Light-bellied Brent Geese and Wigeon benefit from the algae being a source of food. Given that sustained high levels of macroalgal growth is linked to organic enrichment, there is a potential for a reduction in macroalgal abundance as a result of improvements to sewage discharges. Although such factors are complex and may operate over the long-term, it is advised that they be considered in future assessments of waterbird distribution patterns at this site.

Fisheries & aquaculture

An area of 2.5 km^2 in Killala Bay is designated as a Shellfish Water under the EU Shellfish Waters Directive[19] (No. 32) (DoEHLG, 2009) (overlapping with count subsites 0D455 and 0D457 and lying entirely within the SPA). It comprises an area of the River Moy Estuary and Killala Bay, (up to the high water mark), from the western point of Bartragh Island south to Kilroe and from the townland of Bullockpark, northeast to Bartragh Island. The designation relates to the cultivation of Oysters (*Crassostrea gigas*).

The Sea Fisheries Protection Authority (SFPA) is responsible for classifying shellfish production areas and the current classification of the Killala Bay Bivalve Mollusc Production Area is Class A (Oysters) as of 20th July 2012 (www.sfpa.ie).

Various commercial inshore fishing activities are likely to occur adjacent to the site (detail and spatial scale unknown). Line fishing and other static methods (e.g. pots) are widespread across the bay but mobile fishing gears are confined largely to outer subsites and areas outside of the site (DoEHLG, 2009). The main pier is Killala Pier at Geyerris Point (in subsite 0D454).

Recreational disturbance

The town of Inishcrone is a popular holiday destination whose main attraction is the sandy beach (Inishcrone Strand 0C455) that is backed to the south by high dunes and a golf course. This beach is used for bathing, general beach recreation, surfing, wind-surfing and kite surfing amongst other activities.

Killala is a popular tourist destination. The nearby Ross Strand (0D443) is a popular beach used for swimming and watersports and achieved Blue Flag status in 2012.

The River Moy and Moy Estuary is world famous as Ireland's most prolific salmon angling waters. Sea fishing is also a popular activity. Boats can be launched from Lacken Pier (0D447) and small boat fishing in Lackan Bay targets a variety of species including Turbot, Plaice and Dab (Dunlop, 2009). Charter boats operate from Killala Pier. Shore angling occurs on Ross Strand (0D443) and Inishcrone beach (0D455).

Others

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

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

Wildfowling was not recorded at the site during the 2010/11 Waterbird Survey Programme. In response to the freezing conditions experienced in the winter of 2010, the Department of the Environment, Heritage and Local Government extended a temporary closure of the hunting season for wild birds (8^{th} – 30^{th} December 2010 inclusive).

5.4.4 Disturbance Assessment

During the 2010/11 survey period, five activities/events were recorded that had the potential to cause disturbance to waterbirds. These were: walking (including with dogs), motorised vehicles, horse-riding, hand-gathering of molluscs (winkle picking), and activities associated with intertidal aquaculture (Table 5.8).

Walking (including with dogs) was by far the most widespread activity occurring in eight subsites overall and accounting for the peak disturbance score in seven of these. The presence of dogs generally led to a higher score as a result of the higher 'intensity' of the activity. Horse riding was a regular activity within 0C456 (Barrow) and activities associated with aquaculture were confined to the two subsites (0C455 and 0D457) that contain a designated Shellfish Area.

A summary of the disturbance assessment is shown in Table 5.8 and full results are shown in Appendix 10. 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 Activities	Peak Disturbance Score	Activity Responsible
0C455	Inishcrone Beach (low-tide)	2	7	• Walking (incl. with dogs)
0C456	Barrow	2	6/7	• Horse Riding
0C457	Scurmore	-	-	
0C481	Bartragh Island East	1	7	• Walking (incl. with dogs)
0D424	Croghan Bay	-	-	
0D425	Ross Bay (Killala)	-	-	
0D441	Killogeary	-	-	
0D442	Ballysakeery	-	-	
0D443	Bartragh Island northwest	-	-	
0D444	Rathfran Friary	-	-	
0D445	Steelaun	-	-	
0D446	Lackan Bay inner	2	7	• Walking (incl. with dogs)
0D447	Lackan Bay outer	1	6	• Walking (incl. with dogs)
0D448	Quignaleka	1	5	• Walking (incl. with dogs)
0D449	Belleek	1	6	• Walking (incl. with dogs)
0D450	Garrankeel - Rathmoy	-	-	
0D451	Carrowkelly	1	7	• Walking (incl. with dogs)
0D452	Castleconnor	-	-	
0D453	Inishdugh	-	-	
0D454	Killala - Rinnaun Point	-	-	
0D455	Kilroe	2	5	• Intertidal aquaculture
0D457	Bartragh Is. South	1	6	• Intertidal aquaculture
0D458	Bullockpark	1	3	• Hand gathering of molluscs
0D486	Rathfran Bay	-	-	
0D487	Ballinlena	-	-	

Table 5.9 Killala Bay/Moy Estuary - subsite rankings based on total numbers of waterbirds (LT surveys) by peak disturbance score

Species ► / Subsites ▼	RP	GP	GV	SS	DN	BA	CU	RK
0C455	V		L		M	L	L	L
0C456		H			L	L	H	M
0C457	V		L	H	M	V	H	M
0C481							L	
0D424						L	M	M
0D425	L	V	M			M	M	M
0D441							M	M
0D442	L		V		H	M	H	H
0D443	H		H	M		H	M	L
0D444		M				M	V	M
0D445	M	M	V		L	M	H	M
0D446	H	V	M	H	H	M	H	M
0D447		L	V		L	M	L	L
0D448								L
0D449								
0D450					M	L	L	H
0D451	L				V		M	V
0D452					L	H	H	M
0D453					L	H	H	H
0D454	M		L		H	H	H	V
0D455	H	H	V	V	V	V	H	H
0D457	V	L	H	V	V	V	V	H
0D458		L	H		M	M	H	H
0D486				M				
0D487					H		V	

5.4.5 Discussion

Many of the 'activities' identified at the Killala Bay/Moy Estuary may act so as to modify the wetland habitats. While physical loss might be considered more historic in nature (e.g. the building of slips/piers), on-going modifications to intertidal and coastal habitats may occur due to changes in natural processes (e.g. sedimentation or erosion rates) as a result of former physical events.

Human recreational activities at coastal sites occur less frequently during winter months and the range of activities is much reduced. Nevertheless recreational activity in the form of walkers (with/without dogs) occurred in a third of count subsites and was a regular activity in several (e.g. 0C455, 0D446).

Any activity that causes disturbance can lead to the displacement of 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[20] (reduced survival or reproductive success) consequences at population level may result.

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

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:-

- 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 (1st 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: KILLALA BAY/MOY ESTUARY SPA

SITE CODE: 004036

This large site comprises the estuary of the River Moy and the inner part of Killala Bay, including Lackan Bay and Rathfran Bay, in Counties Mayo and Sligo. It is a funnel-shaped estuary, *c*. 7 km wide at its outer limit. It is very well sheltered by a sandy island, Bartragh, and by a sandy peninsula that extends from Enniscrone on the eastern side. Extensive intertidal sand and mud flats are exposed at low tide. For the most part, these flats are unvegetated, but mats of Eelgrass (*Zostera* spp.), Beaked Tasselweed (*Ruppia maritima*) and green algae (*Ulva* spp.) occur, which provide important feeding material for waterfowl species.

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Ringed Plover, Golden Plover, Grey Plover, Sanderling, Dunlin, Bar-tailed Godwit, Curlew 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.

The site is very important for wintering waterfowl and provides excellent feeding grounds for the birds, as well as high-tide roosts. Eight species have populations of national importance, i.e. Ringed Plover (245), Golden Plover (2,361), Grey Plover (221), Sanderling (123), Dunlin (2,073), Bar-tailed Godwit (366), Curlew (731) and Redshank (372) - all figures are mean peaks for the five year period 1995/96 to 1999/2000). A range of other species occurs, including Light-bellied Brent Goose (170), Shelduck (64), Wigeon (339), Teal (236), Red-breasted Merganser (44), Red-throated Diver (15), Oystercatcher (531), Lapwing (1,854) and Greenshank (24). The site is also used by Mallard (92), Turnstone (50), Grey Heron (21) and Cormorant (40). Substantial numbers of gulls are present at the site during winter, including Black-headed Gull (338), Common Gull (368), Herring Gull (336) and Great Black-backed Gull (120).

Killala Bay/Moy Estuary SPA is of high ornithological importance as it supports eight species that have populations of national importance, including a very substantial population of Grey Plover (3.4% of the all-Ireland total). The presence of Red-throated Diver, Golden Plover and Bar-tailed Godwit is of particular note as these species are listed on Annex I of the E.U. Birds Directive.


SPA 004036
Sligo
Killala
Inishcrone
Ballina
CO. SLIGO
CO. MAYO
Castlebar
CO. ROSCOMMON
CO. GALWAY
Lackan Bay
Benwee or Kilcummin Head
Bone Rock
Carrigbarnagh
Carrickpatrick
Killala Bar
KILLALA
Cill Ala
INISHCRONE
Inis Crabhann
Legend
SPA 004036
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
KILLALA BAY / MOY ESTUARY SPA
CONSERVATION OBJECTIVES
SPA DESIGNATION
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
SITE CODE: SPA 004036
CO. MAYO; version 1.02
CO. SLIGO; version 1.02
0 0.5 1 1.5 2 km
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 garshuíomhach 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: Feb 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) and Boland & Crowe (2012).

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, organised in 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 alpina*
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 maritima*
RM	Red-breasted Merganser	*Mergus serrator*
RH	Red-throated Diver	*Gavia stellata*
RK	Redshank	*Tringa totanus*
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

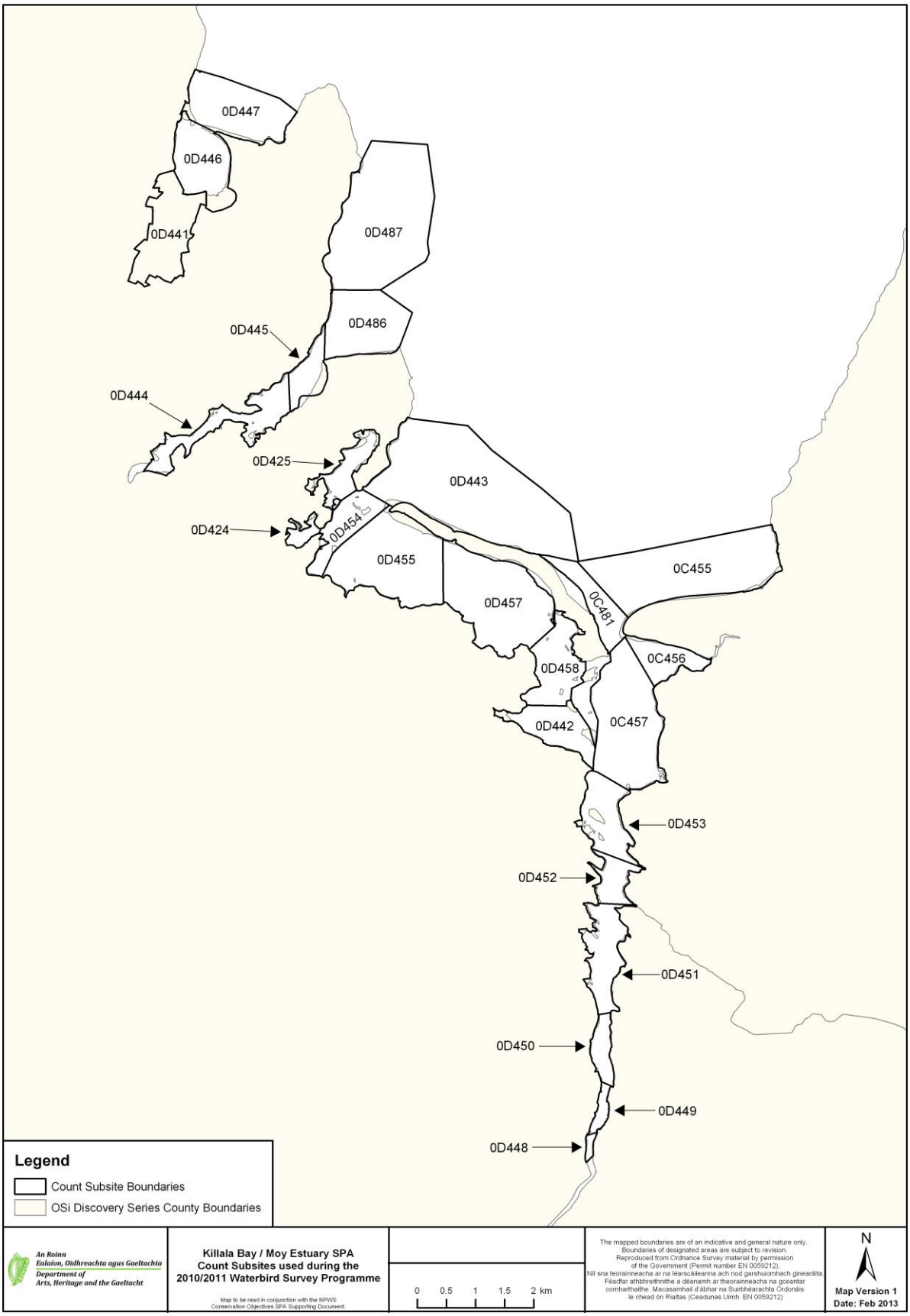
[a] dives <3m.

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

Killala Bay/Moy Estuary – Waterbird Survey Programme 2010/11 – Count Subsites

Subsite Code	Subsite name	Subsite Area (ha)
0C455	Inishcrone Beach (low-tide)	301.13
0C456	Barrow	60.07
0C457	Scurmore	232.54
0C481	Bartragh Island East	69.14
0D424	Croghan Bay	17.67
0D425	Ross Bay (Killala)	58.01
0D441	Killogeary	136.37
0D442	Ballysakeery	87.00
0D443	Bartragh Island northwest	472.27
0D444	Rathfran Friary	102.12
0D445	Steelaun	50.23
0D446	Lackan Bay inner	118.19
0D447	Lackan Bay outer	153.25
0D448	Quignaleka	5.91
0D449	Belleek	15.86
0D450	Garrankeel - Rathmoy	34.83
0D451	Carrowkelly	95.59
0D452	Castleconnor	44.40
0D453	Inishdugh	94.24
0D454	Killala - Rinnaun Point	73.24
0D455	Kilroe	235.60
0D457	Bartragh Is. South	243.39
0D458	Bullockpark	104.14
0D486	Rathfran Bay	141.88
0D487	Ballinlena	361.22


0D447
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0D487
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0D444
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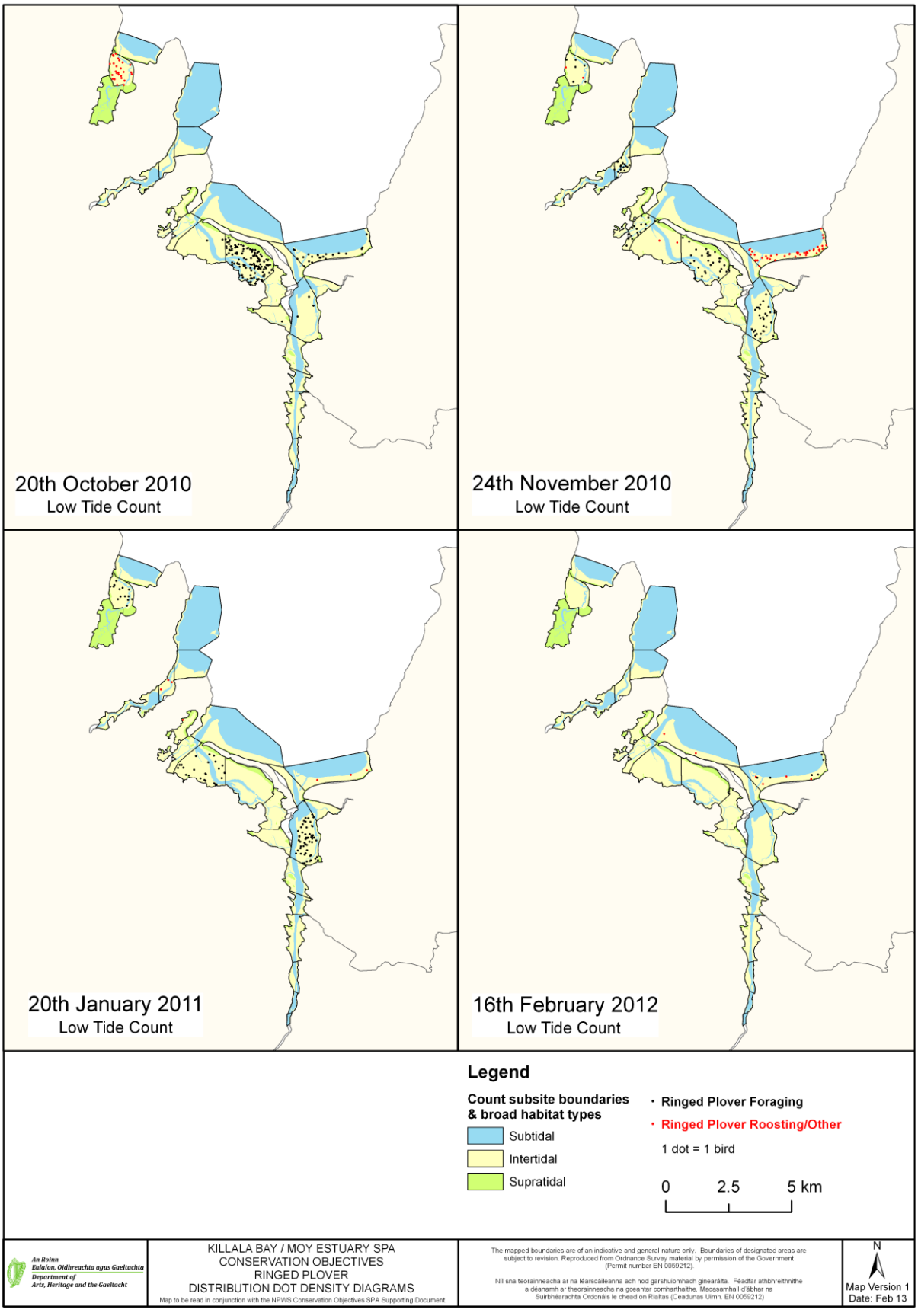
0D455
0C455
0D457
0C481
0C456
0D458
0D442
0C457
0D453
0D452
0D451
0D450
0D449
0D448
Legend
Count Subsite Boundaries
OSi Discovery Series County Boundaries
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Killala Bay / Moy Estuary SPA
Count Subsites used during the
2010/2011 Waterbird Survey Programme
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
0 0.5 1 1.5 2 km
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: Feb 2013

APPENDIX 7

Killala Bay/Moy Estuary

Waterbird distribution (dot-density diagrams) recorded during low tide surveys (October 2010 – February 2011)

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


20th October 2010
Low Tide Count
24th November 2010
Low Tide Count
20th January 2011
Low Tide Count
16th February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Ringed Plover Foraging
Ringed Plover Roosting/Other
1 dot = 1 bird
0
2.5
5 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
KILLALA BAY / MOY ESTUARY SPA
CONSERVATION OBJECTIVES
RINGED PLOVER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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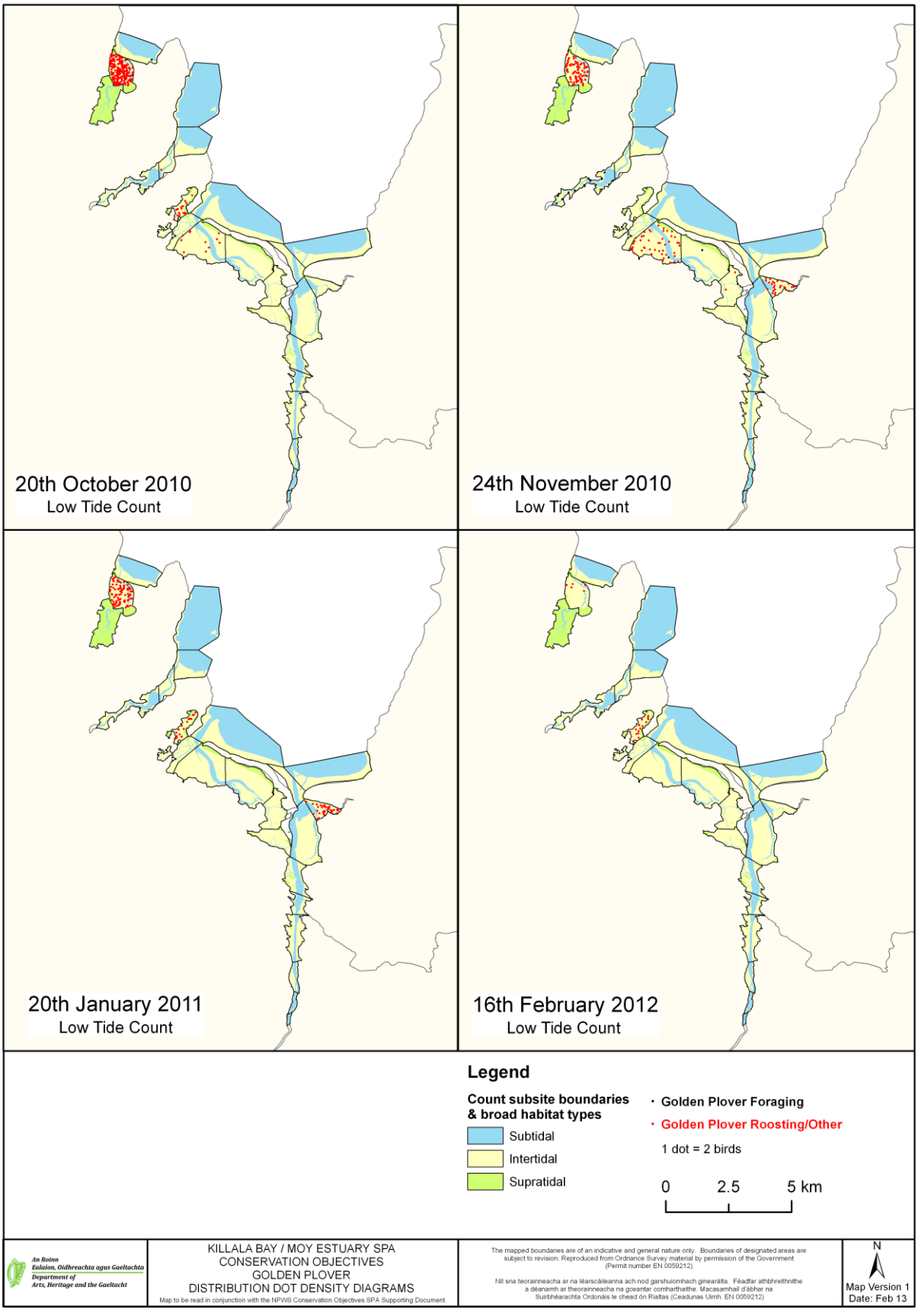
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: Feb 13


20th October 2010
Low Tide Count
24th November 2010
Low Tide Count
20th January 2011
Low Tide Count
16th February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Golden Plover Foraging
Golden Plover Roosting/Other
1 dot = 2 birds
0
2.5
5 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
KILLALA BAY / MOY ESTUARY SPA
CONSERVATION OBJECTIVES
GOLDEN PLOVER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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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)
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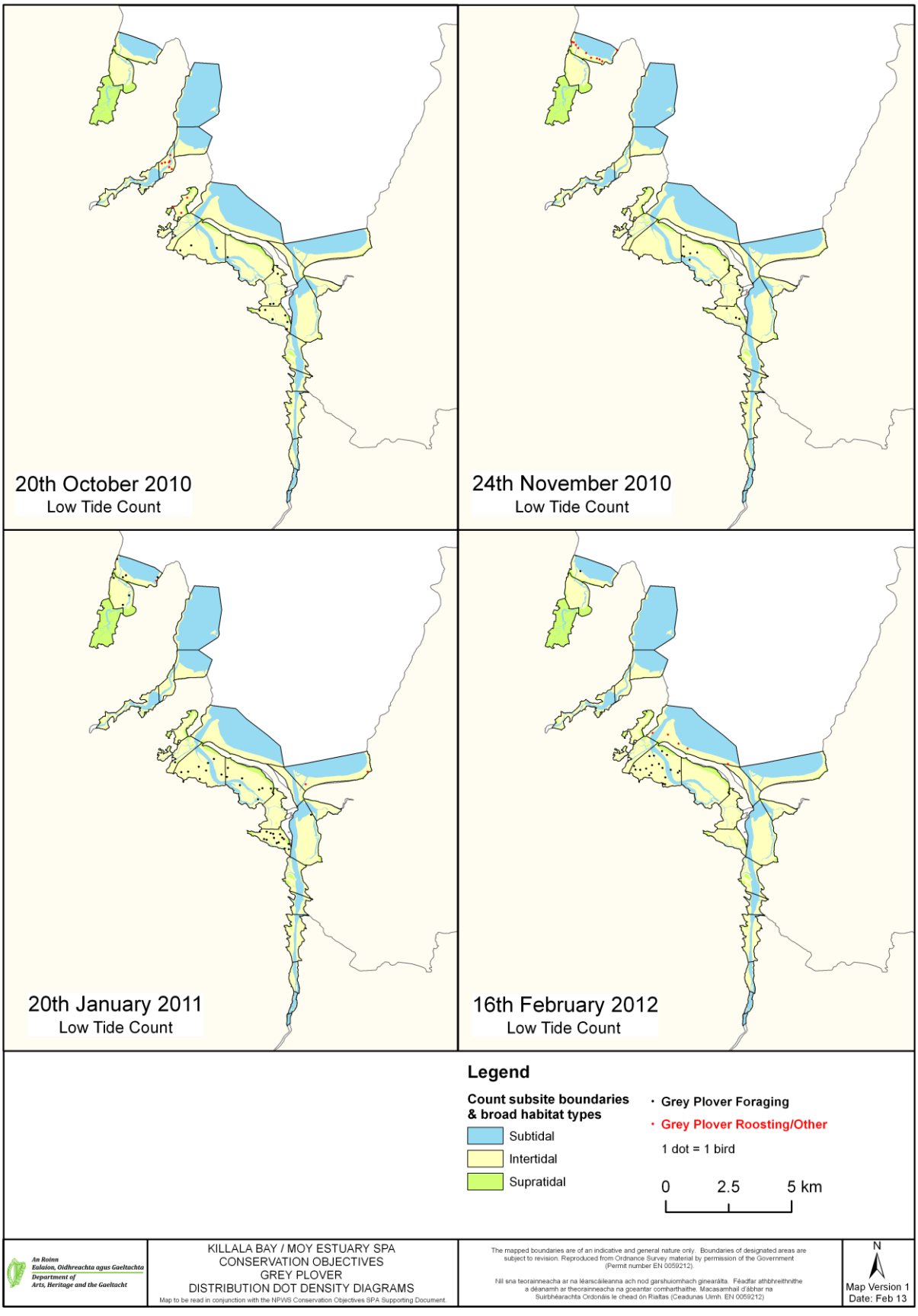
Map Version 1
Date: Feb 13


20th October 2010
Low Tide Count
24th November 2010
Low Tide Count
20th January 2011
Low Tide Count
16th February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Grey Plover Foraging
Grey Plover Roosting/Other
1 dot = 1 bird
0
2.5
5 km
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Department of Arts, Heritage and the Gaeltacht
KILLALA BAY / MOY ESTUARY SPA
CONSERVATION OBJECTIVES
GREY PLOVER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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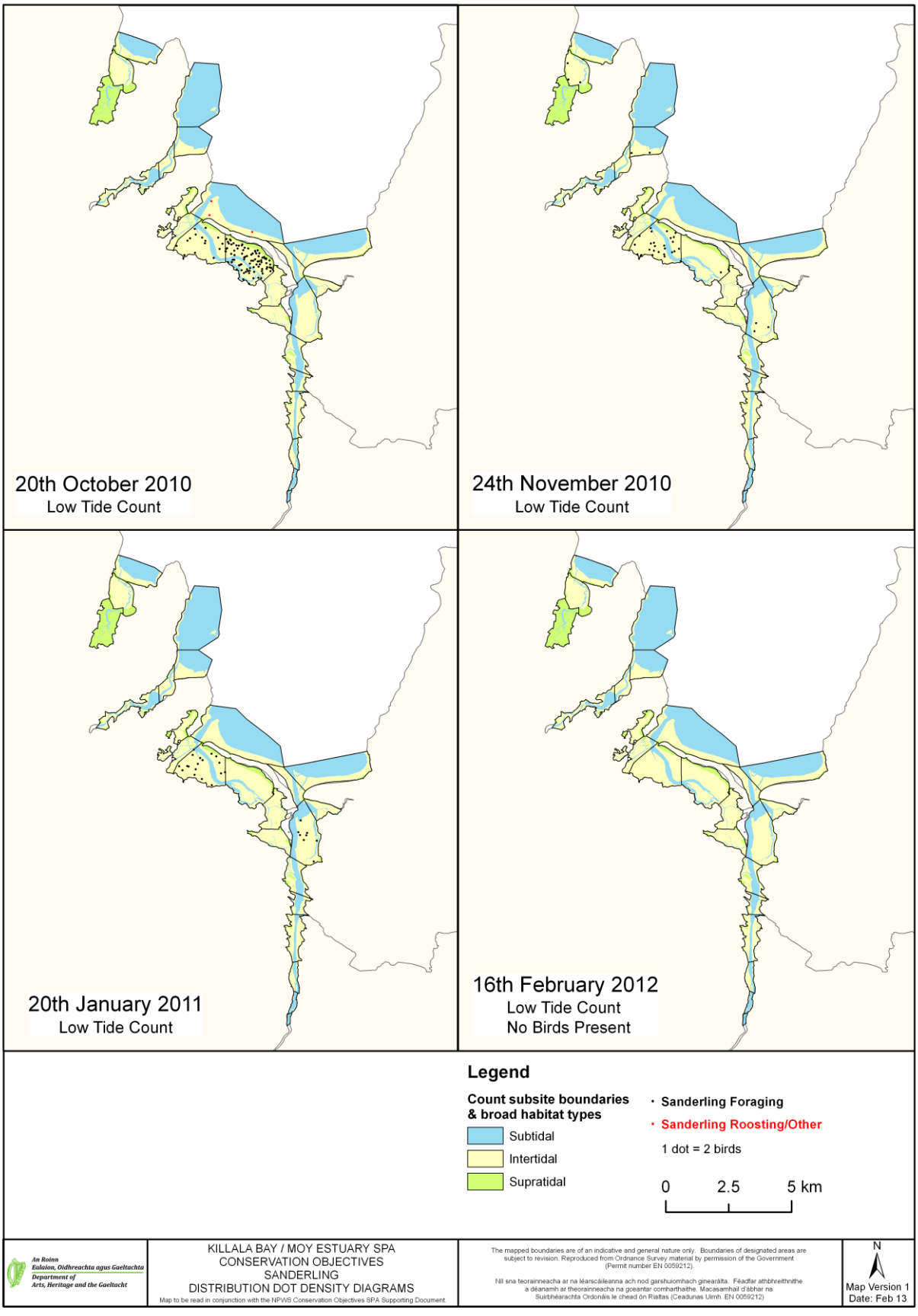
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: Feb 13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Low Tide Count
24th November 2010
Low Tide Count
20th January 2011
Low Tide Count
16th February 2012
Low Tide Count
No Birds Present
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Sanderling Foraging
Sanderling Roosting/Other
1 dot = 2 birds
0
2.5
5 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
KILLALA BAY / MOY ESTUARY SPA
CONSERVATION OBJECTIVES
SANDERLING
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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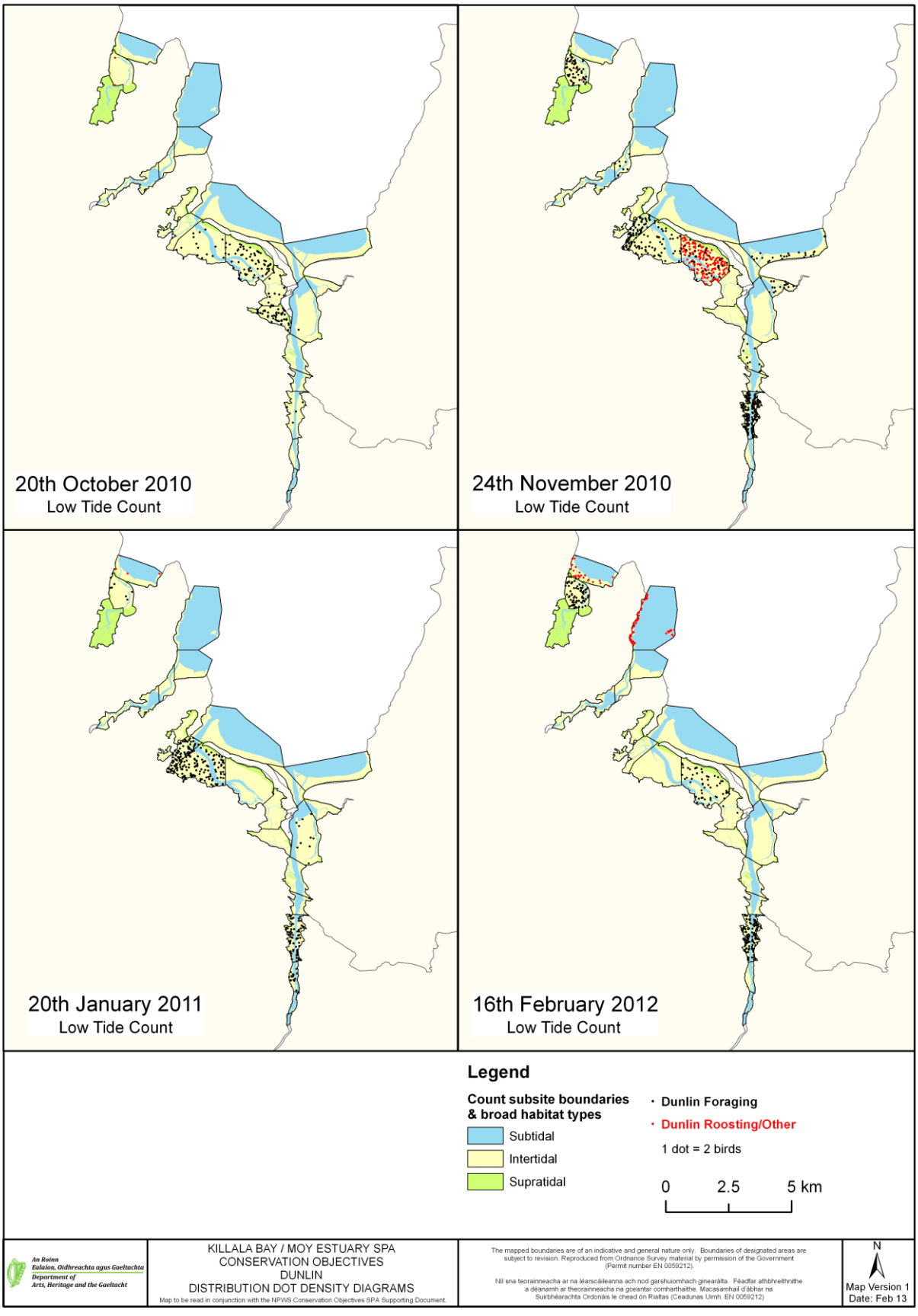
Date: Feb 13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24th November 2010
Low Tide Count
20th January 2011
Low Tide Count
16th February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Dunlin Foraging
Dunlin Roosting/Other
1 dot = 2 birds
0
2.5
5 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
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CONSERVATION OBJECTIVES
DUNLIN
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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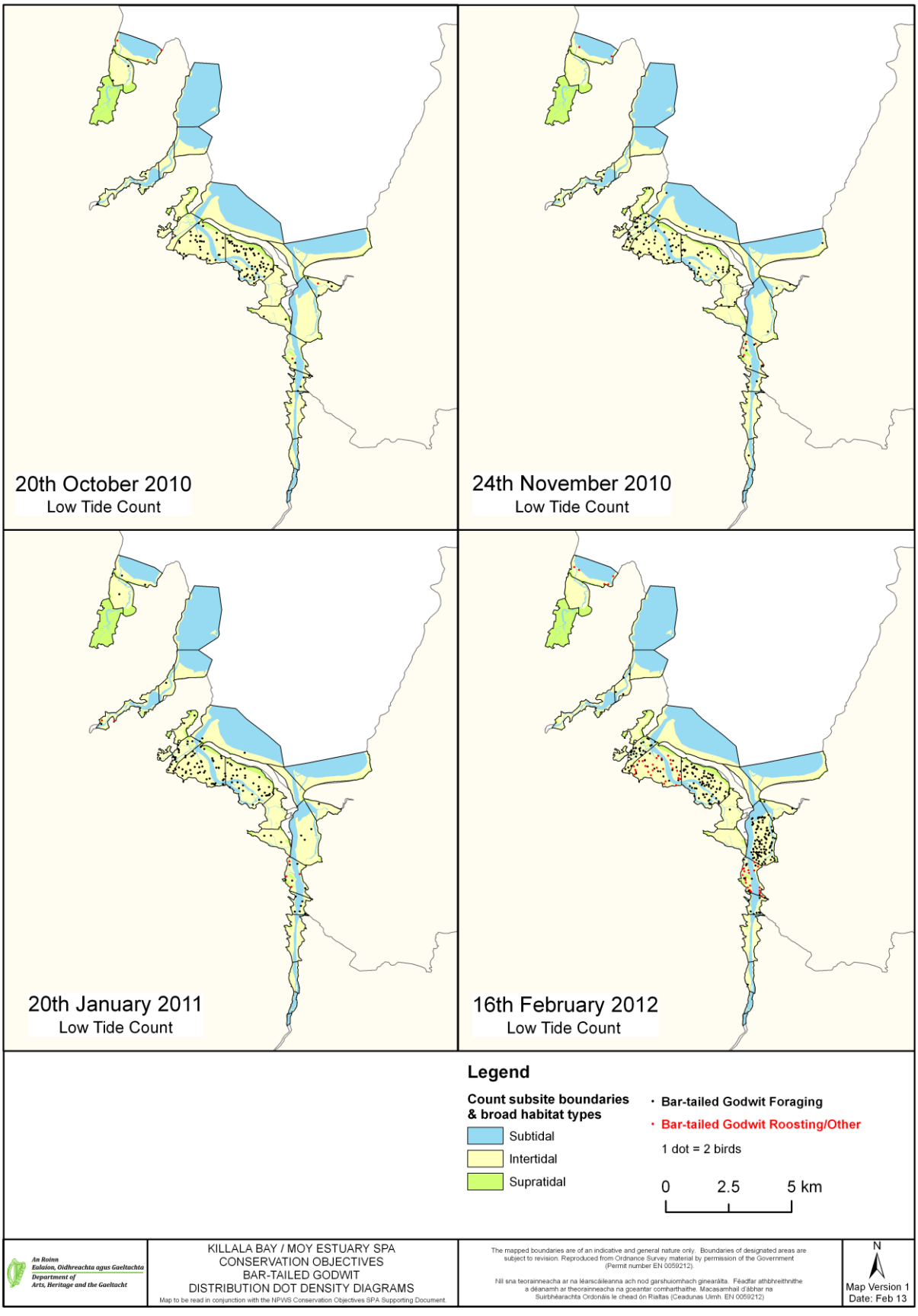
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24th November 2010
Low Tide Count
20th January 2011
Low Tide Count
16th February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Bar-tailed Godwit Foraging
Bar-tailed Godwit Roosting/Other
1 dot = 2 birds
0
2.5
5 km
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KILLALA BAY / MOY 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.
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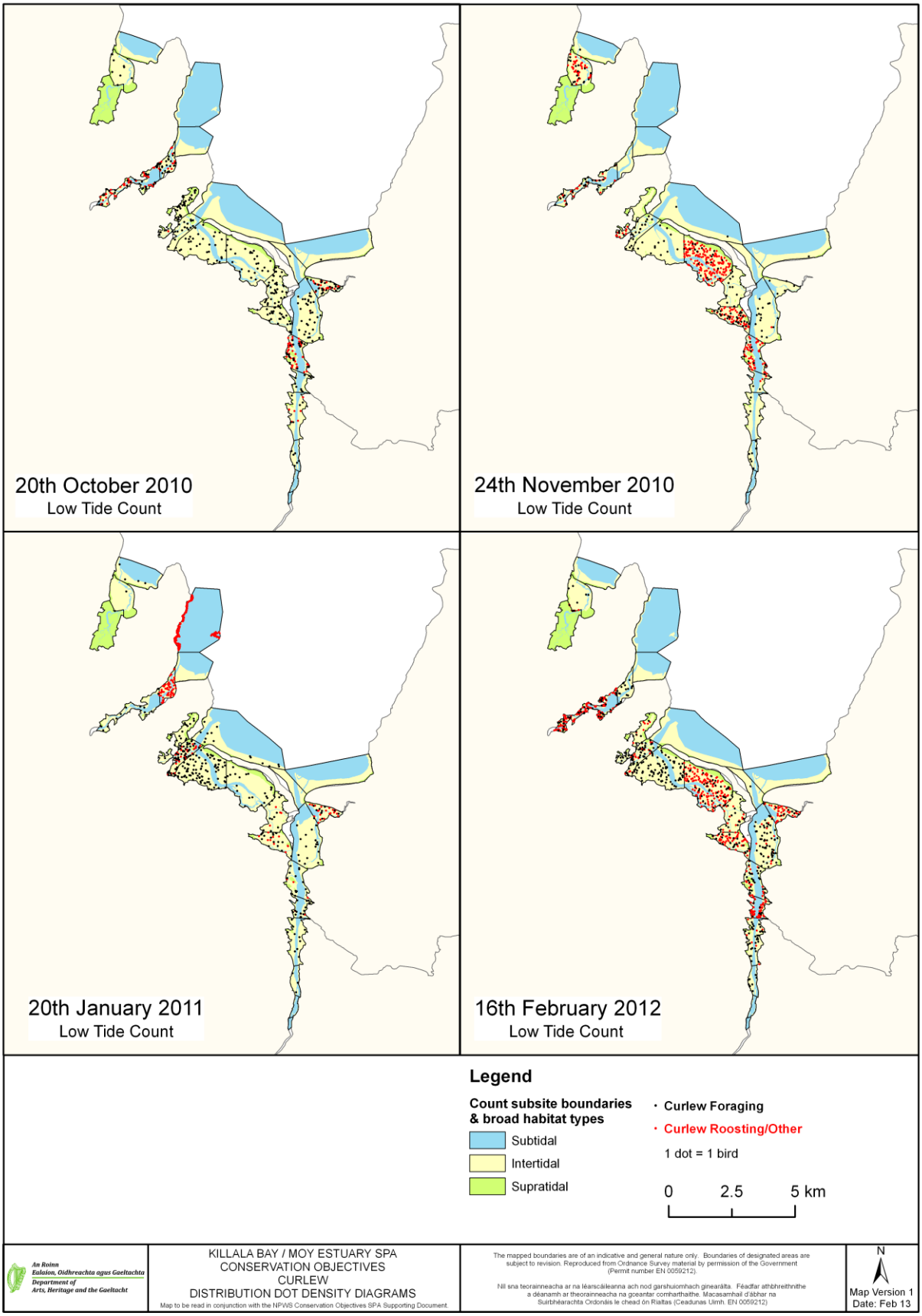
Map Version 1
Date: Feb 13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Low Tide Count
24th November 2010
Low Tide Count
20th January 2011
Low Tide Count
16th February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Curlew Foraging
Curlew Roosting/Other
1 dot = 1 bird
0
2.5
5 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
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KILLALA BAY / MOY ESTUARY SPA
CONSERVATION OBJECTIVES
CURLEW
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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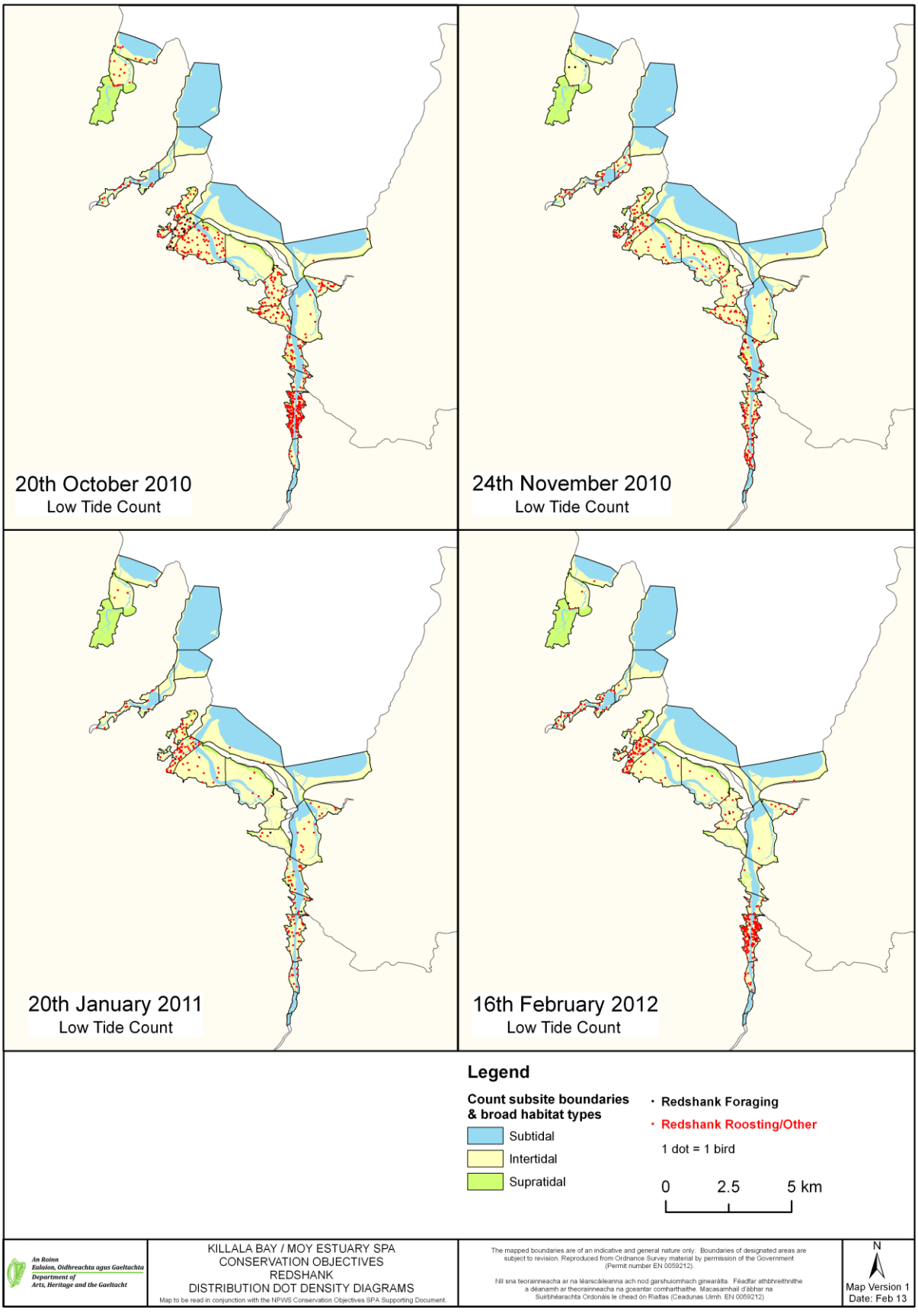
Map Version 1
Date: Feb 13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Low Tide Count
24th November 2010
Low Tide Count
20th January 2011
Low Tide Count
16th February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Redshank Foraging
Redshank Roosting/Other
1 dot = 1 bird
0
2.5
5 km
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KILLALA BAY / MOY 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).
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N
Map Version 1
Date: Feb 13

APPENDIX 8

Killala Bay/Moy Estuary

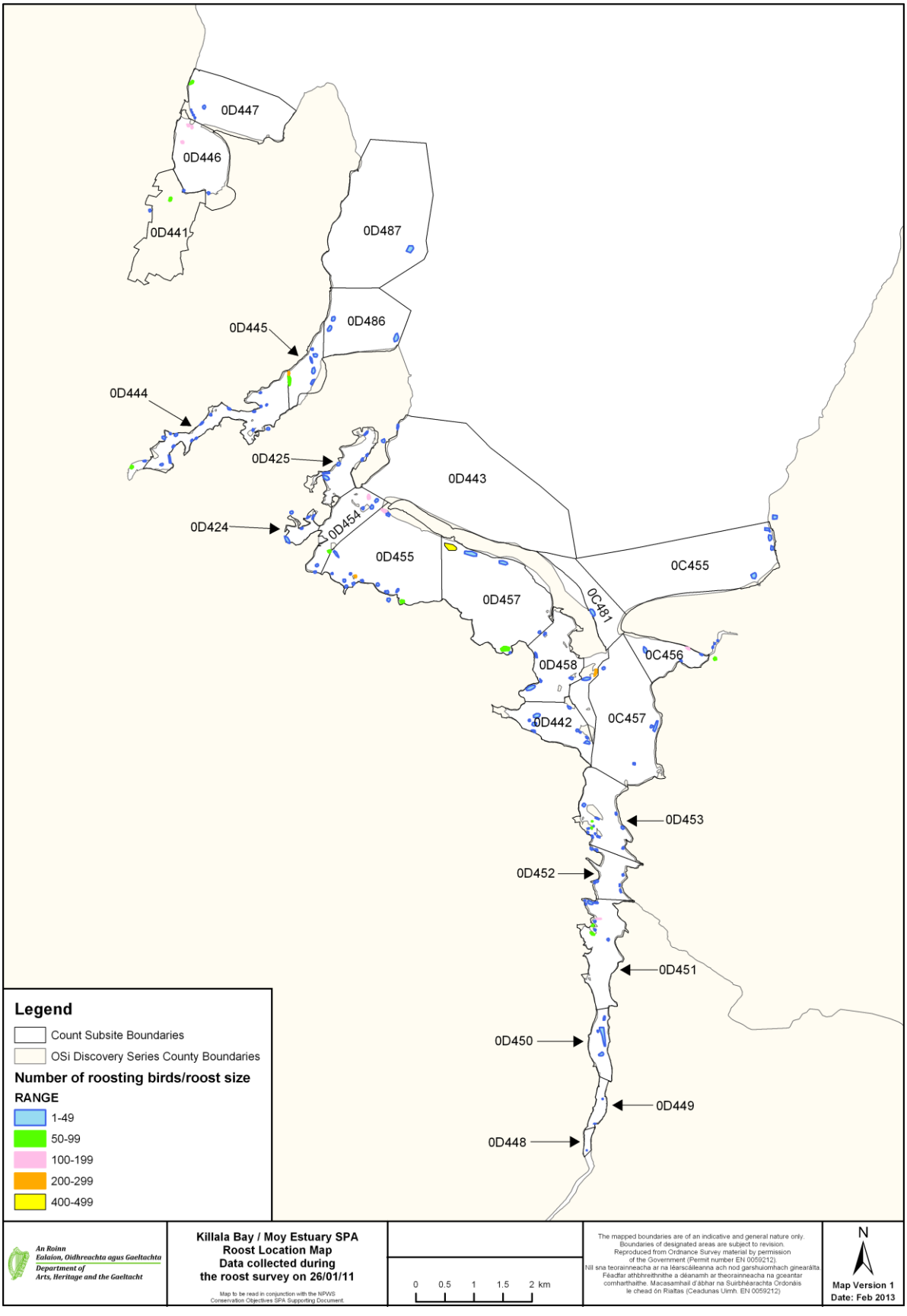
(1a) Summary data and roost location maps from the roost survey 26th January 2011
(Please see Sections 5.3.1 and 5.3.2 for further details on methods/limitations)

Subsite Code	Subsite Name	No. roost locations	No. species	Species
0C455	Inishcrone Beach (low-tide)	5	7	BH, CM, HG, KN, OC, RP, SS
0C456	Barrow	8	9	BA, CM, CU, L., OC, RK, SN, T., WN
0C457	Scurmore	6	9	BA, BH, CA, HG, L., OC, RK, SU, WN
0C481	Bartragh Island East	1	3	BH, GB, HG
0D424	Croghan Bay	6	7	CU, ET, MA, PB, SU, T., WN
0D425	Ross Bay (Killala)	7	7	CU, DN, ET, H., L., OC, SU
0D441	Killogeary	2	3	BH, CM, L.
0D442	Ballysakeery	9	7	CM, CU, GK, OC, RK, SU, WN
0D443	Bartragh Island northwest	1	1	RK
0D444	Rathfran Friary	19	10	BH, CA, CM, CU, GK, MA, RK, SU, T., WN
0D445	Steelaun	7	13	BA, CA, CM, CU, DN, HG, L., MA, OC, RK, SU, T., WN
0D446	Lackan Bay inner	5	6	BA, CM, DN, GV, OC, WN
0D447	Lackan Bay outer	6	6	CM, CU, DN, GV, ND, OC
0D448	Quignaleka	1	1	CA
0D449	Belleek	2	1	BH
0D450	Garrankeel - Rathmoy	4	2	BH, RM
0D451	Carrowkelly	10	8	BH, CA, CU, L., MA, RK, T., WN
0D452	Castleconnor	7	7	CU, GK, GJ, MA, RK, T., WN
0D453	Inishdugh	13	11	BA, BH, CU, DN, GK, L., MA, RK, SU, T., WN
0D454	Killala - Rinnaun Point	7	12	BA, CA, CM, CU, DN, GK, HG, MA, PB, RM, RK, SA
0D455	Kilroe	15	16	BA, CA, CM, CU, DN, GK, HG, L., MA, OC, PB, RK, SU, T., TT, WN
0D457	Bartragh Is. South	6	6	CU, GK, OC, SU, T., U.
0D458	Bullockpark	5	7	CU, DN, GK, RK, SU, T., WN
0D486	Rathfran Bay	3	11	BA, CA, CM, CU, DN, GB, GV, HG, OC, RK, SA
0D487	Ballinlena	1	1	XU (unidentified Shag/Cormorant)

* note that numbers of birds are not totalled for each subsite because some subsites were visited more than once and the same birds may have been counted more than once.

(1b) Killala Bay/Moy Estuary SPA (4036) SCI species and recorded roosts 26/01/11 - shows number of roost locations within subsite, and in brackets, the peak number recorded at a single roost location

Subsite Code	RP	BA	GP	GV	SS	DN	CU	RK
0C455	1 (4)				1 (43)			
0C456		1 (25)					3 (40)	1 (4)
0C457		1 (87)					2 (55)	1 93)
0C481								
0D424							1 (36)	
0D425						1 (8)	2 (32)	
0D441								
0D442							1 (4)	2 (22)
0D443								1 (1)
0D444							5 (38)	8 (20)
0D445		1 (1)				1 (23)	1 (7)	1 (13)
0D446		1 (15)		1 (40)		2 (60)		
0D447				1 (6)		2 (20)	1 (39)	
0D448								
0D449								
0D450								
0D451							1 (1)	1 (50)
0D452							1 (17)	1 (2)
0D453		2 (1)				1 (19)	4 (4)	6 (8)
0D454		1 (47)				1 (73)	1 (20)	1 (5)
0D455		4 (210)				1 (2)	8 (50)	7 (19)
0D457							1 (38)	1 (5)
0D458						1 (1)	2 (11)	
0D486		1 (35)		1 (16)		1 (10)	1 (3)	1 (8)
0D487								


0D447
0D446
0D441
0D487
0D445
0D486
0D444
0D425
0D443
0D424
0D454
0D455
0C455
0D457
0C481
0C456
0D458
0D442
0C457
0D453
0D452
0D451
0D450
0D449
0D448
Legend
Count Subsite Boundaries
OSi Discovery Series County Boundaries
Number of roosting birds/roost size
RANGE
1-49
50-99
100-199
200-299
400-499
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Killala Bay / Moy Estuary SPA
Roost Location Map
Data collected during
the roost survey on 26/01/11
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
0 0.5 1 1.5 2 km
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: Feb 2013

(2a) Summary data and roost location maps from the roost survey 1st March 2011

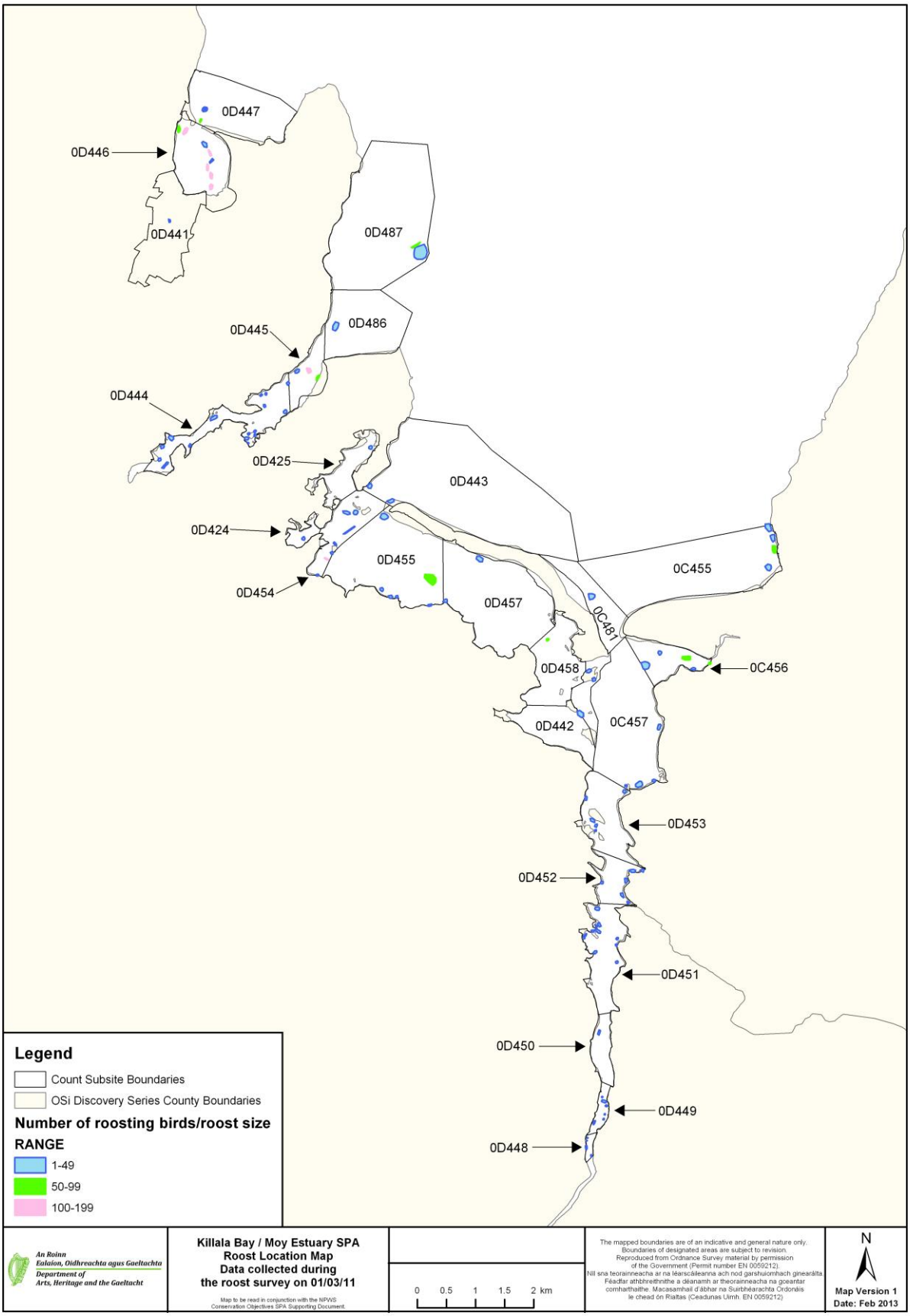
(Please see Sections 5.3.1 and 5.3.2 for further details on methods/limitations)

Subsite Code	Subsite Name	No. roost locations	No. species	Species
0C455	Inishcrone Beach (low-tide)	4	6	CM, DN, OC, PB, PS, RP
0C456	Barrow	5	5	BH, CM, CU, OC, PB
0C457	Scurmore	5	7	CU, GK, MA, PB, RK, SU, WN
0C481	Bartragh Island East	1	2	HG, RM
0D424	Croghan Bay	1	1	CU, MA, PB, RK, SU, WN
0D425	Ross Bay (Killala)	1	1	GP
0D441	Killogeary	1	1	CM
0D442	Ballysakeery	1	1	CU
0D443	Bartragh Island northwest	2	5	CA, GB, HG, OC, SA
0D444	Rathfran Friary	16	10	BH, CM, CU, MA, RM, RK, SN, SU, T., WN
0D445	Steelaun	3	5	BH, CM, MA, PB, SU
0D446	Lackan Bay inner	8	9	BH, CM, CU, DN, GP, HG, KN, OC, RP
0D447	Lackan Bay outer	5	5	GB, GV, HG, KN, OC
0D448	Quignaleka	5	5	BH, CM, CU, OC, RK
0D449	Belleek	6	3	BH, CM, HG
0D450	Garrankeel - Rathmoy	1	1	T.
0D451	Carrowkelly	12	7	BH, CA, GK, L., MA, RK, T.
0D452	Castleconnor	6	7	CU, GK, ET, MA, RK, T., WN
0D453	Inishdugh	5	6	CU, GK, MA, RK, T., WN
0D454	Killala - Rinnaun Point	7	10	BH, CM, CU, ET, GB, GP, HG, MA, PB, RK
0D455	Kilroe	6	7	BA, CA, CU, GK, OC, RK, TT
0D457	Bartragh Is. South	2	4	BA, DN, GV, T.
0D458	Bullockpark	2	3	CU, OC, TT
0D486	Rathfran Bay	1	3	BA, HG, OC
0D487	Ballinlena	2	8?	CA, CM, GB, HG, OC, SA, U., UU

* note that numbers of birds are not totalled for each subsite because some subsites were visited more than once and the same birds may have been counted more than once.
** note that some roosts overlap on the roost map.

(2b) Killala Bay/Moy Estuary SPA (4036) SCI species and recorded roosts 01/03/11 - shows number of roost locations within subsite, and in brackets, the peak number recorded at a single roost location

Subsite Code	RP	BA	GP	GV	SS	DN	CU	RK
0C455	2 (12)					1 (35)		
0C456							1 (75)	
0C457							2 (8)	1 (10)
0C481								
0D424							1 (3)	
0D425			1 (21)					
0D441								
0D442							1 (9)	
0D443								
0D444							6 (44)	1 (1)
0D445								
0D446	1 (10)		1 (166)			1 (87)	2 (20)	
0D447				1 (15)				
0D448								1 (9)
0D449								
0D450								
0D451								2 (10)
0D452							1 (15)	2 (9)
0D453							1 (4)	1 (17)
0D454			1 (1)				3 (11)	1 (3)
0D455		1 (3)					3 (51)	1 (9)
0D457		1 (3)		1 (7)		1 (5)		
0D458							2 (38)	
0D486								
0D487		1 (8)						


0D447
0D446
0D441
0D487
0D486
0D445
0D444
0D425
0D443
0D424
0D455
0C455
0D454
0D457
0C481
0D458
0C456
0D442
0C457
0D453
0D452
0D451
0D450
0D449
0D448
Legend
Count Subsite Boundaries
OSi Discovery Series County Boundaries
Number of roosting birds/roost size
RANGE
1-49
50-99
100-199
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Killala Bay / Moy Estuary SPA
Roost Location Map
Data collected during the roost survey on 01/03/11
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
0 0.5 1 1.5 2 km
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 Ordanáis le cead ón Rialtas (Ceadunas Uimh. EN 0059212)
N
Map Version 1
Date: Feb 2013

APPENDIX 9

Killala Bay/Moy 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 Killala Bay/Moy 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	0C455	0C456	0C457	0C481	0D424	0D425	0D441	0D442	0D443	0D444	0D445	0D446
1. Coastal protection, sea defences & stabilisation												
1.1 Linear defences	O											
4. Industrial, port & related development												
4.2 Fishing harbour	H											
4.3 Slipway	O											
4.4 Pier	O											
6. Pollution												
6.1 Domestic & urban waste water	O				O							
6.4 Agricultural & forestry effluents					O	O		O				
6.8 Others										O		
8. Transport & communications												
8.3 Bridges & aqueducts										O		
8.5 Road schemes	O				P							
8.6 Car parks	O								O			
11.2 Nature trails			O									
12.7 Jet-skiing	O											
12.10 SCUBA & snorkeling	O								P			
12.11 Canoeing	O											
12.12 Surfing	O											
12.13 Rowing	O											
12.15 Angling									O			
12.17 Bathing & general beach recreation	O								O			
12.18 Walking, incl. dog walking	O	O		O					O			O
12.19 Birdwatching								O	O			
12.22 Motorised vehicles												O

12.23 Horse-riding	O	O							O			
12.25 Golf courses		O							P			
14. Bait-collecting												
14.1 Digging for lugworms/ragworms							O		O			
15. Fisheries & Aquaculture												
15.1 Professional passive fishing (e.g. longlining)		U	U	U		U	U	U	U	U	U	U
15.4 Fish traps & other fixed devices & nets									U			
15.5 Leisure fishing	O								O			
15.6 Molluscs - hand-gathering												O
16.1 Saltmarsh grazing/harvesting						O						
16.2 Grazing: intensive (terrestrial)						O		O				
16.4 Sand dune grazing						O			O			O
16.5 Stock feeding						O						O
16.10 Mowing/grassland cutting								O				
16.16 Agricultural activities not mentioned above						O						
19. Natural events												
19.2 Severe cold weather	O	O	O	O	O	O	O	O	O	O	O	O

Activity/Event	0D447	OD448	0D449	0D450	0D451	0D452	0D453	0D454	0D455	0D457	0D458	0D486	0D487
1. Coastal protection, sea defences & stabilisation													
1.1 Linear defences			O					O					
1.2 Training walls								O					
1.5 Marram grass planting									H	H			
2. Barrage schemes/drainage													
2.2 Altered drainage/river channel								O					
4. Industrial, port & related development													
4.2 Fishing harbour								O					
4.3 Slipway			O								H		
4.4 Pier	O		O					O/P					O
4.7 Ship & boat building/repair								O					
6. Pollution													
6.1 Domestic & urban waste water						O	O	O					
6.4 Agricultural & forestry effluents						O	O						
8. Transport & communications													
8.6 Car parks								P					
8.8 Rail lines									O				
12. Tourism & recreation													
12.1 Marinas								P					
12.2 Non-marina moorings			O										
12.5 Leisure centres, sports ground		O						P					
12.14 Tourist boat trips								O					
12.15 Angling								O				O	
12.17 Bathing & general beach recreation													
12.18 Walking, incl. dog walking	O	O	O		O		O	O					

12.19 Birdwatching						O	O	O		O	O		
12.22 Motorised vehicles									O				
12.23 Horse-riding							O						
12.25 Golf courses									P	P	P		
14. Bait-collecting													
14.1 Digging for lugworms/ragworms								O					
15. Fisheries & Aquaculture													
15.1 Professional passive fishing (e.g. longlining)	U							U	U	U	U	U	U
15.2 Professional active fishing	U												U
15.4 Fish traps & other fixed devices & nets												U	U
15.5 Leisure fishing	O												
15.6 Molluscs - hand-gathering									O		O		
15.8 Fish-farming			H										
15.9 Intertidal aquaculture e.g. trestles									O	O			
16. Agriculture & forestry													
16.1 Saltmarsh grazing/harvesting					O					O			
16.2 Grazing: intensive (terrestrial)						O	O						
16.3 Grazing: non-intensive (terrestrial)					O								
16.4 Sand dune grazing	O								O	O			
16.10 Mowing/grassland cutting						O	O						
19. Natural events													
19.2 Severe cold weather	O	O	O	O	O	O	O	O	O	O	O	O	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 records from the 2010/11 Waterbird Survey Programme

Activity/Event	0C455	0C456	0C481	0D446	0D447	0D448	0D449	0D451	0D455	0D457	0D458
12. Tourism & recreation											
12.18 Walking, incl. dog walking	7	5	7	7	6	5	6	7			
12.22 Motorised vehicles				6							
12.23 Horse-riding	5	6/7									
15. Fisheries & Aquaculture											
15.6 Molluscs - hand-gathering									3		3
15.9 Intertidal aquaculture e.g. trestles									5	6	