Boyne Estuary
Special Protection Area

(Site Code 4080)

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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 Boyne 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 designation process and to the site designated as Boyne Estuary Special Protection Area, as well as introducing the concept of conservation objectives and their formulation.

Part Two provides site designation information for Boyne Estuary Special Protection Area 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 2011/12 Waterbird Survey Programme, drawing also on data from NPWS monitoring programmes (e.g. benthic surveys) and the Irish Wetland Bird Survey (I-WeBS). Part Five concludes with information on activities and events that occur in and around the site which may interact with waterbirds during the non-breeding season and includes an assessment of activities that were recorded to cause disturbance to non-breeding waterbirds during the 2011/12 Waterbird Survey Programme.

PART ONE - INTRODUCTION

1.1 Introduction to the designation of Special Protection Areas

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

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

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

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

The National Parks & Wildlife Service (NPWS), part of the Department of the Arts, Heritage and the Gaeltacht, 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 important is compiled. These species are known as **Special Conservation Interests** and can be divided into two categories:

Selection species:

The species occurring at a site which identifies the site as qualifying for SPA status i.e. a species that met at least one of the following conditions:

- 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; and/or
- 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).

Additional Conservations Interests:

- Relevant Annex I or migratory species which exceed the all-Ireland 1% threshold during the baseline period but were not selection species for the site.

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

1.2 Introduction to Boyne Estuary Special Protection Area

This moderately-sized coastal site is situated east of Drogheda Town on the border of Counties Louth and Meath. The site comprises the estuary of the Boyne River, from downstream of the town of Drogheda, flowing eastwards towards Baltray where it narrows behind a sand and shingle spit bounded by sand dunes, before entering the sea. A stretch of sandy coastline north and south of the estuary mouth is included in the designated site.

Apart from one section which is over 1 km wide, the estuary width is mostly less than 500 m. The river channel, which is navigable and regularly dredged to allow passage to the port of Drogheda, is defined by training walls which are breached in several places. Intertidal flats occur along both sides of the channelled river.

The estuary sediments vary from fine muds in the sheltered areas to sandy muds or sands towards the mouth while the linear stretches of shoreline north and south of the estuary mouth are composed mostly of sand (sand flats). Eelgrass (*Zostera* spp.) was known to occur in the estuary (but not recorded during recent intertidal surveys) and several intertidal areas are fringed with salt marsh.

The Site Synopsis for Boyne 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[3] 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 Boyne 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).

[3] Conservation objectives for breeding SCI species are in prep.

PART TWO – SITE DESIGNATION INFORMATION

2.1 Special Conservation Interests of Boyne Estuary Special Protection Area

The **Selection Species** and **Additional Special Conservation Interests**[4] for Boyne Estuary SPA are listed below and summarised in Table 2.1. This table also shows the importance of Boyne Estuary SPA for SCI species, relative to the importance of other sites within Ireland, within the mid-east and border regions[5], and within Counties Meath and Louth[6].

The Selection Species listed for Boyne Estuary SPA are as follows:-

1. 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 6,070 individuals.

2. During winter the site regularly supports 1% or more of the all-Ireland population of Knot (*Calidris canutua*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 1,771 individuals.

3. During winter the site regularly supports 1% or more of the biogeographic population of Black-tailed Godwit (*Limosa limosa*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 471 individuals.

4. During winter the site regularly supports 1% or more of the all-Ireland population of Turnstone (*Arenaria interpres*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 175 individuals.

Additional Special Conservation Interests for Boyne Estuary SPA are as follows:

5. During winter the site regularly supports 1% or more of the all-Ireland population of Shelduck (*Tadorna tadorna*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 218 individuals.

6. During winter the site regularly supports 1% or more of the all-Ireland population of Oystercatcher (*Haematopus ostralegus*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 1,090 individuals.

7. 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 98 individuals.

8. During winter the site regularly supports 1% or more of the all-Ireland population of Lapwing (*Vanellus vanellus*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 4,657 individuals.

9. 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 69 individuals.

[4] Note that Special Conservation Interest species are listed in the order of Selection Species followed by additional Special Conservation Interest species. Within these two categories, species are listed in taxonomic order.

[5] This site sits on the border of the mid east and border regions.

[6] This site crosses the borders of Counties Meath and Louth.

10. 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 583 individuals.

11. The Boyne Estuary SPA supports a breeding population of the Annex I species Little Tern (*Sterna albifrons*). In 1995, the All-Ireland Tern Survey recorded a total of 14 pairs. This exceeds the all-Ireland 1% threshold making this site of national importance.

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

Table 2.1 Designation Summary: species listed for Boyne 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]
Selection Species	Golden Plover (*Pluvialis apricaria*)	Yes	6,070	All-Ireland importance	5	1	1
	Knot (*Calidris canutus*)		1,771	All-Ireland importance	5	2	2
	Black-tailed Godwit (*Limosa limosa*)		471	Biogeographic importance	14	2	2
	Turnstone (*Arenaria interpres*)		175	All-Ireland importance	8	1	1
Additional Special Conservation Interests	Shelduck (*Tadorna tadorna*)		218	All-Ireland importance	13	4	2
	Oystercatcher (*Haematopus ostralegus*)		1,090	All-Ireland importance	12	4	2
	Grey Plover (*Pluvialis squatarola*)		98	All-Ireland importance	17	2	2
	Lapwing (*vanellus vanellus*)		4,657	All-Ireland importance	11	2	2
	Sanderling (*Calidris alba*)		69	All-Ireland importance	14	1	1
	Redshank (*Tringa totanus*)		583	All-Ireland importance	12	4	3
	Little Tern (*Sterna albifrons*)	Yes	14 pairs (breeding population)	All-Ireland importance	n/a	n/a	n/a
Other conservation designations associated with the site[b]		**SAC**	**RAMSAR SITE**	**IMPORTANT BIRD AREA (IBA)**	**WILDFOWL SANCTUARY**	**OTHER**	**OTHER**
		SAC 1957	No	Yes	Yes	pNHA	

[a] Baseline data are the 5-year mean peak counts for the period 1995/96 – 1999/00 (I-WeBS) with the exception of Little Tern (see main text). n/a = not assessed.
[b] Note that other designations associated with Boyne 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 Mid East region and the Border region (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 Co Meath and Co Louth (cross-border site).

PART THREE – CONSERVATION OBJECTIVES FOR BOYNE ESTUARY SPA

3.1 Conservation Objectives for the non-breeding Special Conservation Interests of Boyne Estuary SPA

The overarching Conservation Objective for Boyne 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 Boyne 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 Boyne 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.[7] Waterbird populations are deemed to be unfavourable when they have declined by 25% or more, as assessed by the most recent population trend analysis.[8]

- 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.[9]

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).

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

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

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

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

Objective 2: *To maintain the favourable conservation condition of the wetland habitat at Boyne 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 **594 ha**, other than that occurring from natural patterns of variation.

The boundary of Boyne 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 Boyne Estuary SPA this broad category is estimated to be **165 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 Boyne Estuary SPA this is estimated to be **321 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[10] 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 Boyne Estuary SPA this is estimated to be **108 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.

[10] 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 Boyne Estuary SPA.

Objective 1: *To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Boyne Estuary SPA, which is defined by the following list of attributes and targets:*				
Parameter	**Attribute**	**Measure**	**Target**	**Notes**
Population	Population trend	Percentage change as per population trend assessment using waterbird count data collected through the Irish Wetland Bird Survey and other surveys.	The long term population trend should be stable or increasing	Waterbird population trends are presented in Part Four of this document.
Range	Distribution	Range, timing or intensity of use of areas used by waterbirds, as determined by regular low tide and other waterbird surveys.	There should be no significant decrease in the range, timing or intensity of use of areas by the waterbird species of Special Conservation Interest other than that occurring from natural patterns of variation.	Waterbird distribution from the 2011/12 waterbird survey programme is reviewed in Part Five of this document.
Objective 2: *To maintain the favourable conservation condition of the wetland habitat at Boyne 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 594 ha, other than that occurring from natural patterns of variation.	The wetland habitat area was estimated as 594 ha using OSI data and relevant orthophotographs.

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

4.1 Population data for non-breeding waterbird SCI species of Boyne Estuary SPA

Non-breeding waterbirds are counted at the Boyne Estuary each winter as part of the Irish Wetland Bird Survey (I-WeBS). With the exception of two seasons (2004/05 and 2005/06) the site has been counted in every year since its inception in 1994 (Crowe, 2005). The site was counted once in 2006/07; otherwise the core survey months (September to March inclusive) were covered in the majority of seasons. The core count 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[11].

In most seasons the site has been counted as a single count area covering approximately 452 ha (Crowe, 2005). Note that the SPA area and the I-WeBS count area are not coincident, the SPA being larger due to the inclusion of a shoreline section to the north of the estuary mouth.

Table 4.1 presents population[12] data for non-breeding waterbirds of the Boyne Estuary. Annual maxima were identified and used to calculate the five-year mean peak for each species. The baseline period was 1995/96 – 1999/00 and the most recent average is the four-year mean across the period 2005/06 – 2009/10.

When examining waterbird data, it is standard practice to use the mean of peak counts because they reflect more accurately the importance of a site for a particular species. Data are assessed within five-year periods (i.e. five-year peak mean) which help to account for inconsistencies in data gathering (i.e. differing coverage) or fluctuations in numbers. But 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 highlights where the numbers shown surpass thresholds of International or all-Ireland importance. These thresholds are different for the baseline and recent time periods used; international thresholds are outlined in Wetlands International (2002) and Wetlands International (2006) for the baseline and recent site data respectively, while all-Ireland thresholds are presented within Crowe et al. (2008).

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

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

Table 4.1 Population data for non-breeding waterbird Special Conservation Interest Species of Boyne Estuary SPA

Site Special Conservation Interests (SCIs)	Baseline Period[1] (1995/96 – 1999/00)	Recent Site Data[2] (2005/06 – 2009/10)
Golden Plover*	6,070 (n)	4,148 (n)
Knot*	1,771 (n)	859 (n)
Black-tailed Godwit*	471 (i)	231 (n)
Turnstone*	175 (n)	66
Shelduck	218 (n)	108
Oystercatcher	1,090 (n)	1,257 (n)
Grey Plover	98 (n)	77 (n)
Lapwing	4,657 (n)	1,936
Sanderling	69 (n)	200 (n)
Redshank	583 (n)	473 (n)

* denotes site selection species. [1]Baseline data is the 5-year mean peak count for the period 1995/96 – 1999/00; [2]recent site data is the 4-year mean for the 5-year period 2005/06 – 2009/10 (I-WeBS).
(i) denotes numbers of international importance; (n) denotes numbers of all-Ireland importance.

4.2 Waterbird population trends for the Boyne 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 (as opposed to the five year means calculated in Section 4.1 above) 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 non-breeding waterbird SCI species for the data period 1994/95 to 2008/09[13]. 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.

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.

[13] Note that the data period shown for I-WeBS data (Section 4.1) and the data period used for calculating population trends (Section 4.2) are not the same.

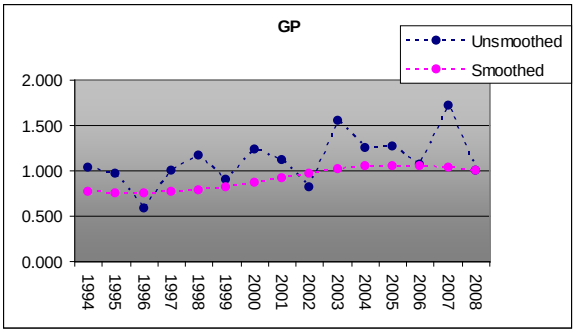
Table 4.2 Site Population Trends for non-breeding waterbird Special Conservation Interest species of Boyne Estuary SPA

Site Special Conservation Interests (SCIs)	Site Population Trend[1] 12 Yr	Site Population Trend[2] 5 Yr
Golden Plover*	+ 35.7	+ 5.3
Knot*	+ 80.1	- 20.4
Black-tailed Godwit*	+ 21.0	+ 27.8
Turnstone*	- 31.6	- 27.5
Shelduck	+ 39.0	+ 27.6
Oystercatcher	+ 7.7	- 12.5
Grey Plover	+ 64.0	- 27.2
Lapwing	- 45.9	+ 1.5
Sanderling	+ 366.8	- 28.2
Redshank	- 1.0	+ 23.9

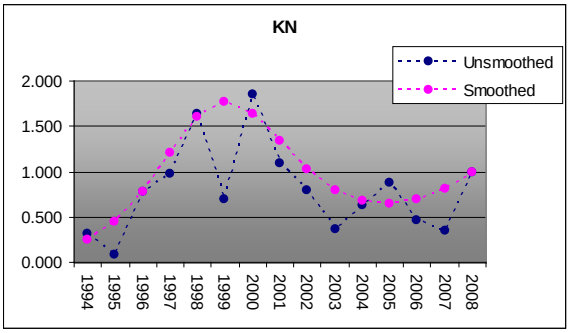
* denotes site selection species; [1]trend analysis: 12 yr = 1995/96 – 2007/08; [2]trend analysis: 5 yr = 2002/03 – 2007/08.

For selected species, explanatory notes are given below to aid the interpretation of trends. Graph headings use waterbird species codes and a list of these is provided in Appendix 4.

Golden Plover – the smoothed trend highlights a gradual increase in numbers up to 2007/08. The rate of increase was lower in the most recent five year period. This pattern is relatively consistent with the national trend (Boland & Crowe, 2012[14]).

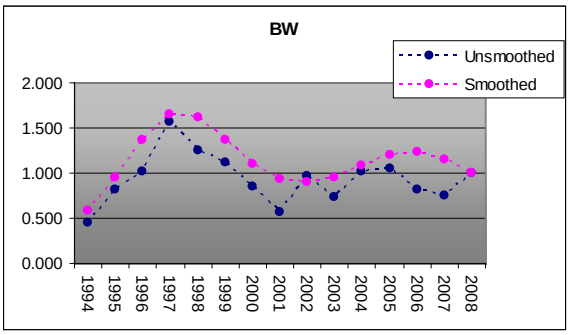


Knot – numbers have fluctuated throughout I-WeBS, with a period of increase (up to 2000/01) followed by a decrease, followed by a marginal increase in recent seasons. Nationally, numbers of Knot remained relatively stable up until 2005/06 and have since increased (Boland & Crowe, 2012).

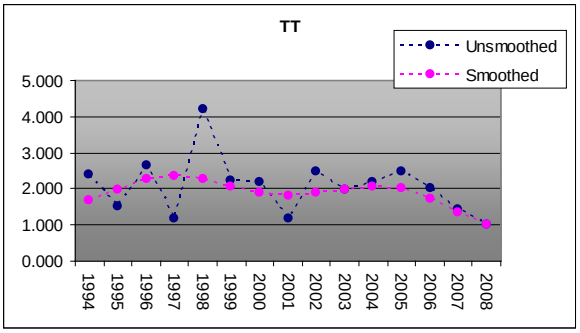


[14] National trends presented in Boland & Crowe (2012) update those previously shown in Crowe (2005).

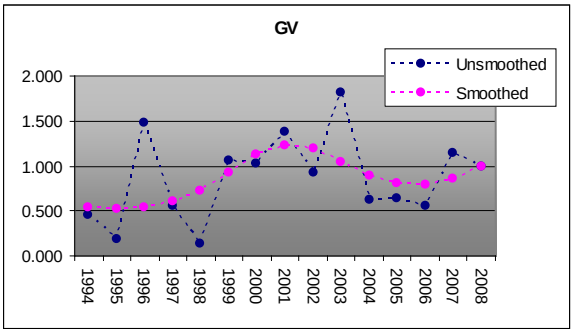
Black-tailed Godwit – numbers have fluctuated and there was an early period of increasing numbers (1994/95 to 1997/98) followed by a return to former levels. Nationally this species has increased throughout I-WeBS (Boland & Crowe, 2012).



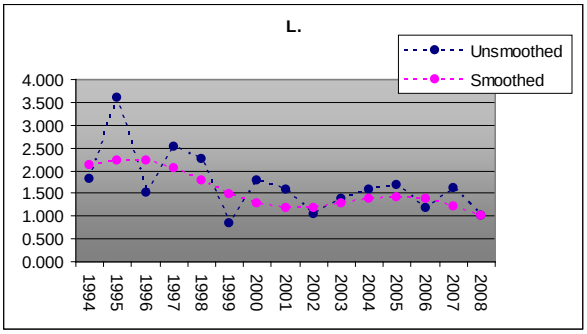
Turnstone – numbers at this site showed marked inter-annual variation, particularly during the early I-WeBS seasons, sometimes doubling or halving in successive years. A notable peak was recorded in the season 1998/99. The smoothed trend line however highlights the underlying gradual decline which became more marked in latter seasons.



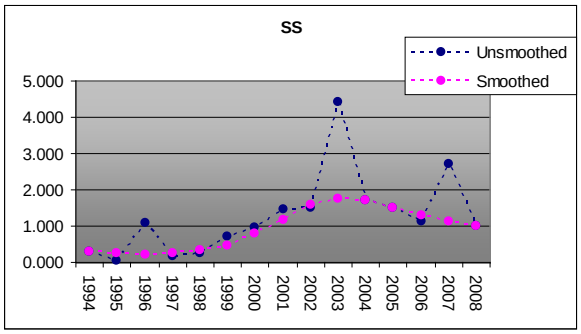
Grey Plover – there has been a long-term trend for increase which contradicts the national trend for decline (Boland & Crowe, 2012) and trends observed in Britain and Northern Ireland (Calbrade et al. 2010).



Lapwing – the smoothed trend highlights a progressive decrease in numbers throughout I-WeBS. This is consistent with the long-term national trend for decline (Boland & Crowe, 2012).



Sanderling – numbers at the Boyne Estuary increased since the mid 1990's. This increase is in line with the national trend (Boland & Crowe, 2012), although the numbers since the early to mid 2000's have shown a relatively shallow decline.



4.3 Boyne Estuary SPA – site conservation condition of non-breeding 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 to the ten non-breeding waterbird species of Special Conservation Interest listed for Boyne Estuary SPA, and based on the long-term population trend for the site, it has been determined that (Table 4.3):-

1. 2 species are currently considered as **Unfavourable** (Turnstone and Lapwing);
2. 1 species is currently considered as **Intermediate Unfavourable** (Redshank);
3. 7 species are currently considered as **Favourable** (Golden Plover, Knot, Black-tailed Godwit, Shelduck, Oystercatcher, Grey Plover and Sanderling);

Site conservation condition and population trends were also reviewed in light of species' all-Ireland and international trends (Table 4.3). The calculation of all-Ireland trends (island of Ireland) for the long-term (12-year) data period was facilitated by the provision of indices from

the I-WeBS and the WeBS database[15]; International trends follow Wetlands International (2006).

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

Special Conservation Interests	BoCCI Category[a]	Site Population Trend[b]	Site Conservation Condition	Current all-Ireland Trend[c]	Current International Trend[d]
Golden Plover*	Red	+ 35.7	Favourable	- 2.2	Decline
Knot*	Red	+ 80.1	Favourable	- 2.91	Decline
Black-tailed Godwit*	Amber	+ 21.0	Favourable	+ 70.2	Increase
Turnstone*	Green	- 31.6	Unfavourable	+ 16.1	Decline
Shelduck	Amber	+ 39.0	Favourable	+ 4.46	Stable
Oystercatcher	Amber	+ 7.7	Favourable	+ 23.5	Decline
Grey Plover	Amber	+ 64.0	Favourable	- 33.1	Decline
Lapwing	Red	- 45.9	Unfavourable	- 40.12	Decline
Sanderling	Green	+366.8	Favourable	+ 109.3	Stable/Increase
Redshank	Red	-1.0	Intermediate (Unfavourable)	+ 22.7	Stable/Decline

* denotes site selection species.
[a]After Lynas *et al.* (2007); [b] Site population trend analysis; see Table 4.2; [c]all-Ireland trend calculated for period 1994/95 to 2008/09; [d]international trend after Wetland International (2006).

Table 4.3 also shows the relationship between a species' long-term site trend and the current all-Ireland trend for the same time period (1994/95 to 2008/09). The colour coding used represents the following cases:-

- Green – species whose populations are stable or increasing at both site level and all-Ireland level.
- Beige – species whose populations are declining at both site level and all-Ireland 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 all-Ireland level.
- Pink - species whose populations are exhibiting a 25.0 – 49.9% decline at site level but are stable or increasing at all-Ireland level.
- Red - species whose populations are exhibiting a decline of >50.0% at site level but are stable or increasing at all-Ireland level.

The pink and red categories highlight where populations are stable at all-Ireland 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).

[15] kindly provided by the I-WeBS Office and the British Trust for Ornithology.

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 Boyne Estuary SPA.

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

The information provided is intended to:-

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

Note however, that the information does not aim to provide a comprehensive assessment on which to assess plans and projects as required under the Habitats Directive, but rather should inform the scope of these assessments and help direct where further detailed examinations are required. The information presented in this report was compiled in August 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 54 waterbird species that have been recorded within the Boyne Estuary count area. These species represent eleven waterbird families: *Gaviidae* (divers), *Podicipedidae* (grebes), *Anatidae* (swans, geese and ducks), *Rallidae* (Water Rail, Moorhen & Coot), *Haematopodidae* (oystercatchers), *Charadriidae* (plovers and lapwings), *Scolopacidae* (sandpipers and allies) and *Laridae* (gulls and terns) plus *Phalacrocoracidae* (Cormorants), *Ciconiiformes* (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[16] or species that use the site at certain times only (e.g. as a cold weather refuge).

23 waterbird species occurred on a regular basis within the Boyne Estuary I-WeBS count area during the period 1994/95 – 2009/10.[17] Ten of these species are listed as SCIs for the SPA, and the additional 13 non-SCI species are listed in Table 5.1.

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

[17] Regular is defined as a species that has occurred in 12 out of the 14-year data period (two years data missing 2004/05 and 2005/06).

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

Species	Baseline Data Period[1] (1995/96 – 1999/00)	Recent Site Average[2] (2005/06 – 2009/10)
Mute Swan (*Cygnus olor*)	13	20
Light-bellied Brent Geese (*Branta bernicla hrota*)	172	441 (i)
Wigeon (*Anas penelope*)	454	266
Teal (*Anas crecca*)	230	239
Mallard (*Anas platyrhynchos*)	197	134
Little Grebe (*Tachybaptus ruficollis*)	4	7
Cormorant (*Phalacrocorax carbo*)	97	38
Grey Heron (*Ardea cinerea*)	19	12
Ringed Plover (*Charadrius hiaticula*)	80	50
Dunlin (*Calidris alpina*)	480	577
Snipe (*Gallinago gallinago*)	18	2
Curlew (*Numenius arquata*)	395	280
Greenshank (*Tringa nebularia*)	6	4

[1] Baseline data is the 5-year mean peak for the period 1995/96 – 1999/00 (I-WeBS); [2]recent site data is the 4-year mean for the 5-year period 2005/06 – 2009/10 (I-WeBS); (i) denotes numbers of international importance.

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 Boyne Estuary SPA. Information is provided for the following categories[18]:-

- 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 seldom meets all 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 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 mainly 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

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

(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 terrestrial 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

	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]
SELECTION SPECIES							
Golden Plover *Pluvialis apricaria*	Charadriidae (wading birds)	Intermediate	4	Wide	Intertidal mud and sand flats	2	Moderate
Knot *Calidris canutus*	Scolopacidae (wading birds)	Localised	4	Narrower	Intertidal mud and sand flats	3	Moderate
Black-tailed Godwit *Limosa limosa*	Scolopacidae (wading birds)	Localised	4	Wide	Intertidal mud and sand flats	2	High
Turnstone *Arenaria interpres*	Scolopacidae (wading birds)	Localised	4	Wide	Intertidal mud and sand flats	2	High
ADDITIONAL SPECIAL CONSERVATION INTERESTS							
Shelduck *Tadorna tadorna*	Anatidae (shelducks)	Localised	1, 5	Wide	Intertidal mud and sand flats	3	High
Oystercatcher *Haematopus ostralegus*	Haematopodidae (wading birds)	Intermediate	4	Narrower	Intertidal mud and sand flats	2	High
Grey Plover *Pluvialis squatarola*	Charadriidae (wading birds)	Localised	4	Wide	Intertidal mud and sand flats	3	High
Lapwing *Vanellus vanellus*	Charadriidae (wading birds)	Widespread	4	Wide	Intertidal mud and sand flats	2	Moderate
Sanderling *Calidris alba*	Scolopacidae (wading birds)	Localised	4, 6	Wide	Intertidal mud and sand flats	3	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 Boyne Estuary. Note that this is the main habitat used when foraging (except Golden Plover & Lapwing (roosting)).
[E] Ability to utilise alternative habitats refers to the species ability to utilise other habitats adjacent to the site. 1 = wide-ranging species with requirement to utilise the site as and when required; 2 = reliant on site but highly likely to utilise alternative habitats at certain times (e.g. high tide); 3 = considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
[F] Site fidelity on non-breeding grounds: Unknown; Weak; Moderate; or High (based on published literature).

5.3 The 2011/12 waterbird survey programme

5.3.1 Introduction

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

At Boyne Estuary SPA, a standard survey programme of four low tide counts (October, November & December 2011 and February 2012) and a high tide count (January 2012) were completed across the site.[19] Waterbirds were counted within a series of 14 count subsites (Appendix 6).

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

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 gravel/pebbles or shingle and gravel shores. In the case of the Boyne Estuary, this category also includes training walls, widespread across the site, that are surrounded by intertidal habitat and effectively form rocky intertidal habitat in places.
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. Refers also to manmade structures such as piers and jetties that are connected to land.
For more details please refer to NPWS (2011a).	

In addition to the main survey programme described above, two separate high tide roost survey were completed on 28th November 2011 and 27th February 2012. These dates were chosen to reflect roosting distribution during a spring tide and neap tide respectively. During these surveys, waterbird roost sites were located, species and numbers of waterbirds counted and the position of the roosts marked onto field maps.

5.3.2 Waterbird data, analyses and presentation

The aim of data analyses was to understand how waterbirds are distributed across the site of Boyne 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

[19] Low tide surveys: 03/10/11, 05/11/11, 02/12/11 & 01/02/12 plus a high tide survey on 11/01/12.

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

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

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

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 from low tide surveys were used to prepare distribution maps ('dot density maps'). 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 (intertidal/subtidal) for the birds counted, the resulting map is equivalent to presenting numbers and densities and provides a relatively quick way of assessing species foraging distribution.

Roost maps were produced from roost survey data (November 2011 and February 2012) and show the mapped locations of waterbird roosts.

Notes on data interpretation and methodological limitations

Subsite rankings and dot-density maps relate to the distribution of waterbirds at subsite level as recorded within the survey area during the 2011/12 waterbird survey programme. Care must be taken in the interpretation of these data, and subsite rankings in isolation should not be used to infer a higher level of conservation importance to one area over another without a detailed examination of data and understanding of each species' ecology. For instance, while some species are known to be highly site-faithful, both at site level and within-site level (e.g. Dunlin), other species may range more widely across a site(s). While some species by their nature may aggregate in high numbers, others such as Greenshank or Grey Heron may not. It is also important to consider that distribution maps and data refer to a single season of low

tide surveys. Although important patterns of distribution will emerge, these distributions should not be considered absolute; waterbirds by their nature are highly mobile and various factors including tide (e.g. spring/neap), temperature, direction of prevailing winds, changing prey densities/availabilities and degree of human activity across the site, could lead to patterns that may change in different months and years.

Dot-density maps are not intended to show the actual position of each bird; the dots are placed randomly within subsites so no conclusions can be made at a scale finer than subsite. Dots are placed in the appropriate subsites and broad habitat types for the birds counted but given that the broad habitats are based on OS mapping, there are various cases where the mapping does not accurately portray where a bird was. One example is 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. Assigning birds to habitat categories proved particularly difficult and often subjective at Boyne Estuary because of the presence of training walls/breakwaters and beacons that are widespread across the site. For example, when surrounded by intertidal habitat and effectively forming a rocky intertidal substratum, breakwaters were considered to be equivalent to intertidal habitat; but birds roosting at the top of such structures at high tide were assigned to supratidal habitat. Data and dot density map interpretation as well as future data analyses should be mindful of such habitat features. Flock maps (held by NPWS) provide more details on bird position.

In general, 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 40 waterbird species were recorded during the 2011/12 survey programme at Boyne Estuary. Cummins and Crowe (2012) provide a summary of waterbird data collected.

All SCI species were recorded within all counts undertaken with the exception of Knot and Shelduck that were both absent from the first 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 percentage occupancy, defined as the average proportion of subsites in which a species occurred during low tide counts was lowest for Sanderling that occurred in *c*16% of subsites (Table 5.4). Redshank was the most widespread species, occurring in over 80% of subsites during low tide surveys.

Average percentage area occupancy (Table 5.4) 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. Although Sanderling occurred in very few subsites, this translated to over 50% of the count area because the subsites occupied were large (including the two outer shore subsites 0VL04 and 0ZL08). A similar result was found for Knot. Oystercatcher and Redshank were the most widespread species, occurring, on average, in over 80% of the area surveyed. Five of the SCI species occurred, on average, across 50% or more of the area surveyed. Shelduck revealed a relatively restricted distribution (26% of survey area).

Table 5.4 Boyne Estuary 2011/2012 waterbird surveys – summary data

Site Special Conservation Interests (SCIs)	Peak number - LT surveys[I]	Peak number - HT survey[II]	Average subsite % occupancy [III]	Average % area occupancy [III]
Golden Plover*	4,974 (n)	22	23 (± 9)	36 (± 27)
Knot*	275 (n)	340 (n)	17 (± 11)	50 (± 19)
Black-tailed Godwit*	175 (n)	62	43 (± 6)	58 (± 20)
Turnstone*	67	84	21 (± 10)	48 (± 9)
Shelduck	206 (n)	131	40 (± 8)	26 (± 5)
Oystercatcher	238	469	63 (± 14)	85 (± 13)
Grey Plover	785 (n)	469 (n)	18 (± 12)	39 (± 21)
Lapwing	2,768 (n)	2,523 (n)	52 (± 18)	36 (± 8)
Sanderling	266 (n)	359 (n)	16 (± 4)	56 (± 3)
Redshank	276	234	82 (± 12)	82 (± 18)

* site selection species; (n) denotes numbers of all-Ireland importance (1% thresholds; 1999/00 – 2003/04 Crowe et al. 2008); [I] 4 low-tide counts undertaken on 03/10/11, 05/11/11, 02/12/11 & 01/02/12; [II] High-tide count undertaken on 11/01/12; [III] Mean (± s.d.) averaged across four low tide surveys (except Knot and Shelduck that were average across three surveys).

Species richness (total number of species) across the whole site ranged from 28 to 34, with 28, 34, 32 and 28 species recorded during the four low tide counts respectively; and 30 species during the high tide survey.

During low tide surveys subsite species richness ranged from an average one species (0ZL04 Beaulieu House) to 18 species (0VL04 Lady's Finger) (Table 5.5). Over 70% of subsites supported on average, ten or more species. All subsites supported a greater number of species during low tide as opposed to high tide surveys which could indicate that either birds leave the site at high tide or are not as detectable, or a combination of both.

Table 5.5 Subsite species richness

Subsite	Subsite Name	Mean (±S.D) LT Survey	HT Survey	Peak Overall
0VL01	Mornington West	10 (±2)	8	12 (LT)
0VL02	Mornington East	12 (±2)	7	13 (LT)
0VL03	The Beacon	14 (±4)	10	19 (LT)
0VL04	Lady's Finger	18 (±3)	15	20 (LT)
0VL06	Boyne Channel	15 (±3)	0	17 (LT)
0ZL01	Tom Roe's Quay	4(±2)	1	6 (LT)
0ZL02	Arp	10 (±3)	11	14 (LT)
0ZL03	Port to Beaulieu	14 (±3)	4	15 (LT)
0ZL04	Beaulieu House	1 (±0)	0	1 (LT)
0ZL05	Beaulieu Pier-Mornington	15 (±1)	13	16 (LT)
0ZL06	Quinsborough West	5 (±1)	3	6 (LT)
0ZL07	Quinsborough East	3 (±1)	3	4 (LT)
0ZL08	Baltray	13 (±4)	2	14 (LT)
0ZL09	Braghan	15 (±2)	12	18 (LT)

5.3.4 Waterbird distribution

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

Ranked assessments relate to the broad habitat that birds were observed in. In some cases, data for different broad habitats have been combined such as intertidal and supratidal habitats (roosting birds) or intertidal/subtidal, the latter for some wading birds in order to include those individuals that had their feet in water and hence recorded as subtidal (see superscripts and their description for each table).

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 Boyne Estuary. Waterbird distribution dot-density maps are provided in Appendix 7; summary roost data are presented in Appendix 8.

Table 5.6 (a) Boyne 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 ▼	GP	KN	BW	TT	SU	OC	GV	L.	SS	RK
0VL01			V		H	M	H	M		H
0VL02	V		V	M	V	M	V	V		H
0VL03	V	L	L	M	V	M	M	H	H	H
0VL04	L	V	H	V		V	V		V	H
0VL06	H		H	V	H	H		M		M
0ZL01						L		L		L
0ZL02			M			M		M		H
0ZL03	M		V		L	M	H	V		H
0ZL04										
0ZL05	H		L	M	M	M	M	H		V
0ZL06			M		M	L		L		L
0ZL07										M
0ZL08	H	V	L	H		V	V		V	L
0ZL09	V	M	V	M	H	M		V		V

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

Species ► / Subsites ▼	GP	KN	BW	TT	SU	OC	GV	L.	SS	RK
0VL01					7			5		
0VL02					5			7		5
0VL03			2	3	2					2
0VL04		1		1		1	1		1	8
0VL06				2	1	2		3		6
0ZL01										
0ZL02					8					4
0ZL03								4		7
0ZL04								1		
0ZL05			1		4					3
0ZL06					5			6		
0ZL07										
0ZL08										
0ZL09	1		3		3			2		1

Table 5.6 (c) Boyne Estuary Subsite assessment – total numbers foraging (LT surveys) (Intertidal[I], Subtidal[II], Int/Sub combined[III], Int/Supra combined[IV]) Low, M Moderate; H High V Very high; please see Section 5.3.2 for methods)

Species ► / Subsites ▼	GP[I]	KN[I]	BW[III]	TT[IV]	SU[I]	SU[II]	OC[III]	GV[I]	L.[I]	SS[I]	RK[III]
0VL01			V		H		M		M		H
0VL02			V	M		V	H	V	H		H
0VL03		L	L	H	V		M	M	V		H
0VL04	M	V	H	V			V	V		V	M
0VL06				V			H				M
0ZL01											
0ZL02			M				H				V
0ZL03	V		V		V		M	H	V		H
0ZL04											
0ZL05	H		M	M	V	V	M		V		V
0ZL06			M				L		M		L
0ZL07											M
0ZL08	V	V	H	H			V	V		V	M
0ZL09	L	H	H	M	M		L		H		V

Table 5.6 (d) Boyne Estuary Subsite assessment – ranked peak intertidal foraging density for selected species - LT surveys

Species ► / Subsites ▼	KN	BW	OC	GV	SS	RK
0VL01		2	9			6
0VL02		1	4	1		9
0VL03	4	9	7	2		8
0VL04	2	10	2	3	2	11
0VL06			1			10
0ZL01						
0ZL02		7	3			4
0ZL03		4	8	5		5
0ZL04						
0ZL05		6	10			2
0ZL06		3	6			7
0ZL07						3
0ZL08	1	8	5	4	1	12
0ZL09	3	5	11			1

Table 5.6 (e) Boyne Estuary Subsite assessment – total numbers (roosting/other behaviour) during LT surveys (Intertidal[I], Subtidal[II], Int/Sub combined[III]) Low, M Moderate; H High V Very high; please see Section 5.3.2 for methods).

Species ► / Subsites ▼	GP[I]	KN[I]	BW[III]	TT	SU[I]	SU[II]	OC[III]	GV[III]	L.[III]	SS[I]	RK[III]
0VL01				*Not recorded*	M	V		V	H		
0VL02	V				V				V		
0VL03	V				V				H	V	V
0VL04		V	H							V	H
0VL06					H		V		L		M
0ZL01							H		L		M
0ZL02									M		H
0ZL03			V						H		V
0ZL04											
0ZL05	H				L			V	H		V
0ZL06					H						
0ZL07											
0ZL08	M	V					V	V			
0ZL09	V		V		V	V	H		V		V

Table 5.6 (f) Boyne Estuary Subsite assessment – ranked total numbers (roosting/other behaviour) during HT survey (Intertidal[I], Subtidal[II], Int/Sub combined[III], Int/Supra combined[IV])

Species ► / Subsites ▼	GP	KN[I]	BW[IV]	TT[IV]	SU[II]	OC[III]	GV[III]	L.[IV]	SS[I]	RK[III]	RK[IV]
0VL01	*Not recorded*				6			5			
0VL02					5						5
0VL03			3	2	1						2
0VL04		1		1		1	1		1	2	8
0VL06					3			3			6
0ZL01											
0ZL02					7						4
0ZL03								4			7
0ZL04											
0ZL05			1		4			1			3
0ZL06					8			6			
0ZL07											
0ZL08											
0ZL09			3		2			2		1	1

Boyne Estuary - Waterbird Survey Programme 2011/12

Waterbird distribution - discussion notes

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

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

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
Whole-site numbers of Golden Plover rose from 250 on 03/10/11 to a low tide peak of 4,974 just a month later (05/11/11). The high tide survey recorded just 22 individuals. Golden Plovers were recorded in eight subsites overall but only three subsites recorded the species on more than one occasion (0VL03, 0ZL05 and 0ZL09). 0ZL09 (Braghan) recorded peak numbers on two occasions (03/10/11 and 02/12/11), 0VL03 (The Beacon) on one occasion (05/11/11) and 0VL02 (Mornington East) on one occasion (01/02/12), the latter also supporting the peak subsite number (3,520 individuals). The total 22 Golden Plovers recorded during the high tide survey were all within 0ZL09 (Braghan).
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 occur 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. Although Golden Plovers eat a wide range of invertebrate species, relatively little is known about their intertidal feeding patterns (Gillings et al. 2006). Relatively few Golden Plovers were recorded foraging intertidally during low tide surveys with the exception of the December survey (02/12/11) when 144 individuals foraged across four subsites (0VL04, 0ZL05, 0ZL08 and 0ZL09); 43% were within 0ZL08 (Baltray). Five Golden Plover foraged within 0ZL03 on 01/02/12.
Roosting Distribution
Most Golden Plovers were recorded roosting upon tidal flats. 0ZL09 (Braghan) held peak numbers on 03/10/11 and 02/12/11 (243 and 557 respectively). 0VL03 (The Beacon) supported peak numbers and 99% of all recorded on 05/11/11 (4,970 birds) and 0VL02 (Mornington East) held peak numbers on 01/02/12 (3,520 – 88% of all counted). During the November 2011 roost survey a total of 1,058 Golden Plovers were recorded roosting at three positions in two subsites; 0VL04 and 0ZL08. An estimated flock of 7,000 were observed in flight over 0ZL09 (Braghan) heading north. During the February 2012 roost survey a field observer positioned overlooking 0ZL09 (Braghan) observed 2,500 Golden Plovers in flight, these birds having been flushed by a walker just before the count commenced. No roosting individuals were recorded.

Knot *Calidris canutus* - Family (group): Scolopacidae (wading birds)

Knot are a high Arctic breeding species. Two populations are recognised in Western Eurasia and Africa - *C. c canutus* and *C. c. islandica*. The latter breeds in north and east Greenland and northern Canada and winters in north-west Europe. Knot that winter in Ireland are almost entirely from the *islandica* population. The Wadden Sea is an important staging ground for the species after a non-stop flight from the breeding grounds (van der Kam, 2004).

Numbers

Numbers of Knot rose from 87 in November 2011 to a low tide peak of 275 on 02/12/2011. 340 Knot were counted during the high tide survey on 11/01/12.

Knot were recorded mostly within 0VL04 (Lady's Finger) and 0ZL08 (Baltray), with further single observations within 0VL03 (The Beacon) and 0ZL09 (Braghan). The subsite peak count was 340 within 0VL04 (Lady's Finger) during the high tide survey.

Foraging Distribution

Knots are specialist intertidal foragers; pecking visible items off the surface or probing to the depth that their bill (3.5cm) allows. The preferred prey items are bivalve molluscs including *Scrobicularia plana, Macoma balthica* and *Mytilus edulis* of smaller size-classes (shell length in the range 6 – 16mm depending on bivalve species and shape of shell) (Dekinga & Piersma, 1993).

Knot foraged intertidally during two low tide surveys (05/11/11 and 02/12/11) and across four subsites (0VL03, 0VL04, 0ZL08 and 0ZL09) overall. 0VL04 (Lady's Finger) supported peak numbers on 05/11/11 (84), the birds foraging on the lower shore in the north of the subsite. Around half of these birds then flew north into 0ZL08. This latter subsite (Baltray) held peak numbers (203) on 02/12/11, birds again foraging on the lower shore. Some individuals were observed to fly south into 0VL04 during this count. 0VL03 and 0ZL09 held small numbers on 02/12/11 only (4 and 14 respectively).

The intertidal sediments of 0VL04 and 0ZL08 are classified as 'fine sands dominated by bivalves' (NPWS, 2011b). The fauna is dominated by the bivalves *Tellina tenuis* and *Donax vittatus* which can occur in high abundances.

The peak intertidal foraging density was 2.4 Knot ha^{-1} recorded for 0ZL08 (Baltray). All other subsite densities were less than 1 Knot ha^{-1}. The whole site average intertidal foraging density was 0.25 Knot ha^{-1}.

Roosting Distribution

0VL04 (Lady's Finger) and 0ZL08 (Baltray) recorded 44 and 93 roosting individuals respectively during the low tide surveys on 02/12/11 and 01/02/12. 340 Knot roosted during the high tide survey and all were within 0VL04 (Lady's Finger).

1,048 Knot were recorded during the November 2011 roost survey of which 1,014 were roosting intertidally (note that as some areas were visited twice during this survey, this total could include double-counted birds). 0VL04 supported the peak number roosting at any one roost location (260) and recorded birds at four positions overall. The flock of 260 were positioned on the middle shore. 0ZL08 (Baltray) recorded a roost of *c*241 individuals although this roost was transient with birds observed to fly south as the tide pushed up.

188 Knot were recorded during the February 2012 roost survey of which 176 were roosting intertidally. All were located within 0VL04 (Lady's Finger). The birds were observed to fly in from the west and settled on the mid shore for a while before moving NW in response to the encroaching tide.

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

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

Numbers

Numbers of Black-tailed Godwits peaked early when 175 were recorded during the October 2011 low tide survey. Only this count surpassed the threshold of all-Ireland importance. Thereafter number dropped gradually to 115 during the December 2011 survey. 62 individuals were recorded during the high tide survey. These site peaks are down on recent I-WeBS counts, for example the I-WeBS site peaks for 2008/09 and 2009/10 being 367 and 264 respectively. However, higher I-WeBS counts recorded at Boyne Estuary have been recorded largely during autumn and spring/passage periods (September/March) and therefore outside of the survey period for the 2011/12 Waterbird Survey Programme.

Black-tailed Godwits were recorded in 11 subsites overall (all except 0ZL01, 0ZL04, and 0ZL07). Peak numbers were held by four different subsites (0ZL03, 0VL02, 0ZL09 and 0VL01) for the four low tide survey dates respectively. 0ZL03 (Port to Beaulieu) recorded the subsite peak (162 individuals).

Foraging Distribution

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

At Boyne Estuary, Black-tailed Godwits foraged intertidally within ten subsites overall: 0VL01, 0VL02, 0VL03, 0VL04, 0ZL02, 0ZL03, 0ZL05, 0ZL06, 0ZL08, 0ZL09. 0ZL03 (Port to Beaulieu) held peak numbers on two low tide occasions (03/10/11 & 02/12/11); supporting 78% of all individuals counted on 03/10/11. 0VL02 (Mornington East) recorded peak numbers on 05/11/11 (74) and 0VL01 (Mornington West) on 01/02/12. 0ZL03 (Port to Beaulieu) was the most favoured subsite – recording peak or second highest numbers in all four low tide surveys. No individuals were recorded foraging during the high tide survey.

Black-tailed Godwits therefore foraged preferentially within inner estuarine subsites as opposed to the two outer, sandy subsites (0ZL08 and 0VL04), and particularly within subsites along the southern estuary (0ZL03, 0VL01, 0VL02) which observed numbers far exceeding those recorded in other subsites. The estuarine sediments of the Boyne are classified as 'intertidal mud and fine sands dominated by *Hediste diversicolor* and *Corophium volutator*' (NPWS, 2011b) and mudflats are most extensive along the southern shore of the estuary from Mornington to Burrow Point. The Ragworm *Hediste diversicolor* dominates, a large worm that can be taken by this wader, but bivalves *Macoma balthica* and *Scrobicularia plana* also occur and are likely to form a major part of the godwit diet.

Terrestrial foraging, although likely to occur around the site, was not recorded during the 2011/12 survey programme.

Four subsites recorded an average intertidal foraging density of greater than 2 Black-tailed Godwits ha^{-1} (0VL01, 0VL02, 0ZL03 and 0ZL06). The peak was recorded for 0VL02 (Mornington East) (3.2 Black-tailed Godwits ha^{-1}). The whole site average intertidal foraging density was 0.27 Black-tailed Godwits ha^{-1}.

Roosting Distribution

During low tide surveys only irregular records were made of Black-tailed Godwits roosting intertidally. 116 were recorded within 0ZL03 (Port to Beaulieu) on 03/10/11 and 59 roosted within 0ZL09 (Braghan) on 01/02/12.

62 individuals were recorded during the high tide survey (0VL03, 0ZL05, 0ZL09), and 59 of these roosted supratidally within 0ZL05 (Beaulieu Pier-Mornington).

0ZL03 (Port to Beaulieu) held the largest single roost (44 birds) during the November 2011 roost survey where the birds roosted supratidally (saltmarsh) in the southeast of the subsite. 0ZL09 (Braghan) appears to offer a variety of roosting options with six different roost locations during the November roost survey. A large supratidal roost (287) was recorded there also during the February 2012 roost survey; very few individuals recorded elsewhere. These godwits roosted within saltmarsh in the south of the subsite (incl. *Spartina*). Note that this roost count of 287 Black-tailed Godwits is higher than any of the counts recorded during the low tide survey programme.

Turnstone Family (group): Scolopacidae (wading birds)
Turnstones breed widely in both the high and low arctic zones. Two subspecies are recognised. The nominate subspecies is divided into three recognised populations that occur in Western Eurasia and Africa, one of which breeds in north-eastern Canada and northern and eastern Greenland and winters mainly in Western Europe and West Africa (Delaney et al. 2009). Iceland is used as a staging post. Wintering Turnstones in Ireland have a widespread distribution and are a familiar species of open, non-estuarine, rocky shorelines although they do occur regularly within estuaries.
Numbers
Numbers of Turnstone peaked early with 67 recorded in the October 2011 survey, but thereafter dropped gradually to a low 12 individuals during the February 2012 low tide survey. 84 Turnstones were counted during the high tide survey. No whole-site count surpassed the threshold of all-Ireland importance. Turnstones were recorded in seven subsites overall (0VL02, 0VL03, 0VL04, 0VL06, 0ZL05, 0ZL08 and 0ZL09). 0VL04 (Lady's Finger) held peak numbers in all four low tide surveys with a low tide peak of 58 individuals; numbers overall representing between 42% and 95% of all individuals counted on survey days. The joint peak number (11) was shared by 0VL06 during the December low tide survey. 0VL04 (Lady's Finger) held 75% of all individuals counted (63) during the high tide survey.
Foraging Distribution
Turnstones are generally associated with shorelines with rocky substratum, particularly those with algal wrack zones within which the birds forage for prey species such as amphipods (crustaceans), insects and small molluscs. At Boyne Estuary, Turnstones foraged across seven subsites overall: 0VL02, 0VL03, 0VL04, 0VL06, 0ZL05, 0ZL08 & 0ZL09. Data were analysed for intertidal and supratidal habitat combined due to the subjectivity in habitat classification of the man-made rocky substratum of channel walls and breakwaters. 0VL04 (Lady's Finger) held peak numbers in all surveys with numbers ranging from 42% to 95% of all counted on respective dates. In October 2011, 24 Turnstone foraged intertidally in the north of the subsite but they were upon a bank made of stone and Mussels (*Mytilus edulis*); a further 14 foraged upon a similar 'habitat' further south. Both areas had algal cover. The same areas supported foraging individuals in November 2011 and during the high tide survey. On one occasion 0VL06 (Boyne Channel) shared the peak number of foraging individuals (11). Thereafter other subsites recorded very low numbers irregularly.
Roosting Distribution
Roosting/other behaviour was not recorded during low tide surveys. The high tide survey on 11/01/12 recorded six Turnstone roosting intertidally in 0VL03 (the Beacon) and eight within 0VL04 (Lady's Finger) (4 intertidal plus 4 supratidal). 123 Turnstones were recorded during the November 2011 roost survey but almost all of these birds were foraging. Five individuals roosted supratidally within 0VL06 (Boyne Channel). The February 2012 roost survey recorded an intertidal roost of 32 individuals within 0VL03 (the Beacon). 17 roosted within 0VL08 (Baltray) (top of shore) and two roosts of three and seven birds were recorded for 0VL04 (Lady's Finger). In 0VL04 the birds were observed to roost intertidally (shingle) and along the north wall of the channel.

Shelduck *Tadorna tadorna* - Family (group): Anatidae (ducks)
Tadorna tadorna has five known populations which breed across temperate Eurasia. The northwest Europe population breeds and winters along coasts of Britain, Ireland, Scandinavia, the Baltic and continental Europe. Although a breeding species in Ireland, Shelducks undertake a moult migration each autumn. Large moult gatherings occur along traditionally used areas of the north German coast of the Wadden Sea although several sites in Britain have also become recognised as important moulting areas such as Bridgewater Bay (Severn Estuary), the Humber Estuary, the Wash, and the Firth of Forth. Following the moult, the ducks then migrate to wintering areas.
Numbers
Shelduck were not recorded during the October 2011 low tide survey but thereafter numbers rose each month to a peak during the final count on 01/02/12 (206 individuals), a site count that surpassed the threshold of all-Ireland importance. Shelduck were recorded in nine subsites overall (0VL01, 0VL02, 0VL03, 0VL06, 0ZL02, 0ZL03, 0ZL05, 0ZL06 and 0ZL09). Three subsites recorded the species most regularly (three low tide surveys): 0VL01 (Mornington West), 0VL02 (Mornington East) and 0VL03 (the beacon). 0VL03 (The Beacon) held peak numbers in two low tide surveys (05/11/11 and 02/12/11) with a peak number of 86 individuals. Peak numbers were also supported by 0VL02 (Mornington East) (01/02/12). 0VL06 (Boyne Channel) held peak numbers (35) during the high tide survey.
Foraging Distribution
Shelducks can forage in a variety of ways from scything their bill through wet mud on exposed tidal flats, to dabbling and scything in shallow water and up-ending in deeper waters. They can therefore forage throughout the tidal cycle. At Boyne Estuary, most records of foraging Shelduck were of birds foraging intertidally. This was most regularly observed in 0VL03 (The Beacon) which supported the peak number of 82 on 02/12/11 (100% of those counted on that day). Smaller and irregular numbers were recorded within 0VL01, 0ZL03, 0ZL06 and 0ZL09. The estuarine sediments of the Boyne are classified as 'intertidal mud and fine sands dominated by *Hediste diversicolor* and *Corophium volutator'* (NPWS, 2011b) and mudflats are most extensive along the southern shore of the estuary from Mornington to Burrow Point. The small gastropod *Hydrobia ulvae*, a favoured prey of Shelduck, are found in moderate abundances (NPWS, 2011b) although benthic results (ASU, 2011) suggest that they can be highly clumped in distribution. Occasional records were made of low numbers foraging subtidally within 0VL02, 0VL06 and 0ZL05.
Roosting Distribution
Relatively few records were made of Shelduck in roosting/other behaviour during low tide surveys with one-off records for 0VL02, 0VL03, 0ZL06 and 0ZL09. During the final survey low tide survey however (01/02/12), 191 Shelduck roosted intertidally across five subsites. 0VL02 (Mornington East) held the most (65) closely followed by 0VL06 (Boyne Channel) (63). 0VL03 (The Beacon) held 39 and lower numbers were recorded in 0VL01 and 0Zl05. 110 Shelduck roosted subtidally during the high tide survey and were distributed across eight subsites; 0VL03 (The Beacon) supporting the most (30). 91 Shelduck were recorded during the November 2011 roost survey; 68 of these were roosting. 0VL06 (Boyne Channel) supported the largest number in one position (22 birds) closely followed by 0VL03 (The Beacon) which supported 19 individuals; these birds roosting/other subtidally. 113 Shelduck were recorded during the February 2012 roost survey, these birds distributed across seven subsites. The largest single roost of 42 subtidal individuals was recorded for 0VL03 (The Beacon), birds roosting subtidally. 19 Shelduck roosted subtidally within OVL01. Thereafter smaller numbers were distributed across 0ZL02, 0ZL03, 0ZL05, 0ZL06 and 0ZL09.

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

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

Numbers

Whole-site numbers during low tide surveys ranged from 119 (02/12/11) to 238 (03/10/11). Nearly double this low tide peak was recorded during the high tide survey (469 individuals). No count surpassed the threshold of all-Ireland importance.

Oystercatchers were relatively widespread and occurred in 12 of the 14 subsites (not in 0ZL04 and 0ZL07). However, only two subsites supported the species in all five surveys of the programme: 0VL04 (Lady's Finger) and 0VL06 (Boyne Channel).

0VL04 (Lady's Finger) held peak numbers during the first three low tide surveys and recorded the low tide subsite peak of 99 Oystercatchers on 05/11/11, as well as supporting a large 414 individuals during the high tide survey (88% of all counted on that date). 0ZL08 (Baltray) held good numbers in low tide surveys and recorded the subsite peak on 01/02/12. 0VL06 (Boyne Channel) held good numbers ranked as second or third highest in all five surveys

Foraging Distribution

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

Between 82% and 99% of all Oystercatchers recorded during low tide surveys were foraging. Overall a total of eleven subsites were used but only four subsites held foraging individuals in all four low tide surveys: 0VL01 (Mornington West), 0VL04 (Lady's Finger), 0VL06 (Boyne Channel) and 0ZL08 (Baltray). The data collected suggests a subsite preference with 0VL04 (Lady's Finger) supporting peak numbers on three low tide survey occasions and 0ZL08 (Baltray) recording peak numbers once (01/02/12) and numbers ranked as second highest on all other low tide counts.

In 0VL04, the Oystercatchers were mostly associated with the shingle/mixed sediment shore and sea walls along the river channel plus other shingle banks, likely due to these providing attachment for Mussels (*Mytilus edulis*).

The highest average intertidal foraging density within a single subsite was recorded for 0VL06 (Boyne Channel) on 03/10/11 (2.9 Oystercatchers ha^{-1}). 0ZL08 (Baltray), 0ZL02 (Arp), 0VL04 (Lady's Finger) and 0VL02 (Mornington East) each supported 1 Oystercatcher ha^{-1} on at least one occasion. The average whole site foraging density was 0.5 individuals ha^{-1}.

Roosting Distribution

Relatively few records were made of Oystercatchers in roosting/other behaviour during low tide surveys, the peak number being 19 recorded within 0VL06 (Boyne Channel) on 02/12/11.

410 Oystercatchers roosted intertidally within 0VL04 (Lady's Finger) during the high tide survey (11/01/12).

The November 2011 roost survey recorded good numbers of roosting individuals. Of note was 0ZL09 (Braghan) which held a single roost of 550 individuals that were positioned on the channel wall. 0VL06 held two roosts of 360 and 337 Oystercatchers, again positioned on the channel wall. 0ZL04 (Lady's Finger) and 0ZL08 (Baltray) held smaller numbers.

312 Oystercatchers were recorded during the February 2012 roost survey, these birds distributed across two subsites. 255 roosted as one flock intertidally within 0ZL04 (Lady's Finger), these birds moving up the beach as the tide encroached. A further 57 roosted within 0VL03 (The Beacon), positioned supratidally on the channel wall.

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

Whole site numbers of Grey Plovers rose from just three in October 2011 to 31 the following month before dropping to five during the December low tide survey. However, 785 were recorded on 01/02/12 surpassing the threshold of all-Ireland importance. The pattern of a gradual rise in numbers is consistent with that shown by I-WeBS data in general (Crowe, 2005).

Grey Plovers were recorded in a total seven subsites throughout the entire survey programme but subsite use during individual surveys ranged from one subsite (02/12/11) to two subsites (03/10/11 & 01/02/12) to five subsites (05/11/11). 0VL04 (Lady's Finger) held peak numbers on two occasions, 0VL02 (Mornington East) and 0ZL08 (Baltray) once each. The subsite peak count was 785 individuals recorded within 0ZL08 (Baltray) on 01/02/12.

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 in five subsites overall (0VL02, 0VL03, 0VL04, 0ZL03 and 0ZL08). 0VL04 (Lady's Finger) held foraging individuals on three survey occasions and the highest number at any one time was 10 individuals; birds dispersed over the lower shore. 0VL02 (Mornington East) recorded 13 individuals foraging on one occasion only. Baltray (0ZL08) held peak numbers (7) on 01/02/12.

The highest average intertidal foraging density within a single subsite was recorded for 0VL02 (Mornington East) on 05/11/11 (0.6 Grey Plover ha^{-1}). The average whole site foraging density was 0.03 individuals ha^{-1}.

Roosting Distribution

During low tide surveys, relatively few Grey Plovers were recorded in roosting/other behaviour with the exception of 01/02/12 when 777 roosted within 0ZL08 (Baltray). 469 Grey Plovers roosted intertidally within 0VL04 (Lady's Finger) during the high tide survey (11/01/12).

The November 2011 roost survey recorded good numbers of roosting individuals. 0ZL08 (Baltray) held two roosts of 400 and 422 individuals, birds positioned intertidally. 19 roosted intertidally (mid shore) within 0VL04 (Lady's Finger). Total numbers counted during this survey surpass any total counted during the low tide surveys.

84 Grey Plovers were recorded during the February 2012 roost survey, all within 0VL04 (Lady's Finger), the majority of which roosted intertidally in the mid-shore along with Knot (84) and Bar-tailed Godwits (12).

Lapwing *Vanellus vanellus* - Family (group): Charadriidae (wading birds)
The Lapwing is a monotypic species and has a wide Palearctic breeding distribution from Britain and Ireland in the west to eastern and southern Siberia in the east with a southern limit extending into Spain (Delaney et al. 2009). Birds breeding in Britain and Ireland are partial migrants with some residing over winter and some migrating south. The wintering population is enhanced by Lapwings moving in from continental Europe and northern and western Britain (Wernham et al. 2002). Cold weather movements can see a greater flux of birds to Ireland's estuaries.
Numbers
Whole site numbers of Lapwing rose steadily from 160 in October 2011 to a peak on 01/02/12 of 2,768 individuals, surpassing the threshold of all-Ireland importance. 2,523 Lapwings were recorded during the high tide survey. Across the survey programme, Lapwings were recorded within ten subsites. Seven subsite held the species regularly (three surveys or more) as follows: 0VL02, 0VL03, 0VL06, 0ZL02, 0ZL03, 0ZL05 and 0ZL09. Peak numbers were supported by 0ZL09 (Braghan) (03/10/11 & 02/12/110, 0ZL03 (Port to Beaulieu) (05/11/11) and 0VL02 (Mornington East) (01/02/12). The low tide subsite peak count was 705 (0VL02 Mornington East (01/02/12).
Foraging Distribution
Lapwings are traditionally considered as 'inland' waders. During winter they can be observed across a wide variety of habitats, principally using lowland farmland and freshwater wetlands (e.g. turloughs and callows) but also coastal wetlands where they feed on a variety of soil and surface-living invertebrates. They are opportunistic and mobile birds and will readily exploit temporary food sources such as newly-ploughed fields. Estuaries are typically used as roosting areas where large flocks may be observed roosting upon the tidal flats but coastal areas will also be used to a greater degree during cold weather events when farmland and freshwater habitats freeze over. There is evidence in the UK that utilisation of coastal habitats has increased, coupled with an increase in intertidal feeding (Gillings et al. 2006). At Boyne Estuary intertidal foraging was a relatively common occurrence and observed regularly (three surveys or more) within 0VL03 (The Beacon), 0ZL03 (Port to Beaulieu), 0ZL05 (Beaulieu Pier-Mornington) and 0ZL09 (Braghan). 466 Lapwings foraged intertidally on 05/11/11, 294 within 0ZL03 (Port to Beaulieu). The largest number however was 1,325 that foraged intertidally on 01/02/12. These birds were distributed across seven subsites, the peak number (387) within 0ZL03 (Port to Beaulieu). A further 303 foraged within 0VL02 (Mornington East) and 278 within 0ZL02 (Arp). The sediments of these subsites are classified as 'intertidal mud and fine sands dominated by *Hediste diversicolor* and *Corophium volutator'* (NPWS, 2011b).
Roosting Distribution
Lapwings roosted intertidally across nine subsites. 0ZL09 (Braghan) held peak numbers during the first three low tide surveys and 0VL02 (Mornington East) supported peak numbers on 01/02/12. 0VL03 (The Beacon) and 0ZL05 (Beaulieu Pier-Mornington) held good numbers during most counts. The high tide survey (11/01/12) recorded 2,522 Lapwings roosting supratidally. 912 were located within 0ZL05 (Beaulieu Pier-Mornington) with a further 648 within 0ZL09 (Braghan). 414 were within 0VL06 (Boyne Channel). Smaller numbers roosted within 0VL01 (Mornington West), 0ZL03 (Port to Beaulieu) and 0ZL06 (Quinsborough West). 1,894 Lapwings were recorded roosting during the November spring tide 2011 roost survey distributed across seven subsites. 0ZL03 (Port to Beaulieu) supported the largest single roost (264 individuals), roosting along the channel wall. 0ZL09 (Braghan) supported one roost of 233 individuals, with roosting birds at eight individual locations overall. In contrast only one solitary roosting individual was counted during the February 2012 (neap tide) roost survey, and no individuals were recorded foraging.

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 Sanderling 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 Sanderlings rose from just seven in October 2011 to a site peak of 266 on 01/02/2012. 359 individuals were recorded during the January 2012 high tide survey. Only these latter two counts surpassed the threshold of all-Ireland importance.

Sanderlings were recorded in three subsites: 0VL03 (the Beacon), 0VL04 (Lady's Finger) and 0ZL08 (Baltray), the latter generally supporting peak numbers during low tide surveys and the low tide subsite peak number of 265 (01/02/12). 0VL04 (Lady's Finger) held all Sanderling recorded during the high tide survey (359).

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.

At the Boyne Estuary, Sanderlings foraged intertidally across two subsites: 0VL04 (Lady's Finger) and 0ZL08 (Baltray). Baltray held peak numbers during three low tide surveys but peak numbers foraged within 0VL04 (Lady's Finger) during the high tide survey. These outer 'open shore' subsites are characterised by fine sand sediments dominated by bivalves (NPWS, 2011b). The fauna is dominated by the bivalves *Tellina tenuis* and *Donax vittatus* which can occur in high abundances.

The peak intertidal foraging density was 3.0 Sanderling ha^{-1} recorded for 0ZL08 (Baltray). Densities recorded within 0VL04 (Lady's Finger) peaked at 0.4 individuals per hectare. The whole site average intertidal foraging density was 0.03 Sanderling ha^{-1}.

Roosting Distribution

Almost no Sanderlings were recorded roosting during low tide surveys. 204 Sanderlings roosted intertidally during the January 2012 high tide survey, positioned in the mid shore zone of 0VL04 (Lady's Finger).

128 Sanderlings were recorded roosting during the November 2011 spring tide roost survey and were distributed across two subsites: 0VL04 (Lady's Finger) and 0ZL08 (Baltray), the latter supporting the largest number (107) at a single roost site. These birds roosted intertidally, shifting as the tide encroached. The area known as 'The Haven' at Baltray (0VL04) is a previously-known important Sanderling roost site (N Harmey *pers. comm.)* but as this subsite was counted some 1.5 hours prior to high tide, the birds were still foraging at this time. Indeed, a further *c*326 Sanderlings foraged within 0ZL08 during this survey, resulting in a total subsite count at this time of over 400 Sanderlings, surpassing all whole-site low tide counts recorded.

In contrast only 33 were counted roosting during the February 2012 neap tide roost survey when the majority of individuals were recorded foraging. These 33 individuals were positioned intertidally within 0VL04 (Lady's Finger).

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 197 (01/02/12) to 276 (03/10/11 and 02/12/11). 234 Redshanks were recorded during the high tide survey (11/02/12). No count surpassed the threshold of all-Ireland importance. Redshanks were widespread and recorded within 13 subsites overall (not in 0Zl04). Nine subsites recorded Redshanks during all four low tide surveys as follows: 0VL01, 0VL02, 0VL03, 0VL04, 0VL06, 0ZL02, 0ZL03, 0ZL05, 0ZL09. Peak numbers during low tide surveys were recorded within 0ZL05 (Beaulieu Pier-Mornington) and 0ZL09 (Braghan). The peak subsite count of 92 Redshanks was recorded within 0ZL09 on 05/11/11.
Foraging Distribution
Redshanks forage mainly by pecking at the surface or probing within intertidal mudflats; favouring the muddier sections of sites (e.g. Rehfisch et al. 2000) where they prey upon species such as the Ragworm *Hediste diversicolor* or Mud Snail *Hydrobia ulvae.* A particularly favoured prey is the burrowing amphipod *Corophium volutator.* Redshanks foraged intertidally across 13 subsites (as above) and regularly (within all low tide surveys) within eight: 0VL01, 0VL02, 0VL03, 0VL04, 0VL06, 0ZL02, 0ZL03, 0ZL09. Peak numbers were recorded within 0ZL05 (Beaulieu Pier-Mornington) on 03/10/11 and 02/12/11; 0ZL09 (Braghan) on 05/11/11 and 0ZL02 (Arp) on 01/02/12. 0VL02 (Mornington East), 0VL03 (The Beacon), and 0ZL03 (Port to Beaulieu) were notable for supporting numbers ranked as 'high' on more than one survey occasion. The estuarine sediments of the Boyne are classified as 'intertidal mud and fine sands dominated by *Hediste diversicolor* and *Corophium volutator'* (NPWS, 2011b) and mudflats are most extensive along the southern shore of the estuary from Mornington to Burrow Point. Both of these characterising species could form prey for Redshanks, indeed *Corophium volutator* was recorded in 11 out of 15 stations sampled during a recent benthic survey (ASU, 2011). The peak intertidal foraging density was 4.9 Redshank recorded for 0ZL09 (Braghan) on 05/11/11. A further four subsites recorded densities that exceeded 2 individuals per hectare (0ZL02, 0ZL03, 0ZL05, 0ZL07). The whole site average intertidal foraging density was 0.7 Redshanks ha^{-1}.
Roosting Distribution
Irregular records were made of Redshanks roosting/other during low tide surveys; the majority of these birds foraging. The peak number recorded was 27 within 0ZL03 (Port to Beaulieu) on 03/10/11. A total 234 Redshanks roosted during the high tide survey, the peak number (125) within 0ZL09 (Braghan). 56 were within 0VL03 (The Beacon). 356 Redshanks were counted roosting during the November 2011 spring tide roost survey but some flocks were not counted due to birds being obscured by saltmarsh. The largest single roost was 105 individuals (0ZL09 Braghan) although this number was estimated due to birds being partially obscured by vegetation. This subsite supported roosting Redshanks at seven different positions overall; and clearly the greater numbers during this survey programme. 0VL03 (The Beacon) supported a roost of 45 individuals, positioned at the edge of saltmarsh in the SE of the subsite. 182 Redshanks were roosting during the February 2012 neap tide roost survey. 0ZL09 (Braghan) again held the largest single roost (64 birds) followed by 0VL03 (The Beacon) (56), the latter in a relatively similar position to that recorded in November 2011. 0VL01 held a roost of 46 Redshanks.

5.4 Boyne Estuary - Activities and Events

5.4.1 Introduction

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

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

Section 5 of the Conservation Advice Notes provides information on activities and events that occur in and around Boyne 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. Drogheda Borough Council, 2011, Louth County Council, 2009, Meath County Council, 2012), County Meath Biodiversity Action Plan (Meath County Council, 2008), Eastern River Basin District documents (e.g. ERBD, 2010a, b) and other available documents relevant to the ecology of the site.

In addition, information was collected during the 2011/12 waterbird survey programme (NPWS, 2011a) 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 80+ 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 17 reporting under the EU Habitats 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 Boyne 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 Boyne 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 Boyne Estuary, those that have the potential to cause disturbance to waterbird species are highlighted.

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

Table 5.7 Scoring system for disturbance assessment

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

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

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

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

5.4.3 Overview of activities at Boyne Estuary

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

The Boyne Estuary forms the boundary between Counties Meath and Louth. The estuary runs in a west to east direction from Drogheda to the open coast where a sand and shingle spit partially encloses the mouth. Together with Dundalk, Drogheda is one of the largest provincial towns in the country (Louth County Council, 2009). The coastline from the mouth of the Boyne (and indeed north of the Boyne estuary also) and as far south as Gormanston, is one continuous sandy beach referred to as the 'Gold Coast' (Meath County Council, 2012).

Baltray lies at the mouth of the Boyne (adjacent subsites 0ZL08 and 0ZL09) and is a moderate-sized village with adjacent Golf Club.

One of the main features of Boyne Estuary is the shipping channel that leads to Drogheda Port. As a consequence, the estuary is highly modified in nature. The navigable channel, which is maintained by regular dredging, is defined by training walls, these being breached in places. Intertidal flats occur along both sides of the channelled river. According to McCorry & Ryle (2009) the occurrence of training walls has affected the development of saltmarsh within the estuary.

Drogheda Port Company provides facilities for both general freight and containers, and handles over 1 million tonnes of cargo each year (www.droghedaport.ie). The deep water facilities lies adjacent (north) of subsite 0ZL03 at Tom Roe's Point, with a jetty and pilot station on the southern shore. There is an additional jetty (Drogheda Port Company fishmeal jetty) adjacent to subsite 0VL03 as well as several other smaller piers/jetties.

Coastal flood prevention works are proposed at Baltray (Louth County Council, 2009).

Land claim has occurred at various places around the site. Of note is approximately 18ha of mudflat at Stragrennan (Stragrennan Polder) which was in-filled by Drogheda Port Company in 2000 using dredged spoil (relates to subsite 0ZL02). This area has since been subject to restoration works and now fills completely at high tide although it will likely take some time for the mudflat communities to recover completely.

The water quality of the Boyne Estuary is classified as moderate according to the Eastern River Basin District Management Plan (ERBD, 2010a). Classified as a 'heaviliy modified waterbody,' the pressures upon the system are identified as wastewater/industrial discharges (70%), dangerous substances (20%) and agricultural inflows (10%). A waste water treatment plant at Drogheda, several points of wastewater discharge and the adjacent urban area of Drogheda all contribute. Coastal waters are classified of high quality (Boyne estuary plume) (ERBD, 2010b).

The Boyne Estuary is known as a Salmon (*Salmo salar*) and Trout (*Salmo trutta*) fishery but there is also a small population of Bass (*Dicentrarchus labrax*). Baltray and Mornington strands are popular locations for shore fishing, producing Bass during the summer months as well as Mackerel; occasionally shoals enter the estuary itself (www.fishinginireland.ie). Bait (Ragworm *Hediste diversicolor*; Lugworm *Arenicola marina*) is caught in the estuary (although not recorded during the 2011/12 Waterbird Survey programme), and the small slipways to be found around the estuary facilitate access of small boat anglers.

An estuarine fish survey conducted in 2009 (CRFB, 2009) recorded a total of 23 fish species of which Sprat (*Sprattus sprattus*) and Flounder (*Platichthys flesus*) were the most numerous.

Various inshore fishing activities are likely to occur adjacent to the site (detail and spatial scale unknown). There are no known shellfish waters or aquaculture activities associated with the site. The hand-gathering of edible molluscs (e.g. Periwinkles *Littorina littorea*) was not recorded during the 2011/12 Waterbird Survey Programme.

Given the large urban area and smaller settlements close to the site, human recreational activities are likely to be a major feature at the site. In most parts the site is bounded by roads, facilitating walkers along the site boundaries, indeed walking was recorded in or by seven of the 14 subsites during the Waterbird Survey Programme. Power boating, water-skiing, horse riding and walking all occur along the open coast subsites (0ZL08 and 0VL04).

The environmental NGO CoastWatch Ireland is engaged in on-going conservation efforts in and around the site. Another eNGO, Louth Nature Trust, is particularly active in the area and manages the Little Tern Project at Baltray (the Haven), providing management, monitoring and wardening during the tern breeding season.

Spartina anglica occurs frequently around the site and is quite extensive in places e.g. near Baltry. It is not known when this species was planted or colonised the estuary. There were attempts to remove *Spartina* in the past at Banktown (relates to 0ZL09), a project designed to compensate for the infilling of mudflats at Stragrennan (McCorry & Ryle, 2009). These attempts were unsuccessful.

Wildfowling was not recorded at the site during the 2011/12 Waterbird Survey Programme and part of the site is protected by a no shooting order.

5.4.4 Disturbance Assessment

Six activities/events were recorded during 2011/12 survey work that had the potential to cause disturbance to waterbirds (Table 5.8), with between one and four activities recorded within individual subsites. The activities recorded were: flight path (aircraft flying over), walking (incl. dogs), powered watercraft, non-powered watercraft, shooting and horse-riding.

The most common activity was people walking along the shoreline with/without dogs; recorded within seven subsites overall. Shooting (as opposed to wildfowling) was recorded adjacent to five subsites but was observed to have little determinable effects on waterbirds hence the moderate score of 4 assigned to subsites (Table 5.8).

A summary is shown in Table 5.8 and full results of the disturbance assessment are shown in Appendix 10. Individual activities/events are scored separately and there has been no attempt to produce cumulative scores for different activities occurring at the same time, although cumulative effects are likely.

As a final review, Table 5.9 shows the peak disturbance scores overlaid on the subsite assessment table (total waterbird numbers, LT surveys).

Table 5.8 Disturbance Assessment Summary Table
Number of activities recorded during field surveys (2011/12 waterbird survey programme) observed to cause disturbance to waterbirds. The calculated peak disturbance score is shown (see text for explanation).
Scores 0 – 3 = Low Scores 4 – 6 = Moderate Scores 7 – 9 = High. Grey shading = no activity recorded.

Table 5.9 Boyne Estuary - subsite rankings based on total numbers of waterbirds (LT surveys) by

Subsite Code	Subsite Name	Number Activities	Peak Disturbance Score	Activity Responsible
0VL01	Mornington West			
0VL02	Mornington East			
0VL03	The Beacon			
0VL04	Lady's Finger	3	7	• Walking (incl. with dogs)
0VL06	Boyne Channel	1	5	• Walking (incl. with dogs)
0ZL01	Tom Roe's Quay	1	5	• Walking (incl. with dogs)
0ZL02	Arp			
0ZL03	Port to Beaulieu			
0ZL04	Beaulieu House	1	4	• Shooting
0ZL05	Beaulieu Pier-Mornington	3	5	• non-powered watercraft • Walking (incl. with dogs)
0ZL06	Quinsborough West	4	6	• Powered watercraft
0ZL07	Quinsborough East	3	6	• Powered watercraft
0ZL08	Baltray	1	7	• Walking (incl. with dogs)
0ZL09	Braghan	2	5	• Aircraft flying over

peak disturbance score

Species ► / Subsites ▼	GP	KN	BW	TT	SU	OC	GV	L.	SS	RK
0VL01			V		H	M	H	M		H
0VL02	V		V	M	V	M	V	V		H
0VL03	V	L	L	M	V	M	M	H	H	H
0VL04	L	V	H	V		V	V		V	H
0VL06	H		H	V	H	H		M		M
0ZL01						L		L		L
0ZL02			M			M		M		H
0ZL03	M		V		L	M	H	V		H
0ZL04										
0ZL05	H		L	M	M	M	M	H		V
0ZL06			M		M	L		L		L
0ZL07										M
0ZL08	H	V	L	H		V	V		V	L
0ZL09	V	M	V	M	H	M		V		V

5.4.5 Discussion

Many of the 'activities' identified at the Boyne Estuary may act so as to modify the wetland habitats. While physical loss might be considered more historic in nature (e.g. land claim, the construction of training walls etc.), on-going modifications to intertidal habitats may occur due to changes in natural processes (e.g. sedimentation or erosion rates) as a result of former physical events, as well as from on-going activities such as navigation dredging and the encroachment of *Spartina anglica.*

Human recreational activities at coastal areas are likely to be less during winter months. Nevertheless recreational activity, mostly walking (with/without dogs) was widespread across the site. 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.

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:-

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

- 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: BOYNE ESTUARY SPA

SITE CODE: 004080

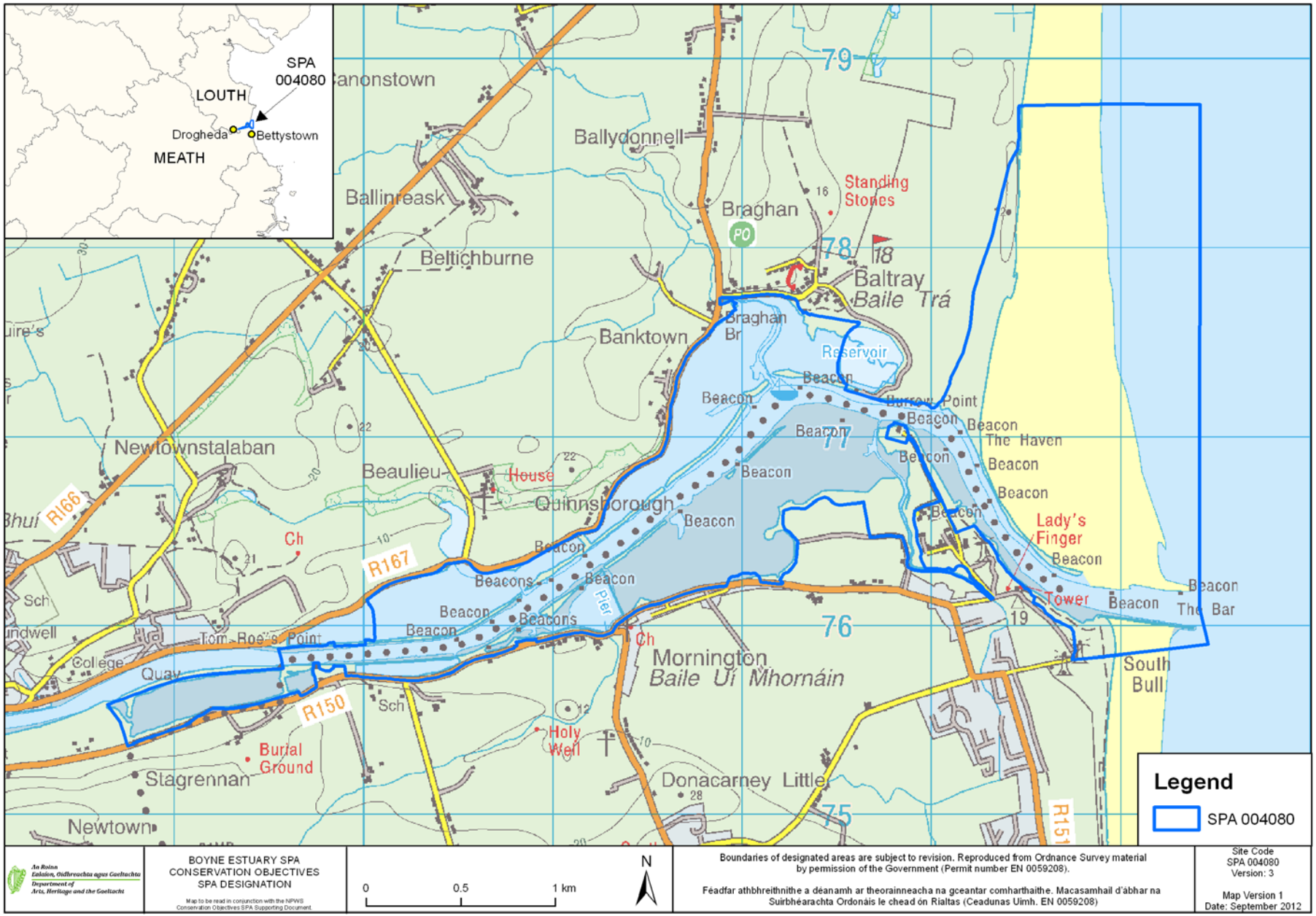
This moderately-sized coastal site is situated west of Drogheda on the border of Counties Louth and Meath. The site comprises most of the estuary of the Boyne River, a substantial river which drains a large catchment. Apart from one section which is over 1 km wide, its width is mostly less than 500 m. The river channel, which is navigable and dredged, is defined by training walls, these being breached in places. Intertidal flats occur along the sides of the channelled river. The sediments vary from fine muds in the sheltered areas to sandy muds or sands towards the river mouth. The linear stretches of intertidal flats to the north and south of the river mouth are mainly composed of sand. One or more species of Eelgrass (*Zostera* spp.) occur in the estuary. Parts of the intertidal areas are fringed by salt marshes, most of which are of the Atlantic type, and dominated by Sea-purslane (*Halimione portulacoides*). Other species present include Common Saltmarsh-grass (*Puccinellia maritima*), Sea Plantain (*Plantago maritima*), Lax-flowered Sea-lavender (*Limonium humile*) and Glasswort (*Salicornia* spp.). Common Cord-grass (*Spartina anglica*) occurs frequently on the flats and salt marshes.

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Shelduck, Oystercatcher, Golden Plover, Grey Plover, Lapwing, Knot, Sanderling, Black-tailed Godwit, Redshank, Turnstone and Little Tern. 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 Boyne Estuary is the second most important estuary for wintering birds on the Louth-Meath coastline. Black-tailed Godwit occurs here in internationally important numbers (471). A further nine species have populations of national importance, i.e. Shelduck (218), Oystercatcher (1,090), Golden Plover (6,070), Grey Plover (98), Lapwing (4,657), Knot (1,771), Sanderling (69), Redshank (583) and Turnstone (175) - all figures are mean peaks for the 5 year period 1995/96-1999/2000. Of particular note is that the site supports 6% of the national population of Knot and almost 4% of the total for Golden Plover. Other species which occur include Bar-tailed Godwit (76), Cormorant (97), Brent Goose (172), Wigeon (454), Teal (230), Dunlin (480), Curlew (395), Mallard (197), Red-breasted Merganser (14), Greenshank (6), Ringed Plover (80) and Mute Swan (13). The site provides both feeding and high-tide roost areas for the birds. The estuary also attracts large numbers of gulls in winter, including Black-headed Gull (593), Common Gull (145), Herring Gull (403) and Great Black-backed Gull (160).

Little Tern have bred here since at least 1984. In the intervening years breeding numbers and fledgling success has varied significantly. In 1996 approximately 20 pairs fledged 15 - 20 chicks but in 1998 and 1999 part of the shingle bank where the birds nested was washed away by storms. In 2007 a successful Little Tern breeding colony was recorded.

The site is of considerable ornithological importance for wintering waterfowl, with Black-tailed Godwit occurring in internationally important numbers and nine other species having populations of national importance. Of particular significance is that two of the wintering species, Golden Plover and Bar-tailed Godwit are listed on Annex I of the E.U. Birds Directive. Little Tern is also listed on Annex I of this directive.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Baltray
Baile Trá
Banktown
Reservoir
Burrow Point
The Haven
Newtownstalaban
Beaulieu
House
Quinnsborough
Lady's
Finger
Tower
The Bar
South
Bull
R166
R167
R150
R151
Ch
Pier
Tom Roe's Point
College
Quay
Mornington
Baile Uí Mhornáin
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Donacarney Little
Newtown
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SPA 004080
BOYNE ESTUARY SPA
CONSERVATION OBJECTIVES
SPA DESIGNATION
Map to be read in conjunction with the NPWS
Conservation Objectives SPA Supporting Document.
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Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material
by permission of the Government (Permit number EN 0059208).
Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na
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Site Code
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Version: 3
Map Version 1
Date: September 2012

APPENDIX 2

Waterbird data sources

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

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

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

- Swan Surveys

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

- Greenland White-fronted Goose

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

- Greylag Geese

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

- Barnacle Goose (*Branta leucopsis*)

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

- Light-bellied Brent Geese

Special autumn surveys of this species have been conducted since 1996, organised 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

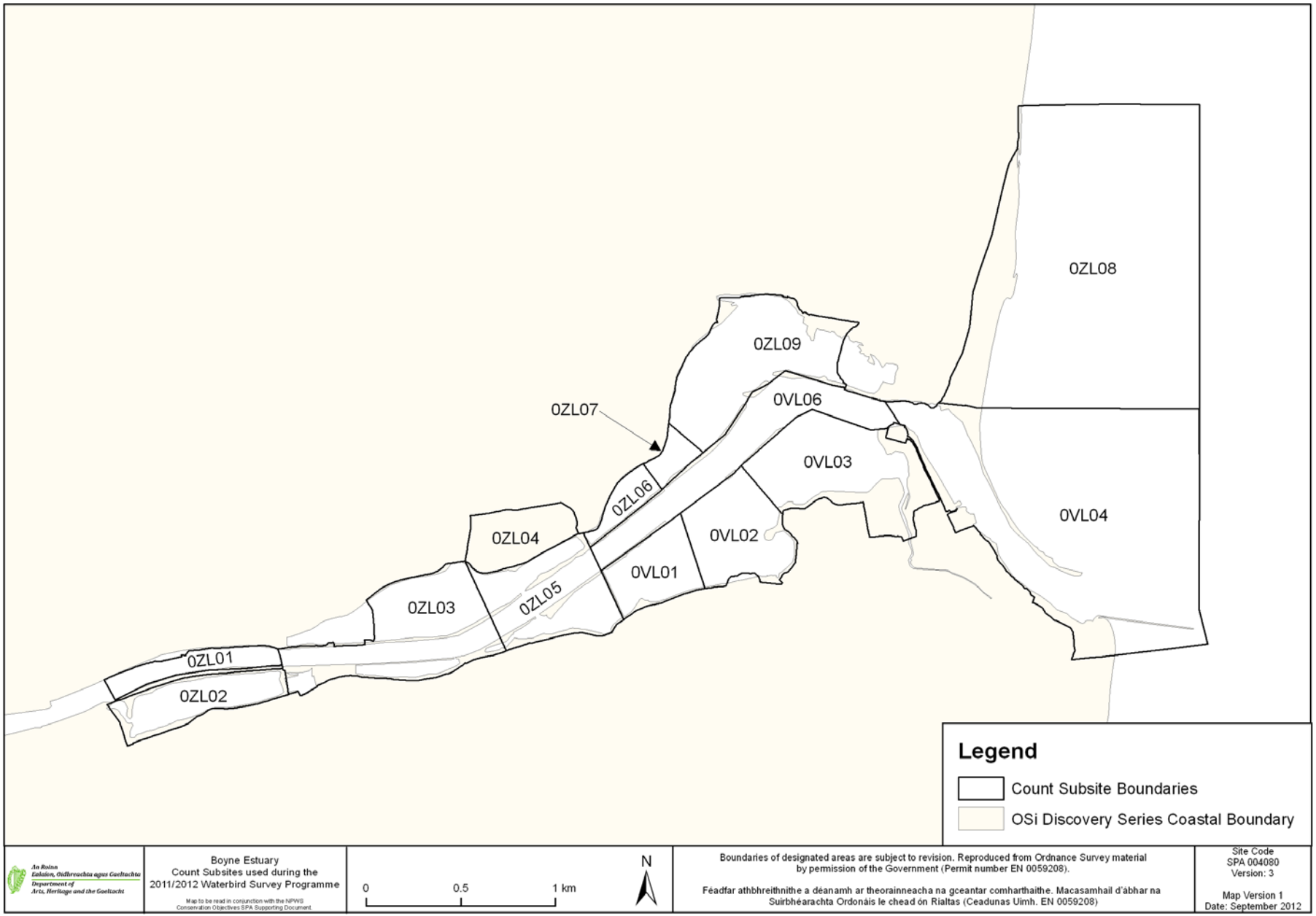
[a] dives <3m.

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

Boyne Estuary – Waterbird Survey Programme 2011/12 – Count Subsites

Subsite	Subsite Name	Subsite Area (ha)
0VL01	Mornington West	16.34
0VL02	Mornington East	25.13
0VL03	The Beacon	40.83
0VL04	Lady's Finger	153.02
0VL06	Boyne Channel	33.47
0ZL01	Tom Roe's Quay	9.99
0ZL02	Arp	18.90
0ZL03	Port to Beaulieu	41.51
0ZL04	Beaulieu House	15.04
0ZL05	Beaulieu Pier-Mornington	29.61
0ZL06	Quinsborough West	6.25
0ZL07	Quinsborough East	4.64
0ZL08	Baltray	182.01
0ZL09	Braghan	42.46
	TOTAL COUNT AREA	**619.20**


0ZL08
0ZL09
0ZL07
0VL06
0VL03
0ZL06
0VL04
0ZL04
0VL02
0VL01
0ZL03
0ZL05
0ZL01
0ZL02
Legend
Count Subsite Boundaries
OSi Discovery Series Coastal Boundary
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
Boyne Estuary
Count Subsites used during the 2011/2012 Waterbird Survey Programme
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
0
0.5
1 km
N
Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059208)
Site Code
SPA 004080
Version: 3
Map Version 1
Date: September 2012

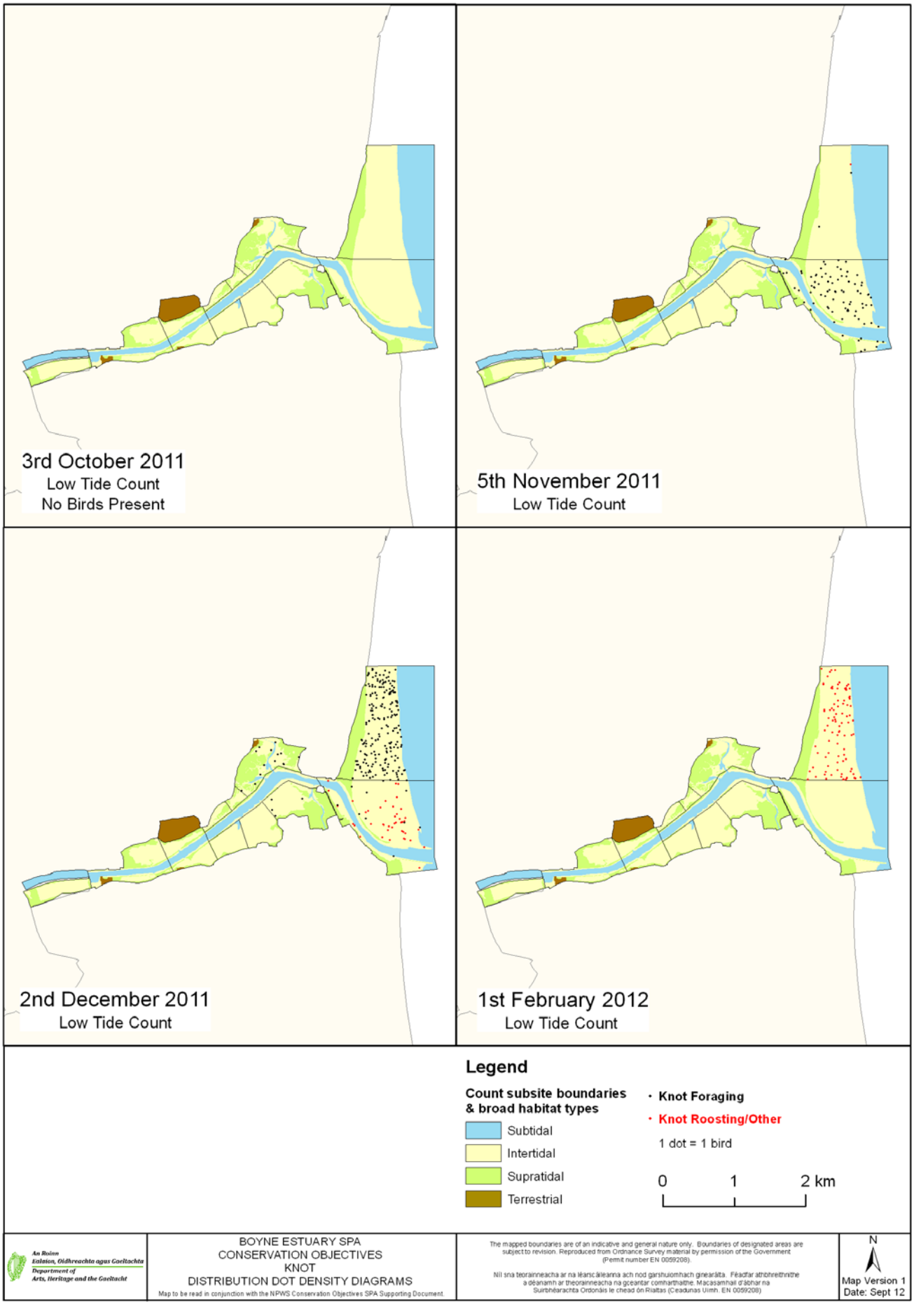
APPENDIX 7

Boyne Estuary

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

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


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Golden Plover Foraging
Golden Plover Roosting/Other
1 dot = 20 birds
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE ESTUARY SPA
CONSERVATION OBJECTIVES
GOLDEN PLOVER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208).
N
Map Version 1
Date: Sept 12


3rd October 2011
Low Tide Count
No Birds Present
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Knot Foraging
Knot Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE ESTUARY SPA
CONSERVATION OBJECTIVES
KNOT
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
N
Map Version 1
Date: Sept 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Black-tailed Godwit Foraging
Black-tailed Godwit Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE ESTUARY SPA
CONSERVATION OBJECTIVES
BLACK-TAILED GODWIT
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
N
Map Version 1
Date: Sept 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Turnstone Foraging
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE ESTUARY SPA
CONSERVATION OBJECTIVES
TURNSTONE
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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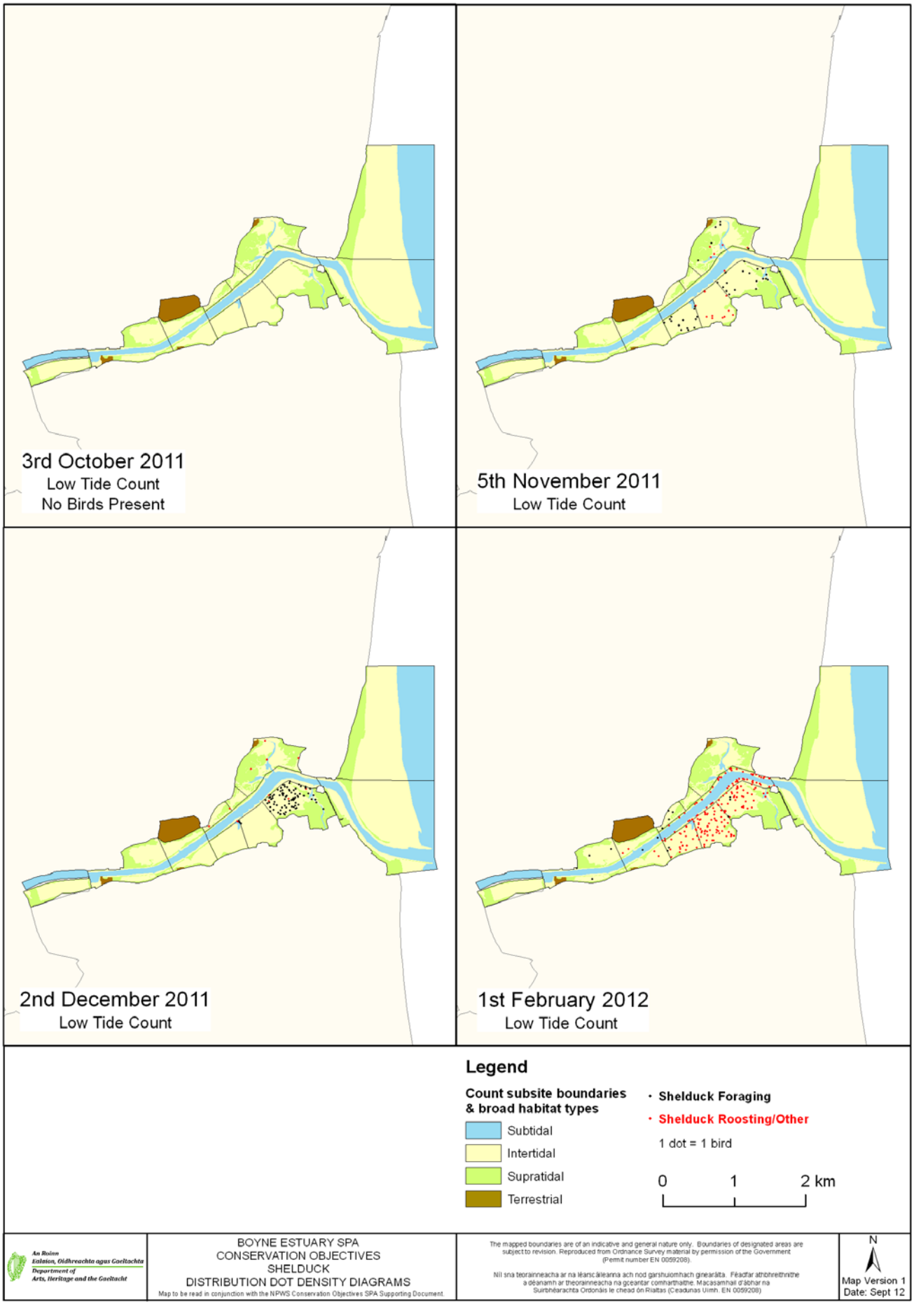
Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Maoirsíonn Suirbhéireacht Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
N
Map Version 1
Date: Sept 12


3rd October 2011
Low Tide Count
No Birds Present
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Shelduck Foraging
Shelduck Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE ESTUARY SPA
CONSERVATION OBJECTIVES
SHELDUCK
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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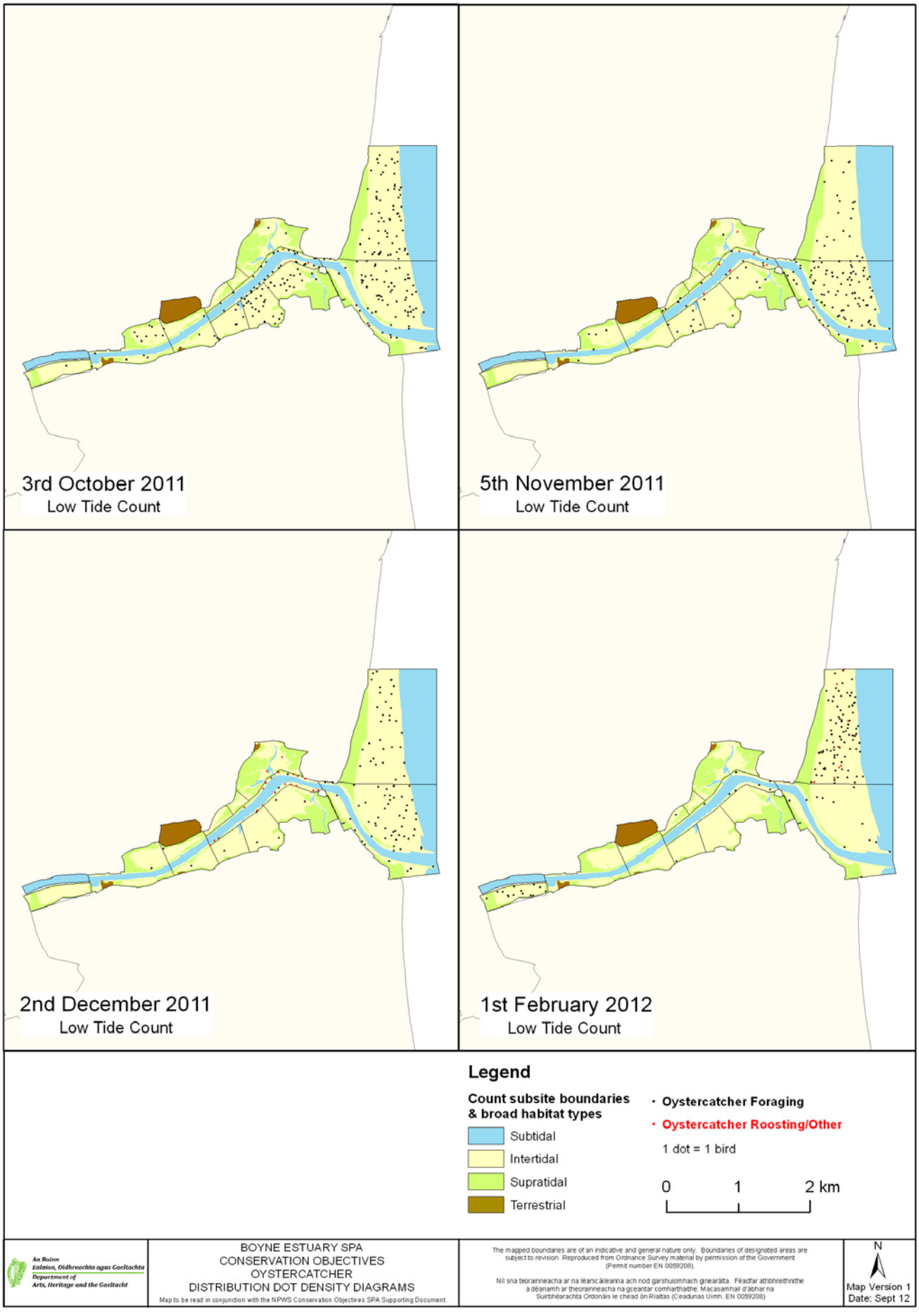
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
N
Map Version 1
Date: Sept 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Oystercatcher Foraging
Oystercatcher Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE ESTUARY SPA
CONSERVATION OBJECTIVES
OYSTERCATCHER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
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N
Map Version 1
Date: Sept 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Grey Plover Foraging
Grey Plover Roosting/Other
1 dot = 2 birds
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE ESTUARY SPA
CONSERVATION OBJECTIVES
GREY PLOVER
DISTRIBUTION DOT DENSITY DIAGRAMS
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Níl sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
N
Map Version 1
Date: Sept 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Lapwing Foraging
Lapwing Roosting/Other
1 dot = 2 birds
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE ESTUARY SPA
CONSERVATION OBJECTIVES
LAPWING
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 dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
N
Map Version 1
Date: Sept 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Sanderling Foraging
Sanderling Roosting/Other
1 dot = 2 birds
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE 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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Níl sna teorainneacha ar na léarscáileanna ach nod gárshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
N
Map Version 1
Date: Sept 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Redshank Foraging
Redshank Roosting/Other
1 dot = 1 bird
0
1
2 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE 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 0059208).
Nil sna teorainneacha ar na léarscáileanna ach nod garshuiomhach ginearálta. Féadfar athbhreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
N
Map Version 1
Date: Sept 12

APPENDIX 8

Boyne Estuary

(1a) Summary data and roost location maps from the roost survey 28th November 2011

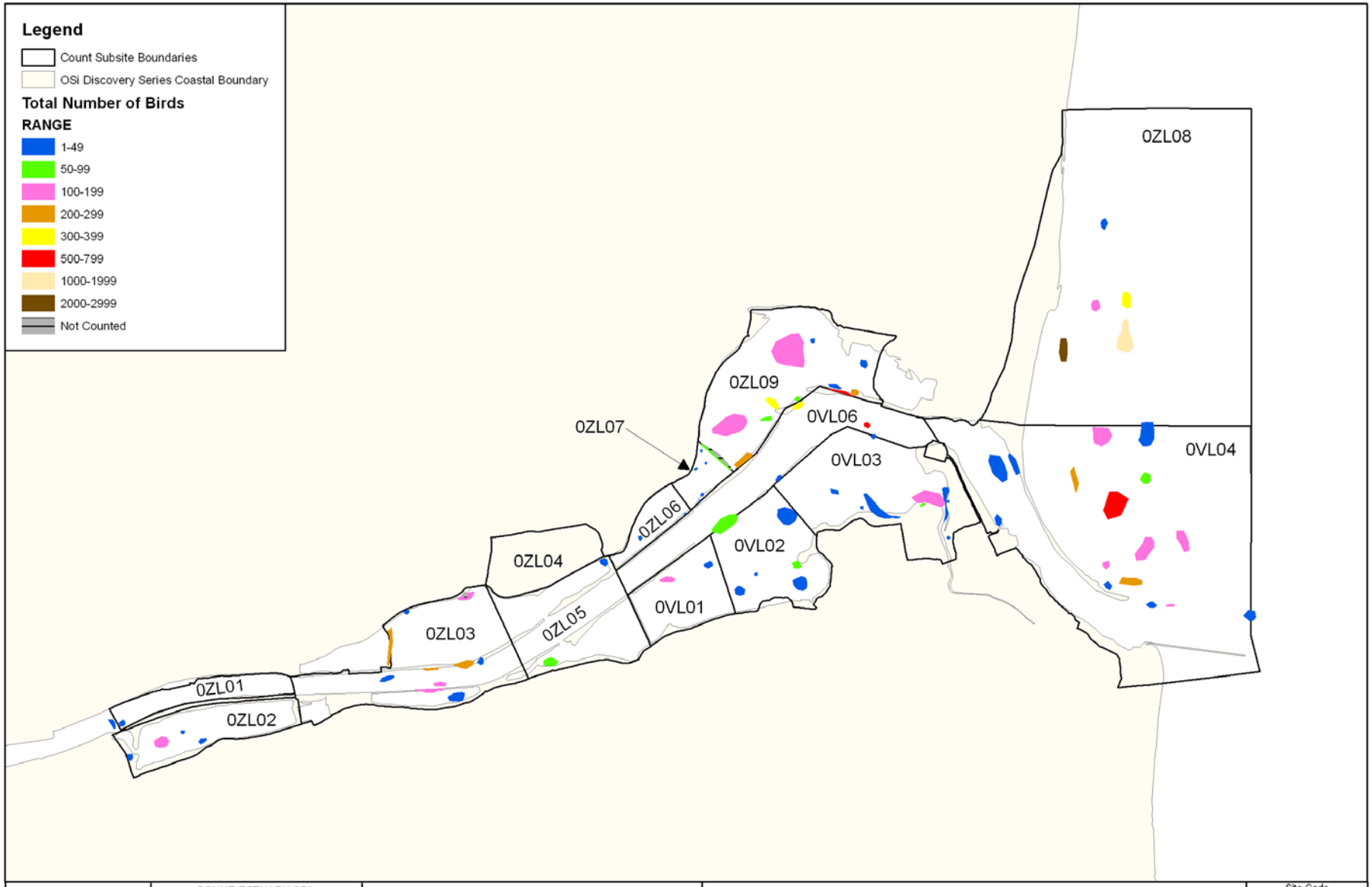
(Please see Sections 5.3.1 and 5.3.2 for further details on methods/limitations)

Subsite Code	Subsite Name	Number individual roost locations	No. Species	Species (alphabetical order)
0VL01	Mornington West	2	5	GB, H., ET, L., MA
0VL02	Mornington East	5	9	CA, H., ET, L., MA, RK, SU, T., WN
0VL03	The Beacon	9	9	BW, H., MA, PB, RK, SU, SN, T., WN
0VL04	Lady's Finger	16	14	BA, CM, CA, DN, GP, GB, GV, HG, KN, OC, RK, SS, T., TT
0VL06	Boyne Channel	4	11	BH, CM, CA, GB, H., HG, L., LB, OC, SU, TT
0ZL01	Tom Roe's Quay	1	1	BH
0ZL02	Arp	4	6	BH, CM, GB, H., HG, SN
0ZL03	Port to Beaulieu	11	11	BH, BW, GB, H., L., MA, MS, PB, RK, T., WN
0ZL04	Beaulieu House	-	-	
0ZL05	Beaulieu Pier-Mornington	2	7	BA, GB, GK, L., PB, RK, SN
0ZL06	Quinsborough West	2	4	MA, RK, SN, SU
0ZL07	Quinsborough East	6	6	CU, L., RK, SU, SN, WN
0ZL08	Baltray	5	10	BA, CM, DN, GB, GP, GV, HG, KN, OC, SS
0ZL09	Braghan	12	14	BA, BH, BW, CM, CU, DN, H., L., MA, OC, RK, SN, T., WN

* note that numbers of birds are not totalled because some subsites were visited more than once

(1b) Boyne Estuary SPA (4080) SCI species and recorded roosts 28/11/11 - shows number of roost locations within subsite, and in brackets, the peak number recorded at a single roost location

Subsite Code	GP	KN	BW	TT	SU	OC	GV	L.	SS	RK
0VL01								1 (138)		
0VL02					2 (13)			2 (58)		1 (12)
0VL03			1 (44)		2 (19)					2 (45)
0VL04	2 (434)	4 (260)		3 (1)		6 (146)	1 (19)		1 (14)	1 (5)
0VL06				1 (5)	1 (22)	2 (360)		2 (20)		
0ZL01										
0ZL02										
0ZL03			1 (n/c)					4 (264)		4 (8)
0ZL04										
0ZL05								1 (60)		1 (1)
0ZL06					1 (5)					1 (1)
0ZL07					1 (2)			1 (47)		2 (27)
0ZL08	1 (624)	3 (241)				4 (200)	3 (422)		1 (107)	
0ZL09			6 (20)			1 (550)		8 (233)		7 (105)


Legend
Count Subsite Boundaries
OSi Discovery Series Coastal Boundary
Total Number of Birds
RANGE
1-49
50-99
100-199
200-299
300-399
500-799
1000-1999
2000-2999
Not Counted
0ZL08
0ZL09
0ZL07
0VL06
0VL03
0VL04
0ZL06
0ZL04
0VL02
0VL01
0ZL03
0ZL05
0ZL01
0ZL02
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE ESTUARY SPA
ROOST LOCATION MAP
DATA COLLECTED DURING
THE ROOST SURVEY ON 28/11/2011
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document
0
0.5
1 km
N
Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059208)
Site Code
SPA 004080
Version: 3
Map Version 1
Date: September 2012

(2a) Summary data and roost location maps from the roost survey 27th February 2012

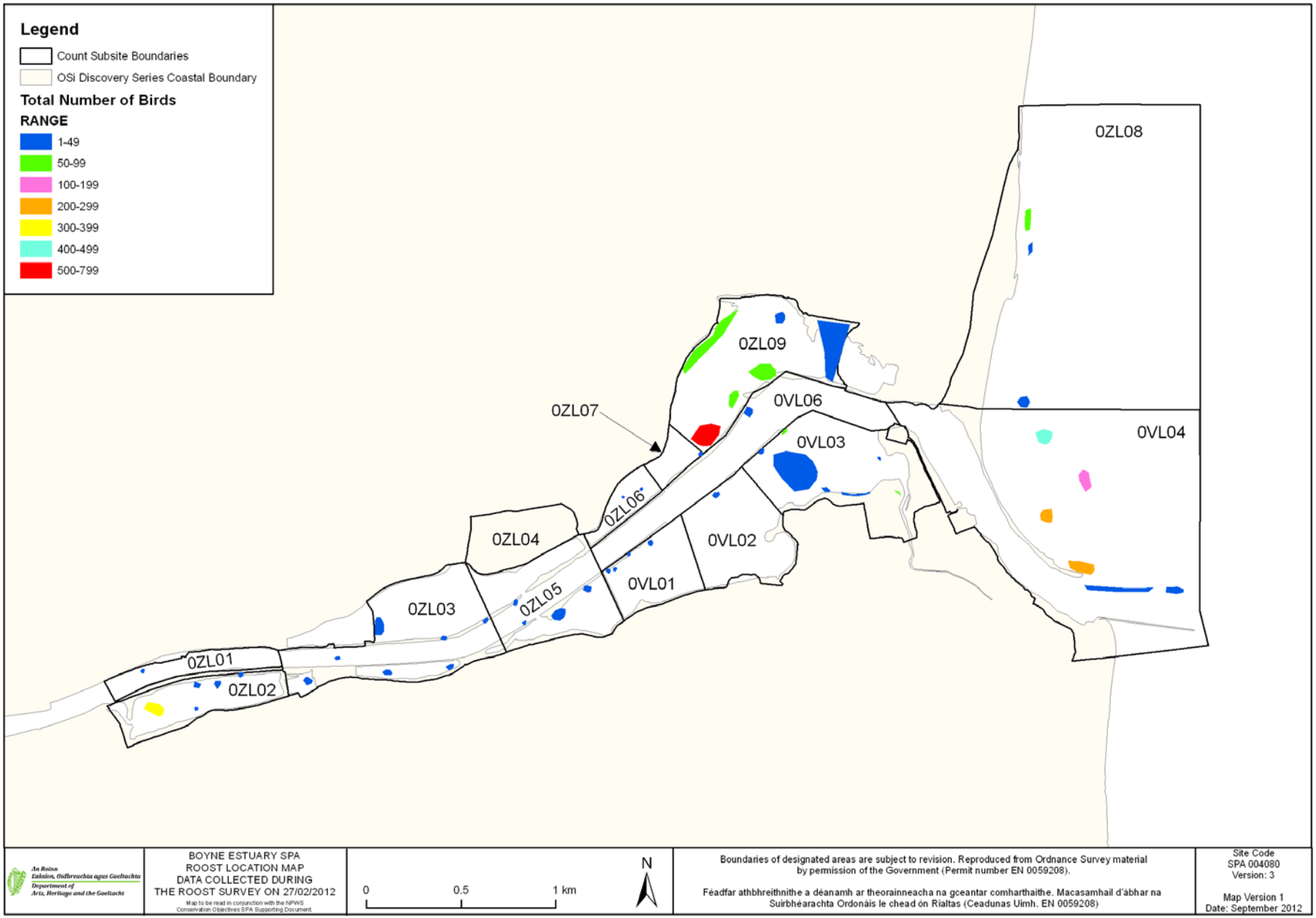
(Please see Sections 5.3.1 and 5.3.2 for further details on methods/limitations)

Subsite Code	Subsite Name	Number individual roost locations	No. Species	Species (alphabetical order)
0VL01	Mornington West	4	4	BW, PB, RK, SU
0VL02	Mornington East	1	2	GB, WN
0VL03	The Beacon	7	11	BH, BW, CA, CU, L., MA, OC, RK, SU, TT, WN
0VL04	Lady's Finger	6	10	BA, CA, DN, GB, GV, HG, KN, OC, RP, TT
0VL06	Boyne Channel	1	1	RK
0ZL01	Tom Roe's Quay	1	1	MA
0ZL02	Arp	5	7	BH, CM, CU, HG, PB, RK, SU
0ZL03	Port to Beaulieu	7	5	CU, MA, MS, SU, T.
0ZL04	Beaulieu House	-	-	
0ZL05	Beaulieu Pier-Mornington	4	5	CU, MA, MS, SU, T.
0ZL06	Quinsborough West	2	1	SU
0ZL07	Quinsborough East	1	1	T.
0ZL08	Baltray	3	4	BA, GB, SS, TT
0ZL09	Braghan	6	9	BH, BW, CU, GK, MA, RK, SU, T., WN

* note that numbers of birds are not totalled because some subsites were visited more than once

(2b) Boyne Estuary SPA (4080) SCI species and recorded roosts 27/02/12 - shows number of roost locations within subsite, and in brackets, the peak number recorded at a single roost location

Subsite Code	GP	KN	BW	TT	SU	OC	GV	L.	SS	RK
0VL01			1 (12)		1 (19)					2 (46)
0VL02										
0VL03			1 (1)	1 (32)	1 (42)	1 (57)		1 (1)		1 (56)
0VL04		2 (91)		2 (7)		2 (255)	2 (84)			
0VL06										1 (4)
0ZL01										
0ZL02					1 (2)					1 (6)
0ZL03					3 (7)					
0ZL04										
0ZL05					2 (8)					
0ZL06					1 (4)					
0ZL07										
0ZL08				1 (17)					1 (33)	
0ZL09			2 (287)		4 (14)					1 (64)


Legend
Count Subsite Boundaries
OSi Discovery Series Coastal Boundary
Total Number of Birds
RANGE
1-49
50-99
100-199
200-299
300-399
400-499
500-799
0ZL08
0ZL09
0ZL07
0VL06
0VL04
0VL03
0ZL06
0ZL04
0VL02
0VL01
0ZL05
0ZL03
0ZL01
0ZL02
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
BOYNE ESTUARY SPA
ROOST LOCATION MAP
DATA COLLECTED DURING
THE ROOST SURVEY ON 27/02/2012
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document
0
0.5
1 km
N
Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059208).
Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le cead ón Rialtas (Ceadunas Uimh. EN 0059208)
Site Code
SPA 004080
Version: 3
Map Version 1
Date: September 2012

APPENDIX 9

Boyne 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 Boyne 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.

ACTIVITIES/EVENTS	0VL01	0VL02	0VL03	0VL04	0VL06	0ZL01	0ZL02	0ZL03	0ZL04	0ZL05	0ZL06	0ZL07	0ZL08	0ZL09
1. Coastal protection, sea defences & stabilisation														
1.1 Linear defences	O	O	O	O	O	O	O	O		O	O	O		O
1.2 Training walls	O	O	O	O	O	O	O	O		O				
1.4 *Spartina anglica* growing/planted		O	O					O		O	O	O		O
1.5 Marram grass				O									O	
2. Barrage schemes/drainage														
2.1 Weirs and barrages for river management														O
2.2 Altered drainage/river channel					H	O	O	H		H				
2.3 Other channel modifications	O	O	O	O	O	O	O	O		O				
2.4 Tidal barrages														O
4. Industrial, port & related development														
4.1 Industrial port						O	O	O		O				
4.4 Pier			O			O				O	H	H		
4.5 Manufacturing industries						O	O	O						
6. Pollution														
6.1 Domestic & urban waste water														O
6.2 Industrial			O	O										
7. Sediment extraction														
7.1 Channel dredging (maintenance & navigation)	O	O	O	O	O	O	H	O		O				
7.6 Removal of estuarine sediment						O	O							
8. Transport & communications														
8.2 Flight path/Aircraft				O							O			O
8.3 Bridges & aqueducts														O
8.4 Tunnel														
8.5 Road schemes	O	O	O	O		O	O	O	O	O	O	O		O
8.7 Shipping channel, shipping lanes					O	O	O	O		O				

9. Urbanisation														
9.1 Urbanised areas, housing	O	O	O	O		O	O	O		O	O			O
12. Tourism & recreation														
12.6 Power boating & water-skiing (powered watercraft)											O	O		
12.8 Sailing										O				
12.18 Walking, incl. dog walking			O	O	O	O				O	O	O	O	
12.19 Birdwatching	O	O	O		O	O	O	O		O				
12.22 Motorised vehicles			O	O										
12.23 Horse-riding				O										
12.25 Golf courses													O	
13. Wildfowl & hunting														
13.1 Wildfowling	H	H	H	H	H	H	H	H		H				
13.2 Other hunting/shooting									O	O	O	O		O
16. Agriculture & forestry														
16.2 Grazing: intensive (terrestrial)									O					
16.4 Sand dune grazing													O	
16.9 Removal of hedges, scrub	O	O	O	O										
16.10 Mowing/grassland cutting									O					
16.13 Agricultural land-claim			O											
16.14 In-filling				H	H	H	H	H	H					H
18. Wildlife habitat management														
18.2 Habitat creation & restoration - intertidal								O						
18.3 Habitat creation & restoration - terrestrial						O	O							
19. Natural events														
19.1 Storms, floods and storm surges	H	H	H	H	H	H	H	H		H				
19.2 Severe cold weather	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 2011/12 Waterbird Survey Programme

ACTIVITIES/EVENTS	0VL01	0VL02	0VL03	0VL04	0VL06	0ZL01	0ZL02	0ZL03	0ZL04	0ZL05	0ZL06	0ZL07	0ZL08	0ZL09
8. Transport & communications														
8.2 Flight path/aircraft				4							4			5
12. Tourism & recreation														
12.6 Power boating & water-skiing (powered watercraft)											6	6		
12.8 Sailing (non powered watercraft)										5				
12.18 Walking, incl. dog walking				7	5	5				5	5	5	7	
12.23 Horse-riding				5										
13. Wildfowl & hunting														
13.2 Other hunting/shooting									4	4	4	4		4