Annex II

Marine Institute Bird Studies

Drumcliff Bay Special Protection Area (004013) and Cummeen Harbour Special Protection Area (004035)

Appropriate Assessment of Aquaculture

April 2015

Notice

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Executive Summary

This report contains the Appropriate Assessment of proposed aquaculture activities in Drumcliff Bay SPA and Cummeen Strand SPA, Co. Sligo. There are also a number of other SPAs located within 15km of these bays, namely Ballysadare Bay SPA (004129); Aughris Head Bay SPA (004133); Ardboline Island and Horse Island SPA (004135); Ballintemple & Ballygilgan SPA (004234); Inishmurray SPA (004068) and Sligo / Leitrim SPA (004187).

This assessment is based on a desktop review of existing information. This included published reports and papers and unpublished data from waterbird surveys. Where relevant, the report identifies information gaps that may affect the reliability of the conclusions of this assessment.

Constraints to the assessment include the lack of detailed information about the proposed aquaculture activities; lack of information about the nature of waterbird responses to some of the activities assessed - notably on proposed clam farming practices.

Methodology

Analysis of the likely impacts of activities covered in this assessment was based on calculations of spatial overlap between the SCI species distribution and the spatial extent of the activities. These analyses focus on distribution patterns of feeding, or potentially feeding birds, as the main potential impacts will be to the availability and/or quality of feeding habitat, although we have included assessment of potential impacts on roosting birds, where relevant. The distribution of waterbird was initially analysed using data from the Irish Wetland Bird Survey (IWeBS) counts and National Parks and Wildlife Service (NPWS) baseline waterbird survey counts (carried out in 2010/11); however, due to data constraints the main analysis utilised the NPWS low tide count data from 2010/2011; with other data sources and consultation used to further examine emerging trends. Maps of flock locations from the NPWS baseline waterbird survey low-tide counts and descriptions of waterbird distribution have also been used to interpret the patterns derived from these analyses. It should be noted therefore that we were restricted to using NPWS low tide count data from 4 no. counts over the winter of 2010/2011 in our quantitative analysis of spatial and population impacts.

The methodology used to identify potentially significant impacts is focussed on the Conservation Objectives, and their attributes, that have been defined and described for the Drumcliff Bay SPA and Cummeen Strand SPA. Impacts that will cause displacement of 5% or more of the total SPA population of a non-breeding SCI species (for each site) have been assessed as potentially having a significant negative impact and are examined further in the context of species behaviour; relationship with aquaculture types; population trends etc.

Conservation objectives

The Special Conservation Interests (SCIs) of Drumcliff Bay SPA include non-breeding populations of Bar-tailed Godwit and Sanderling; while the SCIs of Cummeen Strand are Light-bellied Brent Goose, Oystercatcher and Redshank. The conservation objectives for these species are to maintain their favourable conservation condition, which are defined by there being stable or increasing long-term population trends and no significant decrease in numbers or range of areas used within Drumcliff Bay SPA and Cummeen Strand SPA, respectively.

The wetland habitats within the Drumcliff Bay SPA and Cummeen Strand SPA and the waterbirds that utilise this resource are an additional SCI (the wetlands and water birds SCI). The conservation objective for this SCI is to maintain its favourable conservation condition, which is defined by there being no significant decrease in the permanent area occupied by wetland habitats.

Screening

All of the SCI species for the Drumcliff Bay SPA and Cummeen Strand SPA make significant use of subtidal and/or intertidal habitat within the SPA and were, therefore, carried forward for full Appropriate Assessment. Each sites is addressed separately, in Chapters 7.0 (Drumcliff Bay SPA) and 8.0 (Cummeen Strand SPA), respectively.

The SCI species listed for Ballysadare Bay SPA (004129); Aughris Head Bay SPA (004133); Ardboline Island and Horse Island SPA (004135); Ballintemple & Ballygilgan SPA (004234); Inishmurray SPA (004068) and Sligo / Leitrim SPA (004187) include a diverse range of waders, wildfowl, seabirds and terrestrial species such as Peregrine Falcon and Chough. Chapter 4.0 of the AA screens all listed SCIs against the proposed aquaculture activities (including activities on the foreshore, access, disturbance etc.). Of these the potential for impacts on Barnacle Goose at Ballintemple & Ballygilgan SPA (004234), which immediately adjoins Drumcliff Bay SPA, could not be discounted. Barnacle Geese are therefore, carried forward for full Appropriate Assessment. Ballysadare Bay SPA (004129) is designated for Light-bellied Brent Goose, Grey Plover, Dunlin, Bar-tailed Godwit and Redshank; a number of these species are shared as SCIs with Drumcliff Bay SPA and Cummeen Strand SPA. While the possibility of movement of waders and wildfowl between these three Co. Sligo bays cannot be discounted, linkages between the SPA sites are poorly understood.

Description of aquaculture activities

Traditionally the bays in Co. Sligo have been used to culture both Pacific Oyster (*Crassostrea gigas*) and Manila Clam. Intertidal culture of the Pacific Oyster (*Crassostrea gigas*) using oyster trestles is widespread in Ireland and occurs in 16 SPAs and the potential impact of this activity on waterbird populations has been addressed by targeted studies and in a number of Appropriate Assessments to date. At sites in both Drumcliff Bay SPA and Cummeen Strand SPA it is proposed to culture the Pacific Oyster using trestles in intertidal habitat; the proposed licence blocks also extend into the shallow subtidal. The trestles are usually located in the lower part of the intertidal zone, in areas that are only fully exposed on low spring tides. Oysters are to be grown at Drumcliff / Cummeen in mesh bags placed on top of the trestles, where they are on-grown until they are ready for harvesting. Oyster husbandry activities mainly take place during spring low tides. At sites with large areas of trestle blocks, husbandry activities may take place on every suitable tide. Access points are also described for each bay. As no information is available at this time as to the % occupation of the licence blocks by trestles; a conservative approach of 100% occupation has been adopted. Onsite activities; the location and size of aquaculture plots etc. is summarised in Ch. 6.0 of this Assessment.

In contrast to the wide distribution of oyster farming around the Irish coast, outside of Co. Sligo, we are aware of only a single site at Rossbehy, Glenbeigh, Co. Kerry where Manila clam are currently farmed. As a result unlike the detailed study of the impact of oyster cultivation on shorebirds (Gittings and O'Donoghue, 2012), there is limited data on the relationship between shorebirds and clam parcs (apart from limited observations in Glenbeigh; Marine Institute, 2011a). Thus a conservative approach of 100% occupation of sites by clam mesh and resultant 100% displacement of SCIs from within aquaculture plots has been adopted to initially examine spatial / population impacts on SCIs.

In recent years, however, due to the outbreak of disease no Manila clam are currently being cultivated in Drumcliff or Cummeen. The licence renewals / applications are divided into two types; i) those sites where it is solely proposed to cultivate Pacific oyster on trestles and ii) those sites where it is solely proposed to cultivate Pacific oyster on trestles, but at some time in the future the applicant wishes to reserve the right to commence the cultivation of clam again (following a suitable fallow period to remove disease concerns from the site).

Assessment of aquaculture activities

As noted above the potential impact of oyster and / or clam cultivation was assessed for each bay, respectively; for Bar-tailed Godwit, Sanderling and Barnacle Goose in Drumcliff Bay SPA (and neighbouring Ballintemple & Ballygilgan SPA) and Light-bellied Brent Goose, Oystercatcher and Redshank in Cummeen Strand SPA.

Bar-tailed Godwit and Sanderling both show negative response to oyster trestles (Gittings and O'Donoghue, 2012); potential for impact was therefore assessed on the basis of complete exclusion for both oyster trestles and clam parcs.

Oystercatcher and Redshank show neutral / positive response to oyster trestles; while Light-bellied Brent Goose shows a variable response (Gittings and O'Donoghue, 2012). The response of Light-bellied Brent Geese has been further considered by subsequent field observations and in most cases is also neutral / positive. While one might therefore screen out all three species from further consideration they have been considered in full in this assessment due to the uncertainty regarding how they interact with clam parcs and the possibility of conversion of many of the oyster farming licences to clam licences in the future (discussed in detail below).

Drumcliff Bay SPA

Bar-tailed Godwit

In Drumcliff Bay SPA the primary risk of potential impact on Bar-tailed Godwit is at Ardtermon Strand where trestles could displace 4.66% of the SPA population. Trend analysis has shown that Bar-tailed Godwit is, however, increasing within the SPA. Some caution must, however, be exercised in assessing impacts at Ardtermon as the assessment is based on a relatively restricted data set (4 no. NPWS low tide counts from 2010 / 2011). For example the peak count of 790 birds recorded at Ardtermon highlights the high degree of variation between counts (i.e. 6.3% of the population in this instance). The potential for movement of Bar-tailed Godwit between Drumcliff, Cummeen and Ballysadare is also mentioned in the NPWS Conservation Objective Supporting document (NPWS, 2013b).

While, no significant impacts are predicted for any of the other licence renewal / application blocks for this species in Drumcliff Bay SPA; the total displacement across all sites would range from 5.2% (based on mean count values) to 8.03% (based upon maximum counts). This is predominantly at the Ardtermon site and overall is greater than the 5% threshold used as guide for identifying potentially significant impact on this SCI.

We understand that NPWS (pers comm.) have recently undertaken further low tide work in the Bay (this was not available at the time of writing); we would, however, recommend that this be reviewed to recheck the above findings. If these data do not provide the necessary insight we would recommend that further monitoring of the low tide use of the key Bar-tailed Godwit sites within the SPA by should be undertaken in order to fully assess the potential for negative impacts at Ardtermon.

Sanderling

The main area where Sanderling could be impacted by the granting of licence applications / renewals would be at Ballinphunta (sub site 0C449); here displacement of 1.5% of the SPA population is predicted for oysters based on mean numbers (this increases to 1.8% when the peak Sanderling count is used).This is well below the 5% threshold for a significant impact on this SCI. While the NPWS low tide counts did not record Sanderling from Ardtermon, NPWS (T. Roderick, pers comm.) noted that Sanderling do use this site; suitable intertidal habitat certainly occurs at this site.

While the population trends in Drumcliff Bay SPA are negative for Sanderling (-59; compared to +125 nationally); as discussed above the low number / variability in timing of early IWeBS coverage (counts per winter, months of coverage and years with no data) does not allow confidence in the trends for this species in Drumcliff Bay. In recent years counts have been more frequent; with a strong correlation between the number of counts and the number of Sanderling recorded (see paragraph 5.4); and a pattern of increasing numbers in the last 5 year period. Thus the predicted level of impact (<2%) is unlikely to have a significant impact on Sanderling at Drumcliff Bay SPA. It is, however, recommended that Sanderling numbers at key sites, including Ardtermon, be monitored annually (from IWeBS data).

Barnacle Geese

While detailed evidence on patterns of site use of the Lissadell goose field are not available; given the continued increase in the Sligo flock; it would appear that current levels of activity in the Sligo area (including aquaculture activity) are not negatively impacting on Barnacle Geese numbers using the complex of Ballintemple / Ballygilgan SPA (004234), Inishmurray SPA (004068) and Ardboline Island / Horse Island SPA (004135). However, we understand from NPWS that the Ballygilgan goose field is to be subject of a targeted management plan in order to encourage greater use of the site by Barnacle Geese (T. Roderick, pers comm.). Intensification of activities and / or landward expansion of activities are therefore a concern if they were to result in increased levels of disturbance and displacement.

In order to allow ongoing aquaculture activities at this location, firstly the Code of Practice should be revisited by the Industry, BIM and NPWS to ensure any practices licenced do not result in disturbance impacts on Barnacle Geese using Ballintemple / Ballygilgan SPA and that aquaculture activities are considered as part of overall site management. Furthermore, numbers using both the Ballintemple subsite and Lissadell (Ballygilgan) subsite should be monitored for any signs of disturbance and / or displacement by onshore aquaculture activities.

Cummeen Strand SPA

As noted the following assessment starts with the assumption of total exclusion even though all three species show neutral / positive association to oyster trestles. This approach allows us to adopt a worst case scenario (precautionary principle) under which sites could revert to clam culture and the relationship of Light-bellied Brent Geese, Oystercatcher and Redshank to these are less clearly understood.

Light-bellied Brent Geese

Negative impacts on this SCI species are deemed unlikely at all sites outside of Cummeen Strand (subsite 0C466). Based upon the conservative assumption of total exclusion, Cummeen Strand clearly emerges as the sub-site with greatest potential for negative impacts on Light-bellied Brent Geese (overall displacement of 4.64% - 9.39% if all oyster plots were to be licenced). Under a worst case scenario licencing of all aquaculture plots within Cummeen Strand SPA could result in displacement of up to 5.17% - 10.42% of birds. This is greater than the 5% threshold used as guide for identifying potentially significant impact on this SCI. However, this is based on the very conservative estimate of total exclusion of birds from licence plots; which is not supported by field observations, and thus is not a realistic assessment of impact levels.

Rather, while it is concluded that the aquaculture licences will have some adverse impacts on this SCI; given its positive population trend and the fact that this species does occur and is known to forage within oyster trestles and clam parcs (though the evidence on this front is more limited); then the level of impact is more likely to be on the lower end of this spectrum.

Due to the very large area proposed for cultivation at Cummeen Strand (0C466) it is however recommended that use of this area by Light-bellied Brent Geese be monitored in line with annual population levels as derived from IWeBS data.

Oystercatcher

Based upon the conservative assumption of total exclusion, the overall displacement of Oystercatcher caused by oyster licences would be 4.56% - 5.57% (based on mean and peak counts); and 0.99% - 1.20% for sites proposing to farm oysters or clams. Total levels of displacement would be therefore be 5.55% - 6.77% across all activities if one assumes 100% occupation of licence blocks and total exclusion of Oystercatcher from same. While, this is greater than the 5% threshold used as guide for identifying potentially significant impacts on this SCI, Gittings and O'Donoghue (2012) found the assumption of total exclusion to be untrue; thus impacts are likely to be significantly less than those predicted above and thus are likely to be well below the 5% significance threshold.

Redshank

The overall displacement of Redshank caused by oyster licences only could be 5.91% - 8.23% of the site population of this species, depending on whether the assessment is based on mean or maximum number of birds counted at low tide in each sub-site. Displacement from oyster / clam plots would be a further 1.32%-1.86%; resulting in a cumulative impact across all plots of 7.23% - 10.09% for Redshank based upon total exclusion. The main impacts are predicted to be in Cummeen Strand (subsite 0C466); where displacement due to oysters (assuming 100% occupation and total exclusion) would be over 5-8%. As noted, this conservative approach (of total exclusion) was adopted to allow for some uncertainty as to how Redshank responds to clam parcs to be considered. However, as detailed in Table 6.2 not all applications wish to revert to farming clams; most will continue to farm oysters – and as noted Redshank have been shown by Gittings and O'Donoghue (2012) to show a neutral / positive reaction to trestles. The maximum level of displacement from those plot switching to clam farming would be <2%; the remaining sites being used to cultivate oysters only. Thus, the overall impact on Redshank is unlikely on balance to reach the levels noted above.

A note of caution with respect to Redshank is, however, warranted as this the population trend recorded for this species by NPWS is -31 (as compared to a national trend of -4.8; see Table 6.1). Therefore, we would therefore recommend that the relationship between clam farming and this species be further examined before a switch back to clam farming is undertaken. This would also offer the opportunity to consider the relationship between shorebirds and clam cultivation as a whole. As noted in paragraph 5.19, an analysis of Jaunuary IWeBS data for Redshank over the period 1994/95 to 2012/13 in Cummeen Strand SPA shows a consistent and generally stable trend; which mirrors the national trend in this species (Boland and Crowe 2012). This suggests that confidence in the trend of -31 as given in Table 5.4 for Redshank is low and that the site population may be more stable over the longer term (up to 2012/13) than is suggested in this table. In recent years the greater number of counts has provided a robust dataset; thus in coming years Redshank numbers should continue to be monitored thorough IWeBS and Redshank population / trend data should inform any switch to clam harvesting.

Cumulative impacts

This assessment considered the cumulative impacts of the combined effects of the aquaculture and other activities within the SPA (including recreational activities, boat traffic, hand collection of shellfish, bait digging and effluent discharge).

Disturbance levels at Drumcliff Bay SPA would appear to be lower than at Cummeen Strand SPA; the latter is close to Sligo Town and residential developments of Strandhill and Rosses Point. In contrast the environs of Drumcliff Bay are largely agricultural. Sligo Airport is now largely used by light aircraft and coastguard helicopters; though disturbance of birds by aircraft was noted by NPWS during the low tide survey work in 2010/11.

Both bays are prone to disturbance from recreational activity in the intertidal zone which could have in-combination effects with displacement impacts from aquaculture activities. Beaches such as Ardtermon,

Lissadell and Ballygilgan are popular and walkers with dogs were in particular noted as a source of disturbance. Aquaculture activities were noted as disturbing at a number of sites.

Acknowledgements

We are grateful to Louise Collins (BIM Aquaculture Regional Officer for Donegal and Sligo) for providing information about existing aquaculture activities in Drumcliff Bay SPA and Cummeen Strand SPA. Francis O'Beirn (Marine Institute) provided useful information and answered many queries. We are also grateful to Mike Trewby for provided information, insight and data about waterbird counts and distribution in Drumcliff Bay SPA and Cummeen Strand SPA; and Robert Wilkes (EPA) who provided information on *Zostera*. Thanks also to Olivia Crowe (BirdWatch Ireland) and Lesley Lewis, Rebbeca Jeffrey, Tim Roderick and David Tierney (NPWS) who also assisted with the provision of bird data and comments on Barnacle Geese. Thanks also to Martin Enright and Dr David Cabot for observations on the use of the shoreline by Barnacle Geese.

1. Introduction

1.1 Atkins (Ecology) was commissioned by the Marine Institute to provide ornithological services in relation to the appropriate assessment of aquaculture and shellfisheries on coastal Special Protection Areas (SPAs).

1.2 This report contains the appropriate assessment of aquaculture licence areas in Drumcliff Bay and Cummeen Strand. The activities being assessed are within the Drumcliff Bay SPA (site code 004013) and Cummeen Strand SPA (site code 004035) and these SPAs are the primary focus of this assessment. There are six other SPAs within 15 km of the aquaculture and shellfishery areas at Drumcliff Bay and Cummeen Strand (including Ballysadare Bay which is immediately south of Cummeen Strand and is part of the three major intertidal complexes that occur within Sligo Bay).

1.3 These SPAs are: -

- Ballysadare Bay SPA (site code 0041290)
- Aughris Head SPA (site code 004133)
- Ardboline Island and Horse Island SPA (site code 004135)
- Ballintemple and Ballygilgan SPA (site code 004234)
- Inishmurray SPA (site code 004068)
- Sligo/Leitrim Uplands SPA (site code 004187)

1.4 These SPAs are all included in this assessment. The boundaries of these SPAs are shown in Figure 1.1 and Figure 1.2.

1.5 This assessment is based on a desktop review of existing information. This included published reports and papers and unpublished data from waterbird surveys. Where relevant, the report identifies information gaps that may affect the reliability of the conclusions of this assessment.

1.6 For the Appropriate Assessment of aquaculture, the data analysis and reporting was undertaken by Richard Nairn (Natura Consultants) and GIS and report writing support was provided by Paul O'Donoghue and John Deasy.

1.7 Scientific names and British Trust for Ornithology (BTO) species codes of bird species mentioned in the text are listed in Appendix A.

Site Location

1.8 Drumcliff Bay SPA and Cummeen Strand SPA are located within Sligo Bay, Co. Sligo on the northwest coast of Ireland. The boundary of Drumcliff Bay SPA extends from Raghly Point in the west to the estuary of Drumcliff River in the east. The SPA runs north of Rosses Point and along the coastline on the northern side of the bay.

1.9 The boundary of Cummeen Strand SPA extends east from Killaspug Point and Coney Island to Sligo and the mouth of the Garavogue River. The SPA boundary runs along the coastline of Rosses Point on the northern side of the bay and along Cummeen Strand on the southern side of the bay (Figure 1.1). It is more usually known locally as Sligo Harbour.

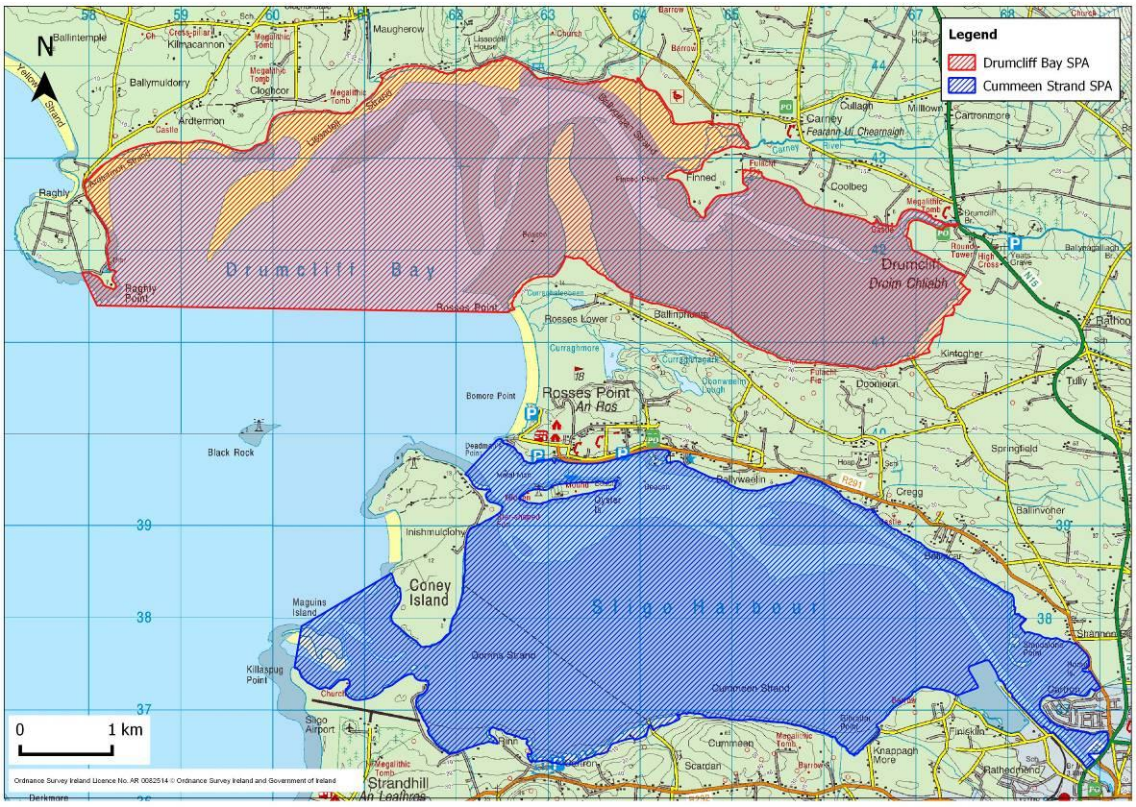

Figure 1.1 – Boundary of Drumcliff Bay SPA and Cummeen Strand SPA, Co. Sligo

1.10 As noted, a number of further SPAs also occur with 15 km of Drumcliff Bay SPA and Cummeen Strand SPA including Ardboline Island and Horse Island SPA, Aughris Head SPA, Ballintemple and Ballygilgan SPA, Ballysadare Bay SPA, Inishmurray SPA and Sligo/Leitrim Uplands SPA. Their locations are illustrated in Figure 1.2, below.

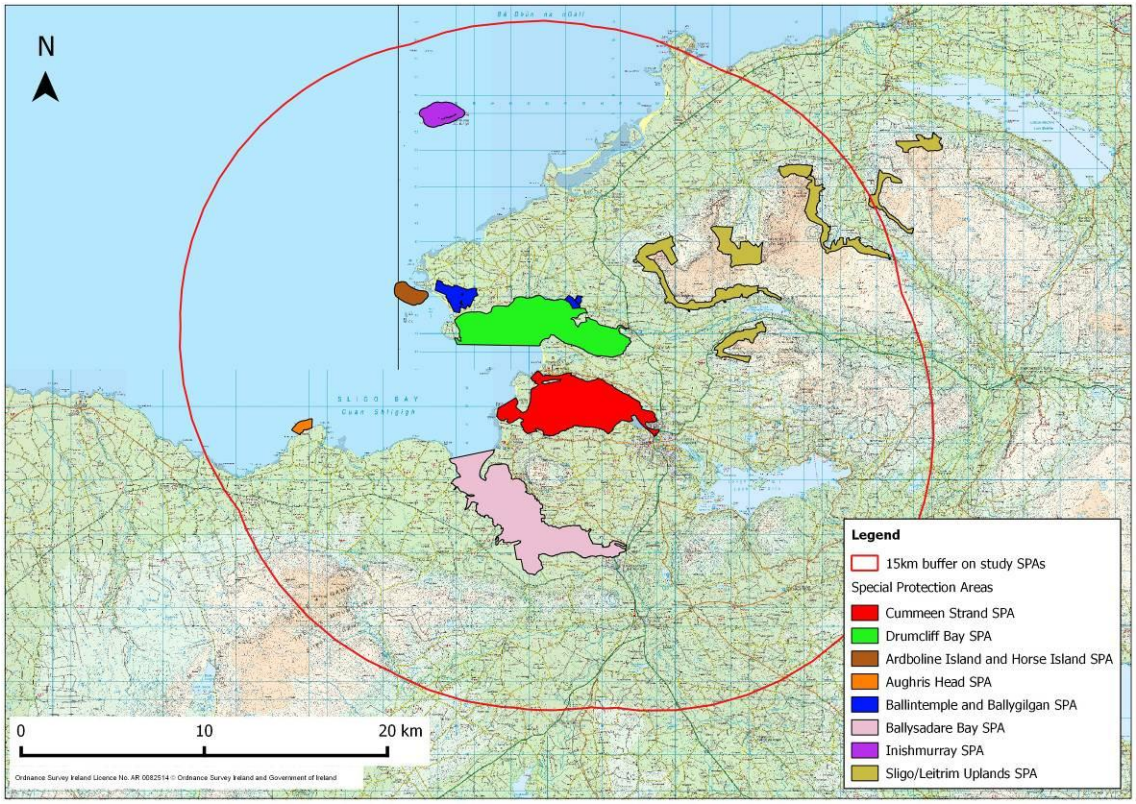

Figure 1.2 - Special Protection Areas within 15 km of Drumcliff Bay SPA and Cummeen Strand SPA.

Site Description

1.11 Drumcliff Bay SPA and Cummeen Strand SPA are two of the three large SPAs that cover a large portion of the intertidal habitats that occur within inner Sligo Bay. The other SPA is Ballysadare Bay SPA located to the south of the SPAs being considered as part of this assessment.

Drumcliff Bay SPA (004013)

1.12 Drumcliff Bay SPA covers a total area of 1,843 ha with 831 ha classified as subtidal, a habitat which occurs below mean low water mark. These areas are generally covered by sea water and include tidal rivers, creeks and channels that do not dry out at low water. An additional 918 ha are classified as intertidal. These habitats occur between mean high water and mean low water mark and are important areas for foraging and roosting shorebirds during low water and high water depending on the species requirements. The remaining 94 ha are classified as supratidal, or areas which lie above the mean high water mark. This habitat provides roosting areas for birds that may be displaced from the intertidal area when water levels rise on the flood tide or as foraging areas for other bird species (NPWS, 2013a/b).

1.13 Drumcliff Bay is a shallow intertidal bay which is predominantly composed of fine sands based on NPWS biotope information. Admiralty chart 2852 indicates that the majority of the SPA is above drying height, that is, the land surface is exposed at Lowest Astronomical Tide (LAT). The remaining areas of the bay are generally less than 5 m water depth above LAT. Two intertidal creeks are marked, one, Drumcliff Channel runs along the northern side of the bay and into the bay behind the spit at Rosses Point. The other is located to the west of the spit at Rosses Point. Water depths in these channels are 3 to 4 metres above LAT.

1.14 The coastline on the north side of the bay is dominated by a series of sandy beaches namely Ballygilgan Strand, Lissadell Strand and Ardtermon Strand. Saltmarsh habitat occurs at various sheltered locations within the bay. The spit north of Rosses Point supports embryonic dune, fixed dune and saltmarsh habitats (McCorry and Ryle, 2009)

1.15 Ballintemple and Ballygilgan SPA is located close to Drumcliff Bay SPA. It comprises two areas, Ballintemple, north of Raghly Point, and the ‘goose field’ at Ballygilgan, east of Lissadell House. These areas of improved permanent pasture are a traditional wintering site with a combined total of 4,140 Barnacle Geese recorded in the 2013 census (Crowe *et al.* 2014).

Cummeen Strand SPA (004035)

1.16 Cummeen Strand SPA covers a total area of 1,732 ha with 326 ha classified as subtidal, a habitat which occurs below mean low water mark. These areas are generally covered by sea water and include tidal rivers, creeks and channels that do not dry out at low water. An additional 1,353 ha are classified as intertidal. These habitats occur between mean high water and mean low water mark and are important areas for foraging and roosting shorebirds during low water and high water depending on the species requirements. The remaining 53 ha are classified as supratidal, or areas which lie above the mean high water mark. This habitat provides roosting areas for birds that may be displaced from the intertidal area when water levels rise on the flood tide or as foraging areas for other bird species (NPWS, 2013c/d).

1.17 Cummeen Strand SPA is more sheltered, being semi-enclosed by Oyster Island, Coney Island and Maguins Island at the seaward end. The bay is very shallow with almost the entire area covered by the SPA boundary above drying height, leaving large areas of the intertidal flats exposed at low tide. A channel which is 2 to 3 m deep below LAT runs from Deadman’s Point in the northwest of the bay, around Oyster Island on both sides and continues to Sligo in the east where the Garavogue River enters the bay.

1.18 Salt marsh habitats are present on the fringes of Sligo Harbour and are important roosting sites for birds displaced from the intertidal zone during high tide. Sand dune habitat is found at Killaspug Point and Coney Island. There is a shingle barrier at Standalone Point near Sligo Town. (NPWS, 2014).

Structure of this report

1.19 The structure of the report is as follows:

- Section 2 describes the methodology used for the assessment.
- Section 3 lists the Special Conservation Interests (SCIs) of the SPAs included in this assessment, and describes the Conservation Objectives, and their attributes and targets, that have been defined for these SCIs.
- Section 4 contains a preliminary screening assessment that screens out SCIs that do not show any significant spatial overlap with the activities being assessed. It also includes a habitat screening that is used to define which of the remaining SCIs are assessed in relation to activities affecting particular habitat zones.
- Section 5 contains a brief summary of the status and distribution of the SCI species, and their habitats, in the SPAs included in this assessment. This section only contains a very brief summary of distribution patterns; detailed analyses of distribution patterns of individual, species are carried out, as appropriate, in the impact assessment sections of relevant activities later in the document.
- Section 6 presents a summary of the potential impacts arising from oyster and clam cultivation in Drumcliff Bay SPA and Cummeen Strand SPA.
- Section 7 contains an assessment of impacts on the SCI species of in Drumcliff Bay SPA (i.e. Sanderling and Bar-tailed Godwit).
- Section 8 contains an assessment of impacts on the SCI species of in Cummeen Strand SPA (i.e. Light-bellied Brent Goose, Oystercatcher and Redshank).
- Section 9 comments on any in-combination effects with other activities, on the conservation objectives of the SCIs of Drumcliff Bay SPA and Cummeen Strand SPA and other nearby SPAs.
- Section 10 provides concluding comments.

Constraints to this assessment

1.20 The spatial extent of the proposed aquaculture plots have been derived from shapefiles supplied by the Marine Institute. Aquaculture profiles for each site were provided by BIM.

1.21 The subsites used for waterbird counts in the Drumcliff Bay SPA and Cummeen Strand SPA cover almost the whole area of the SPAs and some areas outside the SPAs (see Figures 2.1 and 2.2). In Drumcliff Bay an additional area west of Rosses Point (outside the SPA) is counted as part of IWeBS; while in Cummeen Strand the shore west of Coney Island and Maguins Island (outside the SPA) is also counted as part of IWeBS. In the past IWeBS counts were generally undertaken only once a year (predominantly in January), though the number of counts have increased in recent years to 2 or 3 per annum.

1.22 There is a strong base for the assessment of displacement impacts for some of the aquaculture activities, particularly intertidal oyster cultivation. Information on the impact of clam cultivation is more limited; it differs in placement of the clams under a net on the substrate rather than on raised trestles. Also to harvest the clams, they must be dredged from the substrate (clam harvesting is discussed further below).

1.23 The assessment of cumulative impacts provides a general assessment of issues such as recreational impacts, but without detailed information on other activities it is not possible to precisely quantify these potential impacts. General comments are, however, included as appropriate.

2. Methodology

General

2.1 This assessment is based on a desktop review of existing information about waterbird population trends and distribution in Drumcliff Bay SPA and Cummeen Strand SPA/Sligo Harbour, together with consultation with National Parks and Wildlife Service (NPWS), BirdWatch Ireland (BWI), the Marine Institute (MI), Bord Iascaigh Mhara (BIM), Department of Agriculture Food and the Marine (DAFM) as well as consultation locally on Barnacle Geese.

Data sources

2.2 The SPA boundaries are derived from NPWS shapefiles (which were last downloaded on 11th December 2014).

2.3 The spatial extents of the proposed aquaculture plots have been derived from shapefiles supplied by the Marine Institute, based upon site lists supplied to the Marine Institute by the Department of Agriculture, Food and the Marine.

2.4 The waterbird data sources used for the assessment are as follows: -

- Irish Wetland Bird Survey (IWeBS) counts 1994/95-2013/14;
- NPWS Baseline Waterbird Survey (NPWS BWS) 2010/11 counts;
- NPWS Non-estuarine Waterbird Survey (NPWS NEWS) 1998 and 2007 counts;
- Consultation with the IWeBS co-ordinator.

2.5 The distribution of biotopes within Drumcliff Bay and Cummeen Strand/Sligo Harbour are based upon the biotope mapping undertaken by ASU (2007, 2012) and Aquafact (2011) under contract from the Marine Institute (and NPWS in the case of Aquafact, 2011).

2.6 The definition of tidal zones, and the depths of subtidal habitats, are based on NPWS biotope mapping and Admiralty Chart data. The depths represent the depth below the Lowest Astronomical Tide (LAT).

2.7 Data on the timing and height of low tides were obtained from the United Kingdom Hydrographic Offices Admiralty EasyTide website (http://easytide.ukho.gov.uk/).

2.8 Information on other activities (such as recreational use and boat activity) was obtained primarily from a review of potentially disturbing activities recorded during the NPWS BWS counts (Cummins and Crowe, 2011) and observations and experiences of the authors.

2.9 GIS data used for this assessment was mainly received in Irish Transverse Mercator (ESPG: 2157) (ITM) coordinate reference system. GIS data received in the Irish National Grid (IG) coordinate reference system was transformed to the ITM coordinate reference system using the method described by Alcorn (2014).

Subsites

2.10 A number of different sources for bird survey data are available for Drumcliff Bay and Cummeen Strand/Sligo Harbour all of which use slightly different subsites to subdivide the bay during surveys. These are presented below and are referenced in the text thereafter.

BirdWatch Ireland Irish Wetland Bird Survey (IWeBS)

2.11 The majority of Drumcliff Bay SPA is covered in BirdWatch Ireland's Irish Wetland Bird Survey under the Drumcliff Bay Estuary site (site code 0C497). This site is further divided into subsites which are presented below (Figure 2.1). Additional subsites which are not within the SPA boundary are subsite 0C309 which covers Ballygilgan Nature Reserve also known as the "*goose field*" at Lissadell; it is, however, included within Drumcliff Bay / Cummeen Strand pNHA. The other subsite outside the SPA boundary is subsite 0C933, which covers the beach and intertidal area seaward of the beach at Rosses Point (between Deadman's Point to Rosses Point). The spit on the north side of Rosses Point is not included within the IWeBS subsites. Small areas of salt marsh habitat that fringe the inner bay are also outside the IWeBS count boundaries.

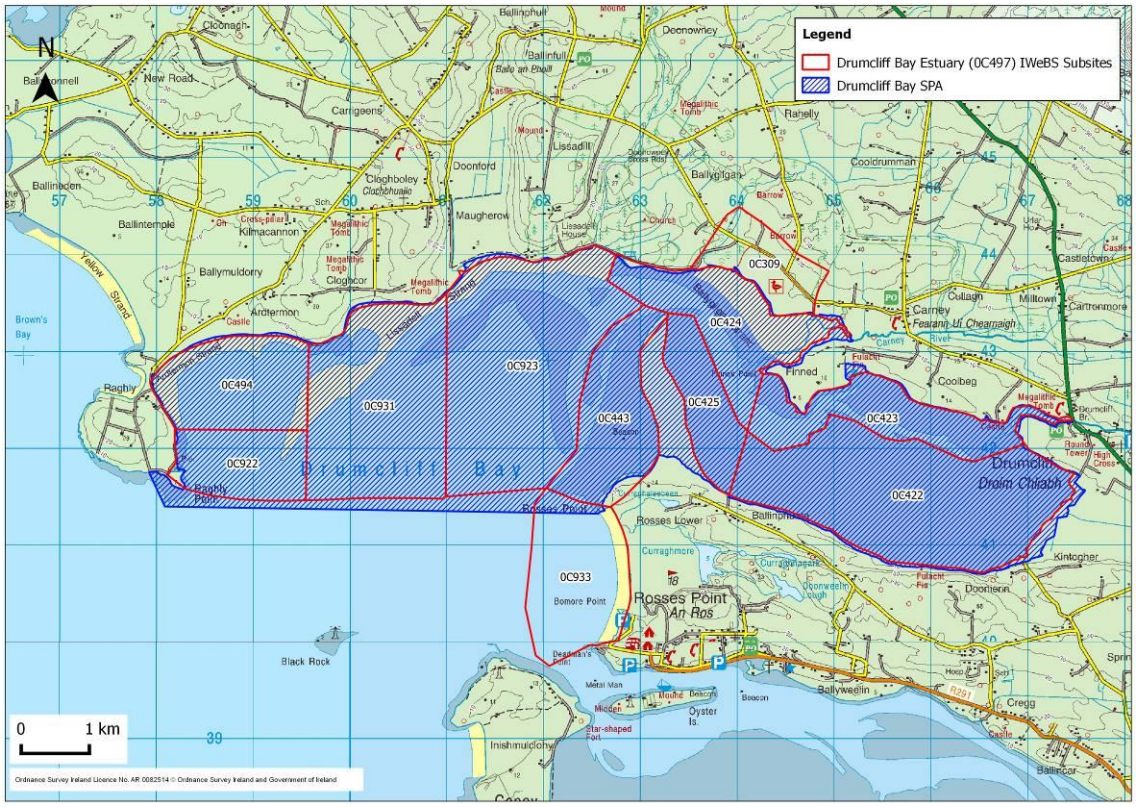

Figure 2.1 – Boundary of area covered by IWeBS high tide counts around Drumcliff Bay Estuary, Co. Sligo.

Table 2.1 – Subsite information for BWI IWeBS at Drumcliff Bay Estuary including subsite areas.

Subsite Code	Subsite Name	Area (ha)
0C309	Ballygilgan NNR (Goose field in Lissadell)	75
0C422	Kintogher/Doonierin	346
0C423	Finned/Coolbeg	131
0C424	Lissadell/Ballygilgan Strand	147
0C425	Lower Rosses	80
0C443	Lower Rosses East	136
0C494	Drumcliff Bay Outer: Ardtermon Strand	138
0C922	Drumcliff Bay Outer: Raghly Harbour	95
0C923	Drumcliff Bay Outer: Maugherow/ Lissadell	361
0C931	Drumcliff Bay Outer: Rosses Point Beaches	273
0C933	Drumcliff Bay Outer: Beach - Deadmans Pt. To Rosses Pt.	153

2.12 The majority of Cummeen Strand SPA is also covered in BirdWatch Ireland's Irish Wetland Bird Survey under the Sligo Harbour site (site code 0C492). This site is further divided into subsites which are presented below (Figure 2.2). Notably, an area of saltmarsh and improved grassland east of Cartron Marsh is included within the IWeBS subsites but not within the SPA boundary. Additional areas excluded from the SPA, but within the IWeBS subsites are Coney Island and Oyster Island. Note that the area of intertidal flat located at the southeast of Sligo Harbour that is outside the SPA boundary is in fact reclaimed land which has been developed as a sewage treatment plant. The OSi Discovery base map used in this image predates this development. Evidence of the reclamation is apparent in 1995 OSi ortho-photography, but the reclamation may predate this.

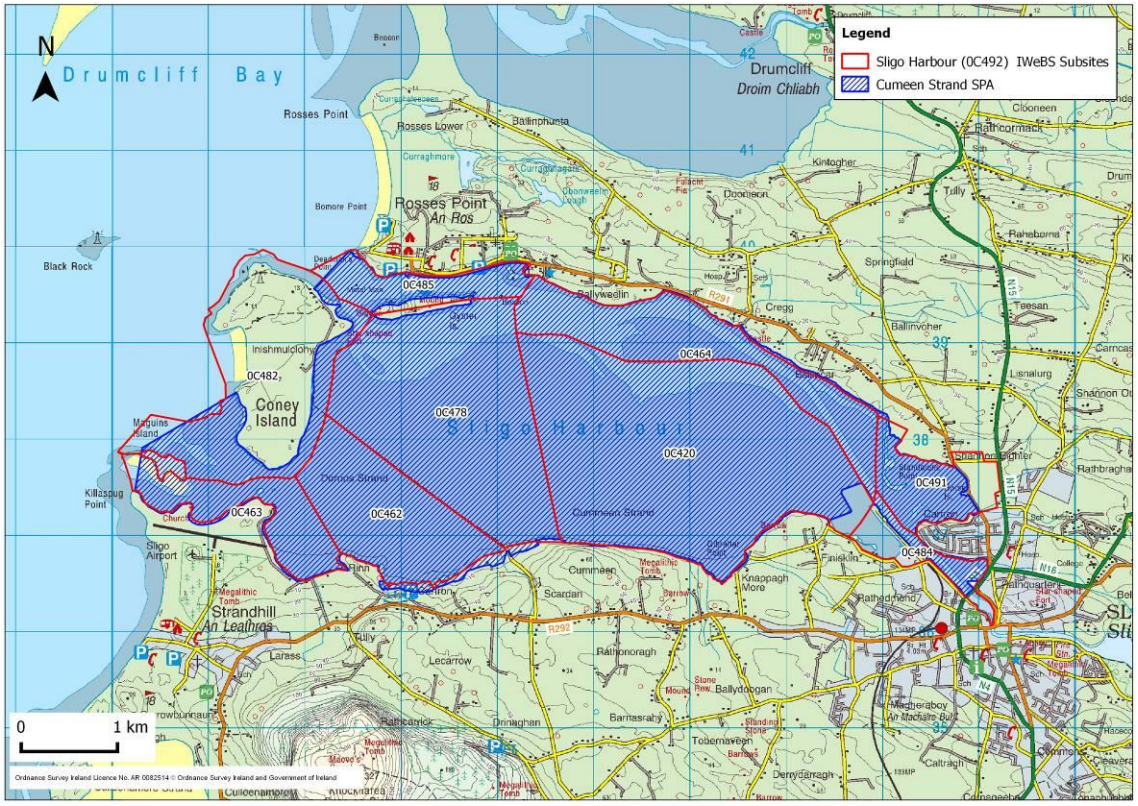

Figure 2.2 – Boundary of area covered by IWeBS high tide counts around Sligo Harbour, Co. Sligo.

Table 2.2 – Subsite information for BWI IWeBS at Sligo Harbour including subsite areas.

Subsite Code	Subsite Name	Area (ha)
0C420	Cummeen Strand East and Gibraltar	594
0C462	Coney Island Road - Dorrins Strand East	183
0C463	Killaspug Point - Dorrins Strand West	104
0C464	Ballincar	191
0C478	Cummeen west from Coney Island Road	402
0C482	Coney Island	310
0C484	Sligo Docks	49
0C485	Rosses Point Harbour	78
0C491	Cartron Marsh	88
0C420	Cummeen Strand East and Gibraltar	594
0C462	Coney Island Road - Dorrins Strand East	183

National Parks and Wildlife Service baseline waterbird survey (BWS)

2.13 For the purposes of the NPWS baseline waterbird survey, Drumcliff Bay was divided into 12 subsites (see Figure 2.3). As with the IWeBS subsites, subsite 0C309 which covers Ballygilgan Nature Reserve also known as the "*goose field*" at Lissadell was also included in the baseline waterbird surveys although outside the SPA boundary. Notably, baseline waterbird survey subsites in outer Drumcliff Bay do not cover a large portion of the subtidal habitat north of a line from Rosses Point to Raghly Point which lies within the SPA boundary. IWeBS subsite 0C933, which covers the beach and intertidal area seaward of the beach at Rosses Point (between Deadman's Point to Rosses Point), was not included in the subsites for the baseline waterbird survey. The spit on the north side of Rosses Point was covered during baseline waterbird survey counts.

2.14 In general, the baseline waterbird survey subsites include the small areas of saltmarsh habitat that fringe the inner bay; for example, an area of saltmarsh and intertidal inlet in the townland of Finned on the north side of inner Drumcliff Bay is included in the baseline waterbird survey subsites, but is excluded from the IWeBS counts even though it is inside the SPA boundary.

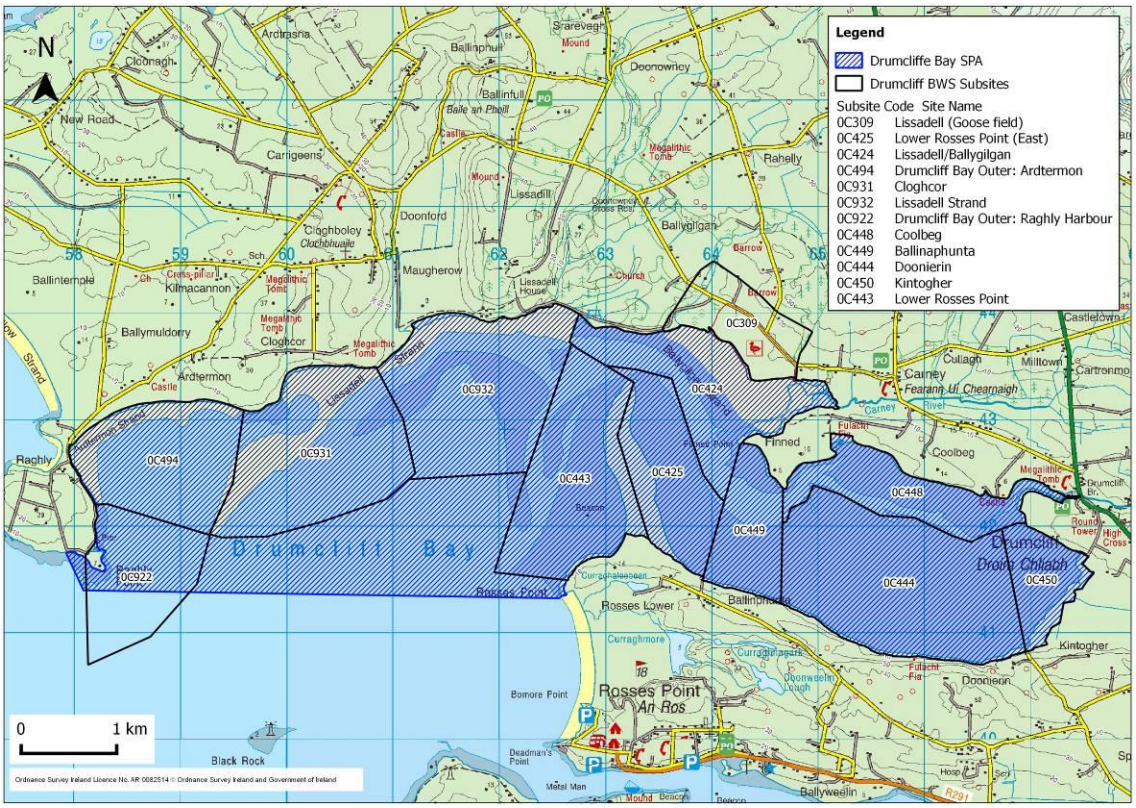

Figure 2.3 – Boundary of NPWS BWS monitoring subsites around Drumcliff Bay.

Table 2.3 – Subsite information for NPWS BWS at Drumcliff Bay including subsite areas.

Subsite Code	Subsite Name	Area (ha)
0C309	Lissadell (Goose field)	75
0C424	Lissadell/Ballygilgan	139
0C425	Lower Rosses Point (East)	105
0C443	Lower Rosses Point	179
0C444	Doonierin	261
0C448	Coolbeg	98
0C449	Ballinaphunta	72
0C450	Kintogher	46
0C494	Drumcliff Bay Outer: Ardtermon	147
0C922	Drumcliff Bay Outer: Raghly Harbour	116

2.15 For the purposes of the NPWS baseline waterbird survey, Cummeen Strand (or Sligo Harbour) was divided into 10 subsites (Figure 2.4).

2.16 A small subsite (0C479) in the estuary of the Garavogue River in Sligo town southeast of the N4 was included in the baseline waterbird survey and is also counted for IWeBS. This area is not within the boundary of the SPA. As with IWeBS subsites, baseline waterbird survey subsites included the terrestrial habitats of Coney Island and Oyster Island. These are not within the boundary of the SPA.

2.17 In general, the baseline waterbird survey subsites include the small areas of saltmarsh habitat that fringe the harbour, which are excluded from the IWeBS subsite boundaries. Notably, the area of reclaimed land in the southeast of the harbour which is within the IWeBS subsites is excluded from the baseline waterbird survey subsites except for a small area of the reclaimed land.

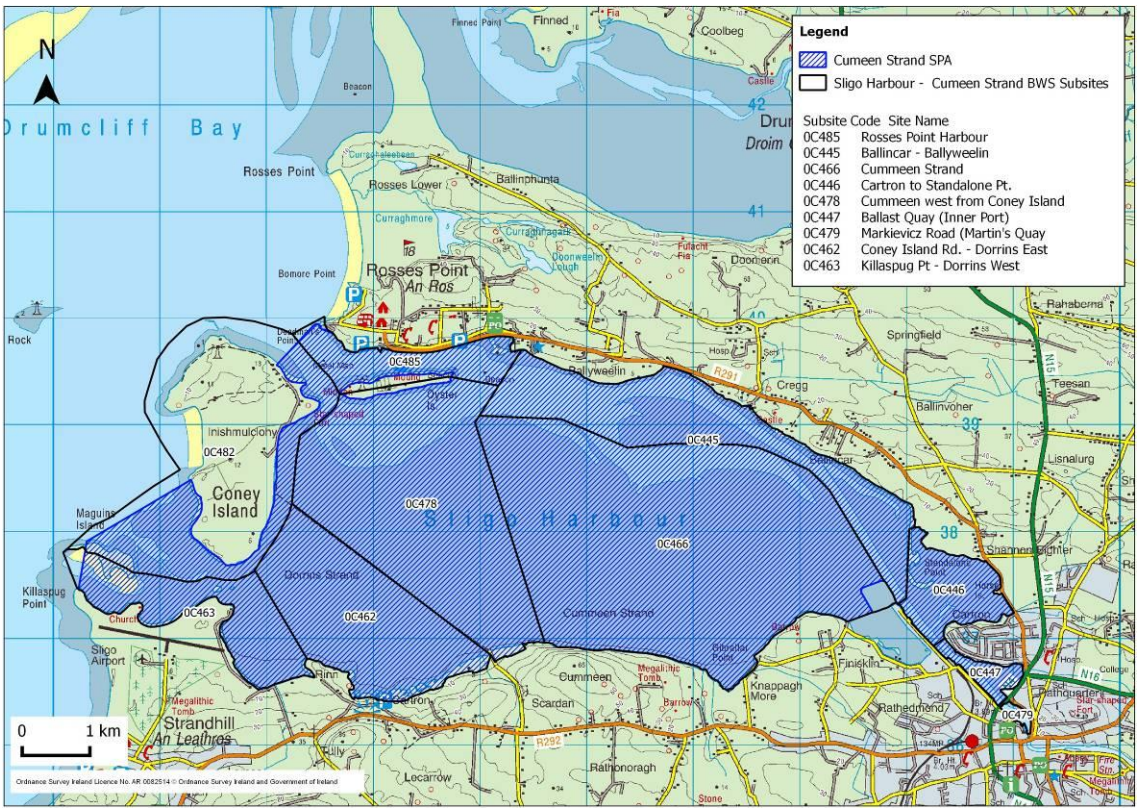

Figure 2.4 – Boundary of NPWS BWS monitoring subsites around Cummeen Strand/Sligo Harbour.

Table 2.4 – Subsite information for NPWS BWS at Sligo Harbour – Cummeen Strand including subsite areas.

Subsite Code	Subsite Name	Area (ha)
0C445	Ballincar - Ballyweelin	203
0C446	Cartron to Standalone Point	63
0C447	Ballast Quay (Inner Port)	16
0C462	Coney Island Road - Dorrins East	197
0C463	Killaspug Point - Dorrins West	110
0C466	Cummeen Strand	625
0C478	Cummeen West from Coney Island	362
0C479	Markievicz Road (Martin's Quay)	4
0C482	Coney Island	351
0C485	Rosses Point Harbour	70

BirdWatch Ireland Non-Estuarine Bird Survey (NEWS)

2.18 The BWI Non-Estuarine Waterbirds Survey (NEWS) transects undertaken at Drumcliff Bay are presented in Figure 2.5. Stretches of coastline outside the boundaries of the SPA include the west side of Raghly Point, the beach at Rosses Point, the northwest side of Coney Island and the beach at Strandhill.

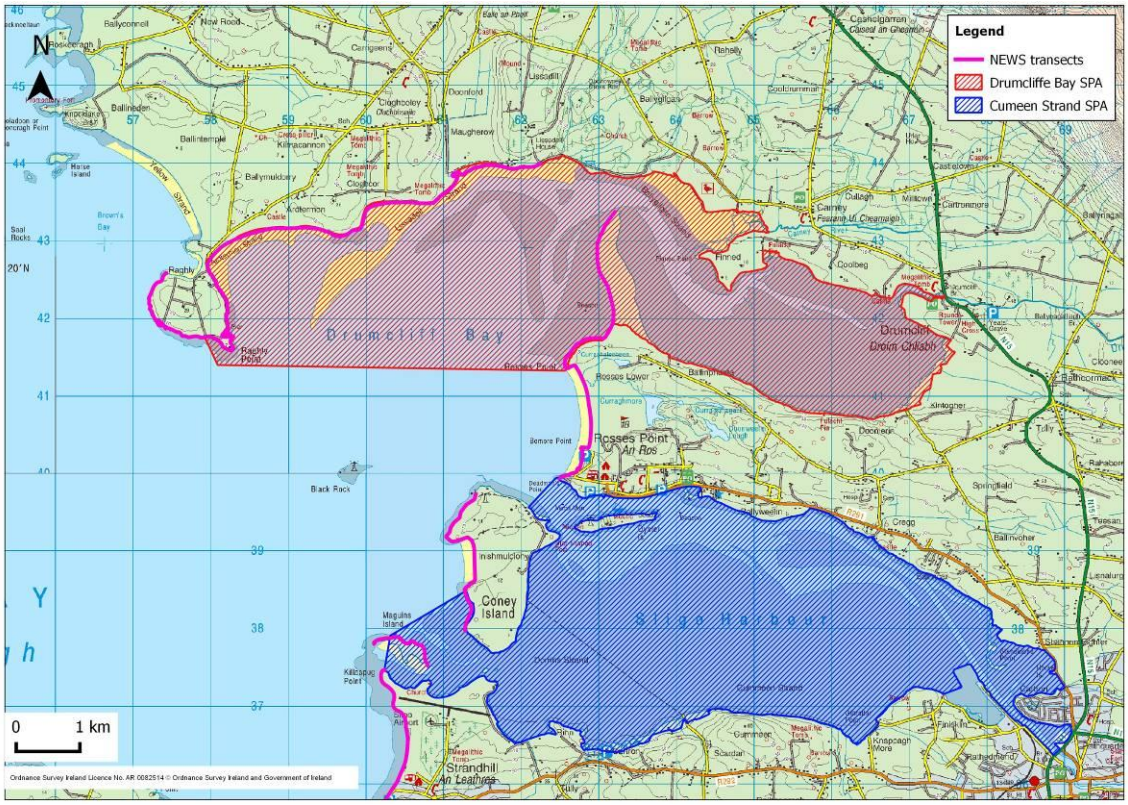

Figure 2.5 – Transects followed by BWI NEWS monitoring counts along the coast at Drumcliff Bay and Cummeen Strand/Sligo Harbour.

Definition of habitat zones

Tidal Zones

2.19 Bathymetric and tidal information from NPWS biotope and United Kingdom Hydrographic Office navigation charts was shown to be significantly out of date when compared to modern aerial photography and bathymetric datasets due to the dynamic sediment deposition particularly in outer Drumcliff Bay and the spit feature/dune complex at Rosses Point and to a lesser extent in Sligo Harbour.

2.20 The NPWS biotope map shows a boundary between the intertidal and subtidal zones which is apparently derived from Ordnance Survey Discovery Series mapping, which in turn, appears to be based on the 1930s six inch mapping. The admiralty chart (2852) for the area contains data from a range of sources including a large portion of bathymetric information for Drumcliff Bay and Sligo Harbour derived from British government and Sligo Harbour commissioners surveys from the 19th and early 20th century with the exception of the navigable channel from Sligo town to Deadman's Point which has been surveyed between the period from 1981 to 2002.

2.21 Contemporary bathymetric data was available from the INFOMAR seabed mapping project and was also accessed[1]. The '*GRIDLIDAR_2008_SLIGO_5M_WGS84_LAT.zip*' file was downloaded in ArcGIS grid format. This Light Detection and Ranging (LiDAR) dataset was collected by INFOMAR using airplane mounted laser equipment in 2008 and provides elevation data for both the terrestrial and shallow marine zones in Sligo Bay. The dataset is available in 5 m grid and referenced to Lowest Astronomical Tide (LAT).

2.22 Contours were generated from this raster at 0.10 m intervals. For the purposes of this study the presentation and smoothness of the contours was improved by calculating a line length for each contour segment and removing those with an attribute of 0.00. The contours were then clipped to within the boundaries of the SPA (downloaded from the NPWS website[2] in December 2014).

2.23 The height of tides for Sligo Harbour was published in Reeds Nautical Almanac (2010) and was used to plot the waterline for Mean Low Water Spring (MLWS), Mean Low Water Neap (MLWN), Mean High Water Neap (MHWN) and Mean High Water Spring (MHWS). The areas between these contours were converted to polygons to allow the areas of each tidal zone to be calculated. These zones consisted of deeper than LAT, LAT to MLWS, MLWS to MLWN, MLWN to MHWN, MHWN to MHWS and higher than MHWS.

2.24 For the purposes of this study, the intertidal zone has been defined as the area between Lowest Astronomical Tide, below which tide levels do not drop unless under the additional effects of suitable metrological and atmospheric conditions. The upper limit of the intertidal zone was set as the height of the tide for Mean High Water Spring (MHWS). Using a GIS, this zone was digitised and the area calculated for each bay as a whole and for the area of each Baseline Waterbird Survey subsites that fell within the SPA boundary. In addition to these values, the area of intertidal habitat covered by the aquaculture licence blocks was calculated using simple geoprocessing tools using a GIS. The percentage impact on potential intertidal habitat for SCI species was then calculated based on these figures, assuming complete exclusion from the aquaculture licence blocks.

[1] http://maps.marine.ie/infomar/
[2] http://www.npws.ie/maps-and-data

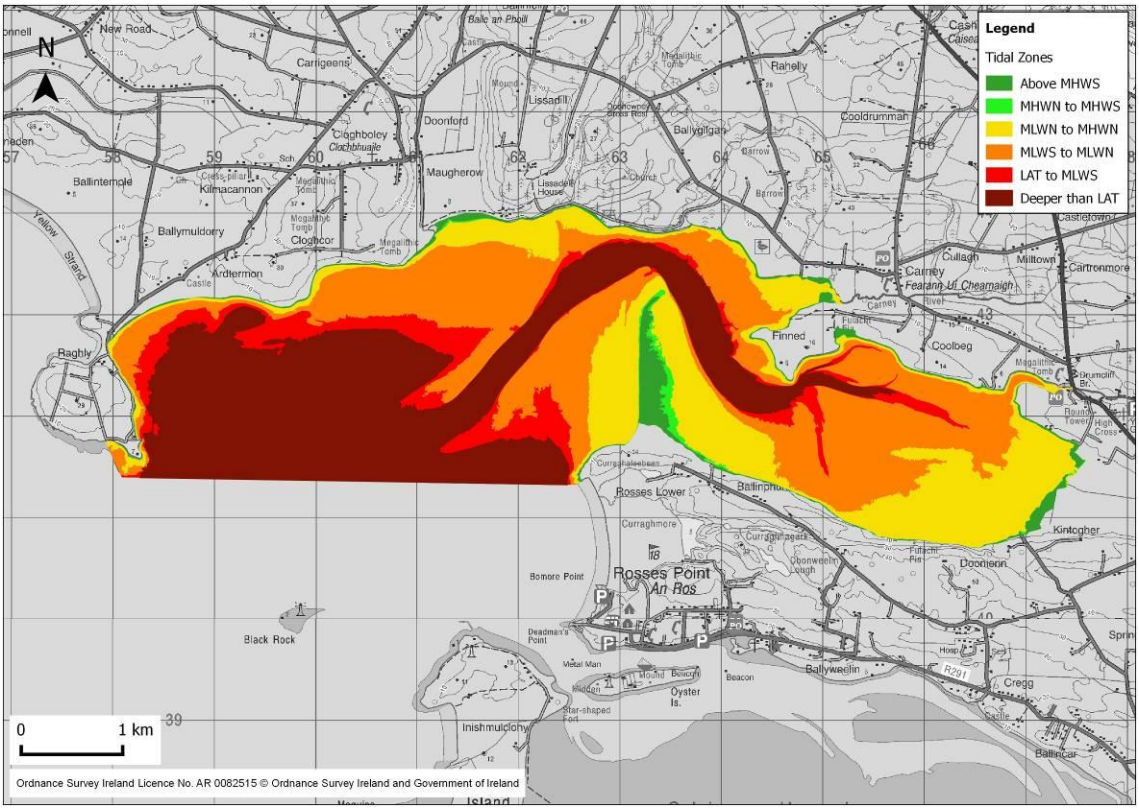

Figure 2.6a – Tidal Zones; Drumcliff Bay.

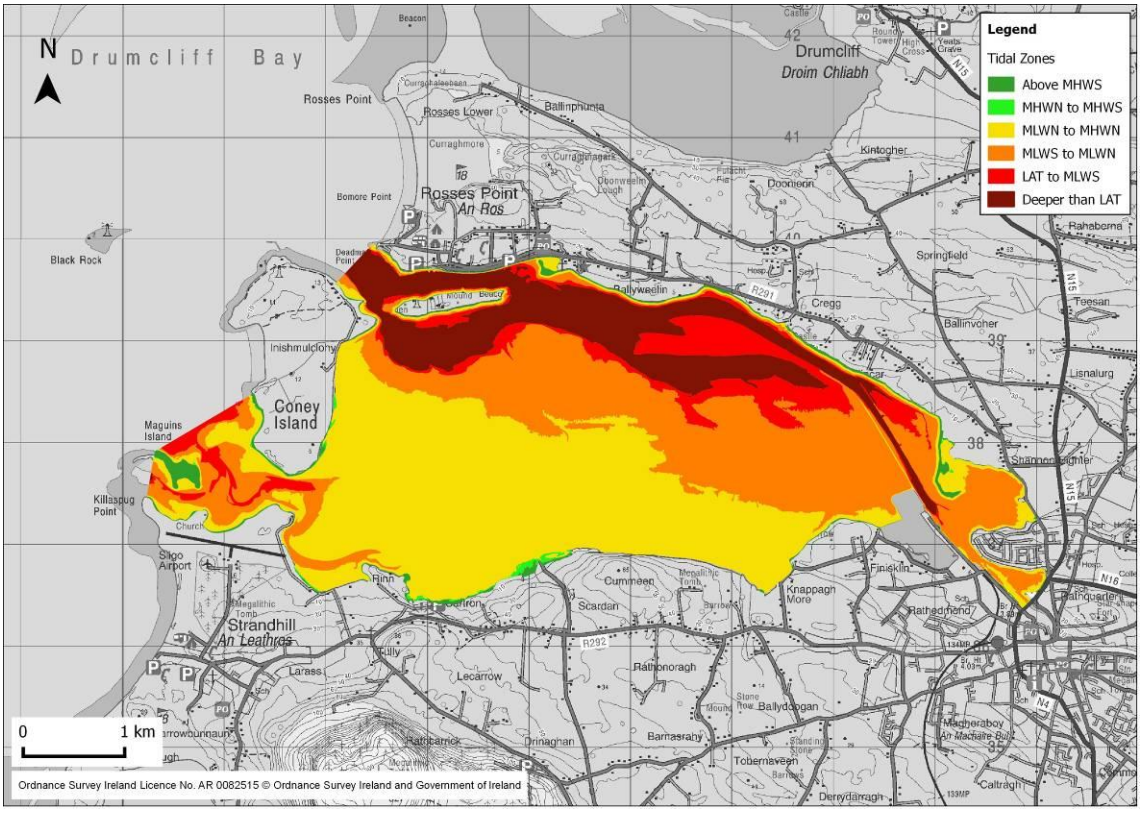

Figure 2.6b – Tidal Zones; Cummeen Strand.

Biotopes

2.25 Intertidal surveys were undertaken at Sligo Bay (Cummeen Strand) and Drumcliff Bay in 2007 and 2010 (ASU, 2007; ASU, 2012) and an intertidal walkover was undertaken in 2013 by Aquatic Services Unit, UCC under contract to the Marine Institute. These data were used to determine the physical and biological nature of this SAC and areas overlapping with Drumcliff Bay SPA and Cummeen Strand SPA (NPWS, 2013).

2.26 In addition, Aquafact, under contract from the Marine Institute and National Parks and Wildlife Service sampled the subtidal areas within Cummeen Strand SAC and Drumcliff Bay SAC on the 7th October, 19th December and 20th December 2010. Full details on the methodology used are described in Aquafact (2011).

2.27 This survey reported that "*sand predominates for the most part in Sligo Harbour out as far as Oyster Island where there is hard ground all around the Island. There is some gravel and mud in varying proportions within the navigational channel in towards Sligo town. In Drumcliff Bay sand predominates with some gravel in patches and hard ground present just east of Raghly Point. West of Drumcliff Bay, along the exposed coastline, hard ground dominates with some sandy patches present in between Ardboline Island and Roskerragh Point and off the sandy shore in Brown Bay. Organic matter levels were relatively low throughout given the sandy nature of the area, however higher organic levels were present in the inner reaches of Sligo Harbour and Drumcliff Bay. Faunal diversity and abundance was relatively high. A* Tellina *community dominated throughout the site, located along the channel and outer reaches of Drumcliff Bay, in the channel in Sligo Harbour, southwest of Coney Island and between Ballyconnell Point and Raghly Point. Epifaunal communities were present mostly in Sligo Harbour and also in the inner reaches of Drumcliff Bay. A* Donax *community was present in the main channel of Drumcliff Bay and an* Abra *and* Macoma *community were present in the inner most reaches of Sligo Harbour and Drumcliff Bay respectively. The biotope SS.SBR.Smus Sublittoral mussel beds (on sublittoral sediment) (EUNIS Code A5.62 was present in the centre of Sligo Harbour and the inner part of Drumcliff Bay. The biotope SS.SSA.IMuSa.FfabMag* Fabulina fabula *and* Magelona mirabilis *with venerid bivalves and amphipods in infralittoral compacted fine muddy sand (EUNIS Code A5.242) was present in Drumcliff Bay and northwest of Raghly Point. The biotope SS.SSA.IFiSa.NcirBat* Nephtys cirrosa *and* Bathyporeia *spp. in infralittoral sand (EUNIS Code A5.233) was present in the channel in Drumcliff Bay. The biotope SS.SCS.CCS.PomB* Pomatoceros triqueter *with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (EUNIS Code A5.141) was present in the centre of Sligo Harbour. The biotope LS.LMu.Mest Polychaete/bivalve-dominated mid estuarine mud shores (EUNIS Code A2.31 was present in Drumcliff Bay*" (Aquafact, 2011)

2.28 Additional sampling of the intertidal sediments in Sligo and Drumcliff Bays were undertaken by Aquatic Services Unit, UCC under contract from the Marine Institute (ASU, 2012). All field work was undertaken between 4th and 8th November 2010. Full details on the methodology used are described in ASU (2010).

2.29 The ASU report states that "*a total of 9 separate broad habitat types were identified for the Drumcliff & Sligo Bays. The exposed sandy beaches to the west of these embayments consist primarily of mobile sands and associated faunal communities. The extensive strands and sandbanks at the mouth of these embayments consist primarily of fine sand communities, dominated by* Angulus tenuis*. Large areas of the strands within both embayments consist of cockle (*Cerastoderma edule*) dominated muddy and fine sands. These fine sand environments give way to muddy sands in the more sheltered parts of the embayments. The estuarine habitats are largely confined to small areas near the mouths of three rivers (Garvoge River in the south eastern part of Sligo Bay and the Drumcliffe and Carney Rivers which flow into the northern parts of Drumcliffe Bay). An extensive mussel bank is present on the Cummeen Strand. In addition, a*

Zostera meadow has been identified along the southern shore of Drumcliffe Bay. A previously identified Zostera *meadow identified in Sligo Bay along the southern shores of Cummeen Strand wasn't identified during the present survey. Hard benthos areas were identified along the northern shore and on exposed headlands at the western extents of both embayments. Strandline communities are present across all suitable shorelines in the area*" (ASU, 2012).

2.30 The intertidal and subtidal habitats in Drumcliff Bay SPA and Cummeen Strand SPA have been classified into nine marine community types (hereafter referred to as biotopes) by NPWS (2013). The distribution of these biotopes within the SAC is shown in Figure 2.6. Biotope information was available to download from the NPWS website as a GIS geodatabase from the Site-specific Conservation Objectives section which was last updated in September 2014. As can be seen the mapping follows the SAC boundary; thus some areas of subtidal SPA are not mapped.

2.31 The extent of the annexed habitat tidal mudflats and sandflats (1140) is illustrated in Figure 2.8; while estuaries (1130) are illustrated in Figure 2.9.

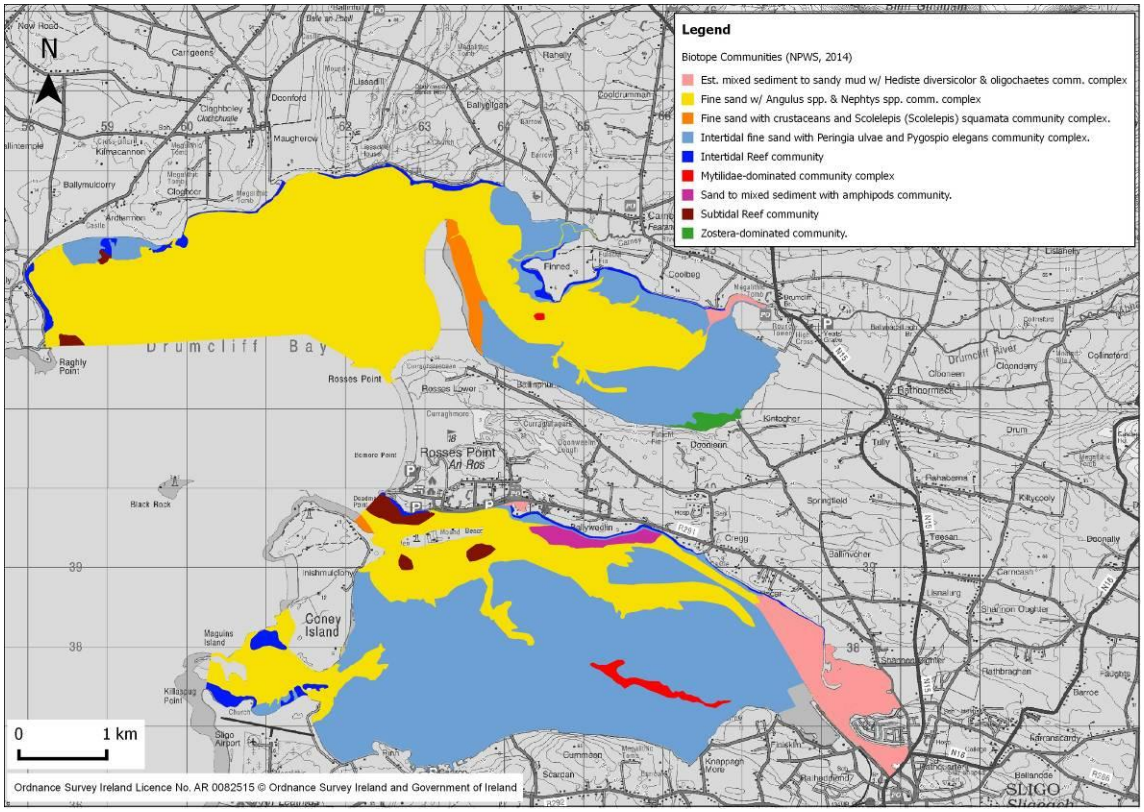

Figure 2.7 – Marine community types for Drumcliff Bay (SPA boundary in red) and Sligo Harbour – Cummeen Strand (SPA boundary in blue) (NPWS, 2014).

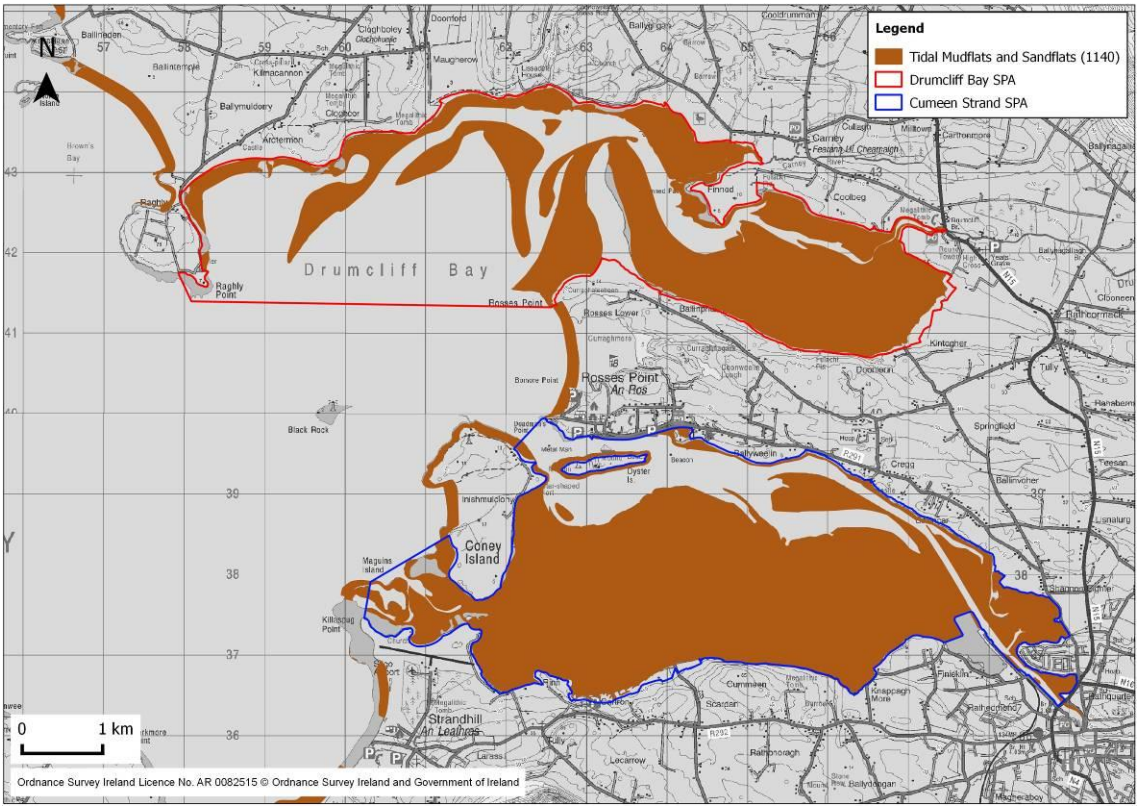

Figure 2.8 – Extent of tidal mudflat and sandflat habitat within Drumcliff Bay and Sligo Harbour – Cummeen Strand (NPWS, 2014).

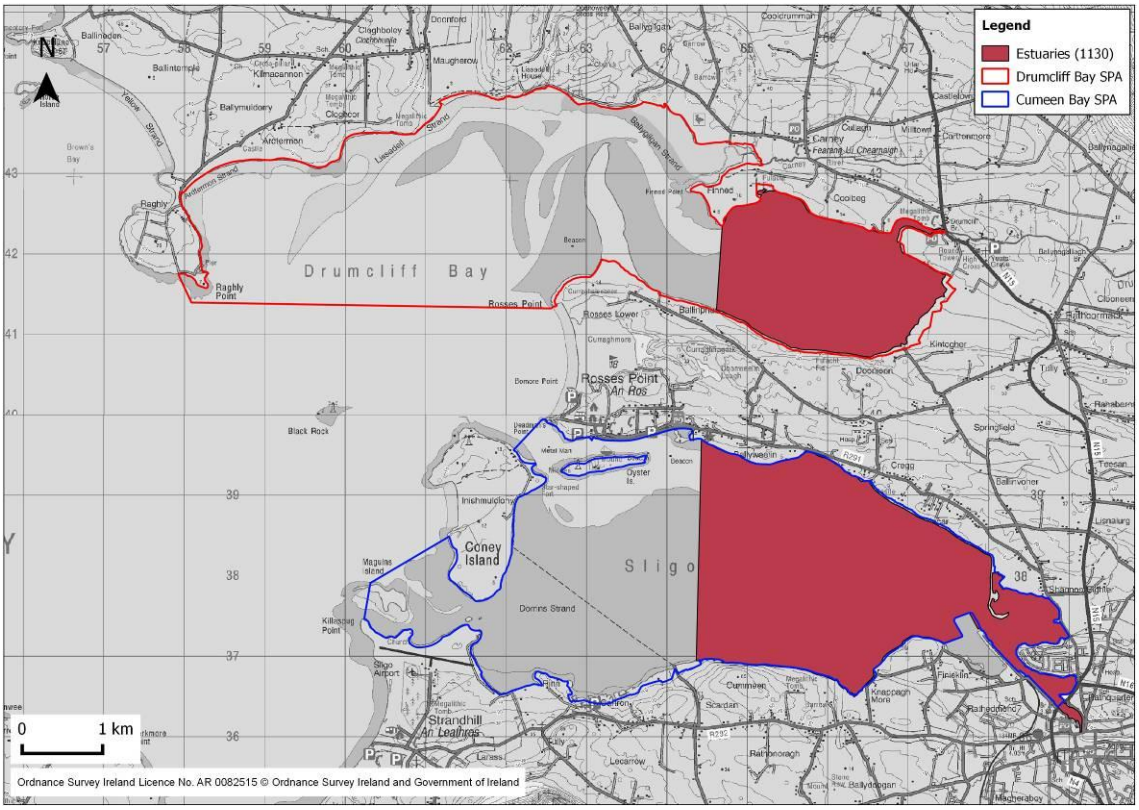

Figure 2.9 – Extent of estuaries habitat within Drumcliff Bay and Sligo Harbour – Cummeen Strand (NPWS, 2014).

Analyses of waterbird distribution

2.32 The analyses of waterbird distribution in this assessment focuses on distribution patterns of feeding, or potentially feeding birds, as the main potential impacts will be to the availability and/or quality of feeding habitat. Most waterbird species will roost at high tide in shoreline or terrestrial areas, which will not be affected by the activities being assessed. However, we have included assessment of potential impacts on roosting birds to species that may roost in subtidal habitats, or when activities can occur during the high tide period.

2.33 Waterbird distribution has been mainly analysed by reviewing count data across subsites from the IWeBS and/or NPWS baseline waterbird survey dataset. However, we have only calculated percentage distributions where we consider the data to be consistent (i.e., excluding counts with poor coverage and/or low numbers). In addition, NPWS baseline waterbird survey flock map data has also been used to examine patterns of spatial distribution.

2.34 There are no SCIs listed for either Drumcliff Bay SPA or Cummeen Strand SPA for their breeding populations. However, a number of species are known to breed on surrounding SPAs; including Kittiwake (Aughris Head SPA), Cormorant (Ardboline Island / Horse Island SPA), Shag, Herring Gull & Arctic Tern (Inishmurray SPA). There are no data available on the distribution of foraging birds from the breeding colonies. We have, however, used data on typical foraging ranges from breeding colonies (mainly from the Seabird Wikispace) to assess their likely foraging ranges. The explanatory document for the Seabird Wikispace (Lascelles, 2008) says "*it may be useful to think of areas within the average foraging range as a core zone of activity being exploited by the majority of the birds the majority of the time, and those between the average and the maximum foraging range as a buffer zone, exploited by fewer birds for less of the time*" (although it also acknowledges that this is not always the case). Therefore, we have generally focused on the mean foraging range (rather than the mean maximum or maximum) to give an indication of the core foraging zones.

2.35 Peregrine Falcon and Chough are also breeding SCIs for Sligo / Leitrim Uplands SPA. These are also considered below.

Use of data sources

BirdWatch Ireland Irish Wetland Bird Survey (IWeBS)

2.36 Waterbird distribution has been monitored as part of the Irish Wetland Bird Survey (IWeBS) each winter since 1995/96. The IWeBS scheme aims to carry out monthly counts each winter between September and March in all sites that are important for non-breeding waterbird populations. Due to the voluntary nature of the scheme, this level of coverage is not always possible to achieve at some IWeBS sites.

2.37 Numbers of counts through the winter for Drumcliff Bay SPA and Cummeen Strand SPA is not as high as for other locations. Often only one count per winter has been achieved, generally in January. Counts for additional months may be incomplete. In a number of IWeBS counts for both SPAs, complete coverage of all sub-sites was not achieved. This suggests that the confidence in the calculated trends in the SCI species for these SPAs is not low.

2.38 Details of the BWI IWeBS methodology are described in the IWeBS counter manual[3] and datasets are available for purchase through BirdWatch Ireland.

[3] available at http://www.birdwatchireland.ie/LinkClick.aspx?fileticket=Ih2CTtw9bjs%3D

National Parks and Wildlife Service Baseline Waterbird Survey (BWS)

Counts

2.39 In the winter of 2010/11, waterbird counts were carried out as part of the National Parks and Wildlife Service's baseline waterbird survey. A site visit was made on the 22nd September 2010 to scope and plan the survey. Four low tide and two high tide counts were carried out between the 21st October 2010 and the 11th February 2011. The counts were carried out by a coordinated team of three (Drumcliff Bay) and five (Cummeen Strand) counters. Each count was completed in a single day with generally good conditions overall but with poorer weather conditions reported on some surveys, including very cold conditions during the December count (Cummins and Crowe, 2011).

2.40 The NPWS baseline waterbird survey counted feeding and roosting birds separately. However, we have generally not analysed their distribution separately. In general, birds at low tide usually roost in the same area as they feed and often the roosting birds are mainly just roosting for short periods of time before resuming feeding. Therefore, the division between feeding and roosting may be a matter of chance depending upon the exact timing of the count.

2.41 Full details of the methodology used and results obtained from the NPWS BWS at Drumcliff Bay and Cummeen Strand are reported in Cummins and Crowe (2011).

NPWS BWS flock maps

2.42 As part of the NPWS BWS the approximate position of the main flocks encountered were mapped. There are some limitations to the interpretation of flock map data because of the difficulties of accurately mapping positions of distant flocks from shoreline vantage points and also the two observers may have varied in the extent to which they mapped flocks. However, where appropriate these have been used to further assess patterns of spatial distribution of qualifying interests for both SPAs.

Aquaculture assessment methodology

General approach

2.43 The methodology used for this Appropriate Assessment is focussed on the Conservation Objectives, and their attributes, that have been defined and described for the SCI species of the Drumcliff Bay SPA and Cummeen Strand SPA. These conservation objectives are the same for all the non-breeding SCI species.

2.44 The conservation objectives for the non-breeding SCI species define two types of attributes to assess conservation condition: long term population trends and numbers or range (distribution) of areas used. This assessment focuses on assessing potential impacts on the spatial distribution of the SCI waterbird species within Drumcliff Bay SPA and Cummeen Strand SPA and, in particular, whether the activities will cause displacement of a significant proportion of the Drumcliff Bay SPA and Cummeen Strand SPA population from the affected area(s). If the activities are not predicted to cause significant displacement, then the activities are not likely to affect the long term population trends. If the activities are predicted to cause significant displacement, then the activities could affect the long term population trends (but see below). In the cases where the activities are predicted to cause significant displacement, the impacts on distribution and population size are assessed separately.

2.45 The basis for the assessments is datasets that indicate the distribution of waterbird species between different broad sectors of Drumcliff Bay SPA and Cummeen Strand SPA (the IWeBS

and NPWS baseline waterbird survey counts). The datasets allow calculation, or qualitative assessment, of the proportion of the Drumcliff Bay SPA and Cummeen Strand SPA population that would be affected if aquaculture activities cause displacement of birds from areas occupied by the activities under consideration. This approach can be considered as a very simple form of habitat association model and represents a conservative form of assessment (see Stillman and Goss-Custard, 2010): the population-level consequences of displacement will depend upon the extent to which the remaining habitat is available (i.e., whether the site is at carrying capacity). In general this assessment method "*will be pessimistic because some of the displaced birds will be able to settle elsewhere and survive in good condition*" (Stillman and Goss-Custard, 2010).

2.46 The assessment of potential disturbance impacts is based mainly on the potential for disturbance to cause displacement of birds from areas they would otherwise occupy. However, where there is limited availability of alternative habitat, or where the energetic costs of moving to alternative habitat is high, disturbance may not cause displacement of birds but may still have population-level consequences (e.g., through increased stress, or reduced food intake, leading to reduced fitness) (Gill *et al*., 2001). However, assessing these types of potential impacts would require detailed population modelling, which would require a major research effort that is beyond the scope of this assessment.

Structure of the assessment

2.47 An initial screening exercise was carried out to screen out SCI species that did not show any potential spatial overlap with effects from any of the proposed activities being assessed.

2.48 The conservation status of all the remaining SCIs and their distribution within Drumcliff Bay SPA and Cummeen Strand SPA was then reviewed. This review included exploratory analyses of the relationships between subsite distribution and various habitat parameters, as well as visual assessment of habitat relationships from the flock map data. The objective was to identify habitat parameters that could be used to interpret species distribution patterns in relation to areas affected by intertidal oyster cultivation.

2.49 The potential impacts of the intertidal oyster cultivation on all the remaining SCI species were assessed. SCI species from other SPAs were included in this assessment, but the assessment was limited to the potential impact on their utilisation of Drumcliff Bay SPA and Cummeen Strand SPA

2.50 The in-combination effects of aquaculture with other activities were then assessed. This stage of the assessment was limited to species for which the in-combination effects of proposed aquaculture activities found relatively high levels of potential displacement. Again the assessment of SCI species from other SPAs was limited to the potential impact on their utilisation of Drumcliff Bay SPA and Cummeen Strand SPA

2.51 Finally, the likely impact on the attributes defined in the conservation objectives for each SCI was assessed. For this stage of the assessment, each SCI population was considered separately in relation to the objectives for the relevant SPA.

Identification of potential impacts

2.52 Potential negative impacts to SCI species from habitat alteration have been identified where the activity may cause negative impacts to prey resources, where there is evidence of a negative response to the activity by the species from previous work, and/or where a negative response is considered possible by analogy to activities that have similar types of impacts on habitat structure and/or by analogy to ecologically similar species.

2.53 As well as considering potential disturbance impacts to foraging birds, we also considered potential disturbance impacts to breeding colonies and roost sites, where relevant. Potential negative disturbance impacts were identified when the spatial and temporal intensity of the activity was considered to represent frequent disturbance. Population modelling studies indicate that a high frequency of disturbance (multiple disturbances per hour) are required to cause negative effects to waterbird survival rates (Durell *et al.,* 2007, 2008; Goss-Custard *et al.,* 2006; West *et al.,* 2006). Therefore, small-scale and/or infrequent disturbance impacts have not been assessed individually for each activity, but are considered as part of the cumulative assessment.

Assessment of impact magnitude

2.54 Where potential impacts from an activity on a SCI species have been identified, or cannot be ruled out, the spatial overlap between the distribution of the species and the spatial extent of the activity was calculated, or qualitatively assessed when quantitative data was not available. This overlap is considered to represent the potential magnitude of the impact, as it represents the maximum potential displacement if the species has a negative response to the activity. Where appropriate, information on species habitat usage was used to refine the assessment of likely impact magnitude.

Assessment of impact significance

2.55 The significance of any potential impacts identified has been assessed with reference to the attributes and targets specified by NPWS for the conservation objective for each SCI. Potential negative impacts are either assessed as significant (if the assessment indicates that they will have a detectable effect on the attributes and targets) or not significant. The significance levels of potential positive impacts have not been assessed.

Drumcliff Bay SPA and Cummeen Strand SPA non-breeding SCI species

Attribute 1 – Long term population trends

2.56 The criteria that we have used for assessing significance with reference to attribute 1 of the conservation objectives are summarised in Table 2.1 and are described below.

2.57 If the impact is predicted to cause spatial displacement of >25% of the total Drumcliff Bay SPA and Cummeen Strand SPA population of a SCI species, then the impact could, pessimistically, cause the long term population trend to show a decrease of 25% or more. Therefore, the impact would be potentially significant with reference to attribute 1 of the conservation objective.

2.58 If the long-term population trend of the species is a decrease of 25% or more, and the impact is predicted to cause spatial displacement of 5% or more (see criteria under Attribute 2), then the impact could prevent the potential recovery of the population. Therefore, the impact would be potentially significant with reference to attribute 1 of the conservation objective.

2.59 If the long-term population trend of the species is a decrease of less than 25%, but the combination of the long-term population trend and the predicted spatial displacement (where the latter is assessed to be significant; see criteria under Attribute 2) would equal or exceed 25%, then the impact could cause the long term population trend to show a decrease of 25% or more. Therefore, the impact would be potentially significant with reference to attribute 1 of the conservation objective.

Table 2.5 - Criteria for assessing significance with reference to attribute 1 of the conservation objectives.

Long-term population decrease (P)	Spatial displacement (S)	Additional criteria	Impact
-	≥ 25%	-	Significant
≥ 25%	≥ 5%	-	Significant
< 25%	≥ 5%	P + S ≥ 25%	Significant

Attribute 2 – Number or range (distribution) of areas used

2.60 Assessing significance with reference to attribute 2 is more difficult because the level of decrease in the numbers or range (distribution) of areas that is considered significant has not been specified by NPWS. There are two obvious ways of specifying this threshold: (i) the value above which other studies have shown that habitat loss causes decreases in estuarine waterbird populations; and (ii) the value above which a decrease in the total population would be detectable against background levels of annual variation.

2.61 There have been some studies that have used individual-based models (IBMs; see Stillman and Goss-Custard, 2010) to model the effect of projected intertidal habitat loss on estuarine waterbird populations. West *et al*. (2007) modelled the effect of percentage of feeding habitat of average quality that could be lost before survivorship was affected. The threshold for the most sensitive species (Black-tailed Godwit) was 40%. Durell *et al*. (2005) found that loss of 20% of mudflat area had significant effects on Oystercatcher and Dunlin mortality and body condition, but did not affect Curlew. Stillman *et al*. (2005) found that, at mean rates of prey density recorded in the study, loss of up to 50% of the total estuary area had no influence on survival rates of any species apart from Curlew. However, under a worst-case scenario (the minimum of the 99% confidence interval of prey density), habitat loss of 2-8% of the total estuary area reduced survival rates of Grey Plover, Black-tailed Godwit, Bar-tailed Godwit, Redshank and Curlew, but not of Oystercatcher, Ringed Plover, Dunlin and Knot. Therefore, the available literature indicates that generally quite high amounts of habitat loss are required to have significant impacts on estuarine waterbird populations, and that very low levels of displacement are unlikely to cause significant impacts. However, it would be difficult to specify a threshold value from the literature as these are likely to be site specific.

2.62 If a given level of displacement is assumed to cause the same level of population decrease (i.e., all the displaced birds die or leave the site), then displacement will have a negative impact on the conservation condition of the species. However, background levels of annual variation in recorded waterbird numbers are generally high, due to both annual variation in absolute population size and the inherent error rate in counting waterbirds in a large and complex site. Therefore, low levels of population decrease will not be detectable (even with a much higher monitoring intensity than is currently carried out). For example, a 1% decrease in the baseline population of Great Northern Diver would be a decrease of one bird. The minimum error level in large-scale waterbird monitoring is considered to be around 5% (Hale, 1974; Prater, 1979; Rappoldt, 1985). Therefore, any population decrease of less than 5% is unlikely to be detectable and, for the purposes of this assessment, 5% has been taken to be the threshold value below which displacement effects are not considered to be significant. This is a conservative threshold, as error levels combined with natural variation are likely to, in many cases; prevent detectability of higher levels of change. This threshold is also likely to be very conservative in relation to levels that would cause reduced survivorship (see above).

Summary

2.63 Impacts have been assessed as potentially having a significant negative impact on attribute 1 of the conservation objectives (the species' long-term population trend), if they are predicted to cause:

- Displacement of 25% or more of the Drumcliff Bay SPA and Cummeen Strand SPA total; or
- Significant displacement levels (i.e., 5% or greater) that combined with current long-term population trends, could result in a long-term population decline of 25%; or
- Significant displacement levels (i.e., 5% or greater) where the current long-term population decline is already equal to or greater than 25%.

2.64 Impacts that will cause displacement of 5% or more of the total Drumcliff Bay SPA and Cummeen Strand SPA population of a SCI species have been assessed as potentially having a significant negative impact on attribute 2 of the conservation objectives (the species' distribution within Drumcliff Bay SPA and Cummeen Strand SPA).

Additional SCIs from other SPAs

2.65 As noted on paragraph 2.29 there are a number of neighbouring sites which are designated for other species, both breeding and wintering.

2.66 Ballysadare Bay SPA shares SCIs with Drumcliff Bay (Bar-tailed Godwit) and Cummeen Strand (Light-bellied Brent Goose & Redshank) as well as Grey Plover and Dunlin. A number of breeding SCIs are also considered; i.e. Kittiwake (Aughris Head SPA); Cormorant (Ardboline Island / Horse Island SPA); Shag, Herring Gull & Arctic Tern (Inishmurray SPA); Peregrine Falcon & Chough (Sligo / Leitrim Uplands SPA).

2.67 Barnacle Goose is an SCI species at Ballintemple / Ballygilgan SPA, Ardboline Island / Horse Island SPA and Inishmurray SPA. Ballintemple / Ballygilgan SPA is notable as it adjoins Drumcliff Bay. There is also an existing code of conduct for aquaculture in this area, which was put in place, in part, to prevent negative impacts on Barnacle Geese using the *goose field* at Ballygilgan.

2.68 These species are all considered in the following screening (Chapter 4.0). The methods of data analysis will be expanded on below as appropriate.

3. Conservation objectives

Drumcliff Bay SPA

Qualifying features

3.1 The Special Conservation Interests (SCIs) of the Drumcliff Bay SPA include non-breeding populations of Sanderling (*Calidris alba*) and Bar-tailed Godwit (*Limosa lapponica*).

3.2 In addition the wetland habitat within the Drumcliff Bay SPA is an additional Special Conservation Interest.

Conservation objectives

SCI species

3.3 The conservation objectives for the non-breeding populations of Sanderling and Bar-tailed Godwit are to maintain their "favourable conservation condition" (NPWS, 2013a).

3.4 The favourable conservation conditions of these species in Drumcliff Bay SPA are defined by various attributes and targets, which are shown in Table 3.1.

Table 3.1 – Attributes and targets for the conservation objectives for non-breeding populations of Sanderling and Bar-tailed Godwit in Drumcliff Bay SPA.

Attribute	Measure	Target	Notes
Population trend	Percentage change	The long term population trend stable or increasing	Population trends are presented in part four of the conservation objectives supporting document [NPWS, 2013b].
Distribution	Range, timing or intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by … [the SCI species] … other than that occurring from natural patterns of variation.	Waterbird distribution from the 2010/11 waterbird survey programme is discussed in part five of the conservation objectives supporting document [NPWS, 2013b].

Source: NPWS (2013a)

Wetlands

3.5 The conservation objective for wetlands at Drumcliff Bay SPA is to "*maintain the favourable conservation condition of the wetland habitat at Drumcliff Bay SPA as a resource for the regularly occurring migratory waterbirds that utilise it*" (NPWS, 2013a).

3.6 The favourable conservation condition of the wetland habitat at Drumcliff Bay is defined by a single attribute and target, which is shown in Table 3.2.

Table 3.2 – Attribute and target for the conservation objective for wetlands at Drumcliff Bay SPA.

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent area occupied by the wetland should be stable and not significantly less than the area of 1,843 ha other than that occurring from natural patterns of variation.	The wetland habitat area was estimated at 1,843 ha using OSi data and relevant orthophotographs. For further information see part three of the conservation objectives supporting document

Source: NPWS (2013a)

Cummeen Strand SPA (004035)

Qualifying features

3.7 The Special Conservation Interests (SCIs) of the Cummeen Strand SPA are non-breeding populations of Light-bellied Brent Goose (*Branta bernicla hrota*), Oystercatcher (*Haematopus ostralegus*) and Redshank (*Tringa totanus*).

3.8 The wetland habitats within the Cummeen Strand SPA are an additional conservation interest.

Conservation objectives

SCI species

3.9 The conservation objectives for the non-breeding populations of Light-bellied Brent Goose, Oystercatcher and Redshank are to maintain their "favourable conservation condition" in Cummeen Strand SPA (NPWS, 2013c).

3.10 The favourable conservation condition of these species in Cummeen Strand SPA are defined by various attributes and targets, which are shown in Table 3.3.

Table 3.3 – Attributes and targets for the conservation objectives for non-breeding populations of Light-bellied Brent Goose, Oystercatcher and Redshank in Cummeen Strand SPA.

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Population trends are presented in part four of the conservation objectives supporting document [NPWS, 2013d].
Distribution	Range, timing or intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by … [the SCI species] … other than that occurring from natural patterns of variation.	Waterbird distribution from the 2010/11 waterbird survey programme is discussed in part five of the conservation objectives supporting document [NPWS, 2013d].

Source: NPWS (2013c)

Wetlands

3.11 The conservation objective for wetlands at Cummeen Strand SPA is to "*maintain the favourable conservation condition of the wetland habitat at Cummeen Strand SPA as a resource for the regularly occurring migratory waterbirds that utilise it*" (NPWS, 2013c).

3.12 The favourable conservation condition of the wetland habitat at Cummeen Strand SPA is defined by a single attribute and target, which is shown in Table 3.4.

Table 3.4 – Attribute and target for the conservation objective for wetlands at Cummeen Strand SPA.

Parameter	Attribute	Measure	Target	Notes
Area	Habitat area	Hectares	The permanent area occupied by the wetland should be stable and not significantly less than the area of 1,732 ha other than that occurring from natural patterns of variation.	The wetland habitat area was estimated at 1,732 ha using OSi data and relevant orthophotographs.

Source: NPWS (2013c)

Special Protection Areas within 15 km

Ballysadare Bay SPA (004129)

Qualifying features

3.13 The Special Conservation Interests (SCIs) of the Ballysadare Bay SPA are non-breeding populations of Light-bellied Brent Goose (*Branta bernicla hrota*), Grey Plover (*Pluvialis squatarola*), Dunlin (*Calidris alpina*), Bar-tailed Godwit (*Limosa lapponica*) and Redshank (*Tringa totanus*).

3.14 The wetland habitat within the Ballysadare Bay SPA is an additional conservation interest.

Conservation objectives

SCI species

3.15 The conservation objectives for the non-breeding populations of Light-bellied Brent Goose, Grey Plover, Dunlin, Bar-tailed Godwit and Redshank are to maintain their "favourable conservation condition" in Ballysadare Bay SPA (NPWS, 2013e).

3.16 The favourable conservation condition of these species in Ballysadare Bay SPA is defined by various attributes and targets, which are shown in Table 3.5.

Table 3.5 – Attributes and targets for the conservation objectives for non-breeding populations of Light-bellied Brent Goose, Dunlin, Bar-tailed Godwit and Redshank in Ballysadare Bay SPA.

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Population trends are presented in part four of the conservation objectives supporting document [NPWS, 2013f].
Distribution	Range, timing or intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by … [the SCI species] … other than that occurring from natural patterns of variation.	Waterbird distribution from the 2010/11 waterbird survey programme is discussed in part five of the conservation objectives supporting document [NPWS, 2013f].

Source: NPWS (2013e)

Aughris Head SPA (004133)

Qualifying features

3.17 The Special Conservation Interest (SCI) of the Aughris Head SPA is a population of breeding Kittiwake (*Rissa tridactyla*) (NPWS, 2015a).

Conservation objectives

SCI species

3.18 A Conservation Objectives document has not been published for this site, therefore, there are no site-specific attributes and targets to define the favourable conservation condition of these species.

Ardboline Island and Horse Island SPA (004135)

Qualifying features

3.19 The Special Conservation Interests (SCIs) of the Ardboline Island and Horse Island SPA are breeding populations of Cormorant (*Phalacrocorax carbo*) and non-breeding populations of Barnacle Goose (*Branta leucopsis*) (NPWS, 2015b)

Conservation objectives

SCI species

3.20 The conservation objectives for site are to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2015b).

3.21 NPWS have only published generic conservation objectives for the Ardboline Island and Horse Island SPA. Therefore, there are no site-specific attributes and targets to define the favourable conservation condition of these species.

3.22 The generic conservation objectives for breeding and non-breeding bird species in the Ardboline Island and Horse Island SPA aim to achieve 'favourable conservation condition' "when 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 large habitat to maintain its populations on a long-term basis" (NPWS, 2015b).

Ballintemple and Ballygilgan SPA (004234)

Qualifying features

3.23 The Special Conservation Interest (SCI) of the Ballintemple and Ballygilgan SPA is the non breeding population of Barnacle Goose (*Branta leucopsis*) (NPWS, 2015c).

Conservation objectives

SCI species

3.24 A Conservation Objectives document has not been published for this site; therefore, there are no site-specific attributes and targets to define the favourable conservation condition of these species.

Inishmurray SPA (004068)

Qualifying features

3.25 The Special Conservation Interests (SCIs) of the Inishmurray SPA (NPWS, 2015d) are populations of: -

- breeding populations of Shag (*Phalacrocorax aristotelis*), Herring Gull (*Larus argentatus*) and Arctic Tern (*Sterna paradisaea*)
- non-breeding Barnacle Goose (*Branta leucopsis*)

Conservation objectives

SCI species

3.26 The conservation objectives for site are to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2015d)

3.27 NPWS have only published generic conservation objectives for the Inishmurray SPA. Therefore, there are no site-specific attributes and targets to define the favourable conservation condition of these species.

3.28 The generic conservation objectives for breeding and non-breeding bird species in the Inishmurray SPA aim to achieve 'favourable conservation condition' "when 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 large habitat to maintain its populations on a long-term basis" (NPWS, 2015d).

Sligo/Leitrim Uplands SPA (004187)

Qualifying features

3.29 The Special Conservation Interest (SCI) species of the Sligo/Leitrim Uplands SPA are breeding Peregrine falcon (*Falco peregrinus*) and Chough (*Pyrrhocorax pyrrhocorax*) (NPWS, 2015e).

Conservation objectives

SCI species

3.30 The conservation objectives for site are to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (NPWS 2015e).

3.31 NPWS have only published generic conservation objectives for the Sligo/Leitrim Uplands SPA. Therefore, there are no site-specific attributes and targets to define the favourable conservation condition of these species.

3.32 The generic conservation objectives for breeding species in the Sligo/Leitrim Uplands SPA aim to achieve 'favourable conservation condition' "when 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 large habitat to maintain its populations on a long-term basis" (NPWS, 2015e).

4. Screening

Drumcliff Bay SPA

SCI Species

4.1 Both of the SCI species for which Drumcliff Bay has been designated, (Sanderling and Bar-tailed Godwit) make significant use of the shallow subtidal and/or intertidal habitat in Drumcliff Bay. The intertidal oyster cultivation and clam cultivation covered in this assessment is centred on areas of intertidal habitat; they therefore have the potential to cause significant changes to habitat structure and/or food availability. The oyster trestle shorebird study undertaken by Gittings and O'Donoghue (2012) showed that Sanderling and Bar-tailed Godwit have a negative response to oyster trestles. The passage of vehicles and human disturbance in the intertidal area can also have an adverse effect on these species (Stolen, 2003; Phalan and Nairn, 2007). Therefore, full appropriate assessment is required for Sanderling and Bar-tailed Godwit.

Wetlands & Waterbirds

4.2 All of the SCI species make significant use of subtidal and/or intertidal habitat in Drumcliff Bay SPA. The Conservation Objectives define the favourable conservation condition of the wetlands and waterbird SCI at Drumcliff Bay purely in terms of habitat area.

4.3 None of the activities being assessed will cause any change in the permanent area occupied by wetland habitat. Therefore, the activities being assessed are not likely to have any significant impact on this SCI and it has been screened out from any further assessment.

Cummeen Strand SPA

4.4 All three species for which Cummeen Strand has been designated, (Light-bellied Brent Goose, Oystercatcher and Redshank) make significant use of the shallow subtidal and/or intertidal habitat in Cummeen Strand (Sligo Harbour). The intertidal oyster cultivation and clam cultivation covered in this assessment is centred on areas of intertidal habitat; they therefore have the potential to cause significant changes to habitat structure and/or food availability. The oyster trestle shorebird study undertaken by Gittings and O'Donoghue (2012) showed that Light-bellied Brent Goose has a variable response to trestles; while Oystercatcher and Redshank show a neutral to positive response to oyster trestles. The passage of vehicles and human disturbance in the intertidal area can also have an adverse effect on all of these species (Stolen, 2003; Phalan and Nairn, 2007).

4.5 Therefore, as the activities being assessed could potentially have significant impacts on SCIs that use subtidal and/or intertidal habitat full appropriate assessment is required for Light-bellied Brent Goose, Oystercatcher and Redshank.

Wetlands & Waterbirds

4.6 All of the SCI species make significant use of subtidal and/or intertidal habitat in Cummeen Strand SPA. The Conservation Objectives define the favourable conservation condition of the wetlands and waterbird SCI at Cummeen Strand (Sligo Harbour) purely in terms of habitat area.

4.7 None of the activities being assessed will cause any change in the permanent area occupied by wetland habitat. Therefore, the activities being assessed are not likely to have any significant impact on this SCI and it has been screened out from any further assessment.

Habitat screening

4.8 For the purposes of this Appropriate Assessment, the broad habitat zones used by the SCI species for feeding and/or roosting have been classified (Table 4.1). The activities covered in this assessment can generally be broken down into components that affect intertidal/shallow subtidal and deep subtidal habitat zones separately. In both sites the predominant area of possible impact is on intertidal habitats (and to a limited extent very shallow subtidal). Only Light-bellied Brent Goose uses shallow subtidal (<0.5m) and moderately deep – deep subtidal (>0.5m) to any significant extent, if at all; in the later case for roosting. The cut-off of <0.5m relates to the maximum depth to which Light-bellied Brent Goose can reach when up-ending (during feeding).

Table 4.1 - Habitat zones and major prey resources likely to be used by SCI species in the Drumcliff Bay SPA & Cummeen Strand SPA.

Species	Intertidal	Shallow subtidal (< 0.5 m)	Moderately deep and deep subtidal (> 0.5 m)	Major prey resources
Sanderling	Feeding & roosting			Littoral invertebrates, notably crustaceans
Bar-tailed Godwit	Feeding & roosting			Littoral invertebrates; notably polychaetes and bivalves
Light-bellied Brent Goose	Feeding & roosting	Feeding & roosting	Roosting	Plants (eel grass *Zostera* spp., algae *Enteromorpha/Ulva* and coastal grassland)
Oystercatcher	Feeding & roosting			Littoral invertebrates; notably polychaetes and bivalves such as cockles, mussels etc.
Redshank	Feeding & roosting			Littoral invertebrates, notably crustaceans

Activity screening

4.9 The spatial patterns of occurrence of some of these species, and/or scientific evidence about the nature of their response to particular activities, may mean that potential impacts can be screened out without detailed analyses. However, for clarity this secondary screening is carried out in the individual sections of this assessment dealing with each activity. Hence all five species across both sites are subject to full appropriate assessment for completeness.

Ballysadare Bay SPA (004129)

4.10 The Special Conservation Interests (SCI) of the SPA are wintering populations of **Light-bellied Brent Goose**, **Grey Plover**, **Dunlin**, **Bar-tailed Godwit** and **Redshank**.

4.11 Of these Bar-tailed Godwit is also an SCI species for Drumcliff Bay SPA; while Light-bellied Brent Goose and Redshank are SCI species for Cummeen Strand SPA.

4.12 Ballysadare Bay is located to the south of Sligo Town; at its closest no more than 3km from the southwestern corner of Cummeen Strand SPA. Drumcliff Bay SPA is located ca. 7-8km to the north (north of Cummeen Strand).

4.13 No evidence is available about the degree of interchange of birds between these sites; though it is noted in the NPWS Conservation Objective supporting documentation that e.g. Bar-tailed Godwit numbers varied across all three bays during low tide counts and that it is highly likely that birds range across all three.

Ballintemple / Ballygilgan SPA (004234)

4.14 The Special Conservation Interest (SCI) of the SPA is a wintering population of **Barnacle Goose**. This site is comprised of two discrete blocks. The goose field at Ballygilgan is located immediately adjoining Drumcliff Bay SPA – at Lissadell; it is also designated as a Nature Reserve. The second area is located to the northwest of Ardtermon (and licence application T11/085A). The population of Barnacle Goose at the site has increased in recent years (3,930 in 2008 and c. 5,000 in 2011) and is now the most important site in the country for this species. The geese feed for much of the winter on fields at Ballintemple and Ballygilgan, which are their core feeding sites, and roost on the nearby island of Inishmurray (also an SPA) (NPWS site synopsis; 2011). Therefore, full appropriate assessment is required for this species.

Ardboline Island / Horse Island (004135)

4.15 The Special Conservation Interests (SCI) of the SPA is a wintering population of **Barnacle Goose** and a breeding population of **Cormorant**. The site is located 16km to the northwest of Sligo Town to the west of Raghly Point. The waters surrounding the island are part of the Drumcliff Bay / Cummeen Strand SAC. The Barnacle Geese using the site are potentially part of the mainland population; this flock can be up to 1,700 individuals, which feed, roost and seek refuge here (NPWS site synopsis, 2002). Due to its potential links with birds using Ballintemple and Ballygilgan SPA, full appropriate assessment is required for Barnacle Geese; this is presented below.

4.16 Ardboline Island supports a nationally important breeding colony of Cormorant (261 pairs in 1998; NPWS site synopsis, 2002). No information is available about the occurrence of visiting Cormorant from the Ardboline Island / Horse Island SPA within Drumcliff Bay or Cummeen Strand. However, an assessment of likely patterns of occurrence can be made, based on information about the species breeding dispersion and foraging behaviour.

4.17 The main Cormorant colony within the SPA occurs at Ardboline Island, which is around 4 km from the nearest intertidal oyster cultivation application area (or ca. 6km for a Cormorant flying along the coastline); while the nearest active area of trestles at Ballygilgan Strand is ca. 8km to the east (or 10km for a Cormorant flying along the coastline). The mean foraging range of Cormorants from their breeding colonies is 8.5 km, with a mean maximum of 32 km and a maximum of 50 km (Seabird Wikispace; http://seabird.wikispaces.com/).Therefore, the intertidal oyster cultivation area is within the potential foraging range of the SPA population, but may only be a peripheral area.

4.18 In winter, Cormorant regularly occur within Drumcliff Bay, Cummeen Strand and Ballysadare Bays; in separate work undertaken in Sligo Harbour shipping channel in 2009-2010 Cormorants were noted at both low and high tide in all months between June and September (R. Nairn, per obs). In a study of Cormorant diet at several Irish coastal breeding colonies West *et al*. (1975), found that birds at the Lambay Island, Mattle and Little Saltee colonies were taking fish species associated with estuarine habitats. At Mattle and Little Saltee, wrasse predominated (77% and 85% of the diet by weight, respectively) indicating that the birds were mainly feeding in marine habitats. However, West *et al*. (1975) considered that, due to the absence of wrasse from their diet, the Lambay Island birds were mainly feeding in the estuaries at Rush and Malahide rather than in the marine waters around Lambay Island. However, birds from the Keeragh Island colony appeared to be feeding exclusively on marine fish, despite Keeragh Island being closer to estuarine habitat compared to the Little Saltee. The diet of Cormorants from two other breeding colonies (Great Saltee and Roaninish) was studied by Tierney *et al*. (2011). Again, wrasse predominated forming 65-70% of the diet by item, but some flatfish were taken indicating some foraging in estuarine habitats.

4.19 Overall, therefore, the available evidence from both the typical foraging range and diets of breeding Cormorants indicates that both Drumcliff Bay and Cummeen Strand in general and the intertidal oyster cultivation area in particular, may provide potential foraging habitat for the SPA Cormorant population but that these areas are not likely to be of major importance in providing food resources for this population. No evidence is available about the response of Cormorants to oyster trestles. Cormorant are fish-eating birds. In general intertidal oyster cultivation is likely to either have no effect on, or increase local abundances of fish (DeAlteris *et al*., 2004; Pinnix *et al*., 2005). There is no evidence that large-scale aquaculture at sites such as Dungarvan is causing negative impacts on fish populations through reduced recruitment or through indirect food web effects. If such ecosystem-scale effects occurred they could be manifested through both displacement of birds (reduced usage of the bay) and/or impacts on long-term population trends. Sustained disturbance due to oyster cultivation could have negative effects on roosting and/or foraging Cormorants in either SPA. While for fish-eating Cormorants *Phalacrocorax carbo,* it was estimated by Gremillet & Schmid (1993) that a disturbance of 30 minutes would result in requirement for the bird to find an extra 23g of fish; maintenance works at the trestles occur at low tide rather than on high tide when Cormorant are likely to forage. Adverse effects on survival are therefore unlikely.

4.20 Thus, intertidal oyster and / or clam cultivation is likely to have neutral or positive impacts on the availability of prey resources for Cormorant in the areas occupied by the activity, compared to areas of similar habitat elsewhere in Drumcliff Bay and Cummeen Strand. Therefore, intertidal oyster cultivation is not likely to cause any displacement of Cormorant within either of these sites.

4.21 Cormorant are not therefore considered further in this assessment.

Aughris Head SPA (004133)

4.22 The Special Conservation Interest (SCI) of the SPA is a breeding population of **Kittiwake** (742 pairs). Aughris Head SPA is located just over 10km west of Drumcliff Bay SPA and Cummeen Strand SPA. The site also supports breeding Guillemot (1211 pairs), Razorbill (87 pairs) and Fulmar (92 pairs[4]). Kittiwake is a seabird that usually feeds in open marine waters. They may come in to the outer part of all three Sligo bays (Drumcliff, Cummeen / Sligo and Ballysadare), but do not usually feed or roost in intertidal habitat, even when it is covered at high tide. Kittiwake / Aughris Head SPA are thus screened out from further consideration.

[4] Source: Natura 2000 Data form; Aughris Head SPA IE004133.

Sligo / Leitrim Uplands (004187)

4.23 The Special Conservation Interests (SCI) of the SPA is a breeding population of **Chough** and **Peregrine Falcon**. The breeding and associated foraging areas lie outside of both Drumcliff Bay SPA and Cummeen Strand SPA. Trewby *et al*. 2010 in their study of Chough in Sligo / Leitrim found that "*The most obvious seasonal shift in habitat use occurred over the autumn and saw birds moving from breeding / post-fledging roosting areas in the uplands (where habitat use was dominated by unimproved grassland) to the coast to avail of foraging opportunities in dune systems. Interestingly, although 'natural' dune habitats (e.g. fixed dune) were utilised, golf courses in dune systems (Rosses Point) and agricultural improved dune grasslands were also popular*". There would appear to be no overlap between current or proposed aquaculture activities and areas favoured by Chough for feeding or roosting (M. Trewby, pers comm.). Chough is therefore screened out from further consideration.

4.24 Five pairs of Peregrine Falcon were recorded feeding on the uplands in 2002. No information is available about the occurrence of visiting Peregrine from the Sligo / Leitrim Uplands SPA within either Drumcliff Bay SPA or Cummeen Strand SPA. However, an assessment of likely patterns of occurrence can be made, based on information about the species breeding dispersion and foraging behaviour.

4.25 The recorded breeding dispersion of Peregrine in Britain and Ireland varies from 2-5 km (nearest neighbour difference; Ratcliffe, 1993). The SPA is only just over 3.5km northeast of Drumcliff Bay just over 5km from Cummeen Strand (Sligo Harbour). It is highly probable that a nesting pair occurs within ca. 5km of both sites. Peregrine regularly feed in intertidal areas during winter, exploiting the availability of large numbers of waterbirds, which provide them with potential prey, and inland breeding Peregrines will often move to the coast in winter for this reason. They are likely to hunt over Drumcliff, Cummeen and Ballysadare during the winter months. During the breeding season, the importance of intertidal areas diminishes as there are few waterbirds present to provide potential prey for Peregrines. However, where Peregrines are breeding, they will presumably continue to hunt over intertidal areas at times during the breeding season. Also, juvenile Peregrines will remain around their nest sites into July/August, when the numbers of waterbirds will build up again. Data on prey taken by breeding Peregrine in northern Britain during March-July (Ratcliffe, 1993) show that Peregrine continue to take significant numbers of waterbirds during this period. However, most of the frequently taken wader species (Lapwing, Golden Plover, Snipe, Woodcock and Curlew were likely to be locally breeding in terrestrial habitats. Peregrines are frequent predators on waders in estuarine habitats in winter (e.g. Cresswell and Whitfield, 1994). During post-breeding dispersal from their nesting areas in the autumn Peregrines are likely to depredate on waders on migration or wintering in estuaries such as Cummeen Strand and Drumcliff Bay. Ratcliffe (1996) classifies Peregrine breeding habitats in Britain into six categories, based on their prey resources. In the "ordinary coast" category, which may correspond to much of the Drumcliff, Cummeen and Ballysadare SPAs, around one-third of the prey-type by weight comprises waders and gulls and terns. However, the large seabird colonies around Aughris Head SPA and Inishmurray SPA may also provide a major component of the diet of Peregrines breeding at western (Benbulban) end of the SPA.

4.26 Peregrines are territorial during the breeding season and their foraging range may depend upon the local population density: for example, Peregrines in north-east Scotland mainly feed within 2km of their nest site, but their foraging range can be extended to 6km or more, while in continental Europe, the foraging ranges may extend up to 15km or more from nest sites (Cramp and Simmons, 2004). The foraging range of breeding Peregrines will be dictated by the availability of food resources and at coastal eyries close to large seabird colonies, "*Peregrines often hunt directly from the eyrie and kill within a few hundred metres*" (Ratcliffe, 1993).

4.27 In conclusion, it seems likely that the intertidal oyster cultivation area provides potentially suitable feeding habitat and is within the foraging range of at least one pair of the SPA Peregrine population. If there are adverse effects of oyster cultivation on waders in either Drumcliff Bay or Cummeen Strand SPAs this could have indirect effects on foraging by Peregrines from the Sligo/Leitrim Uplands SPA. However, the availability of high quality food resources throughout the coastal areas and associated offshore islands and the low numbers of waterbirds that will be present during most of the Peregrine's breeding season in the intertidal zone, indicate that the intertidal oyster and clam cultivation area is probably not of major importance as feeding habitat for the SPA Peregrine population.

4.28 Peregrine is therefore screened out from further consideration.

Inishmurray SPA (004068)

4.29 The Special Conservation Interests (SCI) of the SPA breeding **Shag**, **Herring Gull** and **Arctic Tern** and a wintering population of **Barnacle Geese** According to the NPWS site synopsis "*the site is a regular wintering area for Barnacle Geese, with numbers varying between 100 and 500 birds. These birds are likely to be part of the internationally important population that is centred at Ballintemple and Lissadell on the mainland. The island is of particular importance as it provides a safe refuge for the birds and it is possible that all of the c.1700 geese in this flock roost regularly on the island*". Due to its potential links with birds using Ballintemple and Ballygilgan SPA, full appropriate assessment is required for Barnacle Geese.

4.30 Inishmurray is located just over 10km north of Drumcliff Bay SPA and over 15km from the opening to Cummeen Strand / Sligo Harbour.

4.31 In winter Herring Gulls regularly roost and feed in intertidal and subtidal habitat within both Drumcliff Bay and Cummeen Strand, but it is not known to what extent, if any, Herring Gulls from the Inishmurray SPA breeding colony visit this area in summer (111 pairs bred on the island in 2000). However, an assessment of likely patterns of occurrence can be made, based on information about the species breeding dispersion and foraging behaviour. Cramp and Simmons (2004) quote foraging ranges from breeding colonies in various studies ranging from 22-63 km, while Ratcliffe *et al*. (2000, quoted by Langston, 2010) gave a foraging range of 40 km from breeding colonies. Therefore, the intertidal oyster clam cultivation areas are within the potential foraging range of the SPA population. This is supported by observations in 2009-2010; in which Herring Gulls were present in all months within Sligo Harbour shipping channel at low tide (peak 70, mean 30) and high tide (peak 52, mean 16) (R. Nairn, pers obs).

4.32 The Herring Gull has a very wide and varied diet. However, a number of studies have shown that breeding Herring Gulls often rely heavily on food resources from the intertidal zone (Garthe *et al*., 1999; Kim and Monaghan, 2006; Kubetzki and Garthe, 2003; Pierotti and Annett, 1991; Rome and Ellis, 2004). At some breeding colonies Herring Gulls have been found to predominantly feed on fish (Furness and Barrett, 1985) or fish and garbage (Nogales *et al*., 1995), with fish being mainly obtained from scavenging behind trawlers rather than by direct predation (Nogales *et al*., 1995). Both these examples were located on offshore islands (Ailsa Craig in south-west Scotland and Hornøy in north Norway) without any extensive intertidal habitat nearby; while also offshore Inishmurray is closer to both intertidal and terrestrial feeding areas – diet is more likely to therefore be a varied mix of fish, intertidal prey, garbage and terrestrial prey. The nearest aquaculture site to Inishmurray would be the application to cultivate oyster on trestles at Ardtermon. Gittings and O'Donoghue (2012) found that Herring Gull show a variable / generally neutral response to oyster trestles. Herring Gull are, however, frequently observed feeding and roosting on trestles, so this may be related to site specific factors including the degree of algal cover and epibenthic fauna associated with oyster bags at any given time. Oyster trestles may have a beneficial effect on

foraging Herring Gulls by providing a concentrated source of such associated species as crustaceans.

4.33 The nearest aquaculture site would be the application to cultivate oysters at Ardtermon Beach (ca. 10.6km to the south). Existing operations at Ballygilgan are ca. 12km to the southeast of Inishmurray. Given the proximity of the intertidal oyster and clam cultivation areas to the main breeding colony and the availability of suitable food resources, as indicated by the use of the area in all months, it is unlikely that the either intertidal oyster or clam cultivation area would have a negative impact on Herring Gull breeding at Inishmurray SPA.

4.34 The island also supports a nationally important breeding population of Arctic Tern (113 pairs in 1995; along with 36 pairs of Common Tern). Arctic Terns can feed in open marine waters preferring sheltered waters for foraging (Cramp and Simmons, 2004). The Seabird Wikispace describes its key foraging habitats as: "*open waters and shallow bays, rocky shores, tidal flats, shoals, tide rips, ocean fronts, upwellings, ice edges and faces of tidewater glaciers*." Arctic Terns feed on marine fish (e.g. sand-eels, herring, sprat, capelin, sticklebacks, pipefish, flounder, sole, hake, haddock etc.) crustaceans (e.g. isopods, amphipods, euphausiids, mysids, shore crab, shrimps, and other branchiopods and copepods) and insects. They hunt for fish predominantly by plunge diving which often follows hovering from a height of 1-6m diving to a depth no deeper than 0.5m (Dunn, 1972a, quoted by Cramp and Simmons, 2004). Other prey items such as crustaceans and insects are caught by dipping to surface, oblique-plunge diving or aerial pursuit (studies quoted by Cramp and Simmons, 2004) It has also been recorded scavenging fishing vessels in the Irish Sea (Watson, 1981, quoted by Cramp and Simmons, 2004) and kleptoparasitising other birds (Norrevang, 1960, Williamson, 1948, quoted by Cramp and Simmons, 2004).

4.35 The Seabird Wikispace gives a mean foraging range of 12km, a mean maximum of 12km and a maximum of 21km from breeding colonies[5], but states that "*due to time and energy constraints, parent Arctic Terns have to forage close to the nest, with most feeding taking place within 3 km of the colony, exceptionally up to 10 km*". Newton (2012) states that Arctic Terns "*range more widely [than Little Terns] but would be expected to forage within a 5-10 km zone around their colony during the chick-rearing period*". Cabot and Nisbet (2013) state that Arctic Terns have been tracked foraging up to 15km from a breeding colony in Wales and the maximum range recorded was 57km from the colony (Perrow *et al.* 2011).

4.36 Overall therefore the published data on foraging range would suggest that Drumcliff Bay SPA (>10km) and Cummeen Strand SPA (>15km) are unlikely to be significant foraging areas for Arctic Terns breeding on Inishmurray SPA although non-breeding birds and post-breeding birds during the autumn may move into the bays to feed. Due to the proposed scale, distance from Inishmurray and possible influence of trestles as fish attracting devices - it is unlikely that the either intertidal oyster or clam cultivation area would have a negative impact on Arctic Tern breeding at Inishmurray SPA.

4.37 Shag - 104 pairs bred at Inishmurray in 2000. Shag typically occurs in both offshore and inshore marine waters but usually does not range far from the coast (Cramp and Simmons, 2004). From radio-tagging studies, Wanless *et al*. (1991) found that the mean foraging range of Shags from a colony on the Isle of May in Scotland was 7km (maximum 17km) and that all feeding sites were within 7km of land. In their study, Shags fed most frequently in water depths of 21-40 m, with substrates of either gravel and sand, or rock with thin patchy sediment cover. Using data on duration of foraging trips and flight speeds, Pearson (1968) estimated a maximum foraging range of 19km from a breeding colony on the Farne Islands in England, while Furness and Barrett estimated a median foraging range of 12 km from a colony in Norway; this method is likely to

[5] The literature quotes a maximum foraging range of 29km.

overestimate foraging ranges. Rees (1965, quoted by Cramp and Simmons, 2004) reported a foraging range of 13 km from a roosting area.

4.38 The Seabird Wikispace gives a mean foraging range of 6.5km, a mean maximum of 16km and a maximum of 20km from breeding colonies. It describes key foraging habitats as: "*shallow waters, particularly over sand and gravel banks, areas of high tidal flow*." Shags feed on benthic and demersal prey and can dive up to depths of 70m, with a mean dive depth in the data collated by the Seabird Wikispace of 33m.

4.39 Shag feed almost exclusively on fish which it takes predominantly from midwater, though it also occasionally feeds on bottom dwelling species in coastal areas, also takes small numbers of polychaetes, cephalopods and other molluscs (small, usually benthic crustaceans) The fish component of its diet varies with both season and locality but is generally dominated by sand-eel, herring, and cod, amongst other fish species and some crustaceans (Cramp and Simmons, 2004).

4.40 There is no evidence as to the extent of use of the inner parts of Drumcliff Bay and Cummeen Strand by breeding Shag or by wintering birds; though it is to be expected that birds would especially use the western approaches to both sites and offshore waters (IWeBS data suggest that they are present in both SPAs in winter months. That said licenced and proposed aquaculture activities would appear to be on the outer edge of core foraging ranges of breeding birds; >10km for Drumcliff Bay SPA and >15km for Cummeen Strand. Overall, due to the proposed scale, distance from Inishmurray and possible influence of trestles as fish attracting devices - it is unlikely that the either intertidal oyster or clam cultivation area would have a negative impact on Shag breeding at Inishmurray SPA.

5. Status and distribution of the SCI species

Drumcliff Bay SPA

Waterbird Status

5.1 The conservation condition and trends of the non-breeding waterbird SCI species at Drumcliff Bay SPA are summarised in Table 5.1. The only species with an unfavourable conservation condition is Sanderling. Bar-tailed Godwit has shown substantial increases in its population indices over the monitoring period. However, there are some limitations to the reliability of the population trends calculated from IWeBS data in Drumcliff Bay, due to the limited IWeBS coverage in several winters and a general pattern of an increase in coverage in recent winters. Table 5.1 also shows the relationship between a species' long-term site trend and the current national trend for the 12-year period 1998/99 to 2010/11.

5.2 There are four categories of conservation condition, as follows: -

- 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.

Table 5.1 - SCI species of Drumcliff Bay SPA – Current Site Conservation Condition (after NPWS, 2013b).

Special Conservation Interests	BoCCI Category [a]	Site Population Trend [b]	Site Conservation Condition	Current National Trend [c]	Current International Trend [d]
Sanderling	Green	- 59	Highly Unfavourable	+ 125	Increase
Bar-tailed Godwit	Amber	+ 36	Favourable	+ 35	Increase

[a] After Colhoun and Cummins (2013).
[b] based on the comparison between baseline and recent means;
[c] Recent national trend is for the 12 year period 1998/99 to 2010/11;
[d] International trend after Wetland International (2012).

5.3 Numbers of Sanderling appear to have decreased significantly since the baseline period but it should be noted that IWeBS count coverage during the period 2003/04 to 2007/08 comprised one annual count only. As Sanderling is a relatively mobile species; this level of count coverage may fail to adequately represent the numbers using the site. Count coverage has increased in recent years and annual peak counts have increased (2009/10, 2010/11), but are still lower than the baseline peak mean. A recent (2010/11) high tide peak count (174) obtained during the NPWS baseline waterbird survey programme is also lower than the baseline mean peak number. These patterns are at variance with the national trend and that observed in the UK; numbers of Sanderlings in the Republic of Ireland having increased at a relatively high average annual rate of 7%. An increase is also apparent in Northern Ireland and Britain (Boland and Crowe, 2012; Calbrade *et al.* 2010).

5.4 IWeBS count data for Sanderling for the period 1994/95 to 2001/02 is very variable and is not comparable with the period 2003/04 to 2012/13. The two high counts in 1998/99 and 1999/00 bias the rolling means for the baseline period. These peaks were both in March so are likely to have included passage birds as well as wintering birds. In the period since 2003/04 there is a correlation between the peak count and the number of counts per season. This suggests that higher peaks may have been missed in the period when there was only a single January count. The trend with rolling 5-year means since 2007/08 suggests a general increase in the last 6 winters but this is biased by the increasing number of counts per year. It is concluded that the variability in IWeBS coverage (counts per winter, months of coverage and years with no data) does not allow confidence in the trends for this species in Drumcliff Bay.

5.5 The long-term dataset for Bar-tailed Godwit shows great variability in numbers between years but the same caution must be applied as for Sanderling above. Bar-tailed Godwits are also a relatively mobile wader species and can move in response to local food conditions; low coverage in some seasons may have failed to adequately represent the numbers using the site. Numbers in recent seasons have increased with a peak count of 940 individuals during 2010/11 although the peak high tide count obtained during the NPWS baseline waterbird survey was lower (357). In Ireland, numbers have remained broadly stable throughout IWeBS, while a decline has been evident in Britain since the early 2000's with some recovery in recent seasons (Boland and Crowe, 2012; Calbrade *et al.* 2010).

Waterbird Habitats and Distribution

Habitats

5.6 The intertidal habitats in Drumcliff Bay SPA were surveyed in 2010 by Aquatic Services Unit (2012). The habitats were classified using the standard JNCC system (Connor *et al*. 2004 in ASU, 2012). The exposed sandy beaches to the west of the bay consist primarily of mobile sands and associated communities. The extensive beaches and sandbanks at the mouth of the bay consist primarily of fine sand communities dominated by *Angulus tenuis*. Large areas of these beaches within the bay consist of muddy and fine sands with communities that are dominated by cockle (*Cerastoderma edule*). These fine sand environments give way to muddy sands in the more sheltered parts of the bay. The estuarine habitats are largely confined to small areas near the mouths of the Drumcliff and Carney Rivers which flow into the northern parts of Drumcliff Bay. A *Zostera* meadow has been identified along the southern shore of Drumcliff Bay. Hard benthos areas were identified along the northern shore and on exposed headlands at the western end of the bay. Strandline communities are present across all suitable shorelines.

Distribution

5.7 Detailed analyses of species distribution patterns are included in the impact assessment sections of relevant activities later in this document. The following text summarises the broad distribution patterns derived from these analyses using NPWS baseline waterbird survey data, due to the greater degree of spatial resolution offered by these data. The distributions of foraging and roosting birds of the two SCI species (as e.g. recorded in the NPWS low tide waterbird surveys) were also reviewed to inform the assessment.

5.8 The two SCI species considered in this assessment mainly occur in particular sub-sites of Drumcliff Bay. 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 5.2 (a–f) of the NPWS Conservation Objective supporting document (NPWS, 2013b). The relative importance of each subsite is based on the final rank positions (see 5.3.2 for methodology;

NPWS, 2013b). Where a box is left blank, it simply means that a species was not recorded in that subsite.

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

Sanderling

5.10 Sanderlings foraged intertidally across four subsites: 0C443 (Lower Rosses Point), 0C449 (Ballinaphunta), 0C494 (Ardtermon Strand) and 0C932 (Lissadell Strand). 0C932 (Lissadell Strand) supported peak numbers in three low tide surveys, generally foraging on the lower shore. This subsite is in the outer bay (west of the spit at Rosses Point) and is dominated by sand (<70%) with an intertidal benthic community defined by 'fine sand with crustaceans and *Scolelepis squamata*.' As well as the aforementioned polychaete, the distinguishing species of this community are the crustaceans *Eurydice pulchra*, *Bathyporeia pelagica* and *Haustorius arenarius*; all of which could form prey species for Sanderlings. Sub-site 0C449 (Ballinaphunta) held good numbers (105) on 21/10/10. This subsite is muddier in its upper shore reaches ('intertidal fine sand with *Peringia* (*Hydrobia*) *ulvae* and *Pygospio elegans*) but grades to sandier sediment classified as 'fine sand with crustaceans and *Scolelepis squamata'* on the lower shore.

5.11 It should be borne in mind that overall numbers were low in the November 2010, December 2010 and February 2011 low tide surveys and hence whole-season foraging patterns are not clear. Surveys undertaken at Cummeen Strand on the same dates as Drumcliff Bay indicate that Sanderling regularly utilise the Cummeen Strand subsite (code 0C466; Figure 2.4) for foraging. A total of 174 Sanderlings foraged during the January 2011 high tide survey; over half within 0C425 (Lower Rosses Point; East), 44 in 0C443 (Lower Rosses Point) and smaller numbers in 0C449 (12; Ballinaphunta) and 0C932 (27; Lissadell Strand). 81 Sanderlings foraged during the February 2011 high tide survey; 72% in 0C425 (Lower Rosses Point; East).

5.12 Sanderlings were not recorded roosting during the main survey programme or during the roost survey on 30/11/10 (45 were recorded foraging in 0C443 on that date). No Sanderlings were recorded roosting during the roost survey at Cummeen Strand on the same day. 25 Sanderlings roosted intertidally within the Cummeen Strand subsite (Code 0C466) on 22/11/10.

Bar-tailed Godwit

5.13 Bar-tailed Godwit is a wader species considered characteristic of coastal wetland sites dominated by sand. The birds forage by probing within intertidal sediment for invertebrate species, predominantly large polychaete worms such as Arenicola marina and Nepthys spp (Duijns et al., 2013). The species is characteristic of sites with sandy substrates (e.g. Hill et al. 1993; Summers et al. 2002). Bar-tailed Godwits were recorded foraging within eight subsites overall (0C424, 0C444, 0C448, 0C449, 0C450, 0C494, 0C931 and 0C932; see Figure 2.1 and Table 2.1 for locations and labels). Peak numbers foraging intertidally were recorded for 0C494 (Drumcliff Bay Outer: Ardtermon Strand), 0C932 (Lissadell Strand), 0C449 (Ballinaphunta) and 0C494 for the four low tide surveys respectively. Sub-site 0C494 (Drumcliff Bay Outer: Ardtermon Strand) was notable for supporting numbers always ranked first or second highest; while 0C932 (Lissadell Strand) always supported numbers ranked in the top three. These subsites are in the outer bay (west of the spit at Rosses Point) and are dominated by sand (<70%) with an intertidal benthic community defined by 'fine sand with crustaceans and *Scolelepis squamata*.' The distinguishing species of this community are the crustaceans *Eurydice pulchra*, *Bathyporeia pelagica* and Haustorius arenarius and the polychaete *Scolelepis squamata*. Sub-site 0C494 (Drumcliff Bay Outer: Ardtermon Strand) is in part classified as 'intertidal fine sand with *Peringia (Hydrobia)*

ulvae and *Pygospio elegans*' and supports potential prey species of Bar-tailed Godwits such as polychaetes Arenicola marina and Lanice conchilega. Of note were 870 Knot that were foraging with Bar-tailed Godwits in 0C494 on 02/02/11. A flock of 408 Bar-tailed Godwits foraged in 0C932 (Lissadell Strand) on 22/11/10. These birds foraged on the lower shore as part of a loose flock that also comprised 582 Knot and 44 Sanderling, amongst other species.

5.14 Good numbers of foraging Bar-tailed Godwits were also recorded at Cummeen Strand, surveyed on the same dates as Drumcliff Bay. The areas Ballincar – Ballyweelin, Cummeen Strand and Cummeen west from Coney Island Road were used regularly. Of note were 275 Bar-tailed Godwits foraging within Ballincar – Ballyweelin during the high tide survey on 27/01/11. 135 individuals foraged within Cummeen Strand (subsite) during the October 2010 low tide survey, more than the total number recorded across the Drumcliff bay survey area on the same day. It is clear therefore that this species ranges across both Drumcliff Bay and Cummeen Strand.

5.15 The highest intertidal foraging density recorded for a single subsite was 5.3 birds ha^{-1} (0C494: Drumcliff Bay Outer: Ardtermon Strand). Only two other subsites (0C449 and 0C932) recorded densities greater than 1 birds ha^{-1}. The whole site mean feeding density (intertidal habitat) was 0.5 birds ha^{-1}.

5.16 During low tide surveys, Bar-tailed Godwits were rarely recorded roosting intertidally; single observations recorded for 0C424, 0C444, 0C448 and 0C922. No roosting was recorded during the January 2011 high tide survey. 228 Bar-tailed Godwits roosted intertidally during the high tide survey on 11/02/11; 180 in 0C450 (Kintogher) and 48 in 0C449 (Ballinaphunta). A further 87 roosted supratidally in 0C424 (Lissadell/Ballygilgan Strand); all inner bay subsites. Roosting individuals were recorded from three subsites during the roost survey (30/11/10) the largest roosts recorded in 0C424 (flocks of 230 and 150 birds) that were positioned on the upper shore of Ballygilgan Strand. 0C922 and 0C931 recorded six and two individuals respectively.

Table 5.2 - Population data for non-breeding waterbird Special Conservation Interest Species of Drumcliff Bay SPA (after NPWS 2013b).

Site Special Conservation Interests	Baseline Period [1] (1995/96 – 1999/00)	Recent Site Data [2] (2006/07 – 2010/11)
Sanderling	237 (n)	97
Bar-tailed Godwit	336 (n)	457 (n)

[1] Baseline data is the 4-year mean peak for the period 1995/96 – 1999/00;

[2] Recent site data is the mean peak for the 5-year period 2006/07 – 2010/11 (I-WeBS).

(i) denotes numbers of international importance; (n) denotes numbers of all-Ireland importance.

Note that thresholds differ for the baseline and recent time periods used (refer to Crowe *et al.* (2008) and Wetlands International, 2002 and Wetlands International, 2012 for national and international respectively).

Cummeen Strand SPA

Waterbird Status

5.17 There are three waterbird species of Special Conservation Interest listed for Cummeen Strand SPA. Based on population trends for the site, it has been determined that the status of Redshank is currently considered as Unfavourable. Light-bellied Brent Goose and Oystercatcher are currently considered as Favourable (Table 6.1). Site conservation condition and population trends were also reviewed in light of species' national and international trends (Table 4.4). National trends were provided by the IWeBS Office while International trends follow Wetlands International (2012). Table 6.1 also shows the relationship between a species' long-term site trend and the current national trend for the 12-year period 1998/99 to 2010/11.

5.18 There are four categories of conservation condition, as follows:

- 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.

Table 5.3 - SCI species of Cummeen Strand SPA – Current Site Conservation Condition (after NPWS, 2013d).

Special Conservation Interests	BoCCI Category [a]	Site Population Trend [b]	Site Conservation Condition	Current National Trend [c]	Current International Trend [d]
Light-bellied Brent Goose	Amber	+ 116	Favourable	+ 62.3	Increase
Oystercatcher	Amber	+ 17	Favourable	+ 14.5	Decline
Redshank	Red	- 31	Unfavourable	- 4.8	Stable/Increase

[a] After Colhoun and Cummins (2013).
[b] based on the comparison between baseline and recent means;
[c] recent national trend is for the 12 year period 1998/99 to 2010/11;
[d] international trend after Wetland International (2012).

5.19 An analysis of IWeBS data for Redshank over the period 1994/95 to 2012/13 in Cummeen Strand SPA shows a consistent and generally stable trend. This mirrors the national trend in this species (Boland and Crowe 2012). Redshank has been consistently recorded from the majority of subsites in this SPA, which suggests that the coverage was good in January (except for the years 2000/01 to 2003/04 for which there is no data). Overall, the Redshank population in Ireland does not vary much through the winter (Crowe 2005) so January counts are probably representative of the overall winter population. This suggests that confidence in the trends given in Table 5.4 for Redshank is low and that the site population may be more stable over the longer term (up to 2012/13) than is suggested in this table.

Table 5.4 - Population data for non-breeding waterbird Special Conservation Interest Species of Cummeen Strand SPA (after NPWS 2013d).

Site Special Conservation Interests	Baseline Period 1 (1995/96 – 1999/00)	Recent Site Data 2 (2006/07 – 2010/11)
Light-bellied Brent Goose	223 (i)	481 (i)
Oystercatcher	680 (n)	792 (n)
Redshank	408 (n)	280

[1] Baseline data is the 4-year mean peak for the period 1995/96 – 1999/00;
[2] Recent site data is the mean peak for the 5-year period 2006/07 – 2010/11 (I-WeBS).
(i) denotes numbers of international importance; (n) denotes numbers of all-Ireland importance.

Note that thresholds differ for the baseline and recent time periods used (refer to Crowe et al. (2008) and Wetlands International, 2002 and Wetlands International, 2012 for national and international respectively).

Waterbird habitats and distribution

Habitats

5.20 The intertidal habitats in Cummeen Strand SPA were surveyed in 2010 by Aquatic Services Unit (2012). The habitats were classified using the standard JNCC system (Connor *et al*. 2004; in ASU, 2012). The exposed sandy beaches to the west of the bay consist primarily of mobile sands and associated communities. The extensive beaches and sandbanks at the mouth of the bay consist primarily of fine sand communities dominated by *Angulus tenuis*. Large areas of these beaches within the bay consist of muddy and fine sands with communities that are dominated by cockle (*Cerastoderma edule*). These fine sand environments give way to muddy sands in the more sheltered parts of the bay. The estuarine habitats are largely confined to small areas near the mouths of the Garavogue River in the south-eastern part of Sligo Harbour. *Zostera* beds were present in the southern part of Cummeen Strand (near Knappagh More) in October 1992 covering a minimum total area of 15ha (Nairn *et al*. 2003). The current status of *Zostera* beds and areas of green algae are as shown in Figure 5.1 (data provided by R. Wilkes, EPA). Hard benthos areas were identified along the northern shore and on exposed headlands at the western end of the bay. Strandline communities are present across all suitable shorelines.

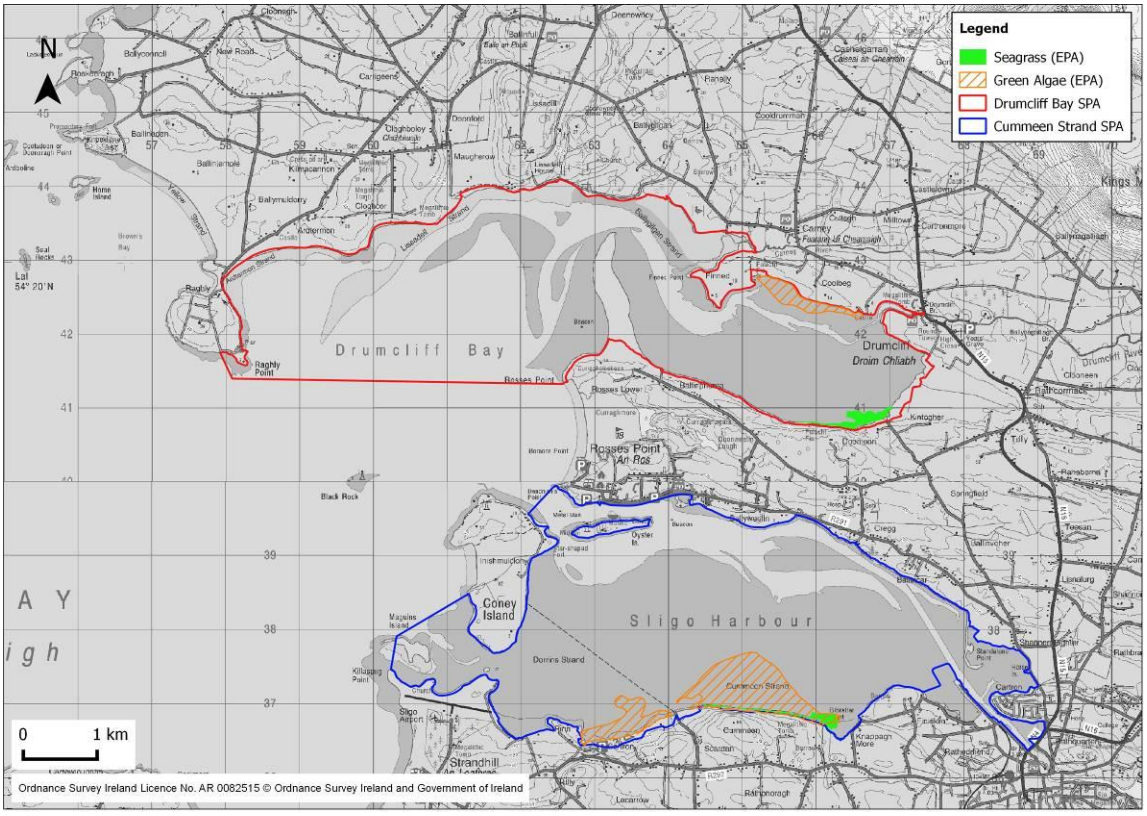

Figure 5.1 – Extent of *Zostera* (seagrass) and green algae (Source: mapping provided by EPA, 2014).

Distribution

5.21 All three SCI species were recorded within all counts of the main NPWS baseline waterbird survey programme in 2010/11. Average subsite occupancy, the average proportion of subsites in which a species occurred during low tide counts, ranged from 65% (Light-bellied Brent Goose) to 85% (Oystercatcher). Thus, all SCI species were reasonably widespread across the site. Average percentage area occupancy is defined as the average proportion of the whole site area that a species occurred in during low tide counts. Although this is a broad calculation across all habitat zones it presents some indication of the range of a species across the site as a whole. Because of the relatively widespread distribution of SCI species, average percentage area occupancy was relatively high for all three species (range 87% to 96%).

Light-bellied Brent Goose

5.22 Brent Geese are grazers and are known for their preference for foraging in intertidal areas with the Eelgrass *Zostera* sp. (Robinson *et al.* 2004). Where this food source is absent or becomes depleted, the birds feed upon algae species, saltmarsh plants and may also undertake terrestrial grazing. *Zostera* spp. is known from only one small patch on the southern side of Cummeen Bay (EPA pers comm). Green algae (*Ulvae* spp.) are widespread across tidal flats and are likely to form a major part of the Brent Goose diet.

5.23 Across the survey period Brent Geese were recorded foraging intertidally across a total of seven subsites and most regularly (three LT surveys or more) within four subsites: 0C466 (Cummeen Strand), 0C478 (Cummeen west from Coney Island Road), 0C482 (Coney Island) and 0C485 (Rosses Point Harbour). Sub-site 0C482 (Coney Island) held peak intertidal numbers in the latter three low tide surveys with a maximum number of 90 individuals on 22/11/10. Sub-site 0C466 (Cummeen Strand) held peak numbers on 21/10/10 (306) that included a flock of 243 individuals that foraged along the southern shore of the subsite and several other smaller flocks. A further 239 individuals foraged subtidally. Sub-site 0C466 (Cummeen Strand) was notable for supporting numbers ranked in the top four in all low tide surveys. 0C485 (Rosses Point Harbour) held good numbers on three occasions.

5.24 Shallow subtidal foraging was widespread (eight subsites). Peak numbers were held by 0C466 (Cummeen Strand), 0C485 (Rosses Point Harbour) and 0C463 (Killaspug Pt - Dorrins Strand West). 0C445 (Ballincar – Ballyweelin) held good numbers regularly. Intertidal foraging was recorded during the January 2011 high tide survey; 244 individuals across five subsites. 57% were within 0C462 (Coney Island Rd. - Dorrins Strand East). A further 175 foraged subtidally in 0C462, while 195 foraged subtidally just to the west in 0C463 (Killaspug Pt - Dorrins Strand West). These two outer bay subsites were clearly favoured at this time. Terrestrial foraging was recorded in areas adjacent to the SPA and this is likely to occur regularly. 52 Brent foraged in grassland adjacent 0C463 (Killaspug Pt - Dorrins Strand West) on 02/02/11. Areas adjacent (east) of 0C446 (Cartron to Standalone Pt.) held good numbers foraging terrestrially during both high tide surveys (maximum number 111). The highest intertidal foraging density within a single subsite was recorded for 0C485 (Rosses Point Harbour) (2 Brent Geese ha^{-1}). The average whole site foraging density was 0.2 individuals ha^{-1}.

5.25 Roosting/other behaviour in Brent Geese was recorded irregularly in intertidal habitat during low tide surveys, the following subsites recording flocks on irregular occasions: 0C446, 0C463, 0C466, 0C478 and 0C482. Of note was a flock of 119 Brent that flew in and rested in 0C446 on 02/02/11 for a short time. 109 Brent roosted intertidally along the southern shore of 0C478 on the same date. Sub-site 0C478 (Cummeen west from Coney Island Road) held good numbers (52) roosting intertidally during the January high tide survey, positioned to the east of Coney island as part of a larger mixed-species roost that included 120 Lapwing and 143 Golden Plover. Sub-site 0C482 (Coney Island) supported 192 Brent roosting intertidally during the February high tide

survey although these birds moved around the subsite and were recorded in various positions, both roosting and foraging. A further 131 Brent roosted subtidally. Subtidal roosting/other behaviour was recorded rarely, often one-off records made for 0C462, 0C463, 0C466, 0C482 and 0C485. Of note (and noted above) was a count of 131 Brent that roosted subtidally in 0C482 (Coney Island) during the February 2011 high tide survey. Counts of 15 and 75 Brent Geese roosted terrestrially adjacent to 0C478 and 0C482 during the low tide survey on 02/02/11. 152 Brent roosted terrestrially adjacent to 0C482 (Coney Island) during the February 2011 high tide survey.

5.26 The roost survey on 30/11/10 recorded roosting Brent Geese at 12 locations but roosting behaviour was concentrated in the outer part of the bay. Indeed, apart from a relatively small number of Brent within 0C466 (Cummeen Strand), all other individuals were located in the outer site around Coney Island (0C462, 0C463 and 0C482). Sub-site 0C463 (Killaspug Pt - Dorrins Strand West) (south of Coney Island) recorded the greatest number of individual roost positions (seven) and the largest single roost (57 individuals), most birds positioned along the southern shoreline of the subsite. The adjacent subsite 0C462 recorded the second largest single roost of 54 individuals; again along the southern shoreline. Sub-site 0C482 held very few individuals roosting (maximum number of two) although 45 were recorded foraging.

Oystercatcher

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

5.28 Oystercatchers foraged across all ten subsites. Sub-site 0C466 (Cummeen Strand) recorded peak numbers in the latter three low tide surveys plus second highest numbers on 21/10/10. The largest number foraging there however was recorded during the January high tide survey (375). This subsite is dominated by the intertidal benthic broad community ‘intertidal fine sand with *Peringia* (*Hydrobia*) *ulvae* and *Pygospio elegans*.’ The Cockle (*Cerastoderma edule*) is a characterising species of this community. Of interest is a large bed of Mussels (*Mytilus edulis*) that occurs mid shore from Finisklin to Cummeen (NPWS, 2013d) that likely explained a concentration of Oystercatchers in the south-east of the subsite on some occasions (e.g. February 2011). Peak numbers on 21/10/10 were recorded for 0C445 (Ballincar - Ballyweelin) (177) one flock comprising 170 individuals that foraged alongside the channel; smaller numbers present in all other low tide surveys. The intertidal habitat of this habitat is similar to that described above although it gives way to a sandy mud/mixed sediment community along the northern shoreline. Of further note was 0C478 (Cummeen west from Coney Island Road) that always recorded numbers ranked in the top three. This subsite is dominated by the intertidal benthic broad community intertidal fine sand with *Peringia* (*Hydrobia*) *ulvae* and *Pygospio elegans* but also supports Cockles; classified as the biotope ‘*Cerastoderma edule* and polychaetes in littoral muddy sand’ by ASU (2012). Oystercatchers forage terrestrially for prey such as earthworms, and although not recorded widely during the 2010/11 surveys this activity is likely to take place around the site (and outside of the SPA boundary) regularly.

5.29 Good numbers of Oystercatcher were recorded foraging across Drumcliff Bay during low tide surveys. While the frequency is largely unknown it is reasonable to assume that some movement of Oystercatchers between these sites occurs. The highest average intertidal foraging density

within a single subsite was recorded for 0C445 (Ballincar - Ballyweelin) (1.9 Oystercatcher ha^{-1}). The second highest foraging density was 1.5 Oystercatchers ha^{-1} recorded for 0C447 (inner Port). The average whole site foraging density was 0.3 individuals ha^{-1}.

5.30 Good numbers of Oystercatchers were recorded roosting/other in intertidal habitat during low tide surveys; this activity recorded for eight subsites: 0C445, 0C446, 0C462, 0C463, 0C466, 0C478, 0C482 and 0C485. Notable subsites that recorded peak or highly ranked numbers were 0C445 (Ballincar - Ballyweelin), 0C466 (Cummeen Strand), 0C478 (Cummeen west from Coney Island Road) and 0C482 (Coney Island). Some 378 Oystercatchers roosted in intertidal habitat during the high tide survey on 27/01/11; nearly 60% of these in 0C466 (Cummeen Strand). A further 32 individuals roosted supratidally in 0C466 but as intertidal habitat was available, many Oystercatchers also foraged (total number foraging was 375 individuals). 0C478 (Cummeen west from Coney Island Road) supported a further 72 individuals roosting intertidally and 220 foraging intertidally. Smaller numbers roosted across a further five subsites (0C445, 0C462, 0C466, 0C482, 0C485). The concurrent high tide survey at Drumcliff Bay recorded good numbers of Oystercatcher (198) roosting intertidally in the inner bay (Kintogher). The February 2011 high tide survey recorded a total 435 Oystercatchers roosting intertidally. 165 individuals were in 0C446 (Cartron to Standalone Pt.), positioned close to Standalone Point, a roost that also comprised 236 Knot, amongst other species. A further 108 Oystercatchers roosted within 0C482 (Coney Island) and 89 roosted at two positions along the southern shore of 0C478 (Cummeen west from Coney Island Road). Four subsites (0C445, 0C463, 0C466 and 0C485) held smaller numbers. The high tide survey at Drumcliff Bay again recorded good numbers of Oystercatcher (368) roosting intertidally in the inner bay (Kintogher).

5.31 During the roost survey (30/11/10) Oystercatchers were recorded roosting within eight subsites (0C445, 0C446, 0C462, 0C463, 0C466 0C478, 0C482 and 0C485). The peak number at a single roost was 340 individuals recorded for 0C445 (Ballincar - Ballyweelin) these birds roosting supratidally near Standalone Point in the east of the subsite. 0C466 (Cummeen Strand) recorded four roosts, the largest of 288 individuals, recorded along the shore in the SE of the subsite (near Barrow). All other roosts comprised 40 or less individuals. 0C463 was notable for recording seven different roost positions. The roost survey at Drumcliff Bay undertaken also on 30/11/10 recorded a large roost (330 individuals) in the inner bay (Kintogher). A further 166 roosted on Ballygilgan Strand and a total of 604 roosting Oystercatchers were counted across this bay, in comparison to the total of 833 that were counted roosting across the Cummeen Strand survey area. Note, totals should be treated with caution as the movement of birds during the survey could lead to double-counting.

Redshank

5.32 Redshank forage mainly by pecking at the surface or probing within intertidal mudflats; favouring the muddier sections of sites where they prey upon species such as the Ragworm *Hediste diversicolor* or Mud Snail *Peringia* (*Hydrobia*) *ulvae*. A particularly favoured prey is the burrowing amphipod *Corophium volutator*. Redshanks foraged intertidally across eight subsites (0C445, 0C446, 0C447, 0C463, 0C466, 0C478, 0C482 and 0C485). Four subsites held foraging individuals in all four low tide surveys (0C445, 0C446, 0C463 and 0C466). Sub-site 0C466 (Cummeen Strand) recorded peak numbers in the first three low tide surveys and second highest numbers in the final survey in February 2011. This subsite is dominated by the intertidal benthic broad community 'Intertidal fine sand with *Peringia* (*Hydrobia*) *ulvae* and *Pygospio elegans'*. The sediment of this community complex is largely fine sand (70% - 97%) but localised areas of more muddy sediment do occur; for example within inner reaches near Finisklin and at Cartron and Cregg (northern shore) where the silt-clay fraction accounts for 77% to 84%. On 21/10/10, the largest flock of Redshank foraged in the south-east of the subsite (spanning 0C447) and on balance, this species tended to forage mostly in this inner muddier part of the subsite, or in the north of the subsite close to the channel, often with feet in water.

5.33 The inner bay subsite 0C446 (Cartron to Standalone Pt.) held peak numbers on 02/02/11 and good numbers during all other low tide surveys (ranked in top three). This subsite has a muddier sediment classified as „estuarine mixed sediment to muddy sand with *Hediste diversicolor* and oligochaetes." ASU (2012) assigned the typical estuary biotope '*Hediste diversicolor*, *Macoma balthica* and *Scrobicularia plana* in littoral sandy mud'. Subsite 0C445 (Ballincar – Ballyweelin) also held good numbers in all surveys (peak number 145). This subsite comprises both intertidal benthic community types described above. The peak intertidal foraging density was 1.8 Redshanks ha^{-1} recorded for 0C446 (Cartron to Standalone Pt.); this subsite recording an average foraging density of 1.0 Redshank ha^{-1} throughout the survey programme. Sub-site 0C445 (Ballincar – Ballyweelin) recorded a density of 1.6 Redshanks ha^{-1} on one occasion. The whole site average intertidal foraging density was 0.2 Redshanks ha^{-1}.

5.34 Almost all Redshanks recorded during low tide surveys were foraging, although there were irregular records of small numbers of Redshank roosting/other. The one exception was 95 Redshanks that roosted intertidally within 0C445 (Ballincar – Ballyweelin) on 21/10/10. With intertidal habitat available, most Redshanks were recorded foraging during the January 2011 high tide survey although numbers during this survey and the early February 2011 low tide survey were down on previous months, possibly due to the cold weather conditions experienced that winter. The largest number roosting intertidally (21) were located within 0C485 (Rosses Point Harbour). 26 Redshanks roosted supratidally in 0C446 (Cartron to Standalone Pt.), a mixed-species roost on Horse Island. A further 92 Redshanks roosted terrestrially (part of a larger mixed-species roost) along the training wall that marks the eastern boundary of the subsite.

5.35 The February 2011 high tide survey recorded 150 roosting Redshanks, 81 of these within 0C466 (Cummeen Strand). The largest flock was 75 individuals that roosted intertidally in the south-eastern corner of the subsite. A further 90 Redshanks roosted terrestrially along the training wall that marks the eastern boundary of the subsite. Other roost records were obtained for 0C445 (4 intertidal), 0C446 (25 intertidal), 0C463 (13 supratidal), 0C478 (40 intertidal) and 0C482 (Coney Island, one terrestrial). Of note was a flock of 58 Redshanks that roosted supratidally in outer Drumcliff Bay (on Raghly Point) on the same day. The roost survey (30/11/10) recorded roosting Redshanks across seven subsites (0C445, 0C446, 0C462, 0C463, 0C466, 0C482 and 0C485). The largest single roost was recorded in 0C466 (Cummeen Strand) where 155 individuals roosted intertidally near Barrow. Slightly further west (off Gibraltar Point), a flock of 101 roosted intertidally, a large mixed-species roost that included 73 Common Gull and 47 Dunlin amongst other species. A flock of 135 Redshanks roosted intertidally within 0C485 (Rosses Point Harbour). Smaller numbers roosted across a further 12 positions. The concurrent roost survey at Drumcliff Bay recorded relatively few roosting Redshanks, 27 individuals recorded from six positions.

6. Aquaculture Impacts

Scope of activity

6.1 The aquaculture activity addressed in this assessment are i) off-bottom culture of Pacific Oysters (*Crassostrea gigas*) using bag and trestles in the intertidal zone (hereafter referred to as intertidal oyster cultivation) and ii) bottom cultivation of clams (*Ruditapes philippinarum*) at Drumcliff Bay and Cummeen Strand Sligo Harbour. Figure 6.1 illustrates the location and extent of currently licenced blocks and licence applications.

Drumcliff Bay SPA

6.2 There are eight aquaculture blocks for consideration within Drumcliff Bay SPA. Three are located on the tidal flats inside the spit at the northern side of Rosses Point peninsula; these are identified in the aquaculture profile as clam cultivation sites (noted on Figure 6.1 as mixed oyster / clam sites); of these, two blocks were previously licenced, while the third most southerly block is an application (Figure 6.2). An additional clam cultivation area (previously licenced) is located at Ballygilgan Strand, along the northern margin of the main tidal channel entering inner Drumcliff Bay. Oyster cultivation does currently occur within Drumcliff Bay. There are also applications for oyster cultivation at Ballygilgan Strand (within three discrete areas – one large block of trestles, and two smaller areas used as part of the cultivation cycle) and one large block at Ardtermon Strand.

6.3 However, due to current issues with clam disease we understand that all licences in Drumcliff Bay are initially proposing to grow Pacific oyster on trestles; but they wish to reserve the option to revert to clams when disease concerns abate. As a result all such licences are considered as mixed oyster / clam sites and are assessed as such below.

Cummeen Strand SPA

6.4 In Cummeen Strand, there are a total of 18 aquaculture blocks with eight identified as solely oyster cultivation areas and ten identified as clam cultivation areas (with a number also highlighting oyster as a secondary species). The majority of the licence areas are located at the southern margin of the channel that runs along the north of Sligo Harbour. Two additional licence areas are located in the southwest of the bay, near Dorrins Strand (Figure 6.1 and 6.2).

6.5 All eight of the oyster cultivation licence areas are application status in Cummeen Strand/Sligo Harbour along with one clam cultivation licence area in the southwest (near Dorrins Strand). The remaining aquaculture blocks are previously licenced for clam cultivation in Cummeen Strand SPA. However, as noted above due to current issues with clam disease we understand that all clam licences in Cummeen Strand are considering growing Pacific oyster on trestles in the short-term (but again, as above, wish to reserve the option to revert to clams when disease concerns abate). Thus in order to assess all possible eventualities; those licences which are purely for oyster are assessed as such; while all clam licences are assessed as mixed oyster / clam sites.

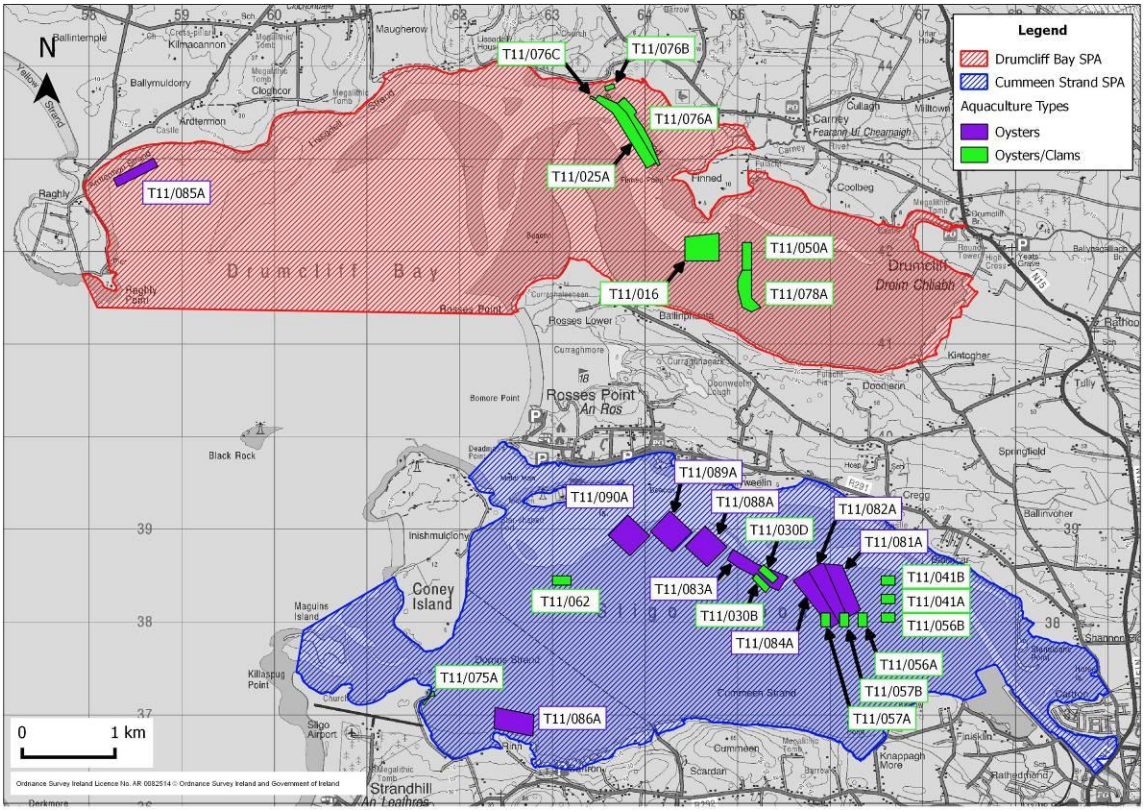

Figure 6.1 – Distribution and type of aquaculture identified for each licence application area in Drumcliff Bay SPA and Cummeen Strand SPA.

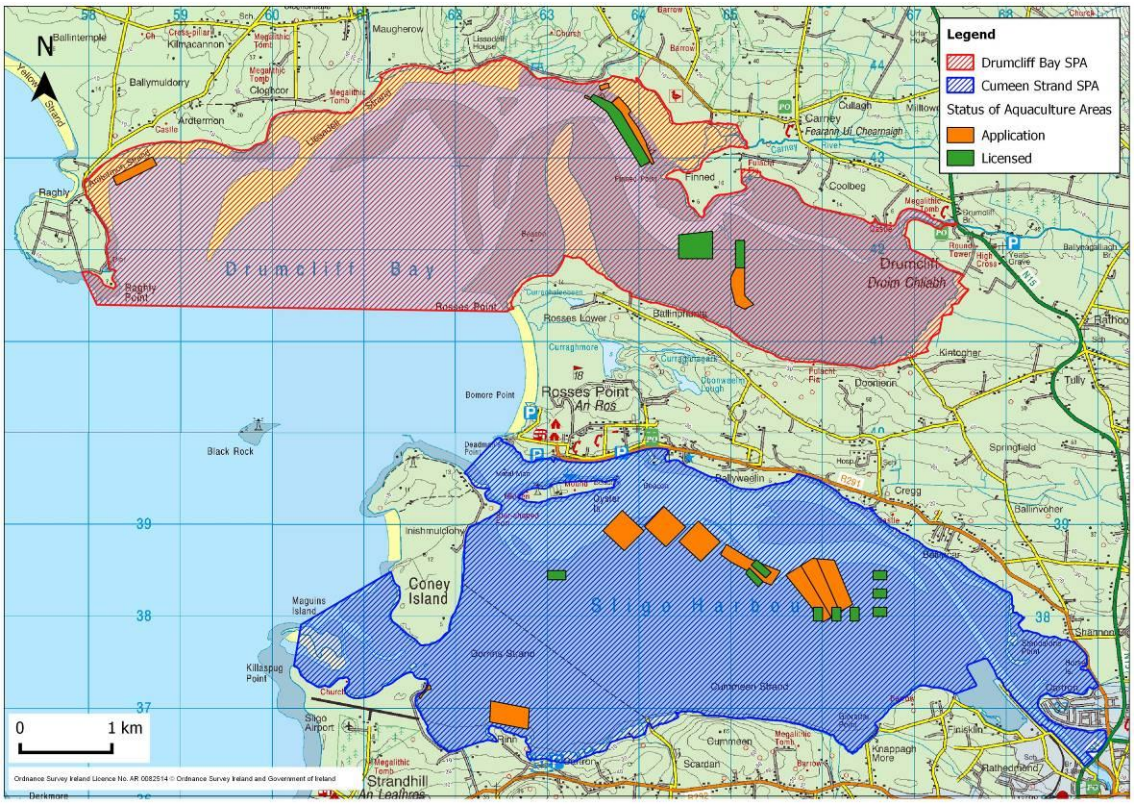

Figure 6.2 – Distribution and status of licence application area for aquaculture in Drumcliff Bay SPA and Cummeen Strand SPA.

Extent of Aquaculture Activities

6.6 The total area occupied by aquaculture licence blocks within Drumcliff Bay SPA and Cummeen Strand SPA is 130.6 ha. Of this area, 41.7 ha are accounted for by aquaculture blocks within Drumcliff Bay SPA. The remaining 89.0 ha of aquaculture blocks are located within Cummeen Strand SPA. The mean size of aquaculture blocks within Drumcliff Bay SPA and Cummeen Strand SPA combined is 5.0 ha; a mean of 5.2 ha within Drumcliff Bay SPA and 4.9 ha within Cummeen Strand SPA, respectively.

6.7 Previously licenced aquaculture blocks in Drumcliff Bay SPA (all clam cultivation) cover a total area of 24.2 ha. In Cummeen Strand SPA, the total area covered by previously licenced aquaculture blocks is 14.3 ha (again all clam cultivation).

6.8 In Drumcliff Bay SPA, the total area of new applications is 17.4 ha. In Cummeen Strand SPA, the total area of new applications is 74.6 ha.

Table 6.1 – Details of previously licenced and new applications for aquaculture activities in Drumcliff Bay SPA and Cummeen Strand SPA.

Licence block ID	Licence block Location	1^0 Species Cultivated	2^0 Species Cultivated	Licence block Status	Licence block area (ha)
T11/016	Drumcliff Bay	Clams	n/a	Licensed	10.4
T11/025A	Drumcliff Bay	Clams	Oysters	Licensed	10.9
T11/050A	Drumcliff Bay	Clams	n/a	Licensed	3.0
T11/076A	Drumcliff Bay	Oysters	Clams	Application	5.6
T11/076B	Drumcliff Bay	Oysters	Clams	Application	0.5
T11/076C	Drumcliff Bay	Oysters	Clams	Application	0.2
T11/078A	Drumcliff Bay	Clams	n/a	Application	6.2
T11/085A	Drumcliff Bay	Oysters	n/a	Application	4.9
T11/030B	Cummeen Strand	Clams	Oysters	Licensed	1.5
T11/030D	Cummeen Strand	Clams	Oysters	Licensed	1.8
T11/041A	Cummeen Strand	Clams	n/a	Licensed	1.5
T11/041B	Cummeen Strand	Clams	n/a	Licensed	1.5
T11/056A	Cummeen Strand	Clams	n/a	Licensed	1.5
T11/056B	Cummeen Strand	Clams	n/a	Licensed	1.5
T11/057A [1]	Cummeen Strand	Clams	Oysters	Licensed	1.5
T11/057B [1]	Cummeen Strand	Clams	n/a	Licensed	1.5
T11/062	Cummeen Strand	Clams	n/a	Licensed	2.0
T11/075A	Cummeen Strand	Clams	n/a	Application	0.4
T11/081A	Cummeen Strand	Oysters	n/a	Application	9.6
T11/082A	Cummeen Strand	Oysters	n/a	Application	9.1
T11/083A [2]	Cummeen Strand	Oysters	n/a	Application	7.5
T11/084A	Cummeen Strand	Oysters	n/a	Application	8.7
T11/086A	Cummeen Strand	Oysters	n/a	Application	9.7
T11/088A	Cummeen Strand	Oysters	n/a	Application	9.9
T11/089A	Cummeen Strand	Oysters	n/a	Application	9.9
T11/090A	Cummeen Strand	Oysters	n/a	Application	9.9

[1] Sites T11/057A & T11/057B partially overlap with licence applications T11/082A and T11/084A.

[2] See also T11/030B & T11/030D; which partially overlap with T11/083A.

Description of Activity

6.9 The following discussion is informed by Appropriate Assessment Profiles prepared by Bord Iascaigh Mhara (BIM, 2014a / b) and a historic Code of Practice from Drumcliff Bay (Anon, n/a; believed to have been prepared by local growers over 10 years ago).

6.10 Culture of the Pacific Oyster *(Crassostrea gigas)* is one of the most widespread aquaculture activities in Ireland. Pacific Oyster production culture began in Ireland in the 1970s. Production levels had reached around 5,000 tonnes in 2003; they increased to around 7,000 tonnes in 2007; 8,700 tonnes were produced in 2013. It occurs within 16 coastal SPAs; thus the potential impact of this activity on waterbird populations is an issue in a number of Appropriate Assessments of aquaculture in coastal SPAs.

6.11 Almost all Pacific Oyster culture in Ireland uses trestles in intertidal habitat. The trestles are usually located in the lower part of the intertidal zone, in areas that are only fully exposed on low spring tides. Large blocks of trestles are usually located on sandflats while smaller areas of trestles may occur on mixed sediment shores and muddy shores. Oyster spat is supplied by hatcheries and is placed in mesh bags. These mesh bags are placed on top of the trestles, where they are on-grown until they are ready for harvesting. Oyster husbandry activities mainly take place during spring low tides. At sites with large areas of trestle blocks, husbandry activities may take place on every suitable tide.

6.12 In Drumcliff Bay the source of seed would be Lissadell hatchery Co. Sligo (type: diploid). The production cycle begins when they bring them in at a size of 2mm in March / April from Lissadell Hatchery; the growth cycle is 3 to 3 ½ years. When the seed is delivered from Lissadell hatchery, it is placed in the mesh plastic bags with mesh size and stocking density appropriate to the seed grade. As the oysters grow stocking densities are reduced. Bag mesh sizes used on site are 2mm to 9mm. Initial stocking densities when deployed into 4mm bags can vary from 800 up to 5,000 oyster seed per bag. As the oysters grow stocking densities are reduced. Generally seed if stocked over 2,000/bag is graded and split in the first couple of months to lower density and by the end of year one the density is between 400 and 1000 oysters per bag. The intertidal area is typically accessed during spring tides (at low tide) using a single tractor. Grading and packing, preparation of bags and trestles and general maintenance is carried out in the outhouse buildings near Lissadell.

6.13 Cultivation of clams involves a different technique from oyster culture. This is the Manilla Clam or Palourde (*Tapes semidecussatus*, also known by the genus name *Ruditapes* or *Venerupis*). In order to grow clams in Drumcliff Bay seed is placed on the foreshore in April and held in specially designed wooden frames covered with 1.2mm mesh. At 8-9mm it is graded and thinned, and this is allowed to grow over the summer until by September it has reached 12-14mm. The young clams are then allowed to over-winter in the frames. In the second year the young clams are then ready to plant out onto the foreshore. The year old clams are laid in the parc in April at a density of 250 per square metre (Plate 6.1 illustrates a similar parc in Glenbeigh, Co. Kerry); they are laid on the surface and will bury themselves within the sediment. By the end of the first year they grow to 10-12 grams, at which time they were ideal for the Italian market where clams are eaten small. The end product (20 gram clams), is usually harvested late in the year.

6.14 The following description of the cultivation technique for clams in Drumcliff Bay is from a history of clam cultivation (Institute of Technology Sligo). Seed was placed on the foreshore in April and held in specially designed wooden frames covered with 1.2mm mesh. Each frame was divided into four sections and held a million 1mm seed. At 8-9mm they were graded and thinned, so that each section held 35,000 seed, and these were allowed to grow over the summer until by September or October they had reached 12-14mm.

6.15 In the second year, when the young clams were 10-12mm along their short axis they were ready to plant, and at Sligo Aquaculture this was done in a 1.2 hectare clam park measuring 186 x 86 yards which took five days to build using a plough to dig in the crab fence and the power-washer to sink the poles in the sand. The year old clams were laid in the park in April at a density of 250 per square metre and dug themselves into the sand within 15 minutes, to reappear only at harvesting time. By the end of the first year they grew to 10-12 grams, at which time they were ideal for the Italian market where clams are eaten small, and by the second 15-25.

6.16 New licence applicants all have indicated to BIM that their source of seed for oysters will be from local hatcheries in Ireland; Lissadell Hatchery, Carton Point Hatchery or Tralee Hatchery. All new applicants are to use bag and trestles as the method of cultivating their oysters. There will be both diploid and triploid seed used if available; triploid currently not used but may be, if available.

Plate 6.1 Clam beds at Rossbehy, Castlemaine Harbour.

Drumcliff Bay SPA aquaculture profile

6.17 The following description of work is taken from the aquaculture profile prepared by BIM for Drumcliff Bay (BIM, 2014a). Aquaculture in Drumcliff Bay is undertaken by three operators who are cultivating clams and oysters (they are Armada Shellfish, Atlantic Clams and Seatrawl Ltd.; BIM, 2014) (Table 1.1). Clams farms in the area have not been seeded in three years due to Brown ring disease which currently has caused all operators in Drumcliff bay to cease clam farming until fallowing of sites has taken place. This is taking a number of years. The final crop of clams being harvested in 2014 was predicted to be 8 tonnes. Clams are unlikely to be seeded for a number of years due to this disease. However, applications to farm clams are likely to continue as operators are keen to resume cultivation of clams once the issue of Brown ring disease has been resolved (BIM, 2014a). In these renewal applications oysters will be the primary species; with clams the secondary species.

6.18 A wild oyster area granted to Sir Robert Gore Booth to farm oysters off the Lissadell seashore in 1865 continues to the present day with oyster and clam cultivation operated by Atlantic Clams from farm buildings at Lissadell (BIM, 2014a); this operation does not come under the aquaculture licence process as licenced by the Department of Agriculture, Food and the Marine. We understand it to be an entirely shorebased activity, which as noted operated from farm buildings at Lissadell. It is not therefore considered further in this assessment.

6.19 New licence application areas are for oyster cultivation of nationally sourced diploid and triploid oysters using the bag and trestle method (BIM, 2014a); though clam is listed as a secondary species for cultivation in a number of instances.

6.20 Access (Figure 6.3) to the intertidal cultivation areas are at three locations around Drumcliff Bay. There is local road access to Ballygilgan Strand which is used to access the northern licence areas. The southern licence areas are accessed from the Ballinphunta Road. Operations in this area are subject to a local *Code of Practice* in order to avoid negative environmental and ecological impacts. The new application area at Ardtermon Strand will be accessed by boat from Raghly Harbour (BIM, 201a4) (T11/085).

Cummeen Strand SPA aquaculture profile

6.21 The following description of work is taken from the aquaculture profile prepared by BIM for Cummeen Strand (BIM, 2014b). There are three operators currently operating in Cummeen Strand (Sligo Harbour) with a total of six licenced sites for oyster and clams which are currently awaiting renewal (covering 9 no. discrete blocks). At present, only oysters are being cultivated by one operator (Coney Island Shellfish Ltd.) with a yield of 10 tonnes in 2014 (BIM, 2014).

6.22 As with Drumcliff Bay, clams in Cummeen Strand/Sligo Harbour have been affected by Brown ring disease. As a result, clams have not been seeded in three years and the final clam crop of 10 tonnes was harvested in 2014 (BIM, 2014). Clams are unlikely to be seeded for a number of years due to this disease. However, applications to farm clams are likely to continue as operators are keen to resume cultivation of clams once the issue of Brown ring disease has been resolved (BIM, 2014). Licence T11/062 has never been used to farm clams.

6.23 Operations don't materially differ from those at Drumcliff; they can be summarised as follows. One operator (Coney Island Shellfish) currently cultivates oysters in the harbour. The oyster cultivation operation uses diploid oysters and the full cycle from seed to harvestable market size is $3\text{-}3^{1}/_{2}$ years in duration. The cycle begins with 2mm seed oysters which are delivered in March/April from Lissadell hatchery being placed in mesh bags on the trestles in the intertidal zone. As the oysters grow, they are annually graded and stocking density in the bags adjusted accordingly (as at Drumcliff bag mesh ranges from 2mm to 9mm).

6.24 Initial stocking densities when deployed into 4mm bags is 2,000 seed per bag. As the oysters grow densities are reduced. Generally seed if stocked over 2,000/bag is split in the first couple of months to lower density and by the end of year one the density is between 400 and 1000 oysters per bag. By the time they reach market size of 80 grams after $3\text{-}3^{1}/_{2}$ years, the stocking density is down to 150 per bag. Grading takes place every year between October and April. Grading and harvesting activities entails actually removing the bags from the inter-tidal zone to a land based site. They are collected by hand, loaded onto trailers and transported by tractor.

6.25 Maintenance activities on-site include shaking and turning of bags. Tractor movements in this instance are simply for the transport of staff to and from site. Harvesting occurs between Septembers to June and involves hand placing of the bags on tractor and trailer to be brought ashore. Frequency of site access is every day by tractor during harvesting.

6.26 Clams are cultivated at Cummeen Strand/Sligo Harbour in one main intertidal area using bags, tray mesh containers and on the seabed in clam parks and under mesh. Seed clams are brought into the area in April and are grown on in trays and bags for 1 year after which time they are sown into the intertidal sediments under a mesh. Netting is placed over the clams and is buried to 10 cm depth. Density of clams into plots is approx $300m^2$ (Gosling, 2003).The netting is changed once in the growing cycle and the mesh is increased as the clams grow larger with age. At 3 years, the clams reach market size and are harvested. Impacts and recovery are dealt later in document.

6.27 New licence application areas are for oyster cultivation of nationally sourced diploid and triploid oysters using the bag and trestle method (BIM, 2014). All new applicants have said their source of seed will be from local hatcheries in Ireland, Lissadell Hatchery, Carton Point Hatchery or Tralee Hatchery. All new applicants are to use bag and trestles as the method of cultivating their oysters.

6.28 Access for tractor and trailers will be required for to the nine new oyster cultivation areas to the north of Cummeen Strand/Sligo Bay. The new application area to the south will be accessed from the shore on foot (Figure 6.3).

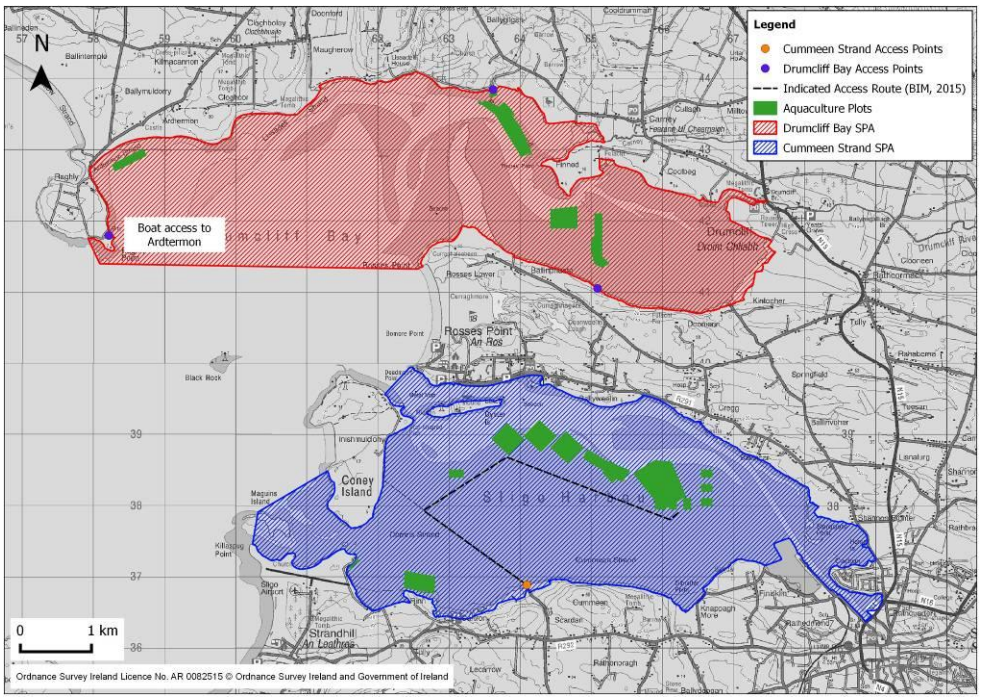

Figure 6.3 - Access points and designated access routes to the licence blocks in Drumcliff Bay and Cummeen Strand SPAs.

Potential impacts of oyster cultivation

Habitat structure

6.29 Intertidal oyster cultivation can alter the intertidal habitat suitable for bird usage through the placement of physical structures (oyster trestles) on the intertidal habitat. This impact may alter the suitability of the habitat for waterbirds by interfering with sightlines and/or creating barriers to movement. Based on the characteristics of species showing positive/neutral or negative responses to trestles, we have hypothesised that trestles may interfere with flocking behaviour causing species that typically occur in large, tightly packed flocks to avoid the trestles (Gittings and O'Donoghue, 2012). Trestles could also interfere with the visibility of potential predators causing increased vigilance and reduced foraging time, while they may also interfere with the ability of hunting raptors to detect and capture prey.

Food resources

Benthic fauna

6.30 Intertidal oyster cultivation may cause impacts to benthic invertebrates through sedimentation and eutrophication, and this could potentially affect food resources for waterbird species.

6.31 In a review of the literature, Dumbauld *et al*. (2009) found variation in the effects of intertidal oyster cultivation on the benthic fauna. In studies in England, France and New Zealand, intertidal oyster cultivation caused increased biodeposition, lower sediment redox potential and reduced diversity and abundance of the benthic fauna. However in studies in Ireland and Canada, few changes in the benthic fauna were reported, presumably due to high currents preventing accumulation of biodeposits.

6.32 The Irish study referred to above was carried out at Dungarvan Harbour (De Grave *et al*., 1998). This study compared an oyster trestle block (in the north-eastern section of the main block of trestles) with a control site approximately 300 m away, with both areas being at the mean tide level. Within the trestle block areas underneath trestles and areas in access lanes were compared. The study found no evidence of elevated levels or organic matter or high densities of organic enrichment indicator species within the trestle blocks. There were minor differences in the benthic community between the control area and the areas sampled under the trestles (higher densities in the trestle areas of *Nephtys hombergii*, *Bathyporeia guiiliamsoniana*, *Gammarus crinicomis*, *Microprotopus maculatus* and *Tellina tenuis* including increased abundance of *Capitella capitata* in the latter area). There appeared to be stronger changes in the benthic community in the access lanes with increased densities of three polychaete species (*Scolopos armiger*, *Eteone longa* and *Sigalion mathildae*) and higher overall diversity, and these changes were considered to be due to the compaction of the habitat by vehicular traffic.

6.33 In a more recent study Forde *et al*. (in press) looked at benthic invertebrates along access tracks, under trestles and in close controls at a number of sites nationally. There was a strong site effect from the study in that significant differences were observed using a variety of invertebrate response (dependent) variables among the sites. Access routes were considered more disturbed than trestle and control locations; most likely due to the influence of compaction from regular vehicle movements. Abundance (among other variables) was significantly higher in control and trestle samples when compared with those derived from access routes. No noticeable difference between control and trestle samples was detected. Therefore, this research indicates that intertidal oyster cultivation is unlikely to have had major impacts on food resources for waterbirds that feed on benthic fauna (F O'Beirn pers comm.).

Zostera

6.34 Intertidal oyster cultivation may cause impacts to seagrass (*Zostera*) beds, which are an important food resource for various waterbirds including Light-bellied Brent Goose. A number of studies have reported negative impacts from off-bottom oyster cultivation on *Zostera* (e.g. Everett *et al*., 1995; Skinner *et al*., 2013; Tallis *et al*., 2009; Wisehart *et al*., 2007)), although longline cultivation may only have minor impacts (Tallis *et al*., 2009), while hanging basket cultivation has been reported to have negligible impacts (Bulmer *et al*., 2012). However, in this instance there is no spatial overlap between oyster/clam culture and *Zostera* beds. In addition, no activities would be countanenced in *Zostera* beds (NPWS 2013g)

Fish

6.35 Dumbauld *et al*. (2009) also reviewed studies of the effects of bivalve shellfish aquaculture on nekton (fish and mobile invertebrates such as crabs). There was only one study that specifically examined intertidal oyster cultivation using bags and trestles (Laffargue *et al*., 2006). This study found that, in an experimental pond mesocosm, sole used the oyster trestles as resting areas during the day, moving out into the open areas (which simulated tidal flats) to forage at night and the authors considered that the "oyster trestles offered cover, camouflage, and safety and were therefore attractive to sole (as artificial reef-structuring effects)". Similarly, De Grave *et al*., (1998) noted that the trestles in their Dungarvan Harbour study site acted as refuges for scavenging crabs and shrimps. There were also a number of studies reviewed by Dumbauld *et al*. (2009) of related types of oyster cultivation (included suspended culture in subtidal waters, rack and bag systems, longlines and oyster grow-out cages). These all involve placing physical structures in the intertidal or subtidal waters and the potential impacts from organic enrichment and benthic community changes associated with oyster cultivation, so provide some degree of analogous situations to intertidal oyster cultivation using bags and trestles. These have generally found either little differences between oyster cultivation areas and nearby uncultivated habitats, or higher densities of nekton in the oyster cultivation areas.

Disturbance

6.36 Intertidal oyster cultivation can require intensive husbandry activity and this may cause impacts to waterbirds using intertidal and/or shallow subtidal habitats through disturbance. Disturbance will not affect high tide roosts, or waterbirds that mainly, or only, use trestle areas when they are covered at high tide (such as Red-breasted Merganser, Great Northern Diver and Cormorant), because no husbandry activity takes place during the high tide period.

6.37 The trestle study (Gittings and O'Donoghue, 2012) examined the combined potential effects of habitat alteration and disturbance from husbandry activity. The sites included in the study included some with very high levels of husbandry activity. Therefore, it is not necessary to consider the disturbance component of the potential impacts separately in relation to potential impacts on waterbirds at low tide. However, disturbance will be returned to as appropriate below.

Potential impacts of clam cultivation

Habitat impacts

6.38 Clam cultivation differs from the cultivation of oysters in that the clams are seeded into the sediment for ongrowing; as these are then covered with a protective netting to prevent predation there exists the possibility that some bird species may be excluded from the areas to be farmed. While green algae (which are fed on by Light-bellied Brent Geese) will grow on the protective netting, this is regularly cleaned by a tractor drawing a heavy brush over the nets to prevent excessive growth of algae. The objective is to ensure that clams, which are mobile and can adjust their position within the netting, have free access to food laden and oxygenated waters. Regularly management prevents development of fucoid species which are not favoured by brent geese.

6.39 Based on the scale of operations relative to the size of Drumcliff Bay and Cummeen Strand depletion of phyto / zooplankton by feeding clams would seem extremely unlikely; nutrient input from clams may in fact result in localised increase in phytoplankton - though it should be noted that the clam beds are within intertidal rather than stable subtidal waters and therefore will experience significant daily water exchange.

6.40 While at some sites ground preparation might be necessary (e.g. removal of rocks etc.) this is not believed to be an issue on the sandflats at Drumcliff and Cummeen; as a consequence there should not be large-scale structural alteration of habitats within which it is proposed to locate clam farms nor damage to reef systems (refer to SAC Assessment).

6.41 There is some evidence that anti-predator netting covering the plots of clams could result in an increase in sedimentation and organic material; this in turn may result in localised alteration in community structure; such as for example an increase in the numbers of deposit feeding species (such as polychaete worms). In a study of ecological impacts of clam cultivation in the Exe Estuary, southern England, by the Ministry of Agriculture, Fisheries and Food in the UK (Spencer *et al.* 1996, 1997); the presence of the netting, increased sedimentation rate which elevated the ground profile by c. 10cm and caused a small but significant increase in percentage fines and percentage organic content of the sediment. The netting also encouraged higher densities of some species of infaunal deposit-feeding worms which became the dominant fauna.

6.42 As is the case for oyster trestles localised compaction of sediment can occur along access tracks or maintenance tracks within the clam farm

6.43 The Code of Practice (Anon, n/a) makes reference to making use of a plough to dig in a crab fence (as an anti-predatory device) and the use of a power washer to sink poles in the sand. It is not known at this time as to whether any of the operators propose to use crab fences.

6.44 The Code of Practice (Anon, n/a) also makes reference to use of bird scarers. Use of bird scarers within the SPA is not to be permitted and this restriction will be a Condition of any licences granted.

6.45 In order to harvest the clams they must be dredged up; using a dredge which works to a depth of ca. 12cm. Our understanding is that the ground is left fallow and allowed to settle over subsequent tides.

Benthic fauna

6.46 The netting used in the study at the Exe Estuary also encouraged higher densities of some species of infaunal deposit-feeding worms which became the dominant fauna. During the first six months of the cultivation process, the fauna was dominated by the opportunistic spionid,

Pygospio elegans. After one year, the stabilizing effect of the netting on the sediment led to the establishment of species such as *Ampharete acutifrons* and *Tubificoides benedii*, which displaced *P. elegans* as the community dominants. The observed biological responses indicate that organic enrichment occurred within net-covered areas. However, the magnitude of community change was far less than that which occurs in association with some other marine culture practices, which create anoxic sediments and impoverished infaunal communities (Spencer *et al*. 1997).

6.47 The changes in density of polychaete worms in the affected areas are likely to influence the prey availability for wader species, including Bar-tailed Godwit, which is a SCI for Drumcliff Bay SPA. Duijns *et al*. (2013) confirmed the importance of polychaete worms in the diet of European-wintering Bar-tailed Godwits. They identified 18 different prey species in the diet of wintering Bar-tailed Godwits. The Ragworm *Hediste diversicolor* was the most common prey item and the only one actively selected. Ragworms, on average, contributed 79% to the diet in terms of biomass, followed by King Ragworm *Alitta virens* (with 17% biomass) and Lugworms *Arenicola marina* (with 2%). Polychaetes such as *Alitta succinea* and *Scoloplos armiger* were also regularly found in the diet. Bivalves, snails and crustaceans contributed less than 1% to the diet.

6.48 As noted it may be necessary to undertake crab control; e.g. at the site at Drumcliff Bay the IT Sligo description of works indicated at the site was baited with 20-30 crab pots and the crab fence had to be maintained free of weed at all times. Impacts, however, are likely to be localised in extent.

6.49 At Drumcliff Bay, in the past the clams were harvested from the sand using a tractor-mounted clam harvesting machine with a theoretical output of up to 4 tonnes a day. As the tractor was driven over the beach, both clams and sand were ploughed up by a blade to a depth of ca. 12 cm and lifted up an elevator to four counter-rotating rollers, where the sand would fall away (IT Sligo). The scale of disturbance associated with this activity is not known. While Spencer *et al*. (1997) considered that the sediment would be severely disturbed by the harvesting process for Manila clams; the role of habitat resilience and recoverability in a dynamic system as found on sand and a mudflat is also a consideration (see Spencer *et al.* 1998). At the time of writing there were no active clam farms in Drumcliff or Cummeen; we have therefore adopted a conservative position of total exclusion of shorebirds from within clam farms as a starting point to assess the potential impact of switching from oyster trestles to clam farming.

Fish

6.50 We are not aware of any published data on the impacts of clam farming on fish. However, as noted above none of the SCI species for Drumcliff Bay SPA or Cummeen Strand SPA have a fish based diet and would not therefore be affected by impacts on fish.

Disturbance

6.51 The amount of disturbance to bird species depends on the frequency of human activity on the intertidal area. The IT Sligo study estimated that a great deal of work was involved at the Drumcliff Bay clam park in keeping the meshes clear of weed using a power washer and in separating the really young clams which tended to clump together with their byssus threads. However, we understand that the use of the clam boxes, during the nursery phase, is confined to a single intertidal area at one site near Lissadell; any disturbance impact during this culture phase would therefore be confined to this location. Clam boxes are on rollers allowing them to be moved easily; we understand, however, that they are mainly kept close to the upper part of the shore to facilitate access. Detailed information on level of work on the nursery boxes is not available; though as noted above seed is placed on the foreshore in wooden frames from April; so much of this grading would occur outside the main winter period during which SCI species would be on

site. Young clams are allowed to grow in these frames through the summer until September / October.

6.52 At the Drumcliff site, birds such as Oystercatcher were treated as predators of Manila clam, and were deterred by the presence of a human bird scarer at every low spring tide (IT Sligo). It is not clear what form this disturbance took. However, if it was effective in deterring Oystercatcher, it would also deter other waders such as Bar-tailed Godwit from feeding in the affected areas. Our current assessment of the potential impact of clam farming in Sligo is that no bird scarers are to be used on site; if this assumption were to change an assessment of the nature and potential impact of such scarers would need to be undertaken prior to re-commencement of clam farming.

7. Impact assessment – Drumcliff Bay SPA

Screening

7.1 Drumcliff Bay SPA is designated for Sanderling and Bar-tailed Godwit. Neither species was screened out; both are therefore carried forward to full Appropriate Assessment.

Displacement

Displacement of birds by aquaculture

7.2 The average number of each of the SCI species that occurred in each subsite of Drumcliff Bay SPA during NPWS low tide surveys is given in Table 7.1 together with the percentage of counts on which the species was recorded. The NPWS low tide waterbird surveys included four low tide counts undertaken during the winter of 2010 / 2011.

Table 7.1 - Distribution of SCIs by sub-site in Drumcliff Bay SPA (based on NPWS low tide surveys 2010-11 only).

Drumcliff Bay SPA Subsite	Sub-site code	Bar-tailed Godwit		Sanderling		Total intertidal area in sub-site (ha)	Total area occupied by licence blocks (ha)	% of area in subsite occupied
		LT Mean	% counts recorded	LT Mean	% counts recorded			
Lissadell/ Ballygilgan Strand	0C424	14	50			95.6	13.79	14.4
Lower Rosses East	0C443			16.50	50	146.49	0	0
Doonierin*	0C444	4.75	75			261.96	12.31	4.7
Coolbeg*	0C448	11.5	100			88.15	0.71	0.8
Ballinaphunta*	0C449			26.25	25	57.71	3.54	6.1
Kintogher	0C450	3	50			48.79	0	0
Drumcliff Bay Outer: Ardtermon Strand	0C494	255.5	100	0.25	25	62.54	4.9	7.8
Drumcliff Bay Outer: Raghly Harbour	0C922	0.75	25			12.53	0	0
Cloghcor	0C931	14.5	25			84.62	0	0
Lissadell Strand	0C932	124.5	100	64.00	75	182.41	0	0

Note: * Subsites 0C444, 0C448 and 0C449 overlap with licence block T11/016 – the area of intertidal habitat impacted by licence area T11/016 was calculated separately with only the overlapping area for each subsite.

7.3 Table 7.1 also shows the percentage of the intertidal area of each sub-site occupied by aquaculture licence blocks. In particular sub-site 0C424 (Lissadell/Ballygilgan Strand) has over 14% by area affected directly by oyster trestles. This sub-site is important for Bar-tailed Godwit which shows a negative response to aquaculture.

Indirect effects of access routes

7.4 The designated access points to the aquaculture licence blocks are shown in Figure 7.1. In Drumcliff Bay SPA the access routes will be relatively short and will not affect additional sub-sites.

Species Accounts

Sanderling

Distribution within Drumcliff Bay

7.5 In the NPWS low tide surveys at Drumcliff Bay (undertaken in 2010 / 2011), Sanderling were recorded in five subsites: 0C425, 0C443, 0C449, 0C494 and 0C932; although 0C425 only recorded the species during the high tide surveys. 0C932 (Lissadell Strand) was clearly the favoured subsite supporting peak numbers in three low tide surveys and the subsite peak count of 188 Sanderling on 21/10/10 (refer to Figure 2.2 for site boundaries). However, it should be borne in mind that overall numbers of Sanderling recorded were low in the November, December and February low tide survey count window.

7.6 Sanderlings foraged intertidally across four subsites: 0C443, 0C449, 0C494 and 0C932. 0C932 (Lissadell Strand) supported peak numbers in three low tide surveys, generally foraging on the lower shore. This subsite is in the outer bay (west of the spit at the northern side of Rosses Point) and is dominated by sand (<70%) with an intertidal benthic community defined by 'fine sand with crustaceans and *Scolelepis squamata*.' As well as the aforementioned polychaete, the distinguishing species of this community are the crustaceans *Eurydice pulchra*, *Bathyporeia pelagica* and *Haustorius arenarius*; all of which could form prey species for Sanderling.

7.7 0C449 (Ballinaphunta) held good numbers (105) on one count on 21/10/10. This subsite is muddier in its upper shore reaches ('intertidal fine sand with *Peringia (Hydrobia) ulvae* and *Pygospio elegans*) but grades to sandier sediment classified as 'fine sand with crustaceans and *Scolelepis squamata*' on the lower shore.

7.8 As noted it should be borne in mind that overall numbers were low in the November, December and February low tide surveys and hence whole-season foraging patterns are not clear. Surveys undertaken at Cummeen Strand on the same dates as Drumcliff Bay indicate that Sanderling also regularly utilise the Cummeen Strand subsite (Code 0C466) for foraging; Sanderling is not, however, an SCI species for Cummeen Strand SPA.

7.9 Of the total of 174 Sanderlings recorded as foraging during the January 2011 high tide survey; over half were within 0C425 (Lower Rosses), 44 in 0C443 (Lower Rosses East) and smaller numbers in 0C449 (12) and 0C932 (27). 81 Sanderlings foraged during the February 2011 high tide survey; 72% of these birds were in 0C425 (Lower Rosses).

Association with aquaculture

7.10 The main overlap between Sanderling and licence blocks in Drumcliff Bay is therefore in OC449 (Ballinphunta) with a minor occurrence in OC494 (Ardtermon Strand); none of the other subsites used by this species is the subject of aquaculture.

7.11 In previous work, Gittings and O'Donoghue (2012) reported a negative association between Sanderling and intertidal oyster trestles. However, the data for Sanderling in this study was limited and the reported association was based on the position of Sanderling in ordination analyses, rather than the more detailed analyses of species distribution that were possible for some other species. Nevertheless, in the extensive study component of Gittings and O'Donoghue (2012), a total of 524 Sanderling were recorded on 14 counts across four sites and there were only two records, each of single birds, within areas of oyster trestles.

7.12 It is assumed that the responses of Sanderling to clam cultivation would also be negative, given that they would be unable to feed beneath the netting, but we are not aware of any published supporting information for this. As part of the Appropriate Assessment of aquaculture in

Castlemaine Harbour SPA, Atkins undertook a limited survey of shorebirds around an existing clam parc in Rossbehy, Glenbeigh, Co. Kerry between January and March, 2011. This was restricted to three counts (in which spatial distribution of birds was considered) in February & March 2011; together with some additional bird data from a further site visit in January 2011 During these counts Sanderling were never recorded within the clam beds; on two of the count days they were observed to feed up to within a few metres of the edge of the clam beds, but they did not move inside them.

Responses to disturbance

7.13 The NPWS Conservation Objectives Supporting Document for Drumcliff Bay SPA (NPWS, 2013b) reports that aquaculture activities were the second most widespread activity (five subsites) and accounted for the peak disturbance score in two subsites in Drumcliff Bay. The disturbance was related to machinery and, in particular, tractors accessing the intertidal area to tend to trestles. NPWS noted that several tractors can be operating at the same time. In all cases these activities resulted in a noticeable disturbance to waterbirds. It should be noted, however, that access at Ardtermon Strand would be by boat from Raghly Point.

7.14 There is an extensive literature on disturbance to shorebirds along sandy beaches. Burger and Gochfield (1991) found over three years that there were significant negative correlations between time devoted to feeding and the time Sanderlings flew or ran because of people and the number of people within 10 and 100 metres of the foraging birds. Burger *et al.* (2007) studied the effects of disturbance on a number of wader species, including Sanderling, in Delaware Bay, USA. They found that some waders began returning to the beach within a minute of when a human intruder was on the beach; however, only about 20% of the Sanderlings returned at 10 minutes. The most extreme response of Sanderlings was to the presence of dogs. This species did not return within 10 minutes of the departure of a dog from the beach. The Sanderling showed a steady response to all levels of disturbance.

7.15 Field observations by Thomas *et al.* (2003) show that number of people, type of activity, free running dogs and proximity of people can significantly reduce the time that Sanderlings spend consuming prey. These four variables also had a statistically significant effect on the distances that Sanderlings moved and the type of response that Sanderling had to the approaching humans. Pfister *et al.* (1992) found that at a migration staging area Sanderling numbers were reduced by around 50% when disturbance levels increased from low to high.

7.16 It is not clear, however, as to whether the findings of these studies are directly applicable. The disturbance impact of dogs is clearly established; as such it will be a condition of any licence that operators may not bring dogs onto the foreshore. However, regular maintenance of trestles differs in that people are working in a consistent and repeated fashion within the oyster trestles – rather than walking towards Sanderling flocks as is the case in many of the beach disturbance studies. The role of habituation to maintenance disturbance must therefore also be considered.

7.17 The level of maintenance of clam nets is significantly less that than required for oysters and much of the cleaning work is done from a tractor; ageing habituation to tractors working on the foreshore is a consideration.

Impact assessment

7.18 Considering only the sub-sites that held Sanderling in the 2010 / 2011 NPWS low tide surveys a total of 8.44ha of the intertidal area in these sub-sites will be occupied by licence blocks (Table 7.2). The main impacts will occur in the sub-sites 0C449 (Ballinaphunta) and 0C494 (Ardtermon Strand). Disturbance during aquaculture operations may also prevent Sanderling from feeding in additional areas around the licence blocks; though as noted the Oyster Study (Gittings and O'Donoghue, 2012) considered maintenance disturbance within its experimental model.

Table 7.2 - Subsites holding Sanderling at low tide in Drumcliff Bay SPA.

Subsite	Sub-site code	LT Mean	Peak Count	% counts recorded	Total intertidal area in sub-site (ha)	Total area occupied by licence blocks (ha)	% of intertidal occupied by licence blocks
Lower Rosses East	0C443	16.50	65	50	146.49	0	0
Ballinaphunta*	0C449	26.25	105	25	57.71	3.54	6.1
Drumcliff Bay Outer: Ardtermon Strand	0C494	0.25	1	25	62.54	4.90	7.8
Lissadell Strand	0C932	64.00	188	75	182.41	0	0
Total					**266.74**	**8.44**	

Bar-tailed Godwit

Distribution within Drumcliff Bay

7.19 In the NPWS low tide waterbird surveys, Bar-tailed Godwits were recorded within nine subsites overall (0C424, 0C444, 0C448, 0C449, 0C450, 0C494, 0C922, 0C931 and 0C932) (see Figure 2.2 for subsite locations). 0C448 (Coolbeg) and 0C494 (Drumcliff Bay Outer: Ardtermon Strand) held the species in all four low tide surveys.

7.20 Peak numbers were recorded for 0C494 (Drumcliff Bay Outer: Ardtermon Strand), 0C932 (Lissadell Strand), 0C449 (Ballinaphunta) for the four low tide surveys, respectively. The subsite peak count was 790 individuals recorded for 0C494 (Drumcliff Bay Outer: Ardtermon Strand) on 02/02/11.

7.21 Bar-tailed Godwits were recorded foraging within eight subsites overall (0C424, 0C444, 0C448, 0C449, 0C450, 0C494, 0C931 and 0C932). Peak numbers foraging intertidally were recorded for 0C494 (Drumcliff Bay Outer: Ardtermon Strand), 0C932 (Lissadell Strand), 0C449 (Ballinaphunta) for the four low tide surveys respectively. 0C494 (Drumcliff Bay Outer: Ardtermon Strand) was notable for supporting numbers always ranked first or second highest; while 0C932 (Lissadell Strand) always supported numbers ranked in the top three subsites. These subsites are in the outer bay (west of the spit at Rosses Point) and are dominated by sand (<70%) with an intertidal benthic community defined by 'fine sand with crustaceans and *Scolelepis squamata*.' The distinguishing species of this community are the crustaceans *Eurydice pulchra*, *Bathyporeia pelagica* and *Haustorius arenarius* and the polychaete *Scolelepis squamata*. 0C494 (Drumcliff Bay Outer: Ardtermon Strand) is in part classified as 'intertidal fine sand with *Peringia (Hydrobia) ulvae* and *Pygospio elegans*' and supports potential prey species of Bar-tailed Godwits such as polychaetes *Arenicola marina* and *Lanice conchilega*. Of note were 870 Knot that were foraging with Bar-tailed Godwits in 0C494 on 02/02/11. In the count on 22/11/10, 408 Bar-tailed Godwits foraged in 0C932. These birds foraged on the lower shore as part of a loose flock that also comprised 582 Knot and 44 Sanderling, amongst other species.

7.22 Good numbers of foraging Bar-tailed Godwits were also recorded at Cummeen Strand, surveyed on the same dates as Drumcliff Bay; Bar-tailed Godwit is not, however, an SCI species for Cummeen Strand SPA. The areas Ballincar – Ballyweelin, Cummeen Strand and Cummeen west from Coney Island Road were used regularly. Of note were 275 Bar-tailed Godwits foraging within the Ballincar – Ballyweelin area during the high tide survey on 27/01/11. 135 individuals foraged within Cummeen Strand (subsite) during the October 2010 low tide survey, more than the total number recorded across the Drumcliff bay survey area on the same day. It is clear therefore that this species ranges across both Drumcliff Bay SPA and Cummeen Strand SPA

7.23 The highest intertidal foraging density recorded for a single subsite was 5.3 Bar-tailed Godwits ha^{-1} (0C494: Drumcliff Bay Outer: Ardtermon Strand). Only two other subsites (0C449 and 0C932) recorded densities greater than 1 Bar-tailed Godwits ha^{-1}. The whole site mean feeding density (intertidal habitat) was 0.5 Bar-tailed Godwits ha^{-1}.

7.24 During low tide surveys, Bar-tailed Godwits were rarely recorded roosting intertidally; single observations recorded for 0C424, 0C444, 0C448 and 0C922. No roosting was recorded during the January 2011 high tide survey. 228 Bar-tailed Godwits roosted intertidally during the high tide survey on 11/02/11; 180 in 0C450 (Kintogher) and 48 in 0C449 (Ballinaphunta). A further 87 roosted supratidally in 0C424 (Lissadell/Ballygilgan Strand); all inner bay subsites.

7.25 Roosting individuals were recorded from three subsites during the roost survey (30/11/10) the largest roosts recorded in 0C424 (flocks of 230 and 150 birds) that were positioned on the upper shore of Ballygilgan Strand. 0C922 and 0C931 recorded six and two individuals, respectively.

7.26 The main overlap between foraging Bar-tailed Godwit at low tide and aquaculture licence blocks in Drumcliff Bay is in three sub-sites: OC449 (Ballinphunta), OC494 (Ardtermon Strand) and OC424 (Lissadell/Ballygilgan Strand). None of the other subsites used by this species is the subject of aquaculture.

Association with aquaculture

7.27 Gittings and O'Donoghue (2012) reported that in 14 of a total of 17 counts, observed numbers within the oyster trestle blocks were lower than the predicted numbers. In the intensive study, mean densities were much higher in the lateral zone containing the tideline, compared to zones above the tideline and, in this zone, were around twice as high outside the trestle blocks compared to within the trestle blocks and this difference was significant ($F_{1,11} = 9.79$, $p = 0.001$). During the intensive study counts in this study in Dungarvan Bay, 15 incidences of disturbance impacts to waterbirds were observed, of which 11 were caused by tractors moving to/from or within the trestle bocks, one was caused by a dog following the tractors, two were caused by horses and one was caused by a Merlin (*Falco columbarius*).

7.28 It is assumed that the responses of Bar-tailed Godwit to clam cultivation would also be negative, given that they would be unable to feed beneath the netting, but there appears to be no supporting published information on the association of Bar-tailed Godwit and clam farming. Bar-tailed Godwit was not recorded in the Rossbehy clam site referred to above. A conservative assessment of total exclusion is therefore adopted.

Responses of foraging birds to disturbance

7.29 There are very little data available on the tolerance of foraging Bar-tailed Godwit to disturbance in intertidal areas. Smit and Visser (1993) reported mean flight initiation distances of 219m (range 150-225m) when approached by people walking over the tidal flats on the Dutch Wadden Sea. In the Delta area this was reduced to a mean distance of 107m (range 88-127m). The behaviour of the people was also significant as bait diggers working at the same spot for longer periods (similar to workers at oyster trestles) were tolerated at shorter distances than a walking person. However, as noted above for Sanderling these studies tended to consider people walking directly at feeding flocks of birds; rather than the consistent pattern of activity within the trestles to which birds may habituate.

7.30 Townsend and O'Connor (1993) studied the effects of bait-digging at Lindisfarne, north-east England on various wader and wildfowl species. In years when bait-digging was permitted on all parts of the study bay numbers of Bar-tailed Godwit were substantially lower (76-90%) than in years when no bait-digging occurred. It was assumed that the majority of the birds were prevented from feeding here by the presence of bait-diggers. Dias *et al.* (2008) studied the effects

of bait-digging and traditional shellfish gathering in waders in the Tagus Estuary, Portugal. They calculated that where the disturbers were present at a density of 0.01 per 10ha of foraging area then Bar-tailed Godwit were disturbed from a mean area of 0.6% (0.2-1.4%) of their available foraging area. They concluded that traditional shellfishing has much more potential to affect waders through disturbance than through the removal of prey. Care must be taken, however, when extrapolating from these studies as bait-digging and traditional shellfish gathering often involves gatherers widely dispersed through the estuary – resulting in a disproportionately high level of disturbance (per obs Ballycotton Bay, Co. Cork).

7.31 Recent observations from the trestle farm in Dungarvan would suggest that habituation may also play an important role; a flock of over 400 Bar-tailed Godwits feeding along the tideline below the trestles on-site (19th February 2014; T. Gittings per obs) were not flushed by passing tractor traffic; birds responded briefly to the presence of the tractor before resuming feeding. The above would suggest that foraging Bar-tailed Godwit can habituate to oyster maintenance activities in a specific fashion. As for Sanderling, however, dogs on site result in a significant negative impact; as noted it will therefore be a condition of any licence that operators may not bring dogs onto the shore.

Impact assessment

7.32 Considering only those subsites where Bar-tailed Godwit was recorded during the low tide surveys, 31.71ha of the total intertidal area would be occupied by aquaculture licence blocks (Table 7.3). The biggest impacts will be in sub-site 0C424 (Lissadell/Ballygilgan Strand) and 0C494 (Ardtermon Strand) with 14.4% and 7.8% respectively of the intertidal area in these subsites being affected.

Table 7.3. Subsites holding Bar-tailed Godwit at low tide in Drumcliff Bay SPA.

Subsite	Sub-site code	LT Mean	Peak Count	% counts recorded	Total intertidal area in sub-site (ha)	Total area occupied by licence blocks (ha)	% of intertidal occupied by licence blocks
Lissadell/Ballygilgan Strand	0C424	14	5.	50	95.6	13.79	14.4
Doonierin*	0C444	4.75	15	75	261.96	12.31	4.7
Coolbeg*	0C448	11.5	22	100	88.15	0.71	0.8
Kintogher	0C450	3	9	50	48.79	0	0.0
Drumcliff Bay Outer: Ardtermon Strand	0C494	255.5	790	100	62.54	4.9	7.8
Drumcliff Bay Outer: Raghly Harbour	0C922	0.75	3	25	12.53	0	0.0
Cloghcor	0C931	14.5	58	25	84.62	0	0.0
Lissadell Strand	0C932	124.50	408	100	182.41	0	0
Total					**654.19**	**31.71**	

7.33 Disturbance during aquaculture operations may also prevent Bar-tailed Godwit from feeding in additional areas around the licence blocks; though as noted the Oyster Study (Gittings and O'Donoghue, 2012) considered maintenance disturbance within its experimental model.

Impact of habitat loss on SCI populations within the SPA

7.34 To recap, the methodology proposed by Gittings and O'Donoghue uses the following methodology to assess potential population level impacts of displacement within the SPA. Impacts have been assessed as potentially having a significant negative impact on attribute 1 of the conservation objectives (the species' long-term population trend), if they are predicted to cause: -

- Displacement of 25% or more of the Drumcliff Bay SPA and Cummeen Strand SPA total; or
- Significant displacement levels (i.e., 5% or greater) that combined with current long-term population trends, could result in a long-term population decline of 25%; or
- Significant displacement levels (i.e., 5% or greater) where the current long-term population decline is already equal to or greater than 25%.

7.35 This criterion has been used in Appropriate Assessments in e.g. Castlemaine Harbour and Dundalk Bay (Marine Institute, 2011a, b) and has been accepted by NPWS in the context of those assessments. The rationale behind this criterion is discussed in those Appropriate Assessments and in sections 2.56 to 2.61 of this report. It should be noted that this is a 'predictive' measure based upon spatial overlap between aquaculture plots and suitable habitat for given SCIs; coupled with an assessment of the relative importance of different areas for a given SCI.

7.36 The population trends and status of both Sanderling and Bar-tailed Godwit are presented in Table 5.1; NPWS (2013b) indicated a declining Sanderling population (-59) and an increasing Bar-tailed Godwit population (+36); however the accuracy of the Sanderling trend is discussed in detail in Chapter 5.0. Both SCIs for Drumcliff Bay, Sanderling and Bar-tailed Godwit, have been shown to display a negative response to areas occupied by oyster trestles. In addition, both species are relatively sensitive to disturbance.

7.37 In order to assess the potential impact at an SPA population level the 4 no. low tide NPWS baseline waterbird survey counts were converted to a low tide mean (and standard deviation to assess count variability) across each subsite used by each SCI; these were in turn converted to a % of the SPA population using a given subsite (thereby giving a sense of the relative importance of different parts of the SPA for each SCI). The % of suitable intertidal habitat within each subsite that would be lost to aquaculture was then calculated – in order to adopt a very conservative approach we assumed total occupation of aquaculture plots and therefore total displacement of SCIs from these habitats (this allows for the lack of extensive data on the relationship between shorebirds and clam parcs to be allowed for; and also keeps open the possibility of farming oyster and / or clams at some sites). Finally, using these estimates of spatial distribution of the SPA population and habitat loss we were able to estimate the % of the SPA population of each SCI that would be impacted by aquaculture within each subsite and across the SPA as a whole (see Table 7.5).

Bar-tailed Godwit

7.38 The overall summary in Table 7.5 shows that licences for oyster trestles in Ardtermon Strand (sub-site 0C494) are predicted to cause a displacement of 4.66% of the overall site population of Bar-tailed Godwit. This is a conservative estimate as the oyster trestles are likely to be aligned parallel to the low water tide mark and they will therefore not occupy the entire licence area. Most of the trestles will only be exposed on low spring tides. Bar-tailed Godwit habitually follow the rising and falling tide line when foraging so they are likely only to be displaced from the area around the oyster trestles when these are exposed during the period around low tide. At other times they are likely to forage higher up the shore.

7.39 The population trends in Drumcliff Bay SPA are positive for Bar-tailed Godwit (+36; compared to +35 nationally; see Table 5.1). However, the variability in IWeBS coverage (counts per winter, months of coverage and years with no data) does not allow confidence in patterns of site usage for this species in Drumcliff Bay. Table 7.5 therefore also includes an estimate of displacement using the maximum count from each subsite. For example while the average count at Ardtermon (0C494) was 255.5 birds; the peak count was 790. This level of site usage would result in a population displacement of up to 6.3% of the SPA population of Bar-tailed Godwits.

Table 7.5 - Overall displacement of Bar-tailed Godwit by subsite in Drumcliff Bay SPA.

Subsite	Subsite code	Based on mean of LT counts		Based on maximum occurrence in LT counts	
		Oyster trestles sites	Oysters and clams	Oyster trestles only	Oysters and clams
Lissadell/Ballygilgan Strand	0C424	0%	0.47%	0%	0.78%
Doonierin	0C444	0%	0.05%	0%	0.83%
Coolbeg	0C448	0%	0.02%	0%	0.12%
Ballinaphunta	0C449	0%	0%	0%	0%
Kintogher	0C450	0%	0%	0%	0%
Drumcliff Bay Outer: Ardtermon Strand	0C494	4.66%	0%	6.3%	0%
Drumcliff Bay Outer: Raghly Harbour	0C922	0%	0%	0%	0%
Cloghcor	0C931	0%	0%	0%	0%
Lissadell Strand	0C932	0%	0%	0%	0%
Total		**4.66%**	**0.54%**	**6.3%**	**1.73%**

7.40 The potential for displacement of Bar-tailed Godwit from Ardtermon Strand at 4.66% to 6.3% is close to the 5%; this however is significantly less than the 25% threshold noted in paragraph 7.43, above. As noted the population is increasing; thus any displacement at Ardtermon would not add to an already declining population trend. Some caution must, however, be excercised in assessing impacts at Ardtermon as the assessment is based on a relatively restricted data set (4 no. NPWS low tide counts from 2010 / 2011). For example the peak count of 790 birds recorded at Ardtermon indicates the potential for displacement of up to 6.3% of the SPA population. Total displacement would be between 5.2% (based on mean count values) and 8.03% (based upon maximum counts).

7.41 We understand that NPWS (pers comm.) have recently undertaken further low tide work in the Bay (this was not available at the time of writing); we would, however, recommend that this be reviewed to recheck the above findings. If these data do not provide the necessary insight we would recommend that further monitoring of the low tide use of the key Bar-tailed Godwit sites within the SPA by this SCI should be undertaken in order to fully assess the potential for negative impacts at Ardtermon.

7.42 No significant impacts are predicted for any of the other licence application blocks for this species in Drumcliff Bay SPA.

Sanderling

7.43 The overall summary in Table 7.6 shows that the maximum predicted displacement of Sanderling would be 1.5% of the overall site population due to Oysters and/or Clams in the Ballinaphunta area (sub-site 0C449); increasing to 1.8% when using peak counts. This is well below the 5%

threshold for a significant impact on this SCI. While the NPWS low tide counts did not record Sanderling from Ardtermon, NPWS (T. Roderick, pers comm.) noted that Sanderling do use this site; suitable intertidal habitat certainly occurs at this site.

Table 7.6 - Overall displacement of Sanderling by subsite in Drumcliff Bay SPA.

Subsite	Subsite code	Based on mean of LT counts		Based on maximum occurrence in LT counts	
		Oyster trestles only	Oysters and clams	Oyster trestles only	Oysters and clams
Lower Rosses	0C425	0%	0%	0%	0%
Lower Rosses East	0C443	0%	0%	0%	0%
Ballinaphunta	0C449	0%	1.5%	0%	1.8%
Drumcliff Bay Outer: Ardtermon Strand	0C494	0%	0%	0%	0%
Lissadell Strand	0C932	0%	0%	0%	0%
Total		**0%**	**1.5%**	**0%**	**1.8%**

7.44 No significant impacts are predicted for any of the other licence application blocks for this species in Drumcliff Bay SPA.

7.45 While the population trends in Drumcliff Bay SPA are negative for Sanderling (-59; compared to +125 nationally); as discussed above the low number / variability in timing of early IWeBS coverage (counts per winter, months of coverage and years with no data) does not allow confidence in the trends for this species in Drumcliff Bay. In recent years counts have been more frequent; with a strong correlation between the number of counts and the number of Sanderling recorded (see paragraph 5.4); and a pattern of increasing numbers in the last 5 year period. Thus the predicted level of impact (<2%) is unlikely to have a significant impact on Sanderling at Drumcliff Bay SPA. It is, however, recommended that Sanderling be counted at the sites above noted as supporting Bar-tailed Godwit; notably at Ardtermon.

Barnacle Goose

7.46 As noted above Barnacle Goose is not an SCI for Drumcliff Bay SPA or Cummeen Strand SPA. It is, however, an SCI for Ballintemple / Ballygilgan SPA (004234), Inishmurray SPA (004068) and Ardboline Island / Horse Island SPA (004135). Birds feeding at Ballintemple / Ballygilgan SPA are known to roost on Inishmurray. The degree of interchange between these sites and Ardboline Island / Horse Island SPA is less clearly understood; but it is believed that birds using all three sites are part of the same flock (NPWS pers comm.).

7.47 Barnacle Goose is a winter visitor to Ireland; the bulk of the population feeds on agricultural land feeding on reseeded grassland and does not use habitats to either roost or feed that might be impacted by the proposed aquaculture activities. Barnacle Geese wintering in Ireland are from the Greenland breeding population and are largely found on islands off the west and northwest coast between Donegal and Galway, with a number of additional isolated flocks further south (Crowe *et al*., 2014). Offshore sites (i.e. Inishmurray SPA & Ardboline Island / Horse Island SPA) used by birds to feed and / or roost in Co. Sligo will not be directly impacted or subject to disturbance by the proposed activities.

7.48 Crowe *et al*. (2014) report on the results of a 2013 national census of Barnacle Geese. Sites in Co. Sligo, together with associated counts are shown in Table 7.4. As noted islands such as Inishmurray appear to be used more as night-time roost rather than feeding sites (unlike e.g. the Inishkea Islands in Co. Mayo which support notable counts of feeding birds).

Table 7.4 – Barnacle Geese numbers (2013); from Appendix 1 of Crowe *et al*., 2014.

Site	County	SPA	Count
Lissadell goose field (G645435)	Co. Sligo	Ballintemple & Ballygilgan SPA	-
Kilmacannon (Drumcliff) (G590440)	Co. Sligo	Ballintemple & Ballygilgan SPA	205
Ballintemple (G570440)	Co. Sligo	Ballintemple & Ballygilgan SPA	4,140
Ardboline (G5544)	Co. Sligo	Ardboline Is / Horse Is SPA	-
Streedagh Estuary (G6507100	Co. Sligo	n/a	246
Inishmurray (G570540)	Co. Sligo	Inishmurray SPA	17
		Subtotal	**4608**

7.49 Flyway threshold for international importance is 890 birds; 175 for national importance (Mitchell Hall, 2013; quoted in Crowe *et al*., 2014). On this basis the Ballintemple flock is clearly of international importance (4,140 birds); it has shown a 5.3% increase since 2008, making it the most important site in Ireland. Together with the Inishkea Islands, Co. Mayo (2,250 birds in 2013), these two flocks support a significant proportion of the national count (37%; quoted from Crowe *et al*., 2014). Overall, the national population was 17,500 birds (22% of the flyway population and up 43% since 2008). The Co. Sligo population clearly appears to be healthy; we understand that due to recent increase in numbers large flocks tend to now occur at Ballintemple rather than in the *goose field* at Ballygilgan. The site at Streedagh is located west of Grange (off the N15 national primary road); it does not lie within an SPA.

Impact Assessment

7.50 A number of aquaculture sites are, however, directly relevant because of their proximity to Ballintemple / Ballygilgan SPA (004234). One at Ardtermon (T11/085), close to Raghly Point, is located close to the westernmost of the two discrete blocks which make up this SPA (i.e. in the townlands of Ballintemple, Kilmacannon & Ballymudorry). However, it is separated from the SPA

by a local access road and roadside housing which screen any activities on-site from feeding geese and which would present a greater level of ongoing disturbance than shore based aquaculture activities. As noted above large flocks of Barnacle Geese routinely use Ballintemple; with evidence for less usage currently of the *goose field* at Ballygilgan, Lissadell. It is not anticipated that aquaculture activities at Ardtermon (T11/085A) would negatively impact on Barnacle Geese.

7.51 The second area at Ballygilgan Strand (i.e. the Lissadell goose field) adjoins an existing licence T11/025A (for oyster and clams; currently farming oysters) as well as a new application - T11/076A-C - for a landward expansion of the existing licence area and is for the cultivation of oyster or clam. On occasions, when there is disturbance on the fields covered by the SPA, the entire flock of geese move to the adjacent intertidal area as a refuge (M. Enright, D. Cabot, per comm). NPWS have confirmed that disturbance to geese using Ballygilgan *goose field* is a concern (T. Roderick, pers comm.). While, as noted operations at this site are subject to an industry agreed *Code of Practice* (Anon, n/a); this document is now old and in need of updating in consultation with NPWS. (NPWS were not aware of the existence of the Code of Practice).

7.52 While detailed evidence on patterns of site use of the Lissadell goose field are not available; given the continued increase in the Sligo flock; it would appear that current levels of aquaculture activity are not negatively impacting on Barnacle Geese numbers using the complex of Ballintemple / Ballygilgan SPA (004234), Inishmurray SPA (004068) and Ardboline Island / Horse Island SPA (004135). However, we understand from NPWS that the Ballygilgan *goose field* is to be subject of a targeted management plan in order to encourage greater use of the site by Barnacle Geese (T. Roderick, pers comm.). Intensification of activities and / or landward expansion of activities are therefore a concern if they were to result in increased levels of disturbance and displacement.

7.53 In order to allow ongoing aquaculture activities at this location, firstly the Code of Practice should be revisited by the Industry, BIM and NPWS to ensure any practices licenced do not result in disturbance impacts on Barnacle Geese using Ballintemple / Ballygilgan SPA and that aquaculture activities are considered as part of overall site management. Furthermore, numbers using both the Ballintemple subsite and Lissadell (Ballygilgan) subsite should be monitored for any signs of disturbance and / or displacement by onshore aquaculture activities.

7.54 To fully understand movements between Ballintemple and Ballygilgan most likely also required a clearer understanding of the wider population of Barnacle Geese using the complex of Ballintemple / Ballygilgan SPA (004234), Inishmurray SPA (004068) and Ardboline Island / Horse Island SPA (004135); this, however, is outside the scope of this Appropriate Assessment.

8. Impact assessment – Cummeen Strand SPA

Screening

8.1 The trestle study (Gittings and O'Donoghue, 2012) concluded that Oystercatcher, Redshank and Light-bellied Brent Geese show a neutral/positive response to oyster trestles. Therefore, these species can be screened out from further assessment. However, it is less clear as to how they may be impacted by a reversion to clam farming. Due to the limited data available on the association of the Oystercatcher, Redshank and Light-bellied Brent Geese a conservation approach has been adopted of assessing total exclusion from these plots.

8.2 With respect to clams; as noted above, as part of the Appropriate Assessment of aquaculture in Castlemaine Harbour SPA, Atkins undertook a limited survey of shorebirds around an existing clam parc in Rossbehy, Glenbeigh, Co. Kerry between January and March, 2011. This was restricted to three counts (in which spatial distribution of birds was considered) in February & March 2011; together with some additional bird data from a further site visit in January 2011. During these counts Oystercatcher were widely distributed throughout the study area and did occur within the clam beds; on one of the survey dates a large flock of Light-bellied Brent Geese were also recorded moving through the clam bed on the falling tide. Brent Geese are likely to forage on macroalgae growing on the netting and during site visits goose droppings were observed in and around the clam beds. Redshank was also noted in small numbers feeding in the clam beds on the ebbing and / or flooding tides.

Displacement

8.3 Birds will be generally displaced from the areas covered by the aquaculture licence blocks, notwithstanding the fact that some individuals may forage between the oyster trestles or within the clam parcs. Table 8.1 gives the average numbers of each of the SCIs recorded by sub-site at low tide in the surveys in 2010-11. Aquaculture licences are concentrated in five of these sub-sites and all three SCI are regularly present in these sub-sites.

Table 8.1 - Distribution of SCIs by sub-site containing aquaculture licences in Cummeen Strand SPA (based on NPWS low tide surveys 2010-11 only).

Cummeen Strand SPA Subsite	Sub-site code	Pale-bellied Brent Goose		Oystercatcher		Redshank		Total intertidal area in sub-site	Total intertidal area occupied by licence blocks	% of intertidal occupied by licence blocks
		LT Mean	% counts recorded	LT Mean	% counts recorded	LT Mean	% counts recorded			
Ballincar - Ballyweelin	0C445	42	100	176	100	73	100	104.35	0.95	0.9
Cartron to Standalone Pt.	0C446	32	50	3	75	55	100	59.65	0	0.0
Coney Island Rd. - Dorrins Strand East	0C462	3	50	5	75	10	75	192.73	9.74	5.1
Killaspug Pt - Dorrins Strand West	0C463	68	75	29	100	12	100	100.4	0.41	0.4
Cummeen Strand	0C466	211	100	271	100	197	100	570.05	64.74	11.4
Cummeen west from Coney Island Road	0C478	51	100	173	100	5	50	299.3	11.18	3.7
Total								**1326.48**	**87.02**	

Species Accounts

Light-bellied Brent Geese

Distribution within Cummeen Strand SPA

8.4 Light-bellied Brent Geese are grazers and are known for their preference for foraging in intertidal areas containing the eelgrass *Zostera* sp. (Robinson *et al*. 2004). Where this food source is absent or becomes depleted, the birds feed upon algae species, saltmarsh plants and may also undertake terrestrial grazing. *Zostera* sp. is not currently known at Cummeen Strand; a previously known bed along the southern shore of Cummeen Strand was not recorded during recent sampling (ASU, 2012). Green algae (*Ulvae* spp.) are widespread across tidal flats and are likely to form a major part of the Light-bellied Brent Goose diet (see Figure 5.8 for distribution of *Zostera* and green algae).

8.5 Across the NPWS low-tide survey period Light-bellied Brent Geese were recorded foraging intertidally across a total of seven subsites and most regularly (three low tide surveys or more) within four subsites: 0C466 (Cummeen Strand), 0C478 (Cummeen west from Coney Island Road), 0C482 (Coney Island) and 0C485 (Rosses Point Harbour). 0C482 (Coney Island) held peak intertidal numbers in the latter three low tide surveys with a maximum number of 90 individuals on 22/11/10. 0C466 (Cummeen Strand) held peak numbers on 21/10/10 (306); that included a flock of 243 individuals that foraged along the southern shore of the subsite and several other smaller flocks. A further 239 individuals foraged subtidally 0C466 (Cummeen Strand) was notable for supporting numbers ranked in the top four in all low tide surveys. 0C485 (Rosses Point Harbour) held good numbers on three occasions.

8.6 Subtidal foraging was widespread (eight subsites). Peak numbers were held by 0C466 (Cummeen Strand), 0C485 (Rosses Point Harbour) and 0C463 (Killaspug Pt - Dorrins Strand West). 0C445 (Ballincar – Ballyweelin) held good numbers regularly. Intertidal foraging was recorded during the January 2011 high tide survey; 244 individuals across five subsites. 57% were within 0C462 (Coney Island Rd. - Dorrins Strand East). A further 175 foraged subtidally in 0C462, while 195 foraged subtidally just to the west in 0C463 (Killaspug Pt - Dorrins Strand West). These two outer bay subsites were clearly favoured at this time.

8.7 Terrestrial foraging was recorded in areas adjacent to the SPA and this is likely to occur regularly. 52 Brent foraged in grassland adjacent 0C463 (Killaspug Pt - Dorrins Strand West) on 02/02/11. Areas adjacent (east) of 0C446 (Cartron to Standalone Pt.) held good numbers foraging terrestrially during both high tide surveys (maximum number 111). The area occupied by aquaculture licence blocks will cover up to 6.6% of the intertidal area in those sub-sites used regularly by Light-bellied Brent Geese (Table 8.1).

Associations with aquaculture

8.8 Light-bellied Brent Geese occur regularly in all five sub-sites that are the subject of aquaculture licences (0C445, 0C462, 0C463, 0C466 and 0C478). Subsite 0C466 (Cummeen Strand) is of particular importance for both intertidal and sub-tidal foraging by this species. This is also the sub-site with the widest distribution of proposed aquaculture licences.

8.9 In the study by Gittings and O'Donoghue (2012), comparisons of observed and predicted numbers of Brent Geese in the oyster trestle areas showed a wide scatter of data without consistent trends across sites. At Dungarvan Harbour and Waterford Harbour, observed numbers within the oyster trestle blocks were broadly in line with predicted numbers. At Bannow Bay and in the majority of counts at Ballymacoda Bay, observed numbers within the trestle blocks were lower than the predicted numbers. However, on the two counts at Ballymacoda Bay on the third

count day, observed numbers were higher than predicted numbers. On this count day, the tideline remained in the upper section of the trestles throughout the low tide period and there were no husbandry activities in the oyster trestles.

8.10 As the tide rose most birds would typically be swimming parallel to the tideline in a depth of water such that the tops of the trestles were just emerging from the water. They would feed by dabbling in the water, and as they encountered trestles, part of the flock would climb onto the trestles and feed on the trestles before moving on (Gittings and O'Donoghue, 2012). Since completion of this survey, observations of Light-bellied Brent Geese show them frequently feeding on green algae growing on oyster trestles. The study by Gittings and O'Donoghue (2012) by focusing on low tide observations (to target waders and wildfowl) may have underestimated the use of trestles by foraging Light-bellied Brent Geese when these are only just covered by the rising or falling tide.

Responses to disturbance

8.11 Light-bellied Brent Geese are quite variable in their responses to human disturbance. Riddington *et al.* (1996) studied disturbance factors along a stretch of the north Norfolk coast that caused Brent Geese to take flight. Patterns of activity and undisturbed flight were also quantified, to derive energy budgets. The most frequent source of disturbance was pedestrians. Activity budgets for high-disturbance and low-disturbance days were compared, which showed that birds feed less and are more vigilant when disturbance is greater. On grass pastures, 68.9% of flight was a response to disturbance, which increased estimated hourly energy expenditure (HEE) from 32.2 to 35.6 J/h (10.8%). On exceptionally disturbed days, HEE increased to more than 44.0 J/h. As a consequence of disturbance, geese may need to feed at night for up to an hour in mid-winter, to balance their daily energy budget. Unless they are able to feed easily at night, disturbance may be one of the primary factors influencing local distribution of Light-bellied Brent Geese.

8.12 Phalan and Nairn (2007), studying disturbance in South Dublin Bay, found an average of 0.58 disturbances per individual per hour in Light –bellied Brent Goose, but this was the species that lost most feeding time due to disturbance. Almost 1.5% of the time during the period of observation of an average Light –bellied Brent Goose was spent in flight following a disturbance event (1.3% following anthropogenic disturbance, i.e. excluding disturbance from birds of prey). This was probably because Light –bellied Brent Goose tend to feed together in large flocks and react in unison. Owen (1977) found that disturbance prevented geese from feeding for an average of 3%-5% of their time in a number of estuarine areas in southern England. A significantly greater amount of feeding time was lost per disturbing incident in the six hours around high tide than in the six hours around low tide due to the absence of alternative areas at high tide.

8.13 Mathers *et al.* (2000) found that Light –bellied Brent Geese in Strangford Lough were negatively affected by human activity, but they were less adversely affected than Wigeon. This is probably due to the interspecific differences which allow Brent Geese a greater ability to compensate for negative impacts. These include the feeding methods that Brent Geese employ which allows them to extract a nutritionally superior diet from eelgrass *Zostera* in terms of quality and quantity; they can feed for longer periods within each tidal cycle and because they have a greater tendency to habituate to regular disturbance.

8.14 Light –bellied Brent Geese have demonstrated the ability to habituate to non-threatening disturbance such as walkers on sandflats in Dublin Bay and in parkland in Dublin City. The activity of workers and vehicles servicing oyster trestles is predictable and generally non-threatening and the geese are likely to habituate rapidly to this except where it directly affects a limited area of their preferred food (e.g. *Zostera*). However, disturbance may, on occasions, cause a reduction in feeding time by the geese.

Impact Assessment

8.15 Light–bellied Brent Geese forage widely in the sub-sites occupied by licence blocks. Subsite 0C466 (Cummeen Strand) is of particular importance for both intertidal and sub-tidal foraging by this species. This is also the sub-site with the widest distribution of proposed aquaculture licences. The population trend at Cummeen Strand SPA is one of significant increase (+116; this is significantly higher than the national trend of +62.3)

8.16 Data from elsewhere suggests that Light–bellied Brent Geese show no consistent relationship with oyster trestles and this may depend on the characteristics of the particular site; e.g. maintenance works etc. For example, if the area of trestles has a high density of green algae this may attract the geese to feed there. They have been observed to feed on the trestles in Dungarvan Bay (Gittings and O'Donoghue 2012). Light–bellied Brent Geese are quite variable in their responses to human disturbance. Again, this may depend on the characteristics of the particular site, and whether their preferred food resources, *Zostera* or green algae, occur in the area where the disturbance occurs. Given that oyster bags are often covered in green algae, this is likely to be a source of food for the geese and they may then be excluded from the area of the trestles during maintenance work; however, such work tends to be isolated to a small area of the trestles at any one point in time allowing geese to avoid the workers. However, geese may habituate to such disturbance and are likely to tolerate workers at a range of not more than 50m provided that the disturbance is non-threatening.

8.17 Displacement effects on the total populations of the SCI species that occur within the SPA are calculated as set out in paragraph 7.45. In Table 8.2 the overall displacement of Light–bellied Brent Geese is given for site where it is proposed to culture oysters only; following by sites which may culture oysters or clams (i.e. where there is a proposal to revert in time to clam cultivation). In each case displacement is calculated based on the mean and peak low tide counts.

8.18 Cummeen Strand clearly emerges as the site with greatest potential for negative impacts (overall displacement of 4.24% - 8.54% if all oyster plots were to be licenced). Under a worst case scenario licencing of all aquaculture plots within Cummeen Strand SPA could result in displacement of up to 5.17% - 10.42% of birds. However, this is based on a very conservative estimate of total exclusion of birds from licence plots; which is not supported by field observations, and thus is not a realistic assessment of impact levels.

8.19 Rather, while it is concluded that the aquaculture licences will have some adverse impacts on this SCI; given it positive population trend and the fact that this species does occur and is known to forage within oyster trestles and clam parcs (though the evidence on this front is more limited); then the level of impact is more likely to be on the lower end of this spectrum. Negative impacts on this SCI species are deemed unlikely at all sites outside of Cummeen Strand (0C466).

8.20 Due to the very large area proposed for cultivation at Cummeen Strand (0C466) it is recommended that use of this area by Light-bellied Brent Geese be monitored in line with annual population levels as derived from IWeBS data.

Table 8.2. Overall displacement of Light-bellied Brent Goose by subsite in Cummeen Strand SPA.

Subsite	Subsite code	Based on mean of LT counts		Based on maximum occurrence in LT counts	
		Oyster trestles only	Oysters and clams	Oyster trestles only	Oysters and clams
Ballincar - Ballyweelin	0C445	0.11%	0%	0.21%	0%
Cartron to Standalone Pt.	0C446	0%	0%	0%	0%
Coney Island Rd. - Dorrins Strand East	0C462	0.03%	0%	0%	0%
Killaspug Pt - Dorrins Strand West	0C463	0%	0.05%	0%	0.08%
Cummeen Strand	0C466	3.82%	0.82%	7.73%	1.66%
Cummeen west from Coney Island Road	0C478	0.29%	0.06%	0.61%	0.13%
Coney Island	0C482	0%	0%	0%	0%
Rosses Point Harbour	0C485	0%	0%	0%	0%
Total		**4.24%**	**0.93%**	**8.54%**	**1.88%**

8.21 Light–bellied Brent Geese numbers are increasing in Cummeen Strand (+116) at a faster rate than nationally (+62.3; see Table 6.1).

8.22 The above assessment is based on a primary use of aquaculture plots for the cultivation of oysters. As noted many of the licences wish to retain the right to culture clam in the future. The level of maintenance is predicted to be lower in clam parcs than for oyster trestles. Green algae also grow on clam netting and as observed in Rossbehy, Light–bellied Brent Geese will feed within the clam parc (though as noted these are routinely cleaned). It is not anticipated that the farming of clams at these sites would result in an increase in the level of predicted impact. The above assessment therefore remains valid should clam farming recommence; though as noted this assumes no use of bird scarers on site.

Oystercatcher

Distribution within Cummeen Strand SPA

8.23 Oystercatchers foraged across all ten subsites. 0C466 (Cummeen Strand) recorded peak numbers in the latter three low tide surveys plus second highest numbers on 21/10/10. The largest number foraging there however was recorded during the January high tide survey (375). This subsite is dominated by the intertidal benthic broad community ”intertidal fine sand with *Peringia (Hydrobia) ulvae* and *Pygospio elegans*.‟ The Cockle (*Cerastoderma edule*) is a characterising species of this community. Of interest is a large bed of Mussels (*Mytilus edulis*) that occurs mid shore from Finisklin to Cummeen (NPWS, 2013c) that likely explained a concentration of Oystercatchers in the south-east of the subsite on some occasions (e.g. February 2011).

8.24 Peak numbers on 21/10/10 were recorded for 0C445 (Ballincar - Ballyweelin) (177) one flock comprising 170 individuals that foraged alongside the channel; smaller numbers present in all other low tide surveys. The intertidal community of this habitat is similar to that described above although it gives way to a sandy mud/mixed sediment community along the northern shoreline.

8.25 Of further note was 0C478 (Cummeen west from Coney Island Road) that always recorded numbers ranked in the top three. This subsite is dominated by the intertidal benthic broad community “intertidal fine sand with *Peringia (Hydrobia) ulvae* and *Pygospio elegans* but also supports Cockles; classified as the biotope “*Cerastoderma edule* and polychaetes in littoral muddy sand‟ by ASU (2012).

8.26 Oystercatchers forage terrestrially for prey such as earthworms, and although not recorded widely during the 2010/11 surveys this activity is likely to take place around the site (and outside of the SPA boundary) regularly. Good numbers of Oystercatcher were recorded foraging across Drumcliff Bay during low tide surveys. While the frequency is largely unknown it is reasonable to assume that some movement of Oystercatchers between these sites occurs.

8.27 The highest average intertidal foraging density within a single subsite was recorded for 0C445 (Ballincar - Ballyweelin) (1.9 Oystercatcher ha^{-1}). The second highest foraging density was 1.5 Oystercatchers ha^{-1} recorded for 0C447 (inner Port). The average whole site foraging density was 0.3 individuals ha^{-1}.

8.28 Oystercatchers frequently roost at low tide due to a digestive bottleneck that limits them to consuming a maximum amount of food in each low tide period (van de Kam *et al*. 2004). Good numbers of Oystercatchers were recorded roosting/or engaging in other activity in intertidal habitat during low tide surveys; this activity was recorded for eight subsites: 0C445, 0C446, 0C462, 0C463, 0C466, 0C478, 0C482 and 0C485. Notable subsites that recorded peak or highly ranked numbers were 0C445 (Ballincar - Ballyweelin), 0C466 (Cummeen Strand), 0C478 (Cummeen west from Coney Island Road) and 0C482 (Coney Island).

Association with aquaculture

8.29 Oystercatchers were regularly present at low tide within all five subsites that are the subject of aquaculture licences (0C445, 0C462, 0C463, 0C466 and 0C478). Sub-site 0C466 (Cummeen Strand) was notable in recording peak numbers in all four low tide surveys plus the January 2011 high tide survey and C478 (Cummeen west from Coney Island Road) recorded numbers always ranked in the top three.

8.30 Gittings and O’Donoghue (2012) found that observed numbers within the oyster trestle blocks studied were broadly in line with the predicted numbers across all sites. At Dungarvan Harbour and Waterford Harbour (apart from one count in the close sectors analysis), observed numbers

within the oyster trestle blocks were higher than predicted numbers. On average around half the Oystercatchers recorded on each count were on trestles. Birds on trestles were more likely to be roosting, compared to birds elsewhere: mean percentage feeding on trestles was 62% (s.d. 10%) compared to 87% (s.d. 9%) elsewhere. Birds regularly settled on trestles when they were still below the tideline as they were just becoming exposed. Oystercatcher frequently forage as widely dispersed individuals/loose flocks and these species were generally found to have a positive or neutral response to oyster trestles.

8.31 Hilgerloh *et al.* (2001) studied the distribution and behaviour of waterbirds in relation to intertidal oyster culture at Cork Harbour. Oystercatcher occurred in significantly lower numbers in the trestle area compared to control plot, while there was no difference in the numbers of Dunlin and Redshank. There was no significant difference in the percentage of feeding birds of any of these species between the plots and the feeding rate of Oystercatchers did not differ between the plots.

Responses to disturbance

8.32 Gittings and O'Donoghue (2012) found that detectable disturbance impacts from aquaculture activities were only observed occasionally and were usually only minor (birds which flushed but resettled nearby). Avoidance of the vicinity of husbandry activity would have been difficult to detect in the field due to the low density and dispersed distribution of waterbirds across the sandflats at low tide. However at Dungarvan Harbour, Oystercatchers were frequently observed feeding close to (within 50-100 m) husbandry activity, indicating tolerance of or habituation to this human activity in the intertidal area.

Impact Assessment

8.33 The population trend for Oystercatcher at Cummeen Strand SPA is +17 (national trend +14.5). Oystercatcher forage widely in the areas occupied by the licence blocks. Sub-site 0C466 (Cummeen Strand) is of particular importance for them and this is the sub-site with the largest area of licence blocks. Sub-site 0C478 (Cummeen west from Coney Island Road) also held high densities of Oystercatcher. Available evidence from elsewhere suggests that Oystercatcher will continue to forage in these areas in the expected numbers despite the fact that part of the area is occupied by oyster trestles. Observations elsewhere suggest that they may have a positive or neutral response to the trestles. Disturbance by workers during maintenance operations is likely to have only localised and temporary impacts with Oystercatcher expected to be excluded from areas of up to 50m from workers.

8.34 In Table 8.3 the overall displacement of Oystercatcher is given for sites where it is proposed to culture oysters only; following by sites which may culture oysters or clams (i.e. where there is a proposal to revert in time to clam cultivation). This shows that the total displacement caused by oyster licences only could be 4.56% - 5.57% (based on mean and peak counts); and 0.99% - 1.20% for sites proposing to farm oysters or clams. Total levels of displacement would be 5.55% - 6.77% across all activities if one assumes 100% occupation of licence blocks and total exclusion of Oystercatcher from same. Gittings and O'Donoghue (2012) found this assumption to be untrue; thus impacts are likely to be significantly less than those predicted above and thus are likely to be well below the 5% significance threshold.

Table 8.3 - Overall displacement of Oystercatcher by subsite in Cummeen Strand SPA

Subsite	Subsite code	Based on mean of LT counts		Based on maximum occurrence in LT counts	
		Oyster trestles only	Oysters and clams	Oyster trestles only	Oysters and clams
Ballincar - Ballyweelin	0C445	0.36%	0%	0.44%	0%
Cartron to Standalone Pt.	0C446	0%	0%	0%	0%
Inner Port	0C447	0%	0%	0%	0%
Coney Island Rd. - Dorrins Strand East	0C462	0.03%	0%	0.07%	0%
Killaspug Pt - Dorrins Strand West	0C463	0%	0.02%	0.00%	0.02%
Cummeen Strand	0C466	3.78%	0.81%	4.65%	1.00%
Cummeen west from Coney Island Road	0C478	0.75%	0.16%	0.85%	0.18%
Martin's Quay	0C479	0%	0%	0%	0%
Coney Island	0C482	0%	0%	0%	0%
Rosses Point Harbour	0C485	0%	0%	0%	0%
Total		4.56%	0.99%	5.57%	1.20%

8.35 Thus, it is concluded that the aquaculture licences will have some adverse impacts on this SCI but, given that the species may occur within the licence areas and has a positive or neutral response to oyster trestles, the level of impact is not likely to significantly affect more than 5% of the site population of this species. As noted, while the primary species to be considered for all sites is Pacific oyster; a number of sites include clam as a secondary species, with the intention of farming this species again in the future. T11/062 is the only such site located within 0C478 (Cummeen west from Coney Island Road), which as noted held high densities of Oystercatcher. Licences T11/030B & D; T11056A & B; T11057A & B and T11/041A & B are all located within 0C466 (Cummeen Strand) (see Table 6.1 for details of all licences).

8.36 As noted the conservative approach of total exclusion was adopted in order to allow for some uncertainty in the response of Oystercatcher to clam parcs rather than oyster trestles. However, the clam parcs are small in extent and switching from oyster cultivation to clams is not anticipated to significantly affect the site population of this species nor the assessment presented above.

Redshank

Distribution within Cummeen Strand SPA

8.37 Redshanks were widespread and recorded within nine subsites overall (not in 0C479). Five subsites recorded Redshank in all four low tide surveys: 0C445, 0C446, 0C463, 0C466 and 0C482. 0C466 (Cummeen Strand) recorded peak numbers in the first three low tide surveys and second highest numbers in the final survey in February 2011. 0C446 (Cartron to Standalone Pt.) held peak numbers on 02/02/11 and good numbers during all other low tide surveys (ranked in top three). 0C466 (Cummeen Strand) recorded the subsite peak count of 344 Redshank (21/12/10).

8.38 Redshanks foraged intertidally across eight subsites (0C445, 0C446, 0C447, 0C463, 0C466, 0C478, 0C482 and 0C485). Four subsites held foraging individuals in all four low tide surveys (0C445, 0C446, 0C463 and 0C466). 0C466 (Cummeen Strand) recorded peak numbers in the first three low tide surveys and second highest numbers in the final survey in February 2011. This subsite is dominated by the intertidal benthic broad community "intertidal fine sand with *Peringia (Hydrobia) ulvae* and *Pygospio elegans*. The sediment of this community complex is largely fine sand (70% - 97%) but localised areas of more muddy sediment do occur; for example within inner reaches near Finisklin and at Cartron and Cregg (northern shore) where the silt-clay fraction accounts for 77% to 84%. On 21/10/10, the largest flock of Redshank foraged in the south-east of the subsite (spanning 0C447) and on balance, this species tended to forage mostly in this inner muddier part of the subsite, or in the north of the subsite close to the channel, often with feet in water.

8.39 The inner bay subsite 0C446 (Cartron to Standalone Pt.) held peak numbers on 02/02/11 and good numbers during all other low tide surveys (ranked in top three). This subsite has a muddier sediment classified as "estuarine mixed sediment to muddy sand with *Hediste diversicolor* and oligochaetes." ASU (2012) assigned the typical estuary biotope "*Hediste diversicolor*, *Macoma balthica* and *Scrobicularia plana* in littoral sandy mud." 0C445 (Ballincar – Ballyweelin) also held good numbers in all surveys (peak number 145). This subsite comprises both intertidal benthic community types described above.

8.40 The peak intertidal foraging density was 1.8 Redshanks ha-1 recorded for 0C446 (Cartron to Standalone Pt.); this subsite recording an average foraging density of 1.0 Redshank ha-1 throughout the survey programme. 0C445 (Ballincar – Ballyweelin) recorded a density of 1.6 Redshanks ha^{-1} on one occasion. The whole site average intertidal foraging density was 0.2 Redshanks ha^{-1}.

Association with aquaculture

8.41 Redshank was present at low tide within all five subsites that are the subject of aquaculture licences (0C445, 0C462, 0C463, 0C466 and 0C478). In particular, sub-site 0C466 (Cummeen Strand) recorded peak numbers in the first three low tide surveys and second highest numbers in the final survey in February 2011. 0C466 (Cummeen Strand) recorded the subsite peak count of 344 Redshank (21/12/10). 0C463 (Killnaspug Pt – Dorrins Strand West) also had Redshank present in all four low tide surveys although numbers were considerably smaller.

8.42 Gittings and O'Donoghue (2012) found that the overall trend across all sites studied was for observed numbers of Redshank within the trestle blocks to be broadly in line with the predicted numbers. At Dungarvan Harbour, observed numbers were substantially higher than predicted numbers in four of the five counts in the all sectors analysis, but the difference was much less marked in the close sectors analysis. This reflected the fact that the Redshank distribution in the study area at Dungarvan Harbour was concentrated in the sectors containing the oyster trestle

blocks. Redshank densities were around twice as high within the trestle blocks compared to outside the trestle blocks, and these differences were significant. Redshank frequently forage as widely dispersed individuals/loose flocks and these species were generally found to have a positive or neutral response to oyster trestles.

8.43 Hilgerloh *et al.* (2001) studied the distribution and behaviour of waterbirds in relation to intertidal oyster culture at Cork Harbour. They found no significant difference in the numbers of Redshank in the trestle area compared to control plot. There was no significant difference in the percentage of feeding birds between the plots.

Responses to disturbance

8.44 Gittings and O'Donoghue (2012) found that detectable disturbance impacts from aquaculture activities were only observed occasionally and were usually only minor (birds which flushed but resettled nearby). Avoidance of the vicinity of husbandry activity would have been difficult to detect in the field due to the low density and dispersed distribution of waterbirds across the sandflats at low tide. However at Dungarvan Harbour, Redshank were frequently observed feeding close to (within 50-100 m) husbandry activity, indicating tolerance of or habituation to this human activity in the intertidal area.

Impact Assessment

8.45 Redshank forage widely in the areas occupied by the licence blocks. The population trend for Redshank in Cummeen Strand SPA is one of decline (-31; compared to a national trend of -4.8). Sub-site 0C466 (Cummeen Strand) is of particular importance for them and this is the sub-site with the largest area of licence blocks. Available evidence from elsewhere suggests that Redshank will continue to forage in these areas in the expected numbers despite the fact that part of the area is occupied by oyster trestles. Observations elsewhere suggest that they may have a positive or neutral response to the trestles. Disturbance by workers during maintenance operations is likely to have only localised and temporary impacts with Redshank expected to be excluded from areas of up to 50m from workers. In Table 8.4 the overall displacement of Redshank is given where it is proposed to farm oyster only; followed by figures for sites where it is proposed to farm oysters and / or clams. This shows that the total displacement caused by oyster licences only could be 5.91% - 8.23% of the site population of this species, depending on whether the assessment is based on mean or maximum number of birds counted at low tide in each sub-site. Displacement from oyster / clam plots would be a further 1.32%-1.86%; resulting in a cumulative impact across all plots of 7.23% - 10.09% for Redshank.

8.46 The main impacts are predicted to be in Cummeen Strand (subsite 0C466); where displacement due to oysters (assuming 100% occupation and total exclusion) would be over 5-8%. As noted, this conservative approach was adopted to allow for some uncertainty as to how Redshank responds to clam parcs. If all such plots were in time to change from oysters to clams the maximum level of displacement would be <2%. Given that Gittings and O'Donoghue (2012) found that the overall trend across all sites studied was for observed numbers of Redshank within the trestle blocks to be broadly in line with the predicted numbers then the conservative prediction of ca. 5-8% displacement from oyster trestles is unlikely to be realised. This is an important point given the observed decline in Redshank (-31) in Cummeen Strand SPA reported in the NPWS Conservation Objectives supporting documentation (refer to discussion of IWeBS counts above – this outlines our concerns regarding the accuracy of this trend).

Table 8.4 - Overall displacement of Redshank by subsite in Cummeen Strand SPA

Subsite	Subsite code	Based on mean of LT counts		Based on maximum occurrence in LT counts	
		Oyster trestles only	Oysters and clams	Oyster trestles only	Oysters and clams
Ballincar - Ballyweelin	0C445	0.30%	0%	0.49%	0%
Cartron to Standalone Pt.	0C446	0%	0%	0%	0%
Inner Port	0C447	0%	0%	0%	0%
Coney Island Rd. - Dorrins Strand East	0C462	0.13%	0.13%	0.10%	0.10%
Killaspug Pt - Dorrins Strand West	0C463	0%	0.01%	0%	0.02%
Cummeen Strand	0C466	5.44%	1.17%	7.96%	1.71%
Cummeen west from Coney Island Road	0C478	0.04%	0.01%	0.12%	0.03%
Coney Island	0C482	0%	0%	0%	0%
Rosses Point Harbour	0C485	0%	0%	0%	0%
Total		**5.91%**	**1.32%**	**8.23%**	**1.86%**

8.47 As noted, while the primary species to be considered for all sites is Pacific oyster; a number of sites include clam as a secondary species, with the intention of farming this species again in the future. T11/062 is the only such site located with 0C478 (Cummeen west from Coney Island Road), which as noted held high densities of Redshank. Licences T11/030B & D; T11056A & B; T11057A & B and T11/041A & B are all located within 0C466 (Cummeen Strand) (see Table 6.1 for details of all licences). However, the clam parcs are small in extent and switching from oyster cultivation to clams is not anticipated to significantly affect the site population of this species nor the assessment presented above.

8.48 It is therefore concluded that while the aquaculture licences (notable clam parcs) may have some adverse impacts on this SCI; given that the species is observed to continue to forage within oyster trestles and total displacement from clam parcs would be <2% then the overall level of impact is not likely to significantly affect more than 5% of the site population of this species.

8.49 A note of caution with respect to Redshank is, however, warranted as this the population trend recorded for this species by NPWS is -31 (as compared to a national trend of -4.8; see Table 6.1). Therefore, we would therefore recommend that the relationship between clam farming and this species be further examined before a switch back to clam farming is undertaken. This would also offer the opportunity to consider the relationship between shorebirds and clam cultivation as a whole. As noted in paragraph 5.19, an analysis of IWeBS data for Redshank over the period 1994/95 to 2012/13 in Cummeen Strand SPA shows a consistent and generally stable trend; which mirrors the national trend in this species (Boland and Crowe 2012). Redshank has been consistently recorded from the majority of subsites in this SPA, which suggests that the coverage was good in January (except for the years 2000/01 to 2003/04 for which there is no data). Overall, the Redshank population in Ireland does not vary much through the winter (Crowe 2005) so January counts are probably representative of the overall winter population. This suggests that confidence in the trend of -31 given in Table 5.4 for Redshank is low and that the site population may be more stable over the longer term (up to 2012/13) than is suggested in this table. In recent years the greater number of counts has provided a robust dataset; thus in coming years Reshank numbers should continue to be monitored thorough IWeBS and Redshank population / trend data should inform any switch to clam harvesting.

In-combination effects of aquaculture with other activities

Introduction

8.50 This section presents an assessment of potential cumulative impacts from the aquaculture and fisheries activities considered in this assessment in combination with other relevant activities that could potentially affect the SCI species.

Disturbance

8.51 There is an extensive and complex literature on the impacts of disturbance from human activities on waterbirds in intertidal and shallow subtidal habitats. It is difficult to use this literature to make specific predictions about the nature and extent of potential disturbance impacts as the effects of disturbance vary between species and, within species, vary between sites and within sites. However, in general, with beach walks and/or when access is mainly along the shoreline (i.e. with little activity in the intertidal or shallow subtidal zone), disturbance impacts, while causing local (a few hundred metres) displacement of birds, does not appear to affect the large-scale distribution of birds across sites (e.g., Colwell and Sundeen, 2000; Lafferty, 2001; Gill *et al*., 2001; Neumann *et al*., 2008; Trulio and Sokale, 2008; Yasué, 2006; but see Burton *et al*., 2002) or survivorship (Durell et al., 2007; but see Stillman *et al*., 2012). Disturbance in the intertidal zone will generally have greater impacts (Stillman *et al*., 2012) and, where disturbance rates are high and/or concentrated areas of species food resources are affected, may cause significant impacts to large-scale distribution (Mathers *et al*., 2000) and/or survivorship (Durell et al., 2008; Goss - Custard *et al*., 2006; Stillman *et al*., 2012; West et al., 2007). However, some studies of shellfish gathering in the intertidal zone have concluded that it does not affect waterbird populations (Dias *et al*., 2008; Navedo and Masero, 2007).

8.52 NPWS (2013b/d) identifies disturbance as a factor that can affect the likelihood of Cummeen Strand and Drumcliff Bay SPA achieving the objective 'to maintain the favourable conservation condition of the non-breeding waterbird Special Conservation Interest species listed for the SPA.' In this context disturbance is defined as "*anthropogenic disturbance that occurs in or near the site and is either singular or cumulative in nature that 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*".

Sligo Airport

8.53 Sligo airport is located north of Strandhill. In July 2011 the Sligo to Dublin route was ended resulting in the closure of the airport for commercial traffic. During the NPWS low tide survey at Cummeen Strand, undertaken during the winter of 2010/2011 while the airport was still operating commercially, aircraft (light aircraft and helicopters) related disturbance was recorded in four subsites; 0C462, 0C463, 0C478 and 0C482 with a moderate level of disturbance assigned to each. At Drumcliff, aircraft related disturbance was recorded in three subsites. Again this was due to light aircraft and helicopter disturbance.

8.54 It may be expected that there would be an expected reduction in airplane related disturbance since 2011. However, aviation activity continues at the airport with a light aviation club and, in addition, the Irish Coast Guard operates a search and rescue helicopter based at the airport. Notably these are the aircraft types which caused disturbance to birds during NPWS low tide surveys so this form of disturbance may still be significant for the sites. The airport website contains information for pilots to avoid flying over fields known to hold Barnacle geese to avoid disturbance to the flocks (http://www.sligoairport.com/BarnacleGeese.html).

Boating Activity

8.55 Sligo Yacht Club clubhouse and facilities are located at Rosses Point adjacent to the boundary of Cummeen Strand SPA. The majority of club sailing takes place in Sligo Bay during high tide periods. The club calendar indicates that the majority of events take place from April to October when bird populations are at their lowest. In general, boating activity will not affect waterbirds in intertidal and shallow subtidal areas as these areas are not used for foraging at high tide.

Watersports

8.56 A number of businesses operate watersport activities in the Sligo Bay area. These include kitesurfing which operates at Rosses Point and Lissadell and sea kayaking which offers tours of Oyster Island and Coney Island. These businesses by their nature are generally targeting tourist visitors to the Sligo area and so would be expected to be more active during the summer months when bird populations are at their lowest. However, the location provides suitable weather conditions for year round activities. Additional activities that could cause disturbance include windsurfing and in particular jet skiing.

8.57 Recreational watersports activities that occur in very shallow waters have been observed to cause disturbance to waterbirds. For example, we have observed jet skiers in Ballycotton Bay travelling up tidal channels and across shallowly flooded areas causing disturbance to important feeding and roosting areas. In Cork Harbour, kayakers and windsurfers in the Aghada area can come close into the shoreline causing disturbance to high tide roosts. Similarly, kite-surfers in Dublin Bay have been noted to cause disturbance to some bird species feeding on exposed sandy beaches (John Fox, pers comm.). While, most of these activities will mainly take place around the high tide period; in Kite-surfing in Dublin Bay takes place at all stages of the tide. Wind strength and direction are the key factors; in an onshore wind, the surfer can be in shallow water with the kite above the tide edge, thus displacing foraging birds.

Walking (including with dogs)

8.58 At Cummeen Strand SPA, during the NPWS baseline waterbird surveys in 2010/2011, walking (including with dogs) was the most widespread disturbance activity, occurring in six of the total ten subsites, accounting for moderate disturbance levels in all six sites (NPWS, 2013d). Walking (including with dogs) accounted for peak disturbance in four of the subsites.

8.59 At Drumcliff Bay SPA, during the NPWS baseline waterbird surveys in 2010/2011, walking (including with dogs) was again the most widespread disturbance activity occurring in six subsites. The activity accounted for the peak disturbance score in three of the subsites. NPWS (2013b) note that there is a potential for walking (including with dogs) to occur on all subsites based on a desktop assessment. Observations made at subsite 0C932 at Lissadell Strand show that it is particularly favoured for dog walking with dogs observed to regularly chase birds.

8.60 Two walking trails are advertised on sligowalks.ie which covers coastal routes at Lissadell and Rosses Point. In addition to this another company, advertises guided heritage and environmental tours around Sligo Bay including trips to Coney Island. Access to Coney Island is by boat from Rosses Point, walking or driving across the causeway at low tide or by sea kayak.

Recreational Fishing

8.61 There are three charter sea angling vessels operating from Sligo and Rosses Point. RPS (2012) state that 5,000 visitors have used these boats in recent years for both recreational fishing trips but also sightseeing tours of Sligo Bay.

8.62 No commercial fishing boats operate from Sligo Harbour (RPS, 2012)

Sligo Port

8.63 Sligo port has a long commercial history. In 1998 dredging was undertaken on the navigation channel with the berths dredged in 2006 (RPS, 2012). Since 2006 the port has undergone redevelopment with the improvement of both commercial and recreational facilities. Currently the port can accommodate vessels up to 3,500 DWT. During the period from 2000 to 2011, there were on average 26 commercial vessels per annum visiting Sligo port. The main imports over the period from 2008 to 2011 included coal, fish meal and timber. The exports for this period were scrap metal and logs. Fish meal imports have now finished at Sligo (RPS, 2012).To facilitate the port development, additional dredging works of the navigational channel were undertaken in 2012 with birds predicted to be not significantly impacted by the works (RPS, 2012).

Water Quality

8.64 Organic and nutrient inputs to estuaries increase productivity and may increase food resources for waterbirds. Therefore, adverse impacts to waterbirds might be expected to be caused by declines in organic and nutrient inputs associated with improvements in wastewater treatment There are a number of studies that document the effects of organic and nutrient loading from effluent discharges on the benthic fauna and typically the zones affected by individual discharges are restricted to within a few hundred metres of the outfall (Burton *et al*., 2002b). The available evidence on the effects of nutrient reductions on estuarine waterbird populations is limited but, to date, no significant impacts have been reported (Burton *et al*., 2002, 2003). One study (Alves *et al*., 2012) has reported localised (within 100 m) association between wastewater inputs and bird distribution; in this study the outfalls discharged in the intertidal zone and streams of sewage ran across the intertidal habitat.

8.65 The EPA envision web mapper indicates that one waste water treatment has a hydrological connection to Drumcliff Bay SPA. The 2,500 person equivalent plant is located at Carney on the Carney River which drains into inner Drumcliff Bay around 1 km downstream. It received a ‘pass’ status in the UWWT status 2012 (EPA envision, 2014).

8.66 The EPA envision web mapper shows that two waste water treatment plants output into Cummeen Strand SPA. These are located in Sligo town (at the end of reclaimed land on the western side of the harbour entrance) and at Ballyweelin which is called Rosses Point WWTP.

8.67 The Sligo WWTP is relatively new having been operational since January 2009. This facility replaced an old waste water system which output into the Garavogue river estuary, 1 km upstream from current outfall location. The result has been a discernible positive effect on water quality in the estuary (O"Boyle *et al*. 2010 cited in NPWS, 2013). The facility received a ‘pass’ status in the UWWT status 2012.

8.68 Waste from the Rosses Point WWTP is proposed to be pumped to the Sligo town facility with the existing infrastructure at Ballyweelin becoming an emergency facility. The status of this proposal is currently unknown (NPWS, 2014). The facility received a ‘fail’ status due to “lack of secondary treatment in operation” in the UWWT status 2012 (EPA envision, 2014).

8.69 There is an additional WWTP located at Strandhill, to the north of the headland close to the airport. This received a ‘fail’ status in the UWWT status 2012. It is on the seaward side of Killaspug Point and is outside Cummeen Strand SPA. The plant has a current design capacity of 1,500 population equivalent, but expansion is now planned due to overloading. The contribution of nutrients by this WWTP to Sligo Harbour is not known.

8.70 In addition to these point sources of pollution, agricultural activities along the margin of Drumcliff Bay and Cummeen Strand/Sligo Harbour as well as in the catchments of rivers flowing into the bays provides a diffuse source of nutrient enrichment.

Landuse

8.71 NPWS (2013b) note that the surrounding environment of Drumcliff Bay is less developed than either Cummeen Strand (sometimes referred to as Sligo Harbour) or Ballysadare Bay. Much of the bay is surrounded by lands which are agricultural in character, with scattered housing occurring around the bay; but rarely close to the shoreline. Dominant activities are agriculture (mainly mixed farming), aquaculture and tourism.

8.72 NPWS (2013b) states that while the coastline of the Sligo Bay complex is a major draw for tourism, little direct attention is focused on Drumcliff Estuary, but rather on areas such as Strandhill or Rosses Point. Walking is, however, noted as being popular along sandy beaches such as Lissadell Strand, Ballygilgan Strand and Ardtermon Strand. While these strands support a range of recreational activities during summer (e.g. swimming) these are much reduced during winter and relatively little activity was noted during the 2010/11 waterbird survey programme (NPWS, 2013b). Both Bar-tailed Godwit and Sanderling favour these sites. It would therefore appear unlikely that amenity related disturbance would result in a significant increase in cumulative impacts.

8.73 Cummeen Strand (also known as Sligo Harbour), the estuary of the Garavogue River is a large shallow bay stretching from Sligo Town westwards to Coney Island. The inner bay is dominated by the presence of Sligo Harbour – the channel is routinely dredged for navigational purposes. A fishing harbour and a separate pier for yacht mooring are located at Rosses Point and small piers are found at Raghly Point and on Coney Island (extracted from NPWS, 2013d). The bay is therefore characterised by a much greater degree of residential and commercial development than Drumcliff; notably around Sligo Town, Strandhill and Rosses Point; both of which are popular seaside resorts (though peak tourist activity would be outside the winter period). Beyond the residential ribbon development the surrounding landscape is dominated by agriculture; mainly mixed grazing lands.

8.74 Outside of villages and towns, rural dwellings and ribbon development of housing along main roads are common e.g. along the road from Sligo to Rosses Point. However, the surrounding landscape is largely agricultural with intensively managed grassland predominating. The landscape rises steeply along the southern side of the site. A golf course has encroached onto the dune system at Rosses Point and a small forestry plantation also occurs in dune habitat there (NPWS, 2000). Coney Island is accessible by boat from Rosses Point or by driving or walking over the causeway across Dorrin"s Strand (guided by 14 pillars) at low tide (extracted from NPWS, 2013d).

Assessment

8.75 To summarise, in Drumcliff Bay SPA disturbance noted during the 2010/2011 low tide surveys included aircraft, walking (including with dogs), motorised vehicles, horse-riding, shooting, hand-gathering of molluscs (winkle picking), and activities associated with intertidal aquaculture. There is a general absence of any quantative data on the above activities and the degree to which they might impact on shorebirds; though the observations in 2010 / 2011 clearly identified walking (especially with dogs) as one of the main disturbances (especially at Lissadell Strand). There are, however, no proposals for aquaculture at Lissadell Strand. Aquaculture was noted as a disturbing activity at Ballygilgan (0C424), Coolbeg (0C448), Ballinaphunta (0C449) and Ardtermon (0C494).

8.76 In Cummeen Strand disturbance activities were identified as aircraft, aquaculture machinery (and activities associated with intertidal aquaculture), horse riding, and walking (including with dogs) (NPWS, 2013d); with walking with dogs again emerging as a significant cause of disturbance. Aquaculture was noted as a disturbing activity at Cummeen Strand (0C466).

9. Summary & Recommendations

Drumcliff Bay SPA

Bar-tailed Godwit

9.1 In Drumcliff Bay SPA the primary risk of potential impact on Bar-tailed Godwit is at Ardtermon Strand where trestles could displace 4.66%-6.3% of the SPA population. If both Oysters only and Oyster/Clam licences are considered then the displacement across the entire site is predicted to be in the range 5.2%-8.0% of the site population. Trend analysis has shown that Bar-tailed Godwit is, however, increasing within the SPA. Some caution must, however, be exercised in assessing impacts at Ardtermon as the assessment is based on a relatively restricted data set (4 no. NPWS low tide counts from 2010 / 2011). For example the peak count of 790 birds recorded at Ardtermon highlights the high degree of variation between counts (i.e. 6.3% of the population in this instance). The potential for movement of Bar-tailed Godwit between Drumcliff, Cummeen and Ballysadare is also mentioned in the NPWS Conservation Objective Supporting document (NPWS, 2013b).

9.2 We understand that NPWS (pers comm.) have recently undertaken further low tide work in the Bay (this was not available at the time of writing); we would, however, recommend that this be reviewed to recheck the above findings. If these data do not provide the necessary insight we would recommend that further monitoring of the low tide use of the key Bar-tailed Godwit sites within the SPA by should be undertaken in order to fully assess the potential for negative impacts at Ardtermon.

Sanderling

9.3 The main area where Sanderling could be impacted by the granting of licence applications / renewals would be at Ballinphunta (sub site 0C449); here displacement of 1.5% of the SPA population is predicted for oysters based on mean numbers (this increases to 1.8% when the peak Sanderling count is used).This is well below the 5% threshold for a significant impact on this SCI. While the NPWS low tide counts did not record Sanderling from Ardtermon, NPWS (T. Roderick, pers comm.) noted that Sanderling do use this site; suitable intertidal habitat certainly occurs at this site.

9.4 While the population trends in Drumcliff Bay SPA are negative for Sanderling (-59; compared to +125 nationally); as discussed above the low number / variability in timing of early IWeBS coverage (counts per winter, months of coverage and years with no data) does not allow confidence in the trends for this species in Drumcliff Bay. In recent years counts have been more frequent; with a strong correlation between the number of counts and the number of Sanderling recorded (see paragraph 5.4); and a pattern of increasing numbers in the last 5 year period. Thus the predicted level of impact (<2%) is unlikely to have a significant impact on Sanderling at Drumcliff Bay SPA. It is, however, recommended that Sanderling numbers at key sites, including Ardtermon, be monitored annually (from IWeBS data).

Barnacle Geese

9.5 While detailed evidence on patterns of site use of the Lissadell goose field are not available; it is evident that the numbers of geese in the Sligo flock – i.e. using the complex of Ballintemple / Ballygilgan SPA (004234), Inishmurray SPA (004068) and Ardboline Island / Horse Island SPA (004135) has been increasing (Crowe et al. 2014). However, we understand from NPWS that the Ballygilgan *goose field* is to be subject of a targeted management plan in order to encourage greater use of the site by Barnacle Geese (T. Roderick, pers comm.). Intensification of activities

and / or landward expansion of activities are therefore a concern if they were to result in increased levels of disturbance and displacement.

9.6 In order to allow ongoing aquaculture activities at this location, firstly the Code of Practice should be revisited by the Industry, BIM and NPWS to ensure any practices licenced do not result in disturbance impacts on Barnacle Geese using Ballintemple / Ballygilgan SPA and that aquaculture activities are considered as part of overall site management. Furthermore, numbers using both the Ballintemple subsite and Lissadell (Ballygilgan) subsite should be monitored for any signs of disturbance and / or displacement by aquaculture activities.

Cummeen Strand SPA

9.7 As noted the following assessment starts with the assumption of total exclusion even though all three species show neutral / positive association to oyster trestles. This approach allows us to adopt a worst case scenario (precautionary principle) under which sites could revert to clam culture and the relationship of Light-bellied Brent Geese, Oystercatcher and Redshank to these are less clearly understood.

Light-bellied Brent Geese

9.8 Negative impacts on this SCI species are deemed unlikely at all sites outside of Cummeen Strand (0C466). Based upon the conservative assumption of total exclusion, Cummeen Strand clearly emerges as the site with greatest potential for negative impacts on Light-bellied Brent Geese (overall displacement of 4.64% - 9.39% if all oyster plots were to be licenced). Under a worst case scenario licencing of all aquaculture plots within Cummeen Strand SPA could result in displacement of up to 5.17% - 10.42% of birds. However, this is based on the very conservative estimate of total exclusion of birds from licence plots; which is not supported by field observations, and thus is not a realistic assessment of impact levels.

9.9 Rather, while it is concluded that the aquaculture licences will have some adverse impacts on this SCI; given it positive population trend and the fact that this species does occur and is known to forage within oyster trestles and clam parcs (though the evidence on this front is more limited); then the level of impact is more likely to be significantly less than as noted above.

9.10 Due to the very large area proposed for cultivation at Cummeen Strand (0C466) it is however recommended that use of this area by Light-bellied Brent Geese be monitored in line with annual population levels as derived from IWeBS data.

Oystercatcher

9.11 Based upon the conservative assumption of total exclusion, the overall displacement of Oystercatcher caused by oyster licences would be 4.56% - 5.57% (based on mean and peak counts); and 0.99% - 1.20% for sites proposing to farm oysters or clams. Total levels of displacement would be therefore be 5.55% - 6.77% across all activities if one assumes 100% occupation of licence blocks and total exclusion of Oystercatcher from same. Gittings and O'Donoghue (2012) found this assumption to be untrue; thus impacts are likely to be significantly less than those predicted above and thus are likely to be well below the 5% significance threshold and will thus would not have a significant adverse impact on the conservation objectives of the site.

Redshank

9.12 The overall displacement of Redshank caused by oyster licences only could be 5.91% - 8.23% of the site population of this species, depending on whether the assessment is based on mean or maximum number of birds counted at low tide in each sub-site. Displacement from oyster / clam

plots would be a further 1.32%-1.86%; resulting in a cumulative impact across all plots of 7.23% - 10.09% for Redshank. The main impacts are predicted to be in Cummeen Strand (subsite 0C466); where displacement due to oysters (assuming 100% occupation and total exclusion) would be over 5-8%. As noted, this conservative approach was adopted to allow for some uncertainty as to how Redshank responds to clam parcs to be considered. However, as detailed in Table 6.2 not all applications wish to revert to farming clams; most will cointinue to farm oysters – and as noted Redshank have been shown by Gittings and O'Donoghue (2012) to show a neutral / positive reaction to trestles. The maximum level of displacement from those plot switching to clam farming would be <2%; the remaining sites being for oysters only. Thus, the overall impact on Redshank is unlikely on balance to reach the levels of noted above.

9.13 A note of caution with respect to Redshank is, however, warranted as this the population trend recorded for this species by NPWS is -31 (as compared to a national trend of -4.8; see Table 6.1). We would therefore recommend that the relationship between clam farming and this species be further examined before a switch back to clam farming is undertaken. This would also offer the opportunity to consider the relationship between shorebirds and clam cultivation as a whole.

9.14 Furthermore, due to the scale of operations at Cummeen Strand we would recommend that bird's numbers using this subsite be monitored and compared to overall site numbers as collated by IWeBS.

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Appendix A

Scientific names

Common name	Scientific names	BTO code
Arctic Tern	*Sterna paradisaea*	AE
Bar-tailed Godwit	*Limosa lapponica*	BA
Barnacle Geese	*Branta leucopsis*	BY
Black-tailed Godwit	*Limosa limosa*	BW
Common Tern	*Sterna hirundo*	CN
Cormorant	*Phalacrocorax carbo*	CA
Curlew	*Numenius arquata*	CU
Dunlin	*Calidris alpina*	DN
Grey Plover	*Pluvialis squatarola*	GV
Golden Plover	*Pluvialis apricaria*	GP
Herring Gull	*Larus argentatus*	HG
Kittiwake	*Rissa tridactyla*	KI
Knot	*Calidris canutus*	KN
Lapwing	*Vanellus vanellus*	L.
Light-bellied Brent Goose	*Branta bernicla hrota*	PB
Oystercatcher	*Haematopus ostralegus*	OC
Peregrine falcon	*Falco peregrinus*	PE
Redshank	*Tringa totanus*	RK
Ringed Plover	*Charadrius hiaticula*	RP
Sanderling	*Calidris alba*	SS
Shag	*Phalacrocorax aristotelis*	SA
Snipe	*Gallinago gallinago*	SN
Wigeon	*Tadorna tadorna*	SU
Woodcock	*Scolopax rusticola*	WK