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Annex 2: Lough Swilly Special Protection Area: Appropriate Assessment of Fisheries and Aquaculture

March 2013

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Executive Summary

This report contains the Appropriate Assessment of aquaculture and oyster fishing on the Lough Swilly Special Protection Area (site code 004075). It 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.

Limitations to this assessment

The assessment of the distribution of species that use intertidal habitat is based mainly on four low tide counts in the winter of 2009/10.

There is no detailed information on the foraging habitats and diets of the breeding SCI species (Black-headed Gull, Sandwich Tern and Common Tern).

There is only very limited information available on the existing levels of activity of the various aquaculture and fisheries covered in this assessment. This means that it is difficult to assess to what degree current species distribution patterns may already have been influenced by the activities being assessed.

There is a lack of detailed information on the proposed scale and intensity of many of the activities being assessed. This has meant that we have had to make precautionary worst-case scenario assumptions (e.g. 100% occupancy of bottom-culture plots) that are likely to be very unrealistic.

There are some potential impact mechanisms, for which there are little, or no, published evidence that can be used to assess whether significant impacts are likely (these are highlighted as appropriate).

Methodology

Three broad habitat zones have been defined for this assessment: intertidal, shallow subtidal (< 0.5 deep) and deep subtidal (> 0.5 m deep).

A literature review was carried out to assess the likely main food resources of the SCI species in the Lough Swilly SPA. Information on the impact of the activities on intertidal and subtidal biotopes from the Appropriate Assessment of the Lough Swilly Special Area of Conservation (SAC), and previous published research, have been used to identify potential impacts to prey resources used by the SCI species. Where available, previous research has also been used to identify the likely response (positive, neutral or negative) of the SCI species to the activities.

Most of the analyses of the likely impacts of activities covered in this assessment are based on calculations of spatial overlap between the SCI species distribution and the spatial extent of the activities. These analyses focus on distribution patterns of feeding, or potentially feeding birds, as the main potential impacts will be to the availability and/or quality of feeding habitat, although we have included assessment of potential impacts on roosting birds, where relevant. The distribution of waterbird species that mainly feed in deep subtidal waters have been analysed using data from the Irish Wetland Bird Survey (I-WeBS) counts of Lough Swilly (mainly using data from 2006/07-2010/11). The distribution of waterbird species that mainly feed in intertidal and/or shallow subtidal waters has mainly been analysed using the National Parks and Wildlife Service (NPWS) Baseline Waterbird Survey (BWS) low tide counts (carried out in 2009/10). Maps of flock locations from the NPWS BWS low tide counts and descriptions of waterbird distribution in Sheppard (2002)[1] and NPWS (2011)[2] have also been used to interpret the patterns derived from these analyses.

There are three SCI species listed for their breeding populations. While the location of the breeding colony is known, there is no detailed information available on the distribution of foraging birds from the breeding colony. Therefore, we have not been able to carry out detailed distributional analyses for these species.

The methodology used to identify potentially significant impacts is focussed on the Conservation Objectives, and their attributes, that have been defined and described for the Lough Swilly SPA. Impacts that will cause displacement of 5% or more of the total Lough Swilly population of a non-breeding SCI species have been assessed as potentially having a

[1] Sheppard, R. (2002). The wintering waterbirds of Lough Swilly, County Donegal. Irish Birds, 7, 65–78.
[2] NPWS (2011). Lough Swilly Special Protection Area (Site Code 4075). Version 1.Conservation Objectives Supporting Document.

significant negative impact. Because of lack of information about the spatial distribution of the breeding SCI species we have only been able to make qualitative assessments of the potential impacts on these species.

Conservation objectives

The Special Conservation Interests (SCIs) of the Lough Swilly SPA include: -

- breeding populations of Black-headed Gull, Common Tern and Sandwich Tern; and
- non-breeding populations of Whooper Swan, Greenland White-fronted Goose, Greylag Goose, Shelduck, Wigeon, Teal, Mallard, Shoveler, Scaup, Goldeneye, Red-breasted Merganser, Great Crested Grebe, Grey Heron, Coot, Oystercatcher, Knot, Dunlin, Curlew, Greenshank, Redshank, and Common Gull.

The conservation objectives for the Black-headed Gull, Sandwich Tern and Common Tern breeding populations at Lough Swilly are to maintain their favourable conservation condition, which are defined by there being no significant decline in the abundance of the breeding population, the productivity rate and the distribution of breeding colonies.

The conservation objectives for the non-breeding SCI species Lough Swilly are to maintain their favourable conservation condition, which are defined by there being stable or increasing long-term population trends and no significant decrease in numbers or range of areas used within Lough Swilly.

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

Screening

Whooper Swan, Greenland White-fronted Goose, Greylag Goose and Coot were screened out from any further assessment because they do not have any significant spatial overlap with any of the activities being assessed.

For the purposes of this Appropriate Assessment, the broad habitat zones used by the remaining SCI species for feeding and/or roosting have been classified. The activities covered in this assessment can generally be broken down into components that affect intertidal/shallow subtidal and deep subtidal habitat zones separately. SCI species that are not associated with a habitat zone have been screened out from assessment of activity components affecting that habitat zone.

The Conservation Objectives define the favourable conservation condition of the wetlands and waterbirds SCI at Lough Swilly purely in terms of habitat area. None of the activities being assessed will cause any change in the extents of subtidal, intertidal, supratidal and lagoon habitats. 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.

Waterbird status and distribution

Seven of the non-breeding waterbird SCI species (excluding those screened out from this assessment) have been assessed by the NPWS as having an unfavourable conservation condition in the Lough Swilly SPA: namely Shelduck, Scaup, Red-breasted Merganser, Curlew and Common Gull (intermediate (unfavourable)); and Goldeneye, Great Crested Grebe and Dunlin (moderately unfavourable). Shelduck and Scaup have stable or increasing all-Ireland and international trends, indicating that site-specific factors may be causing their decline at Lough Swilly. The other species with unfavourable conservation condition all have stable or increasing all-Ireland trends.

NPWS have not provided any information on the conservation condition or trends of the breeding SCI species.

In the NPWS BWS low tide counts, the dabbling duck species (Wigeon, Teal, Mallard and Shoveler) mainly occurred in intertidal habitat in the southernmost section of the Lough Swilly (Big Isle and Swilly Estuary) and lagoon and terrestrial habitat in Blanket Nook and Inch Lough & Levels. Shelduck, Knot, Dunlin and Redshank mainly occurred in the subsites with the mud community complex biotope in the upper part of Lough Swilly (Ballybegly, Big Isle and Swilly Estuary), and, to a lesser extent, in the Fahan Creek and the Leannan Estuary. Oystercatcher and Curlew were more widely distributed throughout the intertidal zone.

Analysis of the I-WeBS dataset indicates that both Red-breasted Merganser and Great Crested Grebe are widely distributed in subtidal habitat throughout most of Lough Swilly, while Goldeneye mainly occurred in the lagoon habitats in Blanket Nook and Inch Lough & Levels.

Mussel bottom culture

Within the Lough Swilly SPA there are currently seven sites licensed (covering 512 ha) and another 13 applications (covering 549 ha) pending for mussel bottom culture. There are also an additional three sites licensed (covering 1174 ha) for the bottom culture of mussels and oysters together. The key aspects of this activity in relation to potential impacts on SCI species are: -

- Collection of mussel seed
- Ongrowing of mussel seed in nursery areas mainly in the intertidal
- Further ongrowing of mussels in subtidal waters
- Harvesting of mussels

Collection of mussel seed

The seed mussel harvesting operations will not result in a net reduction in mussel availability and are not likely to cause reduced food availability for Scaup and Goldeneye (the two SCI species that may feed on subtidal mussels). The seed mussel harvesting takes place over a short period of time so any disturbance impacts will be of short duration and will not affect the availability of resources in this area. Therefore, there are no potentially significant impacts that are likely to arise from seed mussel harvesting.

Ongrowing of mussel in the intertidal and subtidal zones

Ongrowing of mussels in intertidal and subtidal zones may cause changes in the physical structure of the habitat, and is considered disturbing to the intertidal biotopes affected, due to extirpation of the characteristic infaunal species from the area covered by mussels, and, in some cases, the sensitivity of characteristic species to organic enrichment, smothering and/or physical disturbance from dredging. Ongrowing of mussels in the subtidal zone may also reduce demersal fish populations, as increasing the density of mussels may result in homogeneous habitat and little provision of refugia for fishes.

Based on previous research six of the intertidal and shallow subtidal SCI species at Lough Swilly can be considered potentially sensitive to negative impacts: Shelduck, Wigeon, Teal, Mallard, Shoveler and Dunlin. Assuming that there is 100% occupancy of the mussel bottom culture plots, and that birds are uniformly distributed through suitable habitat, there is potential for ongrowing of mussel seed in intertidal nursery areas to cause significant displacement impacts to Shelduck, Shoveler and Dunlin. However, it should be noted that the assumption of a negative response of these species to intertidal mussel cover is a precautionary assumption in the absence of clear evidence about the nature of their responses. In particular, there is some evidence that Dunlin may, in fact have a positive association with mussel beds.

Ongrowing of mussels in the subtidal zone is likely to have positive impacts on Scaup and Goldeneye by increasing their food supply. However, it may reduce food resources for fish-eating species. This could result in significant displacement impacts to Red-breasted Merganser and Great Crested Grebe. However, it should be noted that the assumption of a negative response of these species to subtidal mussel cover is a precautionary assumption in the absence of clear evidence about the nature of their responses. Moreover, the existence of alternative prey resources (pelagic fish) that would not be affected mean that complete displacement is probably unlikely to occur.

Our assessment of the potential impacts on Sandwich Tern and Common Tern is limited by the lack of information about the distribution of their foraging habitat within Lough Swilly. However, ongrowing of mussels in subtidal waters could have significant impacts on Common Tern prey resources, potentially causing reduced productivity and, if continued over a period of years, reduced abundance of the breeding colony. Sandwich Tern prey resources are less likely to be significantly affected, but the reliability of this conclusion is low. Also, there is potential for mussel bottom culture to contribute towards a significant cumulative impact on their prey resources if the pelagic fisheries (not covered in this assessment) also affect their prey resources.

Husbandry activity at high tide associated with ongrowing of mussel seed in intertidal nursery areas, the relaying of the seed mussels, the dredging of the seed mussels following ongrowing, the relaying of the mussels into subtidal waters and stock movements during ongrowing all have the potential to cause disturbance impacts to species in the subtidal zone. However, these activities will only occur for short periods of time, and will only affect limited areas of habitat at any one time, so any disturbance impacts will be of short duration and will not affect the availability of resources.

Harvesting of mussels

Mussel harvesting will result in the removal of mussel biomass that would otherwise have been available for birds to feed on. This could affect SCI species that feed on mussels (Scaup, Goldeneye, Oystercatcher, Knot and Common Gull). However, this mussel biomass has been produced by aquaculture. Where the mussels have been cultivated from seed mussels from the managed Irish Sea Fishery, this represents a net input into the system during the cultivation period. Where the mussels have been cultivated from seed mussels from the local seed area, the cultivation will have increased the biomass that would have been produced by this seed mussel resulting in a net increase in food availability during the cultivation period. It will also have made it available to the intertidally feeding species, and dispersed it more widely reducing potential food limitation due to competitive effects. Therefore, there are no potentially significant impacts of mussel biomass removal on SCI species resulting from the harvesting of mussels.

Mussel harvesting will cause disturbance impacts to SCI species that use deep subtidal waters. While these may throughout most of the year they will only affect limited areas of habitat at any one time, so any disturbance impacts will be of short duration and will not affect the availability of resources in this area. Therefore, there are no potentially significant disturbance impacts that are likely to arise from the ongrowing of mussels in subtidal waters.

Oyster bottom culture

This activity involves the bottom culture of both native and Pacific oysters. Within the Lough Swilly SPA there are currently two applications (covering 280 ha) pending for oyster bottom culture. There are also an additional three sites licensed (covering 1174 ha) for the bottom culture of mussels and oysters together. The key aspects of this activity in relation to potential impacts on SCI species are: -

- A nursery phase in the intertidal zone
- Further ongrowing of oysters in subtidal waters
- Harvesting of oysters

Nursery phase in the intertidal zone

The nursery phase in the intertidal zone involves trestles and/or BST longlines in areas licensed for suspended culture, which are in separate areas, outside the oyster bottom culture plots (see below). No activities associated with oyster bottom culture will occur within the intertidal zones of the oyster bottom culture plots.

Ongrowing of oysters in subtidal waters

The areas used for oyster bottom culture will generally be below the lowest astronomical tide, so SCI species that only feed in shallow subtidal habitat are unlikely to be affected.

Ongrowing of oysters in subtidal waters is considered disturbing to the subtidal biotopes affected, due to the sensitivity of some of the characteristic species to organic enrichment, smothering and/or physical disturbance from dredging. Therefore, it could potentially have negative impacts on two SCI species (Scaup and Goldeneye) that feed on benthic invertebrates in deep subtidal waters. The distribution patterns and habitat usage of Goldeneye in Lough Swilly mean that they do not show any significant overlap with the areas potentially affected by this activity. Assuming that there is 100% occupancy of the oyster bottom culture plots, and that birds are uniformly distributed through suitable habitat, there is potential for the ongrowing of oysters in subtidal waters to cause significant displacement impacts to Scaup, due to either a reduction in the suitability of existing mussel beds as feeding habitat, or through impacts to other benthic invertebrates that they feed on. However, it should be noted that the assumption of a negative response of this species to subtidal oyster cover is a precautionary assumption in the absence of clear evidence about the nature of its response.

It is considered unlikely that ongrowing of oysters in subtidal waters would impact negatively on fishes as the oysters, along with shell 'hash', provides a low relief habitat that will increase general heterogeneity in overall structure and which

has been shown to increase diversity and abundance of fish species. Therefore, there are unlikely to be negative impacts on food resources for the mainly fish-eating SCI species (Red-breasted Merganser, Great Crested Grebe, Sandwich Tern and Common Tern).

The relaying of the oysters and the stock movements during ongrowing has the potential to cause disturbance impacts to SCI species that use deep subtidal waters. However, these activities will only occur for short periods of time, and will only affect limited areas of habitat at any one time, so any disturbance impacts will be of short duration and will not affect the availability of resources in this area. Therefore, there are no potentially significant disturbance impacts that are likely to arise from the ongrowing of oysters in subtidal waters.

Harvesting of oysters

Oyster harvesting will result in the removal of oyster biomass that would otherwise have been available for birds to feed on. However, there are no SCI species at Lough Swilly that are likely to feed on oysters in subtidal waters.

The harvesting of oysters will cause disturbance impacts to SCI species that use deep subtidal waters. While these may occur throughout most of the year they will only affect limited areas of habitat at any one time, so any disturbance impacts will be of short duration and will not affect the availability of resources in this area. Therefore, there are no potentially significant disturbance impacts that are likely to arise from the harvesting of oysters in subtidal waters.

Suspended oyster culture

There are two methods of suspended oyster culture in Lough Swilly: bags and trestles in intertidal habitat and BST longlines in subtidal habitat. Within the Lough Swilly SPA there are currently three sites (comprising five plots) licensed for suspended oyster culture and three applications covering a total area of 118 ha.

Suspended oyster culture causes a significant physical alteration to the structure of intertidal and subtidal habitat through the placement of physical structures (oyster trestles or poles and longlines) in the habitat and may also cause impacts to benthic invertebrates through sedimentation and eutrophication. It may also cause impacts to waterbirds through disturbance associated with husbandry activities.

Based on previous research six of the intertidal and shallow subtidal SCI species at Lough Swilly can be considered potentially sensitive to negative impacts from intertidal oyster culture using trestles: Shelduck, Wigeon, Teal, Mallard, Shoveler, Knot, and Dunlin. However, the distribution patterns and habitat usage of these species in Lough Swilly mean that they do not show any significant overlap with the areas potentially affected by this activity.

By analogy with suspended mussel culture (see below) subtidal oyster culture using BST longlines is considered unlikely to cause impacts to the predominantly fish-eating SCI species (Red-breasted Merganser, Great Crested Grebe, Sandwich Tern and Common Tern). The distribution patterns and habitat usage of other two SCI species that feed in deep subtidal habitat (Scaup and Goldeneye) mean that they do not show any significant overlap with the areas potentially affected by this activity.

Suspended mussel culture

There is a single site licensed for suspended mussel culture in the Lough Swilly SPA. This site contains one plot of 12 ha located in subtidal habitat in the *Rathmullan* subsite.

Previous work indicates that suspended mussel culture may increase the abundance of fish, and a detailed study found no evidence of adverse impacts from suspended mussel culture on fish-eating bird species. Therefore, subtidal mussel culture using longlines is unlikely to cause impacts to Red-breasted Merganser, Great Crested Grebe, Sandwich Tern and Common Tern. The distribution patterns and habitat usage of other two SCI species that feed in deep subtidal habitat (Scaup and Goldeneye) mean that they do not show any significant overlap with the areas potentially affected by this activity.

The Fishery Natura Plan for native oysters

The objective of the Fishery Natura Plan (FNP) is to develop a sustainable fishery for native oysters in Lough Swilly. The key aspects in relation to potential impacts on SCI species are: -

- Development of a spawning reserve, a cultch area and a cultch control area
- Fishing native oysters and Pacific oysters with dredges

Development of a spawning reserve, a cultch area and a cultch control area

The Fishery Natura Plan for native oysters (FNP) proposes the creation of a spawning reserve, a cultch area and a cultch control area, all within the Ballybegly subsite. The spawning reserve (55 ha) will be closed to fishing. Pacific oysters will be removed, by dredging, from the reserve and mature native oysters (>55 mm) will be transplanted into the reserve. Mussel and oyster shell will be deposited in the cultch area (50.5 hectares) and Pacific oysters will be removed from the cultch and cultch control areas.

The FNP will result in an increase in oyster density in the spawning reserve and an increase in the cover of both dead shells and live oysters in the cultching area. The cultch control area is an area that will be left unaltered as a comparison and will have no impact on habitat structure or benthic fauna. It seems likely that the responses of species to oyster cover (compared to open mud/sandflats) will be similar to their responses to mussel cover. Therefore, the SCI species that may be negatively affected by increased oyster cover in the intertidal and/or shallow subtidal zones are considered to be Shelduck, Wigeon, Teal, Mallard, Shoveler and Dunlin. Of these species, only Dunlin occurs in significant numbers within the Ballybegly subsite. While crude calculations of spatial overlap indicates a potential displacement effect close to the threshold level for significance, considerations of their patterns of habitat usage in relation to the likely magnitude of change in habitat structure indicate that the spawn reserve and cultching area are unlikely to cause significant impacts to the Lough Swilly Dunlin population.

Work from the Wadden Sea has indicated that there may be reduced densities of mussel-feeding birds on oyster beds compared to mussel beds. However, based on the known distribution of mussel beds, the distribution of Oystercatcher flocks during the NPWS BWS low tide counts, and the likely low numbers/infrequent occurrence of Knot in this subsite, it seems unlikely that the potential reduced suitability of existing mussel beds for mussel-feeding species in the intertidal zone will cause significant displacement impacts to any SCI species.

The potential impacts of habitat alteration of the spawning reserve and the cultching area on SCI species in the subtidal zone will be similar to those from bottom culture of oysters (see above). Therefore, the species that may be negatively affected by increased oyster cover in the subtidal zone are Scaup and Goldeneye. Neither of these species occur in significant numbers within the Ballybegly subsite.

Fishing native oysters and Pacific oysters with dredges

Fishing will occur in areas where Pacific oysters comprise more than 50% of all oysters; and in areas with densities of native oysters > 0.25 m^{-2} where < 70% are juveniles. During its first year of operation, the FNP will potentially result in fishing of 465 ha of intertidal habitat, mainly in the Ballybegly, Ray and Shellfield subsites, and 377 ha of subtidal habitat, mainly in the Ballybegly, Blanket Nook, Castle Shanaghan, Leannan Estuary and Ray subsites (referred to as the *FNP dredging zone*). The area fished for Pacific oysters are expected to decrease during the lifetime of the FNP, but the areas fished for native oysters may increase, if the FNP is successful. There is an existing oyster fishery in Lough Swilly, since the 18th century at least. The degree to which the fishing proposed in the FNP would represent intensification or reduction in fishing activity, and/or changes in the spatial area fished, is not known. However, dredging for Pacific oyster in the last few years has been of a fairly intense nature, particularly in certain areas.

Dredging for oysters represents a physical surface and sub-surface pressure and the characterising species of the affected biotopes are deemed fragile and therefore have a degree of intolerance to dredging but the recoverability of these species is generally likely to be moderate or high. It is considered unlikely that oyster dredging has any significant mortality effect on other bivalves but tube building polychaetes could be damaged. The direct impacts of dredging may, therefore, affect food resources for waterbirds that feed on benthic invertebrates. In addition dredging may affect demersal fish populations, thereby affecting the SCI species that mainly feed on fish.

Fishing will coincide with the main period that the non-breeding waterbirds are using these areas. Therefore, even a temporary reduction in the availability of benthic invertebrates could cause displacement of waterbirds. Therefore, the

potential impact on waterbirds will depend upon the actual spatial and temporal extent and intensity of the fishery and the speed of recovery of sensitive fauna. For example, if it takes a period of months for sensitive fauna to recover, then food resources for waterbirds could be significantly affected if a high intensity fishery occurs over a wide area.

Of the intertidal SCI species that feed on benthic invertebrates, Grey Heron, Oystercatcher, Knot, Dunlin, Curlew, Greenshank, Redshank and Common Gull show significant spatial overlap with the FNP dredging zone. However, considerations of patterns of habitat usage and likely diet indicate that Grey Heron, Oystercatcher, Knot, Redshank and Common Gull are less likely to be affected by the potential impacts of dredging on benthic invertebrates. Dunlin is the species most likely to be affected, given its high degree of overlap with FNP dredging zone and the importance of polychaetes in its diet. This species has an unfavourable conservation condition at Lough Swilly and a decreasing trend over the last five years which reflects national trends.

Of the subtidal SCI species that feed on benthic invertebrates or fish, Goldeneye and Scaup do not show a significant overlap with the FNP dredging zone. Based on the limited available information about their foraging distribution it also appears unlikely that dredging would have significant impacts on prey resources for Sandwich and Common Terns. However, there is potential for dredging to contribute towards a significant cumulative impact on Sandwich and/or Common Tern prey resources if the pelagic fisheries (not covered in this assessment) also affect their prey resources. Red-breasted Merganser and Great Crested Grebe do show a significant overlap with the FNP dredging zone.

Dredging may also cause disturbance to SCI species that use deep subtidal waters. Assuming a moderate disturbance response of 200 m each boat could affect around 13 ha of habitat. Therefore, up to 30 boats dredging an area of no more than 840 ha could result in a significant level of potential disturbance. In theory, depending on stock biomass and density, fishing could occur every day throughout the fishing period (19th September to 31st March). In practice this is unlikely to occur. However, without the provision of details of likely fishing intensity and duration it is impossible to make a realistic assessment of the likely impacts of disturbance and a precautionary approach has to be adopted. On this basis disturbance could potentially have significant impacts on Shelduck, Mallard, Shoveler Red-breasted Merganser and Great Crested Grebe, and, possibly, Common Gull.

There is an existing oyster fishery in Lough Swilly. Therefore, the current status and trends of waterbird populations in Lough Swilly may reflect the impacts (if any) of oyster dredging. Of the species listed above Red-breasted Merganser, Great Crested Grebe, Dunlin, Curlew and Common Gull have unfavourable conservation status, although these mainly reflect the all-Ireland trend (apart from Common Gull, for which there is no all-Ireland trend assessment). There is no historical data on the scale and intensity of the oyster fishery in Lough Swilly so it is not possible to analyse species trends in relation to oyster fishing activity.

Cumulative impacts

This assessment has identified a number of likely significant impacts with reference to the attributes and targets of the Conservation Objectives of the SCI species. However, in many / all cases these may reflect the unrealistic assumptions that we have been forced to make, under the precautionary principle, due to the lack of detailed information about the scale and intensity of the activities being assessed. In addition, some of the activities may be mutually exclusive due to spatial overlap and conflicting regulatory requirements. Therefore, it would be premature to make an assessment of cumulative impacts and no such assessment has been included.

Conclusions

This assessment has identified the following potentially significant impacts: -

- Displacement of Shelduck, Shoveler and Dunlin due to habitat alteration from the ongrowing of mussel seed in intertidal nursery areas.
- Displacement of Red-breasted Merganser and Great Crested Grebe due to impacts on food resources from the ongrowing of mussels in subtidal waters.
- Reduced productivity and, possibly, abundance of the Common Tern breeding colony due to impacts on food resources from the ongrowing of mussels in subtidal waters.
- Displacement of Scaup due to impacts on food resources from the ongrowing of oysters in subtidal waters.
- Displacement of Red-breasted Merganser, Great Crested Grebe, Dunlin, Curlew and Greenshank, and possibly other species, due to impacts on food resources from fishing native and Pacific oysters with dredges as part of the Fishery Natura Plan for native oysters.
- Displacement of Shelduck, Mallard, Shoveler, Red-breasted Merganser and Great Crested Grebe, and, possibly, Common Gull, due to disturbance associated with fishing native and Pacific oysters with dredges as part of the Fishery Natura Plan for native oysters.

However, these potential impacts arise from worst-case scenario assessments, due to the lack of detailed information about the spatial and temporal extent of the activities being assessed. They are based on unrealistic assumptions of 100% occupancy of mussel and oyster bottom culture plots, and fishing oysters to the maximum spatial extent and temporal intensity that would be permitted under the Fishery Natura Plan. They also assume 100% displacement of the affected species. In some cases, there may also be considerable uncertainty about the nature of the species response to the activity being assessed.

No potentially significant impacts have been identified for the following activities: -

- Collection of mussel seed for mussel bottom culture and harvesting of mussels following ongrowing.
- The nursery phase of oyster bottom culture and harvesting of oysters following ongrowing.
- Suspended oyster culture.
- Suspended mussel culture.
- Development of a spawning reserve, a cultch area and a cultch control area as part of the Fishery Natura Plan for native oysters.

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 (SPA).

1.2 This report contains the Appropriate Assessment of aquaculture and oyster fishing on the Lough Swilly Special Protection Area (site code 004075).

1.3 This report is based on a desktop review of existing information. This included published reports and papers and unpublished data from waterbird surveys. In addition, the distribution patterns of key species were discussed with Ralph Sheppard (I-WeBS count coordinator for Lough Swilly). Where relevant, the report identifies information gaps that may affect the reliability of the conclusions of this assessment.

1.4 The data analysis and report writing was done by Tom Gittings. Paul O'Donoghue assisted with project design, document preparation and undertook document review. Data entry was carried out by David Kelleghan. Ross Macklin prepared reviews of the diets of fish-eating SCI species.

1.5 The draft report was reviewed by Mike Trewby, a local ornithologist involved in waterbird counts of Lough Swilly.

1.6 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

1.7 The structure of the report is as follows: -

- Section 2 of the report describes the methodology used for the assessment.
- Section 3 of the report lists the Special Conservation Interests (SCIs) of the Lough Swilly SPA, and describes the Conservation Objectives, and their attributes and targets, that have been defined for these SCIs.
- Section 4 of the report contains a preliminary screening assessment that screens out SCIs that do not show any significant spatial overlap with the activities being assessed. It also includes a habitat screening that is used to define which of the remaining SCIs are assessed in relation to activities affecting particular habitat zones.
- Section 5 of the report contains a brief summary of the status and distribution of the SCI species, and their habitats, in Lough Swilly. This section only contains a very brief summary of distribution patterns; detailed analyses of distribution patterns of individual, species are carried out, as appropriate, in the impact assessment sections of relevant activities later in the document.
- Sections 6-10 contain the assessments of the following activities covered by this Appropriate Assessment: mussel bottom culture, oyster bottom culture, suspended oyster culture, suspended mussel culture and the Fishery Natura Plan for native oysters. Licenses for combined mussel and oyster bottom culture are assessed separately for each activity.

1.8 Each assessment first contains a brief description of the scope of the activity indicating the area(s) affected by the activity, breaking the activity down into separate components, where relevant. For each component the characteristics of the activity are described. The impact assessment is usually subdivided into impacts of habitat alteration and impacts of disturbance. For the assessment of the impacts of habitat alteration, the potential impacts are first discussed and then the likely significant impacts are assessed. The discussion of the potential impacts of habitat alteration describes the physical changes to the habitat structure and considers the potential impacts on food resources before assessing which of the SCI species could potentially be affected by these changes. Each of these species is then assessed with reference to its spatial distribution and/or habitat usage, and the criteria described in the methodology section are applied to assess whether there are likely to be any significant negative impacts. Finally, the conclusions of the assessment are presented. These list the SCI species for which likely significant impacts, with reference to the attributes and targets of the Conservation Objectives, may result from the activity.

Cumulative impacts

1.9 This assessment has identified a number of likely significant impacts with reference to the attributes and targets of the Conservation Objectives of the SCI species. However, in many/all cases these may reflect the unrealistic assumptions that we have been forced to make, under the precautionary principle, due to the lack of detailed information about the scale and intensity of the activities being assessed. In addition, some of the activities may be mutually exclusive due to spatial overlap and conflicting regulatory requirements. Therefore, it would be premature to make an assessment of cumulative impacts and no such assessment has been included.

Limitations to this assessment

1.10 There are a number of limitations to this assessment.

1.11 The assessment of the distribution of species that use intertidal habitat is based mainly on four low tide counts in the winter of 2009/10 (although the general comments about species distribution in Sheppard (2002) provide some supporting information). Therefore, it is not possible to take into account possible variation between winters in species distribution, while the number of counts is too few to allow an assessment of patterns of seasonal variation in species distribution.

1.12 There is no detailed information on the foraging habitats and diets of the breeding SCI species (Black-headed Gull, Sandwich Tern and Common Tern).

1.13 There is only very limited information available on the existing levels of activity of the various aquaculture and fisheries covered in this assessment. This means that it is difficult to assess to what degree current species distribution patterns may already have been influenced by the activities being assessed.

1.14 There is a lack of detailed information on the proposed scale and intensity of many of the activities being assessed. This has meant that we have had to make precautionary worst-case scenario assumptions (e.g., 100% occupancy of bottom-culture plots) that are likely to be very unrealistic.

1.15 There are some potential impact mechanisms, for which there are little, or no, published evidence that can be used to assess whether significant impacts are likely (discussed as appropriate below).

2. Methodology

General

2.1 This assessment is based mainly on a desktop review of existing information about waterbird population trends and distribution in Lough Swilly. This was supplemented by site reconnaissance visits in October 2012 and January 2013.

Data sources

2.2 The spatial extents of the aquaculture and fisheries activities have been derived from shapefiles supplied by the Marine Institute.

2.3 Details of existing and proposed activities have been taken from the draft Appropriate Assessment for the Lough Swilly Special Area of Conservation (SAC AA) and the *Fishery Natura Plan for native oysters in Lough Swilly, 2012-2017* (FNP).

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

- Descriptions of waterbird distribution in Sheppard (2002)
- Irish Wetland Bird Survey (I-WeBS) counts 1994/95-2010/11
- NPWS Baseline Waterbird Survey (NPWS BWS) 2009/10 counts
- The descriptions of waterbird distribution within Lough Swilly in the SPA Conservation Objectives Supporting Document (NPWS, 2011c).

2.5 The extent and nature of intertidal and subtidal habitats are based on the bird use zones in Figure 7 of the Conservation Objectives (NPWS, 2011a) and the biotope mapping for the Lough Swilly SAC (NPWS, 2011a, b), supplemented by Admiralty Chart data.

2.6 Information on the current extent of intertidal mussel beds has been supplied by the Marine Institute (Francis O'Beirn, pers. comm.), supplemented by our survey of the Fahan Creek area, while historical information has been obtained from Edwards (1969).

Subsites

2.7 Most of the analyses and assessments in this document are based on the division of Lough Swilly into the subsites that have been used for the I-WeBS and NPWS BWS counts (Figure 5.1). Descriptions of these subsites are included in Sheppard (2002).

Definition of habitat zones

2.8 Three broad habitat zones have been defined for this assessment: intertidal, shallow subtidal (< 0.5 deep) and deep subtidal (> 0.5 m deep). The rationale for the distinction between the shallow and deep subtidal zones is that Shelduck and dabbling ducks generally do not feed in waters greater than 0.5 m deep (Kirby *et al.*, 2000).

2.9 The intertidal and subtidal (combined shallow and deep) zones used in this assessment are those defined in Map 7 of the Conservation Objectives (NPWS, 2011a). It should be noted that these are apparently derived from Ordnance Survey Discovery Series mapping, which, in turn, appears to be based on the 1930s six inch mapping. Therefore, the details of the boundaries between the intertidal and subtidal zones are likely to have changed. However, these zones have been used because they correspond to the zones described in the Conservation Objectives, and, therefore, they are presumably still likely to provide a reasonable representation of the overall broad distribution of intertidal and subtidal habitats.

2.10 The boundary between the intertidal and subtidal zones on Ordnance Survey mapping probably corresponds to the mean low tide. Therefore, on around 50% of low tides additional intertidal habitat will be exposed.

2.11 The shallow subtidal zone has been defined as the zone between the mean low water spring tide (as defined by Ordnance Survey mapping) and the 0 m contour on the Admiralty Chart, which represents the lowest astronomical tides. Again, it should be noted that much of the Admiralty Chart mapping dates back over 100 years or more, although Fahan Creek and the area to the west of Inch Island were mapped more recently (1984 and 1965, respectively). Also, in reality the spatial extent of the shallow subtidal zone will vary on each low tide, but the overall distribution of the zone between subsites is likely to remain similar.

2.12 For some analyses the deep subtidal zone has been subdivided by the -5 m contour on the Admiralty Chart. The rationale for this division is that the diving duck and grebe SCI species usually feed in waters less than 5 m deep (Cramp and Simmons, 2004).

Analyses of waterbird distribution

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

2.14 Waterbird distribution has been mainly analysed by calculating mean percentage distributions across subsites from I-WeBS and/or NPWS BWS counts. In addition, NPWS BWS flock map data has also been used. For all species, the distribution patterns from these analyses have been compared to the descriptions of their distribution patterns in Sheppard (2002).

I-WeBS

2.15 The distribution of waterbird species that mainly feed in deep subtidal waters have been analysed using I-WeBS counts (which, at Lough Swilly, are done mainly on rising/high tides; Sheppard, 2002). These species can feed throughout the tidal cycle and, while they may feed over intertidal habitats at high tide, their broad spatial distribution between subsites is unlikely to change significantly across the tidal cycle.

2.16 To avoid analyses being biased by distributions of a few birds on counts with low total numbers present, we have only included counts with a total of 30 or more birds. We have also excluded counts with poor coverage (i.e., incomplete subsite coverage).

2.17 For most species, we have used the I-WeBS dataset for the most recent five winters available (2006/07-2010/11), because waterbird distribution between subsites may have changed over

time. However, for Scaup we have used the full I-WeBS dataset because of the low number of counts with sufficient numbers of Scaup recorded.

2.18 It should be noted that most I-WeBS counts do not include separate counts for the West Inch subsite. Sheppard (2002) states that at West Inch: "*the majority of birds are usually located well offshore and are incorporated into the counts for adjacent sections as the boundary is impossible to determine in practice*". Therefore, the lack of separate counts of this subsite does not mean that there was incomplete coverage of Lough Swilly.

NPWS BWS counts

2.19 The distribution of waterbird species that mainly feed in intertidal and/or shallow subtidal waters has mainly been analysed using the NPWS BWS low tide counts, because, for these species, most of their feeding will be done at low tide. While we do not have detailed information on how the spatial distribution of these species varies with the tidal cycle at Lough Swilly, typically such species may move significant distances, as the tide rises, to upper shore/terrestrial feeding areas and/or high tide roosts. Therefore, it would not be safe to assume that their distribution between subsites in I-WeBS counts represents their distribution between subsites at low tide.

2.20 There were four low tide counts in the NPWS BWS and there was complete coverage on each count. However, for some species numbers recorded during the NPWS BWS were low and mean percentage distributions have not been calculated for these species.

2.21 The NPWS BWS 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.

NPWS BWS flock maps

2.22 As part of the NPWS BWS 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 I-WeBS and/or NPWS BWS 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.

2.23 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. However, the complexity of the configuration of the intertidal habitat areas in Lough Swilly is likely to have facilitated the mapping of flock positions, compared to more homogeneous sites such as Dundalk Bay, and the broad patterns that we have used in this assessment are considered to be reasonable interpretations.

Breeding species

2.24 There are three SCI species listed for their breeding populations. While the location of the breeding colony is known, there is no detailed information available on the distribution of foraging birds from the breeding colony. Therefore, we have not been able to carry out detailed distributional analyses for these species.

Assessment methodology

Identification of potential impacts

2.25 A literature review was carried out to assess the likely main food resources of the SCI species in the Lough Swilly SPA (see Appendix B). Information on the impact of the activities on intertidal and subtidal biotopes from the SAC AA, and previous published research, has been used to identify potential impacts to prey resources used by the SCI species. In addition a review of the ecology of key fish species in Lough Swilly was carried out to identify potential impacts on prey resources for fish-eating SCI species (see Appendix C). Where available, previous research (Caldow *et al.*, 2003; Gittings and O'Donoghue, 2011a, 2012; Roycroft *et al.*, 2004, 2007; Scheiffarth *et al.*, 2007; van der Kam *et al.*, 1999; Wehrmann, 2009) has also been used to identify the likely response (positive, neutral or negative) of the SCI species to the activities being assessed.

2.26 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.

Assessment of impact magnitude

2.27 Where potential impacts from an activity on a SCI species have been identified, the spatial overlap between the distribution of the species (see paragraphs 2.13-2.24) and the spatial extent of the activity was calculated, or qualitatively assessed when quantitative data was not available. This overlap is considered to represent the potential magnitude of the impact, as it represents the maximum potential displacement if the species has a negative response to the activity. Where appropriate, information on species habitat usage was used to refine the assessment of likely impact magnitude.

Assessment of impact significance

2.28 The methodology used for this Appropriate Assessment is focussed on the Conservation Objectives, and their attributes, that have been defined and described for the Lough Swilly SPA (NPWS, 2011a, c). These conservation objectives are the same for all the non-breeding SCI species. The breeding SCI species have different conservation objectives. However, because of lack of information about their spatial distribution we have been unable to carry out detailed assessment for these species, and they are not considered further in the following description of our assessment methodology. We have, however, made qualitative assessments of potential impacts on these species.

2.29 Conservation Objective 1 defines two types of attributes to assess conservation condition: long term population trends and numbers or range (distribution) of areas used. This assessment focuses on assessing potential impacts on the spatial distribution of the SCI waterbird species within Lough Swilly and, in particular, whether the activities will cause displacement of a significant proportion of the Lough Swilly population from the affected area(s). If the activities are not predicted to cause significant displacement, then the activities are not likely to affect the long term population trends. If the activities are predicted to cause significant displacement, then the activities could affect the long term population trends (but see below). In the cases where the activities are predicted to cause significant displacement, the impacts on distribution and population size are assessed separately.

2.30 The basis for the assessments are datasets that indicate the distribution of waterbird species between different broad sectors of Lough Swilly (the I-WeBS and NPWS BWS counts). The datasets allow calculation of the proportion of the Lough Swilly population that would be affected if aquaculture or fisheries activities cause displacement of birds from areas occupied by the activities. This approach can be considered as a very simple form of habitat association model and represents a conservative form of assessment (see Stillman and Goss-Custard, 2010): the population-level consequences of displacement will depend upon the extent to which the remaining habitat is available (i.e., whether the site is at carrying capacity). In general this assessment method "*will be pessimistic because some of the displaced birds will be able to settle elsewhere and survive in good condition*" (Stillman and Goss-Custard, 2010).

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

Assessment of significance

2.32 The significance of any potential impacts identified has been assessed with reference to the attributes and targets specified by NPWS (2011a) for this conservation objective. Potential negative impacts are either assessed as significant (if the assessment indicates that they will have a detectable effect on the attributes and targets) or not significant. The significance levels of potential positive impacts have not been assessed.

Attribute 1 – Long term population trends

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

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

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

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

Table 2.1 – Criteria for assessing significance with reference to attribute 1 of the conservation objectives

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

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

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

2.38 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.

2.39 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 Shelduck would be a decrease of seven birds. The minimum error level in large-scale waterbird monitoring is considered to be around 5% (Hale, 1973; Prater, 1979; Rappoldt, 1984). 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.

Summary

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

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

2.41 Impacts that will cause displacement of 5% or more of the total Lough Swilly population of a SCI species have been assessed as potentially having a significant negative impact on attribute 2 of the conservation objectives (the species' distribution within Lough Swilly).

3. Conservation objectives

Qualifying features

3.1 The Special Conservation Interests (SCIs) of the Lough Swilly SPA include: -

- breeding populations of Black-headed Gull, Common Tern and Sandwich Tern; and
- non-breeding populations of Whooper Swan, Greenland White-fronted Goose, Greylag Goose, Shelduck, Wigeon, Teal, Mallard, Shoveler, Scaup, Goldeneye, Red-breasted Merganser, Great Crested Grebe, Grey Heron, Coot, Oystercatcher, Knot, Dunlin, Curlew, Greenshank, Redshank, and Common Gull.

3.2 In addition: -

> "*The wetlands contained within Lough Swilly SPA are identified of conservation importance for breeding and non-breeding migratory waterbirds. Therefore the wetland habitats and the waterbirds that utilise this resource are considered to be an additional Special Conservation Interest*".
>
> (National Parks & Wildlife Service, 2011)

3.3 The SCIs are divided into *Selection Species* and *Additional Special Conservation Interests*. However, this distinction has no relevance for the Appropriate Assessment process and is, therefore, not referred to further in this assessment.

Conservation objectives

Breeding species

3.4 The conservation objectives for the Black-headed Gull, Sandwich Tern and Common Tern breeding populations at Lough Swilly are to maintain their "favourable conservation condition" (NPWS, 2011a).

3.5 The favourable conservation conditions of the Black-headed Gull, Sandwich Tern and Common Tern populations at Lough Swilly are defined by various attributes and targets, which are shown in Table 3.1.

Table 3.1 – Attributes and targets for the conservation objective for Black-headed Gull, Sandwich Tern and Common Tern at Lough Swilly.

Attribute	Measure	Target	Notes
1 Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline	Measure based on standard gull/tern survey methods (see Walsh *et al.*, 1995). Mitchell *et al.* (2004) provides summary population information. The Seabird Monitoring Programme (CMP) also provides background data – http://jncc.defra.gov.uk/smp/Default.apx
2 Productivity rate: fledged young per breeding pair	Mean number	No significant decline	Measure based on standard gull/tern survey methods (see Walsh *et al.*, 1995).
3 Distribution: breeding colonies	Number; location; area (Hectares)	No significant decline	The only known Sandwich Tern breeding site is on Inch Island

Source: NPWS (2011a)

Attributes are not numbered in NPWS (2011a) , but are numbered here for convenience

Mitchell, P. I., Newton, S., Ratcliffe, N., & Dunn, T. E. (Eds.). (2004). Seabird populations of Britain and Ireland. T & AD Poyser, London.

Walsh, P., Halley, D. J., Harris, M. P., Del Nevo, A., Sim, I. M. W., & Tasker, M. L. (1995). Seabird monitoring handbook for Britain and Ireland: a compilation of methods for survey and monitoring of breeding seabirds. Peterborough: Joint Nature Conservation Committee.

Non-breeding species

3.6 The conservation objectives for the Whooper Swan, Greenland White-fronted Goose, Greylag Goose, Shelduck, Wigeon, Teal, Mallard, Shoveler, Scaup, Goldeneye, Red-breasted Merganser, Great Crested Grebe, Grey Heron, Coot, Oystercatcher, Knot, Dunlin, Curlew, Greenshank, Redshank, and Common Gull non-breeding populations at Lough Swilly are to maintain their "favourable conservation condition" (NPWS, 2011a).

3.7 The favourable conservation conditions of the Whooper Swan, Greenland White-fronted Goose, Greylag Goose, Shelduck, Wigeon, Teal, Mallard, Shoveler, Scaup, Goldeneye, Red-breasted Merganser, Great Crested Grebe, Grey Heron, Coot, Oystercatcher, Knot, Dunlin, Curlew, Greenshank, Redshank, and Common Gull non-breeding populations at Lough Swilly are defined by various attributes and targets, which are shown in Table 3.2.

Table 3.2 – Attributes and targets for the conservation objective for Whooper Swan, Greenland White-fronted Goose, Greylag Goose, Shelduck, Wigeon, Teal, Mallard, Shoveler, Scaup, Goldeneye, Red-breasted Merganser, Great Crested Grebe, Grey Heron, Coot, Oystercatcher, Knot, Dunlin, Curlew, Greenshank, Redshank, and Common Gull at Lough Swilly.

Attribute	Measure	Target	Notes
1 Population trend	Percentage trend	Long term population trend stable or increasing	Population trend assessment Generalised Additive Modelling (GAM)) was undertaken using waterbird count data collected through the Irish Wetland Bird Survey and other surveys[1]. See the conservation objectives supporting document for further details.
2 Distribution	Number and range of areas used by waterbirds	There should be no significant decrease in the numbers or range of areas used by waterbird species, other than that occurring from patterns of natural variation	As determined by regular low tide and other waterbird surveys. Waterbird distribution from the 2009/10 waterbird survey programme is discussed in Section 5 of the conservation objectives supporting document.

Source: NPWS (2011a)

Attributes are not numbered in NPWS (2011a) , but are numbered here for convenience

[1] Common Gull: "population trend assessment using Generalised Additive Modelling (GAM)) could not be undertaken for this species due to an incomplete dataset. A measure of population change was calculated using the 'generic threshold' method. See Section 4 of the SPA conservation objectives supporting document for more details."

Wetlands and waterbirds

3.8 The conservation objective for wetlands and waterbirds at Lough Swilly is to "maintain the favourable conservation condition of the wetland habitat at Lough Swilly SPA as a resource for the regularly-occurring migratory waterbirds that use it" (NPWS, 2011a).

3.9 The favourable conservation condition of the wetland habitat at Lough Swilly is defined by a single attribute and target, which is shown in Table 3.3.

Table 3.3 – Attribute and target for the conservation objective for wetlands and waterbirds at Lough Swilly.

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent area occupied by the wetland habitat is stable and not significantly less than the areas of 4,162, 2,419, 201 and 317 hectares for subtidal, intertidal, supratidal and lagoon *(and associated) habitats respectively, other than that occurring from natural patterns of variation. See map 7[1]	Wetland areas defined as follows: subtidal -seaward extent of SPA boundary up to MLWM; intertidal – MLWM to MHWM; supratidal – MHWM to SPA boundary minus the area of terrestrial habitat; lagoon (and associated) habitats – lagoon extent and adjacent wetland habitat as defined by embankments

Source: NPWS (2011a)

[1] Reproduced as Figure 3.1.

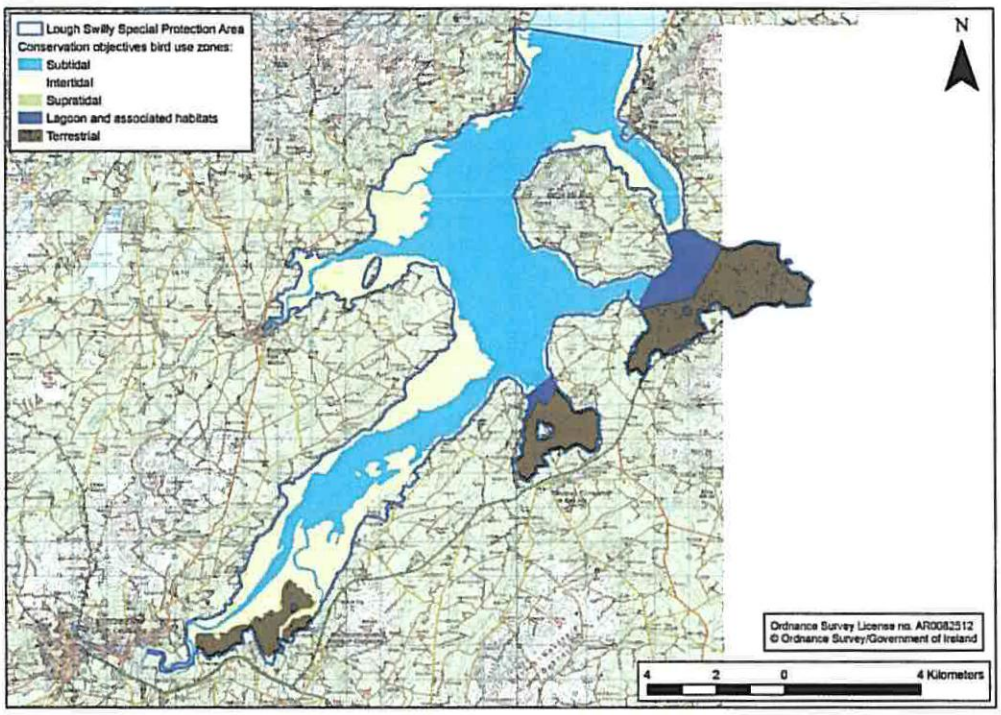

Figure 3.1 – Lough Swilly Conservation Objectives: wetland and waterbirds bird use zones.

4. Screening

SCI species

Preliminary screening

4.1 An initial screening exercise was carried out to identify any SCIs that do not show any significant spatial overlap with any of the activities covered in this assessment.

4.2 Two SCI species do not make any significant use of intertidal or subtidal habitat: Greylag Goose and Coot. These species mainly use the lagoon habitats at Inch Lake and Blanket Nook and agricultural fields. None of the activities being assessed are considered likely to have any impacts on these habitats. Therefore, the activities being assessed are not likely to have any significant impacts on these species and they have been screened out from any further assessment.

4.3 Another two SCI species (Whooper Swan and Greenland White-fronted Goose) also mainly use the lagoon habitats at Inch Lake and Blanket Nook and agricultural fields. These species do use intertidal and subtidal habitat as a nocturnal roost and as a refuge from disturbance. The main such area that they use is the area around the tidal creek just to the north of Big Isle, although Whooper Swan can also occur in small numbers in intertidal and subtidal habitat elsewhere (Ralph Sheppard, pers. comm.). The area around the tidal creek just to the north of Big Isle will not be affected by any of the activities covered by this assessment so there will not be any significant spatial overlap with any of the activities covered in this assessment. Therefore, these species have been screened out from any further assessment.

4.4 The remaining SCI species (Shelduck, Wigeon, Teal, Mallard, Shoveler, Scaup, Goldeneye, Red-breasted Merganser, Great Crested Grebe, Grey Heron, Oystercatcher, Knot, Dunlin, Curlew, Greenshank, Redshank, Black-headed Gull, Common Gull, Sandwich Tern and Common Tern) all make significant use of subtidal and/or intertidal habitat at Lough Swilly. The activities covered in this assessment will affect large areas of subtidal and intertidal habitat and have the potential to cause significant changes to habitat structure and/or food availability. Therefore, the activities being assessed could potentially have significant impacts on SCIs that use subtidal and/or intertidal habitat and full appropriate assessment is required.

Habitat screening

4.5 For the purposes of this Appropriate Assessment, the broad habitat zones used by the SCI species for feeding and/or roosting have been classified (Table 4.1).

4.6 The activities covered in this assessment can generally be broken down into components that affect intertidal/shallow subtidal and deep subtidal habitat zones separately. For the purposes of this Appropriate Assessment, it can be assumed that SCI species that are not listed as being associated with a habitat zone have been screened out from assessment of activity components affecting that habitat zone.

Table 4.1 - Habitat zones and major prey resources likely to be used by SCI species at Lough Swilly

Species	Intertidal	Shallow subtidal (< 0.5 m)	Deep subtidal (> 0.5 m)	Major prey resources
Shelduck	Feeding and roosting	Feeding and roosting	Roosting	Benthic invertebrates
Wigeon	Feeding and roosting	Feeding and roosting	Roosting	Plants
Teal	Feeding and roosting	Feeding and roosting	Roosting	Seeds
Mallard	Feeding and roosting	Feeding and roosting	Roosting	Plants/seeds
Shoveler	Roosting	Feeding and roosting	Roosting	Benthic and pelagic invertebrates; plants/seeds
Scaup		Feeding and roosting	Feeding and roosting	Benthic invertebrates
Goldeneye		Feeding and roosting	Feeding and roosting	Benthic and pelagic invertebrates
Red-breasted Merganser		Feeding and roosting	Feeding and roosting	Benthic invertebrates; demersal and pelagic fish
Great Crested Grebe		Feeding and roosting	Feeding and roosting	Demersal and pelagic fish
Grey Heron	Feeding and roosting	Feeding and roosting		Fish, frogs, insects & small mammals / birds
Oystercatcher	Feeding and roosting			Benthic invertebrates
Knot	Feeding and roosting			Benthic invertebrates
Dunlin	Feeding and roosting			Benthic invertebrates
Curlew	Feeding and roosting			Benthic invertebrates
Greenshank	Feeding and roosting			Benthic invertebrates
Redshank	Feeding and roosting			Benthic invertebrates
Black-headed Gull	Feeding and roosting	Feeding and roosting	Feeding and roosting	Benthic invertebrates
Common Gull	Feeding and roosting	Feeding and roosting	Feeding and roosting	Benthic invertebrates; pelagic fish; scavenger
Sandwich Tern	Roosting	Feeding	Feeding	Demersal and pelagic fish
Common Tern	Roosting	Feeding	Feeding	Demersal and pelagic fish

Foraging depths of Shelduck and dabbling ducks based on Kirby *et al.* (2000)

Major prey resources refer to intertidal and subtidal habitats only; see Appendix B for details

See Appendix B for discussion prey resources

Activity screening

4.7 The spatial patterns of occurrence of some of these species, and/or scientific evidence about the nature of their response to particular activities, may mean that potential impacts can be screened out without detailed analyses. However, for clarity this secondary screening is carried out in the individual sections of this assessment dealing with each activity.

Wetlands and waterbirds

4.8 The Conservation Objectives define the favourable conservation condition of the wetlands and waterbirds SCI at Lough Swilly purely in terms of habitat area.

4.9 None of the activities being assessed will cause any change in the extents of subtidal, intertidal, supratidal and lagoon habitats. 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.

5. Waterbird status and distribution

Waterbird monitoring

5.1 Waterbird distribution around high tide has been monitored by as part of the Irish Wetland Bird Survey (I-WeBS) each winter since 1995/96. Each winter, monthly counts were carried out between September and March, although not all months were counted in each winter. The counts are carried out by a coordinated team of volunteers, normally within a period of 1-2 days.

5.2 In the winter of 2009/10, waterbird counts were carried out as part of the National Parks and Wildlife Service's Baseline Waterbird Survey (NPWS BWS). Four low tide and one high tide count were carried out, as well as a separate high tide roost survey. The counts were carried out by a coordinated team of professional counters. Each count was completed in a single day.

5.3 Lough Swilly has been divided into 14 subsites for the purposes of waterbird monitoring (Figure 5.1). The same subsites were used for both the I-WeBS and the NPWS BWS counts. However, not all subsites have been covered in every I-WeBS count. In particular, the West Inch subsite has rarely been counted. All subsites were covered in each NPWS BWS count.

5.4 Details of the NPWS BWS methodology and results at Lough Swilly are described in Cummins and Crowe (2010) and NPWS (2011c).

Waterbird status

5.5 The conservation condition and trends of the non-breeding waterbird SCI species at Lough Swilly are summarised in Table 5.1. Species with unfavourable conservation condition are Shelduck, Scaup, Red-breasted Merganser, Curlew and Common Gull (intermediate (unfavourable)); and Goldeneye, Great Crested Grebe and Dunlin (moderately unfavourable). Shelduck and Scaup have stable or increasing all-Ireland and international trends, indicating that site-specific factors may be causing their decline at Lough Swilly. The other species with unfavourable conservation condition all have stable or increasing all-Ireland trends.

5.6 NPWS have not provided any information on the conservation condition or trends of the breeding SCI species. The Seabird 2000 survey (see (Mitchell *et al.*, 2004) reported population figures of 800 occupied nests for Black-headed Gull, 258 occupied nests for Sandwich Terns and 89 occupied nests for Common Tern, from surveys carried out in May 2001. The Sandwich Tern population appears to have increased from the 1-50 pairs recorded in 1995, while the Common Tern population is within the range (50-100 pairs) recorded in 1995 (Hannon *et al.*, 1997).

Table 5.1 – Conservation condition and population trends of non-breeding waterbird SCI species at Lough Swilly.

Special Conservation Interests (SCIs)	Site Conservation Condition	12 year site population trend[1] 12YR[b]	5 year site population trend[2] 5YR	Current all-Ireland Trend[3]	Current international trend[3]
Shelduck	Intermediate (Unfavourable)	-8	-2	+4.5	Stable
Teal	Favourable	+37	+9	+11.3	Increase
Wigeon	Favourable	+60.7	+55.9	-20.2	Stable
Mallard	Favourable	+0.6	+1	-16	Stable
Shoveler	Favourable	+16.3	+71.2	+21.3	Stable
Scaup	Intermediate (Unfavourable)	-9.6	-133.6	+88.7	Stable
Goldeneye	Moderately Unfavourable	-32.7	+5.7	-50.7	Stable
Red-breasted Merganser	Intermediate (Unfavourable)	-7.5	-3	-11	n/c
Great Crested Grebe	Moderately Unfavourable	-29	-30.8	-18	Decline
Grey Heron	Favourable	+44.5	+16.6	+29.2	Increase
Oystercatcher	Favourable	+25.3	+21.7	+23.6	Decline
Knot	Favourable	+52	+121.9	-3	Decline
Dunlin	Moderately Unfavourable	-47.9	-22.5	-46.5	Stable
Curlew	Intermediate (Unfavourable)	+17.6	-7.2	-25.7	Decline
Greenshank	Favourable	+88.5	+54.8	+79.7	Stable
Redshank	Favourable	+44.8	+22.5	+22.7	Stable/Decline
Common Gull [4]	Intermediate (Unfavourable)	-9.5	-	n/c	n/c

Source: Tables 4.2 and 4.2 in NPWS (2011)

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; [e] international trend after Wetland International (2006); [4]trend based on two five year averages (see text)

Waterbird habitats and distribution

Habitats

Biotopes

5.7 The habitats used by waterbirds at Lough Swilly have been divided into five zones: subtidal, intertidal, supratidal, lagoon and associated habitats and terrestrial (NPWS, 2011a; 2011c). The distribution of these habitats in relation to the waterbird subsites is shown in Figure 5.2. The intertidal habitat mainly occurs in the western and southern parts of Lough Swilly, with an isolated area in Fahan Creek. Important lagoon and terrestrial habitats occur in Blanket Nook, Inch Lough & Levels and Big Isle/Swilly Estuary.

5.8 The intertidal and subtidal habitats in the Lough Swilly SAC have been classified into six biotopes (NPWS, 2011a; 2011b; see Figure 5.3). The intertidal zone includes areas of mud community complex biotope in the southern end of Lough Swilly (Ballybegly, Big Isle and Swilly Estuary); the upper part of the Leannan Estuary; and in Fahan Creek. Intertidal mixed sediments with polycheates occurs around the shores of the middle part of Lough Swilly. The *Ostrea edulis* dominated community extends across the intertidal and upper subtidal zones in the same areas. The subtidal habitat around Inch Island and in the outer part of Lough Swilly is dominated by the muddy fine sand with *Thyasira flexuosa* and fine sand community complex biotopes, with the latter biotope extending onto the intertidal in the outermost subsites (Lisfannan and Rathmelton). In the narrow subtidal channels in Fahan Creek and in the southern part of Lough Swilly, the subtidal mixed sediments with polycheates biotopes occurs, and this biotope also occurs along the western side of Lough Swilly in Ray.

5.9 It should be noted that the term "dominated" in the name "*Ostrea edulis* dominated community", does not indicate high percentage cover of native (or even Pacific) oysters. In fact the maximum densities recorded in recent surveys are 3.8 m^{-2} (native oysters) and 8.08 m^{-2} (Pacific oysters) (Tully and Clarke, 2012), and the percentage cover of oysters probably rarely, if ever, exceeds 1%.

Mussel beds

5.10 The biotope classification for Lough Swilly ignores the presence of mussel beds, despite the fact that extensive mussel beds are present and are probably of mainly natural origin (see Edwards, 1969). Mussel beds are likely to be an important habitat for several of the SCI species.

5.11 The approximate current distribution of the main intertidal mussel beds within Lough Swilly, based mainly from information provided by the Marine Institute (Francis O Beirn, pers. comm., and observations during Marine Institute oyster surveys) is shown in Figure 5.4. The main bed occurs in the Shellfield subsite, while scattered small patches occur across parts of the Ballybegly, Big Isle and Fahan Creek subsite. Sheppard (2002) also refers to the presence of mussel beds in the Ballybegly subsite.

5.12 The Fahan Creek subsite was walked in January 2013 as part of a reconnaissance visit for this assessment. On the western side of the creek, mussel beds occurred as scattered patches of mainly empty shells/shell fragments with only occasional live mussels (and with occasional oysters also present) (Plates 5.1 and 5.2). These occurred over an extensive area, but the overall percentage cover (including empty shells/shell fragments) was very low. On the eastern side of the creek, mussel beds occurred in larger patches with the patches forming 25-50% cover within the area mapped (Plate 5.3). Again, these patches mainly contained empty shells/shell fragments, although live mussels may have been somewhat more frequent. In both areas, the mussels were

mainly around 30-60 mm long. There were no obvious mussel beds in the area mapped by Edwards (1969) west of Lackan Point.

5.13 The extent of the intertidal mussel beds may have decreased since Edward's (1969) survey (see Figure 5.4).

5.14 The main subtidal seed mussel bed in Lough Swilly is to the west of Inch Island stretching from Drum Point to Hawke's Nest (SAC AA). Apart from this, the extent and distribution of natural and pre-aquaculture subtidal mussel beds is not known.

Plate 5.1 – Mussel beds on the western side of Fahan Creek

Plate 5.2 – Close up of a mussel bed in Fahan Creek

Plate 5.3 – Mussel beds on the eastern side of Fahan Creek

Distribution

Data sources

5.15 Sheppard (2002) includes summary descriptions of the distribution of most of the non-breeding SCI species in Lough Swilly. Apart from changes in the overall status of some species, there is not considered to have been significant changes in the spatial distribution of species since this paper (Ralph Sheppard, pers. comm.).

5.16 The I-WeBS dataset provides information on the distribution of non-breeding waterbird species during rising/high tides (see Sheppard, 2002). For species that exclusively feed and roost in deep subtidal habitat (Scaup, Goldeneye, Red-breasted Merganser), or which roost in subtidal water close to their feeding habitats (Shelduck), this is likely to provide a reasonable indication for their overall distribution patterns across Lough Swilly. Other species, however, feed on intertidal habitat and may have high tide roost sites outside the subsites that they feed in (e.g., most wader species) and/or use terrestrial habitats for feeding at high tide (e.g., dabbling ducks). For these species, the distribution patterns from the I-WeBS dataset will not usually provide a clear indication of their low tide distribution.

5.17 The NPWS BWS included four low tide counts. These provide a good general indication of species low tide distribution but do not have the resolution to detect seasonal variation in low tide distribution and are limited to a single winter.

5.18 Some information about the distribution of the breeding SCI species has been provided by Andrew Speer (NPWS, pers. comm.).

Distribution patterns

5.19 In the NPWS BWS low tide counts, the dabbling duck species (Wigeon, Teal, Mallard and Shoveler) mainly occurred in intertidal habitat in the southernmost section of the Lough Swilly (Big Isle and Swilly Estuary) and lagoon and terrestrial habitat in Blanket Nook and Inch Lough & Levels. Shelduck, Knot, Dunlin and Redshank mainly occurred in the subsites with the mud community complex biotope in the upper part of Lough Swilly (Ballybegly, Big Isle and Swilly

Estuary), and, to a lesser extent, in the Fahan Creek and the Leannan Estuary. Oystercatcher and Curlew were more widely distributed throughout the intertidal zone.

5.20 Analysis of the I-WeBS dataset indicates that both Red-breasted Merganser and Great Crested Grebe are widely distributed in subtidal habitat throughout most of Lough Swilly, while Goldeneye mainly occurred in the lagoon habitats in Blanket Nook and Inch Lough & Levels.

5.21 Detailed analyses of species distribution patterns are included in the impact assessment sections of relevant activities later in this document.

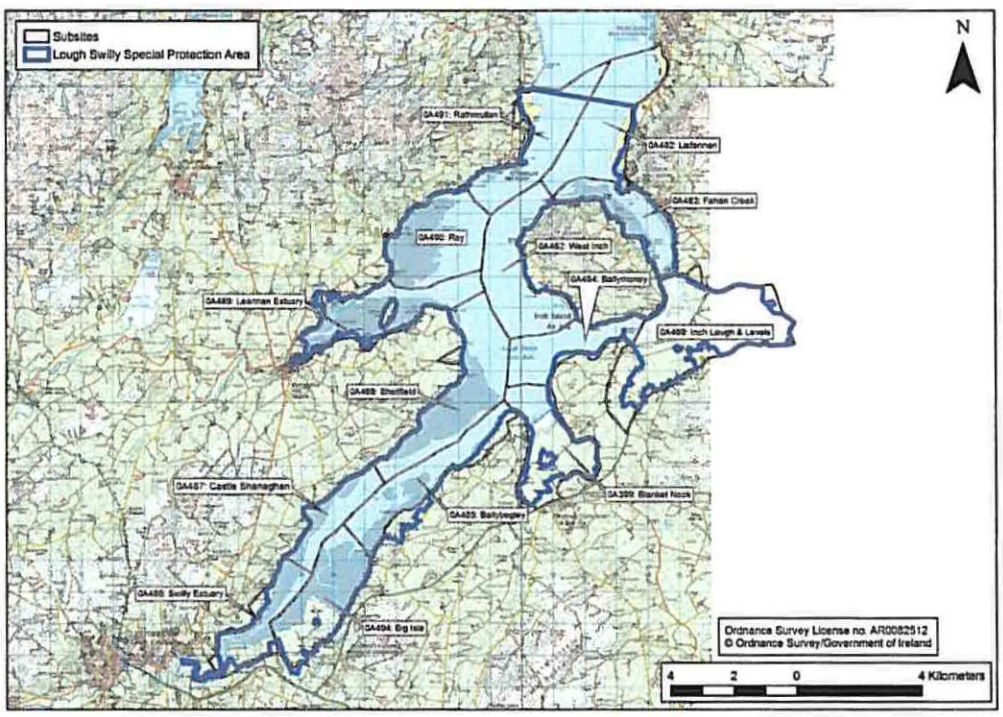

Figure 5.1 – Waterbird monitoring subsites at Lough Swilly.

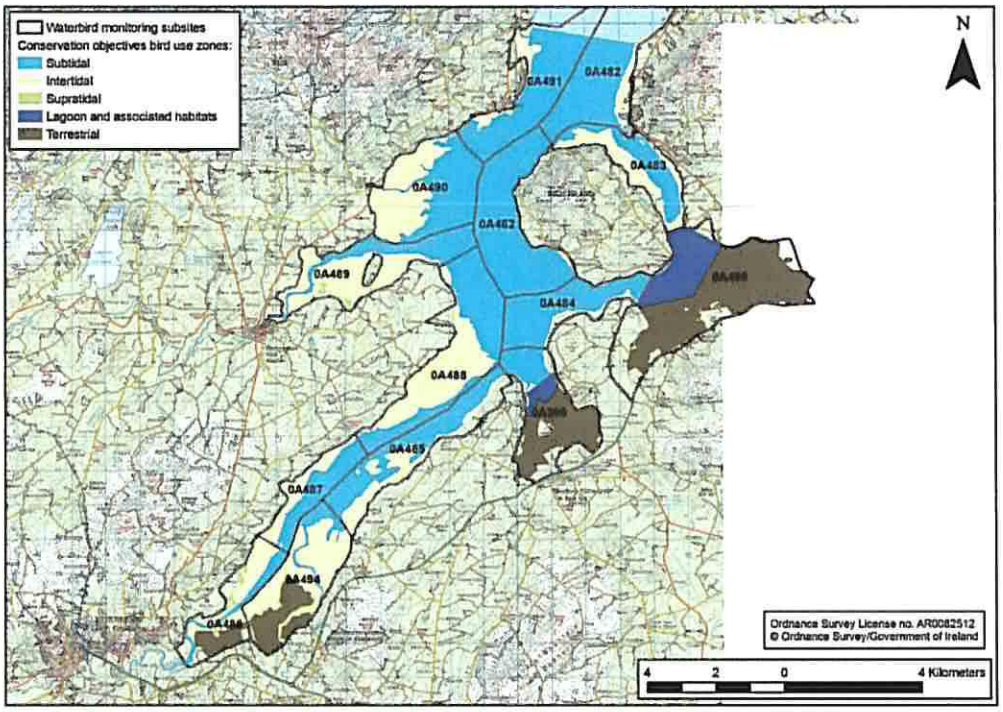

Figure 5.2 – Distribution of bird use zones in relation to the waterbird monitoring subsites.

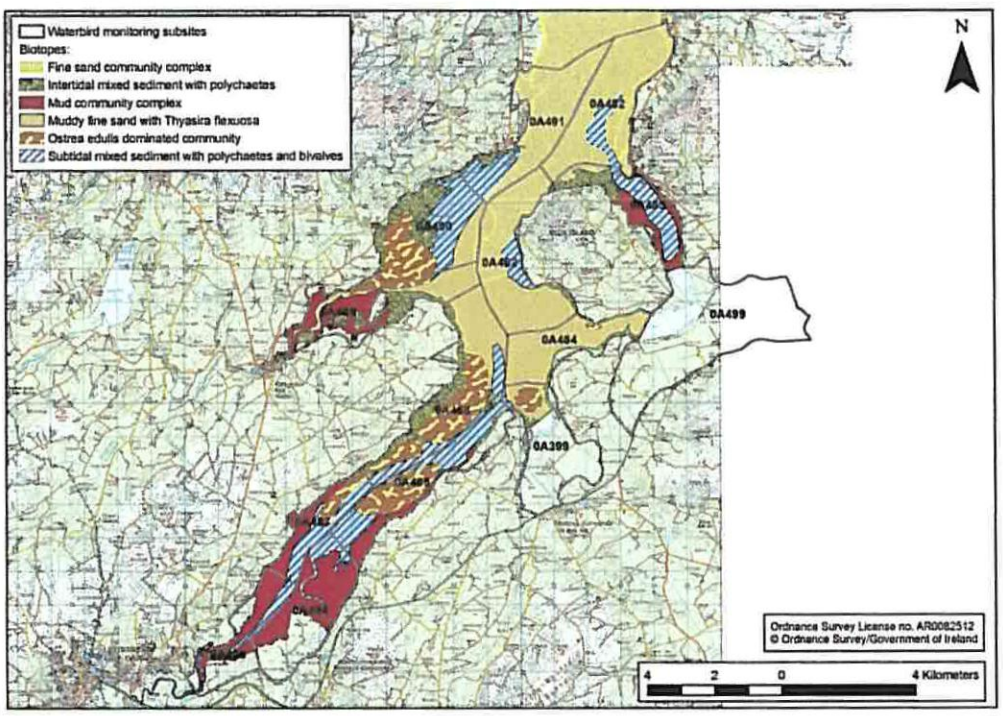

Figure 5.3 - Distribution of biotopes in relation to the waterbird monitoring subsites.

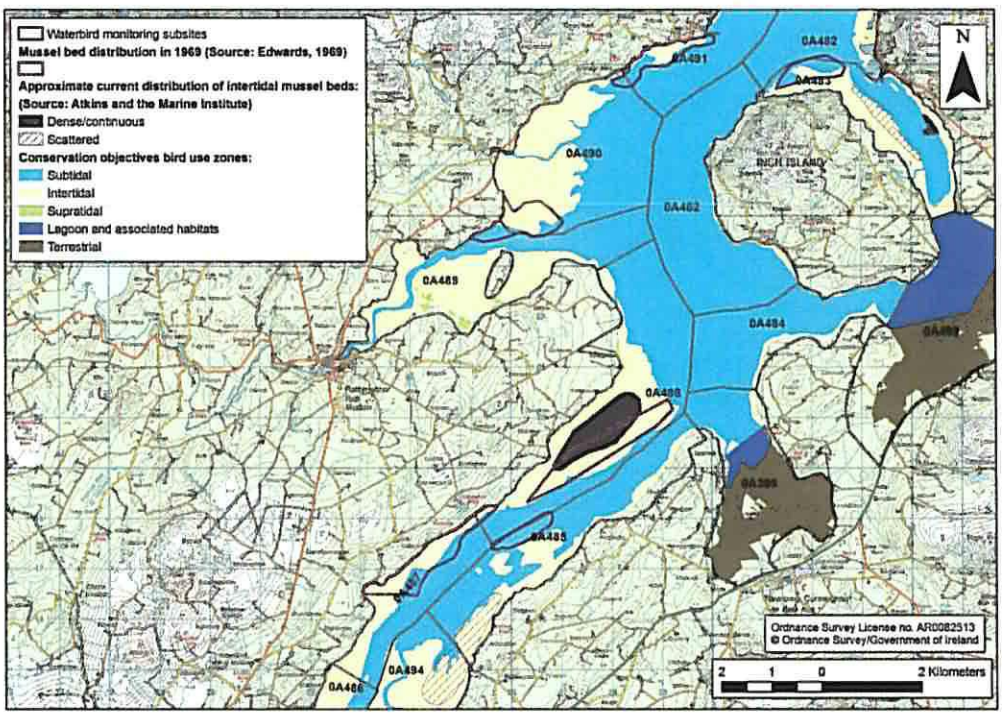

Figure 5.4 - Approximate distribution of the main mussel beds within Lough Swilly.

6. Assessment of mussel bottom culture

Scope of activity

6.1 Within the Lough Swilly SPA there are currently seven sites licensed (covering 512 ha) and another 13 applications (covering 549 ha) pending for mussel bottom culture. There are also an additional three sites licensed (covering 1174 ha) for the bottom culture of mussels and oysters together. The distribution of the licensed sites and application areas (collectively referred to as mussel plots, hereafter) is shown in relation to the intertidal and subtidal bird use zones in Figure 6.1, and in relation to the biotopes in Figure 6.2.

6.2 A full description of this activity is provided in the SAC AA. The key aspects in relation to potential impacts on SCI species are: -

- Collection of mussel seed
- Ongrowing of mussel seed in nursery areas mainly in the intertidal
- Further ongrowing of mussels in subtidal waters (during which the mussels may be moved up to 3-4 times)
- Harvesting of mussels

6.3 These separate components of the activity are assessed separately in the following sections.

1. Collection of mussel seed

Description

6.4 The SAC AA states that: -

> "*Mussel seed sources for Lough Swilly come both from within the bay and from the managed Irish Sea Fishery. The main local seed area is to the west of Inch Island stretching from Drum Point to Hawkes Nest*".

6.5 The seed area is in subtidal habitat.

6.6 The seed mussel harvesting operations in Lough Swilly take place during daytime high tides between August and October, with most activity in October (Table 2 in the SAC AA).

6.7 There is no detailed information available on the intensity of the harvesting operations; i.e. the number of boats, the number of days fished, etc. There are likely to be only a very small number of boats used (only one at a time) as the area represents the interests of one operator (Francis O'Beirn, Marine Institute, pers. comm.).

Potential impacts

6.8 The seed mussel harvesting operations removes a potential food source for two SCI species: Scaup and Goldeneye. However, this seed is ongrown in intertidal areas and will be available to these species to feed on at high tide. After 12-18 months, the mussels are transplanted to subtidal waters, where they will be available to these species to feed on throughout the tidal cycle.

Therefore, seed mussel harvesting does not result in a net reduction in mussel availability and is not likely to cause reduced food availability of Scaup and Goldeneye.

6.9 Seed mussel harvesting could potentially cause disturbance to SCI species that use deep subtidal waters. However, dredging takes place over a short period of time so any disturbance impacts will be of short duration and will not affect the availability of resources in this area.

6.10 Therefore, there are no potentially significant impacts that are likely to arise from seed mussel harvesting.

2. Ongrowing of mussel seed in intertidal nursery areas

Description

6.11 The SAC AA describes this activity as follows: -

> "*When native seed is collected it is immediately transferred to nursery areas, usually in the intertidal. The co-op's nursery areas are in the Farland Creek and Fahan Creek. For other licensed sites, the nursery area may comprise the shallower parts of the site. Stocks remain in the nursery areas for 12 -18 months, at which stage they have reached a size of approximately 35mm, the stock is then transplanted to deeper ongrowing sites*".

6.12 Husbandry activity will take place at high tide throughout the ongrowing period, but will mainly be at a low intensity (SAC AA).

6.13 There is no information available on the proposed occupancy of intertidal habitat within licensed plots. Therefore, we have made the unrealistic assumption of an occupancy rate of 100% (as advised by the Marine Institute). However, this assumption does not imply 100% cover throughout the plots: the normal pattern in intertidal relay plots in Castlemaine Harbour (which we have used as a model) is for seed mussels to be spread in patches, interspersed with areas of clear sediment (Plate 6.1).

Plate 6.1 – Seed mussel beds in the nursery area at Castlemaine Harbour.

6.14 Some of these intertidal areas include natural mussel beds. Therefore, in theory, the extent of natural mussel cover should be determined to allow the potential impact of ongrowing of native seed in intertidal areas to be assessed against the appropriate baseline scenario. In practice this information does not exist, and cannot be obtained. However, all the following assessments of the potential impact of ongrowing of mussels in intertidal areas should be read with the caveat that they may overstate the potential impact as the baseline scenario is not zero mussel cover.

Impact of habitat alteration

Potential impacts

6.15 The SAC AA states that bottom culture of mussels is "considered disturbing" to the intertidal biotopes affected, due to extirpation of the characteristic infaunal species from the area covered by mussels, and, in some cases, the sensitivity of characteristic species to organic enrichment, smothering and/or physical disturbance from dredging.

6.16 This component of the activity will only potentially affect SCI species that make significant use of the intertidal and/or shallow subtidal zones.

6.17 Work carried out at Castlemaine Harbour indicates that, of the intertidal SCI species, Grey Heron, Oystercatcher, Curlew, Redshank, Greenshank and Common Gull are likely to have a neutral or positive response to intertidal mussel cover (Gittings and O'Donoghue, 2011a and unpublished data). In addition, Knot feed on mussel beds and are, therefore, also likely to have a neutral or positive response. Therefore, these species can be screened out from further assessment. Similarly, Caldow *et al.* (2003) also found neutral or positive responses from Oystercatcher, Curlew,Redshank and Black-headed Gull following mussel relay in intertidal habitats, although there was some indication of decreases in Oystercatcher and Redshank in the areas with the highest densities of mussels.

6.18 The remaining intertidal/shallow subtidal SCI species are: Shelduck, Wigeon, Teal, Mallard, Shoveler and Dunlin. Preliminary analysis of the Castlemaine Harbour nursery area monitoring data from 2011/12 indicates that Mallard and Dunlin occurred in the nursery area roughly in the numbers expected from the distribution of habitat. However, levels of mussel cover appeared to be low in 2011/12, so these data do not necessarily predict the responses of these species to high levels of mussel cover. Shelduck, Wigeon and Teal occurred in lower numbers than expected, but the distribution of the latter two species may have reflected broader habitat factors, rather than avoidance of the mussel beds.

6.19 Dunlin can feed on small mussels (Cramp and Simmons, 2004) and Scheiffarth *et al.* (2007) states that mussel beds are "*preferred foraging habitats for many birds in the Wadden Sea*" and species "*visiting mussel beds regularly include Dunlin*". However, of the two citations quoted in support of this statement, one (Nehls *et al.*, 1997) does not refer to Dunlin. The other (Van der Kaam *et al.*, 1999) reported mean densities of around 5 birds per ha on mussel beds in the Wadden Sea. They do not discuss how these densities compare to densities on other habitats in the same area. However, these densities are relatively high compared to those recorded in the NPWS BWS at Lough Swilly (e.g., a mean density of 2.3 birds per ha in the Ballybegly subsite; NPWS, 2011b). However, the latter were calculated using the entire intertidal area within the subsites, not just the habitat zone used by the Dunlin. In an assessment of the Exmouth mussel fishery (Gascoigne and Tindall, 2012), Dunlin were described as occasionally feeding on mussel beds, both on small mussels and associated invertebrates, although the habitat "*does not account for a significant proportion of their distribution on the estuary*". The assessment concluded that the relaying would have a positive impact on food availability for Dunlin by creating additional intertidal mussel beds. At Lough Swilly, Dunlin use mussel bed areas in small groups of 50 or so, but the main Dunlin flocks occur on the open mudflats (Ralph Sheppard, pers. comm.). However, in an

overall Irish context, mussel beds are not considered an important habitat for Dunlin and the important sites for Dunlin are large estuarine sites with extensive areas of soft sediments (Crowe, 2005). While small numbers of Dunlin may use mussel beds, the proposed ongrowing of mussel seed in intertidal nursery areas at the 100% occupancy rate assumed in this assessment would involve the conversion of extensive areas of Lough Swilly from intertidal soft sediment habitat known to support large number of Dunlin to a habitat for which there is only limited, mainly anecdotal, evidence for its suitability for Dunlin. Therefore, in the absence of detailed evidence about the association of Dunlin with high levels of mussel cover, and in accordance with the precautionary principle, Dunlin have been assumed to have a negative response to the habitat alteration caused by this activity.

6.20 Similarly, in the absence of any clear evidence about the association of Shelduck, Wigeon, Teal, Mallard and Shoveler with high levels of mussel cover, and in accordance with the precautionary principle, these species have also been assumed to have a negative response to the habitat alteration caused by this activity.

Assessment

6.21 The percentage of the intertidal area in each subsite occupied by mussel bottom culture plots is shown in Table 6.1.

6.22 The intertidal zones of the licensed plots in Ballybegly and Fahan Creek (the two subsites with significant areas of intertidal licensed plots) were viewed during the reconnaissance visit in the October 2012 and very little mussel cover was evident. If this is representative of recent years, it is reasonable to assume that the existing levels of mussel cover are not significantly affecting waterbird distribution in the intertidal zone. Therefore, waterbird distribution patterns can be used to assess the potential impact of the ongrowing of mussel seed in intertidal nursery areas.

Table 6.1 - Intertidal and subtidal habitat within areas with mussel bottom culture plots.

Zone	Subsite		Subsite area (ha)	Mussel bottom culture plots (ha)			
				Application	Licensed	Total	%[1]
Intertidal	0A462	West Inch	21	0	20	20	93%
	0A483	Fahan Creek	214	3	153	156	73%
	0A484	Ballymoney	36	0	13	13	37%
	0A485	Ballybegly	187	2	54	55	30%
	0A487	Castle Shanaghan	131	28	0	29	22%
	0A489	Leannan Estuary	331	27	0	27	8%
	0A490	Ray	366	23	26	49	13%
	0A491	Rathmullan	75	7	0	7	10%
	0A494	Big Isle	372	39	0	39	10%
Subtidal	0A399	Blanket Nook	119	26	0	26	22%
	0A462	West Inch	723	0	483	483	67%
	0A482	Lisfannan	434	26	12	38	9%
	0A483	Fahan Creek	208	15	162	178	86%
	0A484	Ballymoney	397	70	265	335	84%
	0A485	Ballybegly	369	37	166	203	55%
	0A487	Castle Shanaghan	204	70	85	155	76%
	0A488	Shellfield	448	59	117	176	39%
	0A489	Leannan Estuary	248	34	43	77	31%
	0A490	Ray	381	22	80	102	27%
	0A491	Rathmullan	500	20	0	20	4%
	0A494	Big Isle	79	42	0	42	53%

Intertidal and subtidal habitat defined, as per Map 6 in NPWS (2011).

[1] percentage of subsite area occupied by mussel bottom culture plots

Shelduck

6.23 Sheppard (2002) states that the main flocks occur in the Leannan Estuary, Swilly Estuary/Big Isle and Fahan Creek. In the NPWS BWS, numbers were low on three of the four counts. On the fourth count, the above four areas held the largest numbers, amounting to nearly 90% of the total numbers present. During I-WeBS counts[3], a mean of 93% (s.d. = 6 %, n = 19) of the total Lough Swilly population occurred in these subsites. This distribution reflects the distribution of the mud community complex biotope. Flock maps from the NPWS BWS show that the main Shelduck flocks recorded were almost all within the mud community complex biotope (Figure 6.3).

6.24 The mean distribution of Shelduck across these four subsites during the I-WeBS counts is shown in Table 6.2. The percentages of the intertidal/shallow subtidal zones, and of the mud community complex biotopes, within these subsites are also shown in Table 6.2.

6.25 If there was 100% occupancy of the mussel plots and this caused complete displacement of birds from the affected areas, and if birds are uniformly distributed through the intertidal/shallow subtidal zones habitat or the mud community complex biotope within the affected subsites, then mussel bottom culture would cause displacement of 13-14% of the Lough Swilly Shelduck population (Table 6.2). This impact would be significant with reference to attribute 2 of the conservation objectives.

Table 6.2 – Shelduck distribution, occupancy by mussel plots and predicted displacement of Shelduck by bottom mussel culture.

Subsite	Shelduck distribution[1]		% area in mussel plots[2]		Predicted displacement[3]	
	mean	SD	Intertidal/shallow subtidal	mud	Intertidal/shallow subtidal	mud
Fahan Creek	8%	7%	79%	96%	6%	8%
Swilly Estuary	19%	13%	0%	0%	0%	0%
Leannan Estuary	13%	9%	8%	1%	1%	0%
Big Isle	53%	27%	14%	10%	7%	5%

[1] Mean percentage of I-WeBS count totals within the subsites, using data from 2006/07-2010/11 (excluding counts with poor coverage and/or total Shelduck counts < 30; n = 19)

[2] Percentage of total subsite area occupied by the intertidal and shallow subtidal zones, and by the mud community complex biotope, within the mussel plots

[3] Calculated as mean % within subsite*% of intertidal and shallow subtidal zones /mud community complex biotope within mussel plots; see text for assumptions

Wigeon

6.26 Sheppard (2002) states that: -

"Birds are generally distributed with Swilly Estuary and Blanket Nook being the most consistent sub-sites. Inch can have large numbers but is erratic and the Leannan Estuary seems to have lost its former appeal".

[3] Shelduck typically roost at high tide on subtidal habitat close to their low tide feeding areas. Therefore, unlike many other species, their high tide distribution is likely to be very similar to their low tide distribution, so I-WeBS count data can be used to indicate their potential use of intertidal feeding habitat.

6.27 In the NPWS BWS low tide counts, the majority of Wigeon occurred in terrestrial habitat (mean = 64%, s.d. = 17%), with usually relatively small numbers in intertidal (mean = 14%, s.d. = 10%) and subtidal (mean = 23%, s.d. = 15%) habitat.

6.28 The subsite distribution in the NPWS BWS low tide counts reflects these habitat preferences with most birds occurring in Inch Lough & Levels (mean = 53%, s.d. = 19%). Other subsites with a mean of more than 1% of the total count were the Swilly Estuary (mean = 18%, s.d. = 13%, Blanket Nook (mean = 12%, s.d. = 6%), the Leannan Estuary (mean = 8%, s.d. = 6%) and Big Island (mean = 6%, s.d. = 7%).

6.29 Flock maps from the NPWS BWS low tide counts show that Wigeon flocks in the intertidal and subtidal zones mainly occurred along the edges of tidal channels within the mud community complex biotope (Figure 6.4).

6.30 Neither the subsite distribution, nor the flock maps, shows any evidence of association with the distribution of existing mussel beds.

6.31 Blanket Nook, Leannan Estuary and Big Isle are the only subsites with mussel plots that support significant numbers of Wigeon. In Blanket Nook, nearly all the Wigeon occur in the terrestrial zone. In the Leannan Estuary, the mussel plots occur in the outer part of the subsite, where the intertidal habitat is mainly intertidal mixed sediment with polychaetes, away from the mud community complex biotope that appears to be favoured by Wigeon.

6.32 In Big Isle, the mussel plots include areas of the mud community complex biotope. However, these areas are in the lowermost part of the intertidal zone, while the flock map data suggest that Wigeon mainly occur along tidal creeks in the upper intertidal zone. Moreover, the percentage occurrence of Wigeon in Big Isle during the NPWS BWS low tide counts was relatively low (6%), while the percentage of the intertidal and shallow subtidal zones occupied by mussel plots within the subsite is also low (10%). Therefore, all the Wigeon would have to occur within the small section of the subsite occupied by the mussel plots for significant displacement to occur.

6.33 Based on the results of the NPWS BWS counts, there are unlikely to be any significant displacement impacts to Wigeon from ongrowing of mussel seed in intertidal nursery areas.

Teal

6.34 Sheppard (2002) states that the "*favoured sub-sites*" are the Swilly Estuary and Blanket Nook while Inch Lough and the Leannan Estuary "are also popular".

6.35 In the NPWS BWS low tide counts, the majority of Teal occurred in terrestrial (mean = 44%, s.d. = 13%) and intertidal (mean = 37%, s.d. = 13%) habitat, and relatively small numbers usually in subtidal habitat (mean = 9%, s.d. = 9%).

6.36 Most Teal occurred in the Inch Lough & Levels (OA499) (mean = 38%, s.d. = 10%) and Swilly Estuary (mean = 30%, s.d. = 10%), with Blanket Nook (mean = 19%, s.d. = 9%) and Big Isle (mean = 10%, s.d. = 9%) the only other subsites supporting more than 5% on average. Numbers in the Leannan Estuary were generally low (mean = 4%, s.d. = 6%), although there was one count of 171 Teal (13% of the Lough Swilly total).

6.37 Flock maps from the NPWS BWS low tide counts show that Teal flocks in intertidal and subtidal habitat mainly occurred along the edges of tidal channels in the Swilly Estuary and Big Island subsites (Figure 6.5). No flocks were mapped in the Leannan Estuary subsite.

6.38 Neither the subsite distribution, nor the flock maps, shows any evidence of association with the distribution of existing mussel beds.

6.39 Blanket Nook and Big Isle are the only subsites with mussel plots that supported significant numbers of Teal. In Blanket Nook, all the Teal occurred in the terrestrial zone.

6.40 In Big Isle, the mussel plots are in the lowermost part of the intertidal zone, while the flock map data suggest that Teal mainly occur along tidal creeks in the upper intertidal zone. Moreover, the percentage occurrence of Teal in Big Isle during the NPWS BWS low tide counts was relatively low (10%), while the percentage of the intertidal and shallow subtidal zones occupied by mussel plots within the subsite is also low (14%). Therefore, most of the Teal would have to occur within the small section of the subsite occupied by the mussel plots for significant displacement to occur.

6.41 Based on the results of the NPWS BWS counts, there are unlikely to be any significant displacement impacts to Teal from ongrowing of mussel seed in intertidal nursery areas.

Mallard

6.42 Sheppard (2002) states that "*Big Isle and Inch Lough are the best sub-sites but every sub-site, except Rathmullan is well used*".

6.43 In the NPWS BWS low tide counts, the majority of Mallard occurred in terrestrial (mean = 66%, s.d. = 13%) and intertidal (mean = 29%, s.d. = 9%) habitat, with small numbers in subtidal habitat (mean = 5%, s.d. = 4%).

6.44 Most Mallard occurred in Inch Lough & Levels (mean = 40%, s.d. = 11%) and Blanket Nook (mean = 29%, s.d. = 9%), with Big Isle mean = 14%, s.d. = 5%) the only other subsite supporting more than 5% on average. The remaining 17% of the mean count was distributed across eight further subsites.

6.45 Flock maps from the NPWS BWS low tide counts show that Mallard flocks in intertidal and subtidal habitat often occurred along the edges of tidal channels (Figure 6.6). However, some flocks also occurred in the upper intertidal away from tidal channels. These flocks may have been on the band of mixed sediment shore habitat that runs along the uppermost section of the intertidal (and is not mapped in the NPWS biotope map), as Mallard often feed in this type of habitat in Irish estuaries.

6.46 Neither the subsite distribution, nor the flock maps, shows any shows any evidence of association with the distribution of existing mussel beds.

6.47 Blanket Nook and Big Isle are the only subsites with mussel plots that supported significant numbers of Wigeon. In Blanket Nook, all the Mallard occurred in the terrestrial zone.

6.48 In Big Isle, the mussel plots are in the lowermost part of the intertidal zone, while the flock map data suggest that Mallard mainly occur in the upper intertidal zone. Moreover, the percentage occurrence of Mallard in Big Isle during the NPWS BWS low tide counts was relatively low (14%), while the percentage of the intertidal and shallow subtidal zones occupied by mussel plots within the subsite is also low (14%). Therefore, a large proportion of the Mallard would have to occur within the small section of the subsite occupied by the mussel plots for significant displacement to occur.

6.49 Based on the results of the NPWS BWS counts, there are unlikely to be any significant displacement impacts to Mallard from ongrowing of mussel seed in intertidal nursery areas.

Shoveler

6.50 Sheppard (2002) does not discuss the distribution of Shoveler in any detail, but in his description of the Leannan Estuary he states that "*it once supported one of the largest Shoveler flocks, but is now less reliable*". In general, Shoveler is considered to have a very localised distribution in Lough Swilly occurring mainly in the stretch north of Greenhill to the bay below Castle Shanaghan (Ralph Sheppard, pers. comm.).

6.51 During the NPWS BWS counts, numbers were very low on two of the four counts, so it is difficult to infer distribution patterns from this data.

6.52 During recent I-WeBS counts, a mean of 93% (s.d. = 10%, n = 9) occurred at the southern end of Lough Swilly across the Big Isle, Castle Shanaghan and Swilly Estuary subsites.

6.53 One of the four flocks mapped during the NPWS BWS counts was in the lower intertidal zone of the Big Isle subsite, within a mussel bottom culture plot. However, this was a roosting flock of only four birds. Overall, given the low numbers of flocks mapped during the NPWS BWS counts, it is difficult to infer distribution patterns from this data.

6.54 Mussel plots occupy 39% of the shallow subtidal zone in the Big Isle, Castle Shanaghan and Swilly Estuary subsites. If there was 100% occupancy of the mussel plots and this caused complete displacement of birds from the affected areas, and if birds are uniformly distributed through the shallow subtidal zone within the affected subsites, then mussel bottom culture would cause displacement of 36% of the Lough Swilly Shoveler population

Dunlin

6.55 Sheppard (2002) states that: -

> "*Most of the birds are in one huge flock which moves between Big Isle and Swilly Estuary, constantly, changing its position or breaking up into sub-flocks. Smaller flocks of up to 500 birds are found at Ballybegly, Ray, Lisfannon and the Leannan Estuary*".

6.56 In the NPWS BWS low tide counts, the majority of Dunlin occurred in intertidal habitat (mean = 66%, s.d. = 5%) and intertidal (mean = 29%, s.d. = 9%) habitat, with small numbers in terrestrial habitat (mean = 9%, s.d. = 5%).

6.57 The main concentration was in the southernmost part of Lough Swilly with Ballybegly, Big Isle and Swilly Estuary holding 49-86% of the total numbers (mean = 72%, s.d. =16%), but with the distribution between these subsites varying between the counts. The other concentration was in Lisfannon/Fahan Creek, with 8-19% of the total count (apart from on the first count when overall numbers were low) (mean = 13%, s.d. = 5%). The Leannan Estuary supported small numbers (mean = 5%, s.d. = 4%).

6.58 Flock maps from the NPWS BWS low tide counts show that Dunlin flocks were widely distributed but mainly occurred within the mud community complex biotope (Figure 6.7). The exception was the *Ostrea edulis* dominated community biotope in Ballybegly, which supported moderate-sized flocks on two of the four count days.

6.59 Ballybegly, Big Isle and Fahan Creek are the only subsites with mussel plots that support significant numbers of Dunlin.

6.60 Neither the subsite distribution, nor the flock maps, evidence of association with the distribution of existing mussel beds.

6.61 Ballybegly, Big Isle and the Swilly Estuary should probably be treated as a single unit for the purposes of analysing Dunlin distribution, as there was high variability across the counts in the distribution of Dunlin between these subsites, but relatively low variability in the combined totals across these subsites. Mussel plots occupy around 13% of the total area of intertidal habitat in these subsites. If there was 100% occupancy of the mussel plots and this caused complete displacement of birds from the affected areas, and if birds are uniformly distributed through the intertidal habitat within these subsites, then mussel bottom culture would cause displacement of 9% of the Lough Swilly population.

6.62 For similar reasons as above, Lisfannon and Fahan Creek should probably be treated as a single unit for the purposes of analysing Dunlin distribution. Mussel plots occupy around 59% of the total area of intertidal habitat in these subsites. If there was 100% occupancy of the mussel plots and this caused complete displacement of birds from the affected areas, and if birds are uniformly distributed through the intertidal habitat within these subsites, then mussel bottom culture would cause displacement of 8% of the Lough Swilly population.

6.63 Therefore, mussel bottom culture could potentially cause displacement of 17% of the Lough Swilly population.

6.64 In reality, it seems unlikely that mussel bottom culture would cause 100% occupancy of the mussel plots within the intertidal zone.

6.65 Another assumption made above is that the birds are uniformly distributed through the affected subsites. In the Ballybegly, Big Isle and the Swilly Estuary subsites this assumption may not be too unreasonable. The majority of these subsites are occupied by the mud community complex biotope, which appears to be the favoured habitat for Dunlin. There is a significant area of the *Ostrea edulis* dominated community biotope in Ballybegly, but Dunlin also appeared to favour this habitat. This assumption is probably less reasonable in the Lisfannon and Fahan Creek subsites. These subsites include significant areas of mixed sediment with polychaetes (in the outer part of the Fahan Creek subsite) and the fine sand community complex biotope (Lisfannon). The flock map data, and general knowledge of Dunlin ecology, indicates that Dunlin are likely to mainly occur within the mud community complex biotope in these subsites. Mussel plots occupy around 96% of the total area of mud community complex biotope in these subsites. Therefore, if Dunlin are concentrated within the mud community complex biotope in these subsites, the predicted displacement could rise to around 10%.

6.66 The above potential impacts on Dunlin would be significant with reference to both attributes of the conservation objectives.

Impact of disturbance

6.67 Husbandry activity at high tide has the potential to cause disturbance to SCI species that use subtidal habitat. However, the intensity of this activity will usually be low. Monitoring of husbandry activity in the intertidal mussel nursery at Lough Swilly showed that the percentage of the available habitat that was affected was very low (although at Castlemaine Harbour the husbandry activity occurred at low tide, not high tide). Comparisons with relevant studies in the scientific literature showed that these levels of disturbance intensity were generally much lower than the levels reported to affect survivorship (Gittings and O'Donoghue, 2011a; unpublished data from 2011/12). There is no reason to suppose that higher levels of husbandry activity will occur in intertidal mussel nursery areas at Lough Swilly. Therefore, husbandry activity is unlikely to cause significant disturbance to SCI species.

6.68 The relaying of the seed mussels and the dredging of the seed mussels following ongrowing has the potential to cause disturbance impacts to SCI species that use deep subtidal waters. However,

these activities will only occur for short periods of time at the start and end of the ongrowing period, and will only affect limited areas of habitat at any one time, so any disturbance impacts will be of short duration and will not affect the availability of resources in this area.

6.69 Therefore, there are no potentially significant disturbance impacts that are likely to arise from the ongrowing of mussel seed in intertidal nursery areas.

3. Ongrowing of mussels in subtidal waters

Description

6.70 The SAC AA describes this activity as follows: -

> "*Stock is moved using dredges from the nursery areas to deeper waters within the licensed site, and remains here for 6-9 months until harvest. In many bottom culture regimes the mussels would remain on the same plot until harvest, however, as a result of predation by starfish and local hydrodynamic conditions, mussels grown in Lough Swilly can be moved 3-4 more times prior to harvest. This is especially true for the co-op licensed area (one large licensed site adjacent to Inch Island) as the management regime allows for greater flexibility for movement between the individually allocated ongrowing plots within the licensed area*".

6.71 There is no information available on the current, or proposed, occupancy of subtidal habitat within licensed plots. Therefore, we have made the unrealistic assumption of an occupancy rate of 100% (as advised by the Marine Institute). However, this assumption does not imply 100% cover throughout the plots.

6.72 Some of these subtidal areas may include natural mussel beds. Therefore, the extent of natural mussel cover should be determined to allow the potential impact of ongrowing of mussels in subtidal areas to be assessed against the appropriate baseline scenario.

Impact of habitat alteration

Potential impacts on habitat structure and prey resources

6.73 The SAC AA states that bottom culture of mussels is "considered disturbing" to the subtidal biotopes affected, due to extirpation of the characteristic infaunal species from the area covered by mussels, and, in some cases, the sensitivity of characteristic species to organic enrichment, smothering and/or physical disturbance from dredging.

6.74 Increasing the density of mussels has been demonstrated to cause reduced abundance and diversity of invertebrates. This is due to complete dominance of mussels in terms of space and quite likely filtration (competitive exclusion). There is very little reference to fishes in mussel literature and speculation might lead us to assume that tightly packed mussels will result in homogeneous habitat and little provision of refugia for fishes. However, if an area comprises patches of mussels (of varying densities) among sandy/muddy habitat then this could provide sufficient complexity of habitat to support a diverse fish assemblage. (Francis O'Beirn, Marine Institute, pers. comm.).

Potential impacts on SCI species

6.75 This component of the activity will only potentially affect SCI species that make significant use of the subtidal zone as a feeding habitat. Species that only feed in shallow subtidal habitat are dealt with in the assessment of the ongrowing of mussel seed in intertidal nursery areas.

6.76 Bottom culture of mussels is likely to have positive impacts on Scaup and Goldeneye by increasing their food supply. Mussels are a major component of the diet of Scaup (Cramp and Simmons, 2004). The Goldeneye also feeds on mussels, and while the literature indicates a more varied diet, mussels may predominate where they are available (Cramp and Simmons, 2004).

6.77 Red-breasted Merganser, Great Crested Grebe, Sandwich Tern and Common Tern are mainly fish-eating species. Given the assumption of a 100% occupancy rate of the mussel plots, we have to assume that there is potential for bottom culture of mussels to cause negative impacts to fish populations (see above), although it will only potentially affect fish species that make use of the benthic zone. Such impacts could affect prey resources for Red-breasted Merganser, Great Crested Grebe, Sandwich Tern and Common Tern.

6.78 The major prey resources for the Red-breasted Merganser and Great Crested Grebe SCI populations in Lough Swilly may include benthic invertebrates and demersal and pelagic fish (Appendix B). The fish species that are likely to form significant components of the prey resources include sand goby (a demersal species) and herring, sprat and stickleback (pelagic species). Therefore, even if sand gobies are adversely affected by bottom mussel culture, there will be alternative fish prey resources available. However, benthic invertebrates may also be important prey resources for the Red-breasted Merganser SCI population, and these invertebrates may also be adversely affected by bottom mussel culture (see above). The potential effect of bottom mussel culture on the Red-breasted Merganser and Great Crested Grebe populations will depend upon the relative importance of demersal fish (and benthic invertebrates for the mergansers) in their diet, and the extent to which they can compensate for the reduction in benthic prey resources by increased consumption of pelagic fish. However, the risk of impact is likely to be higher for Red-breasted merganser, given its potentially greater dependence on benthic prey.

6.79 Sandwich Tern and Common Tern mainly feed on fish in the pelagic zone. However, some of the fish species depredated by the terns, while taken in the pelagic zone, are dependent on the benthic zone for aspects of their ecology (see Appendix B). Also, both species, but particularly Common Terns, can feed in very shallow water where they will be able to take fish from the benthic zone. Sand goby (a demersal fish species) may be an important prey resource for Common Terns at Lough Swilly, while another likely prey species (sandeels) also utilises benthic habitats as refugia. Therefore, both these species may be affected by mussel bottom culture. The other likely prey species (herring, sprat and sticklebacks) are pelagic and, therefore, unlikely to be affected. However, the apparent preference of the Common Terns at Lough Swilly for foraging in shallow waters indicates that benthic prey may be a major component of their diets. Sandwich Terns have a similar dietary range, although sand gobies may not be as important. However, their foraging range is not concentrated in shallow waters, indicating that benthic prey may not be as important.

Assessment

6.80 The percentage of the subtidal zone in each subsite occupied by mussel bottom culture licenses or license applications is shown in Table 6.1.

6.81 The current levels of mussel cover within the subtidal zones of the licensed plots are not known. However, these levels are assumed to be low, based on the low levels of mussel cover in the intertidal zones of these plots (see paragraph 6.22). If this is representative of recent years, it is reasonable to assume that the existing levels of mussel cover are not significantly affecting waterbird distribution in the zone. Therefore, waterbird distribution patterns can be used to assess the potential impact of the ongrowing of mussels in subtidal waters.

Red-breasted Merganser

6.82 Sheppard (2002) states that Red-breasted Merganser are: -

> *"spread out along the lough feeding inshore and in mid-channel. No sub-sites have dominance and only Lisfannon [OA482] is curiously under-used".*

6.83 In the NPWS BWS counts they occurred in 12 subsites, without any consistent pattern of preference for any particular area.

6.84 Analysis of the I-WeBS dataset also shows a lot of variability in subsite distribution between counts. However, on most counts the subsites with the most birds were along the main channel on the western side of Lough Swilly opposite Inch Island and to the south of Inch Island. Apart from Fahan Creek, there were notably few in the subsites around Inch Island (Ballymoney, Blanket Nook and Lisfannon). In fact no birds were recorded in any of the counts in Lisfannon. The West Inch subsite was not counted separately during most I-WeBS counts. However, numbers in this subsite were generally low during the NPWS BWS counts.

6.85 For the purposes of calculating potential displacement, subsites have been divided into four groups: a group covering the subsites along the deepwater central channel (Central channel); a group covering the subsites at the southern end of Lough Swilly (Southern); a group covering the subsites at the north-eastern side of Inch Island (North-eastern), and a group covering the subsites at the southern side of Inch Island (Inch south).

6.86 If there was 100% occupancy of the mussel plots and this caused complete displacement of birds from the affected areas (on the basis that the mussel relay at 100% displaced all fish prey species from the area), and if birds are uniformly distributed through the subtidal habitat within the affected subsites, then mussel bottom culture would cause displacement of around 35% of the Lough Swilly Red-breasted Merganser population (Table 6.3). This impact would be significant with reference to both attributes of the conservation objectives. However, the existence of alternative prey resources (pelagic fish) that would not be affected by mussel cover mean that complete displacement is probably unlikely to occur.

Table 6.3 – Red-breasted Merganser distribution, occupancy by mussel plots and predicted displacement of Red-breasted Merganser by bottom mussel culture.

Area[1]	Red-breasted Merganser distribution[2]		% area in mussel plots[3]		Predicted displacement[4]	
	mean	SD	all	< 5 m	all	< 5 m
Central channel	51%	16%	39%	42%	20%	21%
Southern	20%	18%	54%	54%	11%	11%
North-eastern	8%	9%	34%	29%	3%	2%
Inch south	4%	5%	70%	70%	1%	3%

[1] Central channel =Ballybegly, Leannan Estuary, Ray and Shellfield subsites; Southern = Big Isle, Castle Shanaghan and Swilly Estuary subsites; North-eastern = Fahan Creek and Lisfannon subsites; Inch South = Ballymoney and Blanket Nook subsites

[2] Mean percentage of I-WeBS count totals within the subsites, using data from 1996/97-2010/11 (excluding counts with poor coverage and/or total Red-breasted Merganser counts < 30; n = 19)

[3] Percentage of total subsite area occupied by all subtidal habitat (as defined in Map 6 of NPWS, 2011) and by subtidal habitat < 5 m depth (derived from Admiralty Chart data)

[4] Calculated as mean % with subsite*% of all subtidal/ subtidal < 5 m within mussel plot; see text for assumptions

Great Crested Grebe

6.87 Sheppard (2002) states that: -

> "*The population is widely spread along the deep water core of the lough from Rathmullan and into the Swilly Estuary with largest numbers not surprisingly being found in the open waters west of Inch Island and usually recorded for Shellfield or Ballymoney*".

6.88 In the NPWS Baseline Waterbird Survey, around 50-90% of the total count occurred across Blanket Nook, Ballymoney, Shellfield and Ray indicating a concentration in the area to the west and south-west of Inch Island. The I-WeBS dataset also shows a similar pattern with a concentration in the area to the west and south-west of Inch Island, but significant numbers also occur across the upper parts of Lough Swilly.

6.89 For the purposes of calculating potential displacement, subsites have been divided into four groups: a group covering the subsites to the west and south-west of Inch Island (Inch west and south-west); a group covering the subsites at the southern end of Lough Swilly (Southern); and a group covering the subsites at the north-eastern side of Inch Island (North-eastern).

6.90 If there was 100% occupancy of the mussel plots and this caused complete displacement of birds from the affected areas, and if birds are uniformly distributed through the subtidal habitat within the affected subsites, then mussel bottom culture would cause displacement of around 44-48% of the Lough Swilly Great Crested Grebe population (Table 6.4). This impact would be significant with reference to both attributes of the conservation objectives. However, the existence of alternative prey resources (pelagic fish) that would not be affected by mussel cover mean that complete displacement is probably unlikely to occur.

Table 6.4 – Great Crested Grebe distribution, occupancy by mussel plots and predicted displacement of Great Crested Grebe by bottom mussel culture.

Area[1]	Great Crested Grebe distribution[2]		% area in mussel plots[3]		Predicted displacement[4]	
	mean	SD	all	< 5 m	all	< 5 m
Inch west and south-west	40%	22%	53%	64%	21%	26%
Southern	37%	17%	50%	49%	19%	18%
North-eastern	13%	13%	34%	29%	4%	4%

[1] Inch west and south-west = Ballymoney, Leannan Estuary, Ray, Shellfield and West Inch subsites; Southern = Ballybegly, Big Isle, Blanket Nook, Castle Shanaghan and Swilly Estuary subsites; North-eastern = Fahan Creek and Lisfannon subsites

[2] Mean percentage of I-WeBS count totals within the subsites, using data from 1996/97-2010/11 (excluding counts with poor coverage and/or total Great Crested Grebe counts < 30; n = 20)

[3] Percentage of total subsite area occupied by all subtidal habitat (as defined in Map 6 of NPWS, 2011) and by subtidal habitat < 5 m depth (derived from Admiralty Chart data)

[4] Calculated as mean % within subsites*% of all subtidal/ subtidal < 5 m within mussel plot; see text for assumptions

Sandwich Tern and Common Tern

6.91 Sandwich Tern forage throughout most of Lough Swilly from Blanket Nook north to Fanad, while Common Tern tend to use shallow waters around Inch Island, but can use suitable waters throughout Lough Swilly (Andrew Speer, NPWS, pers. comm.). More detailed information on the spatial distribution of foraging Sandwich and Common Terns in Lough Swilly is not available.

6.92 Mussel plots occupy most of the shallow waters around Inch Island (Figure 6.), indicating that there may be a large spatial overlap between mussel bottom culture and Common Tern foraging habitat. Fish species associated with benthic habitat may be a significant component of the Common Tern diet (see above). Therefore, there is a potential risk that mussel bottom culture could have significant impacts on Common Tern prey resources. This impact could affect the productivity rate of the Common Tern breeding colony (attribute 2 of the conservation objectives) and, if it continued over a period of years, could also affect the breeding population abundance of the colony (attribute 1 of the conservation objectives). However, the importance for Common Terns of food resources in the lagoon habitat in Inch Lough, which will not be affected, is not known.

6.93 Sandwich Terns appear to have a much wider foraging range in Lough Swilly (Figure 6.), although it is possible that the areas closest to their breeding colony are the most favoured. They are also potentially less dependent on prey species associated with benthic habitats. Therefore, there is less risk that mussel bottom culture could have significant impacts on Sandwich Tern prey resources. However, there is a high degree of uncertainty about this assessment. Also, there is potential for mussel bottom culture to contribute towards a significant cumulative impact on their prey resources if the pelagic fisheries (not covered in this assessment) also affect their prey resources.

Impact of disturbance

6.94 The relaying of the mussels and the stock movements during ongrowing has the potential to cause disturbance impacts to SCI species that use deep subtidal waters. However, these activities will only occur for short periods of time, and will only affect limited areas of habitat at any one time, so any disturbance impacts will be of short duration and will not affect the availability of resources in this area.

6.95 Therefore, there are no potentially significant disturbance impacts that are likely to arise from the ongrowing of mussels in subtidal waters.

4. Harvesting of mussels

Description

6.96 Mussel harvesting may take place throughout most of the year from March-December.

Impact of habitat alteration

6.97 The potential impacts of dredging are included in the assessment of habitat alteration during the ongrowing of mussels in subtidal waters (see above).

Impact of removal of biomass

6.98 Mussel harvesting will result in the removal of mussel biomass that would otherwise have been available for birds to feed on. This could affect SCI species that feed on mussels (Scaup, Goldeneye, Oystercatcher, Knot and Common Gull). However, this mussel biomass has been produced by aquaculture.

6.99 Where the mussels have been cultivated from seed mussels from the managed Irish Sea Fishery, this represents a net input into the system during the cultivation period.

6.100 Where the mussels have been cultivated from seed mussels from the local seed area, the cultivation will have increased the biomass that would have been produced by this seed mussel resulting in a net increase in food availability during the cultivation period. It will also have made it available to the intertidally feeding species, and dispersed it more widely reducing potential food limitation due to competitive effects.

6.101 Therefore, there are no potentially significant impacts of mussel biomass removal on SCI species resulting from the harvesting of mussels.

Impact of disturbance

6.102 The harvesting of mussels will cause disturbance impacts to SCI species that use deep subtidal waters. While these may throughout most of the year they will only affect limited areas of habitat at any one time, so any disturbance impacts will be of short duration and will not affect the availability of resources in this area.

6.103 Therefore, there are no potentially significant disturbance impacts that are likely to arise from the ongrowing of mussels in subtidal waters.

Conclusions

6.104 Based on assumptions of 100% occupancy of the mussel bottom culture plots, and that birds are uniformly distributed through suitable habitat[4], the following potentially significant impacts have been identified in this assessment.

6.105 Ongrowing of mussel seed in intertidal nursery areas could potentially cause significant displacement impacts to Shelduck, Shoveler and Dunlin. However, it should be noted that the

[4] But note that this assumption has been partially examined through consideration of the species' ecology and analysis of flock map data

assumption of a negative response of these species to intertidal mussel cover is a precautionary assumption in the absence of clear evidence about the nature of their responses. In particular, there is some evidence that Dunlin may, in fact have a positive association with mussel beds.

6.106 Ongrowing of mussels in subtidal waters could potentially cause significant displacement impacts to Red-breasted Merganser and Great Crested Grebe, due to potential impacts on benthic prey resources. However, it should be noted that the assumption of a negative response of these species to subtidal mussel cover is a precautionary assumption in the absence of clear evidence about the nature of their responses. Moreover, the existence of alternative prey resources (pelagic fish) that would not be affected mean that complete displacement is probably unlikely to occur.

6.107 Our assessment of the potential impacts on Sandwich Tern and Common Tern is limited by the lack of information about the distribution of their foraging habitat within Lough Swilly. However, ongrowing of mussels in subtidal waters could have significant impacts on Common Tern prey resources. Sandwich Tern prey resources are less likely to be significantly affected, but the reliability of this conclusion is low. Also, there is potential for mussel bottom culture to contribute towards a significant cumulative impact on their prey resources if the pelagic fisheries (not covered in this assessment) also affect their prey resources.