ANNEX I

Report supporting Appropriate Assessment of Aquaculture in Lower River Shannon SAC

(Site Code: 002165)

August 2019

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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 Climate Action and Environment (DCCAE). The Habitats Directive is transposed in Ireland in the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). Appropriate assessments (AA) and risk assessments (RA) of fishing activities 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 S.I. 290 of 2013. Fisheries projects or plans are taken to mean those fisheries that are subject to annual secondary licencing or authorization. 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. Oyster fisheries, managed by DCENR, do not come under the remit of S.I. 290 of 2013 but are defined as projects or plans as they are authorized annually and are therefore also subject to AA.

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 Executive Summary

2.1 The SAC

Lower River Shannon is designated as a Special Area of Conservation (SAC) under the Habitats Directive. The marine area is designated for the Annex I habitats Sandbanks which are slightly covered by sea water all the time (1110), Estuaries (1130), Mudflats and sandflats not covered by seawater at low tide (1140), Coastal lagoons (1150), Large shallow inlets and bays (1160) and Reefs (1170). The bay supports a variety of sub-tidal and intertidal sedimentary and reef habitats. The area is also designated for marine mammals (bottlenose dolphin, otter), freshwater fish (Sea, Brook, and River lampreys), the freshwater mussel and the Atlantic salmon (only in freshwater). Conservation Objectives for these habitats and species were identified by NPWS (2012a) and relate to the requirement to maintain habitat distribution, structure and function, as defined by characterizing (dominant) species in these habitats. For designated species the objective is to maintain various attributes of the populations including population size, cohort structure and the distribution of the species in the SAC. Guidance on the conservation objectives is provided by NPWS (2012b).

2.2 Activities in the SAC

Aquaculture is confined to the production of shellfish (Oysters, Mussels). The main aquaculture activity is oyster culture, which involves the culture of the native (*Ostrea edulis*) and pacific oyster (*Crassostrea gigas*) on trestles in intertidal areas and subtidally on the seafloor. Mussel culture includes subtidal suspended (longlines) and bottom culture.

The profile of the aquaculture industry in the Lower River Shannon SAC, used in this assessment, was prepared by BIM and is derived from the list of licence applications received by DAFM and provided to the Marine Institute for assessment in August 2013.

2.3 The appropriate assessment process

The function of an appropriate assessment and risk assessment is to determine if the ongoing and proposed aquaculture and fisheries activities are consistent with the Conservation Objectives for the Natura site or if such activities will lead to deterioration in the attributes of the habitats and species over time and in relation to the scale, frequency and intensity of the activities. NPWS (2012b) provide guidance on interpretation of the Conservation Objectives which are, in effect, management targets for habitats and species in the SAC. This guidance is scaled relative to the anticipated sensitivity of habitats and species to disturbance by the proposed activities. Some activities are deemed to be wholly inconsistent with long-term maintenance of certain sensitive habitats while other habitats can tolerate a range of activities. For the practical purpose of management of sedimentary habitats a 15% threshold of overlap between a disturbing activity and a habitat is given in the NPWS guidance. Below this threshold disturbance is deemed to be non-significant. Disturbance is defined as that which leads to a change in the characterizing species of the habitat (which may also indicate change in structure and function). Such disturbance may be temporary or persistent in the sense that change in characterizing species may recover to pre-disturbed state or may persist and accumulate over time.

The appropriate assessment and risk assessment process is divided into a number of stages consisting of a preliminary risk identification, and subsequent assessment (allied with mitigation measures if necessary) which are covered in this report. The first stage of the AA process is an initial screening wherein activities which cannot have, because they do not spatially overlap with a given habitat or have a clear pathway for interaction, any impact on the conservation features and are therefore excluded from further consideration. The next phase is the Natura Impact Statement (NIS) where interactions (or risk of) are identified. Further to this, an assessment on the significance of the likely interactions between activities and conservation features is conducted. Mitigation measures (if necessary) will be introduced in situations where the risk of significant disturbance is identified. In situations where there is no obvious mitigation to reduce the risk of significant impact, it is advised that caution should be applied in licencing decisions. Overall, the Appropriate Assessment is both the process and the assessment undertaken by the competent authority to effectively validate this Screening Report and/or NIS. It is important to note that the screening process is considered conservative, in that other activities which may overlap with habitats but which may have very benign effects are retained for full assessment. In the case or risk assessments consequence and likelihood of the consequence occurring are scored categorically as separate components of risk. Risk scores are used to indicate the requirement for mitigation.

2.4 Data supports

Distribution of habitats and species population data are provided by NPWS[1]. Scientific reports on the potential effects of various activities on habitats and species have been compiled by the MI and provide the evidence base for the findings. The data supporting the assessment of individual activities vary and provides for varying degrees of confidence in the findings.

2.5 Findings

In the Lower Shannon River SAC aquaculture focuses primarily on shellfish species (mussels, oysters) (Figure 5). Oysters are the predominant shellfish species cultured within the SAC, mussels are produced at a lower scale; while Scallops, although licensed, are not currently produced in the area. Based upon this and the information provided in the aquaculture profiling (Section 5), the likely interaction between this aquaculture and conservation features (habitats and species) of the site were considered.

An initial screening exercise resulted in a number of habitat features and species being excluded from further consideration by virtue of the fact that no spatial overlap of the culture activities was expected to occur. The habitats and species excluded from further consideration were Freshwater Pearl Mussel *Margaritifera margaritifera* (1029), Sea Lamprey *Petromyzon marinus* (1095), Brook Lamprey *Lampetra planeri* (1096), River Lamprey *Lampetra fluviatilis (*1099), Atlantic Salmon *Salmo salar* (only in fresh water)(1106), Sandbanks which are slightly covered by sea water all the time (1110), Coastal lagoons

[11] NPWS Geodatabase Ver: July 2015 - http://www.NPWS.ie/mapsanddata/habitatspeciesdata/

(1150), Perennial vegetation of stony banks (1220), Vegetated sea cliffs of the Atlantic and Baltic coasts (1230), *Salicornia* and other annuals colonizing mud and sand (1310), Atlantic salt meadows (Glauco-Puccinellietalia maritimae)(1330), Mediterranean salt meadows (*Juncetalia maritimi*)(1410), Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260), *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) (6410) and 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*).

2.6 Habitats

A full assessment was carried out on the likely interactions between aquaculture operations (as proposed) and the Annex 1 habitats 1110 (Sandbanks which are slightly covered by sea water all the time), 1130 (Estuaries), 1140 (Mudflats and sandflats not covered by seawater at low tide), 1150 (Coastal Lagoon), 1160 (Large Shallow Inlets and Bay) and 1170 (Reefs). The likely effects of the aquaculture activities (species, structures) were considered in light of the sensitivity of the constituent habitats and species of the Annex 1 habitats.

There is no overlap between the Annex I habitats Sandbanks which are slightly covered by sea water all the time (1110) and Coastal Lagoons (1150) and aquaculture activities in the Lower River Shannon SAC, therefore these features were screened out of the assessment.

Furthermore, of the 10 community types listed under the remaining habitat features (1140, 1160 and 1170) two (Estuarine subtidal muddy sand to mixed sediment with gammarids community complex and Mixed subtidal reef community complex) were also excluded from further analysis as they had no overlap with aquaculture activities.

Based upon the scale of spatial overlap the general conclusion relating to the interaction between proposed aquaculture activities with habitats is that consideration can be given to licencing (existing and applications) in the Annex 1 habitats -1140 (Mudflats and sandflats not covered by seawater at low tide), 1160 (Large Shallow Inlets and Bays) and 1170 (Reefs). However, there is one exception where Oyster culture (bottom culture) occurs on the community type Faunal turf-dominated subtidal reef community (28.4%) which is above the threshold (15%) within the qualifying feature 1130 (Estuaries). However, it is questionable whether this activity will be carried out on this community type given the nature of the substrate.

However, based on biological pressures the aquaculture activity of Subtidal Bottom Culture (Mussels, Oysters) poses a potential risk of the introduction and the potential naturalization of non-native species due the placement of mussels and oysters in an uncontained fashion on the seafloor.

Conclusion 1: With one exception (Marine Community type – Anemone-dominated subtidal reef community (28.4%)) which is above the threshold (15%) within the qualifying feature Large Shallow inlet and bay), aquaculture activities (intertidal oyster culture) do not pose a risk of significant disturbance to the qualifying interests (Habitats) of the Lower River Shannon SAC. However, aquaculture activities (bottom mussel, suspended mussel and bottom oyster culture) in-combination with fishery order areas do pose a significant risk of disturbance to a number of qualifying interests in the SAC.

Conclusion 2: Give the long residence time in the Shannon Estuary and the fact that recruitment of the non-native oysters *Crassostrea gigas* is ongoing. The risk posed by the culture of diploid Pacific oyster, *Crassostrea gigas*, cannot be discounted. This risk is further exacerbated by the culture of these oysters on the seabed. It is recommended that all oyster culture be carried out using triploid oysters and that subtidal culture of *C gigas* uncontained on the seafloor be reviewed in light of these findings.

Conclusion 3: The source of mussel seed stock inputted into existing licensed mussel areas is collected locally at present. If seed is sourced outside of the site in the future the risk posed by this activity cannot be discounted. It is recommended that acceptable sources of seed (in terms of alien species assessment) are identified for all shellfish culture operations. The movement of stock in and out of the Lower River Shannon SAC should adhere to relevant fish health legislation and follow best practice guidelines (e.g. http://invasivespeciesireland.com/cops/aquaculture/).

Conclusion 4: 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 activities that are known to occur within the Fishery Order Areas (i.e. bottom culture of oysters and mussel) are deemed disturbing on a number of community types. It should be noted that the information available regarding the extent of usage and type of culture occurring within the Fishery Order Areas is sparse. Therefore the spatial extents listed are the maximum areas the Fishery Order covers, however it is possible that the areas may not be fully utilised by the operators. In the absence of this information and given the fact that the fishery orders are fully licenced, it is clear the decisions regarding the licencing of aquaculture operations should take into account the licence status of the Fishery order areas.

2.7 Species

The likely interactions between the proposed aquaculture activities (incl. Fishery Order Areas) and the Annex II species otter (*Lutra lutra*) 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 otter status relates to movement of people and vehicles within the sites as well as accessing the sites over intertidal areas and via water.

It is concluded that the aquaculture activities (incl. Fishery Order Areas) proposed in areas that potentially overlap with otter habitat do not pose a threat to the conservation status of this species within the SAC.

Conclusion 5: The current and proposed levels of aquaculture activities individually and in-combination with activities in fishery order areas are considered non-disturbing to otter conservation features.

The likely interactions between the proposed aquaculture activities and the Annex II species bottlenose dolphin (*Tursiops truncatus*) were also assessed. The objectives for this species in the SAC focus upon maintaining the favourable conservation condition status of the species which is defined by maintaining

species range and critical habitat. The aspect of the culture activities that could potentially influence the dolphin status relates to presence of fixed aquaculture structures (Longlines) within the critical habitat areas. However, the small spatial extent and the potential for the structures to act as fish aggregation devices suggest present little risk to the feature in question.

It is concluded that the aquaculture activities proposed in areas that have overlap with dolphin critical habitat do not present a risk to the conservation status of this species within the Lower Shannon River SAC.

Conclusion 6: The current and proposed levels of subtidal suspended and bottom culture aquaculture activities are not considered disturbing to the bottlenose dolphin conservation features.

3 Introduction

This document assesses the potential ecological interactions of aquaculture and fisheries activities within the Lower River Shannon SAC (site code 2165) on the Conservation Objectives (COs) of the site (NPWS 21012a, 7/08/2012 Version 1).

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 August 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[2] and shared with the Marine Institute.

4 Conservation Objectives for Lower River Shannon SAC (002165)

The appropriate assessment of aquaculture in relation to the Conservation Objectives for Lower River Shannon SAC is based on Version 1.0 of the objectives (NPWS 2012a - Version 1 August 2012) and supporting documentation (NPWS 2012b - Version 1 March 2012). The spatial data for conservation features was provided by NPWS[3].

4.1 The SAC extent

Lower River Shannon SAC is a very large estuary on the west coast of Ireland where the River Shannon enters the Atlantic Ocean. This very large site (120km) stretches along the Shannon valley from Limerick City in the upper reaches out to the Mouth of the Shannon, an area between Loop Head (Co. Clare) in the north and Kerry Head (Co. Kerry) in the south. The mouth of the estuary is over 15 km wide, narrowing to just over 3 km between Kilcredaun and Kilconly Headlands. The site thus encompasses the Shannon, Feale, Mulkear and Fergus estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head (NPWS, 2013a).

The Lower River Shannon SAC is designated for the marine Annex I qualifying interests of Sandbanks which are slightly covered by sea water all the time (1110), Estuaries (1130), Mudflats and sandflats not covered by seawater at low tide (1140), Coastal lagoons (1150), Large shallow inlets and bays (1160) and Reefs (1170) (Figure 1). The Annex I habitats 1130 and 1160 are large physiographic features that may wholly or partly incorporate other Annex I habitats including Reefs, Sandbanks and Mudflats and sandflats within their areas.

[2] DAFM Aquaculture Database version Aquaculture: 30th Aug 2013
[3] NPWS Geodatabase Ver: July 2015 - http://www.NPWS.ie/mapsanddata/habitatspeciesdata/

A number of coastal habitats can also be found in the SAC, including Mediterranean salt meadows (*Juncetalia maritimi*)(1410), Perennial vegetation of stony banks (1220), Vegetated sea cliffs of the Atlantic and Baltic coasts (1230), Salicornia and other annuals colonizing mud and sand (1310), Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)(1330), Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260), *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)(6410), *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)(91E0)

The SAC is also considered an important site for a number of Annex II species including the common bottlenose dolphin (*Tursiops truncatus,* 1349), the otter (*Lutra lutra,* 1355), Freshwater Pearl Mussel (*Margaritifera margaritifera*, 1029), Sea Lamprey (*Petromyzon marinus*, 1095), Brook Lamprey (*Lampetra planeri,* 1096), River Lamprey (*Lampetra fluviatilis*, 1099) and the Atlantic Salmon (*Salmo salar*, 1106 only in fresh water).

The extent of the SAC is shown in Figure 1 below.

4.2 Qualifying interests (SAC)

The SAC is designated for the following habitats and species (NPWS 2012a), as listed in Annexes I, II of the E.U. Habitats Directive:

1029 Freshwater Pearl Mussel *Margaritifera margaritifera*

1095 Sea Lamprey *Petromyzon marinus*

1096 Brook Lamprey *Lampetra planeri*

1099 River Lamprey *Lampetra fluviatilis*

1106 Atlantic Salmon *Salmo salar* (only in fresh water)

1110 Sandbanks which are slightly covered by sea water all the time

1130 Estuaries

1140 Mudflats and sandflats not covered by seawater at low tide

1150 *Coastal lagoons

1160 Large shallow inlets and bays

1170 Reefs

1220 Perennial vegetation of stony banks

1230 Vegetated sea cliffs of the Atlantic and Baltic coasts

1310 *Salicornia* and other annuals colonizing mud and sand

1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

1349 Bottlenose Dolphin *Tursiops truncatus*

1355 Otter *Lutra lutra*

1410 Mediterranean salt meadows (*Juncetalia maritimi*)

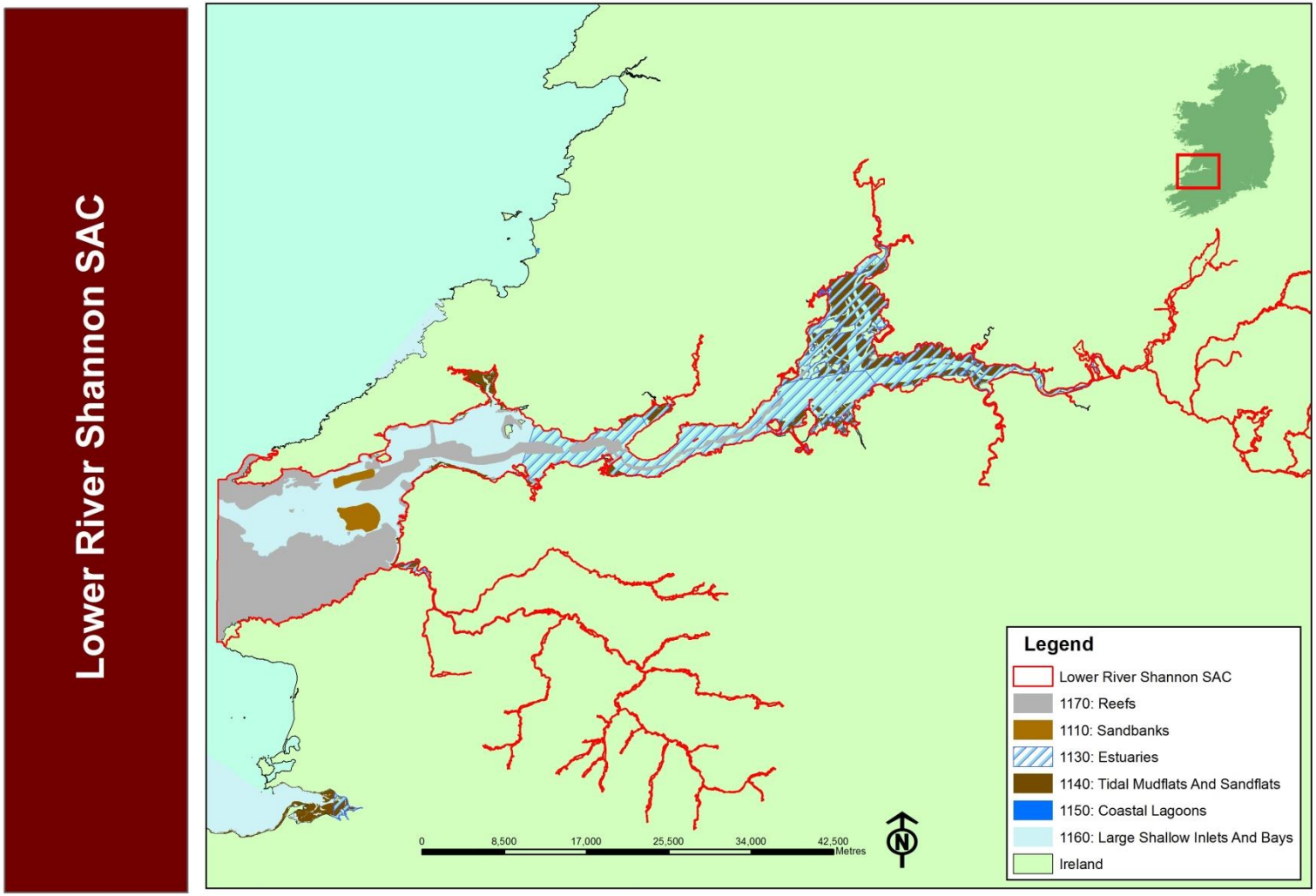
3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)

91E0 *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)

*indicates a priority habitat under the habitats directive

Figure 1: The extent of the Lower River Shannon SAC (Site Code 002165) and qualifying interests (habitats).



Ten constituent communities and community complexes recorded within the qualifying interest Annex 1 habitats (i.e. Sandbanks which are slightly covered by sea water all the time (1110), Estuaries (1130), Mudflats and sandflats not covered by seawater at low tide (1140), Large Shallow inlets and Bays (1160) and Reefs (1170)) are listed in NPWS (2012b) and illustrated in Figure 2 and consist of:

- Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. community
- Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex
- Estuarine subtidal muddy sand to mixed sediment with gammarids community complex
- Subtidal sand to mixed sediment with *Nucula nucleus* community complex
- Subtidal sand to mixed sediment with *Nephtys* spp. community complex
- Fucoid-dominated intertidal reef community complex
- Mixed subtidal reef community complex
- Faunal turf-dominated subtidal reef community
- Anemone-dominated subtidal reef community
- *Laminaria*-dominated community complex

The Lower River Shannon SAC is one of two designated SAC's in Ireland for the bottlenose dolphin *Tursiops truncatus*, the other being West Connacht Coast SAC (002998). The species is listed on Annex II and Annex IV of the E.U. Habitats Directive. According to Berrow *et al.* (2010) the Shannon Estuary is an important habitat for bottlenose dolphins as it is the largest resident population of the species known to occur in Ireland, they occur throughout the year and it is also an important calving area. Smaller apparently resident groups of bottlenose dolphins have been seen regularly at both outer Cork Harbour and the area around north Connemara, Co Galway. Mirimin *et al.* (2011) suggests that the bottlenose dolphins in the Shannon Estuary are genetically discrete and thus of very high conservation value. Several population assessments of bottlenose dolphins have been carried out in the Shannon Estuary since 1997 with the most recent in 2010 (Ingram 2000; Ingram and Rogan 2003; Englund *et al.* 2007; 2008, cited in Berrow *et al.* 2010). Previous abundance estimates for bottlenose dolphins in the Lower River Shannon SAC ranged from 114 in 2008 to 140 in 2006. According to Berrow *et al.* 2010 the most recent estimate (107) is deemed within this range suggesting that, within the power of the survey technique, the population of bottlenose dolphins in the Lower River Shannon SAC is relatively stable. Two distinct areas have been have been identified within the SAC as been important (NPWS 2012a) and are considered critical habitat for the overall welfare and health of the populations at the site. These are located at the mouth of the SAC near Ballybunion Bank and an area between Tarbert, Co Clare and Kilimer, Co. Clare, (Figure 3).

Figure 2: Principal benthic communities recorded within the qualifying interests of the Lower River Shannon SAC (Site Code 002165) (NPWS 2012a).

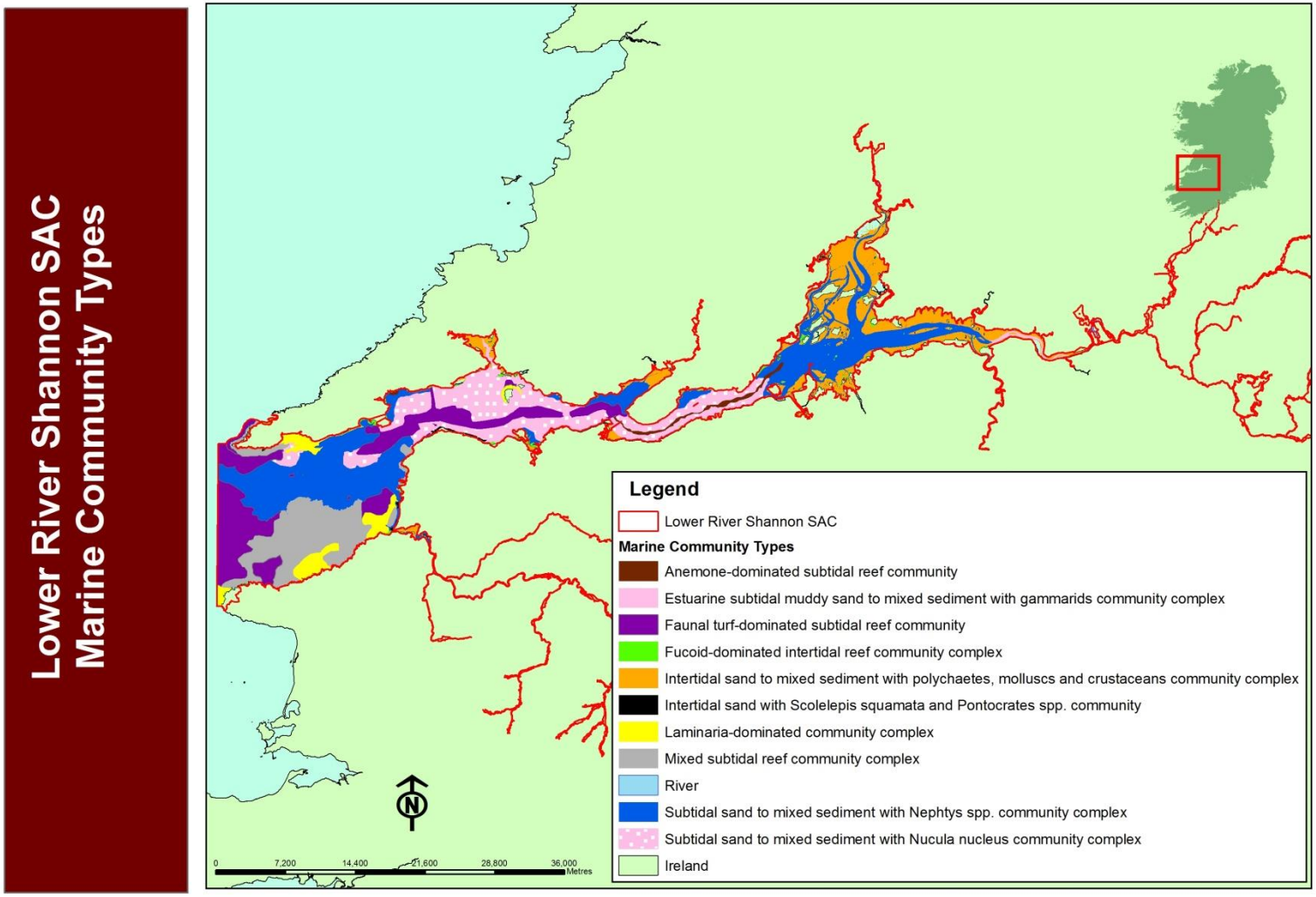
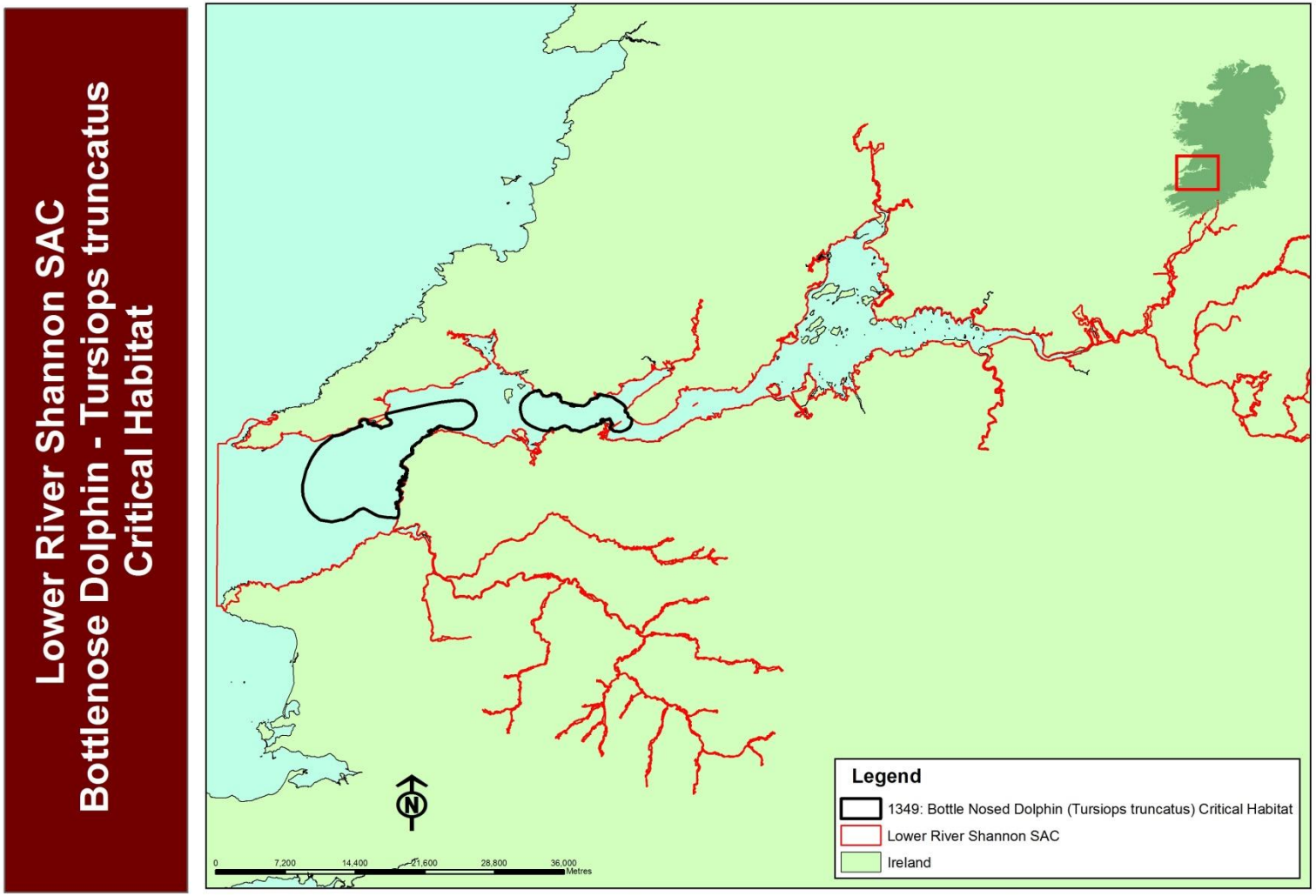


Figure 3: Critical habitat of the bottlenose dolphin (*Tursiops truncatus*) within the Lower River Shannon SAC (Site Code 002165) (NPWS 2012a).



The Shannon River SAC is designated for the otter *Lutra lutra*. The species, which is commonly found on the site (NPWS, 2013a), is listed in Annex II and Annex IV of the E.U. Habitats Directive and is afforded strict protection. According to the NPWS (2009) although otter numbers have declined from 88% in 1980/81 to 70% in 2004/05, otters remain widespread in Ireland.

Other species listed on Annex II, of the E.U. Habitats Directive, found within the site include the Sea Lamprey (*Petromyzon marinus*), Brook Lamprey (*Lampetra planeri*), River Lamprey (*Lampetra fluviatilis*), and Salmon (*Salmo salar* in fresh water only). The latter two species are also listed on Annex V of the E.U. Habitats Directive There are few other river systems in Ireland which contain all three species of lamprey (NPWS, 2013b). According to the most recent Red Data List (King *et al*. 2011) the Sea lamprey is deemed 'Near Threatened', while both the River and Brook lamprey are evaluated at 'Least Concern'.

The Freshwater Pearl Mussel (*Margaritifera margaritifera*), a species listed on Annex II of the E.U. Habitats Directive, occurs in parts of the Cloon River, Co. Clare (NPWS 2012a). According to the most recent Red Data List (Byrne *et al.* 2009) this species is deemed 'Critically Endangered' within Ireland.

Fishing is a main tourist attraction on the Shannon and there are a large number of angler associations. The River Feale is a designated Salmonid Water under the E.U. Freshwater Fish Directive. Other uses of the site include commercial angling, oyster farming and boating (including dolphin-watching trips). In order to allow the public to appreciate these animals whilst ensuring that the population continues to live relatively undisturbed in the area strict guidelines exist, which all licensed tour-boat operators within the region must adhere to, and cover the methods and time allowed with dolphin groups within the Lower River Shannon SAC.

4.3 Conservation objectives for Lower River Shannon SAC

The conservation objectives for the qualifying interests (SAC) were identified in NPWS (2012a). 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 Table 1 below.

4.4 Screening of Adjacent SACs for *ex situ* effects

In addition to the Lower River Shannon SAC there are a number of other Natura 2000 sites proximate to the proposed activities (Figure 4). The characteristic features of these sites are identified in Table 2 where a preliminary screening is carried out on the likely interaction with aquaculture activities based primarily upon the likelihood of spatial overlap. As it was deemed that there are no *ex situ* effects and no effects on features in adjacent SACs all qualifying features of adjacent Natura 2000 sites were screened out.

Table 1: Conservation objectives and targets for marine habitats and species in the Lower River Shannon SAC (Site Code 002165) (NPWS 2012a, 2012b). Annex I and II features listed in bold.

Feature (Community Type)	Objective	Target
1110 Sandbanks which are slightly covered by water all the time	Maintain favourable conservation condition	1,353ha; The distribution and permanent habitat area is stable subject to natural processes. Constituent community types are conserved in a natural condition.
(Subtidal sand to mixed sediment with *Nephtys* spp. community complex)	Maintain favourable conservation condition	1,353ha; Conserve in a natural condition
1130 Estuaries	Maintain favourable conservation condition	24,273ha; The permanent habitat area is stable or increasing, subject to natural processes. Constituent community types are conserved in a natural condition.
(Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex)	Maintain favourable conservation condition	8130ha; Conserve in a natural condition
(Estuarine subtidal muddy sand to mixed sediment with gammarids community complex)	Maintain favourable conservation condition	268ha; Conserve in a natural condition
(Subtidal sand to mixed sediment with *Nucula nucleus* community complex)	Maintain favourable conservation condition	4196ha; Conserve in a natural condition
(Subtidal sand to mixed sediment with *Nephtys* spp. community complex)	Maintain favourable conservation condition	8404ha; Conserve in a natural condition
(Fucoid-dominated intertidal reef community complex)	Maintain favourable conservation condition	678ha; Conserve in a natural condition
(Anemone-dominated subtidal reef community)	Maintain favourable conservation condition	713ha; Conserve in a natural condition
1140 Mudflats and sandflats not covered by seawater at low tide	Maintain favourable conservation condition	8,808 ha; The permanent habitat area is stable or increasing, subject to natural processes. Constituent community types are conserved in a natural condition.

Feature (Community Type)	Objective	Target
(Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. community)	Maintain favourable conservation condition	213ha; Conserve in a natural condition
(Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex)	Maintain favourable conservation condition	8596ha; Conserve in a natural condition
1150 Coastal Lagoons	**Restore favorable conservation condition**	The permanent habitat area is stable or increasing, subject to natural processes. No decline in habitat distribution, subject to natural processes. 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.
1160 Large shallow inlets and bays	Maintain favourable conservation condition	35,282 ha; The permanent habitat area is stable or increasing, subject to natural processes. Constituent community types are conserved in a natural condition.
(Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. community)	Maintain favourable conservation condition	211ha; Conserve in a natural condition
(Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex)	Maintain favourable conservation condition	466ha; Conserve in a natural condition
(Subtidal sand to mixed sediment with *Nucula nucleus* community complex)	Maintain favourable conservation condition	6095ha; Conserve in a natural condition
(Subtidal sand to mixed sediment with *Nephtys* spp. community complex)	Maintain favourable conservation condition	9431ha; Conserve in a natural condition
(Fucoid-dominated intertidal reef community complex)	Maintain favourable conservation condition	616ha; Conserve in a natural condition
(Mixed subtidal reef community complex)	Maintain favourable conservation condition	74644ha; Conserve in a natural condition

Feature (Community Type)	Objective	Target
(Faunal turf-dominated subtidal reef community)	Maintain favourable conservation condition	8710ha; Conserve in a natural condition
(Anemone-dominated subtidal reef community)	Maintain favourable conservation condition	34ha; Conserve in a natural condition
(*Laminaria*-dominated community complex)	Maintain favourable conservation condition	2221ha; Conserve in a natural condition
1170 Reefs	Maintain favourable conservation condition	21,421ha; The distribution and permanent habitat area is stable subject to natural processes. Constituent community types are conserved in a natural condition.
(Fucoid-dominated intertidal reef community complex)	Maintain favourable conservation condition	1294ha; Conserve in a natural condition
(Mixed subtidal reef community complex)	Maintain favourable conservation condition	74644ha; Conserve in a natural condition
(Faunal turf-dominated subtidal reef community)	Maintain favourable conservation condition	9692ha; Conserve in a natural condition
(Anemone-dominated subtidal reef community)	Maintain favourable conservation condition	747ha; Conserve in a natural condition
(*Laminaria*-dominated community complex)	Maintain favourable conservation condition	2224ha; Conserve in a natural condition
1220 Perennial vegetation of stony banks	Maintain favourable conservation condition	Area unknown; The habitat area is stable or increasing, subject to natural processes. 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.
1230 Vegetated sea cliffs of the Atlantic and Baltic coasts	Maintain favourable conservation condition	>67.3km; The habitat area is stable or increasing, subject to natural processes. 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.

Feature (Community Type)	Objective	Target
1310 *Salicornia* and other annuals colonizing mud and sand	Maintain favourable conservation condition	0.223ha; Further unsurveyed areas may be present within the site. The habitat area is stable or increasing, subject to natural processes. 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.
1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	Maintain favourable conservation condition	495.43ha; Further unsurveyed areas may be present within the site. The habitat area is stable or increasing, subject to natural processes. 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.
1410 Mediterranean salt meadows (*Juncetalia maritimi*)	Maintain favourable conservation condition	Area unknown: The habitat area is stable or increasing, subject to natural processes. 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.
3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Maintain favourable conservation condition	Area unknown: The habitat area is stable or increasing, subject to natural processes. 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. Note: The freshwater pearl mussel (1029) conservation objective takes precedence over this objective for habitat 3260 in the Cloon River within this SAC, because the mussel requires environmental conditions closer to natural background levels
6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	Maintain favourable conservation condition	Area unknown: The habitat area is stable or increasing, subject to natural processes. 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.

Feature (Community Type)	Objective	Target
91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)*	Maintain favourable conservation condition	>8.5ha: The habitat area is stable or increasing, subject to natural processes. 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.
1029 Freshwater Pearl Mussel *Margaritifera margaritifera*	**Restore to favorable conservation condition**	Maintain species distribution (7km) within the Cloon River; Population size: Restore adult population >10000; Population structure(Recruitment): Restore 'young mussels' (<65mm) to >20%; Restore 'juvenile mussels' (<30mm) to >5% of population; Population structure (Adult mortality): ≤5% decline in live adults counted; ≤1% dead shells of the adult population and scattered in distribution. Habitat extent: Restore suitable habitat in more than 3.3km, and any additional stretches necessary for salmonid spawning. Restore water quality, substratum quality and appropriate hydrological regimes; Maintain sufficient juvenile salmonids to host glochidial larvae.
1095 Sea Lamprey *Petromyzon marinus*	**Restore to favorable conservation condition**	Increase extent (>75%) of river accessible from estuary to allow upstream migration; remove restrictions (artificial barriers) to allow access to spawning areas. Population structure of juveniles to have at least 3 age/size groups present. Juvenile density in fine sediment at least 1/m². No decline in extent and distribution of spawning beds. More than 50% of sample juvenile habitat sites positive.
1096 Brook Lamprey *Lampetra planeri*	**Maintain favourable conservation condition**	Access to all water courses down to first order streams; remove restrictions (artificial barriers) to allow access to allow up- and downstream migration. Population structure of juveniles to have at least 3 age/size groups present. Juvenile density in fine sediment at least 2/m². No decline in extent and distribution of spawning beds. More than 50% of sample juvenile habitat sites positive.
1099 River Lamprey *Lampetra fluviatilis*	Maintain favourable conservation condition	Access to all water courses down to first order streams; remove restrictions (artificial barriers) to allow access to allow up- and downstream migration. Population structure of juveniles to have at least 3 age/size groups present.

Feature (Community Type)	Objective	Target
		Juvenile density in fine sediment at least 2/m². No decline in extent and distribution of spawning beds. More than 50% of sample juvenile habitat sites positive.
1106 Atlantic *Salmon Salmo salar* (only in fresh water)	**Restore favourable conservation condition**	Increase extent (100%) of river channels down to second order accessible from estuary. Conservation Limit (CL) of number of adult fish spawning for each system consistently exceeded. Maintain or exceed current mean catchment-wide Salmon 0+ fry abundance threshold value (Currently set at 17 salmon fry/5 min sampling). No significant decline in out-migrating smolt abundance. No decline in number and distribution of spawning redds due to anthropogenic causes Water quality at least Q4 at all sites sampled by EPA.
1349 Bottlenose Dolphin *Tursiops truncatus*	Maintain favourable conservation condition	Species range within the site should not be restricted by artificial barriers to site use; Critical areas, representing habitat used preferentially by bottlenose dolphins, should be conserved in a natural condition; Human activities should occur at levels that do not adversely affect the bottlenose dolphin populations
1355 **Otter *Lutra lutra***	**Restore favourable conservation condition**	No significant decline in distribution. No significant decline in extent of terrestrial habitat (596.8ha), marine habitat (4461.6ha), river habitat (500.1km), lake/lagoon habitat (125.6ha) Couching sites and holts - no significant decline and minimise disturbance: Fish biomass - No significant decline in marine fish species in otter diet. Barriers to connectivity - No significant increase.

Figure 4: Natura 2000 sites adjacent to Lower River Shannon SAC (Site Code 002165) (NPWS 2012a).

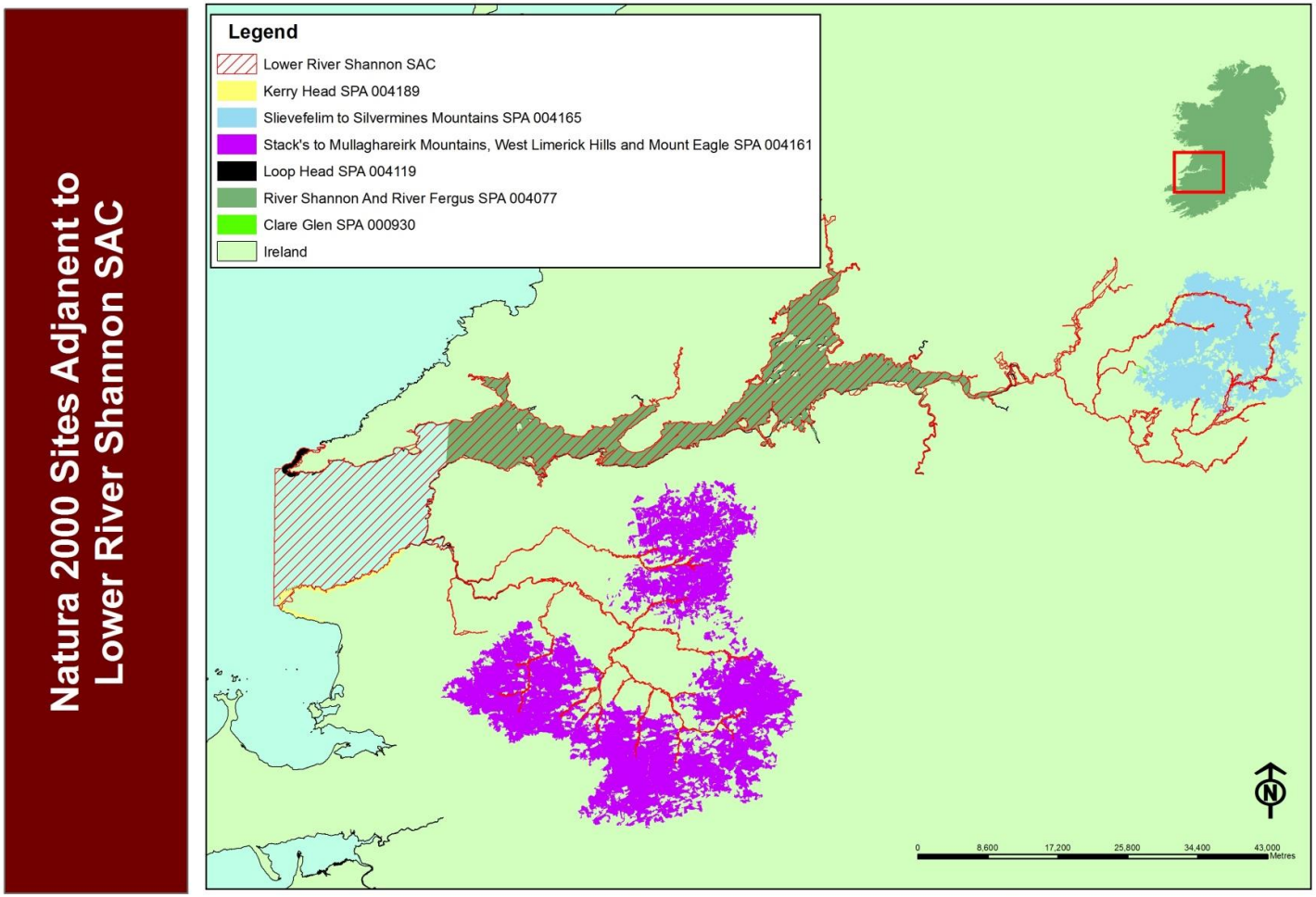


Table 2: Natura Sites adjacent to Lower River Shannon SAC and qualifying features with initial screening assessment on likely interactions with aquaculture activities.

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	AQUACULTURE INITIAL SCREENING
River Shannon and River Fergus Estuaries SPA (004077)	Cormorant (*Phalacrocorax carbo*) [A017]	Subject to separate Assessment report
	Whooper Swan (*Cygnus cygnus*) [A038]	
	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]	
	Shelduck (*Tadorna tadorna*) [A048]	
	Wigeon (*Anas penelope*) [A050]	
	Teal (*Anas crecca*) [A052]	
	Pintail (*Anas acuta*) [A054]	
	Shoveler (*Anas clypeata*) [A056]	
	Scaup (*Aythya marila*) [A062]	
	Ringed Plover (*Charadrius hiaticula*) [A137]	
	Grey Plover (*Pluvialis squatarola*) [A141]	
	Lapwing (*Vanellus vanellus*) [A142]	
	Knot (*Calidris canutus*) [A143]	
	Dunlin (*Calidris alpina*) [A149]	
	Black-tailed Godwit (*Limosa limosa*) [A156]	
	Bar-tailed Godwit (*Limosa lapponica*) [A157]	
	Curlew (*Numenius arquata*) [A160]	
	Redshank (Tringa totanus) [A162]	
	Greenshank (Tringa nebularia) [A164]	
	Black-headed Gull (Chroicocephalus ridibundus) [A179]	
	Wetland and Waterbirds [A999]	

Table 2 cont'd**: Natura Sites adjacent to Lower River Shannon SAC and qualifying features with initial screening assessment on likely interactions with aquaculture activities.**

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	AQUACULTURE INITIAL SCREENING
Loop Head SPA (004119)	Kittiwake (*Rissa tridactyla*) [A188] Guillemot (*Uria aalge*) [A199]	No spatial overlap or likely interaction with activities within Lower Shannon SAC– excluded from further analysis
Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (004161)	Hen Harrier (*Circus cyaneus*) [A082]	No spatial overlap or likely interaction with activities within Lower Shannon SAC– excluded from further analysis
Slievefelim to Silvermines Mountains SPA (004165)	Hen Harrier (*Circus cyaneus*) [A082]	No spatial overlap or likely interaction with activities within Lower Shannon SAC– excluded from further analysis
Kerry Head SPA (004189)	Fulmar (*Fulmarus glacialis*) [A009] Chough (*Pyrrhocorax pyrrhocorax*) [A346]	No spatial overlap or likely interaction with activities within Lower Shannon SAC– excluded from further analysis
Clare Glen SAC (00930)	Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0] *Trichomanes speciosum* (Killarney Fern) [1421]	No spatial overlap or likely interaction with activities within Lower Shannon SAC– excluded from further analysis

5 Details of the proposed plans and projects

5.1 Aquaculture

Aquaculture in the Lower River Shannon SAC focuses primarily on shellfish species (mussels, oysters) (Figure 5). Oysters are the predominant shellfish species cultured within the SAC, mussels are produced at a lower scale; while Scallops, although licensed, are not currently produced in the area. Descriptions of spatial extents of existing and proposed activities within the qualifying interests of the Lower River Shannon SAC were calculated using coordinates of activity areas in a GIS. The spatial extent of the various aquaculture activities (current and proposed) overlapping the habitat features is presented in Table 3 (data provided by DAFM).

5.1.1 Oyster Culture

There are five locations currently in operation for oyster culture within the SAC, located in Rinneville, Carrigaholt, Ballylongford, Askeaton/Foynes, Poulnasherry Bays.

There is currently one licensed oyster producer in Rinneville Bay, the cultivation method employed is bag and trestle. A small number of native (*Ostrea edulis*) and pacific (*Crassostrea gigas*) (diploid) oysters (Approx 10,000 oysters) are onsite. Native and pacific oyster spat is collected on site using plates and shell during spring and autumn. The producer is planning to invest in Seasalter seed with projected tonnage of up to 20 tonnes annual production within 4 years.

There are three licensed sites, and one application, within Carrigaholt Bay for the cultivation of oysters. These involve intertidal bag & trestle cultivation and subtidal bottom culture. Three stages of oyster growth are planned in the Bay. Land based nursery will take in oysters seed (size 3-6m) from Tralee Bay Hatchery. Upon reaching G5 size the oyster will be transferred out to the bag and trestles oyster site and on-grown to 10gr. The stock will then be transferred subtidally to oyster sites for bottom culture. All seed sourced from Tralee Bay Hatchery is currently 100% diploid. The grow out time frame for oysters in the bay from input onto sites to market size is 24+ months.

In Ballylongford Bay two methods of intertidal oyster cultivation are employed bag & trestles and oyster longlines. Triploid oyster seed is sourced from French hatcheries and arrives on site in September. Bag & trestle method involves initial stocking densities of 2000 seed/bag (4ml mesh). The following June density will be reduced to 500/bag (6ml mesh). The seed will be approx 30ml depending on growth conditions. Six months later (approx. Nov/Dec) stocking density reduced again to 140/bag in either 9 or 14ml bags. In general, first top grade will be 2 years from input onto the site with the bottom grade taking up to 3 years to reach market size. Oyster Long lines involves a line made from steel rope placed intertidally on the shore. The rope is kept upright with two strainer posts at each end, with upright posts in between along the line length (approx. 120m). 4/5 baskets are located between each upright, basket size is approximately 2ft x 3ft depth and will hang approx. 1.5ft off the seabed. Long lines can be used for seed and ongrowing.

In Askeaton/Foynes area *C gigas* oysters are cultivated intertidally using bag and trestle method. Seed is sourced from Seasalter. Seed (G6/G7) is placed at a stocking density of 2500/bag, and after 6 months this is split down to 1000/bag. The oysters are then finished by bottom culture in Atlantic shellfish's Order area. Stock on site is 80% diploid, 20% triploid. Future plans also include growing oysters (*C. gigas*) on the seabed.

Oysters are the only species produced in Poulnasherry Bay. Cultivation is by bag and trestle method, stock is sourced (G6/G7) from Seasalter or Guernsey hatcheries. Stock is predominantly diploid with on average 80% diploid and 20% triploid. Initial stocking density is 2000/bag (4ml). Many producers then split down to approx. 900/bag after 6/8 weeks. During the autumn seed numbers are reduced to 500/bag. The final number of oyster in bags for finishing tends to be in the range 140-160/bag. Producers use 4ml, 6ml, 9ml and 14 ml bags in the production cycle. The production cycle is approx. 30 months to have 70% of all seed inputed is sent to market.

5.1.2 Fishery Order Areas

T8/004A: Currently one producer working the order area and approx. 34ha utilised for the relaying of seed and half grown oysters which are then harvested once they reach commercial size.
T8/004B: One producer has leased the entire western order area. The planned usage is for different methods of oyster cultivation in various places dependant on the suitability of the areas within the order areas. Planned usage in the area will be a combination of different methods as appropriate and as methods are developed, i.e. Rafts, Longlines, Floating Flupsys, Bottom Culture, Bags & Trestles and Tidal and Sub-tidal Frames.
T8/08OFO: 25% of the Order area is under cultivation of oysters by bag & trestle.

5.1.3 Mussels

In the Lower River Shannon SAC mussels are produced using bottom cultivation and suspended long-line mussel farming. Cromane Seafoods has a bottom mussel licence in Ballylongford. The site has not been extensively utilised over the years but the company has plans to further utilise the site in coming years. The site is used for bottom culture of mussels. The seed is transplanted by pumping it, mixed with seawater, from the hold of the boat onto the site. The vessels are fitted with a pumping system. This pattern of relaying is achieved by the vessels moving across the site during pumping in an effort to achieve an even distribution of mussel on the site in order to maximise survival and growth. The dredge uses 2--4 single dredges while harvesting. The type of dredge used are 2m mussel dredges with a flat bar that is designed to skim the surface of the substrate and separate mussel seed from the underlying sediment of the substrate and remove the mussel seed.

Within this bay there is an application for two sites for mussel longlines. These sites will be used as collector sites for mussel seed). These longlines will be in Ballylongford/Tarbert area of the Shannon. Production cycle is predicted at 2-3 years.

5.1.4 Access Routes

There is a combination of shore and marine access for the sites within the Lower River Shannon SAC (Figure 5).

The intertidal area is typically accessed during spring tides (at low tide) using tractors or loaders. Preparatory work is always conducted in the intervening periods, including grading and packing, preparation of bags and trestles and general maintenance work which includes shaking and turning of bags, rotating baskets and cages, and hand removal of fouling and seaweed to ensure maintenance of water flow through the bags when submerged. The access routes are identified in Figure 5.

Calculation of area of the access routes in the SAC is linear length (in metres) by a putative route width of 10m, which is considered a sufficiently precautionary estimate, gives a total spatial overlap of 12.7ha within the SAC.

The spatial overlap of access routes on Qualifying Interests is presented in Table 3 (while Tables 6-9 presents spatial overlap on constituent communities of Qualifying Interests of 1130, 1140, 1160 and 1170).

Figure 5: Aquaculture sites (Licenced and Applications) in Lower River Shannon SAC (Site Code 002165).

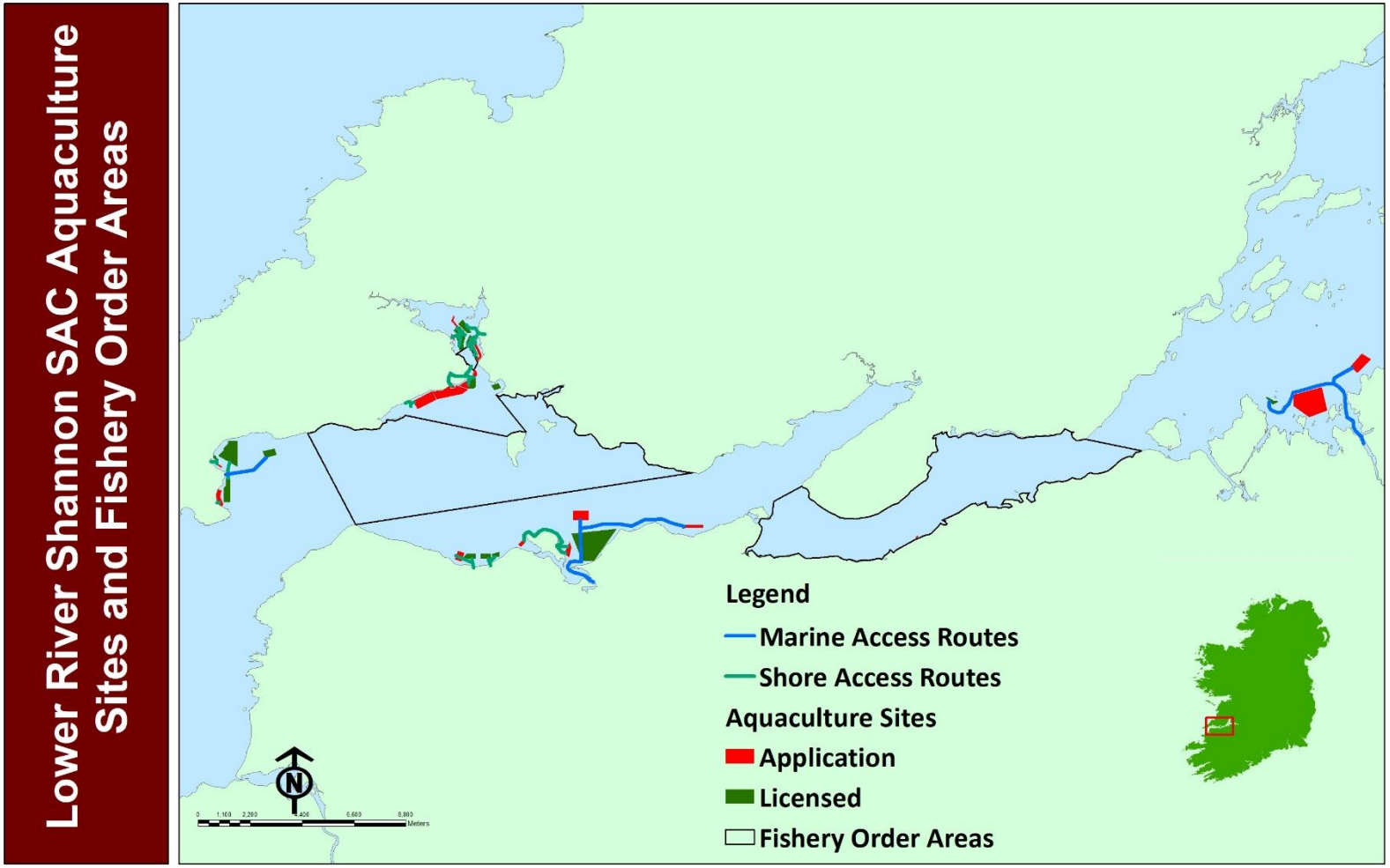


Table 3: Spatial extent (ha) of aquaculture activities and Fishery Order overlapping with qualifying interests and Critical Dolphin Habitat in Lower River Shannon SAC (Site Code 002165). **L = Licensed; A = Application; FO = Fishery Order.**

Species	Status	Location	1130 Estuaries (24,273ha)		1140 Mudflats and sandflats not covered by seawater at low tide (8,808ha)		1160 Large shallow inlets & bays (35,282ha)		1170 Reefs (21,421ha)		1349 Critical Dolphin Habitat	
			Area (ha)	% Feature	Area (ha)	% Feature	Area (ha)	% Feature	Area (ha)	% Feature	Area (ha)	% Feature
Oysters	L	Intertidal	6.23	0.03	41.91	0.48	102.4	0.29	3.00	0.01	5.58	0.04
Oysters	A	Intertidal	0	0	71.29	0.81	138.41	0.39	10.93	0.05	0	0
Oysters	L	Subtidal	0	0	0	0	98.86	0.28	9.60	0.05	14.32	0.10
Oysters	A	Subtidal	134.76	0.55	0	0	79.78	0.23	0	0	0	0
Mussels	L	Subtidal	151.47	0.62	0	0	0	0	3.03	0.014	14.36	0.10
Mussels	A	Subtidal	37.46	0.15	0	0	0	0	0	0	37.46	0.26
Access Routes			1.93	0.01	4.83	0.05	9.83	0.02	3.6	0.01	0	0
Total			331.85	1.31	118.02	1.34	347.51	0.97	30.16	0.13	71.72	0.5
Oysters	FO	Subtidal	4151.70	17.11	199.38	2.27	3823.63	10.8	2020.83	9.44	2050.88	14.23
Total			4483.55	18.42	317.4	3.61	4171.14	11.77	2050.99	9.57	2122.6	14.73

6 Natura Impact Statement for the proposed activities

The potential ecological effects of activities on the conservation objectives for the site relate to the physical and biological effects of fishing gears or aquaculture structures and human activities on designated species, intertidal and sub-tidal habitats, invertebrate communities and biotopes within those broad habitat types. The overall effect on the conservation status will depend on the spatial and temporal extent of fishing and aquaculture activities during the lifetime of the proposed plans and projects and the nature of each of these activities in conjunction with the sensitivity of the receiving environment.

6.1 Aquaculture

Within the qualifying interest of the Lower River Shannon SAC, the species cultured are:

- Mussels (*Mytilus edulis*) in suspended culture (subtidal longlines) and subtidally on the seafloor.
- Oysters (*Ostrea edulis*, *Crassostrea gigas*) in suspended culture (bags & trestles) and subtidally on the seafloor.

Details of the potential biological and physical effects of these aquaculture activities on the habitat features, their sources and the mechanism by which the impact may occur are summarised in Table 4, below**.** The impact summaries identified in the table are derived from published primary literature and review documents that have specifically focused upon the environmental interactions of mariculture (e.g. McKindsey *et al*. 2007; NRC 2010; O'Beirn *et al* 2012; Cranford *et al* 2012; ABPMer 2013a-h).

Filter feeding organisms, for the most part, feed at the lowest trophic level, usually relying primarily on ingestion of phytoplankton. The process is extractive in that it does not rely on the input of feedstuffs in order to produce growth. Suspension feeding bivalves such as oysters and mussels can modify their filtration to account for increasing loads of suspended matter in the water and can increase the production of faeces and pseudofaeces (non-ingested material) which result in the transfer of both organic and inorganic particles to the seafloor. This process is a component of benthic-pelagic coupling (Table 3). The degree of deposition and accumulation of biologically derived material on the seafloor is a function of a number of factors discussed below.

One aspect to consider in relation to the culture of shellfish is the potential risk of alien species arriving into an area among consignments of seed or stock sourced from outside of the area under consideration. When the seed is sourced locally (e.g. mussel culture) the risk is likely zero. When seed is sourced at a small size from hatcheries in Ireland the risk is also small. When seed is sourced from hatcheries outside of Ireland (this represents the majority of cases particularly for oyster culture operations) the risk is also considered small, especially if the nursery phase has been short. When ½-grown stock (oysters and mussels) is introduced from another area (e.g. France, UK) the risk of introducing alien species (hitchhikers) is considered greater given that the stock will have been grown in the wild (open water) for a prolonged period (i.e. ½-grown stock).

Furthermore, the culture of a non-native species (e.g. the Pacific Oyster - *Crassostrea gigas*) may also presents a risk of establishment of this species in the SAC. Recruitment of *C. gigas* has been documented in a number of bays in Ireland (including the Shannon Estuary) and appears to have become naturalised (i.e. establishment of a breeding population) in two locations (Kochmann *et al* 2012; 2013; Zwerschke et al 2016; 2017). This phenomenon has been demonstrated to be exacerbated by the culture of oyster uncontained on the seabed (MagAoidh 2011).

Suspended Shellfish Culture: Suspended culture, may result in faecal and pseudo-faecal material falling to the seabed. In addition, the loss of culture species to the seabed is also a possibility. The degree to which the material disperses away from the location of the culture system (longlines or trestles) depends on the density of mussels on the line, the depth of water and the current regime in the vicinity. Cumulative impacts on seabed, especially in areas where assimilation or dispersion of pseudofaeces is low, may occur over time. A number of features of the site and culture practices will govern the speed at which pseudofaeces are assimilated or dispersed by the site. These relate to:

Hydrography – will govern how quickly the wastes disperse from the culture location and the density at which they will accumulate on the seafloor.

Turbidity in the water - the higher the turbidity the greater the production of pseudo-faeces and faeces by the filter feeding animal and the greater the risk of accumulation on the seafloor.

Density of culture – suspended mussel culture is considered a dense culture method with high densities of culture organisms over a small area. The greater the density of organisms the greater the risk of accumulations of material. The density of culture organisms is a function of:

- depth of the site (shallow sites have shorter droppers and hence fewer culture organisms
- the husbandry practices proper maintenance will result in optimum densities on the lines in order to give high growth rates as well as reducing the risk of drop-off of culture animals to the seafloor and sufficient distance among the longlines to reduce the risk of cumulative impacts in depositional areas.

In addition placement of structures associated with mussel culture can influence the degree of light penetration to the seabed. This is likely important for organisms and habitats e.g. Maërl and seagrasses which need sun light for production. Rafts or lines will to a degree limit light penetration to the sea bed and may therefore reduce production of photosynthesising species. However, such effects have not been demonstrated for seagrass.

Intertidal shellfish culture: Oysters are typically cultured in the intertidal zone using a combination of plastic mesh bags and trestles. Their specific location in the intertidal is dependent upon the level of exposure of the site, the stage of culture and the accessibility of the site. The habitat impact from oyster trestle culture is typically localised to areas directly beneath the culture systems. The physical presence of the trestles and bags may reduce 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. Whether material accumulates is dictated by a number of factors, including:

Hydrography – low current speeds (or small tidal range) may result in material being deposited directly beneath the trestles. If tidal height is high and large volumes of water moved through the culture area an acceleration of water flow can occur beneath the trestles and bags, resulting in a scouring effect or erosion and no accumulation of material.

Turbidity of water – as with suspended mussel culture, oysters have very plastic response to increasing suspended matter in the water column with a consequent increase in faecal or pseudo-faecal production. Oysters can be cultured in estuarine areas (given their polyhaline tolerance) and as a consequence can be exposed to elevated levels of suspended matter. If currents in the vicinity are generally low, elevated suspended matter can result in increase build-up of material beneath culture structures.

Density of culture – the density of oysters in a bag and consequently the density of bags on a trestle will increase the likelihood of accumulation on the seafloor. In addition, if the trestles are located in close proximity a greater dampening effect can be realised with resultant accumulations. Close proximity may also result in impact on shellfish performance due to competitive interactions for food.

Exposure of sites - the degree to which the aquaculture sites are exposed to prevailing weather conditions will also dictate the level of accumulated organic material in the area. As fronts move through culture areas increased wave action will resuspend and disperse material away from the trestles.

Shading may be an issue as a consequence of the structures associated with intertidal oyster culture. The racks and bags are held relatively close to the seabed and as a consequence may shade sensitive species (e.g. seagrasses) found underneath.

Sub-tidal shellfish culture i.e. bottom culture of oysters/mussels: This activity involves relaying shellfish on the seabed. There may be increased enrichment due to production of faeces and pseudofaeces. The existing in-faunal community may be changed as a result. Seabed habitat change may also result as a result of dredging during maintenance and harvesting. Uncontained sub-tidal shellfish 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.

Physical disturbance caused by compaction of sediment from foot traffic and vehicular traffic. Activities associated with the culture of intertidal shellfish include 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.

Other considerations: The high density of the culture organisms in the bottom cultivation method can lead to exclusion of native biota and the ground preparation and harvest methods (by mechanical means or by hand) can lead to considerable disturbance of biota characterising the habitat.

Due to the nature of the (high density) culture methods the risk of transmission of disease within cultured stock is high. The risk of disease transmission from cultured oysters to other species is unknown.

Ireland enjoys a high health status (Category 1) in relation to the fish/shellfish on farms, in rivers and lakes and remains free of many diseases that occur in other countries (www.fishhealth.ie). In Ireland, there are programmes in place that govern the movement of (fish and shellfish) stock for on-growing among sites. These movement controls are supported by a risk-based fish health surveillance programme which is operated on a nationwide basis by the Marine Institute, in co-operation with private veterinary practitioners. Council Directive 2006/88/EC on animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals form the legislative basis that governs the monitoring and management of disease outbreaks in mariculture operations in Ireland. For diseases not listed in this Directive, a Code of Practice and Fish Health Handbook has been developed jointly by the State and industry with the primary objectives of disease prevention and control.

Table 4: Potential indicative environmental pressures of aquaculture activities within the qualifying interests (Annex I Habitats) of the Lower River Shannon SAC.

Activity	Pressure category	Pressure	Potential effects	Equipment	Duration (days)	Time of year	Factors constraining the activity
Aquaculture							
Suspended Culture **Subtidal** (Longlines)	**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 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
		Nutrient exchange	Changes in ammonium and dissolved inorganic nitrogen resulting in increased primary production.				Culture density
	Physical	Current alteration	Baffling effect resulting in a slowing of currents and increasing deposition onto seabed changing sedimentary composition	Floats, longlines, continuous ropes (New Zealand system), and droppers	365	All year	Location (sheltered location for year round activity)
		Shading	Prevention of light penetration to seabed potentially impacting light sensitive species		365	All year	Culture/structure density
	Biological	Deposition	Faecal and pseudofaecal deposition on seabed		365	All year	Hydrography, Turbidity, Culture/structure density

Activity	Pressure category	Pressure	Potential effects	Equipment	Duration (days)	Time of year	Factors constraining the activity
Suspended Culture **Intertidal** (Bags & trestles)			potentially altering sediment and community composition				
		Seston filtration	Alteration of phyto/zooplankton communities and potential impact on carrying capacity		365	All year	Culture density, Turbidity
		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
		Nutrient exchange	Changes in ammonium and dissolved inorganic nitrogen resulting in increased primary production.				Culture density
	Physical	Current alteration	Structures may alter the current regime and resulting increased deposition of fines or scouring.	Trestles and bags, frames and service equipment	365	All year	At low tide only
		Surface disturbance	Ancillary activities at sites, e.g. servicing, transport increase the risk of sediment compaction resulting in sediment changes and associated community changes.	Site services, human & vehicular traffic	365	All year	At low tide only
		Shading	Structures prevent light penetration to the seabed and therefore potentially impact on light sensitive species.	Long lines, Bags, Trestles, Floats, bouchot poles etc	365	All year	Culture/structure density

Metier/ Activity	Pressure category	Pressure	Potential effects	Equipment	Duration (days)	Time of year	Factors constraining the activity
Subtidal culture Bottom Culture	**Biological**	Seston filtration	Alteration of phyto/zooplankton communities and potential impact on carrying capacity		365	All year	Culture density, Turbidity
		Monoculture	Habitat dominated by single species and transformation of infaunal dominated community to epifaunal dominated community.		365	All year	Culture density
		By-catch mortality	Mortality of organisms captured or disturbed during the harvest or process, damage to structural fauna of reefs				
		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	In event of epizootic the ability to manage disease in uncontained subtidal shellfish populations would likely be compromised. The risk introduction of disease causing organisms by introducing seed originating from the 'wild' in other jurisdictions				Screening/ Introduce biosecurity plan
		Nutrient exchange	Increased primary production. N_2 removal at harvest or denitrification at sediment surface				Culture density
	Physical	Surface disturbance	Abrasion at the sediment surface and redistribution of sediment	Dredge		Seasonal	Weather for site access. Size of shellfish and market constraints
		Shallow disturbance	Sub-surface disturbance to 25mm				

Aquaculture and marine mammal interactions

Potential interactions between shellfish culture and marine mammals are broadly summarized in Table 5. Potential impacts on marine mammals as a result of aquaculture interaction include death or injury through entanglement in gear, displacement, altered food chain, disruption of migration pathways (for large cetaceans), and human intervention (marine mammals killed or relocated) (Watson-Capps and Mann, 2005). 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 (National Research Council, 2010). 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).

Otter (*Lutra lutra*)

There is little literature regarding the otter and its potential interactions with aquaculture. According to the NPWS (2009) habitat destruction, pollution and accidental death/persecution are considered the major threats to this species. The main interactions between otter and aquaculture are listed in Table 5.

The most recent otter survey in Ireland was carried out in 2004/2005 (Bailey & Rochford, 2006), which found that otter densities had declined from nearly 90% in 1980 to 70.5%, but that the species was still present throughout the country. However, according to a recent report by NPWS (2009) the overall conservation assessment is "unfavourable - inadequate", reflecting the current unfavourable status of the otter population in the country and, in particular the decline in otter population seen during the 1980s. Notwithstanding the above, the risk posed to otter by proposed shellfish culture activity is considered low. Given the crepuscular nature of the otter, likely interactions (and disturbance) with operators are considered low. Furthermore shellfish culture (intertidal and suspended) are not considered a threat to otters. In the threat response plan NPWS (2009) "Little evidence has come to light in recent studies to suggest that disturbance by recreation is a significant pressure". Recreation in the NPWS report is defined as angling, boating and mariculture.

Bottlenose Dolphin (*Tursiops truncatus*)

There is very little literature describing the likely interactions between aquaculture practices and dolphin behaviour and distribution. Some studies relating to interactions with finfish aquaculture have demonstrated modified behaviour of small cetaceans (i.e. dolphins) in the vicinity of fishfarms during harvesting operations (Diaz-Lopez 2012). Displacement of bottlenose dolphin has been observed at suspended shellfish culture sites (pearl oyster) (Watson-Capps and Mann 2005); however, it is unclear if the displacement was a function of the structures or disturbance resulting from activities at the sites? It is likely that interactions will occur at suspended culture sites (e.g., longlines) and less so at intertidal sites which are, even when inundated, found in quite shallow waters.

Table 5: Potential interactions between aquaculture activities and the qualifying interests (Annex II species) within the Lower River Shannon SAC.

Culture Method	Pressure category	Pressure	Potential effects	Equipment	Duration (days)	Time of year	Factors constraining the activity
All Aquaculture Methods	**Physical**	Habitat Exclusion	Structures may result in a barrier to movement and displacement .	Bags & trestles, longlines	365	All year	Spatial extent and location of structures used for culture.
		Disturbance	Ancillary activities at sites increase the risk of disturbance to marine mammals and other Annex Species	Site services, human, boat and vehicular traffic	365	All year	Seasonal levels of activity relating to seeding, grading, and harvesting. Peak activities do not coincide with more sensitive periods for marine mammals and other Annex Species
		Entanglement	Entanglement by ropes or material used on structures or during operation of farms	Ropes and/or nets used in day to day	365	All year	Farm management practices
		Ingestion	Injury or even mortality due to Ingestion of waste material used on farms	Ties used to secure bags and secure bags to trestle, floats, ropes etc.	365	All year	Farm management practices
		Deterrent Methods	Mammals interfering with cages will result in deterrent actions, e.g. use of Acoustic deterrent or harassment Devices. If all non lethal avenues fail then lethal methods may be employed (under licence).	ADDs and lethal devices (shooting)	365	All year	Fallow periods no fish on-site

7 Screening of Aquaculture Activities

A screening assessment 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 or qualifying interests 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 primarily 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 full assessment is warranted. Likewise if there is no spatial overlap and no obvious interaction is likely to occur, then the possibility of significant impact is discounted and further assessment of possible effects is deemed not to be necessary. Table 3 provides spatial overlap extent between designated habitat features and aquaculture activities within the qualifying interests of the Lower River Shannon SAC.

7.1 Aquaculture Activity Screening

Where the spatial overlap between an aquaculture activity and a habitat feature is zero it is screened out and not considered further unless some other likely interaction is proposed. The Annex I habitats of Sandbanks which are slightly covered by sea water all the time (1110) and Coastal Lagoons (1150) have no spatial overlap with (existing and proposed) aquaculture activities are excluded from further consideration in this assessment.

Table 3 highlights the spatial overlap between (existing and proposed) aquaculture activities and the qualifying interests for habitats (i.e. Estuaries (1130), Mudflats and sandflats not covered by seawater at low tide (1140), Large shallow inlets and bays (1160) and Reefs (1170)) and the Critical Dolphin Habitat.

Tables 6, 7, 8, 9 provide an overview of overlap (ha, %) of aquaculture activities and specific community types within the broad habitat features 1130, 1140 1160 and 1170 (identified from Conservation Objectives, NPWS, 2012a).

Where the overlap between an aquaculture activity and a qualifying feature is zero it is screened out and not considered further in the assessment unless some other likely interaction is proposed. None of the aquaculture activities (existing or proposed) overlaps or likely interacts with the following qualifying features (habitats and species), and therefore these ten habitats and four taxa are excluded from further consideration in this assessment:

- 1029 Freshwater Pearl Mussel *Margaritifera margaritifera*
- 1096 Brook Lamprey *Lampetra planeri*

- 1099 River Lamprey *Lampetra fluviatilis*
- 1110 Sandbanks which are slightly covered by sea water all the time
- 1150 Coastal lagoons
- 1220 Perennial vegetation of stony banks
- 1230 Vegetated sea cliffs of the Atlantic and Baltic coasts
- 1310 *Salicornia* and other annuals colonizing mud and sand
- 1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae)
- 1410 Mediterranean salt meadows (*Juncetalia maritimi*)
- 3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
- 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
- 91E0 *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

The Atlantic Salmon (*Salmo salar*) migrates through the Lower River Shannon SAC Given the nature of the activities proposed for aquaculture in the Lower River Shannon, it is unlikely that existing aquaculture activities or those proposed will impact on the conservation attributes for Salmon, which are;

- Distribution (in freshwater)
- Fry abundance (freshwater)
- Population size of spawners (fish will not be impeded or captured by the proposed activity)
- Smolt abundance (out migrating smolts will not be impeded by the proposed activity)
- Water quality (freshwater)

On this basis Atlantic Salmon *Salmo salar* (1106) is excluded from further analysis.

The Sea lamprey (*Petromyzon marinus*) migrates through the Lower River Shannon SAC into the Fergus, Feale and Mulkear Rivers. The aquaculture activities do not present a barrier to migration of this species, given that any structures used (trestles/longlines etc) will allow the lamprey to swim among and through such structures. It is unlikely that they will impact upon other attributes and their targets for the Sea lamprey, which are primarily freshwater in nature. The attributes are:

- Extent of anadromy
- Population structure (of juveniles for Sea lamprey only)
- Juvenile density in fine sediments (Sea lamprey only)
- Extent and distribution of spawning habitat
- Availability of juvenile habitat (Sea lamprey only)

On this basis, the Sea Lamprey *Petromyzon marinus* (1095) has been excluded from further analysis.

As the aquaculture production activities within the SAC spatially overlap with otter (*Lutra lutra*, 1355) territory, the otter has not been excluded from further analysis.

There is spatial overlap between intensive (Longlines) and extensive (bottom culture) mussel farming and the critical habitat of the Annex II species bottlenose dolphin (*Tursiops truncatus,* 1349). These critical areas (Figure 3) represent high value habitats used preferentially by the species within its overall range at the site and they coincide with areas of steep benthic slope, greater depth and greater currents. It is probable that intensive (Longlines) mussel farming and extensive (bottom culture) may impact upon the following conservation objective and targets for the species:

Objective 1 - To maintain the favourable conservation condition of bottlenose dolphin in Lower River Shannon SAC which is defined by the following targets

- Target 1 - Species range within the site should not be restricted by artificial barriers to site use
- Target 2 - Critical Areas, representing habitat used preferentially by bottlenose dolphin, should be maintained in a natural condition.

On this basis, the Bottlenose Dolphin *Tursiops truncatus* (1349) has not been excluded from further analysis.

Furthermore, of the 10 community types (see Table 1) listed under the qualifying habitat interests of the SAC, six have spatial overlap with aquaculture activities:

- Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. community
- Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex
- Subtidal sand to mixed sediment with *Nucula nucleus* community complex
- Subtidal sand to mixed sediment with *Nephtys* spp. community complex
- Fucoid-dominated intertidal reef community complex
- Anemone-dominated subtidal reef community

On this basis, the following community types have no spatial overlap between them and any aquaculture activities and are excluded from further analysis of aquaculture interactions:

- Estuarine subtidal muddy sand to mixed sediment with gammarids community complex
- Mixed subtidal reef community complex

When overlap was observed it was estimated in a GIS application and calculated on the basis of coverage of specific activity (representing different pressure types), licence status (licenced or application) intersecting with designated conservation features and/or sub-features (community types) and presented in Tables 6,7,8 and 9.

Table 6: Habitat utilisation i.e. spatial overlap in hectares and percentage (given in parentheses) of aquaculture activity and Fishery Order over community types within the qualifying interest 1130 - Estuaries

(Spatial data based on licence database provided by DAFM. Habitat & community data provided in NPWS 2012a, 2012b).

				1130 Estuaries						
Culture Type	Location	Method	Status	Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex (8130ha)	Estuarine subtidal muddy sand to mixed sediment with gammarids community complex (268 ha)	Subtidal sand to mixed sediment with *Nucula nucleus* community complex (4196 ha)	Subtidal sand to mixed sediment with *Nephtys* spp. community complex (8404 ha)	Fucoid-dominated intertidal reef community complex (678 ha)	Faunal turf-dominated subtidal reef community (981 ha)	Anemone-dominated subtidal reef community (713 ha)
Oysters	Intertidal	I	L	4.67 (0.06)	0	0	0.91 (0.01)		0	0
Oysters	Intertidal	I	A	0	0	0	0.08 (9.16E-04)	0.57 (0.08)	0	0
Mussels	Subtidal	I	A	0	0	37.46 (0.89)	0	0	0	0
Oysters	Subtidal	E	L	0	0	0	0	0	0	0
Oysters	Subtidal	E	A	49.69 (0.61)	0	0.39 (0.01)	82.30 (0.98)	2.38 (0.35)	0	0
Mussels	Subtidal	E	L	0	0	119.43 (2.85)	28.99 (0.35)	3.04 (0.45)	0	0
Access Routes				0.3 (0.004)	0	0	0.76 (0.01)	0.87 (0.13)	0	0
Fishery Order	Subtidal			178.53 (2.20)	0	2691 (64.16)	362.82 (4.32)	193.70 (28.57)	169.11 (17.24)	553.74 (77.65)

Table 7: Habitat utilisation i.e. spatial overlap in hectares and percentage (given in parentheses) of aquaculture activity and Fishery Order over community types within the qualifying interest 1140 - Mudflats and sandflats not covered by seawater at low tide.

(Spatial data based on licence database provided by DAFM. Habitat & community data provided in NPWS 2012a, 2012b).

				1140 Mudflats and sandflats not covered by seawater at low tide	
Culture Type	Location	Method	Status	Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. Community (213 ha)	Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex (8596 ha)
Oysters	Intertidal	I	L	0	13.80 (0.16)
Oysters	Intertidal	I	A	6.44 (3.03)	36.26 (0.42)
Mussels	Subtidal	I	A	0	0
Oysters	Subtidal	E	L	0	0
Oysters	Subtidal	E	A	0.21 (0.10)	59.48 (0.69)
Mussels	Subtidal	E	L	0	0
Access Routes				0.03 (0.01)	4.54 (0.053)
Fishery Order	Subtidal			0.41 (0.19)	198.97 (2.32)

Table 8: Habitat utilisation i.e. spatial overlap in hectares and percentage (given in parentheses) of aquaculture activity and Fishery Order over community types within the qualifying interest 1160 - Large shallow inlets and bays. (Spatial data based on licence database provided by DAFM. Habitat & community data provided in NPWS 2012a, 2012b).

				1160 Large shallow inlets and bays								
Culture Type	Location	Method	Status	Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. Community (211 ha)	Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex (466 ha)	Subtidal sand to mixed sediment with *Nucula nucleus* community complex (6095 ha)	Subtidal sand to mixed sediment with *Nephtys* spp. community complex (9431 ha)	Fucoid-dominated intertidal reef community complex (616 ha)	Mixed subtidal reef community complex (7464 ha)	Faunal turf-dominated subtidal reef community (8710 ha)	Anemone dominated subtidal reef community (34 ha)	*Laminaria*-dominated community complex (2221 ha)
Oysters	Intertidal	I	L	0	9.12 (1.96)	4.95 (0.08)	7.62 (0.08)	2.27 (0.37)	0	0	0	0
Oysters	Intertidal	I	A	6.44 (3.05)	34.61 (7.44)	109.97 (1.8)	9.71 (0.1)	8.98 (1.46)	0	0	0	0
Mussels	Subtidal	I	A	0	0	0	0	0	0	0	0	0
Oysters	Subtidal	E	L	0	0	0	72.86 (0.77)	0	0	0	9.60 (28.40)	0
Oysters	Subtidal	E	A	0.21 (0.10)	9.80 (2.10)	49.96 (0.82)	0.01 (1.33E-04)	0.16 (0.03)	0	0	0	0
Mussels	Subtidal	E	L	0	0	0	0	0	0	0	0	0
Access Routes				0.03 (0.001)	4.24 (0.91)	1.78 (0.03)	0.76 (0.0001)	2.76 (0.45)	0	0	0	0
Fishery Order	Subtidal/ Intertidal			0.41 (<0.001)	20.45 (0.04)	2701.07 (44.3)	0	95.65 (15.5)	0	916.27 (10.5)	8.50 (25)	81.13 (3.70)

Table 9: Habitat utilisation i.e. spatial overlap in hectares and percentage (given in parentheses) of aquaculture activity and Fishery Order over community types within the qualifying interest 1170 - Reefs.

(Spatial data based on licence database provided by DAFM. Habitat & community data provided in NPWS 2012a, 2012b).

				1170 Reefs				
Culture Type	Location	Method	Status	Fucoid-dominated intertidal reef community complex (1294 ha)	Mixed subtidal reef community complex (7464 ha)	Faunal turf-dominated subtidal reef community (9692 ha)	Anemone dominated subtidal reef community (747 ha)	*Laminaria*-dominated community complex (2224 ha)
Oysters	Intertidal	I	L	2.27 (0.18)	0	0	0	0
Oysters	Intertidal	I	A	9.55 (0.73)	0	0	0	0
Mussels	Subtidal	I	A	0	0	0	0	0
Oysters	Subtidal	E	L	0	0	0	9.60 (1.29)	0
Oysters	Subtidal	E	A	2.54 (0.20)	0	0	0	0
Mussels	Subtidal	E	L	3.04 (0.24)	0	0	0	0
Access Routes				3.6 (0.20)	0	0	0	0
Fishery Order	Subtidal			289.34 (22.36)	0	1085.42 (11.20)	562.24 (75.27)	83.83 (3.77)

8 Assessment of Aquaculture Activities

8.1 Determining significance

The significance of the possible effects of the proposed activities on habitats, as outlined in the Natura Impact Statement (Section 6) and subsequent screening exercise (Section 7), is determined here in the assessment. The significance of effects is determined on the basis of Conservation Objective guidance for constituent habitats and species (Figures 1, 2 and NPWS 2012a, 2012b).

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 Lower River Shannon SAC the qualifying habitats/species considered subject to potential disturbance and therefore, carried further in this assessment are:

- 1130 Estuaries
- 1140 Mudflats and sandflats not covered by sea water all the time
- 1160 Large shallow inlets and bays
- 1170 Reefs
- 1349 Bottlenose Dolphin *Tursiops truncatus*
- 1355 Otter *Lutra lutra*

For broad habitats and sedimentary communities (Figures 1 and 2) significance of impact is determined in relation to, first and foremost, spatial overlap (see Section 7; Figure 6). Subsequent disturbance and the persistence of disturbance are considered 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 2012b) for constituent communities. The likelihood of change depends on the sensitivity of the characterising species to the activities in question. Sensitivity results from a combination of intolerance to the activity and/or recoverability from the effects of the activity (see Section 8.2 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. This threshold does not apply to sensitive habitats (e.g. *Zostera*, Maerl) where any physical disturbance should generally be avoided.

Effects will be deemed to be significant when cumulatively all disturbing activities lead to long term change (persistent disturbance) in broad habitat/features (or constituent communities) resulting in an impact greater than 15% of the area.

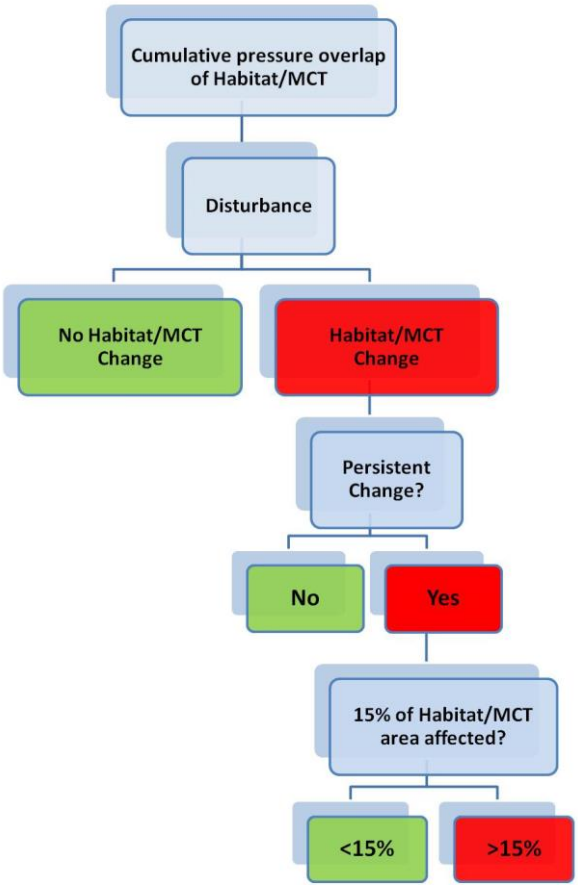


Figure 6: Schematic outlining the determination of significant effects on habitats and marine community types (MCT) (following NPWS 2012b).

In relation to designated species (i.e. Dolphin, Otter) 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.

8.2 Sensitivity and Assessment Rationale

This assessment used a number of sources of information in assessing the sensitivity of the characterising species of each community recorded within the benthic habitats of the Lower River Shannon SAC. The primary source of information is a series of commissioned reviews by the Marine Institute which identify habitat and species sensitivity to a range of pressures likely to result from aquaculture and fishery activities (ABPMer 2013a-h). These reviews draw from the broader literature, including the MarLIN Sensitivity Assessment (Marlin.ac.uk) and the AMBI Sensitivity Scale (Borja *et al*., 2000) and other primary literature. 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 is 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.

In the case of species, communities and habitats of conservation interest, 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 sensitivity is moderate or high then the species/habitats 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 2012a).
- 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 sensitivity 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 the community types (or surrogates) found within the Lower River Shannon SAC to pressures similar to those caused by aquaculture (e.g. smothering, organic enrichment and physical disturbance) are listed, where available, in Table 10. 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 Table 11. The following guidelines broadly underpin the analysis and conclusions of the species and habitat sensitivity assessment:

- Sensitivity 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.
- Sensitivity 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.

Table 10: Matrix showing the characterising community types sensitivity scores x pressure categories for habitats in Lower River Shannon SAC (ABPMer 2013a-h).

Pressure Type	Physical Damage								Change in Habitat Quality									Biological Pressures				Chemical Pollution				Physical
Community Type (EUNIS code)	Surface Disturbance	Shallow Disturbance	Deep Disturbance	Trampling-Access by foot	Trampling-Access by vehicle	Extraction	Siltation (addition of fine sediments, pseudofaeces, fish food)	Smothering (addition of materials biological/non-biological to the surface)	Changes to sediment composition-increased coarseness	Changes to sediment composition-increased fine sediment proportion	Changes to water flow	Increase in turbidity/suspended sediment	Decrease in turbidity/suspended sediment	Organic enrichment-water column	Organic enrichment of sediments-sedimentation	Increased removal of primary production-phytoplankton	Decrease in oxygen levels- sediment	Decrease in oxygen levels-water column	Introduction of non-native species	Removal of Target Species	Removal of Non-target species	Ecosystem Services-Loss of biomass	Introduction of antifoulants	Introduction of medicines	Introduction of hydrocarbons	Prevention of light reaching [illegible]
Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. community (A2.22)* Scores A2.23)	NS (*)	L (*)	L (*)	NS (*)	L-NS (*)	L-M (*)	L-M (*)	L-M (*)	L-M (*)	M (*)	L-M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	L-NS (*)	L-NS (*)	NS (***)	NS (*)	NS (*)	NA	NS (*)	NS (*)	L (*)	NS (*)
Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex (A2.41)* Scores A2.42	NS (*)	L (*)	L (*)	NS (*)	L (*)	L-M (*)	L-M (*)	L-M (*)	NS (*)	NS (*)	L-M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	L (*)	L (*)	H (*)	NS (*)	NS (*)	NA	NS (*)	NS (*)	L (*)	NS (*)
Subtidal sand to mixed sediment with *Nucula nucleus* community complex (A5.4)	H (*)	M (*)	M (*)	NE	NE	N-L (*)	L-M (*)	L-M (*)	H (*)	H (*)	H (*)	H (*)	H (*)	H (*)	H (*)	H (*)	M (*)	M (*)	L (*)	H (*)	H (*)	NA	H (*)	H (*)	M (*)	H (*)

Pressure Type	Physical Damage								Change in Habitat Quality									Biological Pressures				Chemical Pollution				Physical
Community Type (EUNIS code)	Surface Disturbance	Shallow Disturbance	Deep Disturbance	Trampling-Access by foot	Trampling-Access by vehicle	Extraction	Siltation (addition of fine sediments, pseudofaeces, fish food)	Smothering (addition of materials biological/non-biological to the surface)	Changes to sediment composition-increased coarseness	Changes to sediment composition-increased fine sediment proportion	Changes to water flow	Increase in turbidity/suspended sediment	Decrease in turbidity/suspended sediment	Organic enrichment-water column	Organic enrichment of sediments-sedimentation	Increased removal of primary production-phytoplankton	Decrease in oxygen levels- sediment	Decrease in oxygen levels-water column	Introduction of non-native species	Removal of Target Species	Removal of Non-target species	Ecosystem Services-Loss of biomass	Introduction of antifoulants	Introduction of medicines	Introduction of hydrocarbons	Prevention of light reaching [illegible]
Subtidal sand to mixed sediment with *Nephtys* spp. community complex (A5.4)	H (*)	M (*)	M (*)	NE	NE	N-L (*)	L-M (*)	L-M (*)	H (*)	H (*)	H (*)	H (*)	H (*)	H (*)	H (*)	H (*)	M (*)	M (*)	L (*)	H (*)	H (*)	NA	H (*)	H (*)	M (*)	H (*)
Fucoid-dominated intertidal reef community complex (A1.21)	NS (*)	NA	NA	NS (*)	NE	NA	L (*)	M-VH (*)	NA	NA	NS (*)	NS (*)	NS (*)	NS (*)	NE	NS (*)	NE	NS (*)	NS (*)	NS (*)	NS (*)	NA	NS (*)	NS (*)	NS (*)	NS (*)
Faunal turf-dominated subtidal reef community (A4.1/4.2)	NS (*)	NA	NA	NE	NE	NA	NS (*)	M-VH (*)	NA	NA	NS (*)	NS (*)	NS (*)	NS (*)	NE	NS (*)	NE	NS (*)	NS (*)	NS (*)	NS (*)	NA	NS (*)	NS (*)	NS (*)	NS (*)
Anemone-dominated subtidal reef community (A3.24/A3.3)*Scores A3.22	NS (*)	NA	NA	NE	NE	NA	NS (*)	M-VH (*)	NA	NA	NS (*)	NS (*)	NS (*)	NS (*)	NE	NS (*)	NE	NS (*)	NS (*)	NS (*)	NS (*)	NA	NS (*)	NS (*)	NS (*)	NS (*)
Laminaria-dominated community complex (A3.21)* Scores A3.22	NS (*)	NA	NA	NE	NE	NA	NS (*)	M-VH (*)	NA	NA	NS (*)	NS (*)	NS (*)	NS (*)	NE	NS (*)	NE	NS (*)	NS (*)	NS (*)	NS (*)	NA	NS (*)	NS (*)	NS (*)	NS (*)

Note: *No sensitivity listed for this community type using scores for similar habitat as listed.

Table 11: Matrix showing the characterising species sensitivity scores x pressure categories for species in Lower River Shannon SAC (ABPMer 2013a-h).

Pressure Type	Physical Damage								Change in Habitat Quality									Biological Pressures				Chemical Pollution			Physical Pressure
Species	Surface Disturbance	Shallow Disturbance	Deep Disturbance	Trampling-Access by foot	Trampling-Access by vehicle	Extraction	Siltation	Smothering (addition of materials biological or non-biological to the surface)	Changes to sediment composition-	Changes to sediment composition- increased fine sediment proportion	Changes to water flow	Increase in turbidity/suspended sediment	Decrease in turbidity/suspended sediment	Organic enrichment-water column	Organic enrichment of sediments- sedimentation	Increased removal of primary	Decrease in oxygen levels- sediment	Decrease in oxygen levels-water column	Introduction of non-native species	Removal of Target Species	Removal of Non-target species	Introduction of antifoulants	Introduction of medicines	Introduction of hydrocarbons	Prevention of light reaching seabed/features
A. digitatum/	L-M (***)	NE	NE	NE	NE	NE	L (**)	M (*)	NA	NA	L (*)	NS (*)	NS (*)	NEv	NE	NS (*)	NE	M(*)	NEv	NS (*)	NS (*)	NEv	NEv	NS (*)	NS (*)
Bathyporeia spp.	NS (*)	L (***)	L (***)	NS (*)	L (*)	L-M (*)	L (** *)	L-M (*)	L-M (*)	L-M (*)	NS (*)	NS (*)	NS (*)	L-M (*)	L-M (*)	NS (*)	L-M (***)	L-M (***)	L-M (*)	NS (*)	NS (*)	NS (*)	NEv	NEv	NS (*)
C. celata	M (***)	NA	NA	NE	NE	NE	L (**)	M (*)	NA	NA	NEv	NS (***)	NS (*)	NS (***)	NE	NS (*)	NE	NEv	NS (*)	NS (*)	NS (*)	NEv	NEv	NEv	NS (*)
C. volutator	L (***)	L (***)	L (***)	L (*)	L (*)	L (*)	L (** *)	L (***)	M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (***)	NS (*)	L (***)	L (***)	Nev	NS (*)	NS (*)	NA	NEv	L (***)	NS (*)
E. esculentus	L-M (***)	NA	NA	NE	NE	NA	L (** *)	H(*)	NA	NA	NS (*)	NS	NS (*)	NS	NE	NS (*)	NE	H (***)	NS (*)	L-M	NS	NEv	NEv	M-H	NS (*)
H. diversicolor	NS (*)	L-M (**)	L-H (**)	NS (*)	L (*)	L-H (*)	NS (** *)	L-M (**)	M-H (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (**)	NS (**)	NS (*)	NS (**)	NS (**)	L-M (*)	L-M (**)	NS (*)	NS (*)	M-H (**)	M-H (**)	NS (*)
H. ulvae	L-NS (*)	L (***)	L (*)	L-NS (*)	L-NS (*)	M (*)	NS (** *)	L(*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (*)	L (*)	L (*)	L (*)	NS (*)	NS (*)	NEv	NEv	M (*)	NS (*)
P. triqueter	L (***)	L (***)	L (*)	L (*)	L (*)	L (*)	L (*)	L (*)	NS (*)	L (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (*)	NEv	NEv	NS (*)	L (*)	NS (*)	NS (*)	NEv	NEv	NS (*)
M. balthica	L (*)	L (*)	M (**)	L (**)	M (*)	M-H (**)	NS (**)	M-H (*)	M (*)	NS (*)	NS (*)	NS (**)	NS (*)	NS (**)	NS (**)	NS (*)	NS (**)	NS (**)	M (**)	NS (*)	NS (*)	NS (*)	NEv	M (**)	NS (**)
N. hombergii	NS (*)	L (*)	L (***)	NS (*)	L (*)	L (*)	NS (**)	NS (*)	L (*)	NS (*)	NS (**)	NS (*)	NS (*)	NS (*)	NS (**)	NS (*)	NS (***)	NS (***)	NS (*)	M (*)	NS (*)	NS (**)	NEv	M (***)	NS (*)
N. cirrosa	NS (*)	L (***)	L (***)	NS (*)	L (*)	L (*)	NS (** *)	NS (*)	L (*)	NS (*)	L (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	M (*)	M (*)	NS (*)	NS (*)	NEv	NEv	NS (*)
S. armiger	NS (*)	L (*)	L-M (*)	NS (*)	L (*)	H (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (***)	NS (*)	M (***)	M (***)	M (*)	M (**)	NS (*)	NS (*)	NEv	NEv	NS (*)

Pressure Type	Physical Damage								Change in Habitat Quality									Biological Pressures				Chemical Pollution			Physical Pressure
Species	Surface Disturbance	Shallow Disturbance	Deep Disturbance	Trampling-Access by foot	Trampling-Access by vehicle	Extraction	Siltation	Smothering (addition of materials biological or non-biological to the surface)	Changes to sediment composition-	Changes to sediment composition- increased fine sediment proportion	Changes to water flow	Increase in turbidity/suspended sediment	Decrease in turbidity/suspended sediment	Organic enrichment-water column	Organic enrichment of sediments- sedimentation	Increased removal of primary	Decrease in oxygen levels- sediment	Decrease in oxygen levels-water column	Introduction of non-native species	Removal of Target Species	Removal of Non-target species	Introduction of antifoulants	Introduction of medicines	Introduction of hydrocarbons	Prevention of light reaching seabed/features
S. plana	NS (*)	NS (**)	M-H (*)	NS (**)	L (**)	M-H (*)	NS -L (*)	M-H (*)	M-H (*)	NS (*)	NS (*)	L (*)	NS (*)	M (*)	M (*)	NS (*)	NS (*)	NS (*)	M (*)	NS (*)	NS (*)	NS (*)	NA	L (*)	NS (*)
A. nodosum	L (*)	NA	NA	L (***)	NE	NA	NS (***)	VH (*)	NA	NA	NS (***)	L-NS (***)	NS (*)	NS (*)	NE	NS (*)	NE	NS (*)	M (***)	H (***)	NS (*)	NS (***)	NEv	NS (***)	H (***)
Fucus sp.	L (*)	NA	NA	L (***)	NE	NA	M (***)	H (*)	NA	NA	NS (*)	L-NS (***)	NS (**)	NS (***)	NE	NS (*)	NE	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NEv	NS (*)	M (*)
L. digitata	NS (*)	NA	NA	NE	NE	NA	NS (***)	H (*)	NA	NA	NS (***)	M (***)	NS (*)	NS (*)	NE	NS (*)	NE	NEv	M (***)	H (***)	NS (*)	NS (*)	NEv	NS (***)	M (*)
L. hyperborea	L (*)	NA	NA	NE	NE	NA	NS (***)	H (*)	NA	NA	NS (***)	M (***)	NS (*)	NS (***)	NE	NS (*)	NE	NEv	M (*)	M (***)	NS (*)	NS (*)	NEv	NS (***)	M (*)
Halidrys siliquosa	L (*)	NA	NA	L(*)	NE	NA	NS (*)	H (*)	NA	NA	NS (***)	L-NS (***)	NS (***)	NS (***)	NE	NS (*)	NE	NEv	M (***)	NS (*)	NS (*)	NS (*)	NEv	NS (*)	M (***)
S. polyschides	L (*)	NA	NA	NE	NE	NA	NS (*)	M (*)	NA	NA	NS (***)	M (*)	L (*)	NS (*)	NE	NS (*)	NE	NS (*)	M (*)	M (*)	NS (***)	NEv	NEv	NS (*)	M (*)
Ulva sp.	L (*)	NA	NA	L(*)	NE	NA	NS (***)	L (*)	NA	NA	NS (*)	NS (**)	NS (**)	NS (***)	NE	NS (*)	NE	NEv	NEv	NS (*)	NS (*)	NS (***)	NEv	L (***)	M (***)

Table 12: Codes of sensitivity and confidence applying to species and pressure interactions presented in Tables 10 and 11.

Species x Pressure Interaction Codes	
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

- 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).

8.3 Assessment of the effects of aquaculture production on the Conservation Objectives for habitat features in the Lower River Shannon SAC.

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 and species. Different species and habitats will have different tolerance to the pressures associated with aquaculture activities (pressures as discussed in Section 5).

The aquaculture activity overlap six different community types found within the qualifying interest of the SAC. Tables 13 - 17 below identify the likely interactions between the relevant aquaculture activities and the constituent marine community types of the habitat features (1130, 1140, 1160 and 1170, with a broad conclusion and justification on whether the activity is considered disturbing to the feature in question. It must be noted that the sequence of distinguishing disturbance is as highlighted above, whereby activities with spatial overlap on habitat features are assessed further for their ability to cause persistent disturbance on the habitat. If persistent disturbance is likely then the spatial extent of the overlap is considered further. If the overall proportion of the overlap exceeds a threshold of 15% disturbance of the habitat then any further licencing should be informed by interdepartmental review and consultation (NPWS 2012b).

NPWS (2012b) provides lists of species characteristic of benthic communities that are defined in the Conservation Objectives. The sedimentary community types brought further in the analysis are intertidal (tolerant of desiccation and physical stress) and subtidal sand and sand to mixed sediment. The intertidal sands support a community of polychaetes (*Scolelepis squamata*) and crustaceans; while the sand to mixed sediment habitat is dominated by polychaetes (*Hediste diversicolor*), crustaceans and molluscs (*Scrobicularia plana*, *Macoma balthica*, *Hydrobia ulvae*). Subtidal sands/mixed sediments support a community complexes characterised by polychaetes (*Nephtys* spp.). The rocky habitat communities brought further in the analysis, include a Fucoid-dominated intertidal reef community

complex that is dominated by brown algal species with red algae and a faunal aspect typical of the rocky intertidal (i.e. gastropods, and barnacles) and an Anemone-dominated subtidal reef community.

For the qualifying feature - **Estuaries (1130)** - there are a number of attributes (with associated targets) relating to the following broad Annex I habitat features as well as constituent community types

1. Habitat Area - it is unlikely that the activities proposed will reduce the overall extent of permanent habitat with the feature Estuaries. The habitat area is likely to remain stable.
2. Community Distribution - (conserve a range of community types in a natural condition).
   This attribute considered interactions between aquaculture activities and 4 communities identified in the broad Annex I feature (i.e. Estuaries, 1130) and brought forward from the previous screening exercise (Section 7):
   - Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex
   - Subtidal sand to mixed sediment with *Nucula nucleus* community complex
   - Subtidal sand to mixed sediment with *Nephtys* spp. community complex
   - Fucoid-dominated intertidal reef community complex

The community types listed above will be exposed to differing ranges of pressures from aquaculture activities, some of these may result in more chronic and long-term changes in community composition, which were considered during the assessment process. Such activities as dredging for oyster and mussels which will result in physical disturbance to infaunal communites and long line mussel culture which results in organic loading on the seabed resulting in biogeochemical changes to sediment and a likely change in faunal composition - whether this results in permanent change to the community type is unclear. Table 10 lists the community types and Table 11 lists the constituent taxa and both provide a commentary of sensitivity to a range of pressures. The risk scores are derived from a range of sources identified above. Table 12 provides the code for the various categorisation of sensitivity and confidence. The pressures are listed as those likely to result from the primary aquaculture activities (shellfish production) proposed in the Lower Shannon River SAC. Considered in the assessment are Mussels (*Mytilus edulis*) in suspended culture (subtidal longlines) and subtidally on the seafloor; and Oysters (*Ostrea edulis*, *Crassostrea gigas*) in suspended culture (bags & trestles) and subtidally on the seafloor.

Table 13 below identifies the likely interactions between the relevant aquaculture activities and the habitat features (1160) and their constituent community types, with a broad conclusion and justification on whether the activity is considered disturbing to the feature in question. It must be noted that the sequence of distinguishing disturbance is as highlighted above, whereby activities with spatial overlap on habitat features are assessed further for their ability to cause persistent disturbance on the habitat/community type. If persistent disturbance is likely then the spatial extent of the overlap is considered further. No aquaculture activity extends beyond 15% of the community type (Tables 6 and 13). In addition, combined aquaculture activities listed overlap with 1.31% of the habitat feature Estuaries (1130) (Table 3).

For the qualifying feature - **Mudflats and sandflats not covered by seawater at low tide (1140)** - there are a number of attributes (with associated targets) relating to the following broad Annex I habitat features as well as constituent community types

1. Habitat Area - it is unlikely that the activities proposed will reduce the overall extent of permanent habitat with the feature Mudflats and sandflats not covered by seawater at low tide. The habitat area is likely to remain stable.

2. Community Distribution - (conserve a range of community types in a natural condition). This attribute considered interactions with two communities identified in the broad Annex I feature (i.e. Mudflats and sandflats not covered by seawater at low tide,(1140) and brought forward from the previous screening exercise (Section 7):
    - Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. community
    - Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex

The community types listed above will be exposed to differing ranges of pressures from aquaculture activities, some of these may result in more chronic and long-term changes in community composition, which were considered during the assessment process. Such activities as dredging for oyster and mussels which will result in physical disturbance to infaunal communites and long line mussel culture which results in organic loading on the seabed resulting in biogeochemical changes to sediment and a likely change in faunal composition - whether this results in permanent change to the community type is unclear. Table 10 lists the community types and Table 11 lists the constituent taxa and both provide a commentary of sensitivity to a range of pressures. The risk scores are derived from a range of sources identified above. Table 12 provides the code for the various categorisation of sensitivity and confidence. The pressures are listed as those likely to result from the primary aquaculture activities (shellfish production) proposed in the Lower Shannon River SAC. Considered in the assessment are Mussels (*Mytilus edulis*) in suspended culture (subtidal longlines) and subtidally on the seafloor; and Oysters (*Ostrea edulis*, *Crassostrea gigas*) in suspended culture (bags & trestles) and subtidally on the seafloor.

Table 14 below identifies the likely interactions between the relevant aquaculture activities and the habitat features (1140) and their constituent community types, with a broad conclusion and justification on whether the activity is considered disturbing to the feature in question. It must be noted that the sequence of distinguishing disturbance is as highlighted above, whereby activities with spatial overlap on habitat features are assessed further for their ability to cause persistent disturbance on the habitat/community type. If persistent disturbance is likely then the spatial extent of the overlap is considered further. If the proportion of the overlap exceeds a threshold of 15% disturbance of the habitat then any further licencing should be informed by interdepartmental review and consultation (NPWS 2013). No activity (Aquaculture) extends beyond 15% of the community type (Tables 7 and 14). In addition, combined activities of aquaculture overlap with 1.34% of the habitat feature Mudflats and sandflats not covered by seawater at low tide (1140) (Table 3).

For the qualifying feature - **Large Shallow Inlets and Bays (1160)** - there are a number of attributes (with associated targets) relating to the following broad Annex I habitat features as well as constituent community types

1. Habitat Area - it is unlikely that the activities proposed will reduce the overall extent of permanent habitat with the feature Large Shallow Inlets and Bays. The habitat area is likely to remain stable.
2. Community Distribution - (conserve a range of community types in a natural condition). This attribute considered aquaculture interactions with thecommunities identified in the broad Annex I feature (i.e. Large Shallow inlets and bays, 1160) and brought forward from the previous screening exercise (Section 7) and are:
    - Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. community
    - Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex
    - Subtidal sand to mixed sediment with *Nephtys* spp. community complex
    - Fucoid-dominated intertidal reef community complex
    - Mixed subtidal reef community complex
    - Anemone-dominated subtidal reef community

The community types listed above will be exposed to differing ranges of pressures from aquaculture activities, some of these may result in more chronic and long-term changes in community composition, which were considered during the assessment process. Such activities as dredging for oyster and mussels which will result in physical disturbance to infaunal communites and long line mussel culture which results in organic loading on the seabed resulting in biogeochemical changes to sediment and a likely change in faunal composition - whether this results in permanent change to the community type is unclear. Table 10 lists the community types and Table 11 lists the constituent taxa and both provide a commentary of sensitivity to a range of pressures. The risk scores are derived from a range of sources identified above. Table 12 provides the code for the various categorisation of sensitivity and confidence. The pressures are listed as those likely to result from the primary aquaculture activities (shellfish production) proposed in the Lower Shannon River SAC. Considered in the assessment are Mussels (*Mytilus edulis*) in suspended culture (subtidal longlines) and subtidally on the seafloor; and Oysters (*Ostrea edulis*, *Crassostrea gigas*) in suspended culture (bags & trestles) and subtidally on the seafloor.

Table 15 below identifies the likely interactions between the relevant aquaculture activities and the habitat features (1160) and their constituent community types, with a broad conclusion and justification on whether the activity is considered disturbing to the feature in question. It must be noted that the sequence of distinguishing disturbance is as highlighted above, whereby activities with spatial overlap on habitat features are assessed further for their ability to cause persistent disturbance on the habitat/community type. If persistent disturbance is likely then the spatial extent of the overlap is considered further. If the proportion of the overlap exceeds a threshold of 15% disturbance of the habitat then any further licencing should be informed by interdepartmental review and consultation (NPWS 2013). No activity extends beyond 15% of the community type (Tables 8 and 15). In addition,

combined activities listed overlap with 0.97% of the habitat feature (1160) Large Shallow Inlet and Bay (Table 3).

For the qualifying feature - **Reefs (1170)** - there are a number of attributes (with associated targets) relating to the following broad Annex I habitat features as well as constituent community types

1. Distribution of Reef - the distribution of reef habitat within the SAC are unlikely to be affected by the aquaculture activities and are considered stable.
2. Habitat Area - the habitat area of reef is unlikely to be changed by as a consequence of aquaculture activities and is considered stable.
3. Community Distribution (conserve a range of community types in a natural condition)
   This attribute considered interactions with twocommunities identified in the broad Annex I feature (i.e. Reefs, 1170) and brought forward from the previous screening exercise (Section 7):
   - Fucoid-dominated intertidal reef community complex
   - Anemone-dominated subtidal reef community

The community types listed above will be exposed to differing ranges of pressures from aquaculture activities, some of these may result in more chronic and long-term changes in community composition, which were considered during the assessment process. Table 10 lists the community types and Table 11 lists the constituent taxa and both provide a commentary of sensitivity to a range of pressures. The risk scores are derived from a range of sources identified above. Table 12 provides the code for the various categorisation of sensitivity and confidence. The pressures are listed as those likely to result from the primary aquaculture activities (shellfish production) proposed in the Lower Shannon River SAC. Considered in the assessment are Mussels (*Mytilus edulis*) in suspended culture (subtidal longlines) and subtidally on the seafloor; and Oysters (*Ostrea edulis*, *Crassostrea gigas*) in suspended culture (bags & trestles) and subtidally on the seafloor.

Table 16 below identifies the likely interactions between the relevant aquaculture activities and the habitat features (1170) and their constituent community types, with a broad conclusion and justification on whether the activity is considered disturbing to the feature in question. It must be noted that the sequence of distinguishing disturbance is as highlighted above, whereby activities with spatial overlap on habitat features are assessed further for their ability to cause persistent disturbance on the habitat/community type. If persistent disturbance is likely then the spatial extent of the overlap is considered further. If the proportion of the overlap exceeds a threshold of 15% disturbance of the habitat then any further licencing should be informed by interdepartmental review and consultation (NPWS 2013). No activity extends beyond 15% of the community type (Tables 9 and 16). In addition, combined aquaculture activities listed overlap with 0.13% of the habitat feature (1170) Reefs (Table 3).

Biological Pressures

It must be noted that a number of activities (i.e. culture of diploid oysters) have been identified whereby, the risk of proliferation on non-native species in the site cannot be discounted without specific management actions. Successful reproduction of the Pacific oyster *(Crassostrea gigas*) has been documented in areas where this species is cultured in Ireland, including the Lower Shannon River SAC

(Kochmann *et al*., 2013). Kochmann et al (2013) identified a series of hydrological and morphological characteristics that facilitate Pacific oyster settlement, including residence time, which in the case of the Shannon Estuary, was calculated as approximately 53 days (T. Dabrowski, Marine Institute - personal communication). Any residence time greater than 21 days would be considered likely to result in an increased risk of settlement. An additional factor potentially contributing to successful recruitment is availability of suitable substrate (i.e. hard substrate or biogenic features, e.g., mussel shell). However, a negative association with macroalgae was speculated. Therefore, intertidal areas with high levels of macroalgal cover would appear to mitigate against successful recruitment of Pacific oysters (Kochmann et al 2013; Kochmann and Crowe, 2014). Zwerschke et al. (2017) identified greater number so oysters at the same sites in the SAC indicating ongoing recruitment. Furthermore, in addition to the use of diploid oysters throughout the SAC, the risk of successful reproduction is potentially amplified by the uncontained culture of *M. gigas* subtidally on the seabed, where gonad development has been shown to be greater than in oysters held intertidally (MagAoidh, 2011). The collection of 'wild' gigas spat as described in the profile (Section 5) also speaks to the fact that recruitment of this non-native species is ongoing in the SAC. Also the culture of *M. gigas* on the seabed will make it very difficult to manage the risk exacerbation of an introduction or establishment of 'wild' populations of this species or disease outbreaks. In bags or under netting nearly 100% of the culture species can be removed from an area in the event of unforeseen negative impact. It is highly unlikely that 100% of stock broadcast in an uncontained fashion on the seabed (subtidally) can be recaptured. Furthermore, the use of triploid oyster (3n) for seabed culture also cannot be considered a fail-safe given that chemically induced triploids are never 100% successful (i.e., a proportion are diploid) and genetically induced triploids risk reversion to mosaics or diploids. This, allied with the inability to fully retrieve the oysters, presents a risk of successful reproduction (Hallerman et al, 2001; Zhang et al 2010; Sousa et al 2016).

The importation of mussel seed (or half-grown oysters) from areas outside of site also presents a risk of introducing non-native species into the Shannon. The introduction of the non-native gastropod *Crepidula fornicata* into Belfast Lough was thought to be associated with seed mussel introduced from the UK (McNeill et al., 2010).

Table 13: **Interactions between the relevant aquaculture activities and the habitat feature Estuaries (1130) constituent communities with a broad conclusion on the nature of the interactions.**

Culture Type	1130 Estuaries			
	Fucoid-dominated intertidal reef community complex	**Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex**	**Subtidal sand to mixed sediment with *Nucula nucleus* community complex**	**Subtidal sand to mixed sediment with *Nephtys* spp. community complex**
Oysters **Bags & trestles** **Suspended Culture**	**Disturbing: Yes** **Justification:** The species have high recoverability and are tolerant of the impacts of this aquaculture type. The stock is confined in bags, is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The species have high recoverability and are tolerant of the impacts of this aquaculture type. The stock is confined in bags; seed is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**N/A**	**Disturbing: Yes** **Justification:** The community type is deemed tolerant to the majority of pressures from this activity. The stock is confined in bags; seed is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.*
Oysters **Bottom culture**	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also, due to the uncontained placement on the seafloor, wide scale impacts are possible. This activity overlaps 0.35% of this community type	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also due to the uncontained placement on the seafloor, wide scale impacts are possible. This activity overlaps 0.61% of this community type.	**Disturbing: Yes** **Justification** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The habitat and fauna are sensitive to the following impacts: Change in habitat quality & Physical damage. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also, due to the uncontained placement on the seafloor, wide scale impacts are likely. This activity overlaps 0.01% of this community type.	**Disturbing: Yes** **Justification** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The habitat and fauna are sensitive to the following impacts: Change in habitat quality & Physical damage. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also, due to the uncontained placement on the seafloor, wide scale impacts are likely. This activity overlaps 0.98% of this community type.
Mussel **Suspended Culture**	**N/A**	**N/A**	**Disturbing: Yes** **Justification** The community type is deemed sensitive to the pressures from this activity as a consequence of organic enrichment. This activity overlaps 0.89% of this community type.	**N/A**
Mussel **Bottom culture**	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. However, if mussel seed is imported from outside of the site there may be a risk of introducing non-native species. It is unlikely this activity will be carried out on this community type given the nature of the substrate. This activity overlaps 0.45% of this community type.	**N/A**	**Disturbing: Yes** **Justification** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The habitat and fauna are sensitive to the following impacts: Change in habitat quality & Physical damage. If mussel seed is imported from outside of the site there may be a risk of introducing non-native species. This activity overlaps 2.85% of this community type.	**Disturbing: Yes** **Justification** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The habitat and fauna are sensitive to the following impacts: Change in habitat quality & Physical damage. If mussel seed is imported from outside of the site there may be a risk of introducing non-native species. This activity overlaps 0.35% of this community type.

Table 13 cont'd: **Interactions between the relevant aquaculture activities and the habitat feature Estuaries (1130) constituent communities with a broad conclusion on the nature of the interactions.**

Culture Type	1130 Estuaries			
	Fucoid-dominated intertidal reef community complex	**Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex**	**Subtidal sand to mixed sediment with *Nucula nucleus* community complex**	**Subtidal sand to mixed sediment with *Nephtys* spp. community complex**
Access Routes	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.13%.	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.004%.	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.01%.	**N/A**
Cumulative Impact	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 0.93% on this community type. On foot of the use of diploid oysters and the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 0.60% on this community type. On foot of the use of diploid oysters and the uncontained culture on the seabed,, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 3.76% on this community type. On foot of the use of diploid oysters and the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 1.33% on this community type. On foot of the use of diploid oysters and the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*

Table 14: **Interactions between the relevant aquaculture activities and the habitat feature Mudflats and sandflats not covered by seawater at low tide (1140) constituent communities with a broad conclusion on the nature of the interactions.**

Culture Type	1140 Mudflats and sandflats not covered by seawater at low tide	
	Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. community	**Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex**
Oysters **Bags & trestles** **Suspended culture**	**Disturbing: Yes** **Justification:** The species have high recoverability and are tolerant of the impacts of this aquaculture type. The stock is confined in bags, is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The species have high recoverability and are tolerant of the impacts of this aquaculture type. The stock is confined in bags, is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.*
Oysters **Bottom culture**	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also, due to the uncontained placement on the seafloor, wide scale impacts are likely. This activity overlaps 0.10% of this community type (<15% threshold).	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also, due to the uncontained placement on the seafloor, wide scale impacts are likely. This activity overlaps 0.69% of this community type (<15% threshold).
Access Routes	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.053%.	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.01%.
Cumulative Impact	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 0.15% on this community type. On foot of the use of diploid oysters and the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 0.7% on this community type. On foot of the use of diploid oysters and the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*

Table 15: **Interactions between the relevant aquaculture activities and the habitat feature Large shallow inlets and bays (1160) constituent communities with a broad conclusion on the nature of the interactions.**

Culture Type	1160 – Large shallow inlets and bays			
	Intertidal sand with *Scolelepis squamata* and *Pontocrates* spp. community	**Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex**	**Subtidal sand to mixed sediment with *Nucula nucleus* community complex**	**Subtidal sand to mixed sediment with *Nephtys* spp. community complex**
Oysters **Bags & trestles** **Suspended culture**	**Disturbing: Yes** **Justification:** The species have high recoverability and are tolerant of the impacts of this aquaculture type. The stock is confined in bags, is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The species have high recoverability and are tolerant of the impacts of this aquaculture type. The stock is confined in bags, is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification** The community type is deemed tolerant to the majority of pressures from this activity. The stock is confined in bags; seed is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification** The community type is deemed tolerant to the majority of pressures from this activity. The stock is confined in bags; seed is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.*
Oysters **Bottom culture**	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also, due to the uncontained placement on the seafloor, wide scale impacts are likely. This activity overlaps 0.10% of this community type.	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also, due to the uncontained placement on the seafloor, wide scale impacts are likely. This activity overlaps 2.10% of this community type.	**Disturbing: Yes** **Justification** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also due to the uncontained placement on the seafloor, wide scale impacts are likely. This activity overlaps 0.82% of this community type.	**Disturbing: Yes** **Justification** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also due to the uncontained placement on the seafloor, wide scale impacts are likely. This activity overlaps 0.77% of this community type.
Access Routes	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.001%.	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.91%.	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.03%.	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.0001%.
Cumulative Impact Aquaculture	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 0.10% on this community type . On foot of the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 3.01% on this community type . On foot of the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 0.85% on this community type . On foot of the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 0.77% on this community type . On foot of the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*

Table 15 cont'd**: Interactions between the relevant aquaculture activities and the habitat feature Large shallow inlets and bays (1160) constituent communities with a broad conclusion on the nature of the interactions.**

Culture Type	1160 – Large shallow inlets and bays			
	Fucoid-dominated intertidal reef community complex	**Faunal turf-dominated subtidal reef community**	**Anemone-dominated subtidal reef community**	***Laminaria*-dominated community complex**
Oysters **Bags & trestles** **Suspended culture**	**Disturbing: Yes** **Justification:** The species are sensitive to the the impacts (i.e., shading) of this aquaculture type. The stock is confined in bags, is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* This activity overlaps 0.54% of this habitat type.	**N/A**	**N/A**	**N/A**
Oysters **Bottom culture**	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The habitat and fauna are sensitive to the following impacts: Change in habitat quality & Physical damage The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* However, due to the uncontained placement on the seafloor, wide scale impacts are likely. This activity overlaps 0.03% of this community type.	**N/A**	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas* and the uncontained placement on the seafloor may result in wide scale impacts. This activity overlaps 28.4% of this community type.	**N/A**
Access Routes	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.45%.	**N/A**	**N/A**	**N/A**
Cumulative Impact Aquaculture	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 1.02% on this community type. On foot of the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**N/A**	**Disturbing: Yes** **Justification:** The pressure of likely impacting activities is 28.4% on this community type (>15% threshold). Also, on foot of the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas*.	**N/A**

Table 16: Interactions between the relevant aquaculture activities and the habitat feature Reefs (1170) constituent communities with a broad conclusion on the nature of the interactions.

Culture Type	1170 - Reefs	
	Fucoid-dominated intertidal reef community complex	**Anemone-dominated subtidal reef community**
Oysters **Bags & trestles** **Suspended culture**	**Disturbing: Yes** **Justification:** The species are sensitive to the impacts (i.e., shading) of this aquaculture type. The stock is confined in bags, is collected locally and/or sourced from hatcheries and is diploid/triploid. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* This activity overlaps 0.30% of this community type.	**N/A**
Oysters **Bottom culture**	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas.* Also, due to the uncontained placement on the seafloor, wide scale impacts are likely. This activity overlaps 0.20% of this community type.	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The habitat and fauna are sensitive to the following impacts: Change in habitat quality & Physical damage The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas* and the uncontained placement on the seafloor may result in wide scale impacts. This activity overlaps 1.3% of this community type.
Mussel **Bottom culture**	**Disturbing: Yes** **Justification:** The activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. However, if mussel seed is imported from outside of the site there may be a risk of introducing non-native species. It is unlikely this activity will be carried out on this community type given the nature of the substrate. This activity overlaps 0.24% of this habitat type.	**N/A**
Access Routes	**Disturbing: Yes** **Justification:** This community type is sensitive to physical disturbance. The spatial overlap with the community type is 0.2%.	**N/A**
Cumulative Impact Aquaculture	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 0.76% on this community type. On foot of the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*	**Disturbing: Yes** **Justification:** The cumulative pressure of likely impacting activities is 1.3% on this community type. On foot of the uncontained culture on the seabed, the Lower Shannon SAC has increased likelihood of successful recruitment of the alien species *Crassostrea gigas.*

8.4 Assessment of the effects of Fishery Order Areas on the Conservation Objectives for habitat features in the Lower River Shannon SAC.

This assessment follows the same criteria as outlined above (Section 8.3). The Fishery Orders overlap four habitat features (1130, 1140, 1160 and 1170) and two additional community types (Faunal turf-dominated subtidal reef community, *Laminaria*-dominated community complex) found within the qualifying interest of the SAC (Tables 6-9). On the basis of the activities at the order sites (i.e., primarily bottom culture of oysters), the activity is considered disturbing because of the culture of a high density of single species and the physical disturbance associated with harvest. The long residence time in Lower Shannon SAC will increase the likelihood of successful recruitment of the alien species *Crassostrea gigas*. Also, due to the uncontained placement on the seafloor, wide scale impacts are likely. Listed below are the community types specifically interacting with the Fishery Order activities that are considered disturbing (i.e., greater than 15% spatial overlap) within each habitat feature (1130, 1140 and 1170). In summary, the Fishery Orders are considered disturbing to a number of habitat features and their constituent community types.

Estuaries (1130):

The Fishery Order significantly (17.11%) overlaps this feature (Table 3).

The Fishery Order also significantly overlaps a number of community types recorded within this feature (Table 6, Table 17).

- Subtidal sand to mixed sediment with *Nucula nucleus* community complex (64.16%),
- Fucoid-dominated intertidal reef community complex (28.57%),
- Faunal turf-dominated subtidal reef community (17.24%),
- Anemone-dominated subtidal reef community (77.65%)
- *Laminaria*-dominated community complex (98.01%)

Mudflats and sandflats not covered by seawater at low tide (1140)

The Fishery Order overlaps 2.27% of this feature (Table 3).

Large Shallow Inlets and Bays (1160)

The Fishery Orders overlaps 10.8% of this feature (Table 3).

The Fishery Orders also significantly overlaps a number of community types recorded within this feature (Table 8):

- Subtidal sand to mixed sediment with *Nucula nucleus* community complex (44.3%),
- Fucoid-dominated intertidal reef community complex (15.5%),
- Faunal turf-dominated subtidal reef community (10.5%),
- Anemone-dominated subtidal reef community (25%)

Reefs (1170)

The Fishery Orders overlaps 9.44% of this feature (Table 3).

The Fishery Orders also significantly overlaps a number of community types recorded within this feature (Table 9, Table 19):

- Fucoid-dominated intertidal reef community complex (22.36%)
- Anemone-dominated subtidal reef community (75.27%)

It should be noted that the information available regarding the extent of usage and type of culture occurring within the Fishery Order Areas is sparse. Therefore, the spatial extents listed are the maximum areas the Fishery Order covers, however the area may not be fully utilised by the operators.

8.5 Assessment of the effects of aquaculture on the Conservation Objectives for the otter in Lower River Shannon River SAC.

The Lower River Shannon SAC is designated for Annex II species the otter (*Lutra lutra*); the conservation objectives for such are listed in Table 1.

For the qualifying feature - **Otter (*Lutra lutra*)** - there are a number of attributes (with associated targets) which maintain favourable conservation condition (NPWS, 2012a):

1. Distribution - No significant decline
2. Extent of terrestrial habitat - No significant decline
3. Extent of marine habitat - No significant decline
4. Extent of freshwater habitat - No significant decline
5. Couching sites and holts - No significant decline
6. Fish biomass available - No significant decline
7. Barriers to connectivity - No significant increase

As the aquaculture production activities within the SAC spatially overlap with otter (*L. lutra*) territory, these activities may have negative effects on the abundance and distribution of populations of the species.

The risk of negative interactions between aquaculture operations and aquatic mammal species is 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?

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

Suspended Intertidal Oyster Culture

Given the intertidal location of the structures and activities associated this form of oyster culture, it is unlikely that the marine mammals will have any negative interaction with this culture method. Impacts can be discounted.

Suspended Subtidal Mussel Culture

Otter will likely forage in and around mussel lines. The lines are typically large in diameter and the risk of entanglement is minimal. Given that otter foraging is primarily crepuscular the interaction with mussel culture operators is likely to be minimal. It is unlikely that mussel culture poses a risk to otter populations within the site. Impacts can be discounted.

Subtidal Shellfish (Mussels, Oyster) Culture

Given that this culture type does not entail any structures and all operations are likely to be carried out in daylight hours, while otter foraging is primarily crepuscular, the interaction between otter and operator/operations is likely to be minimal. It is unlikely that these culture types pose a risk to otter populations in the Lower Shannon River. Impacts can be discounted.

Fishery Order Areas:

Given that all operations are likely to be carried out in daylight hours, and that otter foraging is primarily crepuscular the interaction with culture operators is likely to be minimal. Structures may be used within these areas but it is unlikely they would pose a risk to otter populations within the site.
Impacts can be discounted.

The proposed activities will not lead to any modification of the following attributes for otter:

- Decline in extent of terrestrial habitat nor marine habitat nor freshwater habitat
- The activity involves net input rather than extraction of fish biomass so that no negative impact on the essential food base (fish biomass) is expected
- The number of couching sites and holts or, therefore, the distribution, will not be directly affected by aquaculture and fisheries activities.
- Shellfish production activities are unlikely to pose any risk to otter populations through entrapment or direct physical injury.
- Disturbance associated with vessel and foot traffic could potentially affect the distribution of otters at the site. However, the level of disturbance is likely to be very low given the likely encounter rates will be low dictated primarily by tidal state.

8.6 Assessment of the effects of aquaculture on the Conservation Objectives for the bottlenose dolphin in the Lower Shannon River SAC.

The Lower River Shannon SAC is designated for the Annex II species the bottlenose dolphin (*Tursiops truncatus*); the conservation objectives for such are listed in Table 1.

For the qualifying feature - **Bottlenose dolphin (*Tursiops truncatus*)** - there are a number of attributes (with associated targets) which maintain favourable conservation condition (NPWS, 2012a):

1. Access to suitable Habitat - species range within the site should not be restricted by artificial barriers.
2. Habitat use - Critical habitat area should be maintained in a natural condition.
3. Human Disturbance - Human activity should occur at levels that do not adversley affect species population at the site

As the aquaculture production activities within the SAC spatially overlap with dolphin critical habitat area, these activities may have negative effects on the range and distribution of populations of the species. Table 20 below identifies the likely interactions between the relevant aquaculture activities and the bottlenose dolphin, with a broad conclusion and justification on whether the activity is considered disturbing to the feature in question.

The risk of negative interactions between aquaculture operations and dolphins is 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?

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

3. Is the species range within the site restricted by artificial barriers to site use?

4. Is the Critical Areas, representing habitat used preferentially by bottlenose dolphin, maintained in a natural condition?

Suspended Intertidal Oyster Culture

Given the intertidal location of the structures and activities associated this form of oyster culture it is unlikely that the marine mammals will have any negative interaction with this culture method. Ancillary activities at sites, i.e. site services human, boat and vehicular traffic, may increase the risk of minor disturbance to marine mammals. Impacts can be discounted.

Subtidal Bottom Shellfish (Mussels, Oyster) Culture

Given that this culture type does not entail any structures, it would not act as a barrier to movement of the species throughout its habitat range, including the critical habitat area. While biological effects of such as aquaculture may alter the natural condition of the critical habitat, it is likely that structure provided by shellfish on the seafloor may increase attraction for dolphin prey items (fish). The schedule of operations may also cause disturbance, however disturbance would be limited to seasonal activities i.e. seeding, grading, and harvesting and would be confined to a small number of vessels. The cumulative impacts of these activities are unlikely to appreciably disturb the marine mammals and result in permanent exclusion. Furthermore, the timing of such activities are such that they are unlikely to coincide with more sensitive periods for marine mammals (May to September calving period). Impacts can be discounted.

Suspended Subtidal Mussel Culture

Given the presence of subtidal fixed structures associated with the suspended subtidal culture of shellfish operations i.e. longlines, there is a possibility that their presence may act as a barrier restricting the range and movement of the species within the critical habitat area however, it is unlikely that it may cause harm due to the ability of the dolphin to avoid structures. We note the recent publication on interactions between dolphin and floating structures used in the culture of shellfish (rafts) (Díaz López and Methion, 2017). The study concluded that shellfish farms appeared to have a positive impact on dolphin occurrence, with increased bottlenose dolphin occurrence at mussel farm locations and in waters close to the aquaculture zones. The structure may act as fish aggregation devices which might benefit the dolphin. Biological effects of such aquaculture may alter the natural condition of the seabed habitat. The schedule of operations may also cause disturbance, however disturbance would be limited to seasonal activities i.e. seeding, grading, and harvesting. Which should not coincide with the more sensitive periods for marine mammals (see above). Ancillary activities at sites, i.e. site services human and boat traffic, may increase the risk of disturbance to marine mammals. However, given the low level of overlap (0.26%) and the limited levels of activity at the risk of permanent exclusion from the site is likely to be very low. Impacts from suspended subtidal mussel culture can be discounted.

Table 17: Interactions between the relevant aquaculture activities and the Critical Habitat of the bottlenose dolphin (*Tursiops truncatus*) with a broad conclusion on the nature of the interactions.

Culture Type	1349 - Bottlenose Dolphin (*Tursiops truncatus*)
Oysters Bags & trestle Suspended culture Intertidal	**Disturbing: No** **Justification:** The activity is carried out in the intertidal which would not affect the subtidal marine mammal. However, there may be limited disturbance due to ancillary activities at sites i.e. site services, human, boat and vehicular traffic.
Oysters Bottom culture Subtidal	**Disturbing: No** **Justification:** There are no physical structures associated with this culture type to act as a barrier to movement or cause displacement. Disturbance would be limited to seasonal activities i.e. seeding, grading, and harvesting. The biological effects of the aquaculture may affect the natural condition of the critical habitat. Yet the presence of oysters may attract prey items for dolphin (fishes).
Mussel Suspended Culture Subtidal	**Disturbing: No** **Justification:** The physical structures associated with this culture type may persistently reduce the range of the species within it's critical habitat, and may be a barrier to free movement. However, dolphin can easily avoid such structures and may be attracted to them on the basis that they might act as fish attraction/aggregation devices. Disturbance would otherwise be limited to seasonal activities i.e. seeding, grading, and harvesting. The biological effects of the aquaculture may affect the natural condition of the critical habitat. However, given the small scale of the activities and the potential positive interactions the activity is considered non-disturbing.
Mussel Bottom culture Subtidal	**Disturbing: No** **Justification:** There are no physical structures associated with this culture type to act as a barrier to movement or cause displacement. Disturbance would be limited to seasonal activities i.e. seeding, grading, and harvesting. Which should not coincide with more sensitive periods for marine mammals. The biological effects of the aquaculture may affect the natural condition of the critical habitat. Yet the presence of oysters may attract prey items for dolphin (i.e., fishes).
Cumulative Impact Aquaculture	**Disturbing: No** **Justification:** While activities associated with these activities are considered potentially disturbing, it is unlikely that they will occur at the same time or in a persistent manner. Potential positive aspects of these activities whereby, they may act as attraction for potential food source for dolphin, is also considered.

9 Other Activities

Fisheries

There are some fishery activities towards the mouth of the River Shannon. These activities comprise shrimp potting (south shore of river near Ballylongford) and tangle net (Crayfish), trammel net (baitfish), creel (lobster and crab) all at the mouth of the estuary (Marine Institute, 2015). All wild fisheries are confined to static gear and present no risk to habitat features. The nature of the tangle netting can present an entanglement risk to mobile species (Otter and Bottlenose Dolphin). However, the location of tangle netting is outside of the range of otter but well within that of dolphin and does present a risk.

Other activities

Commercial ports are located at Foynes and Limerick Docks, with private port terminals at Aughinish, Moneypoint, Shannon Airport and Tarbet. The navigation channel runs the length of the Upper and Lower Shannon sections of the SPA and may require maintenance dredging on occasion (on the approaches to limerick Dock and at the berths at Foynes). A car ferry runs between Tarbert and Killimer. These activities will unlikely have an impact on the current status of habitat features in the SAC, with the exception of dredging of already disturbed channels. The disturbance to species may present a risk if considered in combination with shellfish culture activities identified above.

10 SAC Aquaculture Appropriate Assessment Concluding Statement and Recommendations

In the Lower Shannon River SAC aquaculture focuses primarily on shellfish species (mussels, oysters) (Figure 5). Oysters are the predominant shellfish species cultured within the SAC, mussels are produced at a lower scale; while Scallops, although licensed, are not currently produced in the area. Based upon this and the information provided in the aquaculture profiling (Section 5), the likely interaction between this aquaculture and conservation features (habitats and species) of the site were considered.

An initial screening exercise resulted in a number of habitat features and species being excluded from further consideration by virtue of the fact that no spatial overlap of the culture activities was expected to occur. The habitats and species excluded from further consideration were Freshwater Pearl Mussel *Margaritifera margaritifera* (1029), Sea Lamprey *Petromyzon marinus* (1095), Brook Lamprey *Lampetra planeri* (1096), River Lamprey *Lampetra fluviatilis (*1099), Atlantic Salmon *Salmo salar* (only in fresh water)(1106), Sandbanks which are slightly covered by sea water all the time (1110), Coastal lagoons (1150), Perennial vegetation of stony banks (1220), Vegetated sea cliffs of the Atlantic and Baltic coasts (1230), *Salicornia* and other annuals colonizing mud and sand (1310), Atlantic salt meadows (Glauco-Puccinellietalia maritimae)(1330), Mediterranean salt meadows (*Juncetalia maritimi*)(1410), Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260), *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) (6410) and 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*).

10.1 Habitats

A full assessment was carried out on the likely interactions between aquaculture operations (as proposed) and the Annex 1 habitats 1110 (Sandbanks which are slightly covered by sea water all the time), 1130 (Estuaries), 1140 (Mudflats and sandflats not covered by seawater at low tide), 1150 (Coastal Lagoon), 1160 (Large Shallow Inlets and Bay) and 1170 (Reefs). The likely effects of the aquaculture activities (species, structures) were considered in light of the sensitivity of the constituent habitats and species of the Annex 1 habitats.

There is no overlap between the Annex I habitats Sandbanks which are slightly covered by sea water all the time (1110) and Coastal Lagoons (1150) and aquaculture activities in the Lower River Shannon SAC, therefore these features were screened out of the assessment.

Furthermore, of the 10 community types listed under the remaining habitat features (1140, 1160 and 1170) two (Estuarine subtidal muddy sand to mixed sediment with gammarids community complex and Mixed subtidal reef community complex) were also excluded from further analysis as they had no overlap with aquaculture activities.

Based upon the scale of spatial overlap the general conclusion relating to the interaction between proposed aquaculture activities with habitats is that consideration can be given to licencing (existing

and applications) in the Annex 1 habitats -1140 (Mudflats and sandflats not covered by seawater at low tide), 1160 (Large Shallow Inlets and Bays) and 1170 (Reefs). However, there is one exception where Oyster culture (bottom culture) occurs on the community type Faunal turf-dominated subtidal reef community (28.4%) which is above the threshold (15%) within the qualifying feature 1130 (Estuaries). However, it is questionable whether this activity will be carried out on this community type given the nature of the substrate.

However, based on biological pressures the aquaculture activity of Subtidal Bottom Culture (Mussels, Oysters) poses a potential risk of the introduction and the potential naturalization of non-native species due the placement of mussels and oysters in an uncontained fashion on the seafloor.

Conclusion 1: With one exception (Marine Community type – Anemone-dominated subtidal reef community (28.4%) which is above the threshold (15%) within the qualifying feature Large Shallow inlet and bay), aquaculture activities (intertidal oyster culture) do not pose a risk of significant disturbance to the qualifying interests (Habitats) of the Lower River Shannon SAC. However, some aquaculture activities (bottom mussel, suspended mussel and bottom oyster culture), when considered in-combination with fishery order areas, do pose a significant risk of disturbance to a number of qualifying interests in the SAC.

Conclusion 2: Give the long residence time in the Shannon Estuary and the fact that recruitment of the non-native oysters *Crassostrea gigas* is ongoing. The risk posed by the culture of diploid Pacific oyster, *Crassostrea gigas*, cannot be discounted. This risk is further exacerbated by the culture of these oysters on the seabed. It is recommended that all oyster culture be carried out using triploid oysters and that subtidal culture of *C gigas* uncontained on the seafloor be reviewed in light of these findings.

Conclusion 3: The source of mussel seed stock inputted into existing licensed mussel areas is collected locally at present. If seed is sourced outside of the site in the future the risk posed by this activity cannot be discounted. It is recommended that acceptable sources of seed (in terms of alien species assessment) are identified for all shellfish culture operations. The movement of stock in and out of the Lower River Shannon SAC should adhere to relevant fish health legislation and follow best practice guidelines (e.g. http://invasivespeciesireland.com/cops/aquaculture/).

Conclusion 4: 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 activities that are known to occur within the Fishery Order Areas (i.e. bottom culture of oysters and mussel) are deemed disturbing on a number of community types. It should be noted that the information available regarding the extent of usage and type of culture occurring within the Fishery Order Areas is sparse. Therefore the spatial extents listed are the maximum areas the Fishery Order covers, however it is possible that the areas may not be fully utilised by the operators. In the absence of this information and given the fact that the fishery orders are fully licenced, it is clear the decisions regarding the licencing of aquaculture operations should take into account the licence status of the Fishery order areas.

10.2 Species

The likely interactions between the proposed aquaculture activities (incl. Fishery Order Areas) and the Annex II species otter (*Lutra lutra*) 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 otter status relates to movement of people and vehicles within the sites as well as accessing the sites over intertidal areas and via water.

It is concluded that the aquaculture activities (incl. Fishery Order Areas) proposed in areas that potentially overlap with otter habitat do not pose a threat to the conservation status of this species within the SAC.

Conclusion 5: The current and proposed levels of aquaculture activities individually and in-combination with activities in fishery order areas are considered non-disturbing to otter conservation features.

The likely interactions between the proposed aquaculture activities and the Annex II species bottlenose dolphin (*Tursiops truncatus*) were also assessed. The objectives for this species in the SAC focus upon maintaining the favourable conservation condition status of the species which is defined by maintaining species range and critical habitat. The aspect of the culture activities that could potentially influence the dolphin status relates to presence of fixed aquaculture structures (Longlines) within the critical habitat areas. However, the small spatial extent and the potential for the structure to act as fish aggregation devices suggest present little risk to the feature in question.

It is concluded that the aquaculture activities proposed in areas that have overlap with dolphin critical habitat do not present a risk to the conservation status of this species within the Lower Shannon River SAC.

Conclusion 6: The current and proposed levels of subtidal suspended and bottom culture aquaculture activities are not considered disturbing to the bottlenose dolphin conservation features.

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