Article 6 Assessment of Aquaculture and Fisheries in Inner Donegal Bay SAC (Murvagh, 0133), SPA (Donegal Bay, 004151), SPA (Durnesh Lough, 004145)

# Annex I

Assessment of Aquaculture and Fisheries in Donegal Bay (Murvagh) SAC (0133)

Marine Institute

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# 1 Preface

In Ireland, the implementation of Article 6 of the Habitats Directive in relation to aquaculture and fishing projects and plans that occur within designated sites is achieved through sub-Article 6(3) of the Directive. Fisheries not coming under the scope of Article 6.3, i.e. those fisheries not subject to secondary licencing, are subject to risk assessment. Identified risks to designated features can then be mitigated and deterioration of such features can be avoided as envisaged by sub-article 6.2.

Fisheries, other than oyster fisheries, and aquaculture activities are licenced by the Department of Agriculture, Food and Marine (DAFM). Oyster fisheries are licenced by the Department of Communications Energy and natural Resources (DCENR). The Habitats Directive is transposed in Ireland in the European Communities (Birds and Natural Habitats) Regulations 2011. Habitats and Birds (Habitats Directive and Birds Directive) regulations for sea fisheries are laid out in European Communities (Natural habitats and birds) (Sea-fisheries) Regulations 2009 S.I. 346 of 2009 as amended by S.I. 397 of 2010 and S.I. 237of 2012 Appropriate assessments and risk assessments are carried out against the conservation objectives (COs), and more specifically on the version of the COs that are available at the time of the Assessment, for designated ecological features, within the site, as defined by the National Parks and Wildlife Service (NPWS). NPWS are the competent authority for the management of Natura 2000 sites in Ireland. Obviously, aquaculture and fishing operations existed in coastal areas prior to the designation of such areas under the Directives. Ireland is thereby assessing both existing and proposed aquaculture and fishing activities in such sites. This is an incremental process, as agreed with the EU Commission in 2009, and will eventually cover all fishing and aquaculture activities in all Natura 2000 sites.

The process of identifying existing and proposed activities and submitting these for assessment is, in the case of fisheries projects and plans, outlined in SI 346/2009. Here, the industry or the Minister may bring forward fishing proposals or plans which become subject to assessment. These so called Fishery Natura Plans (FNPs) may simply be descriptions of existing activities or may also include modifications to activities that mitigate, prior to the assessment, perceived effects to the ecology of a designated feature in the site. In the case of other fisheries, that are not projects or plans, data on activity are collated and subject to a risk assessment against the COs. In the case of aquaculture, DAFM receives applications to undertake such activity and submits a set of applications, at a defined point in time, for assessment. The FNPs and aquaculture applications are then subject to AA. If the AA or the RA process finds that the possibility of significant effects cannot be discounted or that there is a likelihood of negative consequence for designated features then such activities will need

to be mitigated further if they are to continue. The assessments are not explicit on how this mitigation should be achieved but rather indicate whether mitigation is required or not and what results should be achieved.

# 2 Introduction

This document assesses the potential ecological impacts of aquaculture and fisheries activities within Donegal Bay (Murvagh) SAC (site code 000133) on the Conservation Objectives of the site (COs).

The information upon which this assessment is based is a list of applications and extant licences for aquaculture activities administered by the Department of Agriculture Food and Marine (DAFM) and forwarded to the Marine Institute as of end of April 2013; as well as aquaculture and fishery profiling information provided on behalf of the operators by Bord Iascaigh Mara. The spatial extent of aquaculture licences is derived from a database managed by the DAFM and shared with the Marine Institute. The sole aquaculture activity considered is the suspended culture (bags & trestles) of oysters (Pacific oyster – *Crassostrea gigas*). While some of the licences also specify the bottom culture of clam species this assessment does not consider this activity on the basis of communications[1] that there is no intention to culture clams at these sites.

# 3 Conservation Objectives for Donegal Bay (Murvagh) SAC (00133)

The appropriate assessment of aquaculture in relation to the Conservation Objectives for Donegal Bay (Murvagh) is based on Version 1.0 of the objectives (NPWS 2012) and supporting documentation (NPWS 2011).

## 3.1 The SAC extent

Donegal Bay (Murvagh) SAC is located to the west of Donegal Town, is located in the inner part of Donegal Bay and comprises the majority of marine habitat inside the Murvagh peninsula. Most of the site consists of intertidal habitats, notably mud and sand flats, sea inlets and bays, tidal rivers, estuarine channels and sandy beaches. The SAC is primarily estuarine in character, with shallow water and intertidal sand and mud flats being the dominant habitats. Sand dunes, including fixed dunes a priority habitat listed on Annex I of the EU Habitats Directive, occur in parts of the site, especially at Murvagh. The boundary of the SAC is shown in Figure 1 below.

[1] E-mail communication to MI from BIM on 23/4/2013

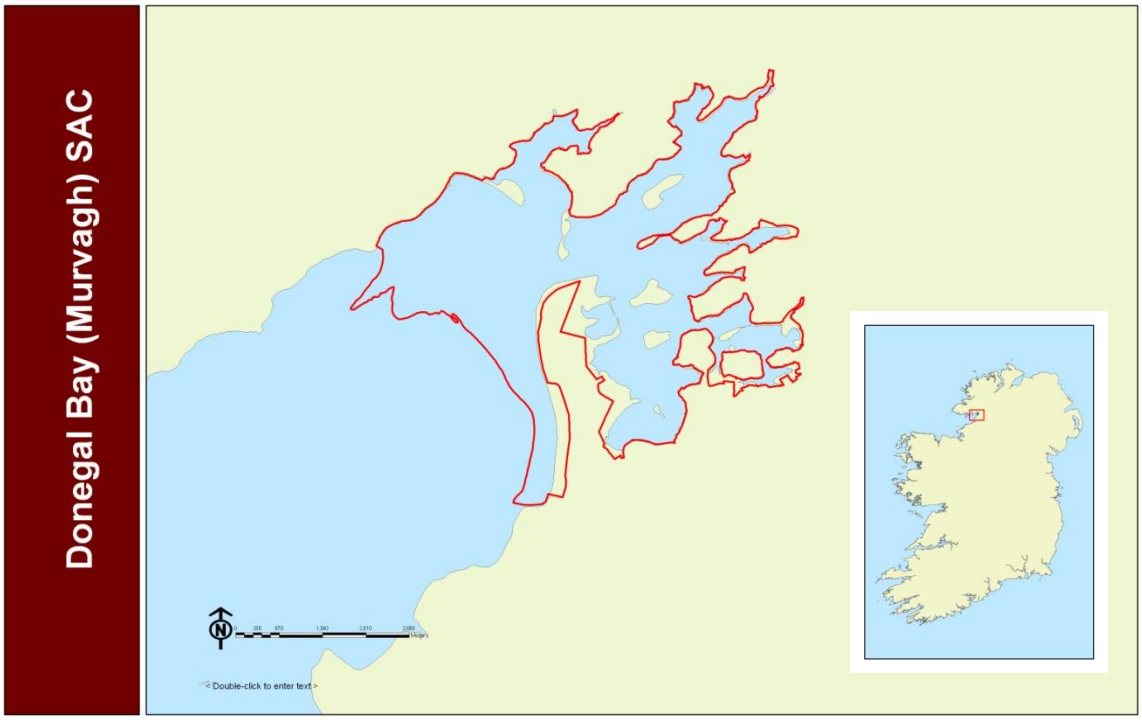


**Figure 1. The extent of Donegal Bay (Murvagh) SAC (site code 000133).**

### 3.2 Qualifying interests (SAC)

The SAC is designated for the following habitats and species, as listed in Annex I and II of the Habitats Directive:

- 1140 Mudflats and sandflats not covered by seawater at low tide
- 1365 Harbour Seal - *Phoca vitulina*
- 2130 Fixed coastal dunes with herbaceous vegetation ('grey dunes')
- 2190 Humid Dune slacks

Constituent communities and community complexes recorded within the qualifying interest Mudflats and sandflats not covered by seawater at low tide (1140) are listed in NPWS (2011) and illustrated in Figure 2 and consist of:

- Estuarine fine sands dominated by polychaetes and oligochaetes community complex
- Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex

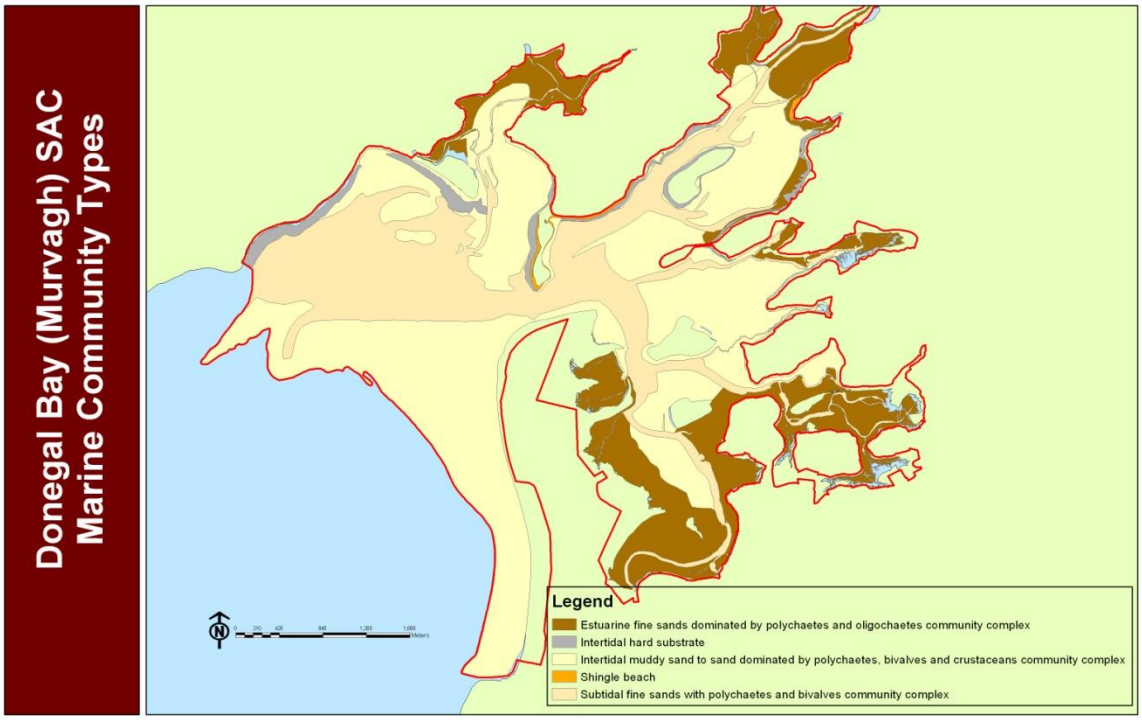


**Figure 2: Principal benthic communities recorded within the qualifying interest Mudflats and sandflats not covered by seawater at low tide within Donegal Bay (Murvagh) SAC (Site Code 000133) (NPWS 2011).**

The Donegal Bay (Murvagh) Sac is designated for the Harbour seal (*Phoca vitulina*) and has been the subject of monitoring of populations during the molting season (August-September) from 2009-2011. Recent estimates of populations at the site range from 209 in 2009, 143 in 2010, and 194 in 2011 (NPWS 2010, 2011a, 2012a). Both 2010 and 2011 estimates were likely considered underestimates based upon restricted visibility during surveying. A number of different sites have been identified within the SAC and are considered important to the overall welfare and health of the populations at the site. Figure 3 identifies these locations and distinguishes between breeding, moulting and resting sites. A prioritisation based upon sensitive periods in the life cycle have been identified by the competent authority, i.e. NPWS (NPWS 2011). Important periods are the pupping season (May-July) and molting season (August-September) and both periods and locations are considered important periods to the overall health of the population in the SAC and that any disturbance during these times should be kept to a minimum. Less information is known about resting period (October-April) and resting areas throughout the SAC. The resting locations provided on Figure 3 are based upon sightings outside of the sensitive time period (late autumn-early spring; NPWS 2011).

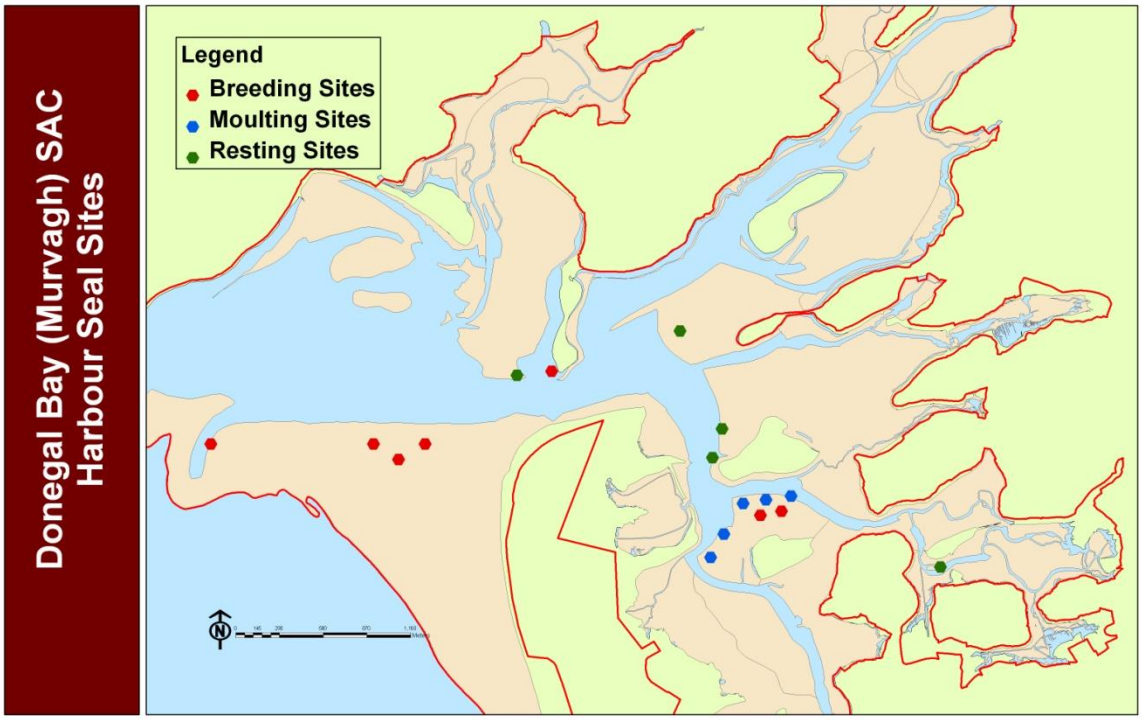


**Figure 3:** Harbour Seal (*Phoca vitulina*) locations in Donegal Bay (Murvagh) SAC.

### 3.3 Conservation objectives for Donegal Bay (Murvagh) SAC

The conservation objectives for the qualifying interests (SAC) were identified by NPWS (2012). The natural condition of the designated features should be preserved with respect to their area, distribution, extent and community distribution. Habitat availability should be maintained for designated species and human disturbance should not adversely affect such species. The features, objectives and targets of each of the qualifying interests within the SAC are listed in Table1 below.

**Table 1: Conservation objectives and targets for marine habitats and species in Donegal Bay (Murvagh) SAC (000133) (NPWS 2012; NPWS 2011)**

| FEATURE | OBJECTIVE | TARGET |
|---|---|---|
| **Mudflats and sandflats not covered by seawater at low tide** | Maintain favourable conservation condition | 1069 ha; Permanent habitat is stable or increasing, subject to natural processes |
| Estuarine fine sands dominated by polychaetes and oligochaetes community complex | Maintain favourable conservation condition | 309ha; Conserved in a natural condition, persistent disturbance to ecology <15% of area |
| Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex | Maintain favourable conservation condition | 759 ha; Conserved in a natural condition, persistent disturbance to ecology <15% of area |
| **Harbour Seal *Phoca vitulina*** | Maintain favourable conservation condition | The range of use within the site should not be restricted by artificial barriers; all sites should be maintained in natural condition; human activities should occur at levels that do not adversely affect harbour seal population at the site. |
| **Fixed coastal dunes with herbaceous vegetation ('grey dunes')** | Restore the favourable conservation condition | 27.01ha; Targets are identified that focus on a wide range of attributes with the ultimate goal of maintaining function and diversity of favourable species and managing levels of negative species. |
| **Humid Dune slacks** | Restore the favourable conservation condition | 0.123ha; Targets are identified that focus on a wide range of attributes with the ultimate goal of maintaining function and diversity of favourable species and managing levels of negative species. |

# 4 Details of the proposed plans and projects

## 4.1 Aquaculture – Oyster Culture

This assessment focuses on aquaculture activities which fall within the qualifying interest of Mudflats and sandflats not covered by seawater at low tide (1140) for which the site is designated. Only one species forms the basis of aquaculture operation in Donegal Bay (Murvagh) SAC, i.e. the Pacific oyster, *Crassostrea gigas*. Oysters are cultured in bags and are held in the water column on trestles - with the majority of operations conducted in the intertidal zone.

Within the boundary of the qualifying interest (Mudflats and sandflats not covered by seawater at low tide - 1069ha) the total area currently licensed for shellfish (oyster) production is 23.47ha or 2.19% of this habitat type. In addition, a further 28.2ha comprises applications for oyster culture or 2.64% of the overall feature type. Furthermore a single oyster fishery order is utilised for oyster culture which is 6.23ha (0.58% cover of 1040 habitat).

The majority of the oyster aquaculture within the Donegal Bay (Murvagh) SAC is concentrated to the north and north-east of the Murvagh peninsula (Figure 4), i.e., east and west of Hassan's peninsula.

Within the extent of the qualifying interest, there are currently 16 sites licensed for the culture of oysters with one fishery order site currently being used. There are 18 applications for culture sites pending that are also considered in this assessment.

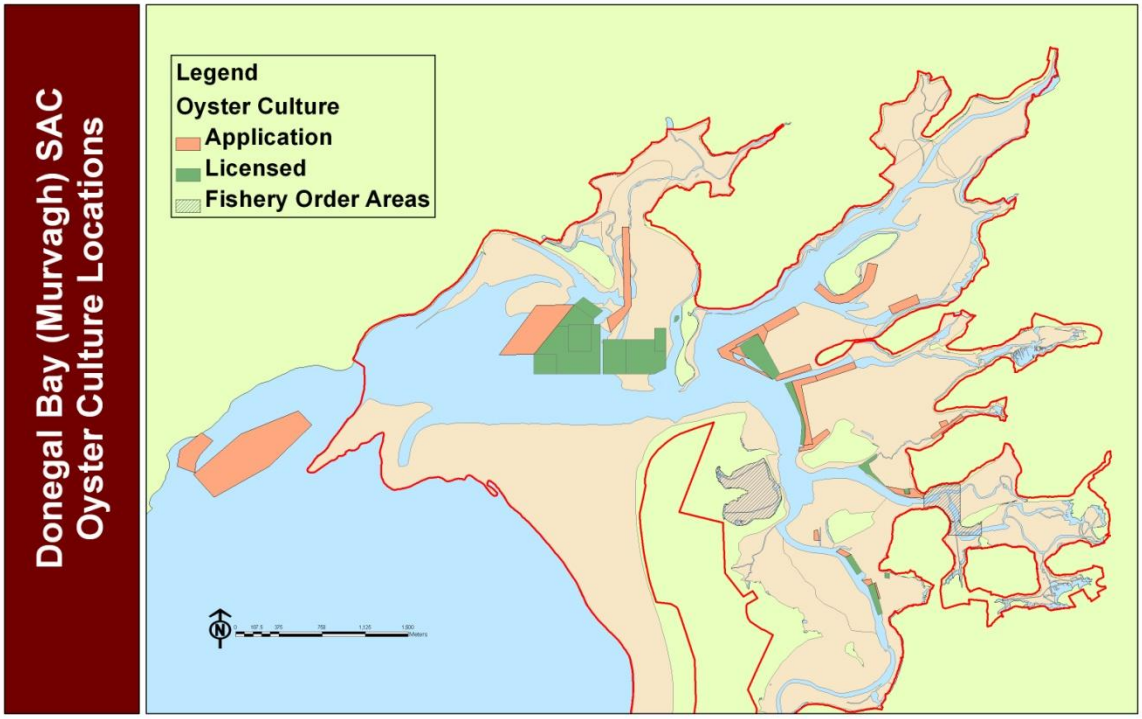


**Figure 4:** Proposed and existing oyster culture activity within the Donegal Bay (Murvagh) SAC.

Oyster farming within Donegal Bay takes place in the intertidal zone using the standard bag and trestle culture method typically employed across the rest of Ireland and abroad. Cultivation of the Pacific oyster (*Crassostrea gigas)* is carried out by growing oysters in mesh bags placed on steel trestles to keep them elevated above the seabed. Oysters are not artificially fed nor do they receive any medicinal treatments. They are filter feeders relying completely on the natural environment for food, and consume phytoplankton when submerged during high tide periods.

Trestles used in Donegal Bay typically measure 3m x 0.5m and stand 0.4 - 0.7m in height above the seabed, each holding 6 bags. There are variations of this. The bags are made of a plastic (HDPE) mesh and are fastened to trestles using rubber straps and hooks. The mesh size varies depending on the grade of oyster stock (4mm, 6mm, 9mm, 13mm).

The production cycle begins in Donegal Bay when 4-10mm (G3 - G7) seed is introduced from French hatcheries in the Spring of each year. Hatcheries from which seed are sourced are:

- GrainOcean
- France Naissin
- Satmar (3 French hatcheries)
- FranceTurbot

Time to harvest, depending on intake size, ranges from 2.5 to 4 years. Donegal Bay is also used for the production of half grown oysters which are harvested at this size and finished in other bays both in Ireland and in France.

Only hatchery produced triploid oysters are grown in Donegal Bay. They grow well in the bay and can be harvested year round.

The majority of licenced sites are accessed by tractor and trailer. Each operator observes one or 2 dedicated access routes to the sites from their land base (Figure 5). At any one time there will be up to 9 tractors, 2 four-wheel drive vehicles operating across the licensed sites in inner Donegal Bay.

Upon receipt from the hatchery, seed is placed in the mesh plastic bags with mesh size and stocking density appropriate to the seed grade. Initial stocking densities are anywhere between 600 and 2000 oysters per bag. As the oysters grow stocking densities are reduced. After the first year oysters will reach an individual weight of 10-15g. At the end of year 2, upon reaching 50-60g, typical stocking densities are set at 250 – 300 per bag and this reduces to a final density of 90 - 110 oysters per bag at finishing prior to harvest, at a weight of approximately 100g each.

Grading takes place annually in early autumn for seed and between January and May for the remainder of stock. Grading and harvesting activities entails actually removing the bags from the inter-tidal zone to the various land bases. They are collected by hand, loaded onto trailers and transported offsite by tractor.

All trestle lines and blocks are labelled by their operators for site management, stock management and traceability purposes. Based upon experience, the operators utilise different areas of their sites for different oyster grades to maximise growth and minimise risks. All stocking and movement

activities are recorded by date and location so that a full record of stock distribution is maintained on an ongoing basis. As appropriate, site boundaries are marked for navigational purposes.

Most of the growers use more exposed upper shore sections of their licensed sites as dedicated holding areas to allow for "hardening" of the final harvestable product ready for transport to market. As well as conditioning the oysters, this also serves to bring all harvestable stock to a single location thus minimising the amount of time spent on the other sites while harvesting to demand.

Maintenance activities on-site include shaking and turning of bags, and hand removal of fouling and seaweed to ensure maintain water flow through the bags when submerged. The bags are shaken and turned on site three – four times over the growing season which is between May and September. Tractor movements in this instance are simply for the transport of staff to and from site. Nearshore (hardening) sites can also be accessed by foot.

Given the scale of the two larger oyster farming operations in Donegal Bay the programme of work becomes continuous over all low tide periods. However, more intensive period of activity occur during Spring (February-April) when the bags are stocked with new seed and existing stock is graded. The Summer months (May-September) are relatively quiet when bags are turned to reduce fouling and ensure even growth of oysters. During the warmer months activity is kept to an absolute minimum so as not to disturb the oysters. When the water temperatures are at their maximum, oysters may become stressed and disturbance may impact negatively on their performance. During October, activity increases to a peak in and around Christmas as harvesting and grading occurs primarily to serve holiday markets.

### 4.2 Spatial Extent of Aquaculture (Oyster Culture) Activities

Spatial extents of existing and proposed activities within the qualifying interest (Mudflats and sandflats not covered by seawater at low tide (1140) of Donegal Bay (Murvagh) SAC were calculated using coordinates of activity areas in a GIS (Figure 3). The spatial extent of the various aquaculture activities (current and proposed) overlapping habitat features is presented in Table 2. In addition, the access routes for those sites not accessed by boat are provided in Figure 5. These routes are typically single or double tracks that run along the most stable shore from the point of entry to the aquaculture sites. Given the necessity for stability, the routes are not always the most direct. An estimate of the spatial extent of access routes based upon a putative width of 10m and linear extent is included in Table 2.

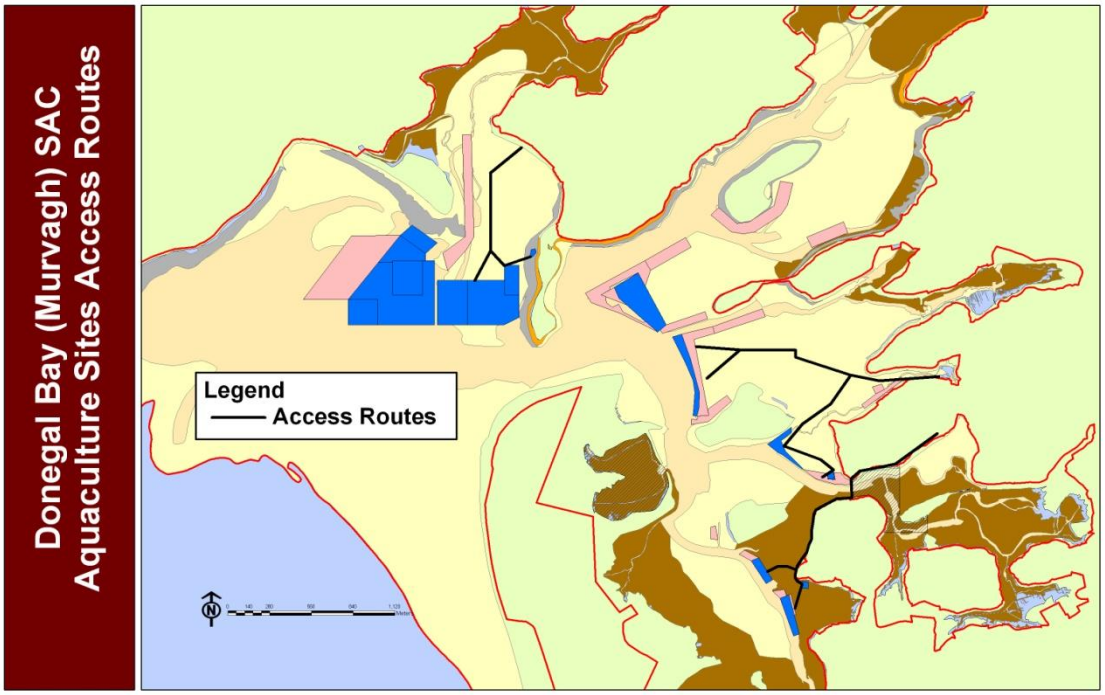


**Figure 5:** Access Routes to Aquaculture sites in Donegal Bay (Murvagh) SAC (access routes not drawn to scale)

Table 2: Spatial extent (ha) of aquaculture activities overlapping with community complexes identified within the qualifying interest (Mudflats and sandflats not covered by seawater at low tide) in Donegal Bay (Murvagh) SAC, presented according to species, method of cultivation and license status.
*** specific community complexes within the qualifying feature Mudflats and sandflats not covered by seawater at low tide (1140)**
**[1] Areas licenced for oysters and clams but oyster culture only activity carried forward in the assessment on foot of communication from BIM[2].**

| License ID | Status | Species | Total License Area (ha) | Estuarine fine sands dominated by polychaetes and oligochaetes community complex* | | Intertidal hard substrate | | Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex* | | Subtidal fine sands with polychaetes and bivalves community complex | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Extent (ha) of marine habitat:** | | | | **309.13** | | **41.68** | | **759.41** | | **412.40** | |
| | | | | **Area** | ***% habitat*** | **Area** | ***% habitat*** | **Area** | ***% habitat*** | **Area** | ***% habitat*** |
| T12/092A | Licensed | Oysters[1] | 2.16 | | | | | 0.73 | 0.10 | 1.43 | 0.35 |
| T12/092B | Licensed | Oysters[1] | 1.34 | | | | | 0.94 | 0.12 | 0.39 | 0.10 |
| T12/092C | Licensed | Oysters[1] | 0.18 | | | | | 0.18 | 0.02 | | |
| T12/145A | Licensed | Oysters[1] | 2.15 | | | 0.14 | 0.33 | 0.17 | 0.02 | 1.84 | 0.45 |
| T12/145B | Licensed | Oysters[1] | 14.14 | | | | | 1.67 | 0.22 | 12.47 | 3.02 |
| T12/243A | Licensed | Oysters[1] | 4.60 | | | | | 0.02 | 0.00 | 4.58 | 1.11 |
| T12/243B | Licensed | Oysters[1] | 3.40 | | | | | | | 3.40 | 0.82 |
| T12/243C | Licensed | Oysters[1] | 6.00 | | | | | 4.59 | 0.60 | 1.41 | 0.34 |
| T12/243D | Licensed | Oysters[1] | 2.00 | | | | | 2.00 | 0.26 | | |
| T12/346A | Licensed | Oysters | 9.25 | | | 0.00 | 0.00 | 9.06 | 1.19 | 0.19 | 0.05 |
| T12/347A | Licensed | Oysters | 5.94 | | | | | 3.32 | 0.44 | 2.62 | 0.63 |
| T12/349A | Licensed | Oysters | 0.17 | | | 0.17 | 0.40 | | | | |
| T12/350A | Licensed | Oysters | 1.43 | 0.24 | 0.08 | | | | | 1.19 | 0.29 |
| T12/350B | Licensed | Oysters | 0.94 | 0.31 | 0.10 | | | | | 0.63 | 0.15 |
| T12/350C | Licensed | Oysters | 0.18 | 0.18 | 0.06 | | | | | | |
| T12/371A | Licensed | Oysters | 3.17 | | | | | 0.04 | 0.01 | 3.13 | 0.76 |
| **Total area (or proportion) of habitat occupied by <u>licenced</u> aquaculture (ha)** | | | | **0.74** | ***0.24*** | **0.30** | ***0.73*** | **22.73** | ***2.99*** | **33.28** | ***8.07*** |

[2] E-mail communication 23/4/2013

| License ID | Status | Species | Total License Area (ha) | Estuarine fine sands dominated by polychaetes and oligochaetes community complex* | | Intertidal hard substrate | | Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex* | | Subtidal fine sands with polychaetes and bivalves community complex | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T12/374A | Application | Oysters | 1.38 | | | | | 1.37 | 0.18 | | |
| T12/396A | Application | Oysters | 13.46 | | | | | 3.62 | 0.48 | 9.84 | 2.39 |
| T12/401A | Application | Oysters | 2.37 | | | | | 1.72 | 0.23 | 0.64 | 0.16 |
| T12/401B | Application | Oysters | 5.34 | | | 0.83 | 2.00 | 3.26 | 0.43 | 1.24 | 0.30 |
| T12/401C | Application | Oysters | 2.03 | 0.05 | 0.01 | | | 0.65 | 0.09 | 1.33 | 0.32 |
| T12/402A | Application | Oysters | 1.56 | | | | | 1.48 | 0.20 | 0.07 | 0.02 |
| T12/402B | Application | Oysters | 3.55 | | | | | 3.12 | 0.41 | 0.44 | 0.11 |
| T12/402C | Application | Oysters | 0.61 | | | | | | | 0.61 | 0.15 |
| T12/402D | Application | Oysters | 0.46 | | | | | 0.46 | 0.06 | 0.00 | 0.00 |
| T12/446A | Application | Oysters | 10.32 | | | 0.30 | 0.73 | 6.69 | 0.88 | 3.32 | 0.81 |
| T12/464A | Application | Oysters | 0.33 | | | | | 0.33 | 0.04 | 0.01 | 0.00 |
| T12/465A | Application | Oysters | 0.33 | 0.05 | 0.02 | | | | | 0.28 | 0.07 |
| T12/463A | Application | Oysters | 0.19 | 0.19 | 0.06 | | | | | | |
| T12/463B | Application | Oysters | 0.42 | 0.15 | 0.05 | | | | | 0.27 | 0.07 |
| T12/467A | Application | Oysters | 4.29 | | | | | 2.29 | 0.30 | 2.01 | 0.49 |
| T12/467C | Application | Oysters | 1.50 | | | | | 1.33 | 0.17 | 0.17 | 0.04 |
| T12/467B | Application | Oysters | 1.84 | | | | | 0.53 | 0.07 | 1.31 | 0.32 |
| T12/467D | Application | Oysters | 0.92 | | | | | 0.92 | 0.12 | | |
| OFO No. 2 | Fishery Order | Oysters | | 5.02 | 1.62 | | | 1.21 | 0.16 | 2.66 | 0.64 |
| **Access Routes** | | | | 1.2 | 0.4 | | | 4.5 | 0.6 | | |
| **Total area *(or proportion)* of habitat occupied by <u>licenced and proposed</u> aquaculture (ha)** | | | | **7.39** | ***2.40*** | **1.44** | ***3.46*** | **56.21** | ***7.41*** | **57.48** | ***13.94*** |

### 4.3 Details of fishing activities in inner Donegal Bay

Fishery in the area east of St. Johns Point and Mullaghmore. Involves mainly punts fishing for sprat, salmon, shrimp, lobster and crab. These small vessels change activity seasonally and even monthly. Approximately 27 punts in total fish in the area. In addition large vessels target sprat and to a lesser extent herring in Autumn in Inver Bay and bottom otter trawls target mixed demersal and Nephrops in Inver Bay and south west to Inishmurray. There is a draft net fishery for salmon in the Inny estuary. There is no fishing activity within the SAC. There is a small amount of fishing for lobster and crab in the south and east coast of the Donegal Bay SPA. This fishery uses pots and possibly trammel nets for capture of bait.

**Pelagic trawl and encircling nets**

a. Sprat: Mainly in Inver Bay. Vesssels >15m and <15m using pelagic trawls fishing out of Killybegs. Up to 20 punts using ring nets and other encircling nets. Autumn fishery in Sept to November
b. Herring: At St. Johns Point, Dec and January using pelagic trawls. Mainly vessels over 15m

**Line fishing**

a. Mackerel: Punts fishing from St. Johns Point to Inver Bay
b. Squid: Punts fishing from St. Johns Point to Inver Bay. Aug - September

**Draft nets**

a. Salmon: Estuary of Inny River into Inver Bay, along shore. 10 draft net licences fishing from mid_May to August 1$^{st}$. Quota for fish is low.

**Pots**

a. Lobster/crab: St. Johns to Doorin Pt. No activity east of Doorin Pt. Some trammel netting (bait fishing) associated with this fishery mainly by smallest vessels with less gear. Vessels with more gear purchase frozen bait. Up to 20 punts, part-time. Mullaghmore to Creevy , 7 punts / half deckers. Fishing effort 200 pots per vessel mainly and exceptionally 300-400 pots per vessel

b. Shrimp: Defined season Aug-May (mainly Sept to Dec). Up to 20 punts (same vessels as in lobster and sprat fishery St. Johns Point to Inver Bay

c. *Nephrops*: St. Johns Point to Inver Bay. Low level of activity, episodic

**Demersal trawl**

a. Mixed fish and Nephrops: St. Johns Point to Inver Bay. Tracks south west from St. Johns to Inishmurray. Vessels over and under 15m fishing out of Killybegs.

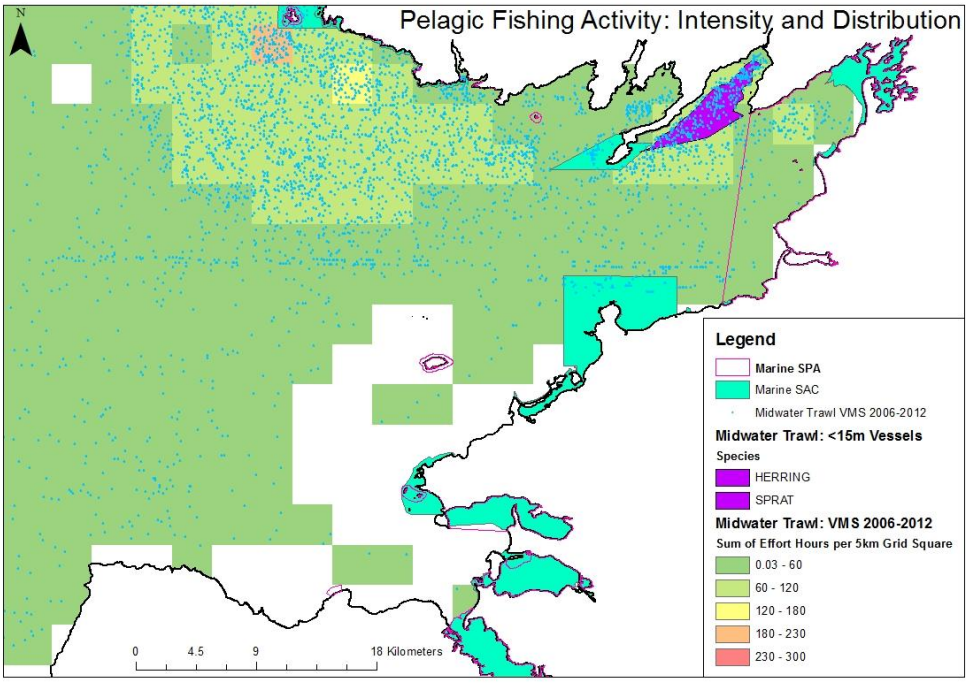


**Figure 6:** Distribution of pelagic fishing activity in Donegal Bay. The SACs and SPAs in the area are shown. VMS data for vessels over 15m are shown. This data is also shown in gridded form in effort hours per 5km$^2$. Polygons showing the locations of fishing by vessels under 15m are indicated.

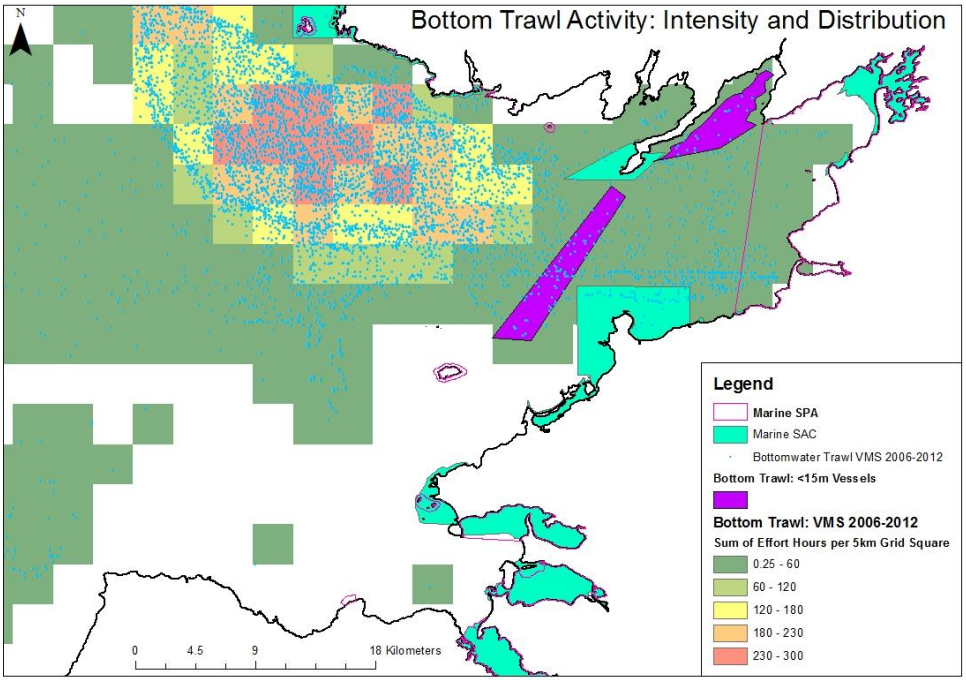


**Figure 7:** Distribution of bottom trawl fishing activity in Donegal Bay. The SACs and SPAs in the area are shown. VMS data for vessels over 15m are shown. This data is also shown in gridded form in effort hours per 5km$^2$. Polygons showing the locations of fishing by vessels under 15m are indicated.

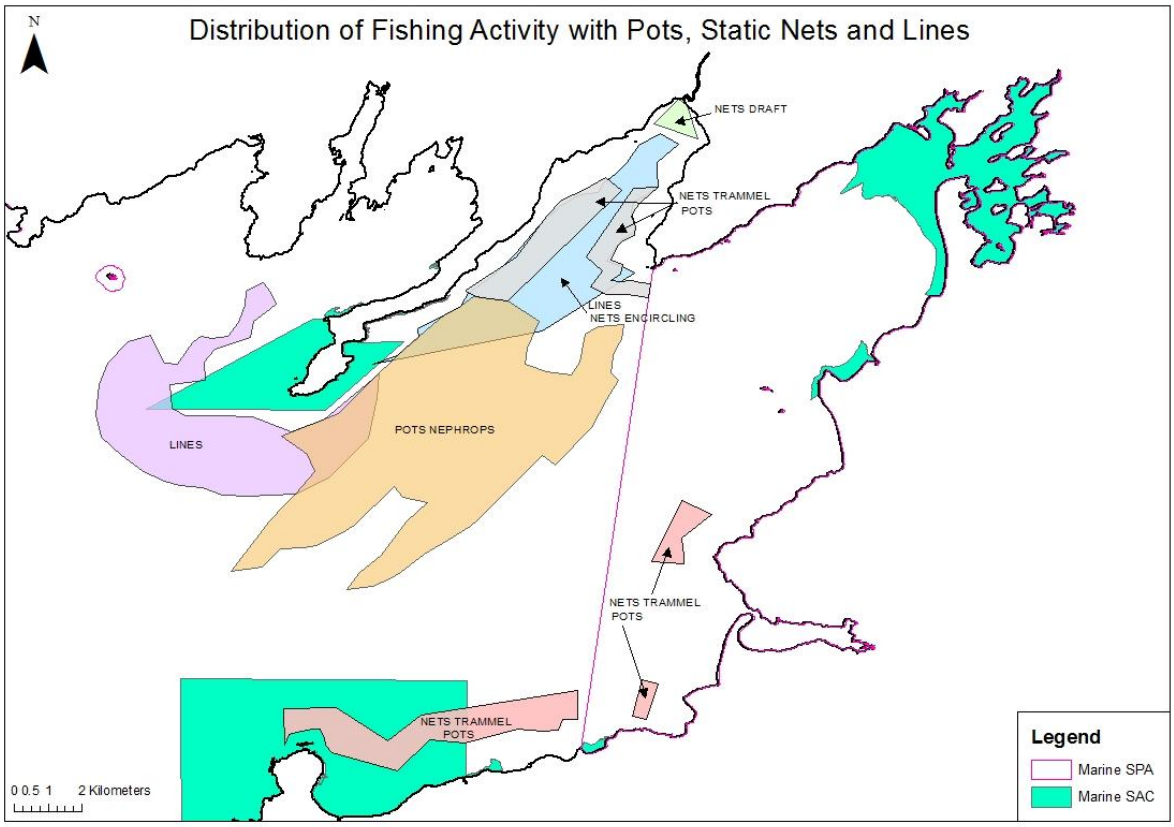


**Figure 8:** Distribution of fishing activity with pots, static nets and lines in Donegal Bay. The SACs and SPAs in the area are shown.

# 5 Natura Impact Statement for the activities

## 5.1 Potential Ecological Effects of aquaculture

The potential effects of the existing and proposed activities on the conservation features of the site are governed by the physical and biological effects of aquaculture species, the structures used and the associated human activities on habitats and invertebrate communities and biotopes of those habitats as well as Annex II species. More specifically, the potential ecological effects of aquaculture on the qualifying interests of the site depend primarily on the type of species being cultured, the system of culture and how they interact with the properties of the receiving habitat. Both extensive and intense aquaculture practices can alter the surrounding environment, both physically and biologically, not only due to the presence of the culture organisms (e.g. increased deposition, disease, shading, fouling, alien species) but also due to the activities associated with the culture mechanisms (e.g. structures resulting in current alteration, dredging, sediment compaction).

Within the qualifying interest of Donegal Bay (Murvagh) SAC, the species cultured is oysters (*Crassostrea gigas*) in suspended culture (contained in bags & trestles) which are confined primarily to intertidal areas. Details of the potential biological and physical effects of this aquaculture activity on the habitat feature, their sources and the mechanism by which the impact may occur are summarised

in Table 3, below**.** The impact summaries identified in the table are derived from published primary literature, review documents that have specifically focused upon the environmental interactions of shellfish culture (e.g. McKindsey et al. 2007; NRC 2010; O'Beirn et al 2012; Cranford et al 2012; ABPMer 2013).

In relation to Harbour seals (*Phoca vitulina*), less information is available on the potential interactions between the species and the activity in question (intertidal oyster culture) (see NRC 2009). There has been no targeted research conducted in similar ecosystems that has directly assessed the impact of this type of aquaculture on harbor seals or indeed any other seal populations. There has, however, been considerable research on short-term responses of harbor seals to disturbance from other sources, and these can be used to inform assessments the potential impacts of disturbance from shellfish culture currently underway and proposed in Donegal Bay (Murvagh) SAC. These disturbance studies have focused on impacts upon groups of seals that are already ashore at haul-out sites. Sources of potential disturbance have varied widely, and include people and dogs (Allen et al., 1984; Brasseur & Fedak, 2003), recreational boaters (Johnson & Acevedo-Gutierrez, 2007; Lelli & Harris, 2001; Lewis & Mathews, 2000), commercial shipping (Jansen et al., 2006), industrial activity (Seuront & Prinzivalli, 2005) and aircraft (Perry et al., 2002). A harbor seal's response to disturbance may vary from an increase in alertness, movement towards the water, to actual entering into the water, i.e. flushing (Allen et al., 1984) and is typically governed by the location and nature of the disturbance activity. For example, kayaks often elicit a stronger response than power boats (Lewis & Mathews, 2000; Suryan & Harvey, 1999), and stationary boats have been shown to elicit a stronger response than boats moving along a predictable route (Johnson & Acevedo-Gutierrez, 2007). Furthermore, the mean distance at which seals are flushed into the water by small boats and people ranges between 80m and 530m, with some disturbances recorded at distances of over 1000m. In certain areas, these empirical studies have been used to inform management actions in marine protected areas, for example where a 1.5km buffer is set around harbor seal haul-out sites in the Dutch Wadden Sea to exclude recreational disturbance (Brasseur & Fedak, 2003).

Displacement from areas may also result from disturbances attributable to the activities of mariculture workers (Becker et al., 2009; 2011). This disturbance may be caused directly by the presence of workers on intertidal areas. However while disturbance from shellfish culture operations have been observed to influence the distribution of seal within a sheltered embayment, no inference can be made on the broader population dynamics of harbour seals (Becker 2011).

Potential interactions between mariculture and marine mammals are broadly summarized in Table 4. It should be noted that direct demonstrations of these impacts are rare, and in most cases, potential effects are therefore predicted from the best existing information (NRC, 2010). Furthermore, none of the studies published to explore impacts on marine mammals and in particular Harbour Seals, were specifically designed to detect ecological impacts on this species (NRC 2009; Becker et al., 2009, 2011). Even where studies have been carried out around shellfish farms, uncertainty over spatial and temporal variation in both the location of structures (Watson-Capps and Mann, 2005) and levels of

disturbance (Becker et al., 2009; 2011) constrain the conclusions that can be drawn about the impacts of mariculture on critical life functions such as reproduction and foraging.

Mariculture operations are considered a source of marine litter (Johnson, 2008). Ingestion of marine litter has also been shown to cause mortality in birds, marine mammals, and marine turtles (Derraik, 2002).

Mariculture structures can provide shelter, roost, or haul-out sites for birds and seals. This is unlikely to have negative effects on bird or seal populations., but it may increase the likelihood that these species cause faecal contamination of mollusc beds.

In the Donegal Bay (Murvagh) SAC it would appear that the overall Harbour Seal numbers (population) has been stable or increasing between 2003 and 2012 (NPWS data) coincident with increasing levels of mariculture production. While no definitive conclusions can be drawn regarding the population status of harbour seals in Donegal and more widely around Ireland, based upon survey reports from 2009-2011 (as no baseline reference values are provided), it would appear that the levels both regionally and nationally are stable (see Figure 2 in NPWS 2012 - http://npws.ie/marine/marinereports/Harbour%20Seal_NPWS%20pilot%20monitoring%20study%202011_Final%20doc.pdf).

### 5.2 Potential ecological effects of fishing

There are no fisheries activities within the SAC. Fisheries therefore have no potential ecological effect on designated marine habitats in the SAC.

The Harbour Seal population is not exposed to any fishing activity in the SAC. It may encounter fishing activity during foraging in inner Donegal Bay. Potential ecological effects include by-catch in fishing gear, reduced availability of prey due to competition with fisheries and disturbance by fishing vessels

**Table 3: Potential indicative environmental pressures of aquaculture activities within the qualifying interest (Mudflats and sandflats not covered by seawater at low tide (1140)) of Donegal Bay (Murvagh) SAC.**

| CULTURE METHOD | PRESSURE CATEGORY | PRESSURE | POTENTIAL EFFECTS | EQUIPMENT | DURATION (DAYS) | TIME OF YEAR | FACTORS CONSTRAINING THE ACTIVITY/EFFECTS |
|---|---|---|---|---|---|---|---|
| **Suspended - Bags & trestles (Oysters)** | **Biological** | Deposition | Faecal and pseudofaecal deposition on seabed potentially altering sediment and community composition | | 365 | All year | Hydrography, Turbidity, Culture/structure density |
| | | Seston filtration | Alteration of phyto/zooplankton communities and potential impact on carrying capacity | | 365 | All year | Culture density, Turbidity |
| | | Shading | Prevention of light penetration to seabed potentially impacting light sensitive species | | 365 | All year | Culture/structure density |
| | | Fouling | Increased secondary production on structures and culture species. Increased nekton production | | 365 | All year | Culture/structure density |
| | | Introduction of non-native species | Potential for non-native culture and 'hitchhiker' species become naturalized | | | | Screening/ Culture method/ Introduce biosecurity plan/seed from low-risk sources |
| | | Disease risk | Potential for disease introduction and uncontrolled spread | | | | Screening/ Introduce biosecurity plan |

| CULTURE METHOD | PRESSURE CATEGORY | PRESSURE | POTENTIAL EFFECTS | EQUIPMENT | DURATION (DAYS) | TIME OF YEAR | FACTORS CONSTRAINING THE ACTIVITY/EFFECTS |
|---|---|---|---|---|---|---|---|
| | | Nutrient exchange | Changes in ammonium and dissolved inorganic nitrogen resulting in increased primary production.<br>$N_2$ removal at harvest or denitrification at sediment surface. | | | | Culture density |
| | **Physical** | Current alteration | Structures may alter the current regime resulting in increased deposition of fines or scouring therefore changing sedimentary composition | Long lines, Baskets, Bags, Trestles, Floats etc | 365 | All year | Culture/structure density |
| | | Surface disturbance | Ancillary activities at sites increase the risk of sediment compaction resulting in sediment changes and associated community changes. | Site services, human & vehicular traffic | | | |
| | | Shading | Structures prevent light penetration to the seabed and therefore potentially impact on light sensitive species | Long lines, Baskets, Bags, Trestles, Floats etc | 365 | All year | Culture/structure density |

**Table 4. Potential interactions between aquaculture activities and the Annex II species Harbour Seal (*Phoca votulina*) within the Donegal Bay (Murvagh) SAC.**

| CULTURE METHOD | PRESSURE CATEGORY | PRESSURE | POTENTIAL EFFECTS | EQUIPMENT | DURATION (DAYS) | TIME OF YEAR | FACTORS CONSTRAINING THE ACTIVITY/EFFECTS |
|---|---|---|---|---|---|---|---|
| **Suspended - Bags & trestles (Oysters)** | **Physical** | Habitat Exclusion | Structures may result in a barrier to movement of seals. | Bags and trestles | 365 | All year | Spatial extent and location of structures used for culture. |
| | | Disturbance | Ancillary activities at sites increase the risk of disturbance to seals at haul out sites (resting, breeding and/or moulting) or in the water. | Site services, human, boat and vehicular traffic | 365 | All year | Seasonal levels of activity relating to seeding, grading, and harvesting. Peak activities do no coincide with more sensitive periods for seals (i.e. pupping and moulting) |
| | | Entanglement | Entanglement of seals from ropes or material used on structures or during operation of farms | Trestles, bags or ropes used in day to day | 365 | All year | Farm management practices |
| | | Ingestion | Ingestion of waste material used on farm | Ties used to secure bags and secure bags to trestle | 365 | All year | Farm management practices |

# 6 Appropriate Assessment and Risk Assessment Screening

Screening is an initial evaluation of the possible impacts that activities may have on the qualifying interests. The screening, is a filter, which may lead to exclusion of certain activities from appropriate assessment proper, thereby simplifying the assessments, if this can be justified unambiguously using limited and clear cut criteria. Screening is a conservative filter that minimises the risk of false negatives.

In this assessment screening of the qualifying interests against the proposed activities is based solely on spatial overlap i.e. if the qualifying interests overlap spatially with the proposed activities then significant impacts due to these activities on the conservation objectives for the qualifying interests is not discounted (not screened out) except where there is absolute and clear rationale for doing so. Where there is relevant spatial overlap appropriate assessment proper is warranted. Likewise if there is no spatial overlap, and all interaction with a QI can be excluded, then the possibility of significant impact is discounted and further assessment of possible effects is deemed not to be necessary. Table 5 provides spatial overlap extent between designated habitats and aquaculture activities within the qualifying interests of Donegal Bay (Murvagh) SAC.

## 6.1 Aquaculture Activity Screening

- Table 5 provides an overview of overlap of aquaculture activities and habitat features (identified from Conservation objectives)
- Where the overlap between an aquaculture activity and a feature is zero it is screened out and not considered further.
- None of the aquaculture activities (or access routes) overlap with 2130 (fixed coastal dunes with herbaceous vegetation 'grey dunes') or 2190 (Humid dune slacks)
- Table 5 lists the percentage overlap of the sole aquaculture activity (oyster- bag and trestle) and habitat/community. Each relevant cell (aquaculture activity – feature/benthic community/designated species combination) for which a non-zero value is obtained is carried further in the assessment in section 8. Those with a zero value are not considered further in the analysis.

  Two habitats are excluded from further consideration in this assessment, they are;

  - 2130 (fixed coastal dunes with herbaceous vegetation 'grey dunes') and
  - 2190 (Humid dune slacks)

## 6.2 Fishing Activity Screening

- There are no fisheries in the SAC. As there is no spatial overlap with SAC Habitats all fishing activities are screened out with respect to impacts on habitats
- Harbour seals in the SAC will not be disturbed by fishing activity. This pressure can be screend out

- Harbour seals may compete with fisheries for fish prey and there is a risk of by-catch. Prey competition and by-catch pressures due to fisheries cannot be screened out and are subject to risk assessment below.

**Table 5:** Habitat utilisation i.e. spatial overlap in hectares and (proportion of specific habitat) by Aquaculture activity within the qualifying interests of Donegal Bay (Murvagh) SAC based on licence database provided by DAFM. Habitat data provided in NPWS 2011 – supporting docs marine and coastal)

| | | **Mudflats and sandflats not covered by seawater at low tide** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Designation** | **Total** | **Constituent Community Complex** | | ***Intertidal hard substrate*** | ***Subtidal fine sands with polychaetes and bivalves community complex*** | ***Harbour Seal (Phoca vitulina)**** | ***Fixed coastal dunes with herbaceous vegetation 'grey dunes' (2130)*** | ***Humid dune slacks (2190)*** |
| | | | **Estuarine fine sands dominated by polychaetes and oligochaetes community complex** | **Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex** | | | | | |
| | ***Area (ha)*** | **1069** | **309** | **759** | **42** | **412** | | **27** | **0.123** |
| **Aquaculture activity - *Oyster (bag and trestle culture)*** | ***Total*** | **63.59 (5.95)** | **7.39 (2.40)** | **56.21 (7.41)** | **1.44 (3.46)** | **57.48 (13.94)** | **116.82*** | **0** | **0** |
| | ***Licenced*** | **25.47 (2.19)** | **0.74 (0.24)** | **22.73 (2.99)** | **0.30 (0.73)** | **33.28 (8.07)** | **57.05*** | **0** | **0** |
| | ***Application*** | **28.20 (2.64)** | **0.43 (0.14)** | **27.77 (3.66)** | **1.14 (2.73)** | **21.55 (5.22)** | **50.89*** | **0** | **0** |
| | ***Fishery Order Area*** | **6.23 (0.58)** | **5.02 (1.62)** | **1.21 (0.16)** | | **2.66 (0.64)** | **8.89*** | **0** | **0** |
| | ***Access Routes*** | **5.70 (0.5)** | **1.20 (0.4)** | **4.50 (0.6)** | | | **5.70*** | | |

*** The estimated overlap with the Harbour Seal is the total estimate of aquaculture area (licenced and applications) based upon the assumption that the harbour seal may range throughout the entire SAC.**

# 7 Appropriate Assessment of Aquaculture

## 7.1 Determining significance

The significance of the possible effects of the proposed activities on habitats, as outlined in the Natura Impact statement, is determined here in the appropriate assessment. The significance of effects is determined on the basis of Conservation Objective guidance for constituent habitats (NPWS 2011) (Figure 4) and species.

Habitats and species that are key contributors to biodiversity and which are sensitive to disturbance should be afforded a high degree of protection i.e. thresholds for impact on these habitats is low and any significant anthropogenic disturbance should be avoided. Within the Donegal Bay (Murvagh) SAC the qualifying habitats/species are:

- 1140 Mudflats and sandflats not covered by seawater at low tide
- 1365 Harbour Seal - *Phoca vitulina*
- 2130 Fixed coastal dunes with herbaceous vegetation ('grey dunes') ***– Screened out of further assessment***
- 2190 Humid Dune slacks ***– Screened out of further assessment***

Significant disturbance for habitats is interpreted in this assessment as indicated in Figure 9. For broad sedimentary communities significance of impact is determined in relation to spatial overlap, disturbance and the persistence of disturbance as follows:

1. The degree to which the activity will disturb the qualifying interest. By disturb is meant change in the characterising species, as listed in the Conservation Objective guidance (NPWS 2011) for constituent communities. The likelihood of change depends on the sensitivity of the characterising species to the aquaculture activities. Sensitivity results from a combination of intolerance to the activity and recoverability from the effects of the activity (see Section 7.1.2 below).
2. The persistence of the disturbance in relation to the intolerance of the community. If the activities are persistent (high frequency, high intensity) and the receiving community has a high intolerance to the activity (i.e. the characterising species of the communities are sensitive and consequently impacted) then such communities could be said to be persistently disturbed
3. The area of communities or proportion of populations disturbed. In the case of community disturbance (continuous or ongoing) of more than 15% of the community area it is deemed to be significant.

Effects will be deemed to be significant when cumulatively they lead to long term change in communities in greater than 15% of the area of any constituent community listed.

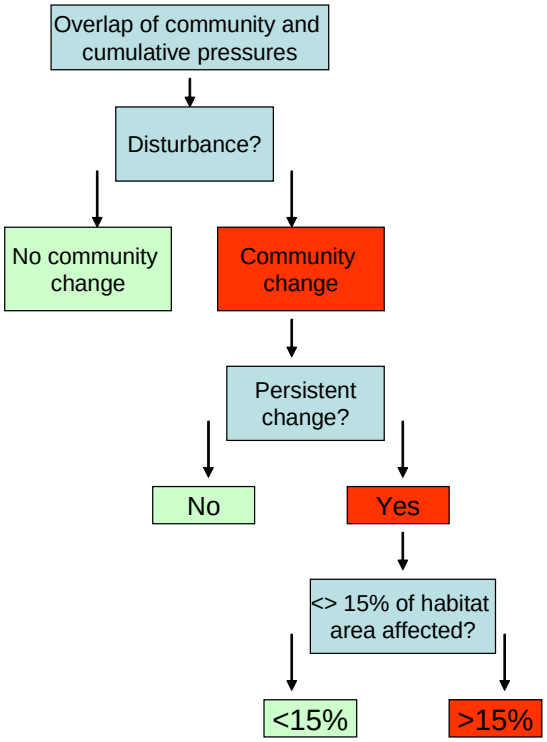


**Figure 9. Determination of significant effects on community distribution, structure and function (following NPWS 2011b).**

In relation to designated species (Harbour Seal) the capacity of the population to maintain itself in the face of anthropogenic induced disturbance or mortality at the site will need to be taken into account in relation to the Conservation Objectives (CO's) on a case by case basis.

### 7.1.1 Supporting evidence and confidence in conclusions

There are various levels of supporting evidence and therefore confidence for conclusions on the effects of activities on the conservation objectives for each qualifying interest. The degree of confidence with respect to findings of significant or no significant effects is categorised as high, medium or low (Table 6).

**Table 6: Level of confidence, based on supporting evidence, in relation to significance of effects and the implication for management decisions**

<table>
<tr><th rowspan="2">Level of confidence</th><th rowspan="2">Supporting evidence</th><th colspan="2">Implication in relation to significance</th></tr>
<tr><th>Where effects are found to be significant (>15% of any community type is persistently disturbed)</th><th>Where effects are found to be insignificant (<15% of any community type is persistently disturbed or where the activity occurs on >15% of the area but is not persistent or activity that is persistent in >15% of the area but is not considered disturbing)</th></tr>
<tr><td>High</td><td>Direct measurement of effects at the site</td><td rowspan="2">The impacting activity is unlikely to be allowed until the effects can be mitigated (i.e. brought below agreed thresholds).</td><td>The activities can proceed without mitigation</td></tr>
<tr><td>Moderate</td><td>Effects deduced from similar activities at similar sites</td><td>The activities can proceed but precautionary mitigation may be introduced.</td></tr>
<tr><td>Low</td><td>Expert judgement, ecological theory and expectation</td><td>The impacting activity may not be allowed until direct measurements of effects at the site shows evidence of non-significant effects</td><td>The activities can proceed but only with significant precautionary mitigation and agreement to provide direct evidence of non-significant effects within an agreed time scale</td></tr>
</table>

### 7.1.2 Sensitivity assessment rationale

This assessment primarily employed a number of sources of information in assessing the sensitivity of the characterising species of each community recorded within the intertidal sedimentary habitat of Donegal Bay (Murvagh) SA, including the MarLIN Sensitivity Assessment (Marlin.ac.uk) and the AMBI Sensitivity Scale (Borja *et al*., 2000) and the Habitat Assessment of sand habitats prepared on behalf of the Marine Institute by ABPMer (2013). The former assessment lists the sensitivity of species/habitat/community to a range of pressures while the latter lists the sensitivity of a species to the pressure of organic enrichment predominantly. Sensitivity of a species to a given pressure is the product of the intolerance (the susceptibility of the species to damage, or death, from an external factor) of the species to the particular pressure and the time taken for its subsequent recovery (recoverability-the ability to return to a state close to that which existed before the activity or event caused change). Life history and biological traits are important determinants of sensitivity of species to pressures from aquaculture.

The separate components of sensitivity (intolerance, recoverability) are relevant in relation to the persistence of the pressure

- For persistent pressures i.e. activities that occur frequently and throughout the year recovery capacity may be of little relevance except for species/habitats that may have extremely rapid (days/weeks) recovery capacity or whose populations can reproduce and recruit in balance with population damage caused by aquaculture. In all but these cases and if intolerance is moderate or high then the species may be negatively affected and will exist in a modified state. Such interactions between aquaculture and species/habitat/community represent persistent disturbance. They become significantly disturbing if more than 15% of the community is thus exposed (NPWS 2011).
- In the case of episodic pressures i.e. activities that are seasonal or discrete in time both the intolerance and recovery components of sensitivity are relevant. If intolerance is high but recoverability is also high relative to the frequency of application of the pressure then the species/habitat/community will be in favourable conservation status for at least a proportion of time.

The sensitivities of species which are characteristic (as listed in the Conservation Objective supporting document) of benthic communities to pressures similar to those caused by aquaculture (e.g. smothering, organic enrichment and physical disturbance) are listed, where available, in Tables 8, 9 and 10. In cases where the sensitivity of a characterising species (NPWS 2011) has not been reported this appropriate assessment adopts the following guidelines:

- Intolerance of certain taxonomic groups such as emergent sessile epifauna to physical pressures is expected to be generally high or moderate because of their form and structure (Roberts *et al.* 2010). Also high for those with large bodies and with fragile shells/structures, but low for those with smaller body size. Body size (Bergman and van Santbrink 2000) and fragility are regarded as indicative of a high intolerance to physical abrasion caused by fishing

gears (i.e. dredges). However, even species with a high intolerance may not be sensitive to the disturbance if their recovery is rapid once the pressure has ceased.

- Intolerance of certain taxonomic groups to increased sedimentation is expected to be low for species which live within the sediment, deposit and suspension feeders; and high for those sensitive to clogging of respiratory or feeding apparatus by silt or fine material.
- Recoverability of species depends on biological traits (Tillin *et al.* 2006) such as reproductive capacity, recruitment rates and generation times. Species with high reproductive capacity, short generation times, high mobility or dispersal capacity may maintain their populations even when faced with persistent pressures; but such environments may become dominated by these (r-selected) species. Slow recovery is correlated with slow growth rates, low fecundity, low and/or irregular recruitment, limited dispersal capacity and long generation times. Recoverability, as listed by MarLIN, assumes that the impacting factor has been removed or stopped and the habitat returned to a state capable of supporting the species or community in question. The recovery process is complex and therefore the recovery of one species does not signify that the associated biomass and functioning of the full ecosystem has recovered (Anand & Desrocher, 2004) cited in Hall *et al*., 2008).

### 7.2 Sensitivity of benthic species and communities in relation to potential disturbance by aquaculture activities

Aquaculture pressures on a given habitat are related to vulnerability (spatial overlap or exposure of the habitat to the equipment/culture organism combined with the sensitivity of the habitat) to the pressures induced by culture activities. To this end the location and orientation of structures associated with the culture organism, the density of culture organisms, the duration of the culture activity and the type of activity are all important considerations when considering risk of disturbance to habitats.

NPWS (2011) provide lists of species characteristic of benthic communities that are defined in the Conservation Objectives. The species defined are typical of estuarine (variably salinity) and intertidal habitats (tolerant of dessication and physical stress). These habitats are typically impoverished with low numbers of species and overall abundances.

Different species and habitats will have different tolerance to the pressures associated with shellfish aquaculture activities (pressures as discussed in Section 5). The constituent communities identified in the broad Annex 1 habitat (i.e., Mudflats and sandflats not covered by seawater at low tide) are: 1) *Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex*, and 2) *Estuarine fine sands dominated by polychaetes and oligochaetes community complex appear typical of sheltered areas*. They are predominantly sandy habitats and given they are intertidal and estuarine, can be exposed to a range of physical and hydrodynamic pressures. Tables 7-10 (inclusive) lists the characterising species and provides a commentary of their sensitivity to a range of pressures. The scores are derived from a range of sources identified in Section 7.1.2. The pressures are listed as those likely to result primarily from the activities carried out in Donegal Bay

(Murvagh) SAC, i.e. intertidal oyster culture in bags on trestles. More specifically, the potential impacts of the operation on the sedimentary communities of Donegal Bay (Murvagh) SAC are:

- **Deposition** on the seabed of oyster faeces and pseudofaeces can lead to organic enrichment and can result in a change in sediment type which in turn can result in changes to the biological communities within. The degree of deposition depends on the culture density, the baffling effect caused by the culture structures, exposure of the site. The physical presence of the trestles and bags may be responsible for reducing water flow and allowing suspended material (silt, clay as well as faeces and pseudo-faeces) to fall out of suspension to the seafloor. The build-up of material will typically occur directly beneath the trestle structures and can result in accumulation of fine, organically rich sediments. These sediments may result in the development of infaunal communities distinct from the surrounding areas. However, suspended oyster culture typically has a moderate and localised (usually under the footprint of the culture activity) effect on inter-tidal benthos (Bouchet and Sauriau 2008; Forrest *et al*. 2009). In addition, the hydrodynamics of an area (e.g. tidal range, fetch and exposure) may also influence any impact of increased sedimentation or organic enrichment by flushing material from beneath the cages thus mitigating any impact on benthic communities.
- **Physical disturbance** caused by compaction of sediment from foot traffic and vehicular traffic. Activities associated with the culture of oyster included the travel to and from the culture sites and within the culture sites using tractors and trailers as well as the activities of workers within the site boundaries.
- **Introduction of non-native species** Oyster culture poses a risk in terms of the introduction of non-native species as the Pacific oyster (*Crassostrea gigas*) itself is a non-native species. Recruitment of *C. gigas* has been documented in a number of Bays in Ireland and appears to have become naturalised (i.e. establishment of a breeding population) in two locations (Kochmann et al 2012; 2013) and may compete with the native species for space and food. The culture of large volumes of Pacific oysters may increase the risk of successful reproduction in Donegal Bay (Murvagh) SAC. The use of triploid (non-reproducing) stock is the main method employed to mange this risk. Furthermore, the introduction of non-native species as 'hitchhikers' on and among culture stock is also considered a risk, the extent of which is dependent upon the duration the stock has spent 'in the wild' outside of Donegal Bay. Half-grown stock (15-30g oysters) which would have been grown for extended periods in places (in particular outside of Ireland) present a higher risk. Oysters grown in other bays in Ireland and 'finished' in Donegal Bay, would not appear to present a risk of introduction of non-native species assuming best practice is applied (e.g. http://invasivespeciesireland.com/cops/aquaculture/).
- **Disease:** Due to the nature of the (high density) culture methods the risk of transmission of disease within cultured stock is high. However, given that *Crassostrea gigas* does not appear to occur in the wild the risk of disease transmission to 'wild' stock is considered low. The risk of disease transmission from cultured oysters to other species is unknown.

**Table 7: Sensitivities to organic enrichment (based on the AMBI classification) of species characteristic of communities which have spatial overlap with aquaculture activities within the Annex 1 Habitats of Donegal Bay (Murvagh) SAC (source: Borja et al 2000).**

| AMBI Classification | Sensitive (I) | Indifferent (II) | Tolerant (III) | Second-order opportunistic (IV) | First-order opportunistic (V) |
|---|---|---|---|---|---|
| **Community** | **Characterising species** | | | | |
| **Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex** | *Tellina (Angulus) tenuis*<br>*Tellina (Angulus) fabula*<br>*Bathyporeia pilosa* | *Nephtys cirrosa* | *Pygospio elegans*<br>*Scolelepis squamata*<br>*Arenicola marina*<br>*Cerastoderma edule* | | |
| **Estuarine fine sands dominated by polychaetes and oligochaetes community complex** | | *Mya truncata* | *Hediste diversicolor*<br>*Pygospio elegans*<br>*Nematoda*<br>*Cerastoderma edule* | | *Heterochaeta costata*<br>*Enchytraeidae*<br>*Tubificoides benedii*<br>*Tubificoides pseudogaster* |

**Table 8: Sensitivity assessment to increased smothering (as reported in www.marlin.ac.uk) of characterising species (numerically dominant) of communities which have spatial overlap with aquaculture activities within the Annex 1 Habitats of Donegal Bay (Murvagh) SAC.**

| | Characterising species | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Community** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex** | ***Tellina (Angulus) tenuis*** | ***Tellina (Angulus) fabula*** | ***Bathyporeia pilosa*** | ***Cerastoderma edule*** | ***Pygospio elegans*** | ***Scolelepis squamata*** | ***Nephtys cirrosa*** | ***Arenicola marina*** | |
| **Estuarine fine sands dominated by polychaetes and oligochaetes community complex** | ***Mya truncata*** | ***Nematoda*** | ***Pygospio elegans*** | ***Cerastoderma edule*** | ***Hediste diversicolor*** | ***Heterochaeta costata*** | ***Tubificoides pseudogaster*** | ***Tubificoides benedii*** | ***Enchytraeidae*** |
| **Sensitivity code :** | | | | | | | | | |
| **Low = Low/Intermediate intolerance, High recoverability** | | | | | | **Not sensitive=Tolerant/Low intolerance, Not relevant/Immediate recoverability** | | | |
| **Very High = High Intolerance, Very low recoverability** | | | | | | **Moderate = High intolerance/High recoverability** | | | |

**Table 9: Sensitivity assessment to physical disturbance (as reported in) of characterising species of communities which have spatial overlap with aquaculture activities within the Annex 1 Habitats of Donegal Bay (Murvagh) SAC (Sources: Tebble 1976; www.marlin.ac.uk)**

| | Characterising species | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Community** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex** | ***Tellina (Angulus) tenuis*** | ***Tellina (Angulus) fabula*** | ***Bathyporeia pilosa*** | ***Cerastoderma edule*** | ***Pygospio elegans*** | ***Scolelepis squamata*** | ***Nephtys cirrosa*** | ***Arenicola marina*** | |
| **Estuarine fine sands dominated by polychaetes and oligochaetes community complex** | ***Mya truncata*** | ***Nematoda*** | ***Pygospio elegans*** | ***Cerastoderma edule*** | ***Hediste diversicolor*** | ***Heterochaeta costata*** | ***Tubificoides pseudogaster*** | ***Tubificoides benedii*** | ***Enchytraeidae*** |
| **Sensitivity code :** | | | | | | | | | |
| **Low = Low/Intermediate intolerance, High recoverability** | | | | | **Not sensitive=Tolerant/Low intolerance, Not relevant/Immediate recoverability** | | | | |
| **Very High = High Intolerance, Very low recoverability** | | | | | **Moderate = High intolerance/High recoverability** | | | | |

**Table 10: Matrix showing the characterising species sensitivity scores x pressure categories for habitats in Donegal Bay (Murvagh) SAC (ABPMer 2013). Table 10a provides the code for the various categorisation of sensitivity and confidence.**

| Broad Pressure Type | Physical Damage | | | | Change in Habitat Quality | | | | | | | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pressure | Trampling-Access by foot | Trampling-Access by vehicle | Siltation | Smothering (addition of materials biological or non-biological to the surface) | Changes to sediment composition- increased fine sediment proportion | Changes to water flow | Increase in turbidity/suspended sediment | Decrease in turbidity/suspended sediment | Organic enrichment of sediments-sedimentation | Increased removal of primary production-phytoplankton | Decrease in oxygen levels- sediment | Introduction of non-native species |
| *Angulus tenuis* | NS (*) | L (*) | NS (*) | H (*) | NS (*) | L-M (*) | L (*) | NS (*) | Nev | L-NS (*) | NEv | M (*) |
| *Bathyporeia* spp. | NS (*) | L (*) | L (***) | L-M (*) | L-M (*) | NS (*) | NS (*) | NS (*) | L-M (*) | NS (*) | L-M (***) | L-M (*) |
| *Cerastoderma edule* | L-M (***) | L-M (*) | L (***) | L-M (*) | NS (*) | L (*) | NS (*) | NS (*) | NS (**) | L-NS (*) | L-M (*) | M (*) |
| *Fabulina fabula* | NS (*) | NS (*) | NS (*) | M (*) | L (*) | L (*) | NS (*) | NS (*) | M-H (*) | L-NS (*) | NS-L (***) | M (*) |
| *Hediste diversicolor* | NS (*) | L (*) | NS (***) | L-M (*) | NS (*) | NS (*) | NS (*) | NS (*) | NS (**) | NS (*) | NS (**) | L-M (*) |
| *Nephtys cirrosa* | NS (*) | L (*) | NS (***) | NS (*) | NS (*) | L (*) | NS (*) | NS (*) | NS (*) | NS (*) | NS (*) | M (*) |
| *Nephtys hombergii* | NS (*) | L (*) | NS (**) | NS (*) | NS (*) | NS (**) | NS (*) | NS (*) | NS (**) | NS (*) | NS (***) | NS (*) |
| *Pygospio elegans* | L (*) | L (*) | L (***) | L-M (***) | NS (**) | L-M (*) | NS (*) | NS (*) | NS (***) | NS (*) | L (**) | M (*) |
| *Scoloplos armiger* | NS (*) | L (*) | NS (*) | NS (*) | NS (*) | NS (*) | NS (*) | NS (*) | NS (***) | NS (*) | M (***) | M (*) |
| *Tubificoides* spp. | L (*) | L (*) | NS (*) | L (*) | NS (*) | NS (***) | NS (*) | NS (*) | NS (***) | NS (*) | NS (***) | NS (*) |

**Table 10a: Codes of sensitivity and confidence applying to species and pressure interactions presented in Table 10.**

| Species x Pressure Interaction Codes for Table 10 | |
|---|---|
| **NA** | Not Assessed |
| **Nev** | No Evidence |
| **NE** | Not Exposed |
| **NS** | Not Sensitive |
| **L** | Low |
| **M** | Medium |
| **H** | High |
| **VH** | Very High |
| ***** | Low confidence |
| **** | Medium confidence |
| ***** | High Confidence |

### 7.3 Assessment of the effects of shellfish production on the Conservation Objectives for habitat features in Donegal Bay (Murvagh) SAC.

Suspended Oyster Culture within Donegal Bay (Murvagh) SAC is confined exclusively to the use of Bags and trestles in the intertidal zone. Suspended oyster culture using bags & trestles (licensed) covers 25.47ha, applications for same covers 28.20ha and 6.23ha in a Fishery Order area of the qualifying interest (Estuary) within the Donegal Bay (Murvagh) SAC.

This aquaculture type overlaps two different community types found within the qualifying interest of the SAC (see below).

**Community Type: Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex**

- Licenced activities for the intertidal culture of oysters (as described above) overlap with 22.73ha of this community complex; this overlap constitutes 2.99% of the habitat area for this community type within the qualifying interest. Activities within an oyster fishery order area overlap this community complex type by 1.21ha equating to approx 0.61% of the community type.
- Applications for the intertidal culture of oysters (as described above) overlap with 27.77ha of this community complex; this overlap constitutes 3.66% of the habitat area for this community type within the qualifying interest.
- Oyster stock is triploid and is sourced at a small size from hatcheries in France.
- This community complex is characterized by a range of infaunal species (refer Tables 7-10, above).
- Within the sites, the characteristic species would appear, on the whole, to be tolerant of sedimentation, organic enrichment and compaction (Table 7).
- It is proposed that operators will confine access to sites to a single route and while this area will likely suffer heavy compaction, the overall area is considered small 4.5ha (0.6% of habitat

area). The impact will be mitigated by a number of features; 1) the routes are selected on the basis of stability (compacted sands) therefore, these areas are less likely to have a diverse range and higher abundances of biota, and 2) disturbance due to compaction is likely to occur more frequently between autumn and early-spring when activity at the site requiring vehicular transport is at a peak. It is anticipated that the biological parameters at the site during this period are minimised and hence the community complex would be considered less sensitive.

- The overall percentage of the feature that will be thus affected is 56.21ha or 7.41%.

**Conclusion:** Impact of suspended culture of oysters on Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex **can be discounted** for the following reasons:

- Stock is contained and therefore complete removal of can be achieved in the event of a disease outbreak or successful *C. gigas* recruitment event resulting from the oysters in culture.
- The stock is hatchery sourced and is therefore not exposed to 'untreated' water for prolonged periods, consequently, the risk of it carrying other non-native species is considered low.
- Triploid stock are utilised thus greatly reducing the risk of reproduction of the Pacific oyster.
- The characterising species of the habitat feature are not considered particularly sensitive to sedimentation, organic enrichment and compaction.

**Community Type: Estuarine fine sands dominated by polychaetes and oligochaetes community complex**

- Sites licensed for oyster culture overlaps with 0.74ha of Estuarine fine sands dominated by polychaetes and oligochaetes community complex; this overlap constitutes 0.24% of the habitat area for this community type within the qualifying interest.
- Oyster culture activity within an oyster fishery order comprises 5.02ha (1.62%) of this habitat type.
- Applications for oyster culture (Bags & trestles) overlap with 0.43ha of Intertidal Mixed Sediment with Polychaetes community; this overlap constitutes 0.14% of the habitat area for this community type within the qualifying interest.
- The total overlap of suspended oyster culture (and access routes) with this habitat type is 7.39ha (2.4%).
- Oyster stock is triploid and is sourced at a small size from hatcheries in France.
- This community is characterized by a range of infaunal polychaetes and bivalves (refer above) which are deemed tolerant/indifferent to organic enrichment (Table 7).

**Conclusion:** Impact of suspended culture of oysters on the Estuarine fine sands dominated by polychaetes and oligochaetes community complex community **can be discounted** for the following reasons:

- Stock is contained and therefore complete removal of can be achieved in the event of a disease outbreak or successful *C. gigas* recruitment event resulting from the oysters in culture.
- The stock is hatchery sourced and is therefore not exposed to untreated water for prolonged periods, consequently, the risk of it carrying other non-native species is considered low.
- Triploid stock are utilised thus greatly reducing the risk of reproduction of the Pacific oyster
- The characterising species are considered tolerant of the primary impacts.

**Overall Conclusion for Feature: 1040 - Mudflats and sandflats not covered by seawater at low tide:**

The interaction between the designation feature (Mudflats and sandflats not covered by seawater at low tide – 1140) and oyster culture activities (existing and proposed) is 63.59ha (5.95% of the overall feature areas). Given that the constituent fauna are considered relatively insensitive to the likely pressures, the impact of the intertidal oyster culture on the habitat feature in question is considered **not disturbing**.

### 7.4 In-combination effects of other activities

Other activities that may occur in the SAC are primarily recreational activities (sailing, boating and beach activities). In the inner part of the SAC boat traffic is confined primarily to the main channel from Donegal town to the sea. It is expected that some boats will move to other areas for seal watching but given the shallow nature of the channels, access is limited. Murvagh beach is a popular recreational beach. Activities are generally confined to the mid-portion of the beach which is a considerable distance from sensitive seal habitat to the north. There are no appreciable fisheries activities in the SAC. In summary, given the relatively isolated nature of the aquaculture there are no likely in-combination effects between other activities and aquaculture.

### 7.5 Other Aquaculture activities outside the conservation feature area – 1140

Beyond the boundary of the Donegal Bay (Murvagh) SAC there are other aquaculture activities proposed within the Donegal Bay SPA that are considered in terms of cumulative and in-combination effects. Within this area there are three aquaculture applications considered, one area for the on-bottom (extensive) production of oysters comprising 31.2ha, one area for intensive intertidal culture of oysters comprising 5.2ha and one area for the extensive culture of the native sea urchin (*Paracentrotus lividus*) which is 3.7ha.

In short, these activities are have no spatial overlap with community types described for the feature of conservation interest within the SAC. While the intertidal culture of urchins (ranching) and intertidal oyster culture may have some impact on the seafloor, the effect is likely to be localised and will not extend into the qualifying interest.

**Conclusion:** *In relation to these two culture methods (intertidal oyster culture and intertidal urchin culture) there are no in-combination impacts to assess and the activities appear to pose little or no risk of disturbance to the SAC features.*

Subtidal extensive culture of oysters involves the placement of oysters in an uncontained fashion on the seabed after a nursery phase in the intertidal zone. It is proposed that suitably sized oysters (> 15g – ½-grown) are spread within the licenced area. Oysters will be checked periodically when the progress (growth and mortality) of the oysters will be monitored and intervention will be necessary if anomalies are discovered. For example, oysters may need turning-over if excessive fouling or siltation is noted on the animals. Such intervention, as well as harvesting (when oysters are approximately 100g, will be carried out using oyster dredges deployed from boats. The dredges are typically 1.5m wide and have contact with the substrate via a flat blade. Harvest is expected 24-36 months after initial seeding. This may be shorter depending upon the size of the seed and the production capabilities of the area in question. This culture method is carried out in an uncontained fashion whereby oysters are spread on the seabed and left to grow to market size for 18-24 months. This activity presents risks on a number of fronts which are presented in Table 11 (below).

- Uncontained sub-tidal oyster culture will lead to change in community structure and function through the addition, at high % cover, of an epi-benthic species (living on the seabed) to an infaunal sedimentary community.
- The activities associated with this culture practice (dredging of the seabed) are considered disturbing which can lead to removal and/or destruction of infaunal species and changes to sediment composition. In addition, the location of large numbers of a single epifaunal species onto what is, in essence, an infaunal dominated system will likely result in a change to the habitat.
- The location of the oysters in an uncontained fashion subtidally on the seabed will present risks if removal has to be effected. Such removal might be necessary in the event there is a disease outbreak or if oysters (a non-native) species demonstrate reproductive capabilities. In effect, 100% removal will be almost impossible if it is deemed necessary.
- The ongoing risks associated with the introduction of ½ grown or 'wild' seed from outside Ireland. While the risk of introduction of listed diseases in the target organism are monitored and mitigated under legislations (Council Directive 2006/88/EC which deals with the health of aquaculture animals and the prevention and control of certain aquatic diseases). However, this practice presents the risk of establishment and spread of species that are associated with the introduced bivalves (Carlton 1989, 1999). These species may include both "hitchhiking" species i.e., animals and plants that grow associated with the bivalves and both listed and potentially non-listed diseases or parasites that may cause outbreaks in the same or other species (Barber 1996).
- In recent year, Pacific oyster spatfall has been recorded at number of locations in Ireland (Kochmann et al 2012; 2013). This is thought to be related to a warming trend of waters and increased acclimation to conditions by oysters. Oysters held subtidally have been demonstrated to have higher condition indices than those held intertidally in Ireland (Mag Aoidh, 2011). Condition index is directly correlated with ability to produce gametogenic material in oysters (Crosby and Gale 1990). The culture of oysters subtidally will therefore

likely increase the risk of successful reproduction. This is further exacerbated by higher densities of the oysters that generally prevail under culture conditions resulting in the increasing probability of successful larval formation (Allee effect). To date, no instances of Pacific oyster settlement have been recorded in Donegal Bay. However, calculations on residence time in a portion of the inner bay have demonstrated that the time for full refresh of water with the bay ranges from 5.3 to 73.7 days (Tomasz Dabrowski, Marine Institute – personal communication). Given the larval phase of oysters can be anything from 2-4 weeks (and perhaps longer) successful recruitment in the bay cannot be ruled out if the more conservative calculation of residence time is considered. Furthermore, it is unlikely that hatchery derived triploid seed will be used for subtidal un-contained culture.

**Conclusion***: On the basis of the points above, subtidal extensive culture of Pacific oysters (*Crassostrea gigas*) does potentially pose risk to the SAC that cannot be discounted.*

**Table 11: Potential indicative environmental pressures of on-bottom aquaculture activities.**

| CULTURE METHOD | PRESSURE CATEGORY | PRESSURE | POTENTIAL EFFECTS | EQUIPMENT | DURATION (DAYS) | TIME OF YEAR | FACTORS CONSTRAINING THE ACTIVITY/EFFECTS |
|---|---|---|---|---|---|---|---|
| **Bottom (Oysters)** | **Biological** | Deposition | Faecal and pseudofaecal deposition on seabed potentially altering sediment and community composition | | 365 | All year | Hydrography, Turbidity, Culture/structure density |
| | | Seston filtration | Alteration of phyto/zooplankton communities and potential impact on carrying capacity | | 365 | All year | Culture density, Turbidity |
| | | Fouling | Increased secondary production on culture species. Increased nekton production | | 365 | All year | Culture density |
| | | Introduction of non-native species | Potential for non-native species (*C. gigas*) to reproduce and proliferate in SAC (oysters only). Potential for alien species to be included with culture stock (hitch-hikers). | | | | Screening, Density, Culture Method |
| | | Disease risk | Potential for disease introduction and uncontrolled spread | | | | Screening and Fish health legislation |
| | | Nutrient exchange | Changes in ammonium and dissolved inorganic nitrogen resulting in increased primary production. $N_2$ removal at harvest or denitrification at sediment surface. | | 365 | All year | Culture density |
| | **Physical** | Surface disturbance | Ancillary activities at sites increase the risk of sediment compaction resulting in sediment changes and associated community changes. | Vessel and oyster dredge | 365 | All year | Good Site practices |
| | | Surface disturbance | Abrasion at the sediment surface and redistribution of sediment | Dredge 'Mop' | Variable depends on predator numbers | unknown | Predation control |
| | | Sub-surface disturbance | Shallow and deep disturbance, Epifaunal and infaunal community disturbance | Dredge | Seed collection, relaying spat, acclimatisation, stock movements and harvesting | unknown | |

### 7.6 Assessment of the effects of shellfish production on the Conservation Objectives for Harbour Seal in Donegal Bay (Murvagh) SAC.

Donegal Bay (Murvagh) SAC is designated for the Harbour Seal (*Phoca vitulina*). The distribution of Harbour seal and site use are summarised in Figure 3. Seal sites identified in Figure 3 correspond to confirmed sightings that have occurred at various times of the year (representing breeding, moulting and resting phases). The conservation objectives for this species are listed in Table 1 and can be found in detail in NPWS (2011; 2012). While the conservation status nationally of the species is considered favourable, the interactions between harbour seals and the features and activities of oyster culture carried out in the SAC must still be ascertained.

The interactions between aquaculture operations and aquatic mammal species are a function of:

1. The location and type of structures used in the culture operations - is there a risk of entanglement or physical harm to the animals from the structures or is access to locations restricted?

2. The schedule of operations on the site – is the frequency such that they can cause disturbance to the animals?

The proposed activities must be considered in light of the following attributes and measures for the Harbour Seal:

- Access to suitable habitat – number of artificial barriers
- Disturbance – frequency and level of impact
- Harbour Seal Sites:
    - Breeding sites
    - Moulting sites
    - Resting sites

Restriction to suitable habitats and levels of disturbance are important pressures that must be considered to ensure the maintenance of favourable conservation status of the harbour seal and implies that the seals must be able to move freely within the site and to access locations considered important to the maintenance of a healthy population. The population are categorised according to various life history stages (important to the maintenance of the population) during the year. Specifically they are breeding, moulting and resting sites (Figure 3). It is important that the access to these sites is not restricted and that disturbance, when at these sites, is kept to a minimum. The structures used in culture of oysters (bags on trestles) may present a physical barrier to seals when both submerged and exposed on the shoreline such that the access to haul-out locations might be blocked. The structures used and activities at the sites do not present a challenge to seals when navigating the subtidal channels. Activities at sites and during movement to and from culture sites may also result in disturbance events for seal hauled out, such that the seals may note an activity (head turn), move towards the water or actually flush into the water. While such disturbance events

might have been documented, the impact of these disturbances at the population level have not been studied more broadly (NRC 2009).

**Existing Aquaculture Operations:** Intertidal oyster culture using bags and trestles has been conducted in and around Donegal Bay (Murvagh) SAC for over 15 years. The current level of production reflects a gradual increase in activity at the site over this period and is represented as licenced activities in Figure 4. It is considered that, given the status of Harbour Seals within the SAC are represented by stable numbers since 2009 (NPWS 2012) that the current production levels (and activities associated with them) are conducive with favourable conservation status.

It is important to point out that the current activities do not physically overlap with any breeding or moulting locations identified in the SAC (Figure 10). In fact, the minimum distance between these site type (moulting site) and current production is approximately 100m. Notwithstanding this, it would appear that the current level of activity at the sensitive times of the year (breeding and moulting, i.e. May to September) is coincident with stable seal counts at the site over the years 2009-2012.

Compared with the breeding and moulting sites, there does appear to be overlap between resting sites and currently licenced sites (Figure 10), particularly in the inner Bay. What is apparent is that there are two resting sites that directly overlap or are proximate to active aquaculture sites (marked with ✚ in Figure 10). There is also a resting site located in the oyster order area (marked with ◆ in Figure 10). Resting sites are sites where seals have been verified at locations outside of the moulting/breeding season. At each of the St. Ernan's and (north west of) Rooney's Island sites the sighting of a single seal during 2007 was used to classify these sites as resting sites (NPWS unpublished data). Furthermore, at the locations identified in Figure 10, it is clear that sightings have been made when full intertidal oyster production with attendant activities would have been carried out.

In relation to resting sites, the location of the sites identified are based upon verified counts at the sites; however, factors such as numbers of seals sighted and levels of exposure (particularly wind) will also determine how important the sites actually are and whether it constitutes important seal habitat sites west of St. Ernan's Island and north of Rooney's Island.

**Conclusion 1: The current levels of licenced aquaculture (including renewals) are considered non-disturbing to harbour seal conservation features.**

1. Stable seal counts at the site appear coincident with existing levels of aquaculture within the SAC.
2. The number of seals using the sites west of St. Ernan's Island and north of Rooney's Island is considered low based upon the recorded numbers at the site.
3. The sandbank west of St. Ernan's is considered exposed to prevailing westerly and south westerly winds. Given the preference of harbour seals for sheltered habitat, the site might be considered insufficient in affording seals protection and comfort.

4. The degree of shelter north of Rooney's Island is considered higher, but the fact that seals were identified directly adjacent to the trestles and presumably the channels suggests their access to haul out is not restricted.

5. The aquaculture operations are accessed across sandflats along established routes and do not pose a disturbance risk or barrier to seals along the channels which would be considered important habitat for seals.

**Aquaculture Applications:** Within the Donegal Bay (Murvagh) SAC there are currently 18 applications for the culture of oysters in the intertidal areas using bags and trestles. Many of these sites can be found adjacent to existing licenced areas with the goal presumably of increasing production capacity at the sites, or exploiting more suitable habitat (lower intertidal areas). However, some of the areas applied for may present a barrier to movement (to haul-out locations) and increase the likelihood of disturbance based on sensitivity of the seal site.

In particular, a single application (T12/464A) to the west of Inispat Island is actually located in an area (sandbank) of high importance for both breeding and moulting of harbour seals. The presence of structure and activities (vehicular and foot traffic) at this site could pose a disturbance risk to the seals at this site particularly at sensitive times of year (early summer to early autumn).There are unlikely to be any mitigation measures that can reduce the risk that culture at this site poses to seals at this important site.

**Conclusion 2: The risk of disturbance to Harbour Seals posed by the licensing of aquaculture (T12/464A) west of Inispat cannot be fully discounted.**

Other sites in the vicinity of St. Ernan's and Rooney's Islands for which applications have been received may present a disturbance risk at known resting sites for seals. In particular, the applications may represent artificial barriers to the free movement of seals within the SAC onto the sandbank west of St. Ernan's and that the access to and from some of the sites ( sites 401A,B,C) by boat (from a launch site at Summerhill) may present a risk to seals using the main channel.

**Conclusion 3: It is considered unlikely that new aquaculture sites in the vicinity of St. Ernans's Island will present a risk of disturbance to Harbour seal on the basis that:**

1. As indicated above, the sites around St. Ernan's island would be considered exposed and given the low number of seals identified at the site, it suggests the area would not be considered a critical resting site.

2. The access to sites (across the channel) by boat will not likely result in any great increase in vessel traffic along the main channel into Donegal Town.

3. Access to the other sites will continue along existing travel routes.

**Conclusion 4: It is considered unlikely that new aquaculture site northwest of Rooney's Island will pose a risk to Harbour seal resting areas on the basis that:**

1. Access to the deep channel adjacent to this site will not be restricted by the structures.

2. The aquaculture operations are accessed across sandflats along established routes and do not pose a disturbance risk to seals along the channels which would be considered important habitat for seals.
3. The site would not be considered critical habitat based upon the number of seals observed at the site.

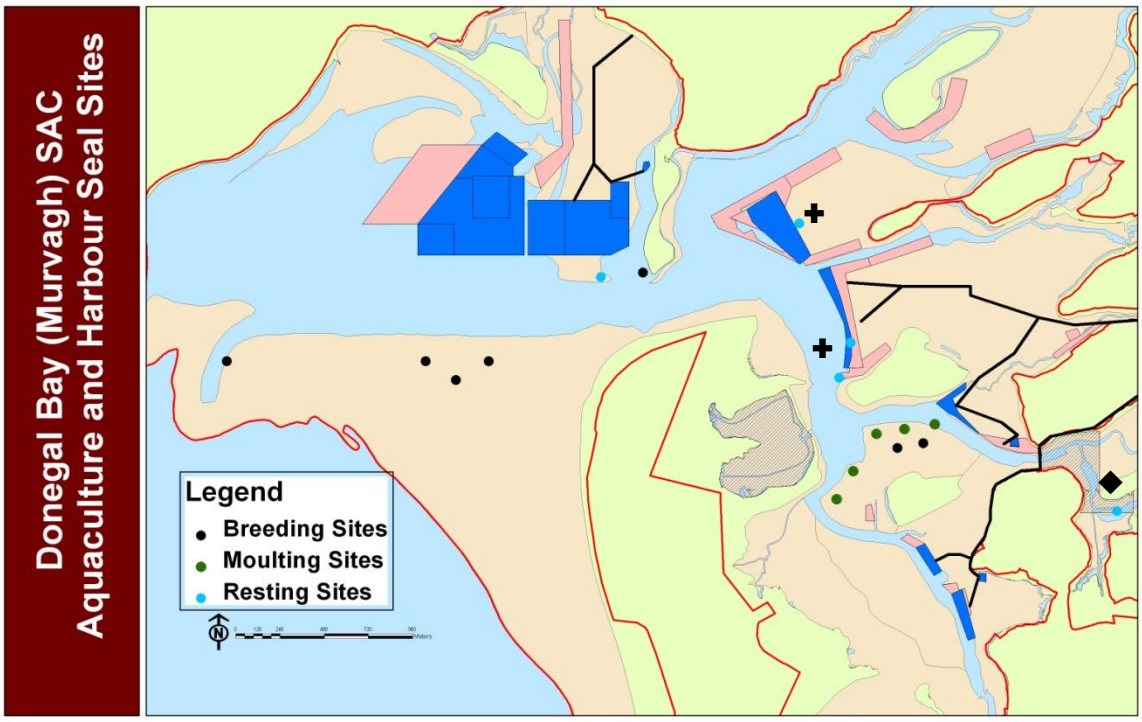


**Figure 10:** Harbour Seal Sites and Oyster Culture Sites (licenced and applications) in Donegal Bay

# 8. Risk assessment of fisheries interactions with the Harbour seal and concluding statement

## 8.1 Harbour Seal

Harbour seals may forage up to 30km from haul out sites in search of prey (Cordes *et al*. 2011). Harbour seal may therefore interact with fisheries in Inner Donegal Bay. Pressures include competition with fisheries for prey and a risk of by-catch in nets.

Harbour Seal feed on Herring, Sprat, Sandeel and gadoids (Wilson et al 2002) and are opportunistic feeders able to switch prey according to availability. Herring and Sprat are more nutritionally valuable to Harbour Seals than Gadoids; gadoids have a lower calorific value. In fact switching from clupeids to gadoids can result in anaemia due to reduced iron absorption caused by anti-metabolites in gadoids (Wilson et al 2002).

Herring stocks in Donegal Bay and the north west generally are low (MI 2013). Sprat is targeted in autumn and winter in inner Donegal Bay and is not subject to TAC. Depletion of clupeid stocks may have consequences for the health of harbour seals. However, the nutritional value of other prey such as sandeel is probably high and these are not targeted by fisheries in the area.

Foraging seals, if attending at fishing vessels, may be caught in the fishing gear. This is rare in the case of mobile gear and most seal by-catch is due to entanglement in bottom set gill nets. There are no gill nets or tangle nets in inner Donegal Bay. There is limited use of trammel nets during summer in shallow water.

The risk to harbour seals through interaction with fisheries (depletion of prey and possibility of by-catch) in Inner Donegal Bay is regarded as low. Consequence is categorised as 1(possible effect on individuals) with a likelihood of 2 (possible) and an overall risk of 2 (see Annex II SPA assessment for risk scoring and MI (2013)). No mitigation is required. However, escalation of fishing activity, particularly for sprat, which is unregulated, may be problematic for Harbour Seals in further depleting their local prey source.

# 9. SAC Appropriate Assessment Concluding Statement and Recommendations in relation to Aquaculture

In Donegal Bay (Murvagh) SAC intertidal oyster culture (using bags and trestles) is the only type of aquaculture activity currently being carried out and proposed for future expansion. Based upon this and the information provided in the aquaculture profiling carried out (Section 5), the likely interaction between this culture methodology and conservation features (habitats and species) of the site were considered.

## 9.1 Habitats

In relation to habitats an initial screening exercise resulted in two habitats features being excluded from further consideration by virtue of the fact that no spatial overlap of the culture activities was

expected to occur. The two habitats excluded from further consideration were 2130 (fixed coastal dunes with herbaceous vegetation 'grey dunes') and 2190 (Humid dune slacks). A full assessment was carried out on the likely interactions between oyster culture operations (as proposed) and the feature of the Annex 1 habitat 1140 (Mudflats and sandflats not covered by seawater at low tide). The likely effects of the aquaculture activities (Species, structures, transport routes) were considered in light of the sensitivity of the constituent habitats and species of the Annex 1 habitat, i.e., Intertidal muddy sand to sand dominated by polychaetes, bivalves and crustaceans community complex and Estuarine fine sands dominated by polychaetes and oligochaetes community complex.

**Conclusion and Recommendation:** *Based upon the scale of spatial overlap and the relatively high tolerance levels of the habitats and species therein, the general conclusions relating to the interaction between oyster culture with habitats is that consideration can be given to licencing (existing and applications) oyster culture in the Annex 1 habitat – 1140 (Mudflats and sandflats not covered by seawater at low tide). It is recommended that there be strict adherence to the access routes identified and that density of culture structures within the sites be maintained at current levels. The movement of stock in and out of Donegal Bay (Murvagh) SAC should adhere to relevant fish health legislation and follow best practice guidelines (e.g. http://invasivespeciesireland.com/cops/aquaculture/).*

*In relation to proposed aquaculture activities outside of the SAC, the culture of intertidal oysters and native sea urchins is considered non-disturbing. The subtidal, uncontained culture of pacific oysters does potentially present a risk of disturbance to the SAC that cannot be discounted.*

### 9.2 Species

The likely interactions between the proposed aquaculture activities and the Annex II Species Harbour Seal (*Phoca vitulina*) were also assessed. The objectives for this species in the SAC focus upon maintaining the good conservation status of the population and consider certain uses of intertidal habitats as important indicators of status. The aspect of the culture activities that could potentially disturb the seal relates to movement of people and vehicles within the sites as well as accessing the sites over intertidal areas and via water. In addition, the physical presence of trestle may restrict seal access to certain habitats.

**Conclusion and Recommendation - Licenced Oyster Culture Activities:** *It is acknowledged in this assessment that the favourable conservation status of the Harbour seal (*Phoca vitulina*) has been achieved given current levels of oyster production within the SAC. On this basis, the current levels of licenced aquaculture (existing and renewals) are considered non-disturbing to harbour seal conservation features. However, it is recommended that measures currently in place to minimise disturbance to seals and other biota should be strictly followed (i.e. strict adherence to access routes and minimisation of disturbance/activity at sites during sensitive periods e.g. breeding, moulting). Furthermore, the aquaculture activities within the Fishery Order Area (No 2) should remain confined to the northern portion of the order area.*

The expansion of oyster culture in the SAC (all licence applications) was considered in light of the likely interactions with Harbour Seals. First, a single application to culture oysters on the same sandbank considered very important for seal pupping and moulting presents a high risk of

disturbance. Risks to seals in relation to access and disturbance as a consequence of licencing certain new areas were considered. Such areas are identified in the assessment above and careful consideration should be given to any decision to licence these sites.

**Conclusion and Recommendation – Applications to Culture Oysters:** *When considering licencing of additional oyster culture activities in the SAC, the maintenance of the favourable conservation status of the Harbour seal status has been considered carefully. It is concluded that, given the likely lack of sensitivity of the locations encountered (in terms f seal sightings and overall abundances), the majority of new applications do not pose any great risk to Harbour seal in terms of habitat occlusion and disturbance. The sandbank north of Inispat is considered an important and sensitive habitat for harbour seal and for this reason the risk of disturbance posed by the single application in the vicinity of this area cannot be discounted. Notwithstanding, best practice should be employed by all operators in order to minimise all potential disturbance of Harbour seal*.

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