Marine Institute Bird Studies

Ballyteige Bay: Appropriate Assessment of Aquaculture

February 2020

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Citation: -

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Executive Summary

This report presents the results of an Appropriate Assessment of aquaculture in Ballyteige Bay. There are two aquaculture sites, covering a total area of 3.3 ha, within Ballyteige Bay. The only aquaculture activity proposed for these sites is oyster trestle cultivation.

The report assesses the potential impact of the development of these aquaculture sites on the Special Conservation Interests (SCIs) of the Ballyteige Burrow SPA, and on the SCIs of other SPAs where these SCIs may have connectivity with Ballyteige Bay. The potential for cumulative impacts from development of these aquaculture sites in combination with other relevant activities and plans is also assessed. The in-combination activities and plans assessed included shoreline access for recreation and shellfish collecting, and discharges from a wastewater treatment plant.

The SCIs of the Ballyteige Burrow SPA covered by this assessment are: Light-bellied Brent Goose, Shelduck, Golden Plover, Grey Plover, Lapwing, Black-tailed Godwit and Bar-tailed Godwit. These have all been selected for their non-breeding/wintering populations. The SCIs of other SPAs covered by this assessment are: the wintering Dunlin, Curlew and Redshank populations of the Bannow Bay SPA, the wintering Wigeon population of the Tacumshin Lake SPA, the breeding Cormorant population of the Keeragh Islands SPA, and the breeding Lesser Black-backed Gull population of the Saltee Islands SPA.

There is likely to be a measurable displacement impact to Grey Plover, and this may be significant when potential displacement due to disturbance is factored in. The predicted displacement impacts to Light-bellied Brent Goose and Wigeon are significant. However, there is a high level of uncertainty about these predictions due to the variable nature of their responses to oyster trestle cultivation, and the likely significant over-estimation of subsite occupancy levels in the displacement calculations.

The predicted displacement impacts to Shelduck, Lapwing, Curlew, Black-tailed Godwit, Bar-tailed Godwit, Dunlin and Redshank are not significant. The predicted displacement impact to Golden Plover is negligible. The limited data that was available for this assessment means that there is a moderate level of uncertainty about these predictions. For two of the species (Curlew and Redshank) there may be no net displacement impact due to the variable nature of their response to oyster trestle cultivation.

Oyster trestle cultivation is likely to have neutral or positive impacts on prey resources for Cormorants, and they will only utilise the areas around the aquaculture sites at high tide when no husbandry activity will be taking place. Therefore, no negative impacts are predicted for this species.

Due to lack of information on the diet of the Saltee Islands Lesser Black-backed Gull colony, the occurrence of Lesser Black-backed Gull in Ballyteige Bay during the summer, and/or the response of Lesser Black-backed Gull to oyster trestles, it is not possible to make an assessment of the potential impact of aquaculture activities in Ballyteige Bay on the colony.

No potentially significant cumulative impacts were identified from the in-combination assessment.

Acknowledgements

We are grateful to Noel Roche (Ballyteigue Oysters Ltd.) for providing aquaculture production data, and to Killian Mullarney for providing information on waterbird usage of Ballyteige Bay.

This assessment uses: data supplied by the Irish Wetland Bird Survey (I-WeBS), a joint scheme of BirdWatch Ireland and the National Parks and Wildlife Service of the Department of Arts, Heritage & the Gaeltacht; and data from the 2001/12 Waterbird Survey Programme as undertaken by the National Parks & Wildlife Service

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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 presents an Appropriate Assessment of aquaculture in Ballyteige Bay. The subject of the assessment are applications for aquaculture licences (referred to as aquaculture sites). The information on the licensing status of aquaculture sites used in this report was provided by the Department of Agriculture, Food and the Marine.

1.3 The only aquaculture activity proposed for these sites is oyster trestle cultivation.

1.4 The aquaculture sites are within the Ballyteige Burrow SPA, which is the primary focus of this assessment. In addition, following a screening exercise, Special Conservation Interests (SCIs) from four other SPAs are included in this assessment. These SPAs are: the Bannow Bay SPA, the Keeragh Islands SPA, the Saltee Islands SPA and the Tacumshin Lake SPA. The SPAs covered by this assessment are shown in Figure 1.1.

1.5 The Ballyteige Burrow SPA includes a section of seaward coast that is rarely used by the SCI species that were the subject of the assessment. Therefore, in this report we distinguish between the Ballyteige Burrow SPA (the entire SPA) and Ballyteige Bay (the estuarine section of the SPA on the northern side of the sand dunes; Figure 1.2).

1.6 This assessment is based on a desktop review of existing information. Where relevant, it identifies information gaps that may affect the reliability of the conclusions of this assessment.

1.7 The data analysis and report writing was done by Tom Gittings. Paul O'Donoghue assisted with project design, document preparation and undertook document review.

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

Structure of this report

1.9 The structure of the report is as follows:

- Chapter 2 of the report describes the methodology used for the assessment.
- Chapter 3 of the report contains a preliminary screening assessment that reviews the Special Conservation Interests (SCIs) of the Ballyteige Burrow SPA, and the SCIs of other SPAs in the wider vicinity and screens out SCIs that do not show any significant spatial overlap with the activities being assessed.
- Chapter 4 of the report describes the Conservation Objectives, and their attributes and targets, of the SCIs that were screened in for this assessment.
- Chapter 5 of the report contains a summary of waterbird habitats and distribution in the Ballyteige Burrow SPA, and of the status and distribution of the SCI species included in the assessment.
- Chapter 6 provides a description of the current and proposed future extent of the aquaculture activities covered by this assessment and the nature of their operations.

- Chapter 7 assesses the likely impact of the oyster trestle cultivation activity included in this assessment on the SCIs associated with intertidal habitat that were screened in for this assessment.

- Chapter 8 assesses the likely impact of the oyster trestle cultivation activity included in this assessment on the other SCIs that were screened in for this assessment.

- Chapter 9 contains an assessment of cumulative impacts.

- Chapter 10 concludes the report by assessing the impact of aquaculture activities in Ballyteige Bay, and any in-combination impacts (if relevant), on the conservation objectives of the SCIs included in this assessment.

Constraints to this assessment

1.10 There was very limited information available on the current and proposed aquaculture activities in Ballyteige Bay. This has meant that we have had to make assumptions about details of the activities, based on experience of oyster trestle cultivation at other Irish coastal sites. This is a particular issue for the assessment of potential disturbance impacts, where the predicted impacts are sensitive to the assumptions made about the likely patterns of husbandry activities.

1.11 There was also very limited waterbird data available for this assessment. The Irish Wetland Bird Survey counts the Ballyteige Burrow SPA as a single count unit, so I-WeBS data cannot be used to examine waterbird distribution patterns within the SPA. We made efforts to consult with the I-WeBS counter, but these were unsuccessful.

1.12 Our assessment has relied mainly on data from the 2011/12 Waterbird Survey Programme counts. This means that we had a very limited dataset of four low tide counts from one winter to use for out displacement analyses. Therefore, a high degree of uncertainty applies to inferring detailed distribution patterns of waterbirds within Ballyteige Bay from these counts.

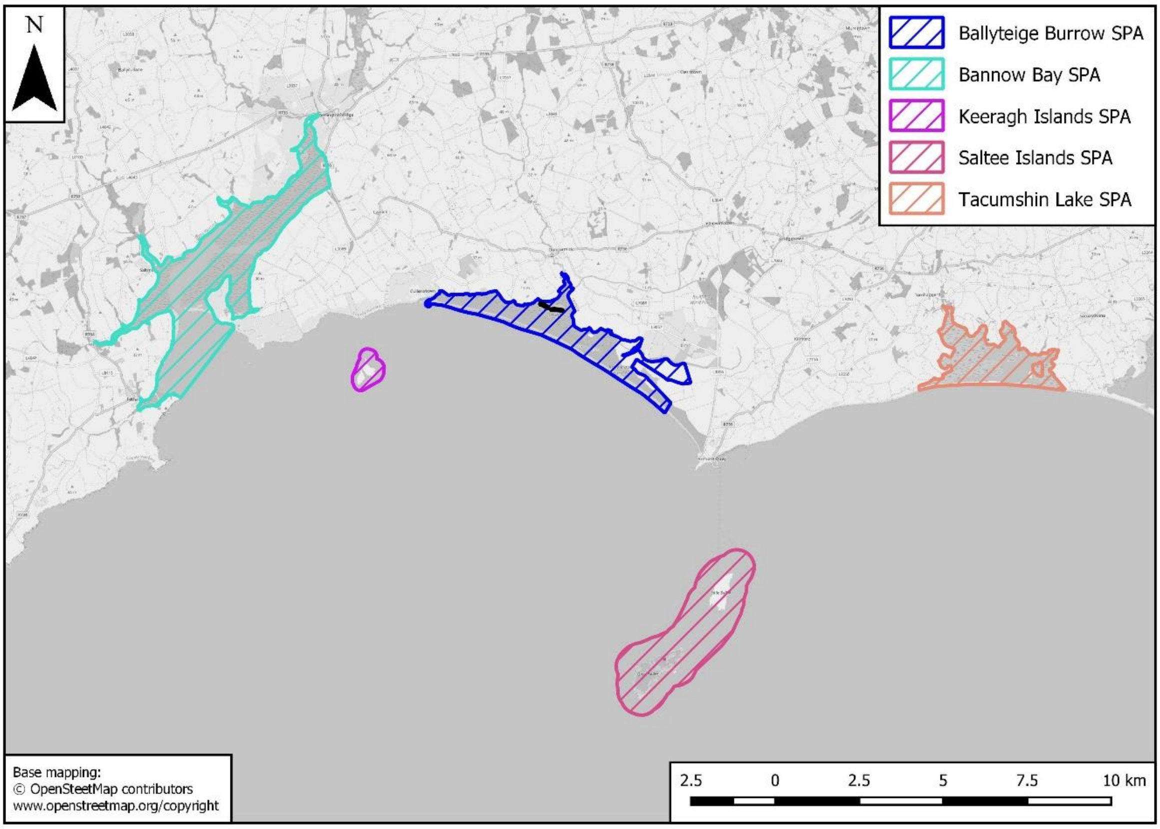

Figure 1.1 – SPAs included in this assessment.

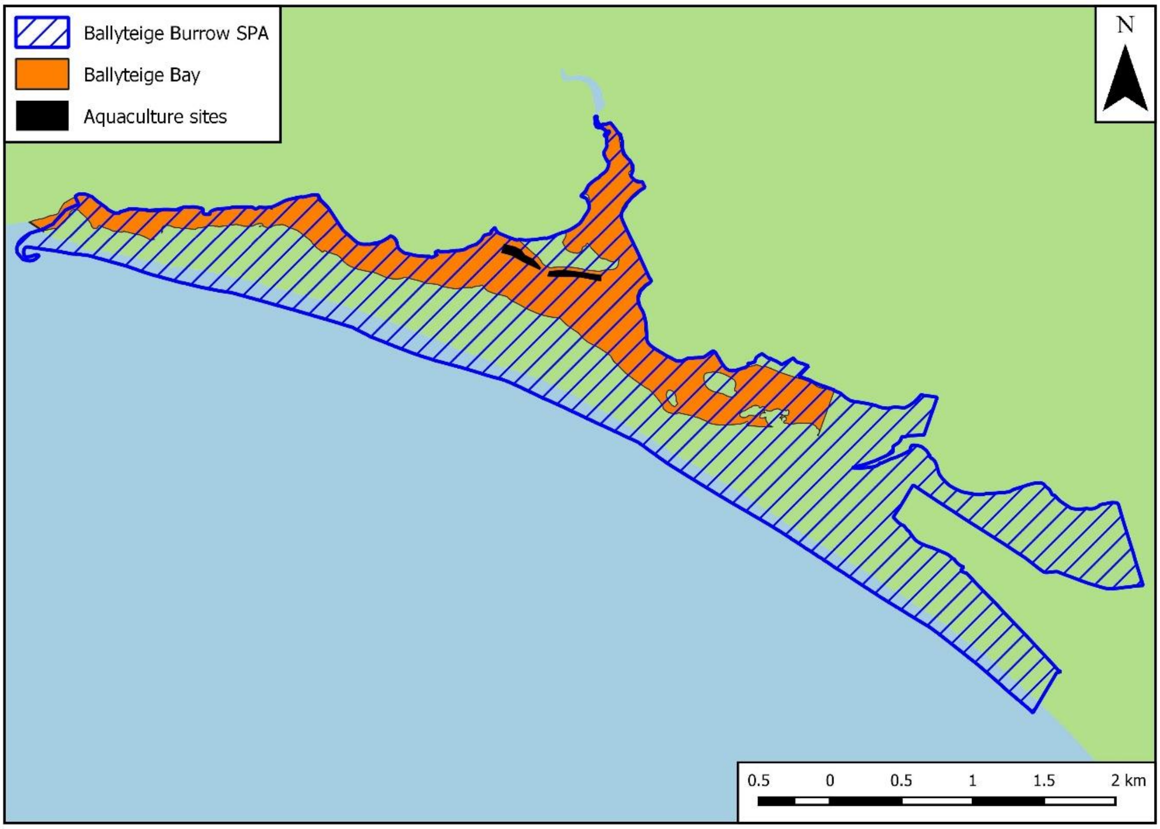

Figure 1.2 – Ballyteige Bay.

2. Methodology

General

2.1 This assessment is based on a desktop review of existing information about waterbird population trends and distribution in Ballyteige Bay, supplemented by site visits to assess the habitat characteristics and tidal regimes in the areas around the aquaculture sites.

Data sources

2.2 The SPA boundaries are derived from NPWS shapefiles[1] (which were last updated in June 2019).

2.3 The spatial extents of the aquaculture sites have been derived from shapefiles supplied by the Marine Institute (shapefile received February 2019).

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

- Irish Wetland Bird Survey (I-WeBS) counts, 1994/95-2015/16.
- NPWS Waterbird Survey Programme (WSP) 2011/12 counts.
- The descriptions of waterbird distribution within the Ballyteige Burrow SPA in the SPA Conservation Objectives Supporting Document (NPWS, 2014a).

2.5 Some additional information on waterbird distribution patterns within the Ballyteige Burrow SPA obtained from consultations with Killian Mullarney, a local ornithologist with long experience of the site.

2.6 Information on the distribution of biotopes was taken from the surveys of intertidal habitats by MERC (2012a) and subtidal habitats by MERC (2012b).

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/).

Intertidal mapping

2.8 Ordnance Survey Ireland (OSI) mapping of intertidal habitat is out of date and does not provide a good representation of the current distribution of intertidal habitat in Ballyteige Bay. The OSI mapping forms the basis for the mapping of the *mudflats and sandflats not covered by seawater at low tide (1140)* Annex I habitat in NPWS (2014b). Therefore, the NPWS mapping is similarly unreliable.

2.9 For the purposes of this assessment, we have used Bing aerial imagery to map the extent of intertidal habitat.

[1] www.npws.ie/maps-and-data/designated-site-data/download-boundary-data (accessed 28th June 2019).

Wintering waterbird datasets

I-WeBS

2.10 Waterbird distribution has been monitored as part of the Irish Wetland Bird Survey (I-WeBS) most winters since 1995/96[2]. No counts were carried out in 2000/01. In 2001/02, only a single, apparently incomplete count, was carried out.

2.11 The I-WeBS scheme aims to carry out monthly counts each winter between September and March in all sites that are important for non-breeding waterbird populations. However, this level of coverage is not always possible to achieve in a volunteer-based scheme. At Ballyteige Bay, between one and seven counts have been carried out each winter (mean 3.9, excluding poor quality counts), with a generally increased level of coverage in more recent winters. Counts have been carried out in January in 16 of the 20 winters with I-WeBS coverage, with counts in the other months in 8-14 of the winters.

2.12 Ballyteige Bay is treated as a single unit for the I-WeBS counts with no divisions into subsites. Detailed information on the timing of the Ballyteige Bay I-WeBS counts is not available for the majority of the counts. However, of the 16 counts for which information is available (all during 1997/98-2004/05), seven were carried out on ebb tides, four at low tide, three at high tide and two on flood tides.

Waterbird Survey Programme

2.13 Details of the Waterbird Survey Programme (WSP) methodology and results at Ballyteige Bay are described in Cummins and Crowe (2012) and Lewis and Tierney (2014).

2.14 Four low tide counts, and one high tide count, were carried out. The low tide counts were carried out in October, November and December 2011 and February 2012. The high tide count was carried out in January 2011. The counts were carried out by a coordinated team of three-four professional counters. Three of the low tide counts were completed in a single day, while the fourth low tide count and the high tide count were competed over two days. There was complete coverage on each count (Cummins and Crowe, 2012).

2.15 The WSP counts covered all of the Ballyteige Burrow SPA as well as areas of coastline and fields outside the SPA. The total area covered was divided into 14 subsites, of which six covered Ballyteige Bay (Figure 2.1 and Figure 2.2).

2.16 The WSP counted feeding and roosting birds separately. However, we have 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.

2.17 As part of the WSP the approximate position of the main flocks encountered were mapped. These flock map data have been used to supplement the analyses of species distribution from the WSP counts. In particular, the flock map data is useful in indicating relationships between species distributions and broad topographical/habitat zones, such as biotopes, edges of tidal channels, upper shore areas, etc.

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[2] Cull & Killag (Ballyteige) I-WeBS site (0O406).

2.18 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 different observers may have varied in the extent to which they mapped flocks.

Assessment methodology

Screening

2.19 The SCIs of the Ballyteige Burrow SPA were reviewed and screened in for detailed assessment if:

- The SCI was considered likely to have significant spatial overlap with the aquaculture activities in Ballyteige Bay, or the potential for such overlap could not be discounted; and
- The SCI was considered likely to be adversely impacted by the aquaculture activities, or the potential for adverse impacts could not be discounted.

2.20 For SCIs of other SPAs, it is difficult to determine the likelihood of spatial overlap as there is generally little information about movements of wintering birds between sites, or about the foraging ranges from breeding colonies.

2.21 Several of the waterbird SCIs of the other SPAs away from Ballyteige Bay are also SCIs of the Ballyteige Burrow SPA. Therefore, these species were screened as part of the screening of the SCIs of the Ballyteige Burrow SPA.

2.22 For additional waterbird SCIs of other SPAs designated for their wintering populations, we considered the general ecology of the species and, in particular, their Ballyteige Bay status and/or the degree of site faithfulness.

2.23 For SCIs designated for their breeding populations, we used information from the literature to define typical foraging ranges for various species.

2.24 The main source for our information on foraging ranges was the BirdLife Seabird Foraging Database (Thaxter *et al.*, 2012), with the additional information provided by Oppel *et al.* (2018) also reviewed. Thaxter *et al.* (2012) provide a range of values for foraging ranges (the mean, the mean maximum and the maximum). The explanatory document for the BirdLife Seabird Foraging Database (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.

2.25 It should be noted that the above approach is analogous to the approach recommended by Scottish Natural Heritage for considering connectivity between SPAs and wind farm developments for the purposes of screening (SNH, 2016). The Scottish Natural Heritage guidance states that: -

> "*In most cases the core range should be used when determining whether there is connectivity between the proposal and the qualifying interests. Maximum ranges are also provided to indicate that birds will, at times, travel further. In exceptional cases distances up to the maximum foraging range may be considered; for example, whilst osprey core foraging range is 10 km an osprey foraging at a loch well beyond this distance from its SPA may still be connected if there is a lack of other closer foraging sites*."

2.26 We are not aware of any other explicit guidance relating to this issue. Therefore, we consider that our approach for screening the SCIs designated for their breeding populations is in accordance with recognised best practise for assessing potential connectivity between breeding bird populations and development proposals.

Identification of potential impacts

2.27 Potential negative impacts to SCI species 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.

2.28 The primary source of information used for the identification of potential impacts is the trestle study (Gittings and O'Donoghue, 2012, 2016b). This study used the results of counts of waterbirds within oyster trestles and in areas of comparable habitat without trestles, and quantification of the available habitat within and outside the trestles, to analyse the relationship between waterbird distribution patterns and the presence of oyster trestles. The main analyses used were: ordination analyses to investigate the influence of oyster trestles on waterbird assemblages (with the position of species in the ordination providing an indication of their association with oyster trestles); and comparison of observed numbers within trestle blocks with numbers predicted assuming that birds are distributed evenly across available habitat. The results of the analyses were used to identify consistent patterns of positive or negative association with oyster trestles across the sites studied and categorised species into the following groups: neutral/positive association, negative association, exclusion response, and variable response (response may vary between sites). In addition, for this assessment, we have carried out further site specific analysis of data from the trestle study (see above).

2.29 The trestle study was carried out during periods with typical levels of husbandry activity. Therefore, the effects of disturbance on waterbirds within the trestle blocks due to husbandry activity associated with intertidal oyster cultivation are included in the categorisation of species responses and such disturbance impacts are not analysed separately in this assessment. However, we have analysed potential disturbance impacts to waterbirds in adjacent areas of tidal habitats outside the trestle blocks.

2.30 The trestle study focused on species associated with the intertidal and/or shallow subtidal habitats. One of the SCIs screened in for this assessment (Cormorant) is a fish-eating species that is primarily associated with deep (>0.5 m) subtidal habitats, and the trestle study does not provide information on its responses to intertidal oyster cultivation. A literature review was carried out to assess the potential impact of intertidal oyster cultivation on fish.

Displacement calculations

General approach

2.31 For most of the species covered by this assessment, we assessed the potential impact of development of the aquaculture sites by calculating the potential displacement as a percentage of the total Ballyteige Bay population. This involves using waterbird count data to calculate the percentage of the total Ballyteige Bay population occurring in the subsites containing the aquaculture sites (waterbird occupancy) and multiplying this by the percentage of tidal habitat in these subsites which is occupied by the aquaculture sites (trestle occupancy).

2.32 We have used similar approaches for previous assessments of oyster trestle cultivation. However, the displacement calculations carried out for the present assessment differ from those previous assessments in two ways: -

- We have used the maximum percentage waterbird occupancy of the subsites containing the aquaculture sites, rather than the mean percentage occupancy.
- We have also included the potential disturbance impacts to waterbirds outside the aquaculture sites from husbandry activity within the aquaculture sites.

2.33 The reasons for these differences are explained below.

Waterbird occupancy

2.34 In general, mean, rather than maximum, waterbird occupancy provides better baseline data for assessing potential displacement impacts. Mean waterbird occupancy measures the overall occupancy levels across the season and indicates the potential cumulative loss of food resources across the season that will result from exclusion of waterbirds from an area.

2.35 At other sites where we have carried out similar assessments, we have had datasets based on a relatively large number of counts over several seasons (e.g., Gittings and O'Donoghue, 2014b), or we have had alternative methods of assessing displacement that can be compared with the occupancy method (e.g., Gittings and O'Donoghue, 2014a), or we have had additional datasets against which the representativeness of the waterbird distribution recorded by the dataset used for the occupancy calculations could be assessed (e.g., Gittings and O'Donoghue, 2016a).

2.36 For the present assessment, the only data that we have on waterbird distribution within Ballyteige Bay is from the WSP low tide counts. There were only four low tide counts carried out, and for several of the SCI species the effective sample size is only two or three counts, as they were absent, or only present in very low numbers on one or two of the low tide counts. We do not have any other data that can be used to evaluate whether the distribution recorded in the WSP low tide counts was representative of typical low tide distribution patterns. A sample size of 2-4 counts is too low for calculations of meaningful occupancy levels using the means of the counts. There would be a high risk of any such calculated means underrepresenting the actual mean occupancy levels due to sampling effects. Therefore, as a precautionary measure, we have used the maximum waterbird occupancies for the calculation of displacement impacts.

2.37 Use of maximum, rather than mean, waterbird occupancies for the present assessment follows the approach taken in the displacement analyses carried out for the Ballymacoda Bay AA (APEM, 2016), which was also based on a dataset that was limited to four low tide counts.

Disturbance

2.38 Displacement of birds from aquaculture sites can be caused by exclusion of birds from the aquaculture sites due to the presence of structures in the aquaculture sites and/or by disturbance due to husbandry activity. In practice, within aquaculture sites it is difficult to distinguish between these two factors and the data that we have on responses to oyster trestle cultivation represents the combined effects of exclusion and disturbance.

2.39 Disturbance can also extend outside the aquaculture sites. However, where there are large aggregations of aquaculture sites, the potential disturbance impact outside the aquaculture sites will be small as most activity will be within the interior of the aquaculture sites. Additionally, in many locations, the configuration of aquaculture sites along the tideline of exposed bays, and the concentration of most waterbird activity along the tideline, means that the potential for disturbance buffers from activity within the aquaculture sites to overlap areas outside the aquaculture sites holding concentrations of waterbirds is very limited.

2.40 The aquaculture sites at Ballyteige Bay differ from the above scenarios due to their size and shape and the position of the aquaculture sites within the bay. The aquaculture sites are small and linear with widths of around 40-70 m, meaning that all activity within the sites will have potential disturbance effects extending outside the sites. The sites are also located in the middle of the bay with a large area of intertidal habitat adjacent to the sites where waterbirds are likely to be distributed at low tide.

Calculation method

2.41 In the following calculations we used proportions of tidal habitat (intertidal and subtidal) rather than intertidal habitat only. The reason for doing so, is that the detailed configuration of the tidal channels in the subsites containing the aquaculture sites appears to be quite variable between different sources of aerial imagery. Also, at low tide parts or all of the tidal channel may be accessible to intertidally feeding birds. Therefore, we consider that using all tidal habitat, rather than only intertidal habitat, is more appropriate in these circumstances.

2.42 We used the WSP low tide count data to calculate the waterbird subsite occupancy as the maximum percentage (across all the low tide counts, excluding those where very low numbers of the SCI species were recorded) of the total count occurring within the two subsites that contain the aquaculture sites ($P_{W\text{-}SO}$).

2.43 We then corrected $P_{W\text{-}SO}$ to account for displacement due to existing aquaculture activity that was occurring at the time of the WSP counts. The formula for this correction is given at the end of this section, as it is based on the subsequent stages of the displacement calculations. This gave us a corrected value ($P_{W\text{-}SO*}$), which was used in the subsequent calculations.

2.44 We then used the proportion of tidal habitat occupied by the aquaculture sites in these two subsites ($P_{TH\text{-}AQU}$) to estimate the percentage of birds in these subsites that would be expected to occur in the aquaculture sites. The predicted displacement of birds due to exclusion from the aquaculture sites (D_{excl}) is then given by the product of these two percentages:

$$D_{excl} = P_{W\text{-}SO*} * P_{TH\text{-}AQU}$$

2.45 To calculate the displacement due to disturbance, we needed to define the spatial and temporal patterns of husbandry activity within the aquaculture sites, and the response of waterbirds to disturbance.

2.46 A single husbandry worker working on trestles within an aquaculture site represents a point disturbance source. The potential disturbance impact of such a source can by assessed by drawing buffers around the point representing distances at which birds show various levels of response to disturbance. However, in practice, there are usually multiple husbandry workers present in aquaculture sites, which they will move around while they are working. We do not have data on the likely spatial patterns of husbandry activity within the aquaculture sites at Ballyteige Bay. Instead, as a crude approximation, we divided each of the aquaculture sites into four approximately equal segments and assumed that, at any one time, activity within each aquaculture site would be restricted to one of the segments.

2.47 Husbandry activity in small aquaculture sites, such as those in Ballyteige Bay, typically does not take place on every low tide. Based on experience at other oyster trestle cultivation sites in Ireland, we have assumed that husbandry activity will take place on around one-third of days at Ballyteige Bay. We have also assumed that husbandry activity in the two aquaculture sites will take place at the same time.

2.48 We used data from monitoring at Dungarvan Harbour (Gittings and O'Donoghue, 2018a, 2018b, 2019; see Chapter 7) to quantify the potential response of waterbirds to husbandry-related disturbance. This monitoring reported an 80% flush rate within 100 m (n = 5 observations) and a 23% flush rate at distances of 100-300 m (n = 30 observations). Because of the small sample size, we have used a 100% displacement rate for the 0-100 m distance band, and we rounded up to a 25% displacement rate for the 100-300 m distance band.

2.49 We calculated the potential displacement impact due to disturbance (D_{dist}): -

$$D_{dist} = (P_{W\text{-}SO^*} - D_{excl}) * (P_{TH\text{-}100} + (P_{TH\text{-}300} * 0.25)) * 0.33$$

where $P_{TH\text{-}100}$ = the proportion of tidal habitat in the subsites containing the aquaculture sites within 100 m, and 100-300 m, respectively of the aquaculture sites (excluding the habitat within the aquaculture sites). The displacement due to exclusion (D_{excl}) is factored out of this calculation to avoid double counting this impact.

2.50 For each species, we calculated two values of D_{dist}: one using buffers from point sources located at the centroids of each of the aquaculture sites (Figure 2.3), and the other using buffers from segments in each of the aquaculture sites. The latter used the mean of two combinations of segments: one using segments at the opposite ends of the aquaculture sites (Figure 2.4) and the other using segments at adjacent ends of the aquaculture sites (Figure 2.5). Sections of the buffers that overlapped the subsite 0OL06 were excluded from the analyses due to the lack of sightlines from the aquaculture sites to that subsite. These calculations gave a range of minimum to maximum displacement impacts due to disturbance.

2.51 To factor in displacement due to existing aquaculture activity, we corrected $P_{W\text{-}SO}$ using the following formula:

$$P_{W\text{-}SO^*} = P_{W\text{-}SO} + (P_{W\text{-}SO}/(1\text{-} P_{TH\text{-}AQU})\text{-} P_{W\text{-}SO}) + (P_{W\text{-}SO}/(1\text{-} (P_{TH\text{-}100}/4))\text{-} P_{W\text{-}SO}) + (P_{W\text{-}SO}/(1\text{-} (P_{TH\text{-}300}/16))\text{-} P_{W\text{-}SO})$$

2.52 The correction of $P_{TH\text{-}100}$ by a factor of 1/4, and $P_{TH\text{-}300}$ by a factor of 1/16, account for the temporal pattern of husbandry activity (recorded on one out of the four WSP counts) and the 25% flush rate in the 100-300 m distance band.

2.53 In practice the above correction only increased the predicted displacement by a maximum of 0.2%.

Impacts on population trends

2.54 We have information on aquaculture production levels at Ballyteige Bay from 2008-2018. This provides an indication of the intensity of aquaculture activity over those years. Therefore, in theory, analysis of the waterbird population trends over this period could reveal evidence about the nature of any impacts from aquaculture on the waterbird populations.

2.55 The Conservation Objectives Supporting Document (NPWS, 2014a) provides population trend information for the Ballyteige Burrow SPA over the period 1995/96-2010/11. This does not match well with the period for which we have aquaculture production data. Therefore, we have carried out our own analyses.

2.56 We used the I-WeBS dataset to calculate population trends over the period 2007/08-2015/16, as 2015/16 is the most recent winter for which I-WeBS data was available. Also, this broadly corresponds to the period for which Burke *et al.* (2018) calculated national population trends. For comparison with those national population trends, we calculated five year mean peak counts for the beginning and end of the period.

2.57 Aquaculture production at Ballyteige Bay showed an increasing trend across this period. Therefore, if aquaculture in Ballyteige Bay was having a negative impact on waterbird populations we would expect decreasing trends in waterbird populations at Ballyteige Bay relative to the national trend.

2.58 The above represents a very simple analysis. More complex methods of investigating population trends using GLM to impute missing counts and GAM to model smoothed trends are widely used in analyses of waterbird population trends. However, these were not used by NPWS (2014a) at Ballyteige Bay due to the variable level of I-WeBS coverage.

Assumptions

2.59 Our displacement analysis relies on the following assumptions: -

- All the species are completely excluded from areas occupied by oyster trestle cultivation.
- The disturbance responses derived from the Dungarvan Harbour data are representative of the likely disturbance responses in Ballyteige Bay.
- The subsite occupancy values used in the analyses are representative of typical subsite occupancy values across seasons.
- Within the subsites containing the aquaculture sites, and in the absence of any oyster trestle cultivation activity, the waterbirds would occur within the aquaculture sites in proportion to the area occupied by the aquaculture sites.
- Disturbance to waterbirds from oyster trestle cultivation activity will only be potentially significant if it causes displacement of birds.

2.60 The assumption that all the species are completely excluded from areas occupied by oyster trestle cultivation is precautionary. While this assumption is correct for at least one of the species covered by the assessment (Grey Plover), other species show reduced densities within areas of oyster trestle cultivation but are not completely excluded (Bar-tailed Godwit and Dunlin), while other species appear to show variable responses to oyster trestle cultivation which differ between sites (Light-bellied Brent Goose and Curlew).

2.61 We consider the overall pattern of disturbance responses derived from the Dungarvan Harbour data to be broadly representative of typical patterns of disturbance responses to oyster trestle cultivation activity, but the precise quantitative values are likely to vary between species and with flock sizes (see Chapter 7).

2.62 The subsite occupancy values used in the analyses are based on a very small number of counts (2-4 counts) from a single season. For this reason, we have used the maximum, rather than the mean, subsite occupancy values. However, this may still underestimate overall occupancy levels across seasons, as illustrated by the following analysis of data from Bannow Bay.

2.63 At Bannow Bay, counts from three seasons were used for an updated displacement analysis (Gittings and O'Donoghue, 2017) with four counts being carried out in each season. Table 2.1 compares the number of annual peak subsite occupancy values in the two subsites that were used for the displacement analyses that were greater than the overall mean subsite occupancy values across all three seasons. For all species except Light-bellied Brent Goose, there were some annual peak subsite occupancy values that were less than the overall mean. Across all species, 20% of the annual peak subsite occupancy values were less than the overall mean across all seasons. Therefore, even with the use of maximum, rather than mean, subsite occupancy, there is still a significant risk of underestimating overall subsite occupancy levels across seasons.

Table 2.1 - Comparison of annual peak subsite occupancy in subsites used for displacement analyses at Bannow Bay in three seasons with overall mean subsite occupancy across all three seasons.

Species	Number of annual peak values > overall mean		Number of counts included in overall mean
	0O413	0O418	
Light-bellied Brent Goose	3	3	11
Shelduck	2	3	9
Wigeon	2	3	7
Golden Plover	1	2	11
Grey Plover	1	3	12
Lapwing	2	3	12
Curlew	3	2	11
Black-tailed Godwit	3	2	7
Bar-tailed Godwit	3	2	12
Dunlin	2	2	12
Redshank	3	3	10
Totals	25	28	114

Derived from analysis of datasets used for Gittings and O'Donoghue (2017). Counts with overall totals of < 100, or < 10 for Grey Plover, were excluded from the calculations of overall means (see Gittings and O'Donoghue, 2017).

2.64 The assumption that species are effectively uniformly distributed within subsites (at least with respect to aquaculture sites) is unlikely to be strictly correct at most sites but may be a reasonable approximation at Ballyteige Bay. In Ballyteige Bay, the subsites containing the aquaculture sites are relatively small and do not appear to have significant habitat variation. As it is an estuarine site, rather than open sandflat, waterbirds will generally be widely distributed across the intertidal habitat at low tide, rather than concentrated on the tideline. However, there may be some concentration of the species associated with shallow subtidal habitat (Light-bellied Brent Goose, Shelduck and Wigeon) along the tidal channels, while waders may roost along the edges of the tidal channels for short periods at low tide.

2.65 Behavioural responses to disturbance (such as flush responses) will not necessarily indicate the potential impact of disturbance on the species population. Species responses to disturbance should reflect the costs of responding to the disturbance (Gill *et al.*, 2001): if there is alternative habitat available and the costs of moving to this habitat are low, species may show a stronger avoidance of disturbed areas, compared to species with little alternative habitat available and/or higher costs of moving to this habitat. However, if species distributions at the site-scale are not affected by disturbance, and there is sufficient knowledge of the species use of the site to assess that habitat factors/resource availability are not restricting their distribution, it will generally be reasonable to assume that disturbance is not having an impact on the species population. Moreover, for SCIs in SPAs, if species distributions at the site-scale are affected by disturbance this would be in conflict with the site-specific conservation objectives for the site.

Assessment of significance

2.66 We assessed the significance of any potential impacts identified with reference to the attributes and targets specified by NPWS (2014c, 2012b and 2011a). Potential negative impacts were 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.

Ballyteige Burrow SPA and Bannow Bay SPA SCIs

Attribute 2 – Distribution

2.67 For these SCIs, we have focused on attribute 2 (distribution) of the conservation objectives.

2.68 Assessing significance with reference to attribute 2 is difficult because the level of decrease in the range, timing or intensity of use 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 Bannow Bay population would be detectable against background levels of annual variation.

2.69 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.

2.70 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 Turnstone would be a decrease of two birds. 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).

Attribute 1 - Population trends

2.71 Impacts on this attribute are only likely to occur if there are high levels of displacement impacts. However, there is a high level of uncertainty about the magnitude of the displacement impacts that are likely to occur. Therefore, we do not consider that it would be appropriate to attempt to assess the impact on this attribute given the current level of available data.

Keeragh Islands SPA and Saltee Islands SPA SCIs

2.72 Two SCIs were screened in from these SPAs: the Cormorant breeding population in the Keeragh Islands and the Lesser Black-backed Gull breeding population in the Saltee Islands.

2.73 NPWS have published site specific conservation objectives for the Saltee Islands SPA, which include detailed attributes and targets for the Lesser Black-backed Gull breeding population. NPWS have only published generic conservation objectives for the Keeragh Islands SPA. However, for the purposes of our assessment, we have assumed that the attributes and targets specified for the Cormorant breeding population in the Saltee Islands SPA[3] also apply to the Cormorant breeding population in the Keeragh Islands SPA.

2.74 We used these attributes and targets to assess the significance of potential impacts to these two SCIs.

[3] Cormorant is also a SCI of the Saltee Islands SPA, but this SCI was screened out due to the distance from Ballyteige Bay relative to the typical foraging range of the species.

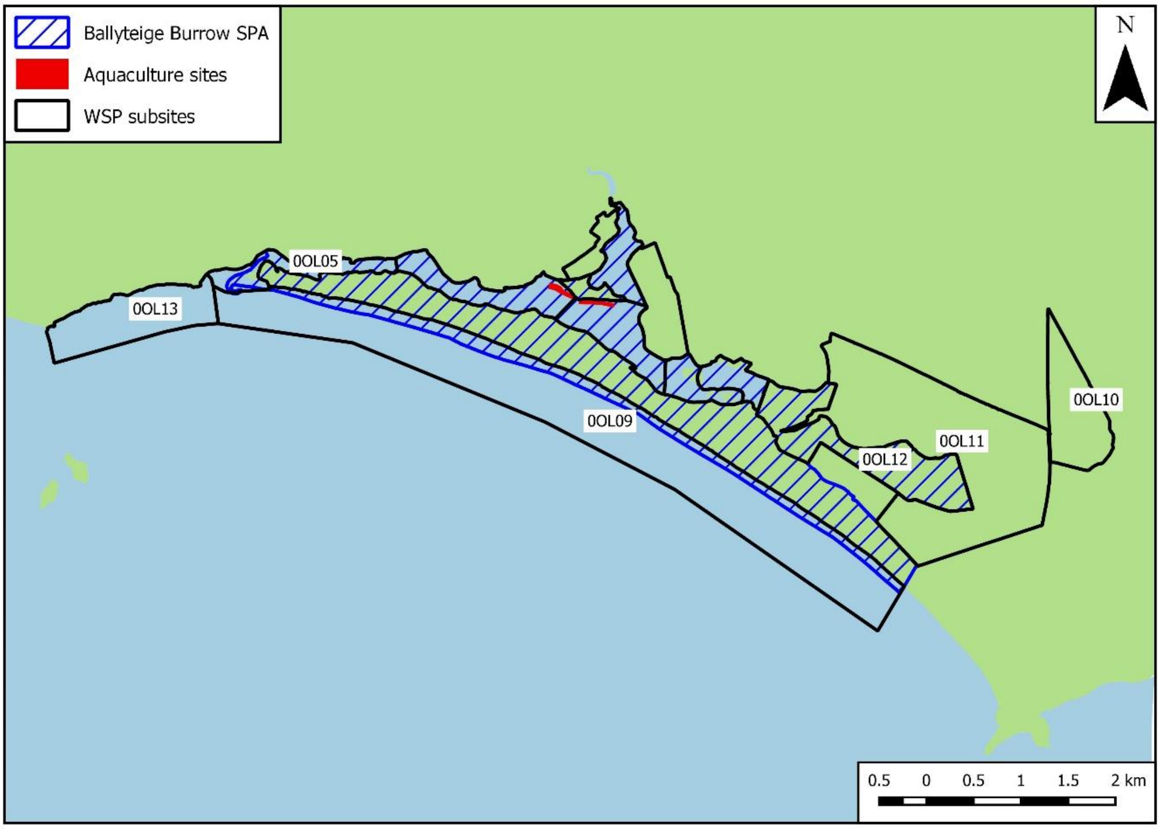

Figure 2.1 – WSP subsites (overall map).

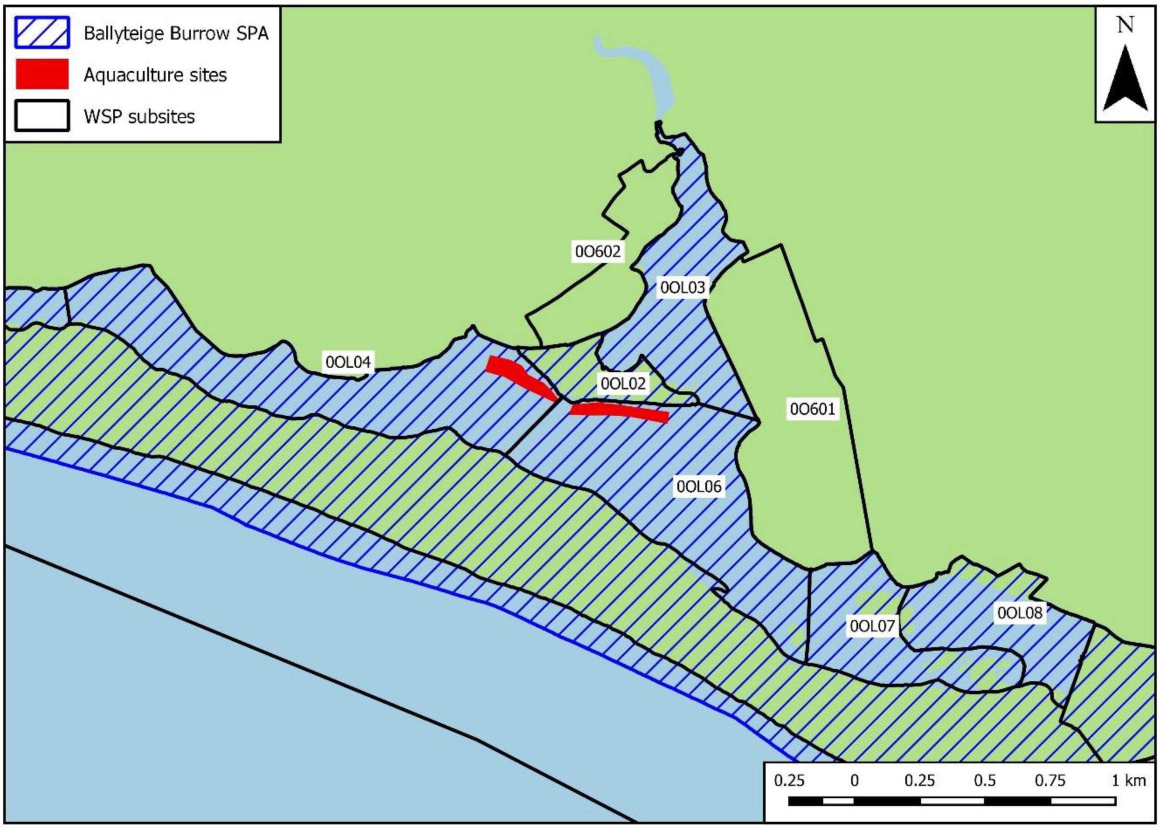

Figure 2.2 – WSP subsites (middle and upper bay).

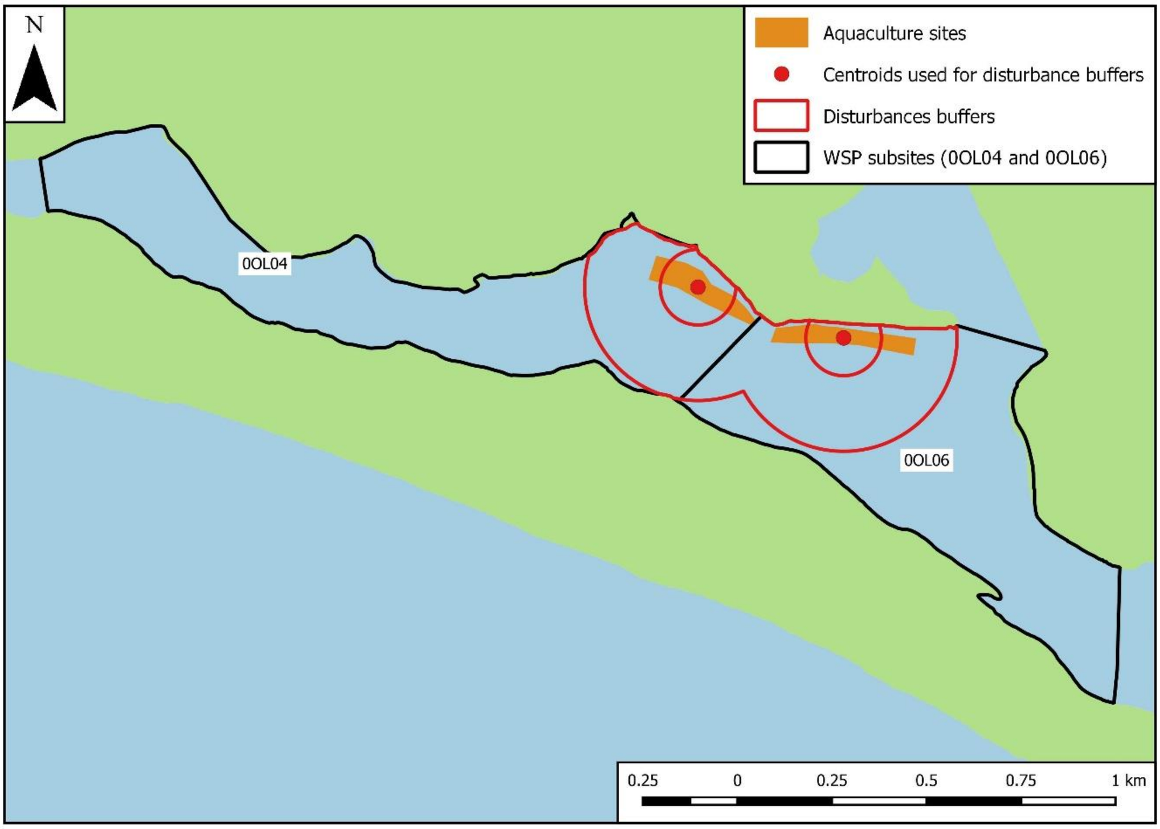

Figure 2.3 – Disturbance buffers generated using the centroids of each aquaculture site.

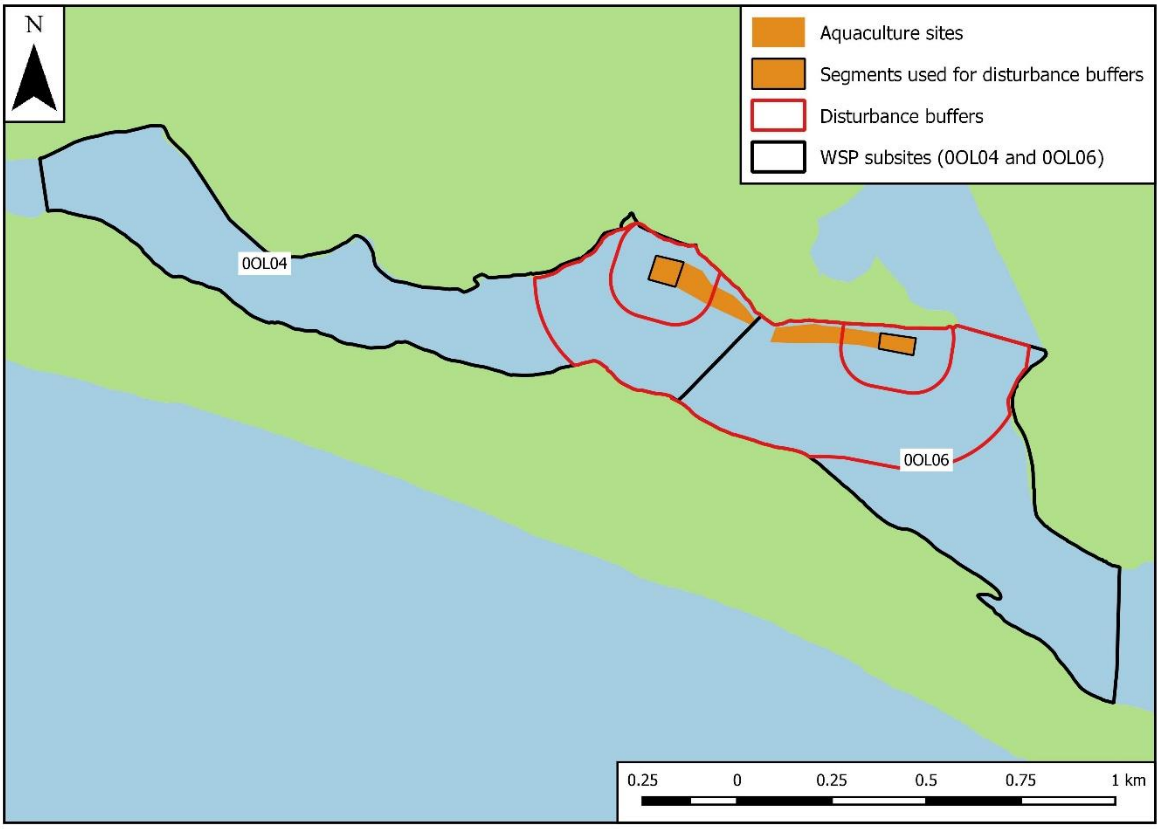

Figure 2.4 – Disturbance buffers generated using segments located at the opposite ends of each aquaculture site.

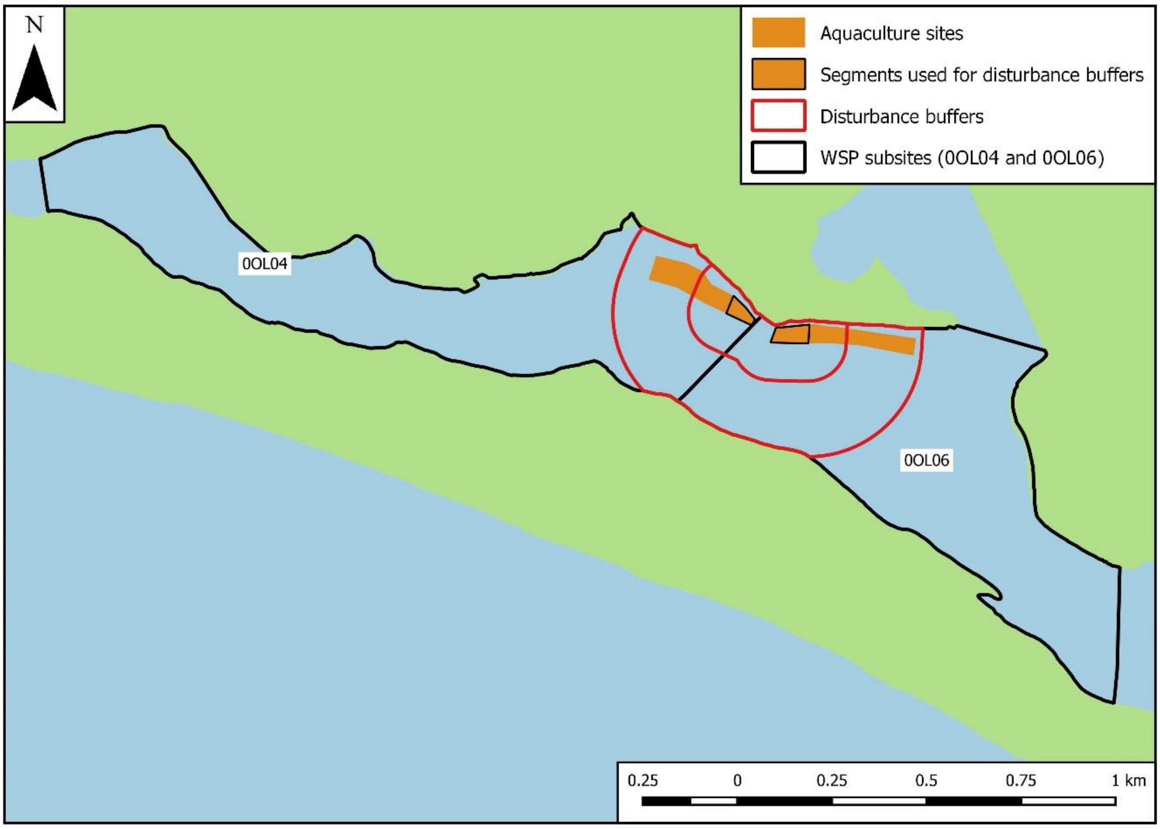

Figure 2.5 - Disturbance buffers generated using segments located at the adjacent ends of each aquaculture site.

3. Screening

Introduction

3.1 In addition to the Ballyteige Burrow SPA, the Bannow Bay, Keeragh Islands, Saltee Islands and Tacumshin Lake SPAs are also within 15 km of the aquaculture sites in Ballyteige Bay (Figure 3.1). There is also potential connectivity with the Lady's Island Lake, The Raven and the Wexford Harbour SPAs (Figure 3.1).

Ballyteige Burrow SPA

Waterbird SCIs

3.2 The following species are listed as SCIs of the Ballyteige Burrow SPA: Light-bellied Brent Goose, Shelduck, Golden Plover, Grey Plover, Lapwing, Black-tailed Godwit and Bar-tailed Godwit. All of these species make significant use of subtidal and/or intertidal habitat in Ballyteige Bay. The aquaculture activities covered in this assessment will affect 3.3 ha of intertidal and subtidal habitat and have the potential to cause significant changes to habitat structure and/or food availability, and/or because disturbance impacts to the SCI species. Therefore, the activities being assessed could potentially have significant impacts on SCIs that use subtidal and/or intertidal habitat.

Wetland SCI

3.3 The wetland habitat is also listed as a SCI of the Ballyteige Burrow SPA. The Conservation Objectives define the favourable conservation condition of this SCI purely in terms of habitat area. 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.

Other SPAs

3.4 SPAs in the wider vicinity of Ballyteige Bay are shown in Figure 3.1. There are a number of SPAs along the coastline on either side of Ballyteige Bay that are designated for various wintering waterbird and/or breeding seabird populations. It is known that some waterbird species regularly move between some of these SPAs: e.g., Whooper Swans move between the Wexford Harbour and Slobs and Tacumshin Lake SPAs. Therefore, it is necessary to consider the potential for impacts to Special Conservation Interests (SCIs) of other SPAs away from Ballyteige Burrow.

3.5 Some of the SCIs of the other SPAs away from Ballyteige Burrow are also SCIs of the Ballyteige Burrow SPA. Therefore, these species will be assessed as part of the assessment of the potential impacts to the Ballyteige Burrow SPA. The additional waterbird and seabird species that are SCIs of other SPAs are listed in Table 3.1 and Table 3.2.

3.6 The additional breeding seabird species include several species that feed in open marine waters and do not usually come into enclosed estuarine areas (Fulmar, Gannet, Puffin, Razorbill, Guillemot and Kittiwake; Table 3.1). Therefore, these species can all be screened out as there is unlikely to be any significant overlap between their foraging ranges and the aquaculture sites. The other breeding seabird SCIs include several for which the aquaculture sites in Ballyteige Bay are well outside their likely core foraging (Cormorant in the Saltee Islands, Shag, Little Tern, Sandwich Tern, Common Tern, Roseate Tern, Arctic Tern and Black-headed Gull; Table 3.1). This leaves only the Cormorant SCI of the Keeragh Islands SPA and the Lesser Black-backed Gull and the Lesser Black-backed Gull and Herring Gull SCIs of the Saltee Islands SPA as likely to have significant spatial overlap with the aquaculture sites in Ballyteige Bay. However, Herring Gull has a neutral/positive response to oyster trestle cultivation (Gittings and O'Donoghue, 2016b) and can therefore be screened out from further assessment.

3.7 The additional wintering waterbird SCIs include several that are of rare occurrence, or occur in very low numbers, in Ballyteige Bay (Bewick's Swan, Gadwall, Pintail, Shoveler, Tufted Duck, Coot and Knot; Table 3.2). Therefore, these SCIs can all be screened out as they are unlikely to have any significant overlap with the aquaculture sites. Whooper Swan can be screened out because the distance of Ballyteige Bay from Tacumshin Lake (around 10 km) is a lot greater than its likely core foraging range of 5 km (SNH, 2016). The other SCIs include four waders that are SCIs of the Bannow Bay SPA (Curlew, Dunlin and Redshank; Table 3.2). These SCIs have all been screened in due to the likelihood that there is significant waterbird movement between Ballyteige Bay and Bannow Bay due to the unusual tidal regime in Ballyteige Bay. The Wigeon SCI of the Tacumshin Lake SPA has also been screened in due to the low site fidelity of wintering populations of this species.

Table 3.1 - Breeding seabird SCIs of other SPAs in the wider vicinity of Ballyteige Bay that are not SCIs of the Ballyteige Burrow SPA.

Species	SPA	Within core range	Suitable habitat	Preliminary screening
Fulmar	Saltee Islands SPA	yes	no	screened out
Gannet	Saltee Islands SPA	yes	no	screened out
Cormorant	Keeragh Islands SPA	yes	yes	screened in
	Saltee Islands SPA	no	yes	screened out
Shag	Saltee Islands SPA	no	yes	screened out
Puffin	Saltee Islands SPA	no	no	screened out
Razorbill	Saltee Islands SPA	yes	no	screened out
Guillemot	Saltee Islands SPA	yes	no	screened out
Little Tern	Wexford Harbour and Slobs	no	yes	screened out
Sandwich Tern	Lady's Island Lake	no	yes	screened out
Common Tern	Lady's Island Lake	no	yes	screened out
Roseate Tern	Lady's Island Lake	no	yes	screened out
Arctic Tern	Lady's Island Lake	no	yes	screened out
Kittiwake	Saltee Islands SPA	yes	no	screened out
Black-headed Gull	Lady's Island Lake	no	yes	screened out
Lesser Black-backed Gull	Saltee Islands SPA	yes	yes	screened in
Herring Gull	Saltee Islands SPA	yes	yes	screened out

Note: Herring Gull screened out due to neutral/positive response to oyster trestle cultivation (Gittings and O'Donoghue, 2016b).

Table 3.2 – Wintering waterbird SCIs of other SPAs on the south Wexford coast that are not SCIs of the Ballyteige Burrow SPA.

Species	SPA	Ballyteige Bay status	Site fidelity	Preliminary screening
Bewick's Swan	Tacumshin Lake	rare	high	screened out
Whooper Swan	Tacumshin Lake	regular	moderate/high	screened out
Wigeon	Tacumshin Lake	regular	weak	screened in
Gadwall	Lady's Island Lake	rare	not classified	screened out
	Tacumshin Lake	rare	not classified	screened out
Teal	Tacumshin Lake	regular	weak	screened out
Pintail	Bannow Bay	rare	weak	screened out
	Tacumshin Lake	regular	weak	screened out
Shoveler	Tacumshin Lake	rare	moderate	screened out
Tufted Duck	Tacumshin Lake	rare	not classified	screened out
Little Grebe	Tacumshin Lake	regular	unknown	screened out
Coot	Tacumshin Lake	rare	unknown	screened out
Curlew	Bannow Bay	regular	high	screened in
Knot	Bannow Bay	rare	moderate	screened out
Dunlin	Bannow Bay	regular	moderate	screened in
Redshank	Bannow Bay	regular	moderate	screened in

Note: Ballyteige Bay status based on review of I-WeBS data; Bewick's Swan and Pintail were regular in 1990s, and Knot was regular in the 2000s, but these species are all now of very rare occurrence. Site fidelity based on NPWS (2011b, 2014d).

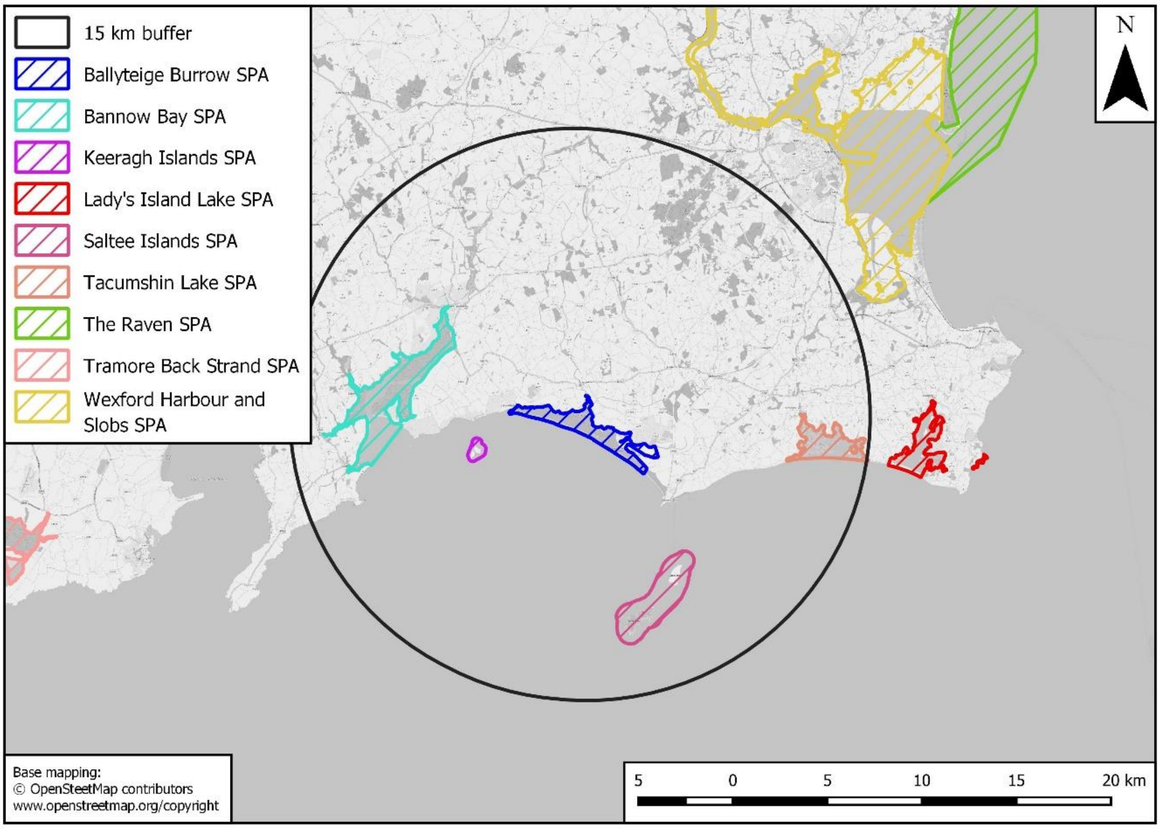

Figure 3.1 – SPAs in the vicinity of Ballyteige Bay.

4. Conservation objectives

Ballyteige Burrow SPA

4.1 The conservation objectives for the Light-bellied Brent Goose, Shelduck, Golden Plover, Grey Plover, Lapwing, Black-tailed Godwit and Bar-tailed Godwit SCIs of the Ballyteige Burrow SPA are to maintain their favourable conservation condition (NPWS, 2014c).

4.2 The favourable conservation conditions of these SCIs in the Ballyteige Burrow SPA are defined by various attributes and targets, which are shown in Table 4.1.

Table 4.1 - Attributes and targets for the conservation objectives for the Light-bellied Brent Goose, Shelduck, Golden Plover, Grey Plover, Lapwing, Black-tailed Godwit and Bar-tailed Godwit SCIs of the Ballyteige Burrow SPA.

Attribute		Measure	Target	Notes
1	Population trend	Percentage change	Long term population trend stable or increasing	Waterbird population trends are presented in part four of the Conservation Objectives Supporting Document
2	Distribution	Range, timing and intensity of use of areas	There should be no significant decrease in the range, timing and intensity of use of areas by … [SCI species] other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the Conservation Objectives Supporting Document

Source: NPWS (2014c).

Attributes are not numbered in NPWS (2014c) but are numbered here for convenience.

Bannow Bay SPA

4.3 The conservation objectives for the Curlew, Dunlin and Redshank SCIs of the Bannow Bay SPA are to maintain their favourable conservation condition (NPWS, 2012b).

4.4 The favourable conservation conditions of these SCIs in the Ballyteige Burrow SPA are defined by various attributes and targets, which are shown in Table 4.1.

Table 4.2 - Attributes and targets for the conservation objectives for the Curlew, Dunlin and Redshank SCIs of the Bannow Bay SPA.

Attribute	Measure	Target	Notes
1 Population trend	Percentage change	Long term population trend stable or increasing	Waterbird population trends are presented in part four of the Conservation Objectives Supporting Document
2 Distribution	Range, timing and intensity of use of areas	There should be no significant decrease in the range, timing and intensity of use of areas by … [SCI species] other than that occurring from natural patterns of variation	As determined by regular low tide and other waterbird surveys. Waterbird distribution from the 2009/10 waterbird survey programme is discussed in Part Five of the conservation objectives supporting document

Source: NPWS (2012b).

Attributes are not numbered in NPWS (2012b) but are numbered here for convenience.

Tacumshin Lake SPA

4.5 The conservation objectives for the Wigeon SCI of the Tacumshin Lake SPA is to maintain its favourable conservation condition (NPWS, 2018b).

4.6 Site-specific conservation objectives have not been published for the Tacumshin Lake SPA. However, attributes and targets published for the SCIs of the Ballyteige Burrow SPA (Table 4.1) can be assumed to also apply to the Wigeon SCI of the Tacumshin Lake SPA.

Keeragh Islands SPA

4.7 The conservation objective for the Cormorant breeding population in the Keeragh Islands SPA is to maintain or restore its favourable conservation condition (NPWS, 2018a).

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

Saltee Islands SPA

4.9 The conservation objective for the Lesser Black-backed Gull breeding population in the Saltee Islands SPA is to maintain its favourable conservation condition (NPWS, 2011a). The favourable conservation condition of this species at the Saltee Islands SPA is defined by the following attributes: breeding population abundance, productivity rate, distribution of breeding colonies, availability of prey biomass, barriers to connectivity, and disturbance at the breeding site.

5. Status and habitats and distribution of the SCI species

Status of the SCI species

Ballyteige Burrow SPA

5.1 The status of the SCI species in the Ballyteige Burrow SPA as reported in the Conservation Objectives Supporting Document (NPWS, 2014a) is summarised in Table 5.1.

Table 5.1 – Status of the SCI species in the Ballyteige Burrow SPA as reported in the Conservation Objectives Supporting Document (NPWS, 2014a).

Special Conservation Interests (SCIs)	Site Conservation Condition	Site population trend[1]	All-Ireland Trend[2]	International trend[4]
Light-bellied Brent Goose	Favourable	+84	Increasing	Increasing
Shelduck	Highly Unfavourable	-77	Stable	Stable
Golden Plover	Favourable	+12	Declining	Decreasing?
Grey Plover	Intermediate (unfavourable)	-12	Declining	Decreasing?
Lapwing	Highly Unfavourable	-60	Declining	Stable
Black-tailed Godwit	Unfavourable	-48	Increasing	Increasing
Bar-tailed Godwit	Highly Unfavourable	-70	Stable	Increasing

Source: Table 4.4 in NPWS (2014a).

[1] change between the 1995/96-1999/00 and 2006/07-2010/11 mean annual peak counts; [2] all-Ireland trends from Crowe and Holt (2013); [4] international trends after Wetland International (2006).

5.2 The population trends reported in the Conservation Objectives Supporting Document (NPWS, 2014a) are now around ten years out of date. The population changes up to the most recent available I-WeBS data are summarised in Table 5.2, and compared to recently published estimates of all-Ireland population changes (Burke *et al.*, 2018).

Table 5.2 –Short-term and long-term percentage changes in the population estimates for the SCI species in the Ballyteige Burrow SPA compared to the national estimates.

Special Conservation Interests (SCIs)	Short-term change		Long-term change	
	Ballyteige Burrow	all-Ireland	Ballyteige Burrow	all-Ireland
Light-bellied Brent Goose	-3%	-15%	+35%	+96%
Shelduck	-2%	-14%	-68%	-30%
Golden Plover	-61%	-24%	-56%	-44%
Grey Plover	+38%	-6%	+59%	-54%
Lapwing	-52%	-16%	-81%	-67%
Black-tailed Godwit	+86%	+4%	-30%	+45%
Bar-tailed Godwit	+14%	+4%	-2%	+6%

Note: The percentage changes are the changes between the mean annual peak counts (Ballyteige Burrow) and the mean annual peak estimates (all-Ireland) between the periods 2006/07-2010/11 and 2011/12-2015/16 (short-term) and 1994/95-1998/99 and 2011/12-2015/16 (long-term). Ballyteige Burrow percentage changes calculated from I-WeBS data. All-Ireland percentage changes from Burke *et al.* (2018).

Bannow Bay SPA

5.3 The conservation condition and trends of the Bannow Bay SCI species included in this assessment are summarised in Table 5.1. Shelduck, Grey Plover, Knot and Dunlin have been classified as having highly unfavourable conservation condition, while Light-bellied Brent Goose, Golden Plover, Lapwing, Curlew and Redshank have been classified as having intermediate (unfavourable)) conservation condition.

Table 5.3 - Conservation condition and population trends of the SCI assessment species at Bannow Bay.

Special Conservation Interests (SCIs)	Site Conservation Condition	12 year site population trend[1]	5 year site population trend[2]	Current all-Ireland Trend[3]	Current international trend[4]
Light-bellied Brent Goose	Intermediate (unfavourable)	-6.99	-9.44	+58	Increase
Shelduck	Highly Unfavourable	-52.6	-48.9	+4.46	Stable (*alpina*)
Golden Plover	Intermediate (unfavourable)	-2.6	-29.0	-2.2	Stable
Grey Plover	Highly Unfavourable	-72.1	-52.8	-33.1	Stable
Lapwing	Intermediate (unfavourable)	-3.0	-35.4	-40.12	Decline
Dunlin	Highly Unfavourable	-75.7	-57.5	-46.5	Decline
Black-tailed Godwit	Favourable	+27.2	+39.6	+70.2	Decline
Bar-tailed Godwit	Favourable	+10.1	-10.6	+1.5	Decline
Curlew	Intermediate (unfavourable)	-17.3	-22.7	-25.7	Decline
Redshank	Intermediate (unfavourable)	-4.6	-21.4	+22.7	Stable/Decline

Source: Tables 4.1 and 4.2 in NPWS (2012a).

n/c = not calculated. [1]site population trend analysis, 12 yr = 1994–2007; [2] site population trend analysis, 5 yr = 2002–2007; [3]all-Ireland trend calculated for period 1994/95 to 2008/09; [4] international trends after Wetland International (2006).

Tacumshin Lake SPA

5.4 The conservation condition of the Wigeon SCI of the Tacumshin Lake SPA has not been assessed.

Keeragh Islands SPA

5.5 The conservation condition of the breeding Cormorant population in the Keeragh Islands SPA has not been assessed.

5.6 The available population data (all apparently occupied nests) are: 160 (1986), 239 (1987), 200 (1988), 206 (1989) and 200 (2000) (JNCC Seabird Colony Data; http://jncc.defra.gov.uk/page-4460).

Saltee Islands SPA

5.7 The conservation condition of the breeding Lesser Black-backed Gull population in the Saltee Islands SPA has not been assessed.

5.8 The available population data (all apparently occupied nests or apparently occupied territories) are: 82 (1986), 80 (1987), 80 (1989), 620 (1994), 500 (1996), 231 (1998) and 184 (2000) (JNCC Seabird

Colony Data; http://jncc.defra.gov.uk/page-4460). All this data is for the Great Saltee Island only, except for the data for 2000 which includes 40 on the Little Saltee Island.

Waterbird habitats in Ballyteige Bay

Tidal patterns

5.9 Ballyteige Bay has an unusual tidal regime.

5.10 The report on the WSP counts states that tides times "were hard to predict as there was on average a 2-hour lag given the unique tidal flow into and out of the intertidal sections of the site" (Cummins and Crowe, 2012). It has also been noted that Ballyteige Bay "*strips much better on a neap tide (the reverse of most bays) due to the narrow mouth to the sea apparently" and, as a result "the existing oyster farmer avails of neap tides rather than spring tides*" (Brian O'Loan, BIM, pers. comm.).

Table 5.4 – Observations of tidal conditions at Ballyteige Bay.

Date	Low tide		Conditions observed	Notes
	time	height		
13/04/2017	14:02	0.7 m	13:30-14:30	Extensive area of intertidal exposed but with wide flooded area in middle of bay. Aquaculture sites at least partly exposed and husbandry work taking place.
08/03/2019	12:45	0.8 m	11:30-14:30	Strong SW winds and heavy rain. Tide barely went out with only narrow strips of intertidal exposed along shorelines. No exposure of aquaculture sites.
28/03/2019*	04:38	1.2 m	07:00-10:00	Tide very low with extensive areas of intertidal exposed

* 28/03/2019 observation: K. Mullarney (pers. comm.).

Habitats

5.11 The majority of intertidal habitat in Ballyteige Bay is unvegetated littoral sediment habitat: i.e., LS habitat, as defined by Fossitt (2007). Areas of saltmarsh occur in several locations (Figure 5.1).

5.12 The littoral sediment habitat was classified into three biotopes by MERC (2012a). The habitat inside the bay was classified as the *Hediste diversicolor dominated gravelly sandy mud shores (LS.LMx.GvMu)*. This biotope is characterised by "sheltered gravelly sandy mud, subject to reduced salinity, mainly on the mid and lower shore" with abundant ragworm *Hediste diversicolor* dominating the benthic fauna. The habitat along the outer beach was classified as the *barren or amphipod dominated mobile sand shores (LS.LSa.MoSa)* biotope. This biotope is "typically situated along open stretches of coastline, with a relatively high degree of wave exposure", but "where the wave exposure is less, and the shore profile more shallow, mobile sand communities may also be present on the upper part of the shore, with more stable fine sand communities present lower down". The third biotope was the *strandlines (LS.LSa.St)* biotope, which was not mapped due to its ephemeral nature.

5.13 Despite the major differences in sediment type and benthic fauna between the inner bay and outer beach, the Conservation Objectives for the Ballyteige Burrow SAC classify all the littoral sediment habitat as a single community type: the *mixed sediment to sand with nematodes and Tubificoides benedii community complex* (NPWS, 2014b; Figure 5.1).

5.14 The subtidal habitat in Ballyteige Bay was classified as a single biotope type by MERC (2012b): the sublittoral sands and muddy sands (SS.SSA) biotope. The Conservation Objectives for the

Ballyteige Burrow SAC also classify the subtidal habitat as a single community type: the *sand with crustaceans and Nephtys hombergii community complex* (NPWS, 2014b; Figure 5.1).

Waterbird distribution in Ballyteige Bay

Habitat Uses

5.15 The broad habitat usage recorded in the WSP low tide counts is summarised in Table 5.5. Most species occurred mainly in the intertidal zone, and, for the waders, the occurrence subtidal zone presumably refers to birds wading in shallow water just below the tideline.

Table 5.5 - Habitat use in the 2011/12 WSP low tide counts.

Species	Mean percentage of total count in habitat zones			
	Subtidal	Intertidal	Supratidal	Terrestrial
Light-bellied Brent Goose	11%	54%	14%	20%
Shelduck	50%	45%	5%	0%
Wigeon	22%	69%	9%	0%
Golden Plover	0%	100%	0%	0%
Grey Plover	0%	100%	0%	0%
Lapwing	0%	92%	7%	1%
Curlew	1%	88%	6%	4%
Black-tailed Godwit	1%	76%	0%	23%
Bar-tailed Godwit	20%	80%	0%	0%
Dunlin	0%	100%	0%	0%
Redshank	7%	92%	0%	1%

Data source: 2011/12 Waterbird Survey Programme as undertaken by the National Parks & Wildlife Service.
Sample sizes: n = 4 for all species, except Shelduck (n = 2), and Light-bellied Brent Goose, Wigeon, Grey Plover, Lapwing and Black-tailed Godwit (n =3).

Waterbird distribution

5.16 The outer part of the Ballyteige Burrow SPA (subsites 0OL09 and 0OL13) appears to be of very low importance for the SCI species with only two records during the WSP low tide counts: 18 Light-bellied Brent Goose and 1 Curlew on 8th February 2012.

5.17 Several SCI species (Shelduck, Golden Plover, Lapwing, Black-tailed Godwit, Bar-tailed Godwit, Dunlin, Redshank) were concentrated in the upper part of Ballyteige Bay in the two subsites adjacent to the Cull (0OL09 and 0OL13) and, for some species, in the Duncormick River Estuary (subsites 0OL03) (Table 5.6). Grey Plover appears to show a relatively even distribution across most of the bay but was absent from the lowermost section (Table 5.6). Light-bellied Brent Goose, Wigeon and Curlew were distributed across most of the bay without clear patterns in their densities (Table 5.6).

Table 5.6 – Mean waterbird densities (birds/ha) in the 2010/11 WSP low tide counts.

Species	Outer	Mid		Estuary	The Cull	
	0OL05	0OL04	0OL06	0OL03	0OL07	0OL08
Light-bellied Brent Goose	1.9	0.2	4.7	0.6	21.1	0.3
Shelduck	0.0	0.0	0.1	0.0	0.0	1.5
Wigeon	0.6	3.8	1.7	1.2	0.0	1.7
Golden Plover	0.0	0.0	0.4	49.4	309.2	119.0
Grey Plover	0.0	0.2	0.5	0.3	0.9	0.2
Lapwing	4.4	5.1	13.2	32.0	35.7	59.1
Curlew	3.7	0.8	0.9	0.7	4.7	3.5
Black-tailed Godwit	0.0	0.1	0.6	5.4	0.2	4.2
Bar-tailed Godwit	0.0	0.1	0.3	1.0	0.7	2.2
Dunlin	0.0	0.0	1.3	1.3	9.9	10.3
Redshank	0.0	0.1	0.6	3.3	2.3	3.8

Data source: 2011/12 Waterbird Survey Programme as undertaken by the National Parks & Wildlife Service.

Sample sizes: n = 4 for all species, except Shelduck (n = 2), and Light-bellied Brent Goose, Wigeon, Grey Plover, Lapwing and Black-tailed Godwit (n =3).

Linkages with other sites

5.18 The unusual tidal patterns in Ballyteige Bay suggest that waterbird movements between Ballyteige Bay and other sites are likely to occur. On days with very limited tidal exposure (such as was observed on 8th March 2017; Table 5.4), waterbirds must move elsewhere to find suitable feeding habitat. While many of the SCI species may feed in fields, movement to Bannow Bay may also occur. Waterbirds may also exploit the asynchrony in the tidal cycle between Ballyteige Bay and Bannow Bay by moving to Ballyteige Bay on neap low tides when intertidal exposure is at a minimum in Bannow Bay but at a maximum in Ballyteige Bay.

5.19 A local ornithologist with long experience of observing birds in Ballyteige Bay and Bannow Bay has noted evidence of movement between Ballyteige Bay and Bannow Bay from observations of rare waders and birds with unusual plumage (K. Mullarney, pers. comm.).

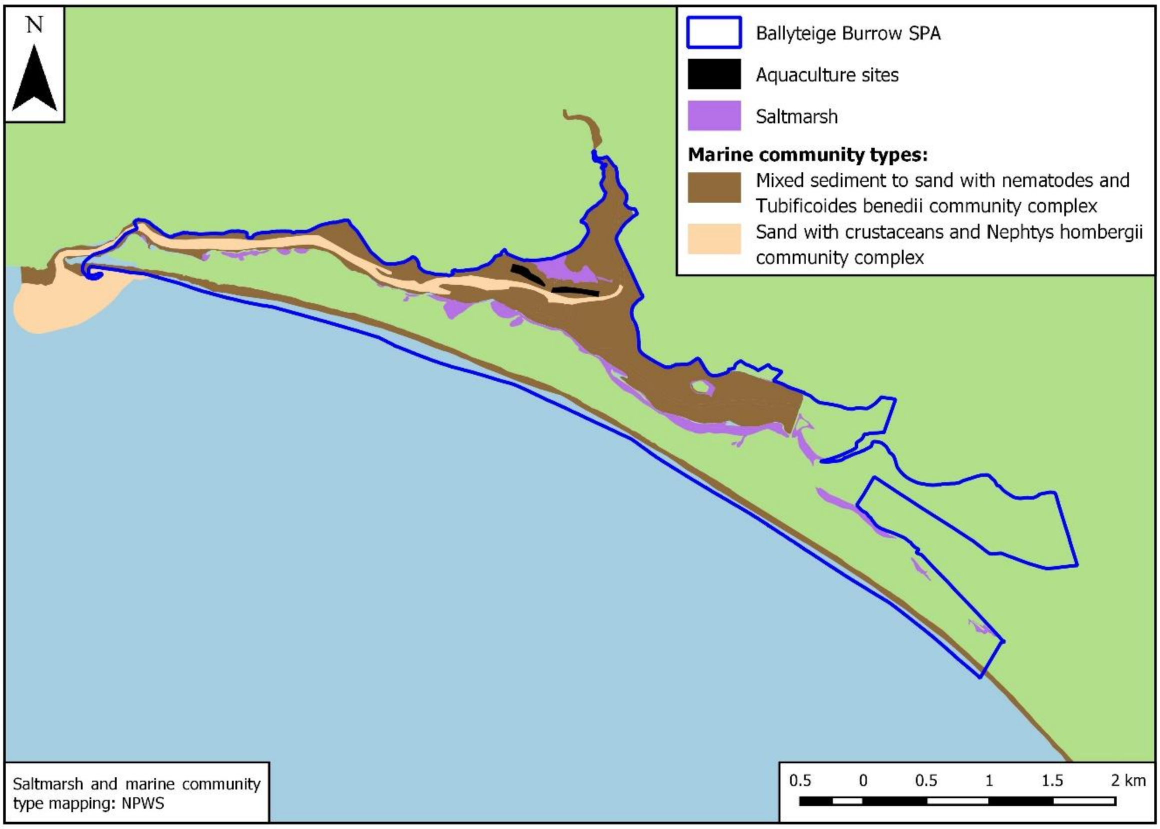

Figure 5.1 – Distribution of marine community types and saltmarsh within the Ballyteige Burrow SPA, as mapped by NPWS.

6. Aquaculture activities at Ballyteige Burrow

Scope of activity

6.1 There are two aquaculture sites, covering a total area of 3.3 ha, at Ballyteige Burrow. These are both classified as applications, although there is current oyster cultivation activity in at least one of the sites (T03/038A). The applicants for the two sites are different indicating that aquaculture activity within the sites will be carried out by different operators.

6.2 The two aquaculture sites are located in the middle of Ballyteige Bay on the northern side of the main tidal channel (Figure 6.1). The only information received about these sites is in the attributes of the shapefile received from the Marine Institute. However, the existing oyster cultivation activity in T03/038A is oyster trestle cultivation. It is our understanding that oyster trestle cultivation is the only activity proposed for both sites.

Table 6.1 – Aquaculture sites at Ballyteige Burrow.

Site	Type	Activity	Area (ha)
T03/038A	Application	Oysters	1.7
T03/095A	Application	Oysters	1.6

History of activity

6.3 Very little information on the history of aquaculture activity in Ballyteige Bay was received for this assessment. Aerial imagery indicates that oyster trestle cultivation activity has been taking place in Ballyteige Bay since at least 1995. We understand that, prior to 2005, four operators were active, but since 2005 only a single operator has been active. Production data received indicates an increase in production from 2008 to 2013, with a slight decrease after 2015.

6.4 The approximate extent of trestles in Ballyteige Bay in June 2010 is shown in Figure 6.2.

Description of activity

6.5 No specific details have been received about the existing or proposed aquaculture activities at Ballyteige Burrow. The following text is a general description of oyster trestle cultivation, adapted from Gittings and O'Donoghue (2012).

6.6 Oyster trestles vary in height but are typically do not exceed 0.5 m height and their height above the sediment is often less as they sink into the sediment.

6.7 The trestles are usually arranged in single or paired rows with a separation of around 4 m between rows and with wider (10-20 m) access lanes. Where the trestles occur on open sandflats the rows are usually orientated more or less perpendicularly to the tideline.

6.8 Oyster spat is supplied by hatcheries and is placed in mesh bags. Generally, only a proportion of the trestles hold oyster bags at any one time. The bags are placed on top of the trestles, where they are on-grown until they are ready for harvesting. The function of the trestles is to keep the animals off the seabed, preventing grit getting inside the oysters, providing increased water flow and allowing suitable shell growth. The mesh bags facilitate handling and prevent predation.

6.9 Oyster husbandry activities mainly take place during spring low tides. Workers usually access the trestles by driving tractors across the beach and will often drive through shallow water on the receding tide to make the most use of the time available. Husbandry activities involve turning the mesh bags every spring tide to rid the bags of any settled silt, stop the growth of oyster shell into the mesh and destroy fouling organisms.

6.10 At Ballyteige Bay, the small size of the aquaculture sites means that husbandry activity is only likely to take place on a proportion of low tides, rather than on every low tide. During the 2011/12 WSP survey, aquaculture activity was only recorded on one of the four low tide counts (NPWS, 2014a).

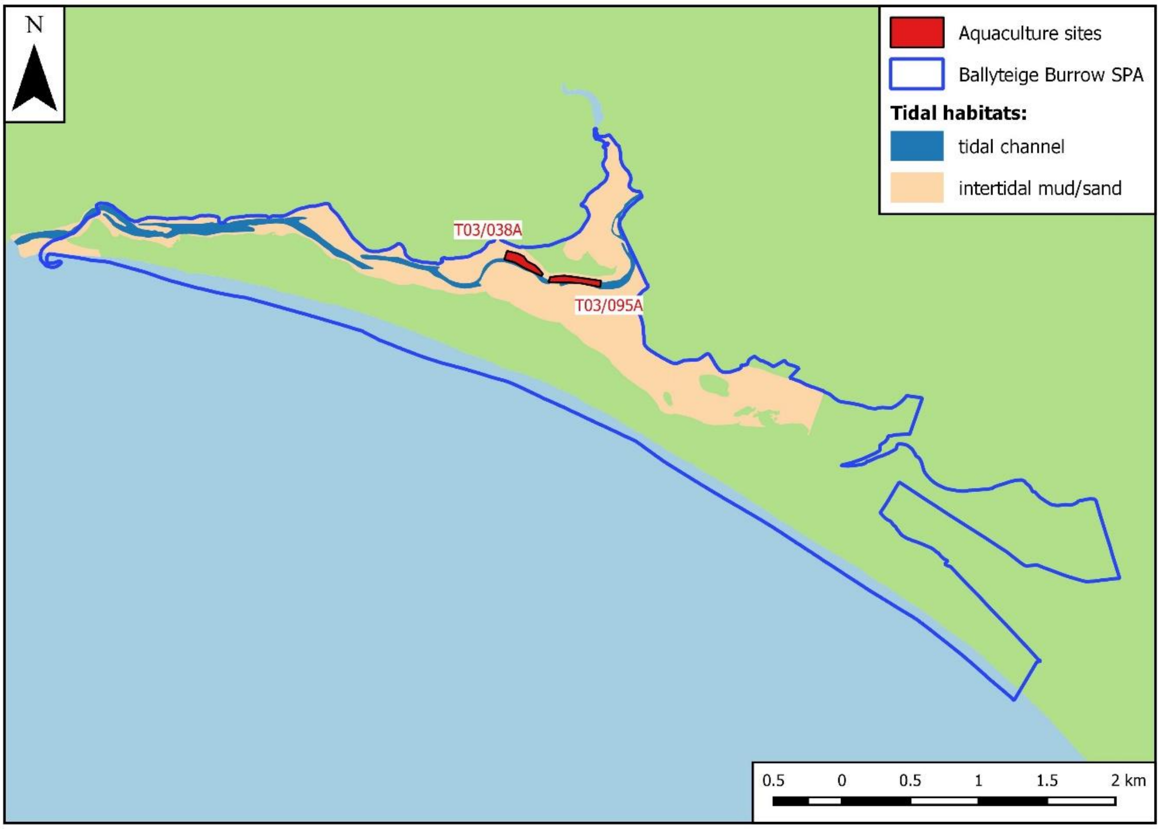

Figure 6.1 – Aquaculture sites in Ballyteige Bay.

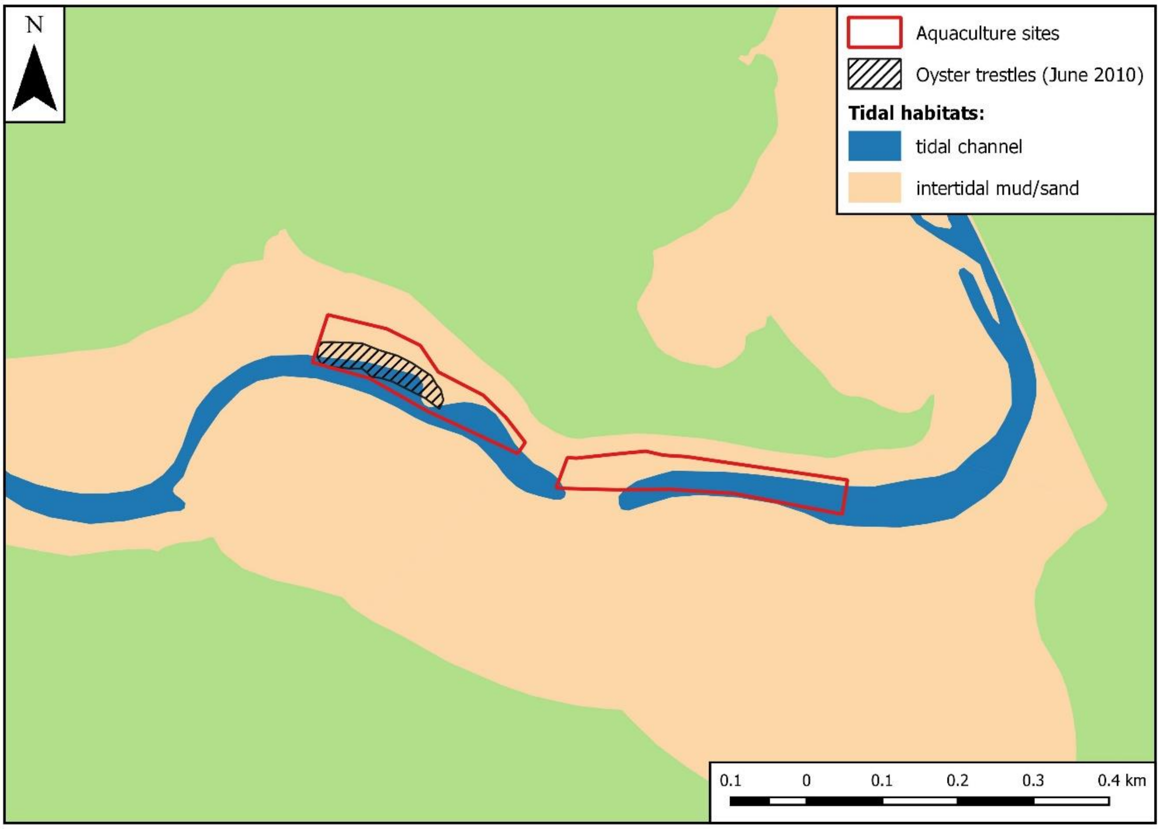

Figure 6.2 – Approximate extent of oyster trestles in Ballyteige Bay in June 2010.

7. Assessment of impacts on intertidal waterbird species

Introduction

7.1 This section presents a detailed assessment of the potential impacts of the existing and proposed aquaculture activities in Ballyteige Bay on the SCI species of Ballyteige Burrow SPA. These also include the Wigeon SCI screened in from the Tacumshin Lake SPA and the four SCI species screened in from the Bannow Bay SPA.

7.2 Husbandry activity is presumed to take place in a 3-4 hour period around low tide[4]. Therefore, husbandry activities will not cause any disturbance impacts outside the low tide period and will not cause impacts to any high tide roosts.

Response to intertidal oyster cultivation

Displacement from areas occupied by oyster trestles

7.3 The overall response of the waterbird species to oyster trestles is summarised in Table 7.1. As there is likely to be signifcant interchange with Bannow Bay, evidence about waterbirds response to oyster trestles at Bannow Bay is also included in Table 7.1 (where available). The latter is presented in the form of Jacobs Index (D) values, which represent the degree of positive or negative association with oyster trestles: D can vary from -1 (indicating complete avoidance) to +1 (strong preference).

7.4 Grey Plover appears to be completely excluded from areas occupied by oyster trestles. This was first demonstrated in the data from the trestle study and has been further supported by subsequent monitoring work at Dungarvan Harbour (Gittings and O'Donoghue, 2015, 2018a, 2018b and 2019). These species did not occur in sufficient numbers in the trestle study counts to calculate D index values for Bannow Bay.

7.5 Dunlin and Bar-tailed Godwit both showed strong avoidance of oyster trestles in the data from the trestle study. For Bar-tailed Godwit, this avoidance has been further supported by subsequent monitoring work at Dungarvan Harbour (Gittings and O'Donoghue, 2015, 2018a, 2018b and 2019). This monitoring work indicated that the relationship with oyster trestles appears to be more complex for Dunlin, although there is still likely to be an overall avoidance effect at the site scale. The D index values from Bannow Bay conform to an avoidance effect for both species.

7.6 Light-bellied Brent Goose showed a variable response pattern in the trestle study with neutral/positive patterns of association at some sites, and negative patterns at other sites. At Bannow Bay, Light-bellied Brent Goose were only recorded on two of the four trestle study counts and they showed strongly negative patterns of association with trestles on both of these counts. This species often feeds on the algae that attaches to the trestle bags and at some sites large numbers can be present on the trestles on the ebb/flood tides to exploit this food source. However, this behaviour appears to be rare at Bannow Bay (Gittings and O'Donoghue, 2016a).

7.7 In the trestle study report, Curlew was classified as having an overall neutral/positive pattern of association with oyster trestles. However, based on further analysis of the dataset we now consider

[4] References in this text to low tide in Ballyteige Bay refers to the period of maximum exposure of intertidal habitat within Ballyteige Bay. As discussed in Chapter 5, the timing of this period in Ballyteige Bay may differ from the timing of low tide in adjacent areas.

that the response should be classified as variable (Gittings and O'Donoghue, 2016b). At Bannow Bay, Curlew showed a consistently negative pattern of association with oyster trestles.

7.8 In the trestle study report, Redshank was classified as having an overall neutral/positive pattern of association with oyster trestles. This is supported by mean D indices close to zero across all sites, and summed D indices close to, or greater than, zero at five of the six sites included in the study. However, Bannow Bay was the one site where Redshank showed a negative pattern of association with oyster trestles.

Table 7.1 - Summary of patterns of association with oyster trestles at Bannow Bay.

Species	Overall response	Jacobs index (D) values for Bannow Bay							
		All sectors				Close sectors			
		D sum	D min	D max	n	D sum	D max	D min	n
Light-bellied Brent Goose	Variable	-0.86	-0.69	-1.00	2	-0.92	-0.81	-1.00	2
Shelduck	(Negative)	-	-	-	-	-	-	-	-
Wigeon	-	-	-	-	-	-	-	-	-
Golden Plover	-	-	-	-	-	-	-	-	-
Grey Plover	Exclusion	-	-	-	-	-	-	-	-
Lapwing	(Negative)	-	-1.00	-1.00	3	-	-1.00	-1.00	2
Knot	Exclusion	-	-	-	-	-	-	-	-
Dunlin	Negative	-1.00	-1.00	-1.00	4	-1.00	-1.00	-1.00	4
Black-tailed Godwit	(Negative)	-1.00	-1.00	-1.00	2	-	-	-	-
Bar-tailed Godwit	Negative	-0.78	-0.67	-0.87	4	-0.60	-0.40	-0.81	3
Curlew	Variable	-0.66	-0.58	-0.95	3	-0.33	-0.39	-0.91	2
Redshank	Neutral/ positive	-0.76	-0.69	-0.95	3	-0.74	-0.59	-0.90	3

Note: Overall response is as classified by Gittings and O'Donoghue (2012), with the exception of Curlew (see text).

7.9 The other species included in this assessment are: Shelduck, Wigeon, Golden Plover, Lapwing and Black-tailed Godwit. These species were not recorded in sufficient numbers in the trestle study to carry out formal analyses of their association with trestles across sites. This reflects the fact that these species tend to occur on muddier sediments, unlike the sandier sediments typically used for intertidal oyster cultivation. However, for Shelduck, Lapwing and Black-tailed Godwit, the trestle study found some weak evidence of negative association with trestles, from ordination analyses and/or qualitative assessment of count data.

7.10 Shelduck are large ducks that stand over 0.5 m tall. Therefore, trestles may impede their movements while foraging as, unlike smaller waders, they will not be able to freely move under the trestles.

7.11 The trestle study only produced limited data for Wigeon, with a neutral/positive pattern of association at one site, and a negative pattern at another site. This species can feed on the algae that attaches to the trestle bags.

7.12 Golden Plover and Lapwing mainly use intertidal areas for roosting. Golden Plover typically roost in large expanses of open mudflat or sandflat, while Lapwing use more varied substrates for roosting, including mixed sediments and rocky shores. It is very unlikely that Golden Plover would roost within trestle blocks, but one could imagine that Lapwing might roost on trestles. However, Lapwing showed strongly negative patterns of association with oyster trestles on three of the four trestle study counts at Bannow Bay.

7.13 Black-tailed Godwit is behaviourally and ecologically similar to Bar-tailed Godwit, as indicated by the fact that small numbers of Bar-tailed Godwits often associate with Black-tailed Godwits in Cork Harbour. Therefore, it seems likely that Black-tailed Godwit will show a similarly strong negative response to trestles, as shown by Bar-tailed Godwit. At Bannow Bay, there was sufficient data to calculate D indices and these indicate a strongly negative patterns of association with oyster trestles.

Disturbance

7.14 During waterbird monitoring work at Dungarvan Harbour (Gittings and O'Donoghue, 2015, 2018a, and 2018b), we collected observations on the disturbance responses of four target species (Grey Plover, Bar-tailed Godwit, Knot and Dunlin) to oyster trestle cultivation husbandry activity. These observations were made in an area from which oyster trestles had been removed (the Bird Corridor) and involved responses to oyster husbandry activity in adjacent areas of oyster trestles, or to movements of tractors travelling to/from areas of oyster trestles past the Bird Corridor. Mapping of tideline positions and the disturbance sources relative to the configuration of the adjacent areas of trestles allowed reliable estimation of bird response distances within distance bands of 100 m width from the disturbance sources.

7.15 There were only four observations of husbandry activity within the 0-100 m distance band, but 80% of those observations resulted in flush response. In distance bands of 100-200 m and 200-300 m, 18% and 26%, respectively, of observations involved a flush response. At distance bands of over 300 m, there was only a single observation of a flush response.

7.16 While the response to disturbance is likely to vary between species, this dataset is too small to examine such differences. Disturbance responses are also likely to vary with flock sizes, with larger flocks being more sensitive to disturbance (Laursen *et al.*, 2005). However, the overall pattern of disturbance responses summarised above is in line with qualitative observations from Dungarvan Harbour and other sites with oyster trestle cultivation (unpublished data). These observations indicate that waterbirds show a degree of habituation to disturbance from oyster trestle cultivation husbandry activity with flush responses generally only occurring when birds are close to the activity.

Table 7.2 – Number of observations of disturbance responses in distance bands from oyster trestle cultivation husbandry activity at Dungarvan Harbour.

Species	Response	Distance bands (m)						Total
		0-100 m	100-200	200-300	300-400	400-500	> 500	
Grey Plover	flush	1	1	1	0	0	0	3
	none	0	3	4	5	5	14	31
Bar-tailed Godwit	flush	1	0	1	0	0	0	2
	none	1	1	6	4	8	21	41
Knot	flush	0	0	1	0	0	0	1
	none	0	2	0	2	1	0	5
Dunlin	flush	2	1	2	1	0	0	6
	none	0	3	4	4	7	12	30
Total	flush	4	2	5	1	0	0	12
	none	1	9	14	15	21	47	107

Data sources: Gittings and O'Donoghue (2018a, 2018b, 2019).

Displacement analysis

7.17 The predicted displacement from oyster trestle cultivation in Ballyteige Bay is shown in Table 7.3. The inclusion of displacement due to disturbance in this assessment doubles the overall predicted displacement impacts. However, the ranges of values between the two disturbance scenarios assessed are very small.

7.18 The highest overall predicted displacement impacts are for Light-bellied Brent Goose and Wigeon (6-7%) and Grey Plover (5%), with predicted impacts under 3% for all other species.

Table 7.3 - Predicted displacement (% of total Ballyteige Bay population).

Species	Waterbird occupancy		Displacement impact		
	Count	Percentage	Exclusion	Disturbance	Overall
Light-bellied Brent Goose	430	98%	3.4%	3.2-3.5%	6.7-7.0%
Shelduck	5	23%	0.8%	0.7-0.8%	1.5-1.6%
Wigeon	395	100%	3.4%	3.2-3.5%	6.7-7.0%
Golden Plover	18	0%	0.0%	0.0%	0.0%
Grey Plover	71	69%	2.4%	2.2-2.5%	4.6-4.9%
Lapwing	1809	35%	1.2%	1.1-1.2%	2.3-2.5%
Curlew	147	36%	1.2%	1.2-1.3%	2.4-2.6%
Black-tailed Godwit	73	21%	0.7%	0.7%	1.4-1.5%
Bar-tailed Godwit	35	33%	1.1%	1.1-1.2%	2.2-2.3%
Dunlin	80	16%	0.6%	0.5-0.6%	1.1-1.2%
Redshank	66	38%	1.3%	1.2-1.4%	2.6-2.7%

Note: The waterbird occupancy columns show the maximum counts, and maximum percentages of the total Ballyteige Bay counts, recorded in the subsites containing the aquaculture sites during the WSP low tide counts. The displacement impact columns show the predicted displacement impacts caused by displacement of birds from the aquaculture sites (exclusion), and by disturbance to birds in adjacent areas of tidal habitat (disturbance). The range of values for the disturbance impact represent the variation between the displacement predicted using disturbance buffers generated by point sources in the centre of the aquaculture sites and displacement impacts generated by disturbance buffers generated using quarter segments of the aquaculture sites (see Chapter 2).

7.19 As discussed above, Light-bellied Brent Goose has a variable response to oyster trestle cultivation and may benefit from oyster trestle cultivation at some sites where it is able to exploit algae growing on the oyster bags as a food resource. This may also apply to Wigeon, although we have very limited evidence for this species about its interactions with oyster trestle cultivation. At Ballyteige Bay, the small size of the aquaculture sites may limit their potential exploitation by Light-bellied Brent Goose and Wigeon due to disturbance from husbandry activities. However, this will not affect their exploitation on ebb and flood tides before/after any husbandry activity takes place and on low tides when no husbandry activity takes place. It also seems certain that the figure for the waterbird occupancy of the subsites containing the aquaculture sites is a large overestimate of the mean waterbird occupancy levels of these subsites. However, the location of the aquaculture sites along the main tidal channel may increase the potential for disturbance impacts from husbandry activity as Light-bellied Brent Goose and Wigeon may gather along this channel at low tide. Overall, while the predicted displacement impacts for Light-bellied Brent Goose and Wigeon are relatively high, there is uncertainty about whether oyster trestle cultivation will have any net displacement impact on Light-bellied Brent Goose at Ballyteige Bay. If a net displacement impact occurs, the predicted displacement impact is likely to be a significant overestimate of the likely displacement impact.

7.20 Grey Plover is one of the species that shows the strongest negative response to oyster trestle cultivation, and it appears to be completely excluded from areas occupied by oyster trestles. Therefore, it is highly likely that development of the aquaculture sites in Ballyteige Bay will cause some level of displacement impact to Grey Plover. Analysis of Grey Plover densities in the low tide counts indicates that they were fairly evenly spread across the intertidal habitat in Ballyteige Bay, apart from the lower part of the bay (subsite 0OL05), and the flock mapping data appears to support this pattern. The subsites containing the aquaculture sites hold around 60% of the intertidal habitat within Ballyteige Bay, so the subsite occupancy figure used for the displacement calculations may be a reasonable estimate of the overall mean subsite occupancy across the season. At Dungarvan Harbour, we have recorded several instances of Grey Plover in intertidal habitat being flushed by husbandry activity in adjacent aquaculture sites at distances of up to 300 m, so a measurable level of displacement due to disturbance is also likely to occur. However, the actual displacement impact due to disturbance will depend upon the distribution and timing of the husbandry activities in the aquaculture sites.

7.21 The predicted displacement impacts were under 3% for all the other species. For two of these species (Curlew and Redshank), there may not be any net displacement impacts as they may have a neutral/positive response to oyster trestle cultivation. The other species mainly occur in the uppermost sections of the bay above the subsites containing the aquaculture sites, so the mean occupancy of those subsites is likely to be low, in line with the occupancy figures that we have used for the displacement calculations. However, the analysis of data from Bannow Bay presented in Chapter 2 shows that, while use of maximum, rather than mean, subsite occupancy levels is a precautionary approach, there is still a significant risk of underestimating overall subsite occupancy levels when using maximum subsite occupancy levels derived from a small number of counts in a single season.

Population trends

7.22 The population trends of the SCI species covered by this assessment in the Ballyteige Burrow SPA are compared with the national trends for these species in Table 7.4.

7.23 The short-term change for Period 2 shows the change in the five year mean annual peak counts between 2006/07-2010/11 and 2011/12-2015/16. This is the period over which production data indicates an overall increase in oyster trestle cultivation activity. Therefore, if oyster trestle cultivation activity was causing significant negative impacts on waterbird populations in the Ballyteige Burrow SPA we would expect decreasing trends in waterbird populations in the Ballyteige Burrow SPA relative to the national trend. However, for nine of the eleven species the population trends in the Ballyteige Burrow SPA are less negative than the national trend. It is notable that Grey Plover, which is the species most likely to be negatively affected (see above) showed an increase over this period, compared to a small decrease in the national population estimate. This species also showed a small increase over the earlier period, compared to a large decrease in the national population estimate.

7.24 Overall, the population trend data does not suggest that the increase in oyster trestle cultivation activity at Ballyteige Bay between 2008 and 2016 caused any negative impacts on the population sizes of the SCI species covered by this assessment. However, full development of the aquaculture sites that are the subject of this assessment would cause an approximately fourfold increase in the spatial extent of oyster trestle cultivation in Ballyteige Bay, compared to the mapped extent in 2010.

Table 7.4 – Percentage changes in the five year mean annual peak counts between 1994/95-1998/99 and 2006/07-2010/11 (Period 1), and between 2006/07-2010/11 and 2011/12-2015/16 (Period 2) in the Ballyteige Burrow SPA compared to the national estimates.

Species	Period 1		Period 2	
	Ballyteige Burrow	all-Ireland	Ballyteige Burrow	all-Ireland
Light-bellied Brent Goose	39%	132%	-3%	-15%
Shelduck	-67%	-19%	-2%	-14%
Wigeon	6%	-29%	-3%	-12%
Golden Plover	12%	-26%	-61%	-24%
Grey Plover	15%	-52%	38%	-6%
Lapwing	-60%	-61%	-52%	-16%
Curlew	-47%	-33%	86%	-13%
Black-tailed Godwit	-39%	39%	14%	+4%
Bar-tailed Godwit	-60%	3%	22%	+4%
Dunlin	-61%	-50%	53%	-23%
Redshank	50%	6%	42%	-24%

Note: Ballyteige Burrow SPA percentage changes calculated from I-WeBS data. All-Ireland percentage changes from Burke *et al.* (2018).

Conclusions

7.25 The conclusions of this assessment are summarised in Table 7.5.

7.26 There is likely to be a measurable displacement impact to Grey Plover, and this may be significant when potential displacement due to disturbance is considered. It should, however, be noted that the population trend data for Grey Plover does not show any evidence of impacts from increasing levels of oyster trestles culture over the period 2008-2016. On this basis, it is likely the displacement impact will be substantially lower than the calculated impacts for the two sites assessed (Table 7.5). Notwithstanding, it is recommended that site activities are confined within the licence blocks as well as maintaining strict adherence to access routes.

7.27 The predicted displacement impacts to Light-bellied Brent Goose and Wigeon are significant. However, there is a high level of uncertainty about this prediction due to the variable nature of their responses to oyster trestle cultivation, and the likely significant overestimation of subsite occupancy levels in the displacement calculations.

7.28 The predicted displacement impacts to all the other species are either negligible or not significant. The limited data that was available for this assessment means that there is a moderate level of uncertainty about these predictions (see Chapter 2). However, we have not identified any specific factors that would suggest a significant underestimation of displacement impacts for any of these species. For two of the species (Curlew and Redshank) there may be no net displacement impact due to the variable nature of their response to oyster trestle cultivation.

Table 7.5 – Summary of impact assessment.

Species	Likelihood of negative impact	Predicted displacement impact	Assessment of significance
Light-bellied Brent Goose	1	6.7-7.0%	(significant)
Shelduck	2	1.5-1.6%	not significant
Wigeon	1	6.7-7.0%	(significant)
Golden Plover	2	0.0%	negligible
Grey Plover	3	4.6-4.9%	significant
Lapwing	2	2.3-2.5%	not significant
Curlew	1	2.4-2.6%	not significant
Black-tailed Godwit	2	1.4-1.5%	not significant
Bar-tailed Godwit	3	2.2-2.3%	not significant
Dunlin	3	1.1-1.2%	not significant
Redshank	1	2.6-2.7%	not significant

Likelihood of a negative impact: 1 = species shows a variable response to oyster trestles, so a neutral or positive impact may occur; 2 = species considered to show a negative response to oyster trestles but evidence for this is weak; 3 = strong evidence that species shows a negative response to oyster trestles.

Assessment of significance: parentheses indicate a high level of uncertainty about the assessment. The uncertainty for all other assessments is moderate.

8. Assessment of impacts on other species

Introduction

8.1 This chapter covers the following species: Cormorant and Lesser Black-backed Gull.

Cormorant

Occurrence in Ballyteige Bay

8.2 No information is available about the occurrence of visiting Cormorant from the Keeragh Islands SPA within Ballyteige Bay. In winter, Cormorant regularly occur within Ballyteige Bay, but it is not known to what extent, if any, Cormorants use Ballyteige Bay in summer.

8.3 West *et al.* (1975) studied the diet of birds from this colony. They did not record any eels, or estuarine or freshwater fish species, and the fish identified included mackerel, plaice and wrasse. Therefore, the birds appeared to be feeding exclusively on marine fish. This would suggest that the birds were not making significant use of food resources within the estuarine section of Ballyteige Bay (including the areas around the aquaculture sites), although they may have been feeding in the outer part of the SPA. However, this study was carried out over 40 years ago. At other marine colonies, Cormorant diets can include a significant component of estuarine and freshwater fish species (West *et al.*, 1975; Tierney *et al.*, 2011). Therefore, more recent evidence on the diet composition of the Keeragh Islands colony would probably be required before their usage of estuarine habitat within Ballyteige Bay can be discounted.

8.4 In the 2011/12 WSP counts, Cormorant mainly occurred in subsites 0OL04-06, comprising the middle and lower sections of Ballyteige Bay (mean percentage of total count = 95%; range 92-100%, n = 5). However, these were mainly low tide counts, and presumably reflect the lack of availability of subtidal habitat in the upper sections of the bay at low tide.

Response to oyster trestles

8.5 No evidence is available about the response of Cormorants to oyster trestle cultivation. However, Cormorants will generally not be affected by disturbance from husbandry activity as they will only be likely to make significant use of areas around oyster trestles at high tide, while husbandry activity occurs at low tide.

8.6 Cormorant are fish-eating birds. Therefore, their response will be heavily influenced by the effects of oyster trestle cultivation on fish.

8.7 Dumbauld *et al.* (2009) 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.

8.8 In addition to the alteration of the physical habitat, aquaculture could also, theoretically, have impacts on fish populations through reduced recruitment (due to direct consumption of eggs and larvae by the cultured bivalves), and/or through indirect food web effects (e.g., consumption of organic matter by the cultured bivalves that would have otherwise been available to support fish; Gibbs, 2004). Carrying capacity modelling of the proposed introduction of suspended culture of green mussels into a New Zealand bay indicated that large-scale bivalve culture could cause the replacement of zooplankton by the cultured bivalves as the major grazers in the system with consequent impacts on pelagic fish (Jiang and Gibbs, 2005). However, Leguerrier *et al.*'s (2004) model of the impact of oyster cultivation on a food web in a French bay indicated that oyster cultivation caused secondary production to increase benefitting fish populations, particularly those that used the mudflats as a nursery area. Lin *et al.*'s (2009) model and observations of the removal of oyster cultivation from a eutrophic lagoon in Taiwan indicated that reef fish populations were enhanced by oyster cultivation, but pelagic and soft-bottom fish increased following the removal of the oyster cultivation.

8.9 Overall, the evidence from the literature summarised above indicates that oyster trestle cultivation is likely to either have no effect on or increase local abundances of fish. The small-scale of the proposed oyster trestle cultivation at Ballyteige Bay, suggests that negative impacts on fish population through reduced recruitment or through indirect food web effects are unlikely to occur.

Impact assessment

8.10 Oyster trestle 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 Ballyteige Bay. No disturbance impacts from husbandry activity are likely as Cormorants are only likely to make significant use of the areas around the aquaculture sites at high tide, while husbandry activity occurs at low tide. Therefore, intertidal oyster cultivation is not likely to cause any displacement of Cormorant within Ballyteige Bay.

Lesser Black-backed Gull

Occurrence in Ballyteige Bay

8.11 No information is available about the occurrence of visiting Lesser Black-backed Gull from the Saltee Islands SPA within Ballyteige Bay. In winter, Lesser Black-backed Gull regularly occur within Ballyteige Bay, but it is not known to what extent, if any, Lesser Black-backed Gull use Ballyteige Bay in summer.

8.12 Some assessment can, however, be made of the potential occurrence of visiting Lesser Black-backed Gull from the Saltee Islands SPA within Ballyteige Bay by considering evidence about the typical foraging range and diet of the species during the breeding season.

8.13 Thaxter *et al.* (2012) quote a mean foraging range of Lesser Black-backed Gull from its breeding colonies of 71.9 km, a mean maximum of 141 km and a maximum of 181 km. However, these figures are based on a very small number of studies (2 for the mean and 3 for the mean maximum). Camphuysen (2011) reported median foraging distances from a breeding colony at Texel (The Netherlands) ranging from 5-31 km, and maximum foraging distances ranging from 19-359 km, depending upon the area that the birds were feeding in. Therefore, it is clear that Lesser Black-backed Gull can range very widely from their breeding colonies and the aquaculture areas in Ballyteige Bay are likely to be within the core foraging range of the Saltee Islands SPA population.

8.14 The Lesser Black Backed Gull is omnivorous and can utilise a wide array of energy sources, consuming fish, small mammals, invertebrates, plant material, rubbish, fish discards, etc. (Cramp and Simmons, 2004). Though it is capable of obtaining food by dipping to surface, shallow plunging and aerial pursuit of prey, a large portion of its diet seems to come from kleptoparasiting food from other birds (both inter- and intra-specific); it is also generally accepted that open sea fish feeding contributes more to the diet of the Lesser Black Backed Gull than scavenging compared to other large gulls (studies quoted by Cramp and Simmons, 2004).

8.15 The diet of Lesser Black-backed Gull has been studied at Irish breeding colonies at Cape Clear (Creme and Kelly, 1992) and the Magharee Islands (Kelly, 2009). At the Magharee Islands, the diet was dominated by terrestrial beetles, marine fish and anthropogenic garbage (54.3%, 27.4% and 20.2%, respectively).

8.16 At two German North Sea colonies, the diet was dominated by marine fish and open sea crabs indicating that the birds were mainly feeding at sea (Kubetzki and Garthe, 2003). However, at another German North Sea colony, during the incubation period the gulls fed mainly upon crustaceans and molluscs from the intertidal zone, but during chick-rearing, they took mainly crustaceans and fish which were gathered mostly as trawler discards (Garthe *et al.*, 1999). At a breeding colony at Texel, the diet was dominated by marine fish but the polychaete worm *Nereis longissimi* comprised 3-25% of the diet over the five seasons studied, which indicates that the birds made significant use of the intertidal zone in at least some seasons (Camphuysen, 2011). At an Irish Sea colony in Cumbria, marine molluscs comprised 10-14% of the diet (Kim and Monaghan, 2006).

8.17 Therefore, while Lesser Black-backed Gull may be more likely to use food resources in the open sea compared to some other gull species, food resources in the intertidal zone can be a significant component of the diet in at least some breeding colonies. In the absence of specific information about the diet of the Lesser Black-backed Gull colony of the Saltee Islands, the possibility cannot be discounted that intertidal habitat in Ballyteige Bay provides food resources for the colony.

Response to oyster trestles

8.18 The trestle study classified the response of Lesser Black-backed Gull to oyster trestles as unknown, due to lack of sufficient data for detailed analysis. While Lesser Black-backed Gull is very closely related to Herring Gull (which has a neutral/positive association with oyster trestles), there are significant ecological differences between the two species, and it would be dangerous to infer that they have a similar response to oyster trestles. Of the 958 Lesser Black-backed Gulls counted across all sites and days in the extensive study only eight birds were recorded within trestle blocks. Furthermore, it is notable that in the trestle study, 18% of the total number of Herring Gulls recorded across all sites and counts were on trestles, but none of the Lesser Black-Backed Gulls were on trestles (total numbers: 958 Lesser Black-Backed Gulls and 1437 Herring Gulls). However, most of the Lesser Black-backed Gull recorded in the extensive study were roosting birds often in large flocks. It would not be surprising that roosting flocks of Lesser Black-backed Gull, which typically occur on open intertidal flats, avoid trestle blocks. But this does not necessarily mean that feeding Lesser Black-backed Gull similarly avoid trestle blocks. In the context of assessing potential impacts to birds visiting Ballyteige Bay on foraging visits from the Saltee Islands colony, it is the impact to feeding birds that is important.

Impact assessment

8.19 Ballyteige Bay is around 10 km from the Saltee Islands Lesser Black-backed Gull colony and is the closest estuarine/intertidal site to the colony. Therefore, if estuarine/intertidal areas provide significant food resources for the colony, it is likely that the intertidal habitat in Ballyteige Bay contribute to these food resources. If Lesser Black-backed Gull has a negative association with oyster trestles, then aquaculture activities in Ballyteige Bay could reduce the availability of prey biomass to the colony.

8.20 Without firm information on the diet of the Saltee Islands Lesser Black-backed Gull colony, the occurrence of Lesser Black-backed Gull in Ballyteige Bay during the summer, and/or the response of Lesser Black-backed Gull to oyster trestles, it is not possible to make an assessment of the potential impact of aquaculture activities in Ballyteige Bay on the colony.

8.21 A follow up investigation on Lesser Black-backed Gull use of intertidal habitats within Ballyteige Bay during important breeding season was conducted and presented in Appendix B. Throughout the survey only a single LBBG was observed foraging intertidally in the Bay. On this basis, it can be concluded that intertidal habitat in Ballyteige Bay is unlikely to be a significant foraging resource for Lesser Black-backed Gulls from the Saltee Islands colony.

9. Assessment of cumulative impacts

Introduction

9.1 This section presents an assessment of potential cumulative impacts from oyster trestle cultivation in combination with other activities. Cormorant is not included in this assessment because the main assessment has concluded that this species is likely to have a neutral or positive response to oyster trestle cultivation. Therefore, as the species included in this assessment are only associated with intertidal habitat, activities only affecting deep subtidal habitat such as boat traffic are not included in this assessment.

Activities

Disturbance generating activities

Beach recreation

9.2 Beach recreation areas occurs on the seaward side of the Ballyteige Burrow SPA associated with access points to the shore at Kilmore Quay and Cullenstown with "accessible areas of the coastal strip" being used in summer for beach recreation and in winter for recreational walking (NPWS, 2014a).

9.3 The southern shoreline of Ballyteige Bay is accessible through the dunes from Kilmore Quay but, due to the distance (4 km to the eastern end of the bay), recreational activity along this shoreline is likely to be limited. There is a farm track that previously provided informal vehicle access to the Cull Bank but, in recent years, this has been closed to the public.

9.4 There are public roads providing access at various locations along the northern shore of the bay, but due to the nature of the sediments and shoreline, opportunities for recreational walking associated with these access points are likely to be limited.

9.5 During the WSP survey, a low level of recreational activity (walking along the shoreline) was observed in bay, with a total of seven instances across all five counts.

Other activities

9.6 Water-based recreational activities were not recorded during the WSP counts. Ballyteige Bay is unlikely to be suitable for such activities although, presumably some may occur along the seaward coast of the Ballyteige Burrow SPA in the summer.

9.7 Bait digging was recorded once during the WSP counts in subsite 0OL06, while hand collection of shellfish (winkle picking) was also recorded on a single occasion in subsite 0OL05. Shore angling was not recorded on the WSP counts but is reported to take place on the seaward coast (NPWS, 2014a).

Potential impacts

9.8 The main concentration of recreational activity in the intertidal zone at the Ballyteige Burrow SPA is likely to be on the seaward coast. The intertidal habitat along this coast is of negligible importance for the SCI species covered by this assessment. There appears to be very little potential for significant levels of recreational activity along the shoreline of Ballyteige Bay, where most of the waterbirds occur.

9.9 Shellfish gathering and bait digging will also involve activity in the intertidal zone. However, the levels of these activities appear to be low and they are unlikely to cause significant disturbance impacts.

9.10 Overall, the available information indicates that non-aquaculture related disturbance generating activities are unlikely to be causing significant impacts to the species covered in this assessment. Therefore, it is not necessary to consider potential in-combination effects with oyster trestle cultivation.

Activities affecting waterbird food resources

Bait digging and shellfish collecting

9.11 Bait digging and shellfish collecting will remove food resources that would otherwise be available for consumption by waterbirds and may also cause mortality to non-target species (Masero *et al.*, 2008). Therefore, if these activities are extensive and/or affect concentrated food resources they could affect waterbird distribution (by causing displacement from depleted areas) and/or survivorship (by reducing the overall carrying capacity of the system).

9.12 In the Ballyteige Burrow SPA, bait digging and shellfish gathering appear to be low intensity activities, with only single observations of each activity during the WSP counts. Therefore, it seems unlikely that bait digging, or winkle picking is having measurable impacts in terms of resource depletion or physical habitat disturbance in the Ballyteige Burrow SPA, and it is not necessary to consider potential in-combination effects with oyster trestle cultivation.

Effluent discharge

9.13 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.

9.14 The Duncormick Wastewater Treatment Plant (WWTP) discharges to the Duncormick River around 700 m upstream of the Ballyteige Burrow SPA boundary (WCC, 2009). This is a secondary treatment plant that services four housing estates and part of the main street in Duncormick. It was constructed as a primary treatment plant in the early 1970s and upgraded to secondary treatment in 2006/07. The Appropriate Assessment for this WWTP concluded that the "contribution of nutrients [from the WWTP] is minimal in comparison to the water volumes of the designated site" (WCC, 2009). Therefore, there is no evidence to indicate that the discharge from this WWTP is likely to be influencing food supply for any of the SCI species, and it is not necessary to consider potential in-combination effects with oyster trestle cultivation.

10. Assessment of impacts on conservation objectives

Introduction

10.1 Potential impacts on the screened-in SCIs are summarised below.

Ballyteige Burrow SPA

Grey Plover

10.2 There is potential for full occupation of the aquaculture sites to cause measurable displacement impacts to this species. On the basis of observed population trends these impacts are unlikely to be significant.

Light-bellied Brent Goose

10.3 There is potential for full occupation of the aquaculture sites to cause significant displacement impacts to this species. However, there is a high level of uncertainty about the likelihood of this impact as this species may not be adversely affected by oyster trestle cultivation. t.

Shelduck, Lapwing, Black-tailed Godwit and Bar-tailed Godwit

10.4 The calculated displacement impacts from full occupation of the aquaculture sites would be non-significant but measurable.

Golden Plover

10.5 The calculated displacement impacts from full occupation of the aquaculture sites would be negligible.

Bannow Bay SPA

Light-bellied Brent Goose, Golden Plover, Grey Plover, Lapwing, Black-tailed Godwit and Bar-tailed Godwit

10.6 This assessment for the Ballyteige Burrow SPA concluded that there is potential for full occupation of the aquaculture sites to cause significant (Light-bellied Brent Goose and Grey Plover), or the potential for such impacts cannot be discounted beyond reasonable scientific doubt (Golden Plover, Lapwing, Black-tailed Godwit and Bar-tailed Godwit).

10.7 The effects of any such impacts on the conservation objectives for the Bannow Bay SPA would depend upon the connectivity between the two sites. If their connectivity is high, the two sites would effectively support a single population and it is possible that major displacement impacts within the Ballyteige Burrow SPA would affect attribute 1 (population trend) of the conservation objectives for the Bannow Bay SPA.

10.8 Any such impacts would not affect attribute 2 (distribution) of the conservation objectives for Bannow Bay SPA, as this attribute refers to distribution within Bannow Bay.

Dunlin, Curlew and Redshank

10.9 The calculated displacement impacts within the Ballyteige Burrow SPA from full occupation of the aquaculture sites would be non-significant but measurable. Given the uncertainty about the assessment, due to the limited data, the potential for significant displacement impacts within the Ballyteige Burrow SPA cannot be discounted beyond reasonable scientific doubt. However, for Curlew and Redshank, is a high level of uncertainty about the likelihood of any negative impacts as these species may not be adversely affected by oyster trestle cultivation.

10.10 The effects of any such impacts on the conservation objectives for the Bannow Bay SPA would depend upon the connectivity between the two sites. If their connectivity is high, the two sites would effectively support a single population and it is possible that major displacement impacts within the Ballyteige Burrow SPA would affect attribute 1 (population trend) of the conservation objectives for the Bannow Bay SPA.

10.11 Any such impacts would not affect attribute 2 (distribution) of the conservation objectives for Bannow Bay SPA, as this attribute refers to distribution within Bannow Bay.

Keeragh Islands SPA

Cormorant

10.12 This assessment has not identified any significant potential impacts from aquaculture activities on this species. Therefore, no impacts to the conservation objectives for this SCI is predicted.

Saltee Islands SPA

Lesser Black-backed Gull

10.13 On foot of follow-up investigations it can be concluded that intertidal habitat in Ballyteige Bay is unlikely to be a significant foraging resource for Lesser Black-backed Gulls from the Saltee Islands colony.

Tacumshin Lake SPA

Wigeon

10.14 There is potential for full occupation of the aquaculture sites to cause significant displacement impacts to this species within the Ballyteige Burrow SPA. However, there is a high level of uncertainty about the likelihood of this impact as this species may not be adversely affected by oyster trestle cultivation.

10.15 The effects of any such impacts on the conservation objectives for the Tacumshin Lake SPA would depend upon the connectivity between the two sites. If their connectivity is high, the two sites would effectively support a single population and it is possible that major displacement impacts within the Ballyteige Burrow SPA would affect attribute 1 (population trend) of the conservation objectives for the Tacumshin Lake SPA.

10.16 Any such impacts would not affect attribute 2 (distribution) of the conservation objectives for Tacumshin Lake SPA, as this attribute refers to distribution within Tacumshin Lake.

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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
Bewick's Swan	*Cygnus columbianus*	BS
Black-headed Gull	*Chroicocephalus ridibundus*	BH
Black-tailed Godwit	*Limosa limosa*	BW
Common Tern	*Sterna hirundo*	CN
Coot	*Fulica atra*	CO
Cormorant	*Phalacrocorax carbo*	CA
Curlew	*Numenius arquata*	CU
Dunlin	*Calidris alpina*	DN
Fulmar	*Fulmarus glacialis*	F.
Gadwall	*Anas strepera*	GA
Gannet	*Morus bassanus*	GX
Golden Plover	*Pluvialis apricaria*	GP
Grey Plover	*Pluvialis squatarola*	GV
Guillemot	*Uria aalge*	GU
Herring Gull	*Larus argentatus*	HG
Kittiwake	*Rissa tridactyla*	KI
Knot	*Calidris canutus*	KN
Lapwing	*Vanellus vanellus*	L
Lesser Black-backed Gull	*Larus fuscus*	LB
Light-bellied Brent Goose	*Branta bernicla hrota*	PB
Little Grebe	*Tachybaptus ruficollis*	LG
Little Tern	*Sternula albifrons*	AF
Pintail	*Anas acuta*	PT
Puffin	*Fratercula arctica*	PU
Razorbill	*Alca torda*	RA
Redshank	*Tringa totanus*	RK
Roseate Tern	*Sterna dougallii*	RS
Sandwich Tern	*Sterna sandvicensis*	TE
Shag	*Phalacrocorax aristotelis*	SA
Shelduck	*Tadorna tadorna*	SU
Shoveler	*Anas clypeata*	SV
Teal	*Anas crecca*	T.
Tufted Duck	*Athya fuligula*	TU
Whooper Swan	*Cygnus cygnus*	WS
Wigeon	*Anas penelope*	WN

Appendix B

Ballyteige Burrow Lesser Black-backed Gull survey

Marine Institute Bird Studies

Ballyteige Burrow Lesser Black-backed Gull survey

August 2020

Notice

This report was produced by Atkins Ecology for the Marine Institute for the specific purpose of the Marine Institute Bird Studies project.

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Contents

1. Introduction

1.1 The Appropriate Assessment report on aquaculture in the Ballyteige Burrow SPA concluded that "*without firm information on the diet of the Saltee Islands Lesser Black-backed Gull colony, the occurrence of Lesser Black-backed Gull in Ballyteige Bay during the summer, and/or the response of Lesser Black-backed Gull to oyster trestles, it is not possible to make an assessment of the potential impact of aquaculture activities in Ballyteige Bay on the colony*" (Gittings and O'Donoghue, 2019; referred to hereafter as the AA report).

1.2 This report presents the results of a Lesser Black-backed Gull survey carried out in the Ballyteige Burrow SPA in June-July 2020. The objective of the survey was to address the information gap identified in the Appropriate Assessment report by establishing whether Lesser Black-backed Gulls forage in intertidal habitats within Ballyteige Burrow during the breeding season.

1.3 The survey also collected data on Lesser Black-backed Gull usage of Bannow Bay and on the summer waterbird populations of the Ballyteige Burrow SPA.

1.4 The Ballyteige Burrow SPA includes a section of seaward coast that is rarely used by the Special Conservation Interest species that were the subject of the Appropriate Assessment, and which does not include any aquaculture sites. Therefore, in this report, as in the AA report, we distinguish between the Ballyteige Burrow SPA (the entire SPA) and Ballyteige Bay (the estuarine section of the SPA on the northern side of the sand dunes).

2. Methods

2.1 We carried out three survey visits to cover the three main phases of the Lesser Black-backed Gull breeding season: 5th June 2020 (incubation period), 6th July 2020 (chick provisioning period), and 20th July 2020 (fledging period).

2.2 The survey visit timings, and the weather conditions during the visits, are shown in Table 2.1. As there is an unusual tidal regime in Ballyteige Bay, the survey timings reflected the exposure period of the intertidal habitat, rather than the predicted low tide for Fethard-on-Sea.

Table 2.1 – Survey visits.

Date	Coverage period	Low tide		Cloud	Wind	Rain
		time	height			
05/06/2020	10:45-17:45	12:11	0.5	0-33%	NW4	showers
06/07/2020	12:30-19:33	13:29	0.6	34-66%	W3	no rain
20/07/2020	11:20-18:42	12:21	0.9	0-33%	S3	no rain

Low tide times and heights for Fethard-on-Sea (www.ukho.gov.uk/easytide).

2.3 On each survey visit the intertidal habitat adjacent to the aquaculture sites was monitored for the duration of the period of exposure (the aquaculture sites monitoring area; Figure 2.1). The monitoring was carried out from the northern shoreline of Ballyteige Bay east of the Duncormick River Estuary. We chose this location because it allowed coverage of the areas holding the main concentrations of waterbirds in the Ballyteige Burrow SPA (see Gittings and O'Donoghue, 2019) without needing to leave the estuary to travel between vantage points. The main vantage point used allowed full coverage of the aquaculture sites monitoring area. This comprised all the intertidal habitat within the potential disturbance zone from the aquaculture sites (cf. Figures 2.3-2.5 in Gittings and O'Donoghue, 2019) and included the eastern third of subsite 0OL04 and most of subsite 0OL06. By walking along the shoreline in either direction it was also possible to cover the remainder of subsite 0OL06, subsite 0OL02 (the Duncormick River Estuary) and subsites 0OL07 and 0OL08 (the uppermost part of Ballyteige Bay).

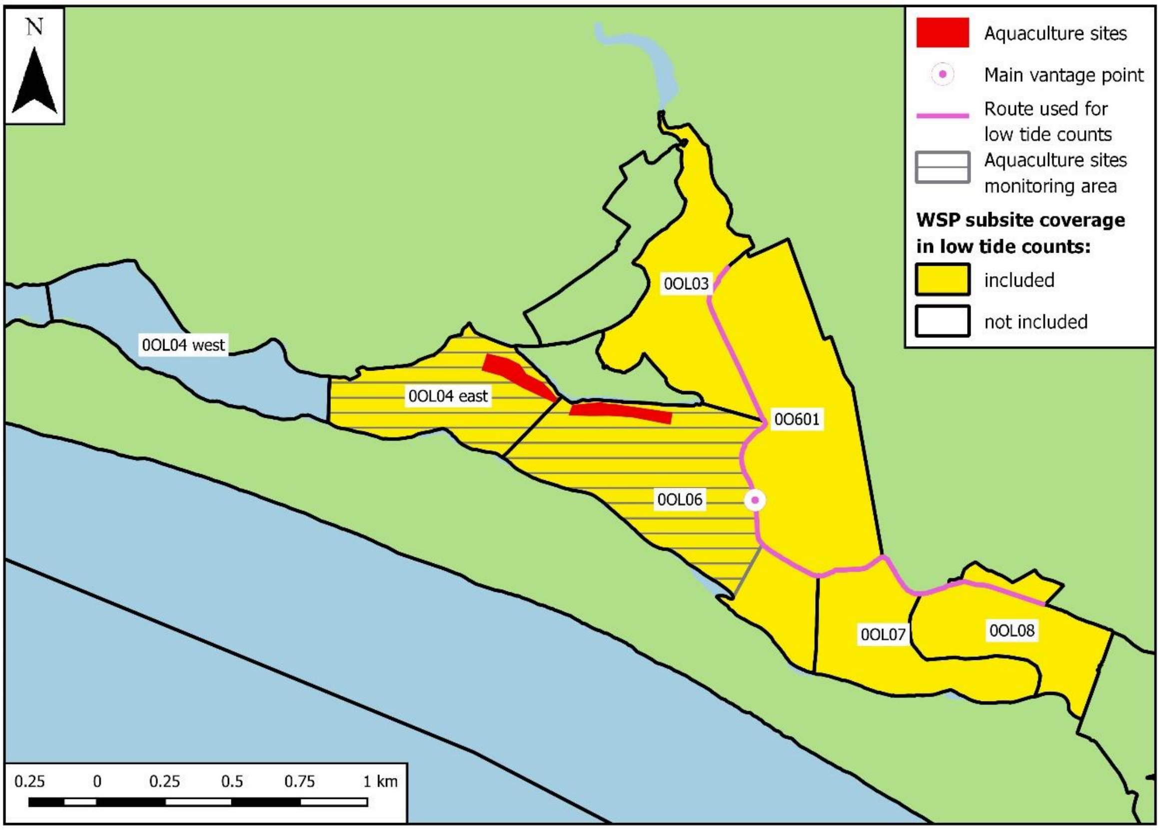

Figure 2.1 – The aquaculture site monitoring area and the coverage of WSP subsites during the low tide counts.

2.4 All observations of Lesser Black-backed Gulls during the survey period were recorded. Observations of birds on intertidal or subtidal habitat within Ballyteige Bay were mapped, their behaviour recorded (feeding, or roosting/other) and the time and duration of their occurrence recorded. Flightlines of birds overflying Ballyteige Bay were mapped and the time of the observation was recorded. The age of all birds was recorded using the following age-classes: juvenile, first-summer, second-summer, third-summer and adult. However, for overflying birds seen from below, it was not always possible to distinguish between the third-summer and adult age-classes.

2.5 In addition to monitoring Lesser Black-backed Gull occurrence, during each visit a full waterbird count was taken during the middle of the coverage period covering subsites 0OL02, 0OL04 (eastern third), 0OL06, 0OL07 and 0OL08. Further additional waterbird counts of the aquaculture sites monitoring area were taken at intervals across the coverage period.

2.6 On the 5th June 2020 and 6th July 2020 survey visits, quick checks of Bannow Bay for Lesser Black-backed Gull were carried out before arriving at Ballyteige Bay. These were carried out from vantage points along the eastern shore and covered most of Bannow Bay upstream of Saltmills. On 5th June 2020, the visit was carried out from 09:50-10:30, while on 6th July 2020, the visit was carried out from 11:20-12:05.

3. Survey results

Tidal exposure patterns in Ballyteige Bay

3.1 On the three survey days, the intertidal habitat around the aquaculture sites was exposed for a period of around 7-8.5 hours, from around 1.5-2 hours before the Fethard-on-Sea low tide to 5.5-6.5 hours after the Fethard-on-Sea low tide. The maximum exposure occurred around 3.5 hours after the Fethard-on-Sea low tide. This meant that the exposure pattern was not symmetric around low water, with a period of around 5-6 hours before low water, compared to 2-3 hours after low water. The maximum extent of tidal exposure was greater on 6th and 20th July 2020, compared to 5th June 2020, even though the lowest predicted tide occurred on the latter date.

Lesser Black-backed Gull in Ballyteige Bay

3.2 On 5th June 2020, we flushed an adult Lesser Black-backed Gull from a tidal channel in subsite 0OL08. The bird was hidden by the angle of the seawall as we approached and flushed as soon as it became visible. As the Herring Gulls and Great Black-backed Gulls seen on subtidal water during the surveys were usually feeding, it seems likely that this bird was feeding before it was flushed. Apart from this record, we did not record any Lesser Black-backed Gull feeding in tidal habitats in Ballyteige Bay on any of the three survey days.

3.3 On 6th July 2020, we recorded a single adult Lesser Black-backed Gull roosting on intertidal habitat in subsite 0OL06.

3.4 On 20th July 2020, we recorded Lesser Black-backed Gulls roosting on intertidal habitat, with Herring Gulls and Great Black-backed Gulls, throughout the duration of the watch. These roosting groups occurred in three general areas: in the middle of the tidal flats in subsite 0OL06 (R1; Figure 3.1), on the tip of the sandbar separating subsite 0OL06 from the Duncormick River Estuary (R2; Figure 3.1), and in the upper section of the Duncormick River Estuary in subsite 0OL02 (R3; Figure 3.1). The roosting numbers increased across the first five hours of the watch, then decreased as the tide began to flood roosts R1 and R3 (Table 3.1). The peak count across all three roosts was 63. Excluding the count of adult/third-summers, across all the counts, 92% of birds recorded were adults, with small numbers of third-summers and juveniles, and a single second-summer.

Table 3.1 – Hourly counts of roosting Lesser Black-backed Gull in Ballyteige Bay on 20th July 2020.

Time period	Age	Roosts		
		R1	R2	R3
11:20-12:20	Adult	0	no count	0
12:20-13:20	Adult	4	no count	0
13:20-14:20	Adult	4	no count	0
14:20-15:20	Adult	5	3	0
	Juvenile	1	0	0
15:20-16:20	Adult	5	no count	16
	third-summer	0		1
	second-summer	1		0
	Juvenile	0		1

Time period	Age	Roosts		
		R1	R2	R3
16:20-17:20	Adult	17	41	0
	third-summer	0	4	0
	Juvenile	0	1	0
17:20-18:20	Adult	2	0	0
	adult/third-summer	0	18	0
	Juvenile	0	1	0
18:20-18:40	Adult	2	0	10

See Figure 3.1 for roost locations.

3.5 On all three survey days, commuting Lesser Black-backed Gull were recorded flying over Ballyteige Bay. Most records (92% of all commuting birds recorded) were of birds broadly following the Duncormick River Estuary (Figure 3.2). A few birds were recorded flying along the dunes or commuting inland/out to sea at Lacken (Figure 3.2). However, the vantage points used for the survey will have biased the survey effort towards recording of birds using the Duncormick River Estuary as a commuting route. The alignment of the Duncormick River Estuary and Lacken commuting routes (Figure 3.2) indicated that the birds were commuting to/from the Saltee Islands. Peak numbers of birds commuting inland were recorded during the mid-afternoon, while peak numbers of birds commuting out to sea were recorded towards the end of each survey period (Table 3.2). The largest number of commuting birds were recorded on 6th July 2020. On 20th July 2020, many of the birds recorded commuting out to sea were probably birds that had been roosting in the upper part of the Duncormick River Estuary (R3; Figure 3.1). Most commuting birds were recorded as adults, although these may have included some third-summers (see paragraph 2.4). The only non-adult/third-summers recorded were single records of second-summers on 5th June 2020 and 20th July 2020. Note that some commuting birds may have been missed while carrying out waterbird counts.

Table 3.2 - Hourly counts of commuting Lesser Black-backed Gull flying inland and out to sea along the Duncormick River Estuary at Ballyteige Bay on the three survey days.

Time period	05/06/2020		06/07/2020		20/07/2020	
	inland	out to sea	inland	out to sea	inland	out to sea
10:00-11:00	0	0				
11:00-12:00	1	0			0	0
12:00-13:00	1	0	0	1	0	0
13:00-14:00	0	0	3	1	0	0
14:00-15:00	2	0	7	1	3	0
15:00-16:00	12	1	6	1	1	5
16:00-17:00	0	3	5	8	2	6
17:00-18:00	0	0	5	11	0	20
18:00-19:00			0	13	0	14
19:00-20:00			0	16		
Totals	**16**	**4**	**26**	**52**	**6**	**45**

Shaded cells indicate the time period was not covered on that survey date. The first and last time periods on each survey day were only partly covered; see coverage periods in Table 2.1.

Lesser Black-backed Gull at Bannow Bay

3.6 When we checked Bannow Bay on 5th June 2020, there was partial exposure of intertidal habitat around the trestles, with extensive exposure in the upper estuary and in the sandflats around Bannow Bay Island. No Lesser Black-backed Gulls were recorded.

3.7 When we checked Bannow Bay on 6th July 2020, the intertidal habitat around the trestles was more or less fully exposed. Two adult Lesser Black-backed Gulls were recorded feeding on intertidal habitat along the edge of the main tidal channel close to the trestles, and a single adult Lesser Black-backed Gull was recorded roosting on intertidal habitat in the upper estuary.

3.8 We did not visit Bannow Bay during the 20th July 2020 survey visit.

Waterbird counts at Ballyteige Bay

3.9 The overall waterbird numbers recorded on the low tide counts increased across the three survey days (Table 2.1). The main species recorded were Curlew, Black-tailed Godwit, Redshank and Black-headed Gull. The peak numbers of Little Egret, Curlew and Black-headed Gull were higher than the five year mean annual peak I-WeBS count (Table 2.1). The highest concentrations of most species occurred in the Duncormick River Estuary (subsite 0OL03) and in the uppermost section of Ballyteige Bay adjacent to the Cull (subsite 0OL08), while the overall numbers in the aquaculture sites monitoring area were generally low (Table 3.4). On 20th July 2020, the large Curlew count included a flock of 338 roosting in the saltmarsh in subsite 0OL08. Most of the Black-headed Gulls recorded were feeding in the intertidal zone. On 5th June 2020 and 6th July 2020, the Herring Gulls and Great Black-backed Gulls were mainly feeding in subtidal water in the tidal channels, while on 20th July 2020 they were mainly roosting with the Lesser Black-backed Gulls.

Table 3.3 – Low tide waterbird counts at Ballyteige Bay in June-July 2020 compared to the five-year mean annual peak I-WeBS counts.

Species	05/06/2020	06/07/2020	20/07/2020	I-WeBS
Shelduck	8	8	0	37
Mallard	1	2	0	48
Cormorant	2	1	1	16
Little Egret	2	25	26	18
Grey Heron	2	2	0	6
Oystercatcher	29	21	54	85
Whimbrel	0	0	1	1
Curlew	6	77	519	342
Black-tailed Godwit	90	207	181	281
Bar-tailed Godwit	0	2	1	320
Dunlin	0	0	7	532
Greenshank	0	4	10	20
Redshank	0	51	192	423
Black-headed Gull	298	344	686	348
Mediterranean Gull	0	4	0	1
Lesser Black-backed Gull	1	0	7	82
Herring Gull	6	11	56	172
Great Black-backed Gull	11	15	31	46

I-WeBS data are the five-year mean annual peak counts for the period 2011/12-2015/16; data supplied by the Irish Wetland Bird Survey (I-WeBS), a joint scheme of BirdWatch Ireland and the National Parks and Wildlife Service of the Department of Arts, Heritage & the Gaeltacht.

Table 3.4 – Maximum counts in the aquaculture sites monitoring area.

Species	05/06/2020	06/07/2020	20/07/2020
Cormorant	0	1	2
Little Egret	3	3	7
Grey Heron	0	1	1
Oystercatcher	7	11	28
Ringed Plover	4	0	3
Whimbrel	0	0	3
Curlew	8	17	40
Black-tailed Godwit	0	2	0
Bar-tailed Godwit	0	1	0
Dunlin	17	0	5
Greenshank	0	1	0
Redshank	3	3	5
Black-headed Gull	23	37	54
Lesser Black-backed Gull	0	0	17
Herring Gull	4	2	12
Great Black-backed Gull	3	6	21

See Figure 2.1 for the extent of the area covered.

Disturbance at Ballyteige Bay

3.10 Husbandry activities took place around the western aquaculture site (T03/038A) on 6th and 20th July 2020. The vantage points used for this survey were too distant from that site to monitor whether the activities caused any disturbance impacts.

3.11 A walking route runs along the northern shore of Ballyteige Bay from the Duncormick River Estuary to the Cull, with small numbers of people using this route on all three survey days. However, most people using this route kept to the shoreline and did not appear to cause significant disturbance responses from waterbirds in the estuary.

3.12 Observations of activities in the tidal zones in Ballyteige Bay are summarised in Table 3.5. There is a route marked out by old wooden posts that crosses the middle of subsite 0OL06, which appears to be used by horse riders to access the dunes to/from the slip at Blackstone. On 20th July 2020, three bait diggers were working in the middle of subsite 0OL06 on the flood tide. The gull flock roosting at R1 (including Lesser Black-backed Gulls) appeared to tolerate their activity but flushed when one of the bait diggers walked back directly towards them.

Table 3.5 – Observations of potential disturbance generating activities in the tidal zones of Ballyteige Bay.

Date	Time	Details
06/07/2020	16:55-17:20	Horse rider and dog rode out to the southern tidal channel across the sandflats in the middle of subsite 0OL06.
	17:20-17:40	Dog ran out across mud in subsite 0OL06 near mouth of Duncormick River Estuary, swam across northern tidal channel and then continued up the Duncormick River Estuary, chasing birds.

Date	Time	Details
	18:20-18:45	Horse rider rode out across the sandflats in the middle of subsite 0OL06, crossed southern tidal channel and continued into dunes, returning back along the same route.
20/07/2020	16:10-17:35	3 bait diggers walked out to middle of subsite 0OL06. They worked around 200-300 m away from the roosting gull flock without causing any disturbance response. One returned at 17:00, flushing the roosting gull flock which was directly on his route. The other two moved up the estuary to the eastern end of subsite 0OL06, returning to the shore at 17:35.
	17:10	Horse rider crossed the estuary from the dunes across the middle of subsite 0OL06.
	18:30	3 horse riders wading below the tideline along the now largely flooded northern shore of subsite 0OL06 west of the mouth of the Duncormick River Estuary.

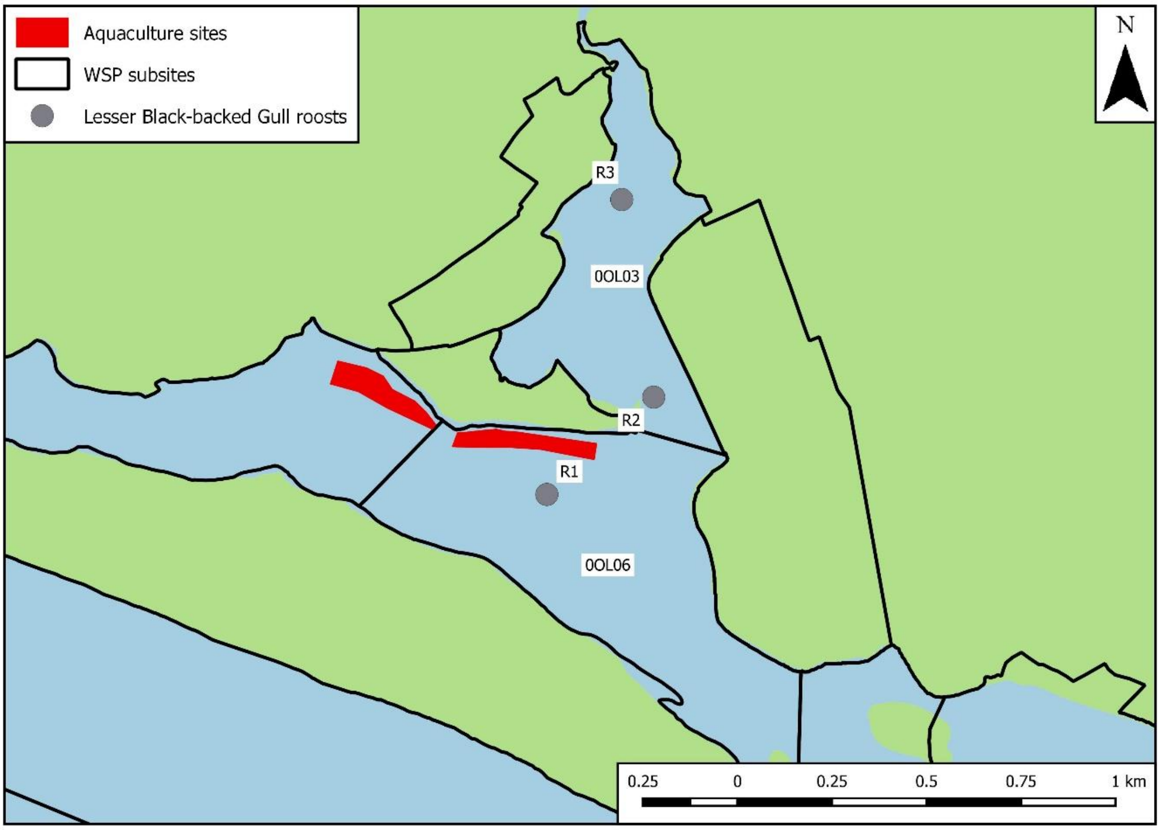

Figure 3.1 – Lesser Black-backed Gull roost locations on 20th July 2020.

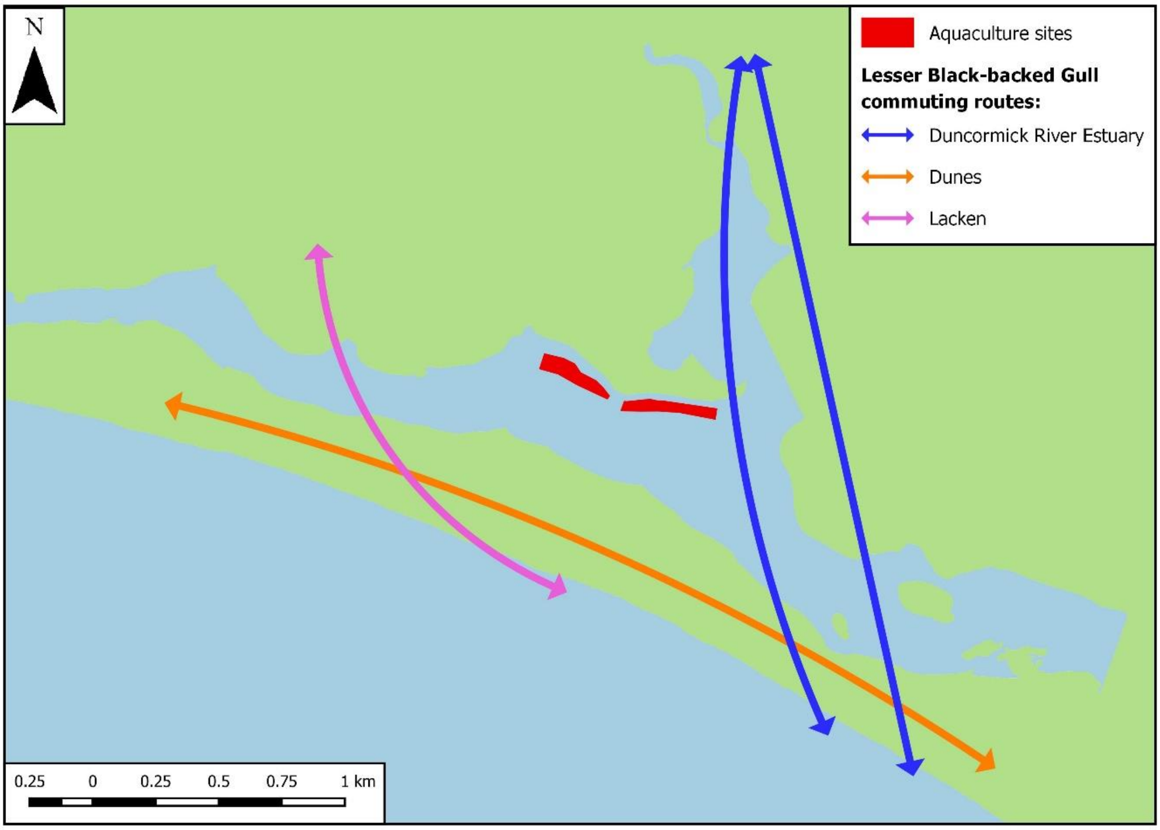

Figure 3.2 – Lesser Black-backed Gull commuting routes.

4. Conclusions

4.1 This survey sampled the incubation, chick provisioning and post-fledging phases of the Lesser Black-backed Gull breeding cycle. The only record of a Lesser Black-backed Gull possibly foraging in tidal habitats in Ballyteige Bay was of a single bird in subtidal water in the uppermost section of the bay. Therefore, it can be concluded that intertidal habitat in Ballyteige Bay is unlikely to be a significant foraging resource for Lesser Black-backed Gulls from the Saltee Islands colony. While our data for Bannow Bay is more limited, we also did not find any evidence to indicate that intertidal habitat there is likely to be a significant foraging resource for Lesser Black-backed Gulls from the Saltee Islands colony.

4.2 We regularly recorded commuting Lesser Black-backed Gulls flying inland/out to sea along the Duncormick River Estuary, and these were presumably birds commuting to/from the Saltee Islands. The numbers recorded on 5th and 20th July 2020 represent around 10% of the adult breeding population of the Saltee Islands colony (251 apparently occupied nests in 2015-2018; Cummins *et al.*, 2019). As this is presumably only one a number of commuting routes, our observations indicate that the terrestrial habitats provide a significant component of the of the foraging resources used by the Saltee Islands colony.

4.3 On 20th July 2020, small roosting flocks of Lesser Black-backed Gulls occurred in Ballyteige Bay. These appeared to be birds returning along the Duncormick River Estuary commuting route, pausing to roost, before continuing onto the Saltee Islands. One of the roost sites occurred within around 100-200 m of aquaculture site T03/095A. Observations of the responses of the gulls to bait diggers indicated that they tolerated activity within a few hundred metres but flushed when they were directly approached. Therefore, while husbandry activity within this aquaculture site may cause disturbance to this roost site the gulls are likely to be able to continue to roost elsewhere in the same general area.

4.4 We recorded high counts of some other waterbird species during the surveys, with the peak Little Egret, Curlew and Black-headed Gull counts exceeding the most recent five-year mean annual peak I-WeBS counts. The occurrence of relatively high waterbird numbers outside the I-WeBS season is not unusual (Cooney, 2017, 2018; T. Gittings, unpublished data for Cork Harbour). In particular, late summer is probably the peak period of utilisation of intertidal habitats by Black-headed Gulls in southern Ireland. This illustrates the limitations of relying solely on I-WeBS data, and other data from winter bird surveys, for assessments of impacts to waterbird populations. However, only three of the species recorded in significant numbers in these surveys are Special Conservation Interests that were screened in for assessment in the AA report (Curlew, Black-tailed Godwit and Redshank). These species were not identified as at being at risk of significant impacts in the AA report. Given the relatively low numbers that occurred in the area around the aquaculture sites, the results of these surveys do not suggest any changes to that assessment.

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