Marine Institute

Updated assessment of aquaculture impacts in Inner Galway Bay on Special Conservation Interests of Inner Galway Bay SPA & other SPAs

July 2019

ATKINS

Marine Institute Bird Studies

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June 2019

Notice

Document History

JOB NUMBER:			DOCUMENT REF: 516490Dg014			
1.0	Draft for Comment	TG	TG	POD	MF	28-06-2019
1.1	Minor amendments	TG	TG	POD	MF	02-07-2019
Revision	Purpose Description	Originated	Checked	Reviewed	Authorised	Date

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Executive Summary

This report present the results of an update to the Appropriate Assessment of aquaculture in Inner Galway Bay that was published in 2014. There are 51 aquaculture sites, covering a total area of 247 ha within Inner Galway Bay. These include 33 licensed sites covering a total area of 76 ha, and 18 application sites, covering a total area of 171 ha. The predominant aquaculture activity is the cultivation of Pacific Oysters using a variety of methods. Other existing and/or planned activities are mussel cultivation using rafts and longlines, bottom cultivation of native oysters, scallop cultivation and seaweed cultivation.

The report assesses the potential impact of the development of these aquaculture sites on the Special Conservation Interests (SCIs) of the Inner Galway Bay SPA, and on the SCIs of other SPAs where these SCIs may have connectivity with Inner Galway Bay. The potential for cumulative impacts from development of these aquaculture sites in combination with other relevant activities and plans is also assessed.

The SCIs of the Inner Galway Bay SPA covered by this assessment are: non-breeding/wintering Light-bellied Brent Goose, Wigeon, Teal, Shoveler, Golden Plover, Lapwing, Ringed Plover, Curlew, Bar-tailed Godwit, Turnstone, Dunlin, Redshank, Black-headed Gull and Common Gull; and breeding Cormorant, Sandwich Tern and Common Tern,. The SCIs of other SPAs covered by this assessment are: the non-breeding/wintering Shoveler, breeding Common Scoter and breeding Common Gull SCIs of the Lough Corrib SPA; and the non-breeding/wintering Wigeon, Golden Plover and Black-tailed Godwit SCIs of the Rahasane Turlough SPA.

Full development of the existing licensed aquaculture sites is unlikely to cause significant displacement impacts to any of the species covered by this assessment.

Full development of the application aquaculture sites may cause significant displacement impacts to a number of species covered by this assessment, particularly Light-bellied Brent Goose, Ringed Plover and Curlew. This is mainly due to the two large sites on either side of the Aughinish Island causeway (T08/115A and T09/519A).

The significance of potential disturbance impacts arising from boat movements to Red-breasted Merganser, roosting Great Northern Diver and high tide waterbird roosts cannot be fully assessed at this stage due to the lack of detailed information about the timing and intensity of husbandry activity and associated use of access routes. However, to minimise impacts to Great Northern Diver it is proposed that boat activity be restricted around one hour before dusk to shortly after dawn, while it is proposed that the proximity of boat movements to high tide roosts should be restricted to avoid disturbance to roosting birds. There remains a risk of disturbance to Red-breasted Merganser for those sites which are accessed by boat. Further quantification of this risk would require more detailed knowledge of the season, frequency and type of boat movements; as if it proves that boat movements are relatively infrequent, or biased towards the months of May – September, such impact may be negligible.

There is potential for beach recreation and other intertidal activities such as shellfish collection to have cumulative impacts on Light-bellied Brent Goose, Ringed Plover and other species in combination with displacement impacts from aquaculture activity.

If the aquaculture activity causes non-negligible disturbance impacts to Red-breasted Merganser, Great Northern Diver and high tide waterbird roosts, there is potential for small boat activity (recreational and fishing boats) to have cumulative impacts on Red-breasted Merganser, Great Northern Diver and high tide waterbird roosts in combination with these disturbance impacts.

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 In 2014, we prepared an Appropriate Assessment report which assessed the impact of aquaculture, in Inner Galway Bay on SCIs of the Inner Galway Bay SPA, and other relevant SPAs (Gittings and O'Donoghue, 2014). The present report presents an updated Appropriate Assessment of aquaculture in Inner Galway Bay. This updated assessment includes the aquaculture sites that were licensed as part of the Appropriate Assessment process, and new aquaculture sites that are the subject of current applications for licences.

1.3 In the 2014 assessment, aquaculture activities within Fishery Orders were considered as part of the main assessment. However, this report follows the practice of our more recent Appropriate Assessment reports (Gittings and O'Donoghue, 2018, 2019) of treating aquaculture activities within Fishery Orders as part of the cumulative assessment. This is considered to be a more appropriate treatment as such activities are not part of the licensing procedure which is the subject of the assessment.

1.4 The main focus of the assessment is the Inner Galway Bay SPA. In addition, Special Conservation Interests of two other SCIs (Lough Corrib SPA and Rahasane Turlough SPA) are also included in this assessment, based on the screening carried out for the 2014 assessment. The SPAs included in this assessment are shown in Figure 1.1.

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

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

1.7 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

1.8 The structure of the report is as follows:

- Chapter 2 describes the methodology used for the assessment.
- Chapter 3 describes the aquaculture activities covered by this assessment.
- Chapter 4 assesses the potential impacts of the aquaculture activities covered by this assessment on the Special Conservation Interests (SCIs) of the SPAs included in the assessment.
- Chapter 5 contains an assessment of cumulative impacts from the aquaculture activities included in this assessment in-combination with impacts from other relevant activities.
- Chapter 6 presents the conclusions of this assessment.

Constraints to this assessment

1.9 Very little information was provided about the timing and intensity of husbandry activity associated with the aquaculture activities covered by this assessment. This lack of information has prevented us from being able to make detailed assessments of potential disturbance impacts.

1.10 The subsites used for waterbird counts in the Inner Galway Bay SPA do not cover the whole SPA and some of the aquaculture sites are not included in any of these subsites.

1.11 There is relatively good information available on the low tide distribution of waterbirds in Inner Galway Bay in winter through the I-WeBS and NPWS WSP counts, but information for the autumn period is limited to a single October count in 2009. There is also a lack of information for specific waterbird features such as the location of nocturnal Great Northern Diver and Cormorant roosts.

1.12 There is a strong evidence base for the assessment of displacement impacts for some of the aquaculture activities (particularly intertidal oyster cultivation and suspended mussel cultivation), but little or no evidence for other activities.

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

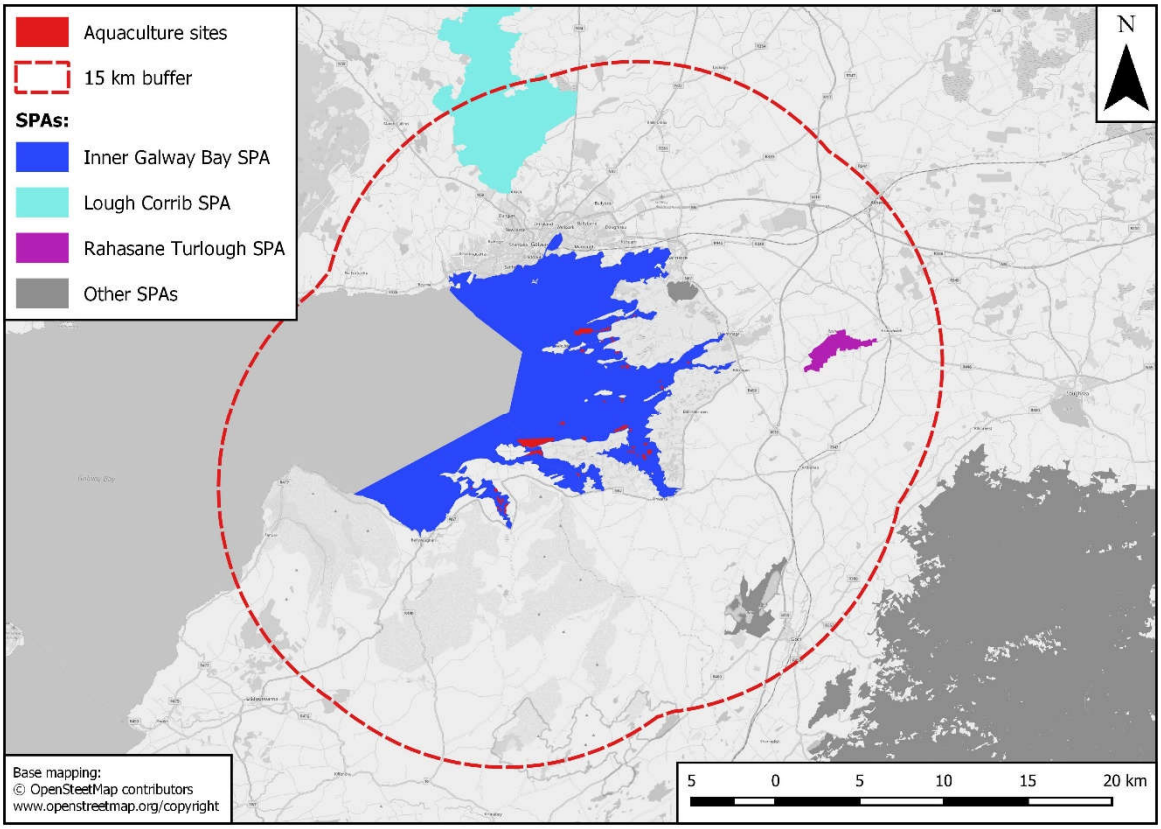


Figure 1.1 – SPAs included in this assessment.

2. Methodology

General

2.1 This assessment is based on a desktop review of existing information about waterbird population trends and distribution in Inner Galway Bay in addition to site familiarisation visits by TG in March 2014 and May 2019.

Data sources

2.2 The SPA boundaries are derived from NPWS shapefiles (which were last updated on 19/09/2018).

2.3 The spatial extents of the aquaculture sites and the Fishery Order areas have been derived from shapefiles supplied by the Marine Institute (received on 13/05/2019), based upon site lists supplied to the Marine Institute by the Department of Agriculture, Food and the Marine. The status of the sites (application or licensed) used in this assessment is as indicated in these shapefiles[1]. Access routes for the new applications were obtained from shapefiles supplied by the Marine Institute (received on 13/05/2019). Access routes for the licensed sites were taken from those used for the 2014 assessment. Details of existing and proposed aquaculture activities have been taken from information sources used for the 2014 assessment (Gittings and O'Donoghue, 2014), and from an unpublished document (*Aquaculture Profiling in Galway Bay Inner*) received from the Marine Institute on 13/05/2019.

2.4 The main waterbird data sources used for the assessment were the Irish Wetland Bird Survey (I-WeBS) counts 1994/95-2016/17 and the Waterbird Survey Programme (WSP) counts 2009/10[2]. Confidential data on seabird colonies in Inner Galway Bay has been supplied by NPWS. Additional waterbird data sources are listed in Gittings and O'Donoghue (2014).

2.5 Information on the disturbance sensitivity of marine SCI species (Red-breasted Merganser, Great Northern Diver and Cormorant) has been obtained from recent work carried out by the present authors (Gittings *et al.*, 2015, Gittings and O'Donoghue, 2016a; Gittings, unpublished data).

2.6 Information used in this assessment on distribution of marine community types, tidal zones and the depths of subtidal habitats, the timing and height of low tides, and other activities (such as recreational use and boat activity) is mainly derived from Gittings and O'Donoghue (2014), and that report should be consulted for further details about the information sources. Some additional information on other activities was also obtained from assessments carried out for the Galway Harbour Extension project (Gittings, 2014, 2015).

Site visits

2.7 A two day site visit was carried out in March 2014 as part of the preparation of the 2014 assessment. Another two day site visit was carried out in May 2019 for the present assessment. All the site visits were carried out during spring low tides. Over the four days of site visits all the major areas of existing and proposed aquaculture activity were visited at low tide.

[1] Aquaculture sites in the shapefile *GB_APP_OCT14_ITM.shp* have been treated as licensed sites for the purposes of this assessment, as advised by the Marine Institute.

[2] In Gittings and O'Donoghue (2014), this was referred to as the Baseline Waterbird Survey (BWS), which was the name originally used for these surveys. However, we have changed the name to reflect the current name for these surveys.

Aquaculture assessment methodology

General

2.8 This report presents an updated assessment based on the 2014 assessment. Therefore the assessment follows the same general approach and uses the same methodology for assessment of displacement impacts (see below). However, instead of considering each aquaculture activity separately, an integrated assessment is presented which considers all the aquaculture activities together.

Species distribution

2.9 The 2014 assessment included exploratory analyses of the relationships between waterbird subsite distribution and habitat parameters. Where these found significant relationships, these analyses have been repeated with the 2011/12-2016/17 I-WeBS dataset. These analyses used the same methods as those carried out for the 2014 assessment (Gittings and O'Donoghue, 2014).

Displacement impacts

2.10 The displacement impact analysis uses the analytical methodology described in Appendix B of Gittings and O'Donoghue (2014). However, we have carried out the analyses using two sets of waterbird distribution data: -

- the 2006/07-2010/11 I-WeBS/WSP dataset (which was used in the 2014 assessment); and
- the 2011/12-2016/17 I-WeBS dataset (which is the latest available waterbird data for Inner Galway Bay).

2.11 This allows comparison of the predicted displacement impacts derived from the two datasets, which provides an indication of the reliability of the waterbird distribution data from which the predictions are derived[3]. We have also calculated separate displacement impact predictions using the licensed sites only, and all the sites. This allows the additional impact of the application sites to be assessed. Therefore, there are four predicted displacement impacts for each species: licensed and all sites from the 2006/07-2010/11 I-WeBS/WSP dataset, and licensed and all sites from the 2011/12-2016/17 I-WeBS dataset.

2.12 The displacement calculations involved defining groups of subsites containing the aquaculture sites, calculating the mean percentage occurrence of the SCI species within the subsite groups, and multiplying this mean percentage occurrence by the percentage of the available habitat within the subsite groups occupied by the activity to obtain the potential displacement. Aquaculture sites that overlap the boundary of a subsite, or are just outside a subsite, and which do not occur in any other subsite, were treated as being within the relevant subsite (Gittings and O'Donoghue, 2014).

2.13 The subsite groups used in the displacement calculations are shown in Table 2.1 and Figure 2.1. There are no I-WeBS subsites covering the area around Island Eddy, so the two aquaculture sites (T09/332 and T09/470A) in that area were not included in the displacement calculations.

[3] As the calculations use percentage distributions between subsites, they should not, in theory, be affected by changes in overall numbers.

Table 2.1 – Subsite groups used in the displacement calculations.

Subsite group	I-WeBS subsites	Aquaculture sites	Notes
Mweeloon Bay	0G494	T09/373A, T09/373B, T09/373C, T09/374A, T09/375A, T09/376A, T09/376B, T09/376C, T09/377A, T09/504A, T09/520A	Includes all of T09/520A
Lackanaloy Creek / Loughnahulla Bay / Shanmullen Channel	0G491, 0G492	T09/374B, T09/375C, T09/376D, T09/376E, T09/377B, T09/436A, T09/437A, T09/438A, T09/503A	
Clarinbridge River	0G485, 0G486, 0G490	T09/065, T09/393, T09/463A	
Kinvarra Bay	0G487, 0G488, 0G489	T09/020, T09/241, T09/309, T09/346, T09/387, T09/414, T09/453A, T09/482A, T09/499A, T09/500A	
Corranroo Bay	0H444	T09/464A, T09/464B	
Aughinish	0H449	T08/115A, T09/424, T09/501A, T09/512A, T09/519A	Includes all of T09/424 and T09/512A
Poulnacarra Bay	0H446	T08/016, T08/036A, T08/036B, T08/063, T08/074, T08/084B, T08/111A, T08/112A, T08/114A	Includes all of T08/074

2.14 There are overlaps between some licensed sites and application sites in the GIS mapping of the aquaculture sites supplied for this assessment. Where such overlaps occur, the full area of the licensed site, and the additional area covered by the application site outside the licensed site, is included in the analyses.

2.15 The assessment methodology includes a correction factor to account for displacement caused by existing activity. In the 2014 assessment, this correction factor was based on recent (at the time) mapping of aquaculture structures. Up to date mapping of aquaculture structures is not available. However, as the mapping of aquaculture structures used in the 2014 assessment was carried out in the middle of the period covered by the 2011/12-2016/17 I-WeBS dataset it remains relevant to the present assessment and has been used in the displacement calculations in this assessment. In any case, due to the small extent of existing aquaculture activity in Inner Galway Bay, the correction factors due to existing activity are very small and have negligible effects on the predicted displacement levels.

Disturbance impacts

2.16 The potential sensitivity to disturbance of the species covered by this assessment was assessed by reference to relevant literature as well as our own experience of the species' behaviour in Irish coastal waters.

2.17 The potential disturbance impacts were assessed by examining the spatial overlap of the species distribution with the aquaculture sites and the access routes to/from the sites and taking account of likely patterns of husbandry activity within the sites.

Assessment of impact significance

2.18 As in the 2014 assessment, and in other similar assessments, we have used a threshold level of 5% to assess whether a potential displacement impact is likely to be significant. The rationale for

this is fully explained in Gittings and O'Donoghue (2014). However, as in those previous assessments, we have been conservative in applying this threshold and we also consider factors that could potentially increase the displacement above the calculated displacement impact.

2.19 The significance of potential disturbance impacts were assessed qualitatively. However, in many cases, sufficient detailed information about likely timing and intensity of activity was not available to allow assessment of significance.

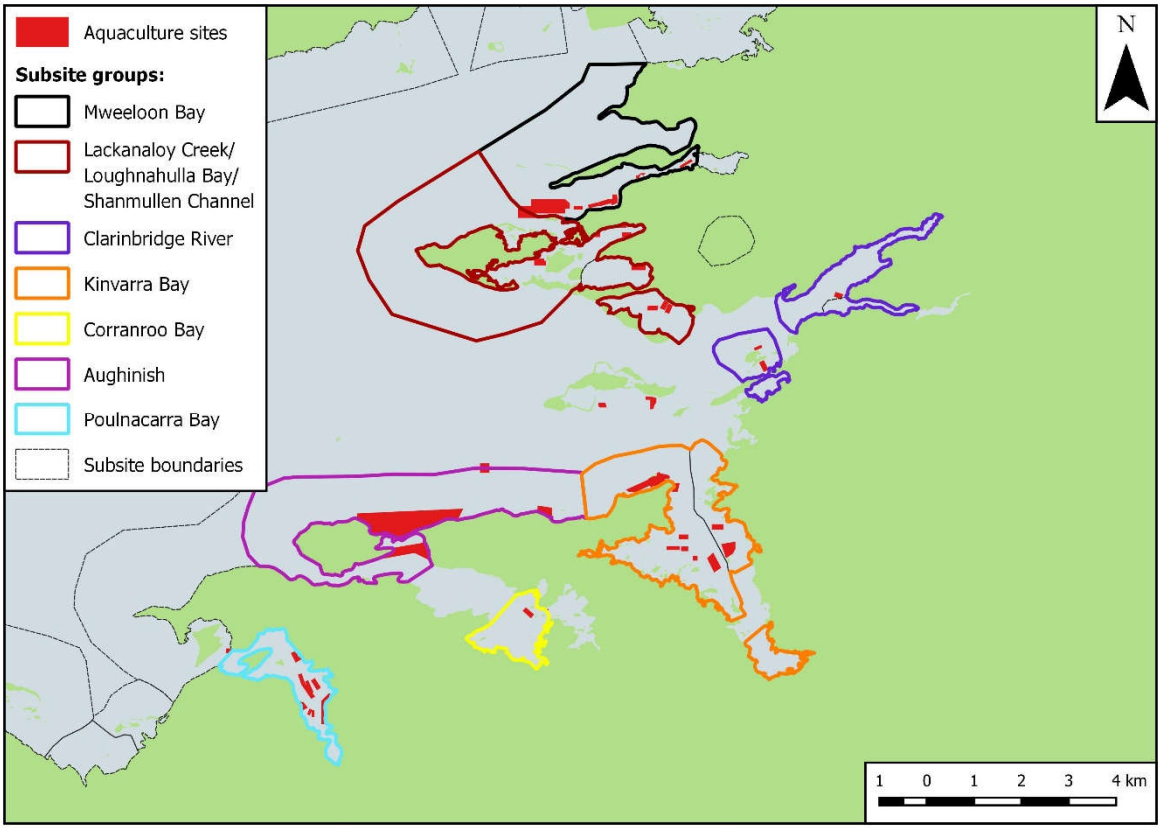


Figure 2.1 – Subsite groups used for the displacement analyses.

3. Aquaculture activities within Inner Galway Bay

Scope of activity

3.1 A total of 51 aquaculture sites, covering a total area of 247 ha[4] occur within Inner Galway Bay (Table 3.1). These include 33 licensed sites covering a total area of 76 ha, and 18 application sites, covering a total area of 171 ha. Most of the sites are small, with a mean area of 2.3 ha (range 0.4-6.8 ha). However, there are four larger sites (all applications) with areas of 11-79 ha. The predominant aquaculture activity is the cultivation of Pacific Oysters using a variety of methods (43 sites covering a total area of 220 ha). Other existing and/or planned activities are mussel cultivation using rafts and longlines (eight sites covering a total area of 29 ha), bottom cultivation of native oysters (one site with an area of 1.8 ha), scallop cultivation (one site with an area of 0.7 ha) and seaweed cultivation (one site with an area of 2.4 ha).

3.2 The 2014 assessment also included sites with proposed lagoon oyster cultivation, intertidal clam cultivation and bottom mussel cultivation, but the sites involved have not been licensed and are not the subject of current applications.

3.3 All the aquaculture sites are within the Inner Galway Bay SPA and occur in the southern two-thirds of the bay with no sites north of Mweeloon Bay (Figure 3.1). The main clusters of sites occur along the eastern side of Inner Galway Bay between Mweeloon Bay and Shanmullen Channel, and along the southern shoreline between Kinvarra Bay and Poulnacarra Bay. There are three sites in the Clarinbridge River Estuary, two sites around Island Eddy and another two sites in offshore waters between Island Eddy and Aughinish Island.

Table 3.1 – Aquaculture sites in Inner Galway Bay.

Location	Site	Type	Activity	Area (ha)
Mweeloon Bay	T09/373A	Licensed	Pacific Oysters (bag and trestle)	0.5
	T09/373B	Licensed	Pacific Oysters (bag and trestle)	0.9
	T09/373C	Licensed	Pacific Oysters (floating trays)	0.8
	T09/374A	Licensed	Pacific Oysters (bag and trestle)	1.3
	T09/375A	Licensed	Pacific Oysters (bag and trestle; floating trays)	2.4
	T09/376A	Licensed	Pacific Oysters (bag and trestle)	1.6
	T09/376B	Licensed	Pacific Oysters (bag and trestle)	1.8
	T09/376C	Licensed	Pacific Oysters (floating trays)	0.8
	T09/377A	Licensed	Pacific Oysters (bag and trestle)	1.5
	T09/504A	Application	Pacific Oysters (bag and trestle)	1.8
	T09/520A	Application	Pacific Oysters (baskets)	29.6

[4] Note that there are overlaps in area between some of the sites, which are not taken into account in the areas cited in this paragraph. However, the overlaps are small.

Location	Site	Type	Activity	Area (ha)
Lackanaloy Creek / Loughnahulla Bay / Shanmullen Channel	T09/374B	Licensed	Pacific Oysters (floating trays)	1.5
	T09/375C	Licensed	Pacific Oysters (floating trays)	1.1
	T09/376D	Licensed	Pacific Oysters (floating trays)	2.0
	T09/376E	Licensed	Pacific Oysters (floating trays)	3.0
	T09/377B	Licensed	Pacific Oysters (floating trays)	1.0
	T09/436A	Application	Pacific Oysters (bag and trestle)	2.0
	T09/437A	Application	Pacific Oysters (bag and trestle)	2.1
	T09/438A	Application	Pacific Oysters (bag and trestle)	2.2
	T09/503A	Application	Pacific Oysters (floating trays)	3.1
Clarinbridge River	T09/065	Licensed	Native Oysters (bottom culture)	1.8
	T09/393	Licensed	Pacific Oysters (bag and trestle)	2.5
	T09/463A	Licensed	Pacific Oysters (bag and trestle)	1.0
Kinvarra Bay	T09/020	Licensed	Mussels (rafts)	6.1
	T09/241	Licensed	Mussels (rafts and longlines)	6.8
	T09/309	Licensed	Pacific Oysters (bag and trestle)	1.5
	T09/346	Licensed	Pacific Oysters (bag and trestle)	1.0
	T09/387	Licensed	Mussels (longlines)	3.0
	T09/414	Licensed	Pacific Oysters (bag and trestle)	6.5
	T09/453A	Licensed	Pacific Oysters (bag and trestle)	2.2
	T09/482A	Licensed	Pacific Oysters (bag and trestle)	2.1
	T09/499A	Application	Pacific Oysters (bag and trestle)	2.0
	T09/500A	Application	Pacific Oysters (bag and trestle)	11.4
Corranroo Bay	T09/464A	Application	Pacific Oysters (bag and trestle)	2.4
	T09/464B	Application	Pacific Oysters (bag and trestle)	0.4
Aughinish	T08/115A	Application	Pacific Oysters (bag and trestle; floating bags; baskets)	17.8
	T09/501A	Application	Pacific Oysters (bag and trestle)	4.9
	T09/519A	Application	Pacific Oysters (baskets)	79.0
Poulnacarra Bay	T08/016	Licensed	Pacific Oysters (bag and trestle)	3.6
	T08/036A	Licensed	Mussels (longlines)	0.9
	T08/036B	Licensed	Mussels (longlines)	2.1
	T08/063	Licensed	Pacific Oysters (bag and trestle)	6.4
	T08/074	Licensed	Pacific Oysters (bag and trestle)	1.0
	T08/084B	Licensed	Pacific Oysters (bag and trestle)	1.6
	T08/111A	Application	Mussels (longline and ropes)	0.8
	T08/112A	Application	Mussels (longlines and ropes)	5.0
	T08/114A	Application	Seaweed (longlines)	2.4
Island Eddy	T09/332	Licensed	Pacific Oysters (bag and trestle)	1.6
	T09/470A	Licensed	Pacific Oysters (bag and trestle)	3.3
offshore	T09/424	Licensed	Mussels (longlines)	4.0
	T09/512A	Application	Scallops (longlines and lanterns)	0.7

Areas calculated from shapefiles supplied by "the Marine Institute; note that there are overlaps between some of the sites.

Pacific Oyster cultivation

3.4 Pacific Oyster cultivation is the main aquaculture activity involved in the sites covered by this assessment. A variety of cultivation methods are being used, or are being proposed, for these sites.

Bag and trestle method

3.5 The bag and trestle method (referred to hereafter as oyster trestle cultivation) is the commonest method of Pacific Oyster cultivation in Ireland. It is also the most frequent method in the sites covered by this assessment, although it is not proposed for use in the two largest sites (T09/519A and T09/520A). The aquaculture profile includes the following description of this method: -

> *"The bag and trestle method uses steel table-like structures which rise from the shore to just above knee height on the middle to lower intertidal zone, arrayed in double rows with wide gaps between the paired rows to allow for tractor access. The trestles hold HDPE bags approximately 1 m by 0.5 m by 10 cm, using rubber and wire clips to close the bags and to fasten them to the trestles. When first put to sea, there may be up to 2000 oysters in a single bag, but as they grow and are graded this number is gradually reduced. Over the course of the two or three years that it takes an oyster to reach saleable size, the density is reduced until market ready oysters, of approximately 100 g each (when grown to full size) are being grown in bags of approximately 100 oysters per bag. The bags need to be shaken, turned and re-secured occasionally to prevent build up of fouling and to ensure the growing oysters maintains a good marketable shape. This usually takes place once on each tidal cycle, when maximum exposure of the shore allows safe access to all trestles. It is most important during the summer months when plankton, the oysters' food, is abundant and oyster growth rates are at their optimum. Oysters are grown on in these bags for up to three years, and will be graded two or three times each year. Summer grading is now looked upon unfavourably by growers as it stresses the oysters and makes them more susceptible to pathogens which are most common during the warm summer months and can lead to high mortality."*

Floating bag method

3.6 The floating bag method is an adaptation of the bag and trestle method. This method is proposed for use in one of the larger application sites (T08/115A) where it may be used in combination with the bag and trestle and hanging baskets methods. It is described as follows in the aquaculture profile: -

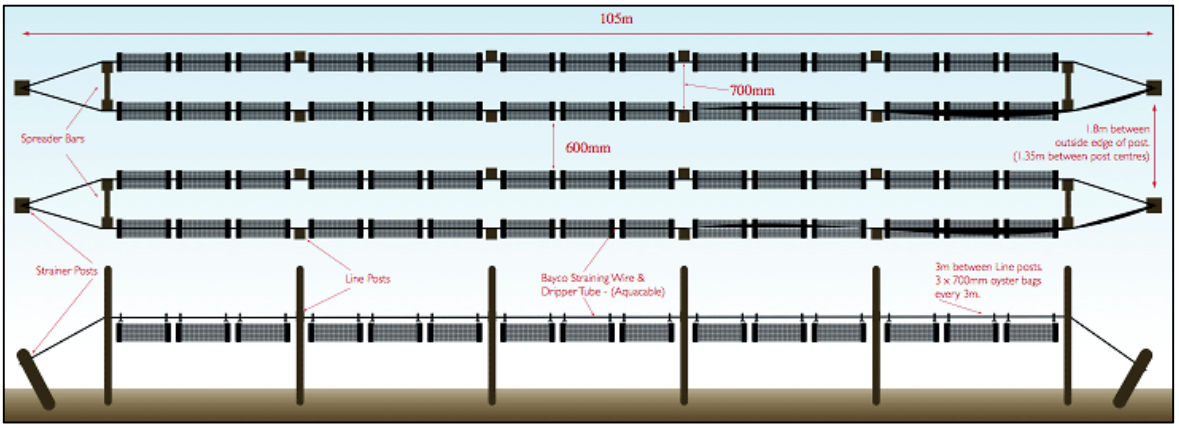
> "*The bags are secured along one of the long sides and a small, purpose-built float is attached to the other side. As the tide rises and falls over the intertidal sites, the buoyant side of the bag rises, and it falls again with the outgoing tide. So essentially, the oysters are turned twice a day, every day. This can result in a more marketable oyster in terms of shape and meat yield. It also means that there are fewer labour inputs. The bags no longer need to be turned but instead only brought back to the packing shed for grading and rebagging before being replaced on the trestles.*"

Hanging baskets method

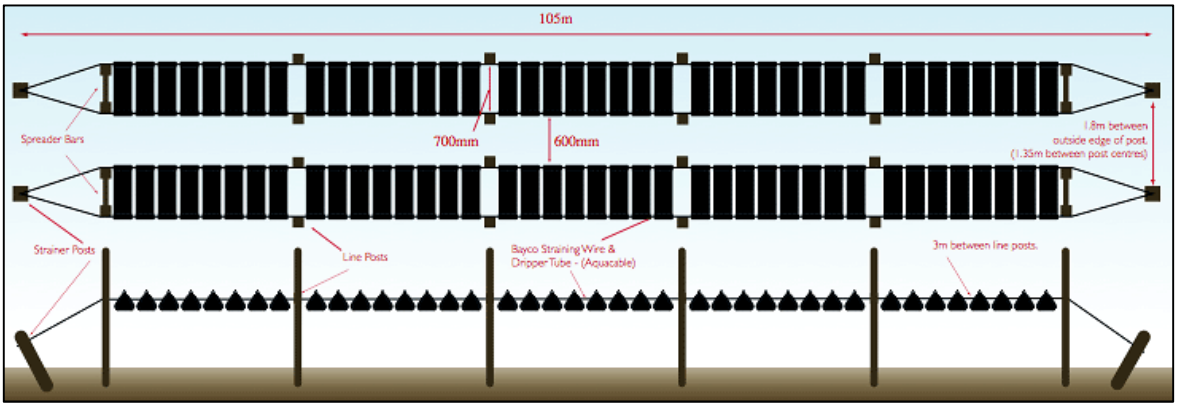
3.7 The hanging baskets method is proposed for use in the three largest sites (T08/115A, T09/119A and T09/120A). It will be the sole method used in two of these sites (T09/119A and T09/120A) and may be used in combination with the bag and trestle and floating bags methods in T08/115A. It is described as follows in the aquaculture profile: -

> "*[The baskets] hang from wires strung between poles on the intertidal. Water movements cause the baskets to rock, again providing a better shaped oyster with a higher meat yield. This method has the added advantage that baskets can be deployed and retrieved at either high water, using a boat, or low water, using a tractor.*"

3.8 According to BIM, the hanging baskets system proposed for the sites in Inner Galway Bay is considered to be similar to the BST longline systems as shown in Text Figure 3.1 and Text Figure 3.2.



Text Figure 3.1 – BST adjustable longline system (www.bstoysters.com/products/farm-layout).



Text Figure 3.2 – BST cross line system (www.bstoysters.com/products/farm-layout).

Floating trays method

3.9 The floating trays method is listed as the cultivation method for six licensed sites and one application site. However, according to the aquaculture profile, this method is no longer being used in Inner Galway Bay. This method was described in the aquaculture profile for the 2014 assessment as follows: -

> *"An alternative suspended culture method involves floating trays or boxes approximately 1.5 m x 1 m x 0.3 m with mesh on top and bottom and either solid or meshed sides. Seed is placed in them and they are strung along ropes fixed to anchor blocks below the low water mark. These boxes are turned frequently in the case of very small seed, or less regularly as the animals grow. The intent is to prevent fouling on the meshes which would impede water flow through the boxes. In October the trays are brought ashore and the seed oysters are either bagged and placed on trestles or relaid in the Co-op bed."*

3.10 The following additional information about this method was also included in the 2014 assessment:

> "*Floating trays are generally put to sea in spring, when new seed is brought in from hatcheries. They are generally brought ashore in October. In some years, they may be left at sea during the winter, when lateness in getting seed from suppliers means that the oysters had not reached a big enough size for redeployment in bags. The floating trays are generally turned once a week or more, at low tide. The operator will wade out to the trays to turn them.*"

Native Oyster cultivation

3.11 There is one licensed site for bottom cultivation of native oysters (T09/65). No information has been provided about the nature of the existing, or proposed, activities in this site. This site was classified as an oyster trestle cultivation site in the 2014 assessment. Therefore, the information in the previous assessment about bottom cultivation of native oysters, which referred to activities in other sites, is not necessarily relevant to this site.

Mussel cultivation

3.12 The existing and proposed mussel cultivation activity in Inner Galway Bay all involve suspended mussel cultivation using longlines and rafts in subtidal waters. It is described as follows in the aquaculture profile: -

> *"Mussels (*Mytilus edulis*) are currently grown in two areas within Galway Bay Inner. The farm at Muckinish [Poulnacarra Bay] is in two adjacent locations. The bivalves are cultured on droppers suspended from longlines. Seed is collected by natural settlement on ropes, and these are spread out over both locations in late summer. Harvesting takes place on a year-round basis, by boat. Applications have been lodged to move these sites a short distance to better exploit the natural depressions in the seabed which allow a longer dropper to be used, and one of the applications also proposes an increase in size from two to five hectares. The second fully licenced mussel-growing operation is at the mouth of Kinvara Bay with a second site between Eddy and Deer islands. The outer site is used for collection of natural settlement mussels. The collectors are moved to the inner site for on-growing. This farm uses rafts from which droppers are hung to grow the mussels. Each farm is accessed by boat, the former from the pier at Muckinish East, the latter from the Kinvara Harbour. Activity on each site continues year round.*"

Scallop cultivation

3.13 There is one application site for cultivation of King Scallops (*Pecten maximus*), located in offshore waters between Island Eddy and Deer Island. The proposed activity is described as follows in the aquaculture profile: -

> "*Like the mussel sites, it is intended to exploit a depression in the bedrock to allow for subtidal culture of these bivalves. Anchor blocks are deployed at either end of the site and several metres down ropes headropes are put in place, suspended from buoys. Scallop seed may be sourced locally, and this is put into lantern nets which hang from the headrope. Scallops are harvested after three or four years in cultivation.*"

Seaweed cultivation

3.14 There is one application site for cultivation of the native seaweed species *Alaria esculenta*, *Palmaria palmata* and *Porphyra umbilicalis*. The proposed activity is described as follows in the aquaculture profile: -

> "*The infrastructure for a seaweed farm is similar to that of a mussel farm. Longlines are suspended one to two metres below the water surface, kept in place by anchor blocks at either end. String that has been seeded at a seaweed hatchery is wound around the headrope and secured in place. This usually takes place in mid-winter. The crop can be harvested by boat in early summer and the site left fallow for the next crop.*"

Fishery Orders

3.15 There are four mapped Fishery Orders in Inner Galway Bay (Figure 3.2). These are all currently inactive.

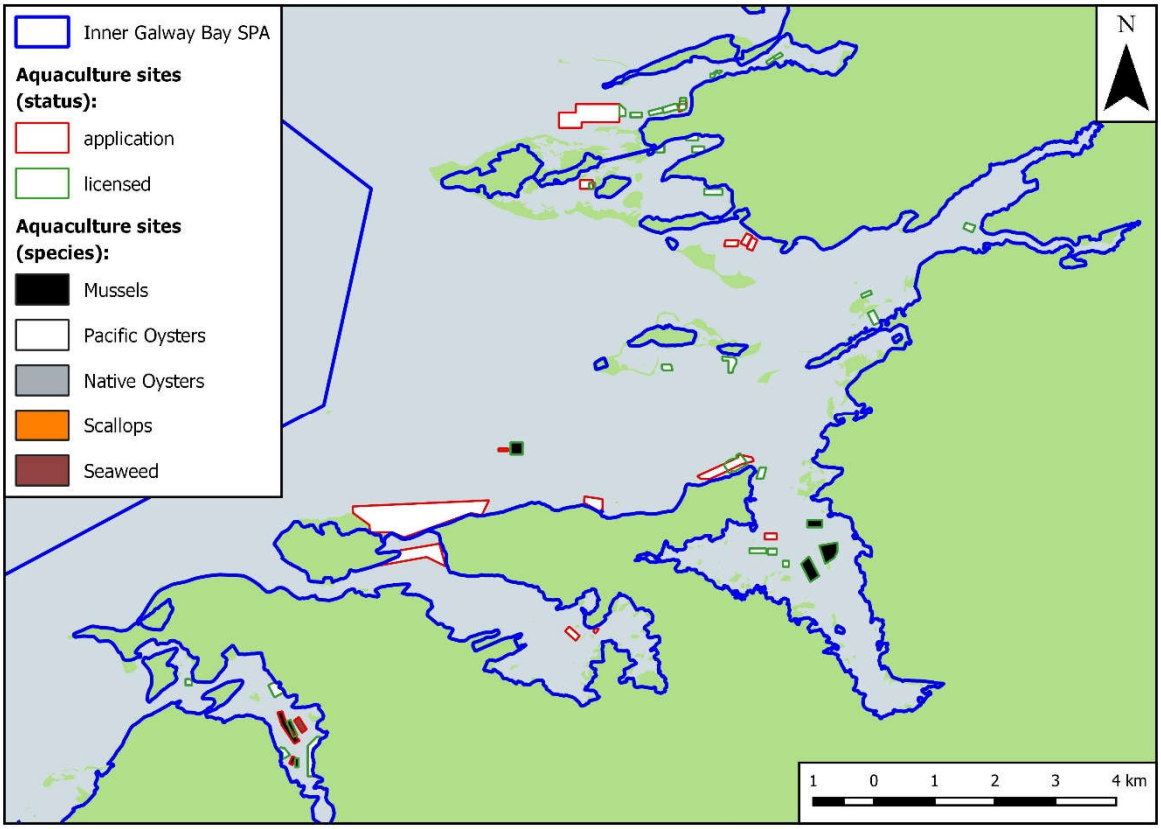


Figure 3.1 – Aquaculture sites in Inner Galway Bay.

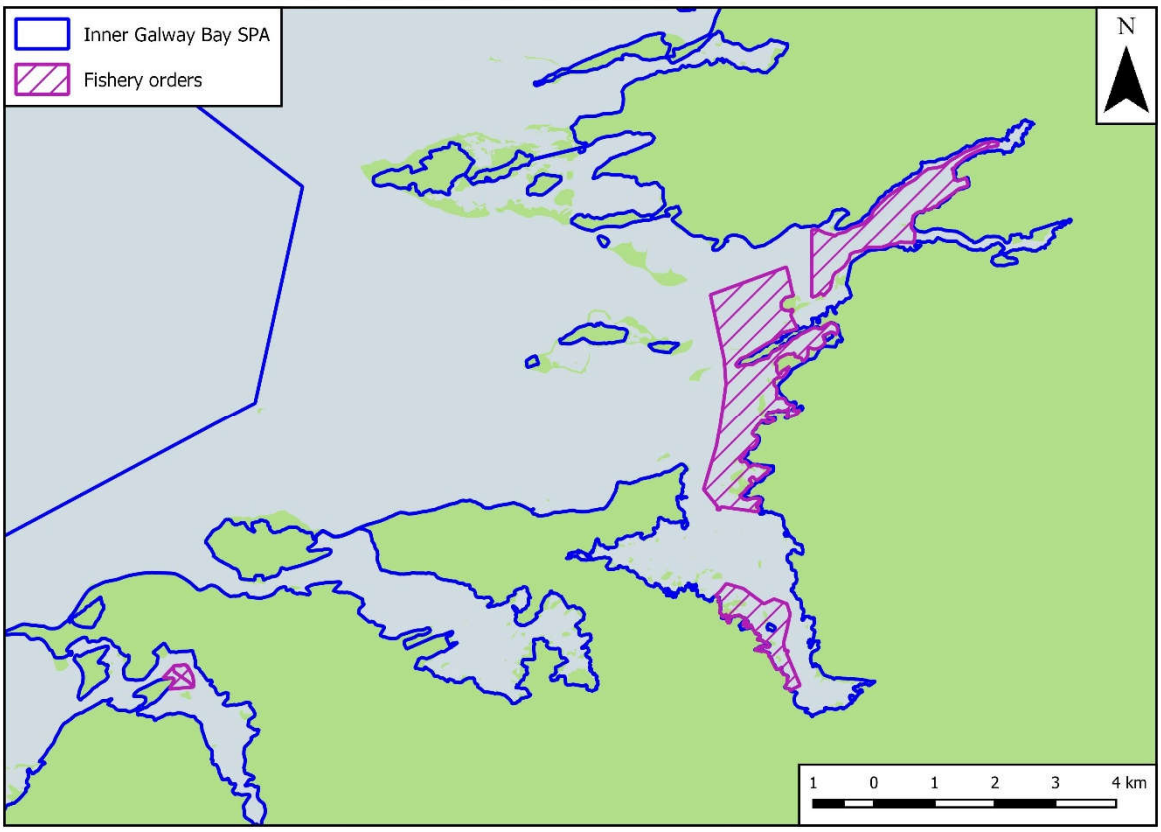


Figure 3.2 – Mapped Fishery Orders in Inner Galway Bay.

4. Impact assessment

SCIs covered by this assessment

4.1 The preliminary screening of SCIs of the Inner Galway Bay SPAs, and other relevant SPAs, is described in Chapter 4 of the 2014 assessment, and has been followed for the present assessment.

4.2 The assessment includes all the SCI species of the Inner Galway Bay SPA: Light-bellied Brent Goose, Wigeon, Teal, Shoveler, Golden Plover, Lapwing, Ringed Plover, Curlew, Bar-tailed Godwit, Turnstone, Dunlin, Redshank, Sandwich Tern, Common Tern, Black-headed Gull and Common Gull. The Sandwich Tern and Common Tern SCIs refer to breeding populations. Cormorant is listed as separate SCIs for its breeding and non-breeding/wintering populations. All the other SCIs refer to non-breeding/wintering populations.

4.3 The assessment also includes the following SCIs of other SPAs: the non-breeding/wintering Shoveler, breeding Common Scoter and breeding Common Gull SCIs of the Lough Corrib SPA; and the non-breeding/wintering Wigeon, Golden Plover and Black-tailed Godwit SCIs of the Rahasane Turlough SPA.

Habitat impacts

4.4 The aquaculture sites in each of the subsite groups are shown in relation to tidal zones in Figure 4.1 - Figure 4.8. The percentages of the intertidal and shallow subtidal habitats occupied by the aquaculture sites in each subsite group are shown in Table 4.1.

Table 4.1 – Percentages of intertidal and shallow subtidal habitats occupied by aquaculture sites in each subsite group.

Subsite group	Zone	Subsite group area (ha)	Percentage occupied by aquaculture sites
Mweeloon Bay	Intertidal	81	<1%
	Shallow subtidal	155	15%
Lackanaloy Creek / Loughnahulla Bay / Shanmullen Channel	Intertidal	189	1%
	Shallow subtidal	243	6%
Clarinbridge River	Intertidal	130	3%
	Shallow subtidal	111	1%
Kinvarra Bay	Intertidal	219	2%
	Shallow subtidal	146	10%
Corranroo Bay	Intertidal	74	0%
	Shallow subtidal	32	2%
Aughinish	Intertidal	152	31%
	Shallow subtidal	81	37%
Poulnacarra Bay	Intertidal	86	3%
	Shallow subtidal	97	15%
Island Eddy	Intertidal	88	<1%
	Shallow subtidal	84	4%

Island Eddy is not covered by any of the I-WeBS subsites, but, for the purposes of the calculations in this table, an Island Eddy subsite group was defined as including all the intertidal and shallow subtidal habitat around Island Eddy and Fiddaun Island, with the eastern boundary defined as the midpoint of the channel between Fiddaun Island and Rincarna Point.

4.5 The aquaculture sites mainly occur below the intertidal zone (Table 4.1). The highest habitat impact is in the Aughinish subsite group where the aquaculture sites occupy around one-third of the intertidal and shallow subtidal habitat (Table 4.1). This is due to two large aquaculture sites either side of the Aughinish Island causeway (Figure 4.6).

Plate 4.1 – *Sargassum muticum* on the sandflats in aquaculture site T09/519A.

4.6 Site T09/519A, on the northern side of the causeway, occupies a sandy bay, which is mapped as a mixture of intertidal sand, fine to medium sand with bivalves and Laminaria-dominated community complexes, with the fucoid-dominated community complex on the upper shore. During the site visit in May 2019, we noted extensive colonisation of the sand flats by the invasive seaweed *Sargassum muticum* (Plate 4.1).

4.7 T08/115A, on the southern side of the causeway, occupies a bay which is mapped as holding the intertidal sandy mud community complex, with the fucoid-dominated community complex on the upper shore. However, during the site visit in May 2019, we noted that there is extensive cover of *Fucus* throughout the bay (Plate 4.2).

4.8 In Mweeloon Bay, 15% of the shallow subtidal habitat in the subsite group is occupied by aquaculture sites. This is mainly due to one large aquaculture site (T09/520A). The habitats occupied by the aquaculture sites in Mweeloon Bay are mainly mapped as the fine to medium sand with bivalves community complex.

4.9 The Kinvarra Bay and Poulnacarra Bay subsite groups also have relatively high occupancy of shallow subtidal habitat by aquaculture sites, but this is due to the combined effect of a number of small sites.

Plate 4.2 – *Fucus* cover in the intertidal sandy mud community complex in aquaculture site T08/115A.

Displacement impacts

Screening

4.10 The screening decisions of the potential displacement impacts for the SCI species included in this assessment are summarised in Table 4.2. The reasons for these screening decisions are fully explained in the relevant sections of the 2014 assessment. However, since that assessment, the classification of the response of Curlew to oyster trestle cultivation has been changed from neutral/positive to variable (Gittings and O'Donoghue, 2016b) and this change is followed in the present assessment.

4.11 In this assessment we have combined bag and trestle oyster cultivation, floating bag oyster cultivation and hanging basket oyster cultivation under a single category (intertidal oyster cultivation). All three methods mainly take place in the intertidal zone and either use trestles (bag and trestle oyster cultivation and floating bag oyster cultivation), or involves structures that are broadly similar to trestles (lines of baskets suspended from poles in hanging basket oyster cultivation; see Text Figure 3.1 and Text Figure 3.2). We have also assumed that the scallop and seaweed cultivation have similar impacts to longline mussel cultivation.

Table 4.2 – Screening of potential for displacement impacts.

Species	Oysters			Mussels	
	Intertidal	Floating trays	Bottom	Longlines	Rafts
Light-bellied Brent Goose	√	X	X	X	√
Wigeon	√	X	X	X	√
Teal	√	√	√	√	√
Shoveler	√	√	√	√	√
Common Scoter	X	X	X	√	√
Red-breasted Merganser	X	X	X	X	X
Great Northern Diver	X	X	X	X	X
Cormorant	X	X	X	X	X
Grey Heron	X	X	X	X	X
Ringed Plover	√	√	√	√	√
Golden Plover	√	X	X	X	X
Lapwing	√	X	X	X	X
Dunlin	√	√	√	√	√
Black-tailed Godwit	√	√	√	√	√
Bar-tailed Godwit	√	√	√	√	√
Curlew	√	√	√	√	√
Redshank	X	√	√	√	√
Turnstone	X	√	√	√	√
Black-headed Gull	√	√	√	√	√
Common Gull	√	√	√	√	√

Impact assessment

Overview

4.12 The methodology used for calculating the displacement impacts assumes that over the course of a season, waterbirds are uniformly distributed through all suitable habitat in each subsite group. This assumption will never be strictly true. It may be a good approximation for some species (such as Curlew) while other species are likely to have more aggregated distribution patterns. Therefore, the calculated displacement impacts present an indication of the likely displacement impact, rather than an accurate prediction, and should be interpreted with reference to specific features of the species ecology that may affect their distribution patterns within the subsite groups.

4.13 The overall cumulative calculated displacement impacts are shown in Table 4.3 and the calculated displacement impacts for each of the subsite groups are shown in Table 4.4 and Table 4.5. This shows that the calculated displacement impacts from the existing licensed sites are all relatively small and well below the 5% threshold. However, the addition of the application sites results in calculated displacement impacts for several species which approach, or exceed, the 5% threshold. This is due mainly to the large application sites on either side of the Aughinish Island causeway (T08/115A and T09/519A). Site T09/519A is a hanging baskets site, while site T08/115A has a mixture of cultivation methods proposed (trestles, hanging bags and hanging baskets). These sites occupy the main areas of intertidal and shallow subtidal habitat within the subsite, on either side of the Aughinish Island causeway. The calculated displacement impacts for the Mweeloon Bay subsite

group were all low despite the relatively large area occupied by the aquaculture sites in this subsite group.

4.14 Six species (Light-bellied Brent Goose, Golden Plover, Lapwing, Ringed Plover, Curlew, and Common Gull) had calculated displacement impacts in at least one of the datasets approaching, or exceeding, the 5% threshold (Table 4.3). Another six species (Wigeon, Teal, Shoveler, Bar-tailed Godwit, Dunlin and Black-headed Gull) had calculated displacement impacts in at least one of the datasets of around 2-3% (Table 4.3).

Table 4.3 – Overall potential cumulative displacement impact from aquaculture activities to the SCI species included in this assessment.

Species	Analysis	2006/07-2010/11	2011/12-2016/17
Light-bellied Brent Goose	licenses	0.3%	1.0%
	all	6.0%	5.7%
Wigeon	licenses	0.5%	0.8%
	all	2.0%	1.7%
Teal	licenses	1.5%	1.4%
	all	2.1%	2.3%
Shoveler	licenses	1.7%	0.0%
	all	3.0%	0.0%
Golden Plover	licenses	0.9%	0.7%
	all	2.0%	4.8%
Lapwing	licenses	0.6%	0.4%
	all	1.1%	5.4%
Ringed Plover	licenses	1.0%	1.0%
	all	5.9%	1.9%
Curlew	licenses	1.1%	0.5%
	all	5.6%	6.5%
Bar-tailed Godwit	licenses	0.9%	0.9%
	all	2.1%	3.2%
Turnstone	licenses	0.1%	0.1%
	all	0.3%	0.1%
Dunlin	licenses	1.0%	0.4%
	all	2.7%	2.8%
Redshank	licenses	0.1%	0.3%
	all	0.3%	0.3%
Black-headed Gull	licenses	0.7%	0.4%
	all	1.1%	3.4%
Common Gull	licenses	0.6%	0.9%
	all	4.6%	2.3%

4.15 Displacement impacts were not calculated for Common Scoter and Black-tailed Godwit due to their infrequent occurrence within Inner Galway Bay (see below).

4.16 Displacement impacts were not calculated for the two aquaculture sites at Island Eddy due to the lack of waterbird data for this area. However, the percentage occupancy of intertidal and shallow subtidal habitat by the aquaculture sites in this area is very low (Table 4.1).

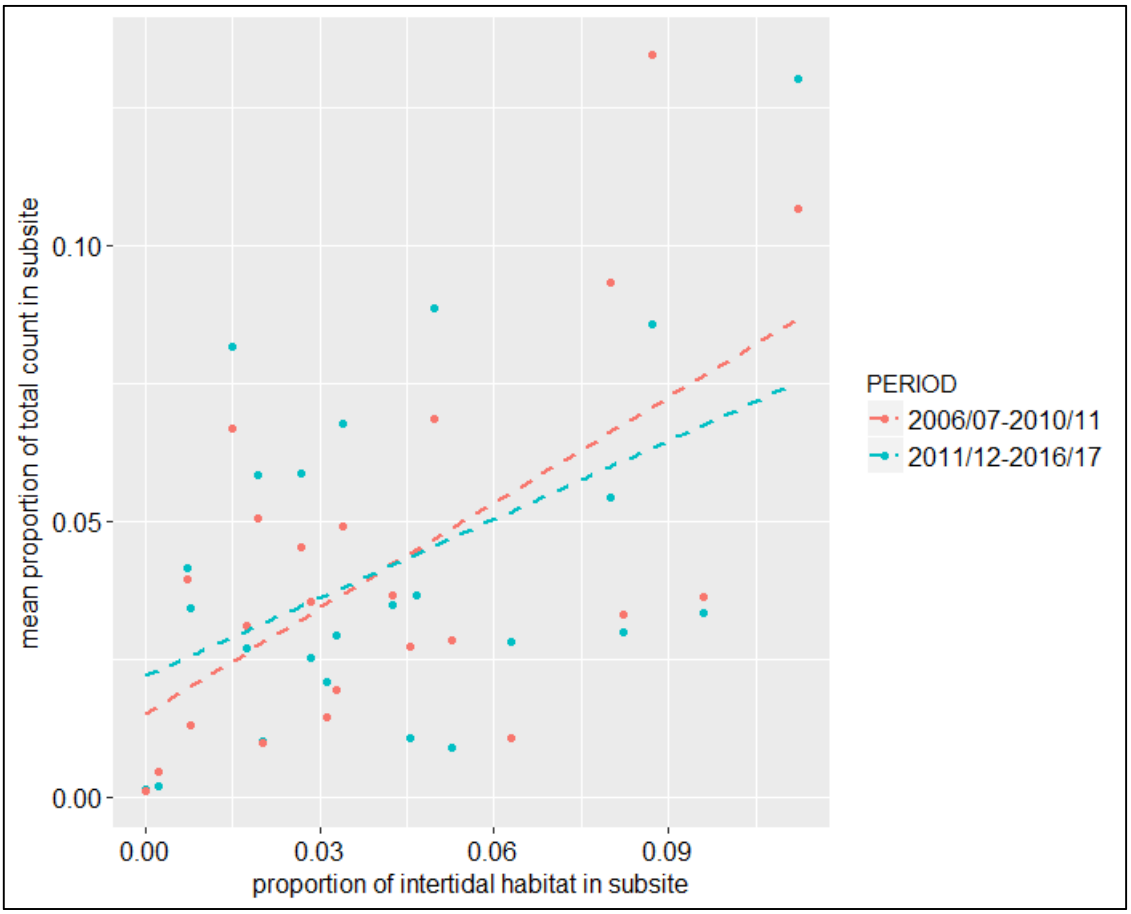
Species with potentially significant calculated displacement impacts

4.17 The main displacement impact for Light-bellied Brent Goose is from the sites along the Aughinish Island causeway in the Aughinish subsite group (T08/115A and T09/519A). The flock maps from the WSP survey indicate that these were the main areas that Light-bellied Brent Goose occurred within the subsite. Therefore, the calculated displacement impact is likely to be a good estimate of the overlap between Light-bellied Brent Goose distribution and these sites. While, Light-bellied Brent Goose can have a positive response to oyster trestle cultivation, this is largely due to birds feeding on the green algae that build up on the bags. The main proposed cultivation methods in these sites are likely to result in lower levels of green algae as the bags are turned twice a day by the tide, rather than requiring manual turning of the bags that takes place at much longer intervals. Therefore the apparent positive response of Light-bellied Brent Goose to bag and trestle cultivation in some sites may not be applicable to the hanging bag and hanging baskets methods proposed for sites T08/115A and T09/519A.

4.18 The high value of the calculated displacement impacts for Golden Plover and Lapwing from the 2011/12-2016/17 dataset reflects single I-WeBS counts in which around 70% of the total count of each species occurred in the Aughinish subsite group. Excluding these counts, the mean percentage occurrence for each species in the Aughinish subsite group was around 3%, compared to mean percentage occurrences in this subsite of 4% (Golden Plover) and 0.3% (Lapwing) in the 2006/07-2010/11 dataset. Therefore, the calculated displacement impact for Golden Plover and Lapwing from the 2006/07-2010/11 dataset probably provides a more reliable indication of the likely overlap between Golden Plover and Lapwing distribution and the aquaculture sites.

4.19 The calculated displacement impact for Ringed Plover from the 2006/07-2010/11 dataset was much higher than from the 2011/12-2016/17 dataset. This reflects much more frequent occurrence in the Aughinish subsite group in the 2006/07-2010/11 dataset (9 out of 12 qualifying counts) compared to the 2011/12-2016/17 dataset (1 out of 7 qualifying counts). Site T09/519A occupies the main extensive area of sandy intertidal habitat within the subsite, while site T09/501A also occurs in an area of sandy intertidal habitat, and the flock maps from the WSP survey indicate that these are the main areas where Ringed Plover occurred within the subsite. Ringed Plover can be erratic in their occurrence patterns and, given the small number of qualifying counts in the 2011/12-2016/17 dataset, the potential for a significant displacement impact cannot be discounted. Ringed Plover appears to be completely excluded by oyster trestle cultivation.

4.20 The calculated displacement impacts for Curlew were very similar between the two datasets, reflecting the predictable nature of this species distribution patterns. Curlew generally has a dispersed distribution pattern across intertidal habitat and its large scale distribution patterns across Inner Galway Bay indicates that it occurs at fairly uniform densities (Text Figure 4.1). In the Aughinish subsite group, the flock maps from the WSP survey indicate that the main areas of occurrence were either side of the Aughinish Island causeway, reflecting the fact that these areas hold the largest amount of intertidal habitat within the subsite. These areas are also largely occupied by the two large aquaculture sites (T08/115A and T09/519A). Overall, therefore, the calculated displacement impacts are likely to provide good indications of the likely overlap between Curlew distribution and the aquaculture sites. However, Curlew appears to have a variable response to oyster trestle cultivation and, even when the response is negative, is not completely excluded. Therefore, the calculated displacement impacts probably overestimate the actual displacement impact that would occur from development of the aquaculture sites.



Text Figure 4.1 – Relationship between Curlew distribution across subsites during I-WeBS counts and the amount of intertidal habitat in the subsites.

4.21 The calculated displacement impact for Common Gull from the 2006/07-2010/11 dataset was close to the 5% threshold, while the calculated displacement impact from the 2011/12-2016/17 dataset was around 50% lower. This reflects the much lower level of occurrence in the Aughinish subsite group in the 2011/12-2016/17 dataset. The relatively high level of occurrence in the Aughinish subsite group in the 2006/07-2010/11 dataset was not due to one or two exceptional counts. Therefore, the difference may reflect a real change in occurrence patterns, although there does not appear to have been an obvious change in overall Common Gull numbers in Inner Galway Bay. In the Aughinish subsite group, the flock maps from the WSP survey indicate that the main area of occurrence was on the southern side of the Aughinish Island causeway, overlapping site T08/115A. Common Gull appears to have a variable response to oyster trestle cultivation and, even when the response is negative, is not completely excluded. Therefore, the calculated displacement impacts probably overestimate the actual displacement impact that would occur from development of the aquaculture sites.

Species with non-significant but non-negligible calculated displacement impacts

4.22 While the calculated displacement impacts for Wigeon, Teal, Shoveler, Bar-tailed Godwit, Dunlin and Black-headed Gull are well below the 5% threshold, they are not negligible. Given the uncertainties involved in the calculated displacement impacts, it is necessary to consider whether there are particular factors that might increase the actual displacement impact.

4.23 The WSP flock map data indicates that the overall distribution of Wigeon and Teal is associated with sheltered bays and the fucoid-dominated community complex. The aquaculture sites are mainly

on more exposed shores, although site T08/115A and the sites in Poulnacarra Bay may be more suitable for these species.

4.24 The calculated displacement impact for Shoveler from the 2006/07-2010/11 dataset was 3%, but the calculated displacement impact for the 2011/12-2016/17 dataset was 0%. This reflects the decline in Shoveler numbers in Inner Galway Bay with most birds occurring in Ahapouleen Turlough during the I-WeBS counts in the 2011/12-2016/17 dataset.

4.25 The aquaculture sites in the Aughinish subsite group are the main contributors to the calculated displacement impacts for Bar-tailed Godwit, Dunlin and Black-headed Gull. The large site on the northern side of the Aughinish Island causeway (T09/519A) occupies a large sandy bay, which is likely to be particularly suitable for these species. However, the extensive *Fucus* cover in the site on the southern side of the Aughinish Island causeway (T08/115A) may reduce the suitability of that site for these species.

Common Scoter and Black-tailed Godwit

4.26 Common Scoter have been recorded occasionally within the Kinvarra Bay and Aughinish subsite groups. However, most of the records from the Kinvarra Bay subsite group are from subsite 0G489 and are more likely to refer to birds in the outer part of the subsite away from the suspended mussel sites. Large scoter flocks have occasionally been recorded from the Aughinish subsite group but significant displacement impacts are unlikely due to the very small size of the mussel and scallop sites. There are no records of Common Scoter from the Poulnacarra Bay subsite group.

4.27 Large flocks of Black-tailed Godwit have been recorded erratically in Inner Galway Bay during I-WeBS counts, possibly reflecting movement to/from Rahasane Turlough. Most records are from Ahapouleen Turlough, or from subsites along the northern and north-eastern shorelines of Inner Galway Bay. There are no records of significant numbers of Black-tailed Godwit from any of the subsite group contained aquaculture sites covered by this assessment.

Table 4.4 – Potential cumulative displacement impact from aquaculture activities to the SCI species included in this assessment in each of the subsite groups using waterbird distribution patterns from the 2006/07-2010/11 dataset.

Species	Analysis	Potential displacement							
		Mweeloon Bay	Lackanaloy - Shanmullen	Clarinbridge	Kinvarra	Corranroo	Aughinish	Poulnacarra	Total
Light-bellied Brent Goose	licenses	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.3%
	all	0.3%	0.8%	0.1%	0.9%	0.0%	3.6%	0.3%	6.0%
Wigeon	licenses	0.1%	0.0%	0.1%	0.3%	0.0%	0.0%	0.1%	0.5%
	all	0.1%	0.0%	0.1%	0.6%	0.1%	0.9%	0.2%	2.0%
Teal	licenses	0.2%	0.2%	0.1%	0.4%	0.0%	0.0%	0.7%	1.5%
	all	0.1%	0.0%	0.1%	0.4%	0.0%	0.2%	1.1%	2.1%
Shoveler	licenses	0.3%	0.3%	0.0%	0.8%	0.0%	0.0%	0.3%	1.7%
	all	0.8%	0.5%	0.2%	0.0%	0.0%	0.1%	1.5%	3.0%
Ringed Plover	licenses	0.0%	0.3%	0.1%	0.3%	0.0%	0.0%	0.2%	1.0%
	all	0.0%	0.2%	0.0%	0.2%	0.0%	5.2%	0.3%	5.9%
Golden Plover	licenses	0.1%	0.0%	0.1%	0.4%	0.0%	0.0%	0.3%	0.9%
	all	0.0%	0.4%	0.3%	0.1%	0.0%	1.1%	0.1%	2.0%
Lapwing	licenses	0.0%	0.0%	0.3%	0.2%	0.0%	0.0%	0.0%	0.6%
	all	0.1%	0.2%	0.3%	0.4%	0.0%	0.1%	0.0%	1.1%
Dunlin	licenses	0.1%	0.1%	0.3%	0.0%	0.0%	0.0%	0.5%	1.0%
	all	0.0%	0.5%	0.2%	0.1%	0.0%	1.9%	0.0%	2.7%
Bar-tailed Godwit	licenses	0.1%	0.1%	0.2%	0.3%	0.0%	0.0%	0.3%	0.9%
	all	0.0%	0.2%	0.1%	0.1%	0.0%	1.6%	0.1%	2.1%
Curlew	licenses	0.1%	0.2%	0.1%	0.2%	0.0%	0.0%	0.5%	1.1%

Species	Analysis	Potential displacement							
		Mweeloon Bay	Lackanaloy - Shanmullen	Clarinbridge	Kinvarra	Corranroo	Aughinish	Poulnacarra	Total
	all	0.2%	0.1%	0.2%	0.5%	0.0%	4.1%	0.4%	5.6%
Redshank	licenses	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	0.1%
	all	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%	0.3%
Turnstone	licenses	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	all	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.3%
Black-headed Gull	licenses	0.1%	0.1%	0.3%	0.2%	0.0%	0.0%	0.1%	0.7%
	all	0.1%	0.0%	0.1%	0.3%	0.0%	0.5%	0.1%	1.1%
Common Gull	licenses	0.0%	0.0%	0.3%	0.2%	0.0%	0.0%	0.1%	0.6%
	all	0.2%	0.1%	0.1%	0.3%	0.0%	3.4%	0.5%	4.6%

Red-breasted Merganser, Great Northern Diver and Cormorant screened out from all potential displacement impacts. Common Scoter and Black-tailed Godwit did not occur in sufficient numbers for analysis.

Table 4.5 – Potential cumulative displacement impact from aquaculture activities to the SCI species included in this assessment in each of the subsite groups using waterbird distribution patterns from the 2011/12-2016/17 dataset.

Species	Analysis	Potential displacement							
		Mweeloon Bay	Lackanaloy - Shanmullen	Clarinbridge	Kinvarra	Corranroo	Aughinish	Poulnacarra	Total
Light-bellied Brent Goose	licenses	0.1%	0.0%	0.0%	0.5%	0.0%	0.0%	0.4%	1.0%
	all	0.3%	0.6%	0.0%	0.9%	0.0%	3.4%	0.4%	5.7%
Wigeon	licenses	0.6%	0.0%	0.2%	0.6%	0.0%	0.0%	0.2%	1.6%
	all	2.2%	0.1%	0.2%	1.1%	0.1%	1.0%	0.2%	4.8%
Teal	licenses	0.1%	0.4%	0.1%	0.4%	0.0%	0.0%	0.0%	1.0%
	all	0.5%	0.7%	0.1%	0.6%	0.1%	1.4%	0.1%	3.3%
Shoveler	licenses	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	all	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ringed Plover	licenses	0.0%	0.1%	0.1%	0.4%	0.0%	0.0%	1.2%	1.6%
	all	0.0%	0.2%	0.1%	0.5%	0.0%	2.0%	1.4%	4.2%
Golden Plover	licenses	0.0%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.4%
	all	0.1%	0.1%	0.2%	0.1%	0.0%	2.2%	0.0%	2.8%
Lapwing	licenses	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.2%
	all	0.2%	0.1%	0.0%	0.2%	0.1%	6.1%	0.1%	6.7%
Dunlin	licenses	0.0%	0.0%	0.4%	0.3%	0.0%	0.0%	0.1%	0.9%
	all	0.0%	0.1%	0.4%	0.5%	0.0%	0.3%	0.1%	1.4%
Bar-tailed Godwit	licenses	0.0%	0.1%	0.5%	0.0%	0.0%	0.0%	0.2%	0.9%
	all	0.0%	0.2%	0.5%	0.1%	0.0%	4.6%	0.3%	5.7%
Curlew	licenses	0.0%	0.0%	0.9%	0.1%	0.0%	0.0%	0.1%	1.1%

Species	Analysis	Potential displacement							
		Mweeloon Bay	Lackanaloy - Shanmullen	Clarinbridge	Kinvarra	Corranroo	Aughinish	Poulnacarra	Total
	all	0.1%	0.1%	0.9%	0.1%	0.0%	2.2%	0.2%	3.5%
Redshank	licenses	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	all	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Turnstone	licenses	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.3%
	all	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.3%
Black-headed Gull	licenses	0.0%	0.1%	0.1%	0.5%	0.0%	0.0%	0.0%	0.8%
	all	0.1%	0.2%	0.1%	0.8%	0.0%	0.3%	0.0%	1.6%
Common Gull	licenses	0.0%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%	0.5%
	all	0.1%	0.1%	0.1%	0.5%	0.0%	3.1%	0.0%	3.9%

Red-breasted Merganser, Great Northern Diver and Cormorant screened out from all potential displacement impacts. Common Scoter and Black-tailed Godwit did not occur in sufficient numbers for analysis.

Disturbance impacts

General

4.28 Disturbance impacts could arise from husbandry activity within the aquaculture sites, and/or from shoreline and marine access routes to the aquaculture sites.

4.29 The disturbance impacts of husbandry activity within the aquaculture sites to waterbirds occurring within the aquaculture sites is included in the assessment of displacement impacts. There is potential for husbandry activity within aquaculture sites to cause disturbance impacts to waterbirds using adjacent habitat outside the aquaculture sites. In large aquaculture sites, this impact is likely to be negligible as most activity will take place in the interior of the site and any potential disturbance zone will be largely within the site. However, with smaller sites, the proportion of edge is higher: e.g., a 200 m disturbance zone from husbandry activity in the centre of a 1 ha site could affect 11.5 ha of habitat outside the site. Due to the small size of most of the aquaculture sites in Inner Galway Bay, there is potential for increased displacement impacts due to disturbance effects extending outside the aquaculture sites. This is particularly likely to be a factor where there are clusters of small aquaculture sites, such as in Kinvarra Bay and in Poulnacarra Bay. However, the significance of such additional displacement impacts will depend upon the frequency of the husbandry activity in these sites. Disturbance recording during the WSP counts (Gittings and O'Donoghue, 2014), and our observations during site visits in 2014 and 2019, suggest that there is a generally low frequency of husbandry activity in most of the sites with existing aquaculture activity.

4.30 Potential disturbance impacts to particular species/groups of species are discussed in the following sections.

Red-breasted Merganser

4.31 Since publication of the 2014 assessment, new evidence has indicated that Red-breasted Merganser has a higher potential sensitivity to disturbance than was previously assumed.

4.32 Observations that we made during survey work in Wexford Harbour indicate that Red-breasted Mergansers can be very sensitive to disturbance from marine traffic (Gittings and O'Donoghue, 2016a, 2016c). A disturbance response was noted in 32 out of the 45 interactions between mergansers and boats that we observed, with birds being flushed on 22 occasions. The disturbance response was related to the lateral distance of the birds from the path of the boat, with 90% of observations within 250 m showing a disturbance response, compared to only 29% of the observations at distances of over 500 m from the path of the boat. Overall 84% of observations within 500 m showed a disturbance response. The birds that did show a response often flushed at long distances from the boat, with some birds flushing at distances of over 1 km, but these were mainly birds that were close to the path of the boat (i.e., the boat was heading straight towards them). While our dataset included responses to three types of boat (a cot, small inshore potting vessels and dredgers), there was no detectable difference in the responses to these boat types (although our analysis was constrained by limited data for the disturbance response to cots at large lateral distances).

4.33 This high sensitivity is also indicated by research into disturbance by ship traffic in the German North and Baltic Seas (Fliessbach *et al.*, 2019). They reported mean escape distances for Red-breasted

Merganser of 1,178 m (individuals) and 681 m (groups)[5], which were the third (individuals), or fourth (groups) highest escape distances of the 22 seabird taxa in their study. Note that these escape distances are straight line distances and are, therefore, not directly comparable with the lateral distances that we reported from Wexford Harbour.

4.34 Distribution patterns of Red-breasted Merganser in Cork Harbour and historical changes in these distribution patterns are also potentially indicative of a high degree of sensitivity to disturbance from marine traffic (Gittings and O'Donoghue, 2019).

4.35 We have used the observed disturbance responses from Wexford Harbour to calculate the theoretical number of mergansers that would be cumulatively flushed by single boat trips along all the marine access routes to the aquaculture sites in Inner Galway Bay (Table 4.6). Single trips to all the existing licensed sites would cumulatively flush a theoretical total of 57 mergansers (about one-third of the Inner Galway Bay population as recorded by I-WeBS counts). Single trips to all the application sites would cumulatively flush a theoretical total of 34 mergansers, causing a 60% increase in the total number of birds flushed.

Table 4.6 - Calculations of the theoretical number of mergansers cumulatively flushed by single boat trips along all the marine access routes.

Group	Lateral distance from boat	Area (ha)	Number of birds encountered	Flush rate	Number of birds flushed
Licences	0-250 m	1513	56	70%	39
	250-500 m	898	33	36%	12
	500-1000 m	1073	40	14%	6
	0-1000 m	*3484*	*129*	-	*57*
Applications	0-250 m	889	33	70%	23
	250-500 m	508	19	36%	7
	500-1000 m	810	30	14%	4
	0-1000 m	2207	82	-	34

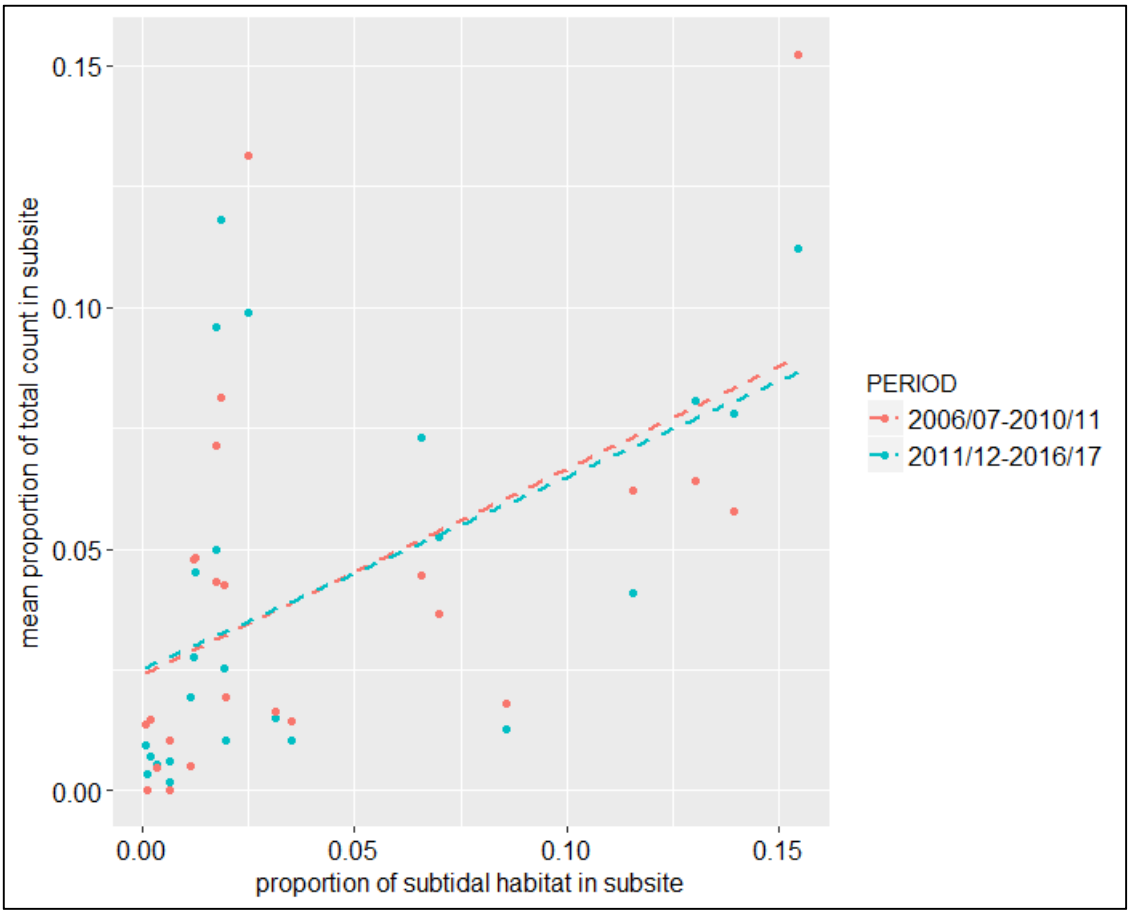
The areas are the summed total areas of shallow subtidal and moderately deep subtidal habitat within the relevant distance zone of each individual route. The number of birds encountered is based on the mean density of Red-breasted Mergansers in I-WeBS counts, 2011/12-2016/17 (3.7 birds / 100 ha). The flush rates are those observed at Wexford Harbour (Gittings and O'Donoghue, 2016a) with the observed > 500 m lateral distance band conservatively assumed to have an upper limit of 1000 m for the purposes of these calculations.

4.36 The calculations in Table 4.6 are theoretical because they assume a uniform density of Red-breasted Mergansers throughout suitable habitat in Inner Galway Bay, and they also do not take account of how changes in distribution patterns at high tide when intertidal areas are flooded may affect densities. The analyses of Red-breasted Merganser distribution patterns showed an approximately linear relationship between habitat area and the proportion of the SPA count in each subsite (Text Figure 4.2), indicating that mergansers occur at relatively uniform densities across Inner Galway Bay. However, there were some subsites that were outliers with much higher than expected merganser numbers for their size: subsites 0G491 and 0G492 in the Lackanaloy Creek / Loughnahulla Bay / Shanmullen Channel subsite group; subsite 0H446 in the Poulnacarra Bay subsite group; and subsite 0H448 in Ballyvaughan Bay. Of these, subsites 0G491, 0G492 and 0H446 each contain a number of aquaculture sites, with marine access routes into subsites 0G491 and 0H446.

4.37 The significance of disturbance impacts from use of marine access routes will depend on the seasonal timing and frequency of husbandry activity in each of the relevant aquaculture sites. As

[5] The difference between the two parameters is that the individual mean counts escape distances for each individual in a group separately, while the group mean only counts a single escape distance for each group.

this level of detail is not available, it is not possible at this stage to make an assessment of the potential disturbance impact to the Red-breasted Merganser population of Inner Galway Bay.



Text Figure 4.2 – Relationship between Red-breasted Merganser distribution across subsites during I-WeBS counts and the amount of subtidal habitat in the subsites.

Great Northern Diver

4.38 In Irish coastal waters, Great Northern Divers appear to be relatively tolerant of disturbance from marine traffic. A survey in Galway Bay, using a small ferry boat, found that they did not show a 'flush' response to boat traffic, even when the survey boat passed within 10 to 20 m of some birds, although some did show a 'dive' response at lateral response distances of up to 100 m from the boat (Gittings *et al.*, 2015). In Cork Harbour, in 113 observations of interactions with shipping (mainly large commercial vessels) at Roches Point no flush responses were observed, although some birds swam away from the ships at lateral response distances of up to 200-300 m (5-13% of the observations at lateral response distances of up to 300 m; T. Gittings, unpublished data). These observations mainly involved large commercial vessels travelling at speeds of around 10 knots.

4.39 Therefore, while there is limited available data, it seems unlikely that vessel traffic along the marine access routes will flush Great Northern Divers unless the boat is heading directly towards the bird. Most disturbance responses are likely to involve birds diving and/or swimming away a short distance and would not involve any significant energy expenditure. Therefore, disturbance from vessel traffic is unlikely to cause significant energetic impacts.

4.40 Wintering populations of Great Northern Divers form nocturnal communal roosts in open water areas (Shackleton, 2012; T. Gittings, unpublished data) and are likely to be much more sensitive to disturbance at these roosts than they are when foraging during the day. The locations of the Great

Northern Diver communal roosts in Inner Galway Bay are not known so the potential disturbance impact from vessel traffic along the marine access routes to these roosts cannot be assessed. However, the roosting Great Northern Divers would only be potentially vulnerable to disturbance impacts from around one hour before dusk to shortly after dawn the following morning.

Cormorant (non-breeding)

4.41 In Irish coastal waters, foraging Cormorants appear to be relatively tolerant of disturbance from marine traffic. In Cork Harbour, disturbance responses were observed on 8-15% of occasions during 102 observations of interactions with shipping at Roches Point, including 19-30% of observations involving lateral response distances of up to 200 m (T. Gittings, unpublished data). These disturbance responses mainly involved birds flushing and flying out of the area. These observations mainly involved large commercial vessels travelling at speeds of around 10 knots. In Wexford Harbour, Cormorants appeared to be relatively tolerant of disturbance by marine traffic (Gittings and O'Donoghue, 2016c).

4.42 Cormorants use two types of roosts: daytime roosts and nocturnal roosts. In a large site, like Inner Galway Bay, there are typically many small daytime roosts widely dispersed throughout the site. Each roost is close to a foraging area, and typical daytime roosts sites include rocky shorelines and islands, sandbanks, seawalls, etc. There are usually only a small number of nocturnal roost sites, and individual roost sites can hold hundreds of birds. Birds may commute substantial distances to/from the nocturnal roost site. In estuarine sites, nocturnal roosts are typically on wooded islands or treelined stretches of shoreline, with cliffs and rocky islands used on more exposed coasts. The larger nocturnal roosts may also hold significant numbers of birds during the daytime. Nocturnal roosts may occur at Lough Rusheen and Deer Island (Gittings and O'Donoghue, 2014), while several other nocturnal roost sites are also likely to occur.

4.43 Roosting Cormorants are likely to be much more sensitive to disturbance than they are when foraging. The impact of disturbance to birds at daytime roosts may be minor due to the typically small size of these roosts and the widespread availability of alternative roosts throughout the site. However, disturbance to nocturnal roosts may have more severe impacts on Cormorant populations (Gittings and O'Donoghue, 2019). The suspected Lough Rusheen and Deer Island roost sites will not be affected by vessel traffic along any of the marine access routes, or husbandry activity in any of the aquaculture sites. However, as the location of other nocturnal roost sites in Inner Galway Bay is not known, the potential disturbance to these roosts cannot be assessed. However, the roosting Cormorants would only be potentially vulnerable to disturbance impacts from around two hours before dusk to shortly after dawn the following morning.

High tide roosts

4.44 Husbandry activity in oyster trestle cultivation sites takes place at low tide, so this activity and associated access to/from the sites will not cause disturbance to high tide roosts. All the other aquaculture activities included in this assessment (including hanging bag, hanging basket and floating tray oyster cultivation) may involve husbandry activity around the high tide period.

4.45 The distribution of waterbird roosts (as mapped in the 2014 assessment) in relation to the aquaculture sites, and access routes to these sites, with potential high tide activity, are shown in Figure 4.9 - Figure 4.11.

4.46 Most roosts are not located close to any of the relevant aquaculture sites or access routes. However, the marine access route from Ballyveleghan Quay into Poulnacarra Bay passes close to a concentration of wader roosts in the outer part of Poulnacarra Bay; however an alternate access from the south would avoid these roosts. Another concentration of wader roosts occurs around the

aquaculture site at Tawin East (T09/503A). Additional individual roosts occur close to some of the other aquaculture sites and access routes. Detailed assessment of the potential disturbance impacts to these roosts is not possible due to the lack of information about the frequency and seasonal timing of husbandry activity in the relevant sites.

Breeding SCIs

Cormorant

4.47 The main Cormorant breeding colony in Inner Galway Bay is located on Deer Island. This is around 1.7 km from the nearest aquaculture site, and around 1.3 km from the nearest marine access route. Therefore, this colony is not likely to be affected by disturbance impacts from aquaculture activity associated with the aquaculture sites covered by this assessment.

4.48 In 2016, three apparently occupied Cormorant territories were recorded on Illauncraggagh in Muckinish Bay (NPWS, unpublished data). This colony is around 250 m from a licensed oyster trestle site (T08/16) on the opposite shore. A marine access route from an application site for seaweed cultivation (T08/114A) passes within around 100 m of this colony. Rodgers and Smith (1995) recommended a set-back distance of 71 m between breeding Double-crested Cormorants and motor boats. However, Rodgers and Schwikert (2002) recommended a much larger set-back distance of 132 m between foraging and loafing Double-crested Cormorants and outboard powered boats. The disturbance response of Cormorants at breeding colonies is likely to be highly site specific depending on the landscape configuration of the area around the breeding colony (which will affect the perceived danger) and the degree of habituation to human activity. It seems unlikely that activity in site T08/16 would cause disturbance to the Illauncraggagh breeding colony, given the distance from the colony, and the physical separation by usually flooded shallow subtidal habitat. However, disturbance from vessel traffic along the marine access route is more likely given the closer distance and the fact that there appears to be limited existing vessel activity in this area. The significance of any such disturbance impact will depend on the seasonal timing and frequency of husbandry activity in the seaweed cultivation site, although a single severe disturbance event can be enough to cause breeding seabirds to abandon a colony in some instances.

Common Tern and Sandwich Tern

4.49 In recent years, the main Common Tern breeding colony in Inner Galway Bay has moved between Mutton Island and Rabbit Island in the northern part of the bay. These islands are over 3.5 km from the nearest aquaculture site.

4.50 The Sandwich Tern breeding colony is on Illaunagurroge in Corranroo Bay and this also holds a subsidiary Common Tern breeding colony. There are no recent published figures on the size of this breeding colony, but counts of 100-200 Sandwich Tern adults in 2018 and 2019 (eBird) indicates that it holds over 100 pairs at a minimum, with smaller numbers of Common Terns (counts of 5-20 adults). There are two application sites for oyster trestle cultivation in Corranroo Bay at distances of around 200 m (T09/464B) and 500 m (T09/464A). However, these are not new applications and these sites were included in the 2014 assessment. That assessment concluded that there was potential for disturbance to the colony from husbandry activity if the workers are accompanied by dogs, but this could be addressed by an appropriate license condition.

Conclusions

4.51 Full development of the existing licensed sites is unlikely to cause significant displacement impacts to any of the species covered by this assessment.

4.52 Full development of the application sites may cause significant displacement impacts to a number of species covered by this assessment, particularly Light-bellied Brent Goose, Ringed Plover and Curlew. This is mainly due to the two large sites on either side of the Aughinish Island causeway (T08/115A and T09/519A).

4.53 The significance of potential disturbance impacts arising from boat movements to Red-breasted Merganser, roosting Great Northern Diver and high tide waterbird roosts cannot be fully assessed at this stage due to the lack of detailed information about the timing and intensity of husbandry activity and associated use of access routes. However, to minimise impacts to Great Northern Diver it is proposed that boat activity be restricted around one hour before dusk to shortly after dawn, while it is proposed that the proximity of boat movements to high tide roosts should be restricted to avoid disturbance to roosting birds. There remains a risk of disturbance to Red-breasted Merganser for those sites which are accessed by boat. Further quantification of this risk would require more detailed knowledge of the season, frequency and type of boat movements; as if it proves that boat movements are relatively infrequent, or biased towards the months of May – September, such impact may be negligible.

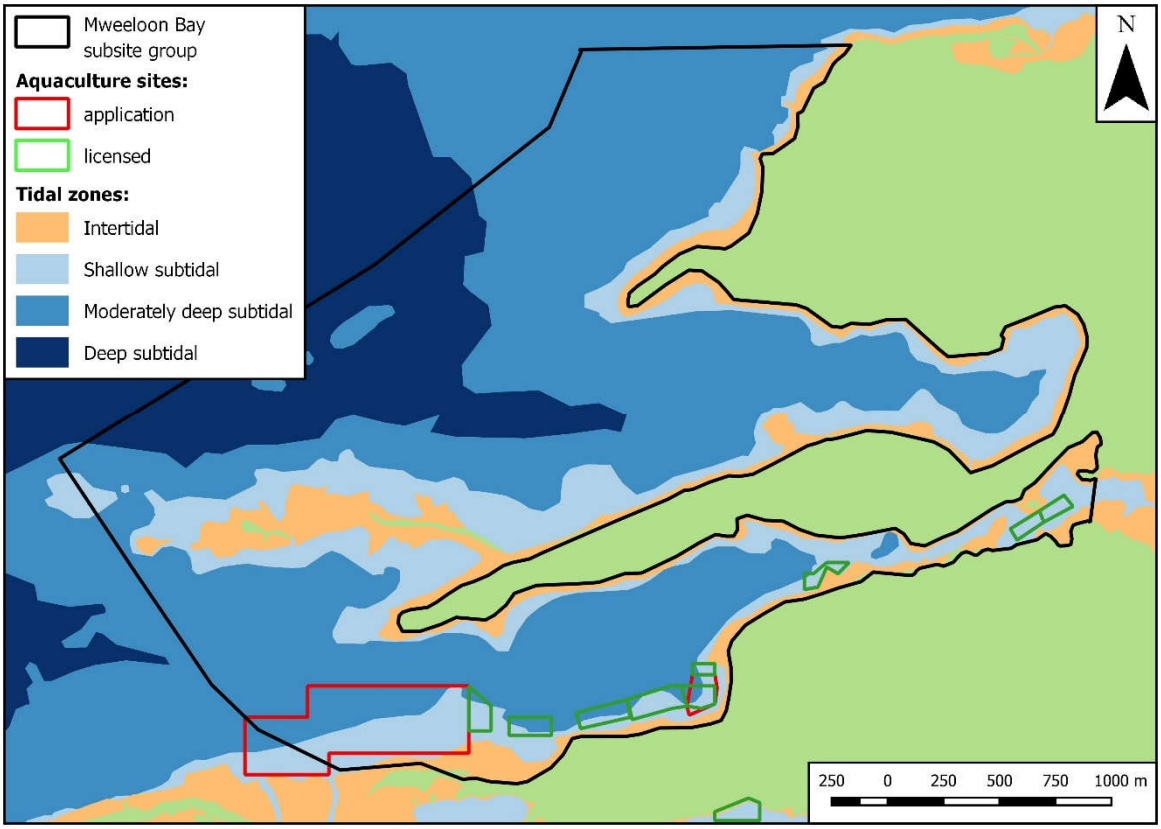


Figure 4.1 – Aquaculture sites and tidal zones in the Mweeloon Bay subsite group.

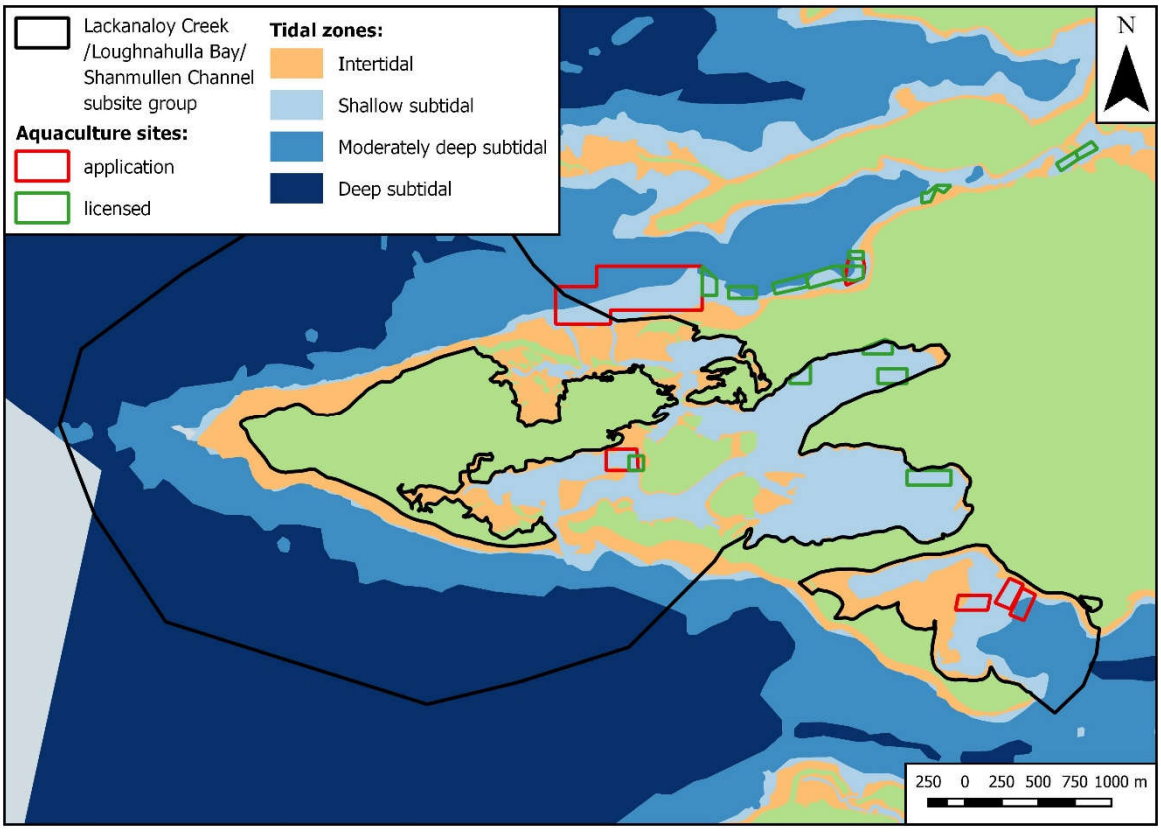


Figure 4.2 – Aquaculture sites and tidal zones in the Lackanaloy Creek / Loughnahulla Bay / Shanmullen Channel subsite group.

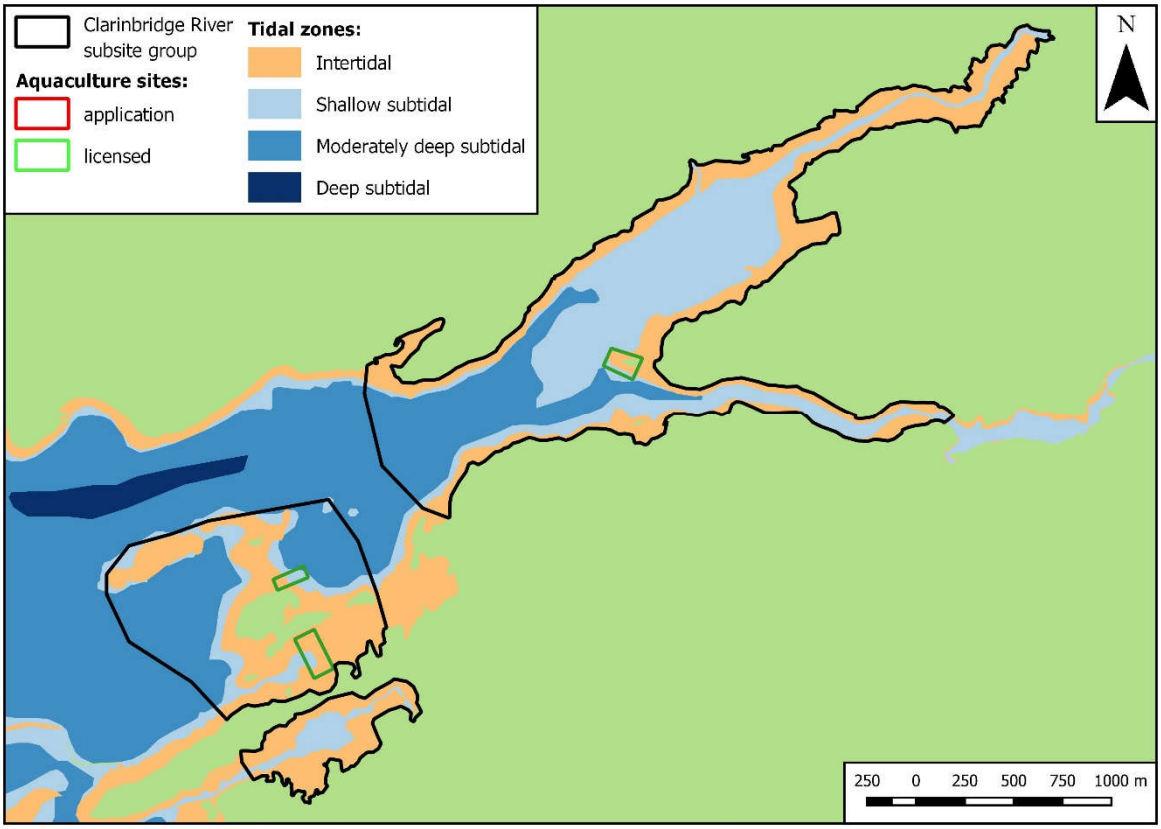


Figure 4.3 – Aquaculture sites and tidal zones in the Clarinbridge River subsite group.

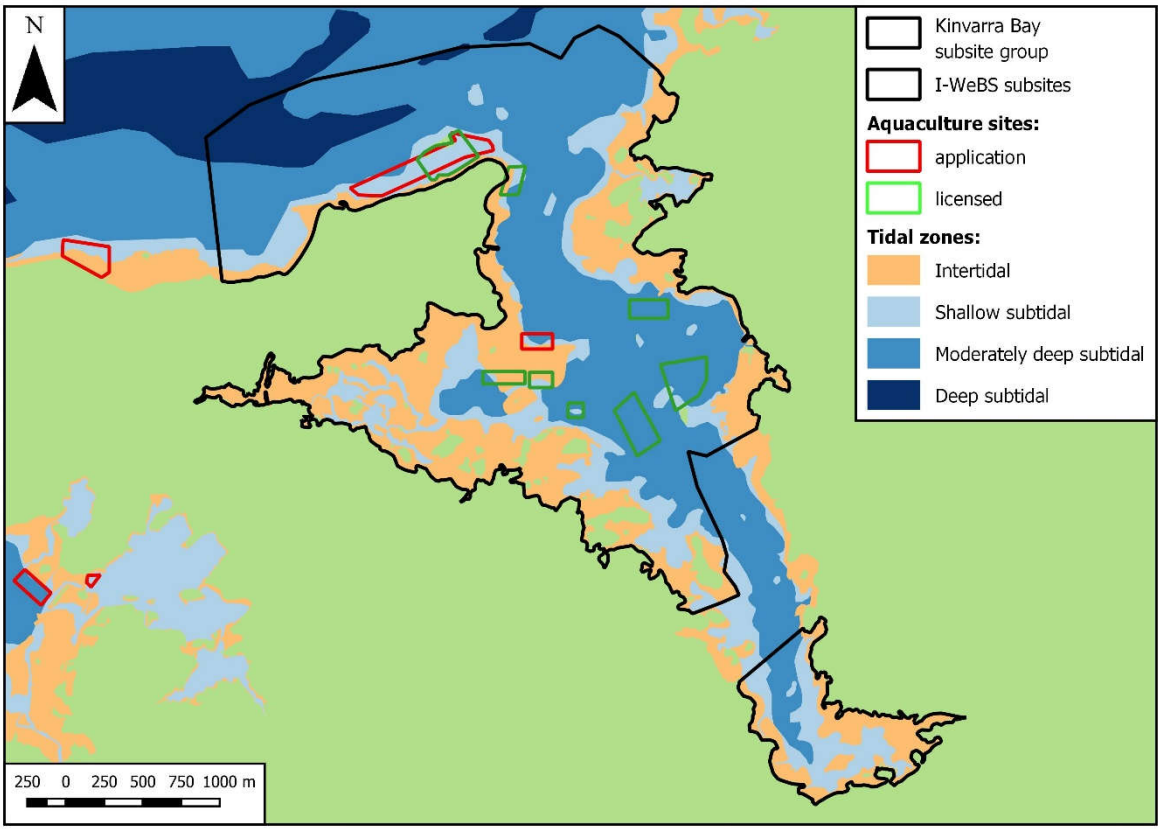


Figure 4.4 – Aquaculture sites and tidal zones in the Kinvarra Bay subsite group.

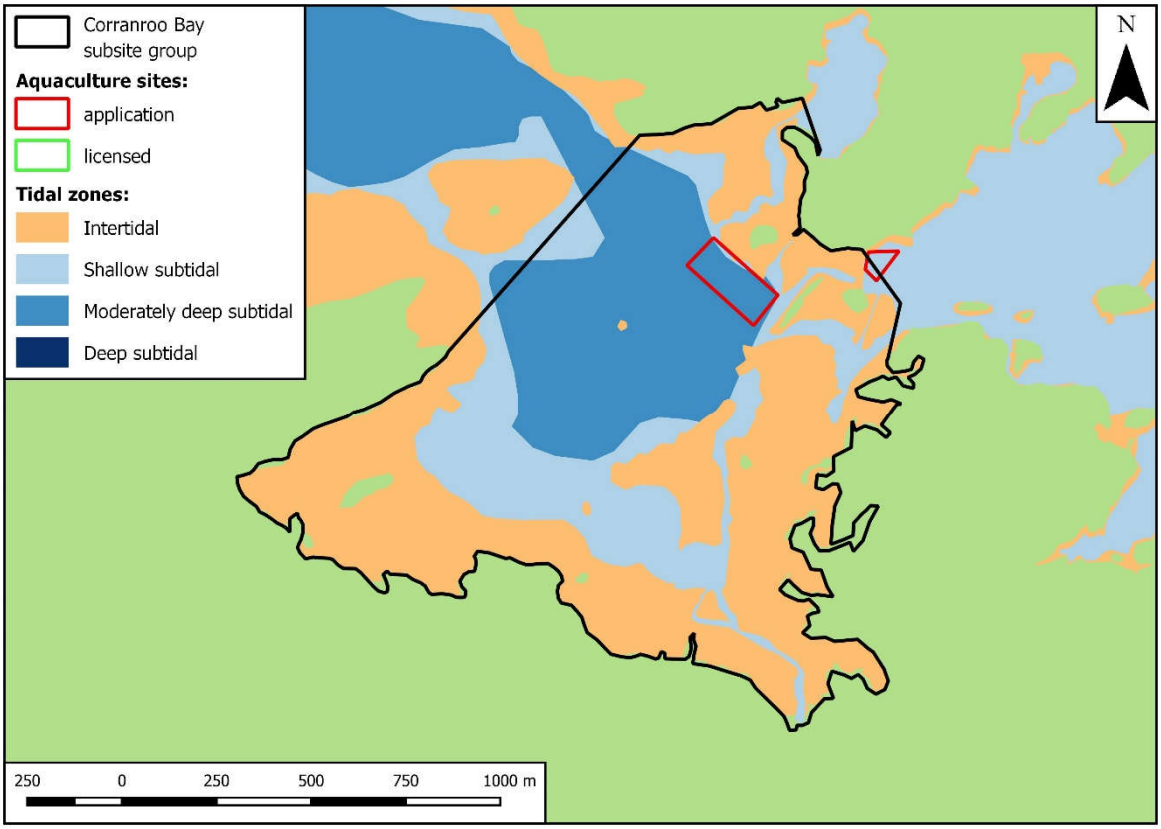


Figure 4.5 – Aquaculture sites and tidal zones in the Corranroo Bay subsite group.

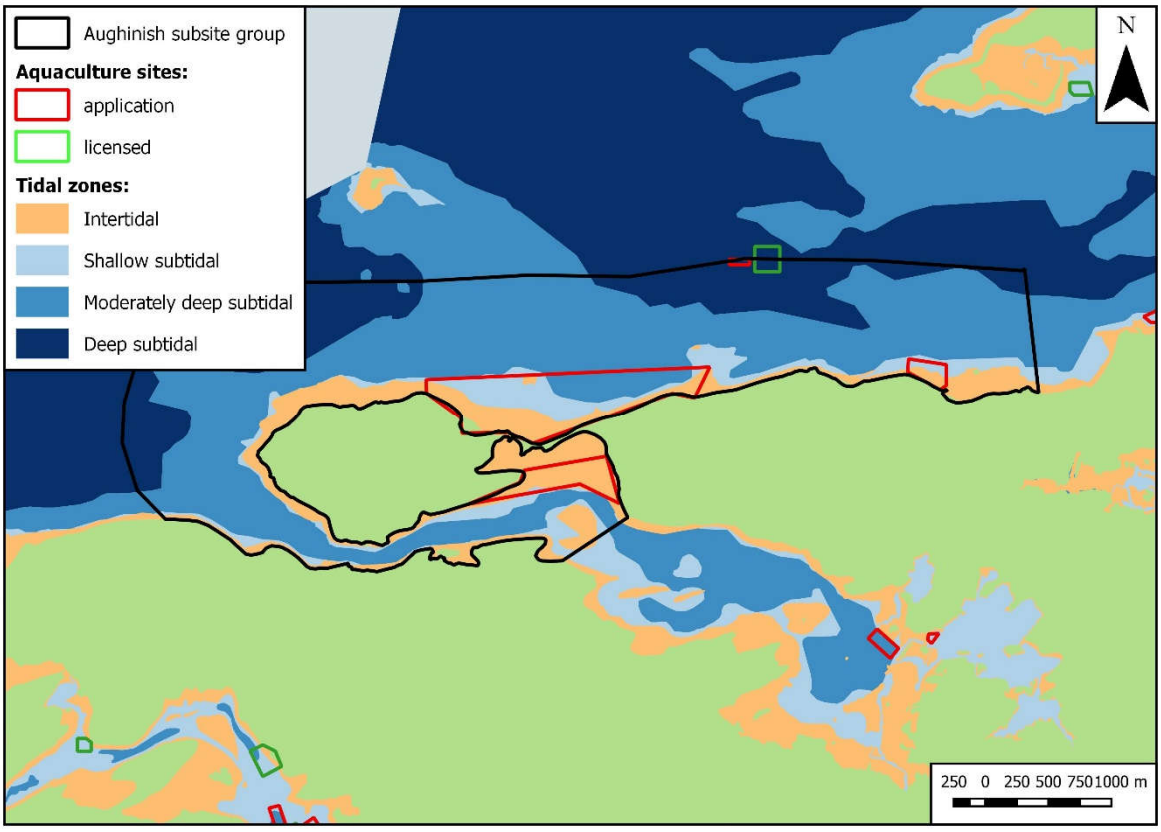


Figure 4.6 – Aquaculture sites and tidal zones in the Aughinish subsite group.

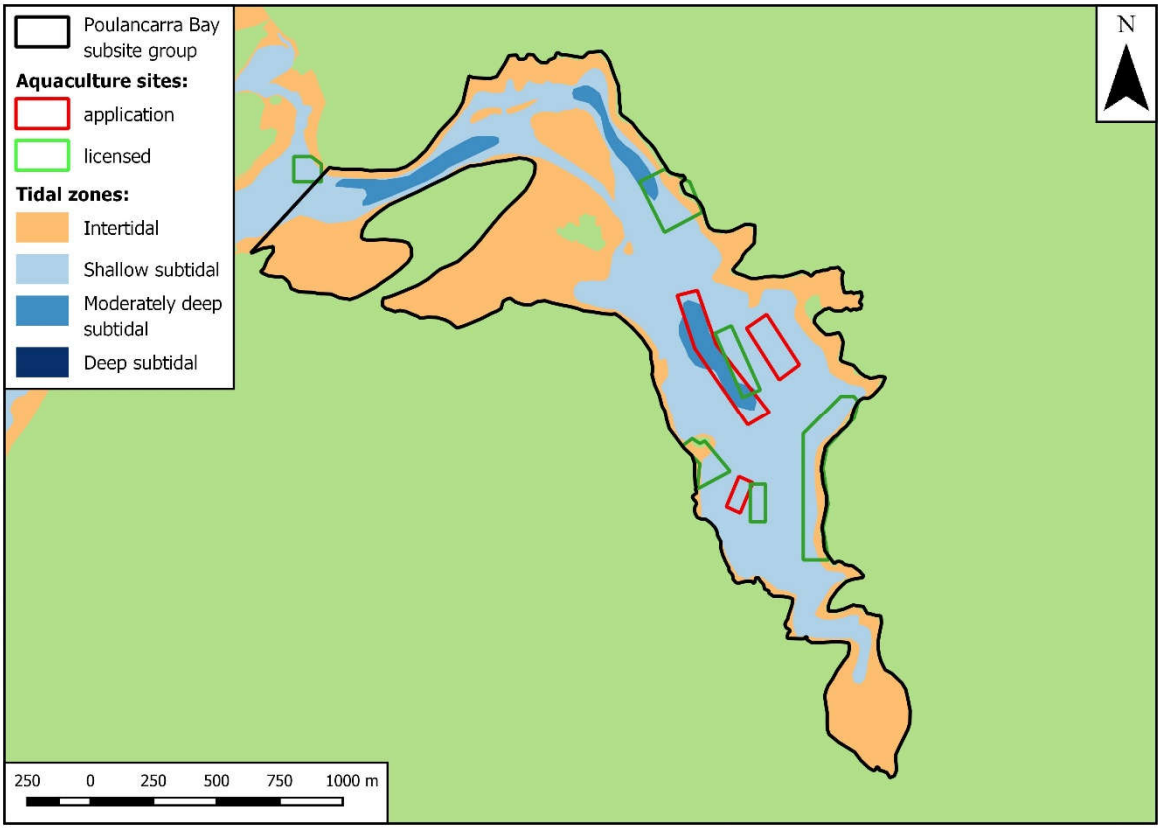


Figure 4.7 – Aquaculture sites and tidal zones in the Poulnacarra Bay subsite group.

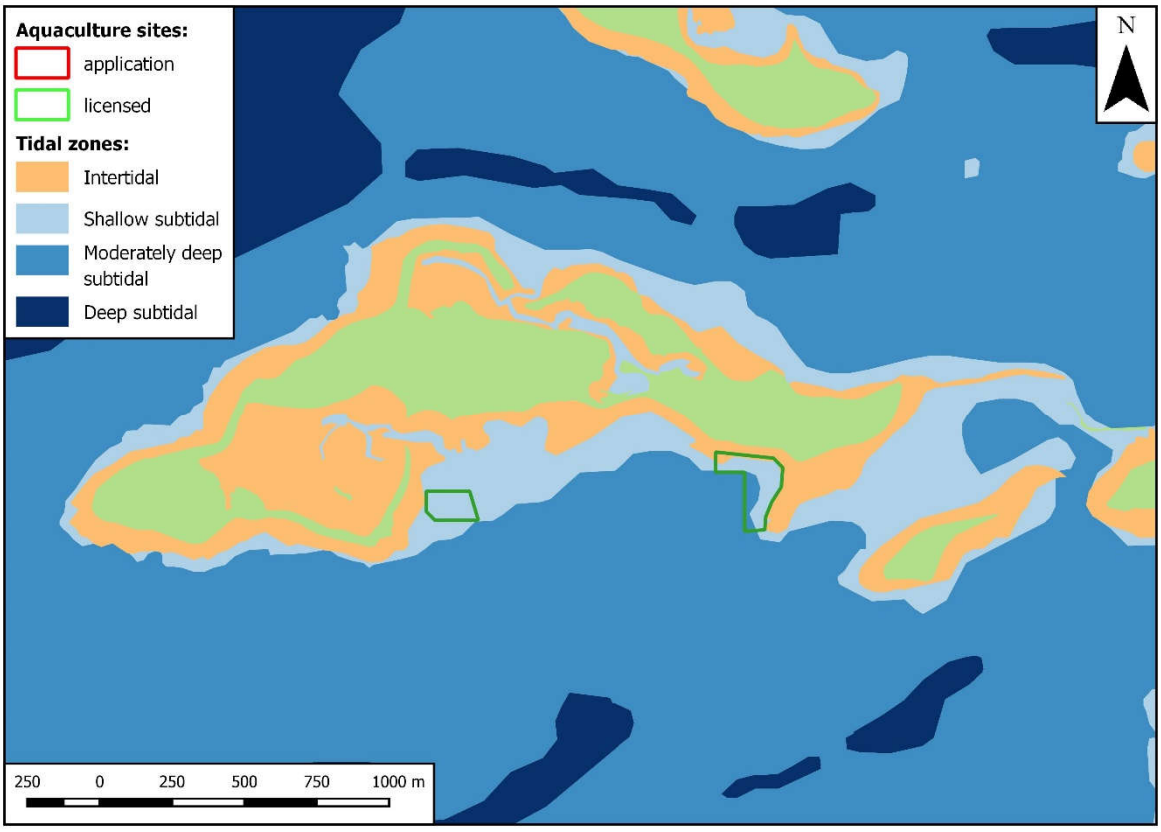


Figure 4.8 – Aquaculture sites and tidal zones at Island Eddy.

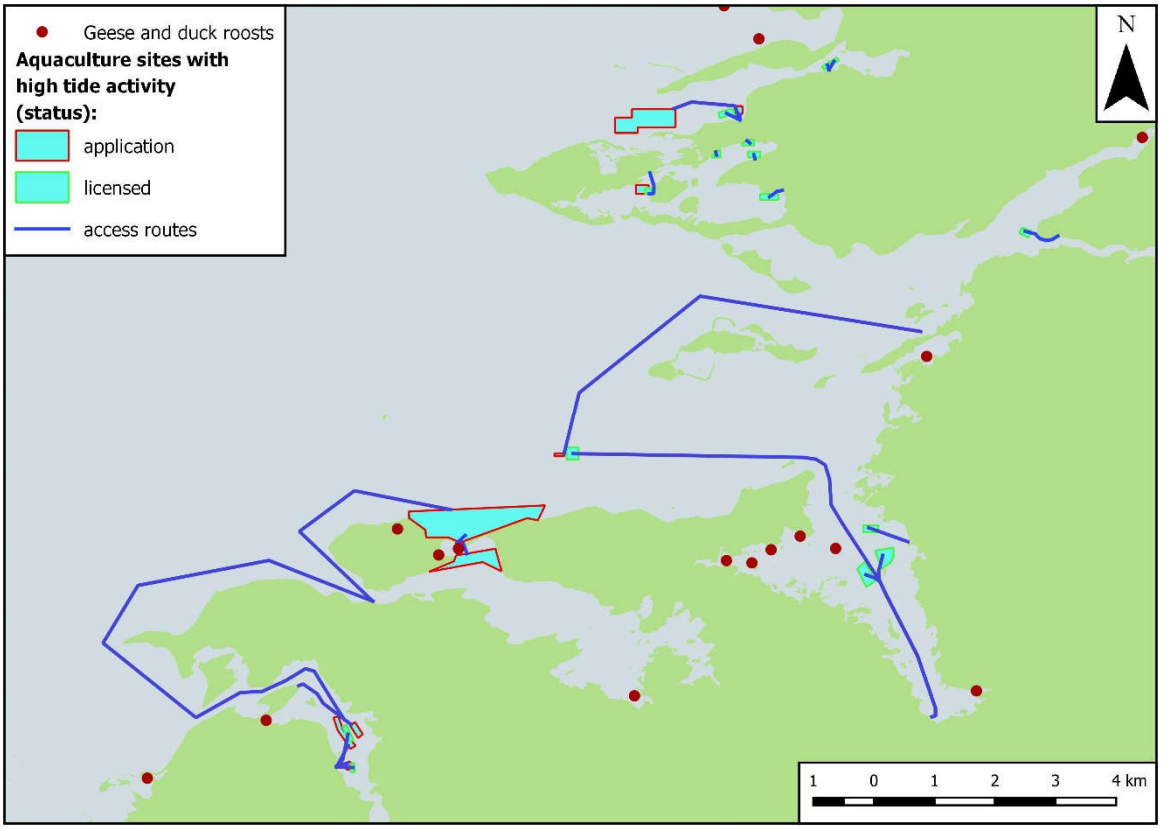


Figure 4.9 – Distribution of high tide Light-bellied Brent Goose, dabbling duck and Cormorant roosts in relation to aquaculture sites and access routes potentially used at high tide.

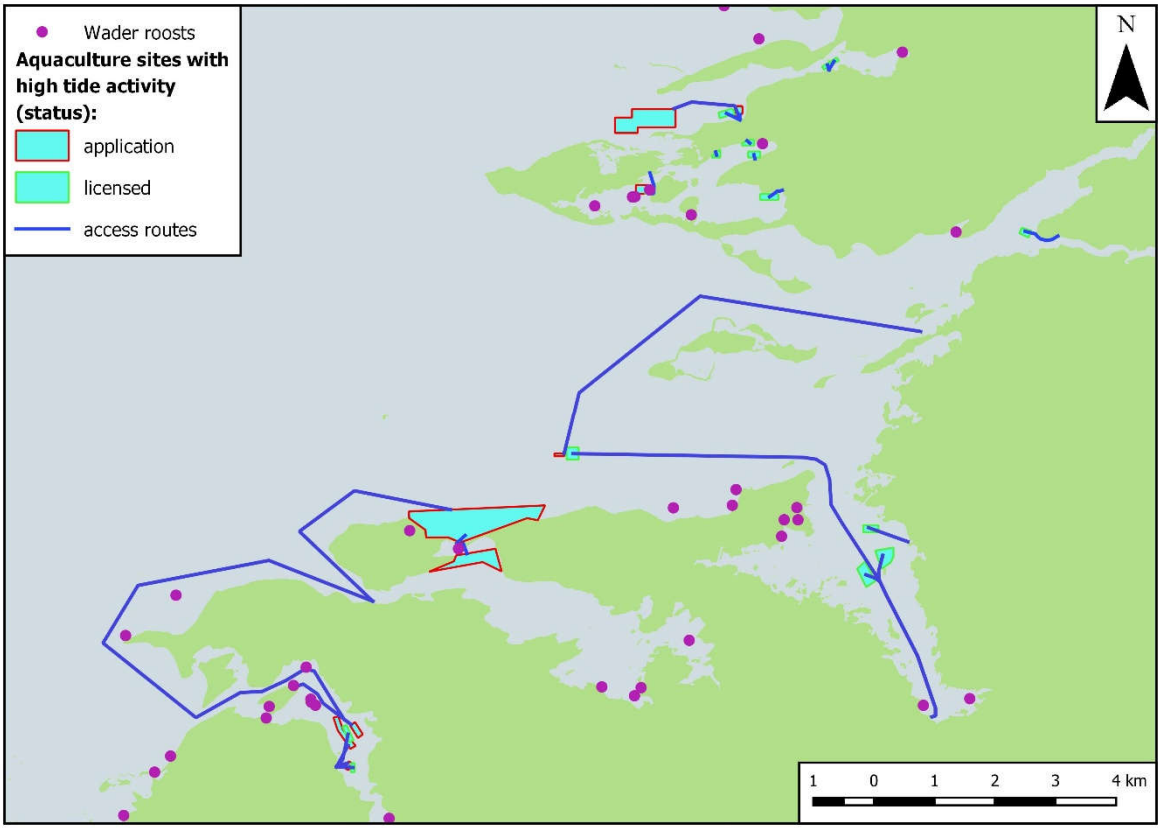


Figure 4.10 – Distribution of high tide wader roosts in relation to aquaculture sites and access routes potentially used at high tide.

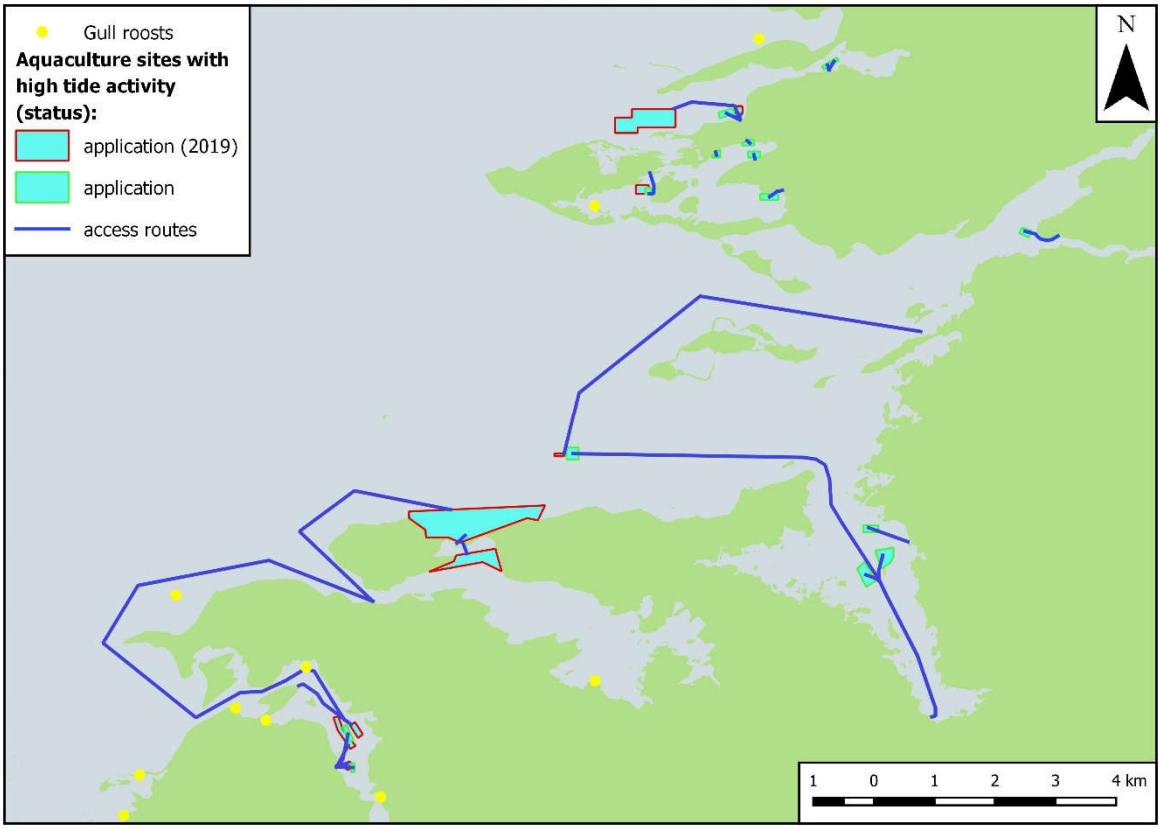


Figure 4.11 – Distribution of high tide gull roosts in relation to aquaculture sites and access routes potentially used at high tide.

5. Cumulative impacts

Introduction

5.1 This chapter presents an assessment of the potential cumulative impacts from the aquaculture activities covered by this assessment in combination with other relevant activities that could potentially affect the SCI species.

5.2 The chapter reviews and updates the cumulative assessment carried out in the 2014 assessment and also assesses any additional potential cumulative impacts arising from the present assessment.

Fishery Orders

5.3 There are four mapped Fishery Orders in Inner Galway Bay (Figure 3.2). Intertidal areas within some of these Fishery Orders were formerly used for oyster trestle cultivation, while the Clarinbridge Fishery Order (T09/007AOFO) was also formerly used for subtidal bottom oyster cultivation. However, these Fishery Orders are all now inactive. Therefore, no assessment is required of the potential cumulative impact of aquaculture activity in these Fishery Orders in-combination with the aquaculture activity in the sites covered by this assessment. In the event that these Fishery Orders become active again, further assessment will be required.

Fisheries activities

5.4 The 2014 assessment did not identify any potentially significant potential cumulative impacts of fisheries activities in Inner Galway Bay in-combination with the aquaculture activity in the sites covered by that assessment. However, it noted that there would be a risk of in-combination effects in the event of recommencement or intensification of scallop and/or razor clam dredging, crayfish set net fisheries, spratt and herring fisheries in the wider area, and native oyster dredging.

Other activities

Cumulative impacts identified in the 2014 assessment

5.5 The 2014 assessment identified the following potentially significant cumulative impacts from other activities in Inner Galway Bay in-combination with the aquaculture activity in the sites covered by that assessment: -

- Displacement impacts from the Galway Harbour Extension project to Great Northern Diver and Cormorant.
- Disturbance impacts to Ringed Plover from intertidal recreation.
- Impacts on food resources for Sandwich Tern and Common Tern from upgrading of wastewater treatment.

5.6 The 2014 assessment was written before the final assessment of the Galway Harbour Extension project had been prepared. The latter found that the potential displacement impacts were negligible (Gittings, 2014). Furthermore, the main impacts from aquaculture activities to Great Northern Diver and Cormorant in the 2014 assessment were from bottom mussel cultivation. This is not an activity that currently occurs in any of the licensed sites, or is proposed for any of the application sites, covered by the present assessment. There are no measurable impacts to these species identified in the present assessment. Therefore, there is no requirement to assess the potential cumulative impacts of aquaculture in-combination with other activities to these species.

5.7 The 2014 assessment concluded that “overall, it is possible, but not highly likely, that disturbance from recreational activity in the intertidal zone could have in-combination effects with displacement impacts from aquaculture activities that cause a measurable increase in the overall cumulative impact” to Ringed Plover. The overall calculated displacement impact for Ringed Plover is now

higher than that calculated in the 2014 assessment. There is also a concentration of intertidal oyster cultivation along the shoreline between Aughinish Island and Doorus Point, overlapping with a beach recreation area at Traught Beach, and other shoreline access points at Newtown Lynch and along the Aughinish Island causeway. This is a sandy shoreline with high potential habitat suitability for Ringed Plover. Therefore, the potential for cumulative impacts from disturbance by beach recreation and other intertidal activity in combination with displacement by intertidal oyster cultivation is particularly high in this area.

5.8 The main impacts from aquaculture activities to Sandwich Tern and Common Tern in the 2014 assessment were also from bottom mussel cultivation. With the exception of the potential for dogs to cause disturbance to the Illaunagurroge breeding colony, which can be controlled by an appropriate licence condition, there are no measurable impacts to these species identified in the present assessment. Therefore, there is no requirement to assess the potential cumulative impacts of aquaculture in-combination with other activities to these species.

Beach recreation / shellfish gathering

5.9 In addition to Ringed Plover (see above), other species could potentially be affected by cumulative impacts from disturbance by beach recreation and other intertidal activity in combination with displacement by intertidal oyster cultivation.

5.10 There is a potentially significant calculated displacement impact to Light-bellied Brent Goose. This species is not likely to be as strongly associated with beach recreation areas as Ringed Plover. However, it may be more vulnerable to disturbance impacts from winkle picking and bait digging.

5.11 There was also a potentially significant calculated displacement impact to Curlew. This species has a dispersed distribution pattern across intertidal habitat so it tends not to occur in large concentrations in specific areas making it less vulnerable to point source disturbance impacts.

5.12 The calculated displacement impacts for Bar-tailed Godwit and Dunlin were below the significance threshold but not negligible. Both these species are likely to experience some degree of disturbance impact from beach recreation and other intertidal activity.

Marine traffic

5.13 There is potential for marine traffic to cause cumulative impacts to Red-breasted Merganser, roosting Great Northern Diver and high tide waterbird roosts in combination with disturbance from aquaculture husbandry activity and associated access to/from the aquaculture sites.

5.14 The recreational boat activity in Inner Galway Bay was reviewed as part of the assessment for the Galway Harbour Extension (Gittings, 2015): -

> "*During the winter (October-March), there is an average of 8 fishing boats and 2 recreational boats on the water on any one day. In addition, yacht races take place on Sundays with an average of 22 boats involved. During the summer (April-September), there is an average of 8 fishing boats and 5 recreational boats on the water on any one day giving a total of 13. However when shoals of mackerel come into the inner bay the number of fishing/recreational vessels on the sea increases temporarily to an average of 16. In addition, yacht races take place on Wednesdays with the same average of 22 boats involved.*"

5.15 The development of the Galway Harbour Extension is expected to increase the average number of boats (recreational boats and fishing boats) on the water per day from around 10 to 12 in the winter months, and from 13 to 18 in the summer months (Gittings, 2015).

5.16 The current distribution patterns of Red-breasted Merganser, roosting Great Northern Diver and high tide waterbird roosts probably reflect existing levels of disturbance from the above activities. Introduction of additional disturbance sources, particularly in areas with low existing levels of disturbance, could have significant cumulative impacts.

5.17 However, before assessing the cumulative impacts, it is first necessary to assess the stand-alone impacts from the aquaculture activities covered by this assessment. As discussed above, further information on the timing and intensity of husbandry activity is required for such an assessment.

6. Conclusions

6.1 Full development of the existing licensed aquaculture sites is unlikely to cause significant displacement impacts to any of the species covered by this assessment.

6.2 Full development of the application aquaculture sites may cause significant displacement impacts to a number of species covered by this assessment, particularly Light-bellied Brent Goose, Ringed Plover and Curlew. This is mainly due to the two large sites on either side of the Aughinish Island causeway (T08/115A and T09/519A).

6.3 The significance of potential disturbance impacts to Red-breasted Merganser, roosting Great Northern Diver and high tide waterbird roosts cannot be fully assessed at this stage due to the lack of detailed information about the timing and intensity of husbandry activity and associated use of access routes.

6.4 There is potential for beach recreation and other intertidal activities such as shellfish collection to have cumulative impacts on Light-bellied Brent Goose, Ringed Plover and other species in combination with displacement impacts from aquaculture activity.

6.5 If the aquaculture activity causes non-negligible disturbance impacts to Red-breasted Merganser, Great Northern Diver and high tide waterbird roosts, there is potential for small boat activity (recreational and fishing boats) to have cumulative impacts on Red-breasted Merganser, Great Northern Diver and high tide waterbird roosts in combination with these disturbance impacts.

7. References

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Appendix A

Scientific names

Common name	Scientific names	BTO code
Bar-tailed Godwit	*Limosa lapponica*	BA
Black-headed Gull	*Chroicocephalus ridibundus*	BH
Black-tailed Godwit	*Limosa limosa*	BW
Common Gull	*Larus canus*	CM
Common Scoter	*Melanitta nigra*	CX
Common Tern	*Sterna hirundo*	CN
Cormorant	*Phalacrocorax carbo*	CA
Curlew	*Numenius arquata*	CU
Double-crested Cormorant	*Phalacrocorax auritus*	-
Dunlin	*Calidris alpina*	DN
Golden Plover	*Pluvialis apricaria*	GP
Great Northern Diver	*Gavia immer*	ND
Grey Heron	*Ardea cinerea*	H.
Lapwing	*Vanellus vanellus*	L.
Light-bellied Brent Goose	*Branta bernicla hrota*	PB
Red-breasted Merganser	*Mergus serrator*	RM
Redshank	*Tringa totanus*	RK
Ringed Plover	*Charadrius hiaticula*	RP
Sandwich Tern	*Thalasseus sandvicensis*	TE
Shoveler	*Anas clypeata*	SV
Teal	*Anas crecca*	T.
Turnstone	*Arenaria interpres*	TT
Wigeon	*Tadorna tadorna*	SU

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