Report supporting Appropriate Assessment of Aquaculture Valentia Harbour/Portmagee Channel SAC (Site Code: 2262)

Marine Institute

Rinville

Oranmore, Co. Galway

Version: February 2020

Contents

List of Figures

List of Tables

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.

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) of aquaculture are carried out against the Conservation Objectives, and more specifically on the version of the Conservation Objectives 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.

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 aquaculture applications are then subject to AA. If the AA 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

Valentia Harbour/Portmagee Channel is designated as a Special Area of Conservation (SAC) under the Habitats Directive. The marine area is designated for three features; large shallow inlet and bay, intertidal mud and sand flats not covered by seawater at low tide and reefs. The bay supports a variety of sub-tidal and intertidal sedimentary and reef habitats including habitats that are sensitive to pressures, which might arise from aquaculture, such as maerl (corraline algae) and seagrasses. Conservation Objectives for these habitats 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 Bay. Guidance on the conservation objectives is provided by NPWS (2012b).

2.2 Activities in the SAC

The only aquaculture activity currently practiced (or proposed) is oyster culture. The Pacific oyster (*Crassostrea gigas*) is cultured on trestles in intertidal areas. The profile of the aquaculture industry in the SAC, used in this assessment, was prepared by BIM and is derived from the list of licences and applications received by DAFM and provided to the MI for assessment in July 2019 and January 2020.

2.3 The appropriate assessment process

The function of an appropriate assessment is to determine if the ongoing and proposed aquaculture 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 (2012a) provide guidance on interpretation of the Conservation Objectives which are, in effect, management targets for habitats and species in the Bay. 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 disturbing activities and a habitat (or community type) 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 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 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.

2.4 Data supports

Distribution of habitats and species population data are provided by NPWS[1]. Information on Aquaculture licences and applications are provided by DAFM[2]. 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 and Recommendations

Aquaculture Recommendations:

The appropriate assessment and risk assessment finds that the activities, at the current and proposed or likely future scale and frequency of activity are consistent with the Conservation Objectives for the SAC. In relation to intertidal shellfish culture activities, given the scale of spatial overlap and the relatively high tolerance levels of some habitats and species therein, the general conclusions relating to the interaction between current and 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).

It is recommended that there be strict adherence to the access routes identified and that density of culture structures within the sites be maintained at current levels.

The movement of stock in and out of Valentia Harbour/Portmagee Channel SAC should adhere to relevant fish health legislation and follow best practice guidelines.

[1] NPWS Geodatabase Ver: March 2017 - http://www.npws.ie/mapsanddata/habitatspeciesdata/

[2] DAFM Aquaculture Database; Version - August 2019

3 Introduction

This document assesses the potential ecological interactions between aquaculture and fisheries activities and the Conservation Objectives (COs) of the Valentia Harbour/Portmagee Channel SAC (site code 2262).

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 July 2019; 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[3] and shared with the Marine Institute. The spatial data for conservation features was provided by NPWS[4].

4 Conservation Objectives for Valentia Harbour/Portmagee Channel SAC (002262)

The appropriate assessment of aquaculture and risk assessment of fisheries in relation to the Conservation Objectives for Valentia Harbour/Portmagee Channel SAC is based on Version 1.0 of the objectives (NPWS 2012a - 31 October 2012) and supporting documentation (NPWS 2012b - Version 1 August, 2012).

4.1 The SAC extent

Valentia Harbour/Portmagee Channel SAC comprises the entirety of the waters inside Valentia Island encompassing islands at the northern (Doolus Bay) and southern (Bray Head) opening to the ocean. The site is comprised of a wide range of intertidal and subtidal habitats, including mudflats and sandflats not covered by seawater at low tide, large shallow inlets and bays as well reefs.

[3] DAFM Aquaculture Database; Version - August 2019

[4] NPWS Geodatabase Ver: March 2017 - http://www.npws.ie/mapsanddata/habitatspeciesdata/
/

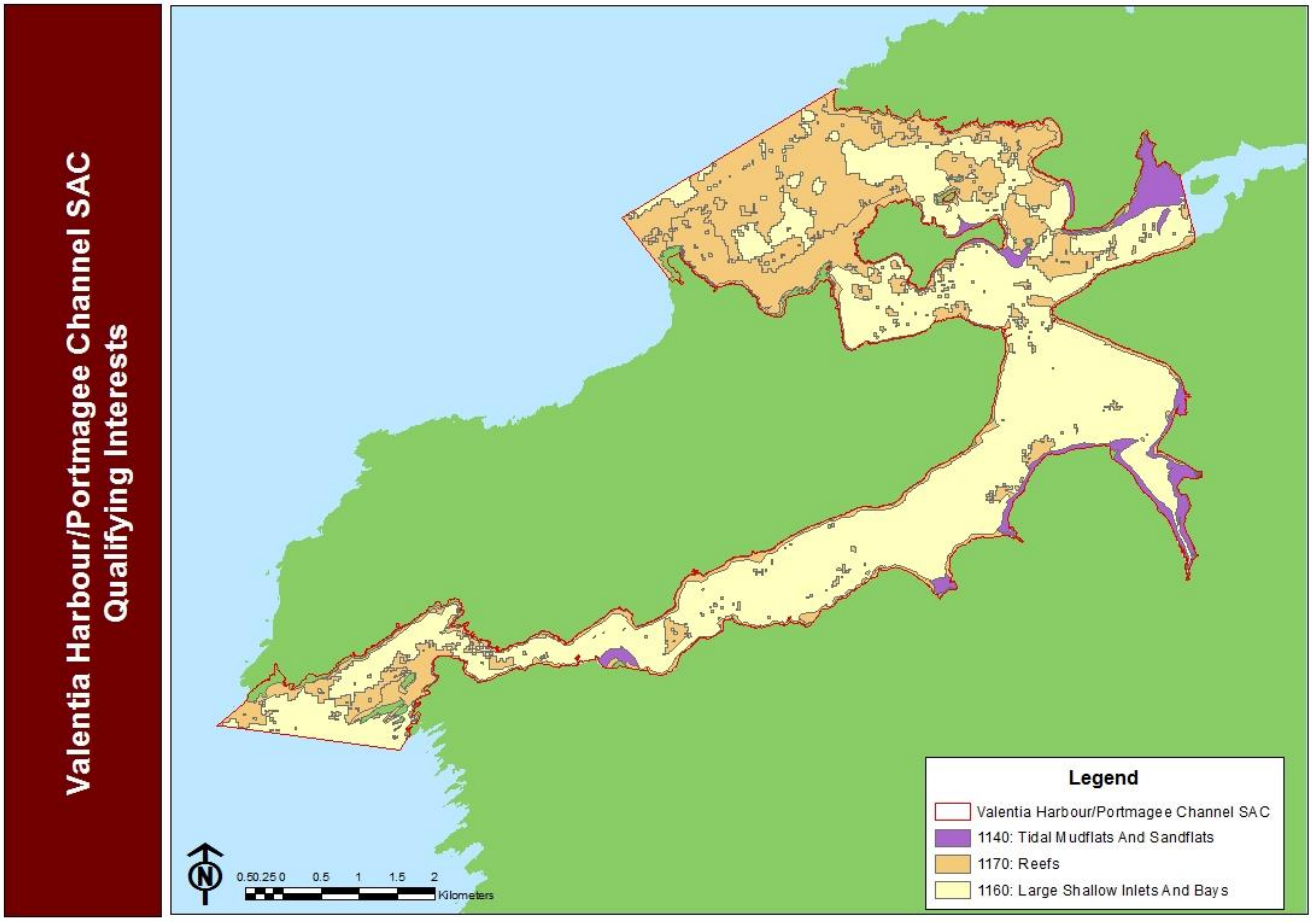

Figure 1. The extent of Valentia Harbour/Portmagee Channel SAC (site code 002262) with constituent qualifying interests (QI).

4.2 Qualifying interests (SAC)

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

- 1140 Mudflats and sandflats not covered by seawater at low tide
- 1160 Large shallow inlets and bays
- 1170 Reefs

Constituent communities and community complexes recorded within the qualifying interest Annex 1 habitats (i.e. 1140 - Mudflats and sandflats not covered by seawater at low tide, 1160 - Large Shallow inlets and Bays and 1170-Reefs) (are listed in NPWS (2012b) and illustrated in Figure 2 and consist of:

1. Maërl-dominated community
2. *Zostera*-dominated community
3. (Maërl-dominated community/ *Zostera*-dominated community)[5]

[5] The community type "Maërl-dominated community/ *Zostera*-dominated community" presented in Marine Community type maps (Figure 2) are not specifically included in conservation objectives (NPWS 2012a).

4. *Edwardsia delapiae* associated community
5. Intertidal sand with nematodes and polychaetes community complex; and
6. Medium to fine sand with *Nephtys cirrosa* and *Spiophanes bombyx* community complex
7. Coarse sediment with *Pisione remota* community complex;
8. Sandy mud to mixed sediment with *Melinna palmate* community complex;
9. Mixed sediment with *Chaetozone gibber* community complex;
10. *Fucus*-dominated intertidal reef community complex;
11. *Laminaria*-dominated community;
12. Echinoderm dominated reef community complex

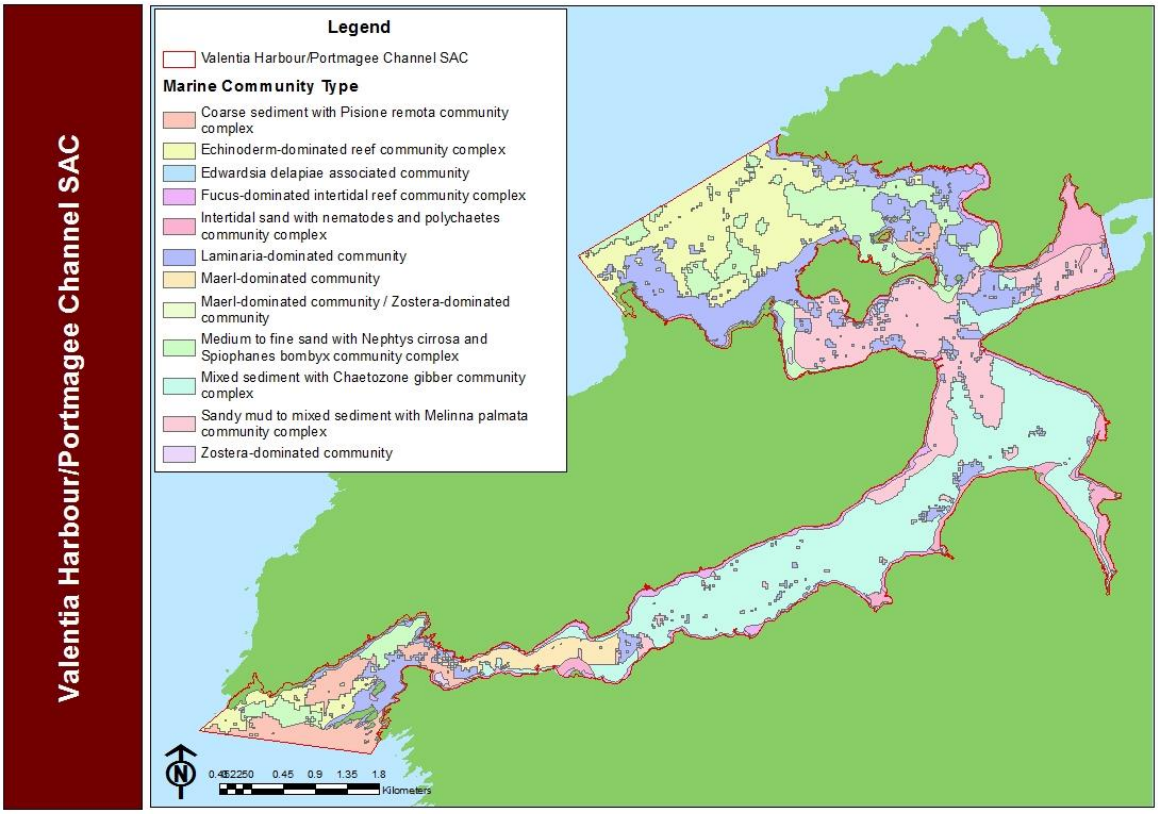

Figure 2. Principal benthic communities recorded within the qualifying interests Large shallow inlets and bays, Mudflats and sandflats not covered by seawater at low tide and reefs within Valentia Harbour/Portmagee Channel SAC (Site Code 002262) (NPWS 2012a,b).

4.3 Conservation objectives for Valentia Island/Portmagee Channel 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.

Of particular importance is the presence within the feature Large Shallow Inlet and Bay of 3 highly sensitive community types. Two communities' 'Mearl- and *Zostera*-dominated', are considered important because to the biogenic structures they provide and the broad range of species which can be found therein; they are considered of high biodiversity value. The third community type, '*Edwardsia delapiae* associated community' is not only important for being the type location of this species; it also harbours a rich infaunal community. These community types are considered important in terms of the structure and function they provided to this Natura site.

Table 1. Conservation objectives and targets for marine habitats and species in Valentia Harbour/Portmagee Channel SAC (0002262) (NPWS 2012a,b). Annex I and II features listed in bold.

FEATURE (COMMUNITY TYPE)	**OBJECTIVE**	**TARGET**
MUDFLATS AND SANDFLATS NOT COVERED BY SEAWATER AT LOW TIDE	Maintain favourable conservation condition	123 ha; Permanent habitat is stable or increasing, subject to natural processes
INTERTIDAL SAND WITH NEMATODES AND POLYCHAETES COMMUNITY COMPLEX	Maintain favourable conservation condition	111 ha; Maintained in a natural condition
MEDIUM TO FINE SAND WITH *NEPHTYS CIRROSA* AND *SPIOPHANES BOMBYX* COMMUNITY COMPLEX	Maintain favourable conservation condition	12 ha; Maintained in a natural condition
LARGE SHALLOW INLETS AND BAYS	Maintain favourable conservation condition	2629 ha;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.
INTERTIDAL SAND WITH NEMATODES AND POLYCHAETES COMMUNITY COMPLEX	Maintain favourable conservation condition	111ha; Maintained in a natural condition
MEDIUM TO FINE SAND WITH *NEPHTYS CIRROSA* AND *SPIOPHANES BOMBYX* COMMUNITY COMPLEX	Maintain favourable conservation condition	294ha; Maintained in a natural condition
MAËRL-DOMINATED COMMUNITY	Maintain favourable conservation condition	59ha; Conserve high quality of this community
ZOSTERA-DOMINATED COMMUNITY	Maintain favourable conservation condition	6ha; Conserve high quality of this community
EDWARDSIA DELAPIAE ASSOCIATED COMMUNITY	Maintain favourable conservation condition	2ha; Conserve high quality of this community

FEATURE (COMMUNITY TYPE)	**OBJECTIVE**	**TARGET**
COARSE SEDIMENT WITH *PISIONE REMOTA* COMMUNITY COMPLEX	Maintain favourable conservation condition	130ha; Maintained in a natural condition
SANDY MUD TO MIXED SEDIMENT WITH *MELINNA PALMATA* COMMUNITY COMPLEX	Maintain favourable conservation condition	359ha; Maintained in a natural condition.
MIXED SEDIMENT WITH *CHAETOZONE GIBBER* COMMUNITY COMPLEX	Maintain favourable conservation condition	715ha; Maintained in a natural condition
FUCUS-DOMINATED INTERTIDAL REEF COMMUNITY COMPLEX	Maintain favourable conservation condition	127ha; Maintained in a natural condition
LAMINARIA-DOMINATED COMMUNITY	Maintain favourable conservation condition	451ha; Maintained in a natural condition
ECHINODERM-DOMINATED REEF COMMUNITY COMPLEX	Maintain favourable conservation condition	374ha; Maintained in a natural condition
REEF	Maintain favourable conservation condition	953ha; 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.
FUCUS-DOMINATED INTERTIDAL REEF COMMUNITY COMPLEX	Maintain favourable conservation condition	127 ha; Maintained in a natural condition
LAMINARIA-DOMINATED COMMUNITY	Maintain favourable conservation condition	451 ha; Maintained in a natural condition
ECHINODERM-DOMINATED REEF COMMUNITY COMPLEX	Maintain favourable conservation condition	374 ha; Maintained in a natural condition

4.4 Screening of Adjacent Natura sites for *ex-situ* effects

In addition to the Valentia Harbour/Portmagee channel SAC there is one other Natura 2000 site (Iveragh Peninsula SPA) which is proximate to the proposed activities (Figure 3). The characteristic features of these sites are identified in Table 2, where a preliminary screening is carried out on the likely interaction with aquaculture and fishery activities based upon the likelihood of spatial overlap. In addition, species migrating to and from the site may be affected by activities, such as fisheries, operating outside the site (*ex situ* effects).

All likely interactions between aquaculture and fisheries activities with qualifying features in Iveragh Peninsula SPA will likely screen out on the basis that; 1) there is no direct overlap between the features and aquaculture (and fisheries) activities (within the SAC) and, 2) *ex situ* effects are considered non-impacting, in that the bird species identified will feed primarily offshore or on land.

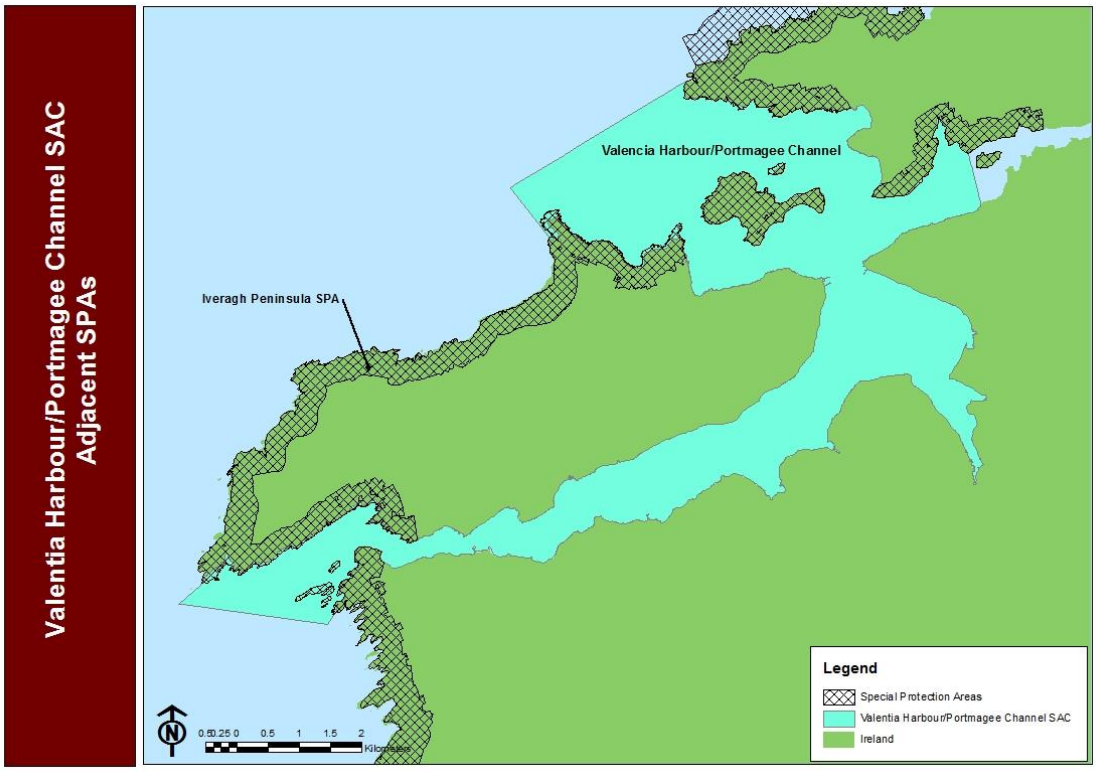

Figure 3. Natura 2000 sites adjacent to the Valentia Harbour/Portmagee Channel SAC**.**

Table 2 Natura Sites adjacent to Valentia Harbour/Portmagee Channel SAC and qualifying features with initial screening assessment on likely interactions with fisheries and aquaculture activities.

NATURA SITE	QUALIFYING FEATURES [SPECIES CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
Iveragh Penninsula SPA (004154)	Fulmar (*Fulmarus glacialis*) [A009]	On the basis that the species will tend to forage offshore or on land (in the case of Chough) there is no likely interaction with existing or proposed aquaculture activities within Valentia Harbour/Portmagee Channel – excluded from further analysis.
	Peregrine (*Falco peregrinus*) [A103]	
	Kittiwake (*Rissa tridactyla*) [A188]	
	Guillemot (*Uria aalge*) [A199]	
	Chough (*Pyrrhocorax pyrrhocorax*) [A346]	

5 Details of the proposed plans and projects

5.1 Aquaculture

Existing and proposed aquaculture sites are presented in Figure 4.

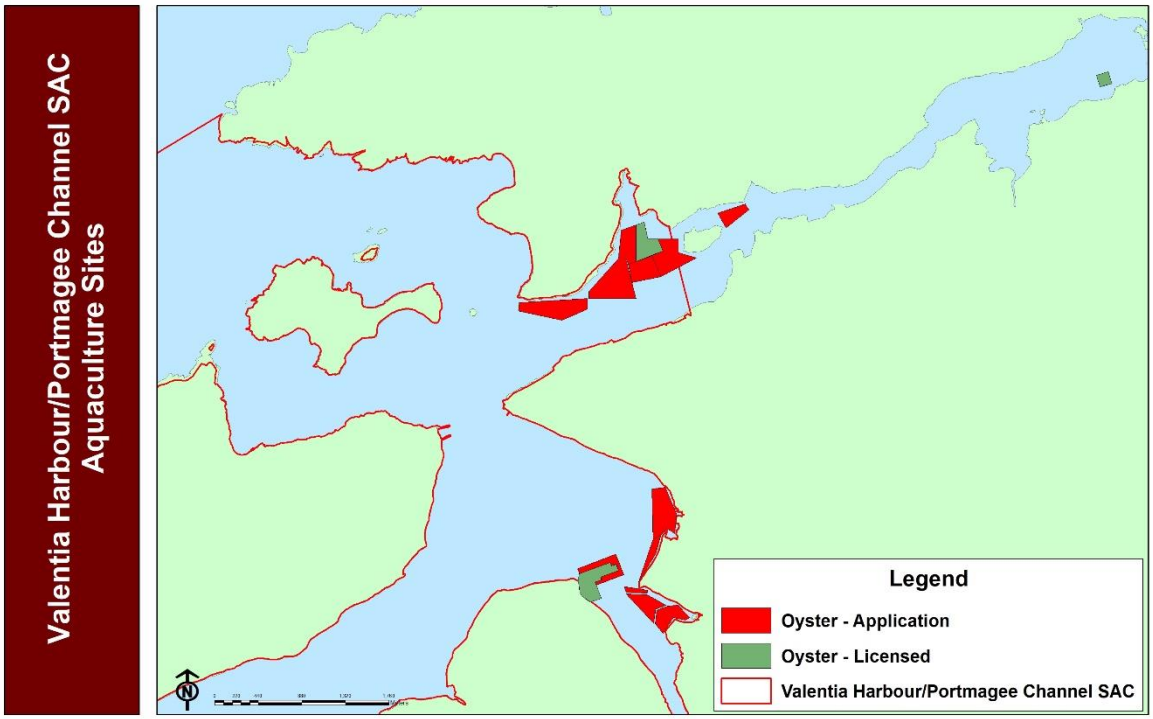

Figure 4: Aquaculture sites (Licenced and Applications) in Valentia Harbour/Portmagee Channel SAC.

Oyster- *C. gigas*

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

Currently Valentia Harbour is used for the production of half-grown oysters which are harvested at this size and finished in other bays both in Ireland and in France. The production cycle begins in Valentia when triploid G6 seed is introduced from the French hatchery, France Nissan. Production takes 18-24 months on site.

Upon receipt from the hatchery, seed is placed in the mesh plastic bags with mesh size and stocking density appropriate to the seed grade. As the oysters grow stocking densities are reduced. Bag sizes used on site are 2mm to 9mm.

Grading takes place annually between October and April. Grading and harvesting activities entails actually removing the bags from the inter-tidal zone to a land based site. They are collected by hand, loaded onto trailers and transported by tractor.

Maintenance activities on-site include shaking and turning of bags. The bags are shaken and turned on site. Tractor movements in this instance are simply for the transport of staff to and from site.

Harvesting occurs between September and June and involves hand placing of the bags on tractor and trailer to be brought ashore.

Access Routes

There are a number of access routes for the operators in the area to the applied licensed sites. For the sites in the northern portion of the SAC, frequency of site access is every day by tractor along the margin of upper shore and land from Ballycarbery Castle to the site. These habitats are typically hard packed sand. Other oyster culture sites have direct access from land with little or no access along the shore outside of licenced areas. Access to sites the Derreen River is along the shore or directly from land. It is proposed that, one site (T06-461A) will be accessed by boat only from a launch point near the mouth of the Derreen River.

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, which gives a total spatial overlap of 3.07ha (Figure 5).

The spatial overlap of access routes on Qualifying Interests 1140, 1160 and 1170 is presented in Table 3 (while Table 4, 5, 6 presents spatial overlap on constituent communities of Qualifying Interests of 1140, 1160 and 1170 respectively).

Figure 5 Existing and proposed access routes to the existing and proposed shellfish culture sites within the Valentia Harbour/Portmagee Channel SAC.

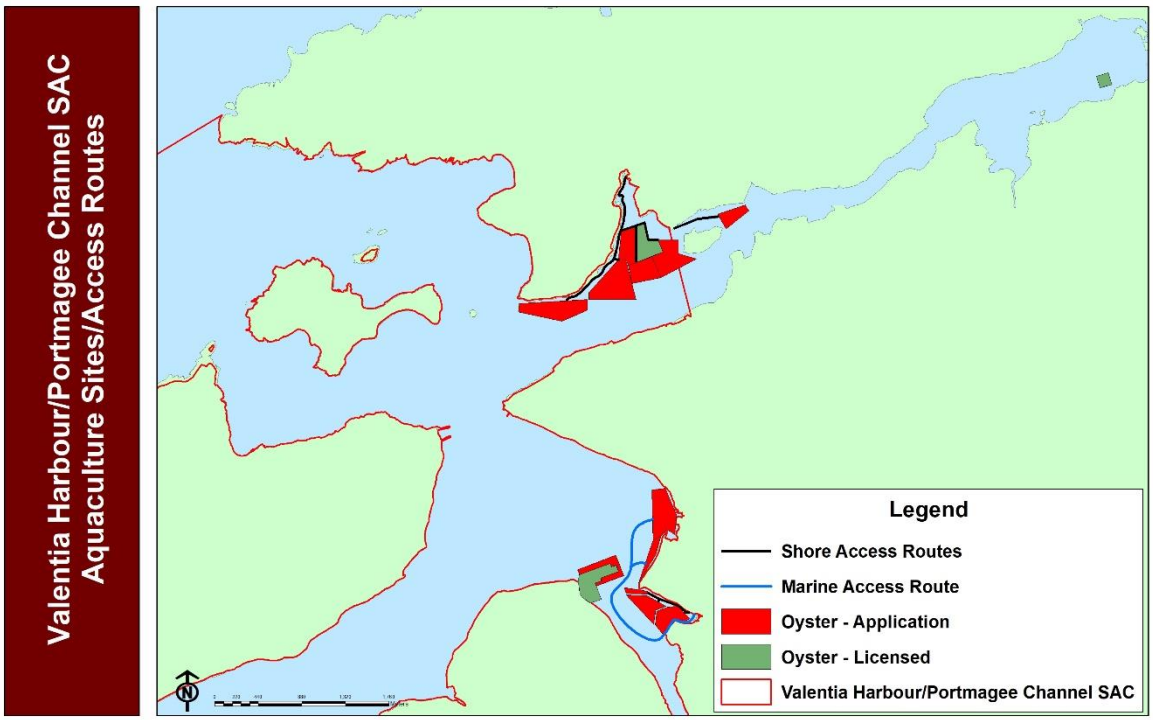

Table 3: Spatial extent (ha) of aquaculture activities overlapping with the qualifying interest (1140 -Mudflats and sandflats not covered by seawater at low tide, 1160-Large shallow inlets and bays and 1170-Reefs) in Valentia Harbour/Portmagee Channel SAC, presented according to culture species, method of cultivation and license status.

Species	Status	Location	1140 - Mudflats and sandflats not covered by seawater at low tide 123ha		1160 - Large shallow inlets and Bays 2629ha		1170 Reefs 953ha	
			Area (ha)	*% Feature*	Area (ha)	*% Feature*	Area (ha)	*% Feature*
Oyster	Licensed	Intertidal	10.58	8.6	12.76	0.49	-	-
Oyster	Application	Intertidal	28.48	23.15	67.48	2.57	3.75	0.39
Access Routes			2.64	2.15	3.07	0.12	0.43	0.05

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 (aquaculture) structures and human activities on designated species, intertidal and sub-tidal habitats and 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 Valentia Harbour/Portmagee Channel SAC, the species cultured are:

1. Oysters (*Crassostrea gigas*), in suspended culture (contained in bags & trestles) confined primarily to intertidal areas.

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 below**.** The impact summaries identified are derived from published primary literature and review documents that have specifically focused upon the environmental interactions of mariculture (e.g. Black 2001; McKindsey et al. 2007; National Research Council 2009, 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. 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 or as a consequence of the stock itself reproducing. 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 and appears to have become naturalised (i.e. establishment

of a breeding population) in two locations (Kochmann et al 2012; 2013) and may compete with the native species for space and food. To date, no settlement of Pacific oysters has been reported in Valentia Harbour/Portmagee Channel SAC (F.O'Beirn, Marine Institute - personal observation).

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:

1. 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.
2. 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.
3. 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.
4. 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 re-suspend 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. sea grasses) found underneath.

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.

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 exercise 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 clear 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 Valentia Harbour/Portmagee Channel SAC.

7.1 Aquaculture Activity Screening

Table 3 highlights the spatial overlap between (existing and proposed) aquaculture activities and both habitat features (i.e. Large Shallow Inlet and Bay, Mudflat and Sandflats not covered by seawater at low tide and Reefs).

Tables 4, 5 and 6 provide an overview of overlap of aquaculture activities (including and specific community types (identified from Conservation objectives) within the broad habitat features 1140, 1160 and 1170, respectively.

Where the overlap between an aquaculture activity and a feature is zero and there is no likely interaction, it is screened out and not considered further. While there are no habitat features that fall into this category, there are a number of marine community types (n=7) within those features that do fall into this category. These marine community types are not carried forward for further assessment. The community types not considered further are:

1. **Coarse sediment with *Pisione remota* community complex**
2. **Echinoderm-dominated reef community complex**
3. ***Edwardsia delapiae* associated community***
4. **Maerl-dominated community***
5. **Maerl-dominated community / *Zostera*-dominated community***
6. **Medium to fine sand with *Nephtys cirrosa* and *Spiophanes bombyx* community complex**
7. ***Zostera*-dominated community***

Table 4: Habitat utilisation i.e. spatial overlap in hectares and percentage (given in parentheses) of Aquaculture activity over community types within the qualifying interest 1140 - Mudflat and sandflats not covered by seawater at low tide of Valentia Harbour/Portmagee Channel SAC. (Spatial data based on licence database provided by DAFM. Habitat data provided in NPWS 2011 – supporting docs marine and coastal)

			1140 - Mudflats and sandflats not covered by seawater at low tide	
Culture Type	**Location**	**Status**	**Intertidal sand with nematodes and polychaetes community complex 111ha**	**Medium to fine sand with *Nephtys cirrosa* and *Spiophanes bombyx* community complex 12ha**
Oysters (*Crassostrea gigas*) in bags & trestles.	**Intertidal**	**Licenced**	**10.57 (9.5%)**	**-**
Oysters (*Crassostrea gigas*) in bags & trestles.	**Intertidal**	**Applications**	**28.42 (25.6%)**	**-**
Access Routes			**2.64 (2.4%)**	**-**

Table 5: Habitat utilisation i.e. spatial overlap in hectares and percentage (given in parentheses) by Aquaculture activity over specific community types within the qualifying interest 1160 – Large shallow inlets and bays of Valentia Harbour/Portmagee Channel SAC based on licence database provided by DAFM. Habitat data provided in NPWS 2012b – supporting docs marine and coastal) I = Intertidal, S = Subtidal; L= licenced, A = application.

			1160 – Large Shallow Inlets and Bays					
Culture Type	**Location**	**Status**	**Coarse sediment with *Pisione remota* community complex**	**Echinoderm-dominated reef community complex**	***Edwardsia delapiae* associated community**	***Fucus*-dominated intertidal reef community complex-127ha**	**Intertidal sand with nematodes and polychaetes community complex-111ha**	***Laminaria*-dominated community-451ha**
Oysters (*Crassostrea gigas*) in bags & trestles.	**I**	**L**	**-**	**-**	**-**	**-**	**10.57 (9.5%)**	**-**
Oysters (*Crassostrea gigas*) in bags & trestles.	**I**	**A**	**-**	**-**	**-**	**1.45 (1.1%)**	**28.42 (25.6%)**	**2.31 (0.51%)**
Access Routes			**-**	**-**	**-**	**0.43 (0.34%)**	**2.64 (2.4%)**	**-**

Table 6 cont.. Habitat utilisation i.e. spatial overlap in hectares and percentage (given in parentheses) by Aquaculture activity over specific community types within the qualifying interest 1160 – Large shallow inlets and bays of Valentia Harbour/Portmagee Channel SAC based on licence database provided by DAFM. Habitat data provided in NPWS 2012b – supporting docs marine and coastal) I = Intertidal, S = Subtidal; L= licenced, A = application.

			1160 – Large shallow inlets and bays					
Culture Type	**Location**	**Status**	**Maerl-dominated community**	**Maerl-dominated community / *Zostera*-dominated community**	**Medium to fine sand with *Nephtys cirrosa* and *Spiophanes bombyx* community complex**	**Mixed sediment with *Chaetozone gibber* community complex-715ha**	**Sandy mud to mixed sediment with *Melinna palmata* community complex-359ha**	***Zostera*-dominated community**
Oysters (*Crassostrea gigas*) in bags & trestles.	**I**	**L**	-	-	-	**2.18 (0.3%)**	-	-
Oysters (*Crassostrea gigas*) in bags & trestles.	**I**	**A**	-	-	-	**15.95 (2.23%)**	**19.29 (5.4%)**	-
Access Routes			-	-	-	-	-	-

Table 7: Habitat utilisation i.e. spatial overlap in hectares and percentage (given in parentheses) by Aquaculture activity over specific community types within the qualifying interest 1170 – Reefs of Valentia Harbour/Portmagee Channel SAC based on licence database provided by DAFM. Habitat data provided in NPWS 2011 – supporting docs marine and coastal) I = Intertidal, S = Subtidal; L= licenced, A = application.

			1170 – Reefs		
Culture Type	**Location**	**Status**	**Echinoderm-dominated reef community complex 374ha**	***Fucus*-dominated intertidal reef community complex 127ha**	***Laminaria*-dominated community 451ha**
Oysters (*Crassostrea gigas*) in bags & trestles.	**I**	**L**	-	-	-
Oysters (*Crassostrea gigas*) in bags & trestles.	**I**	**A**	-	**1.28 (1%)**	**2.06 (0.5%)**
Access Routes			-	**0.43 (0.34%)**	-

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 (Figure 1-3 and NPWS 2012a, b).

Within the Valentia Harbour/Portmagee Channel SAC the qualifying intersts considered subject to potential disturbance and therefore, carried further in this assessment are:

- **1140 Mudflats and sandflats not covered by seawater at low tide**
- **1160 Large shallow inlets and bays**
- **1170 Reefs**

Furthermore, 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. In Valentia Harbour/Portmagee Channel SAC there are four such community types found within the feature Large shallow inlets and Bays (1160). These sensitive habitats include:

1. ***Zostera*-dominated community**
2. **Maerl-dominated community / *Zostera*-dominated community**
3. **Maerl-dominated community**
4. ***Edwardsia delapiae* associated community**

There is no spatial overlap between the current or proposed aquaculture activities and these four sensitive community types. These community types are, therefore, excluded from further analysis.

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; Table 4, 5 and 6). Those community types carried forward for further consideration are:

1. ***Fucus*-dominated intertidal reef community complex**
2. **Intertidal sand with nematodes and polychaetes community complex**
3. ***Laminaria*-dominated community**
4. **Mixed sediment with *Chaetozone gibber* community complex**
5. **Sandy mud to mixed sediment with *Melinna palmata* community complex**

Subsequent disturbance and the persistence of disturbance are considered as follows:

1. <u>The degree to which the activity will disturb the qualifying interest.</u> 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 as listed above (*Zostera*, Maerl, Reef) where any physical disturbance should generally be avoided.

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

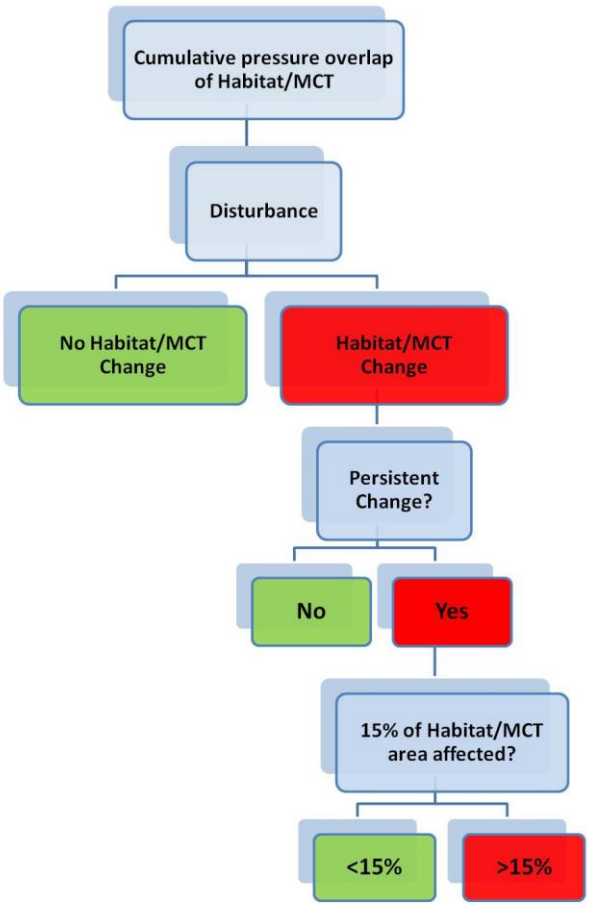

Figure 6: Determination of significant effects on community distribution, structure and function for sedimentary habitats (following NPWS 2012b).

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 habitats of Valentia Harbour/Portmagee Channel 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 2012b).
- 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 Valentia Harbour/Portmagee Channel SAC to pressures similar to those likely to be caused by aquaculture (e.g. smothering, organic enrichment and physical disturbance) are listed, where available, in Table 7. 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.
- 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 Valentia Harbour/Portmagee Channel 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.

NPWS (2012b) provide lists of species characteristic of benthic communities that are defined in the Conservation Objectives. The species defined are typical of fine sedimentary habitats as well as where relevant, intertidal habitats (tolerant of desiccation and physical stress). For the most part, these intertidal communities are typically impoverished with low numbers of species and overall abundances.

Intertidal shellfish aquaculture overlaps with all habitat type listed above (Table 3). In addition, the aquaculture activities overlap a range community types found within the qualifying interest of the SAC (Table 4, 5 and 6). Tables 9, 10 and 11 below identify the likely interactions between the relevant aquaculture activities and the broad habitat features (1140, 1160 and 1170) and their constituent community types, with a broad conclusion and justification on whether the activity is considered disturbing to the feature in question.

Different species and habitats will have different tolerance to the pressures associated with aquaculture activities (pressures as discussed in Sections 6 and 7).

The only constituent community taken forward for further analysis identified in the broad Annex 1 feature (i.e., **Mudflats and sandflats not covered by seawater at low tide**) is:

1. **Intertidal sand with nematodes and polychaetes community complex**

This is predominantly sandy-muddy community type and given it is predominantly intertidal and, in parts, estuarine, can be exposed to a range of physical and hydrodynamic pressures. In conclusion on the basis of

published literature (Forde et al. 2015; O'Carroll et al 2016), this community type is considered tolerant of the culture activity but sensitive to the compaction by vehicles over access routes to the sites. The spatial extent of this community type impacted by this pressure (disturbing activity) is 2.4% (Table 9).

The constituent communities taken forward for further analysis identified in the broad Annex 1 feature (i.e., **Reefs**) is:

1. ***Fucus*-dominated intertidal reef community complex (1.34%)**
2. ***Laminaria*-dominated community (0.5%)**

These reef communities are dominated by macro-algae and a range of epifaunal species. These community types are considered sensitive (by virture of shading and physical disturbance) to all aspects of the culture activity, i.e., trestles and compaction on access routes. The spatial extent of the community type *Fucus*-dominated intertidal reef community complex considered disturbed is 1.34%, while the spatial extent of the community type *Laminaria*-dominated community considered disturbed is 0.5%. (Table 10)

While the feature **Large shallow inlets and bays** includes intertidal communities (considered above), it is subtidal communities which predominate this feature type. In addition to the communities listed above, for which there are distinguishing subtidal characteristics, the feature Large Shallow Inlets and Bays also contain the following community types that have likely interaction with existing and proposed shellfish culture activity;

1. ***Fucus*-dominated intertidal reef community complex**
2. **Intertidal sand with nematodes and polychaetes community complex**
3. ***Laminaria*-dominated community**
4. **Mixed sediment with *Chaetozone gibber* community complex**
5. **Sandy mud to mixed sediment with *Melinna palmata* community complex**

The fauna characterising the habitat types listed above are, for the most part, typical of inshore intertidal and subtidal communities found in fine sedimentary habitats. They are dominated by polychaete worms and bivalves. The reef communities are typical of intertidal habitats dominated by fucoid macroalgae and subtidal hard substrate communities dominated by large macro algal (kelp) and faunal turf (sponges, echinoderms and hydrozoans).

Aquaculture activities in Valentia Harbour/Portmagee Channel SAC comprises shellfish production methods specifically intertidal oyster culture (using bags and trestles).

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 persistence disturbance on the habitat. If persistence disturbance is likely then the spatial extent of the overlap is considered further (Figure 10). Table 11 summarises the likely interactions between the culture activities and community types. It must be noted that aquaculture practices are unlikely to be carried out over some community types on the basis they

are found in fully subtidal areas, e.g., *Laminaria*-dominated community or the substrate is not suited for the deployment of structure used. Shallow subtidal sedimentary community type maybe subject to the pressures resulting from shellfish culture. Those community types considered sensitive to trestle culture of oysters aquaculture (within habitat 1160) are listed below with the combined proportion likely to be considered disturbed are:

1. ***Fucus*-dominated intertidal reef community complex (1.34%)**
2. ***Laminaria*-dominated community (0.5%)**
3. **Intertidal sand with nematodes and polychaetes community complex (2.4%)**
4. **Mixed sediment with *Chaetozone gibber* community complex (2.54%)**
5. **Sandy mud to mixed sediment with *Melinna palmata* community complex (5.4%)**

Table 8: Matrix showing the characterising habitats sensitivity scores x pressure categories for habitats in Valentia Harbour/Portmagee Channel SAC (ABPMer 2013a-h). Table 8 provides the code for the various categorisation of sensitivity and confidence

Pressure Type	*Physical Damage*								*Change in Habitat Quality*										*Biological Pressures*			*Chemical Pollution*			*Physical Pressures*
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 or 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	Introduction of antifoulants	Introduction of medicines	Introduction of hydrocarbons	Prevention of light reaching seabed/features
Mixed sediment with *Chaetozone gibber* community complex (A2.42)	NS (*)	L (*)	L (*)	NS (*)	L (*)	L-M (*)	L-M (*)	L-M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	L (*)	L (*)	H (*)	NS (*)	NS (*)	NS (*)	NS (*)	L (*)	NS (*)
Mixed sediment with *Chaetozone gibber* community complex (A5.44)	NS (*)	L (*)	L (*)	NE	NE	L-M (*)	L-M (*)	L-M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	H (*)	NS (*)	NS (*)	NS (*)	NS (*)	L (*)	NS (*)
Intertidal sand with nematodes and polychaetes community complex (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 (*)	NS (*)	NS (*)	L (*)	NS (*)
Medium to fine sand with *Nephtys cirrosa* and *Spiophanes bombyx* community complex (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 (*)	NS (*)	NS (*)	L (*)	NS (*)
Fucus-dominated intertidal reef community complex (A1.21)	NS (*)	NA	NA	NS (*)	NE	NE	NS (*)	M-VH (*)	NA	NA	NS (*)	NS (*)	NS (*)	NS (*)	NE	NS (*)	NE	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)
Laminaria-dominated community (A3.22)	NS (*)	NA	NA	NE	NE	NE	NS (*)	M-VH (*)	NA	NA	NS (*)	NS (*)	NS (*)	NS (*)	NE	NS (*)	NE	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)
Sandy mud to mixed sediment with Melinna palmata community complex (A5.33)	NS (*)	L (*)	L (*)	NE	NE	L-M (*)	L (*)	L-M (*)	L-M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	L (*)	NS (*)	L (*)	L (*)	H (*)	NS (*)	NS (*)	NS (*)	NS (*)	L (*)	NS (*)

Table 9: Codes of sensitivity and confidence applying to species and pressure interactions presented in Table 7.

Species x Pressure Interaction Codes for Table 9	
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

Table 10. Interactions between the relevant aquaculture activities and the habitat feature 1140 constituent communities with a broad conclusion on the nature of the interactions

	1140 - Mudflats and sandflats not covered by seawater at low tide	
Culture Type	**Intertidal sand with nematodes and polychaetes community complex**	**Medium to fine sand with *Nephtys cirrosa* and *Spiophanes bombyx* community complex**
Oysters (*Crassostrea gigas*) in bags & trestles.	**Disturbing: No** **Justification:** The habitat is considered tolerant to pressures from this activity. The species have high recoverability and are tolerant. The stock is confined in bags, is sourced from hatcheries and are 100% triploid	**N/A**
Vehicular traffic in Intertidal areas.	**Disturbing: Yes** **Justification:** The habitat and species are likely sensitive to persistent pressure (compaction) from this activity. The spatial overlap is 2.4% of the habitat type.	**N/A**

Table 11. Interactions between the relevant aquaculture activities and the habitat feature 1170 constituent communities with a broad conclusion on the nature of the interactions

	1170 – Reefs	
Culture Type	***Fucus*-dominated intertidal reef community complex**	***Laminaria*-dominated community**
Oysters (*Crassostrea gigas*) in bags & trestles.	**Disturbing: Yes** **Justification:** This habitat is sensitive to this activity as a result or organic enrichment and shading. The spatial overlap is 1% of this community type.	**Disturbing: Yes** **Justification:** This habitat is sensitive to this activity as a result or organic enrichment and shading. However, this habitat is unlikely to be used for the culture of oysters given the nature of the substrate (i.e. bedrock and boulders) and depth profile (2m-20m). The spatial overlap is 0.5% of this community type.
Vehicular traffic in Intertidal areas.	**Disturbing: Yes** Justification: The habitat and species are likely sensitive to persistent pressure (compaction) from this activity. The spatial overlap is 0.34% of the habitat type.	**N/A**

Table 12. Interactions between the relevant aquaculture activities and the habitat feature 1160 constituent communities with a broad conclusion on the nature of the interactions.

	1160 – Large shallow inlets and bays				
Culture Type	**Sandy mud to mixed sediment with *Melinna palmata* community complex 359ha**	**Mixed sediment with *Chaetozone gibber* community complex 715ha**	***Fucus*-dominated intertidal reef community complex 127ha**	**Intertidal sand with nematodes and polychaetes community complex 111ha**	***Laminaria*-dominated community 451ha**
Oysters (*Crassostrea gigas*), in bags & trestles.	**Disturbing: Yes** **Justification:** This shallow subtidal habitat is sensitive to this activity as a result or organic enrichment and compaction. The spatial overlap is 5.4% of this community type.	**Disturbing: Yes** **Justification:** This shallow subtidal habitat is sensitive to this activity as a result or organic enrichment and compaction. The spatial overlap is 2.4% of this community type.	**Disturbing: Yes** **Justification:** This habitat is sensitive to this activity as a result or organic enrichment and shading. The spatial overlap is 1.0% of this community type.	**Disturbing: No** **Justification:** The habitat is considered tolerant to pressures from this activity. The species have high recoverability and are tolerant. The stock is confined in bags, is sourced from hatcheries and are 100% triploid	**Disturbing: Yes** **Justification:** This habitat is sensitive to this activity as a result or organic enrichment and shading. However, this habitat is unlikely to be used for the culture of oysters given the nature of the substrate (i.e. bedrock and boulders) and depth profile (2m-20m). The spatial overlap is 0.5% of this community type.
Vehicular traffic in Intertidal areas.	**N/A**	**N/A**	**Disturbing: Yes** **Justification:** The habitat and species are likely sensitive to <u>persistent</u> pressure (compaction) from this activity. The spatial overlap is 0.34% of the habitat type.	**Disturbing: Yes** **Justification:** The habitat and species are likely sensitive to <u>persistent</u> pressure (compaction) from this activity. The spatial overlap is 2.4% of the habitat type.	**N/A**

8.4 Other Considerations

Introduction of non-native species

As already outlined oyster culture may present a risk in terms of the introduction of non-native species as the Pacific oyster (*Crassotrea gigas*) itself is a non-native species. Recruitment of *C. gigas* has been documented in a number of Bays in Ireland and appears to have become naturalised (i.e. establishment of a breeding population) in two locations (Kochmann et al., 2012; 2013) and may compete with the native species for space and food. In addition to having large number of oysters in culture, Kochmann et al., (2013) identified short residence times and large intertidal areas as factors likely contributing to the successful recruitment of oysters in Irish bays. The residence time in Valentia Harbour is lower than the 21 day threshold identified in Kochmann et al (2013). In addition, the use of triploid seed by operators in the bay will further mitigate the risk. Consequently, the risk of Pacific oysters naturalising in Valentia Harbour can be discounted.

While there is minimal risk associated with the introduction of hitchhiker species with hatchery reared oyster seed, the risk posed by the introduction of '½-grown' or 'wild' seed originating from another jurisdiction (e.g. Britain, France) cannot be discounted.

8.5 Aquaculture Conclusions

In summary, it is concluded that within Valentia Harbour/Portmagee Channel SAC, the existing and proposed aquaculture activities overlapping marine community types are considered non-disturbing due to a number of reasons. In certain instances the resilience of the habitat type to the pressure is such that the risk to the habitats is considered non-significant. In certain instances where disturbance is considered likely (vehicular traffic in intertidal areas, trestle over sensitive community types e.g. Laminara), the level of disturbance (individually and cumulatively –see Section 10 below) is less than the 15% threshold identified in guidance documents (NPWS 2012b). Finally, there are examples where the likelihood of interaction between the community type and the culture activity (e.g. scallop culture on the seafloor and *Laminaria* dominated community) was considered very unlikely to occur.

On the basis that seed sourced from hatcheries the risk of introduction of non-native species is considered low. In addition, the environmental conditions found in the SAC allied with the exclusive use of triploid seed would suggest the risk of successful oyster reproduction is considered low.

9 Risk Assessment of Fishing Activities

9.1 Fishing activities

Pot fisheries for shrimp occurs in Valentia from Portmagee to Knightstown from August to March. Fourteen vessels fish approximately 6000 shrimp pots in the area.

A smaller amount of lobster and crab fishing occurs in the Valencia-Portmagee Channel and west of Portmagee and north of Knightstown. An unknown proportion of these vessels may use trammel nets to collect bait. Lobster fishing is more common between March and October.

Periwinkles may be fished on rocky seaweed covered shores in the area.

Some bottom trawling activity occurs west of Portmagee but this is predominantly outside the SAC.

At the current time there is no known scallop dredging in the SAC. (No new application for 'scallop culture' has been received by DAFM).

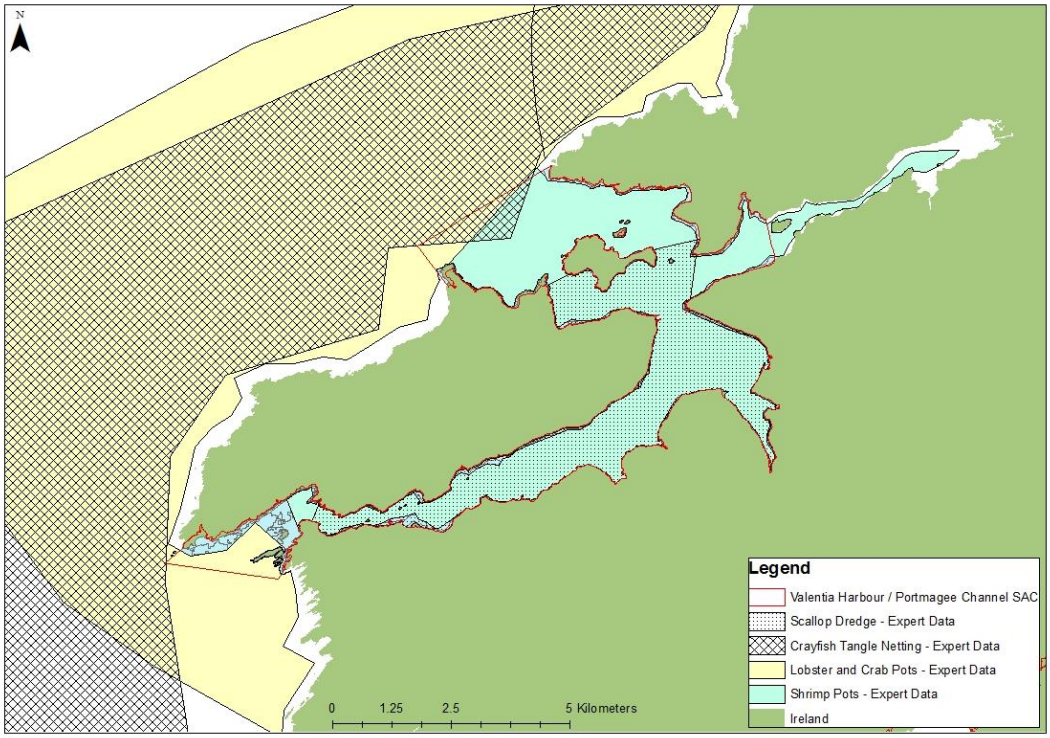

Figure 7 Fishing activity by vessels under 15m in the vicinity of Valencia Harbour / Portmagee Channel SAC.

9.2 Natura Impact Statement for Fisheries

Pot fisheries on reef may cause abrasion of epifauna and Laminaria in reef habitats. This is more likely for lobster pots than for shrimp pots which are lighter and are used on sedimentary habitats and less so on reef. Tangle netting for crayfish has the potential to catch seabirds. Winkle picking causes trampling of epifauna in intertidal areas. Trammel netting for bait and tangle netting or crayfish catches fish fauna associated with designated reef habitat and potentially captures diving seabirds.

9.3 Risk Assessment Methodology:

9.3.1 Determining risk to the conservation objectives

The risk assessment framework follows, where feasible, EC guidance (2012) and includes elements of risk assessment from Fletcher (2002, 2005). The qualitative and semi-quantitative framework is described in Marine Institute (2013) and criteria for risk categorization is shown in Tables 12 and 13 below.

The framework uses categorical conditional probability matrices of likelihood and consequence to assess the risk of an activity to a conservation feature. Categorical likelihood and consequence scores for each such 'incident' (fishery-designated feature interactions) are provided by expert judgement and a base literature resource which has been pre-compiled for each habitat type defined in the COs.

Separate conditional probability matrices for habitats and designated species are used to assess risk. In the case of habitats the consequence criteria largely follow the definitions and methodologies used for AA of projects and plans. In the case of species the consequence categories relate to the degree to which populations and their supporting habitats may be negatively affected by the given activity.

Table 13. Risk categorization for fisheries and designated habitat interactions (see: Marine Institute 2013). Colours indicate risk category. Disturbance is defined as that which leads to a change in characterising species. Such disturbance may be temporary or persistent depending on the frequency of impact and the sensitivity of the receiving environment. Colours indicate the probable need for mitigation of effects from green (no mitigation needed), to yellow (mitigation unlikely to be needed but review on a case by case basis), orange (mitigation probably needed) and red (mitigation required)

Habitats			**Consequence criteria**					
			Activity is not present or has no contact with habitat	Activity occurs and is in contact with habitat	Up to 15% overlap of fishery and habitat seasonally.	Over 15% overlap of fishery and habitat seasonally.	Over 15% of habitat disturbed persistently leading to cumulative impacts	Impact is effectively permanent due to severe habitat alteration.
			No change due to fishing activity can occur	Individual effects on characterising species but this is undetectable relative to background natural variability	Seasonal change in characterising species and community structure and function	Seasonal change in characterising species and structure and function	Persistent change in characterising species, structure and function	Biodiversity reduction associated with impact on key structural species
						Frequency of disturbance < recovery time. Non-cumulative	Frequency of disturbance> recovery time. Cumulative	No recovery or effectively no recovery
Likelihood	**%**	Level	**0**	**1**	**2**	**3**	**4**	**5**
Highly likely	>95	**5**	0	5	10	15	20	25
Probable	50-95	**4**	0	4	8	12	16	20
Possible	20-50	**3**	0	3	6	9	12	15
Unlikely	1-20	**2**	0	2	4	6	8	10
Remote	1	**1**	0	1	2	3	4	5

Table 14. Risk categorization for fisheries and designated species interactions (Marine Institute 2013)

Species			**Consequence criteria**					
			Activity is not present and individuals or population cannot be affected	Activity present. Individuals in the population affected but effect not detectable against background natural variability	Direct or indirect mortality or sub-lethal effects caused to individuals by the activity but population remains self-sustaining	In site population depleted by the activity but regularly sub-vented by immigration. No significant pressure on the population from activities outside the site	Population depleted by the activity both in the site and outside of the site. No immigration or reduced immigration	Population depleted and supporting habitat significantly depleted and unable to continue to support the population
Likelihood	**%**	Level	**0**	**1**	**2**	**3**	**4**	**5**
Highly likely	>95	**5**	**0**	**5**	**10**	**15**	**20**	**25**
Probable	50-95	**4**	**0**	**4**	**8**	**12**	**16**	**20**
Possible	20-50	**3**	**0**	**3**	**6**	**9**	**12**	**15**
Unlikely	1-20	**2**	**0**	**2**	**4**	**6**	**8**	**10**
Remote	1	**1**	**0**	**1**	**2**	**3**	**4**	**5**

9.3.2 Sensitivity of characterizing species and marine communities to physical disturbance by fishing gears

- The approach and rationale to assessment of the sensitivity of species and habitats to fishing activities and the information used in this assessment is similar to that outlined in 8.2 for aquaculture
- NPWS (2012b) provide lists of species characteristic of the habitats that are defined in the Conservation Objectives. The sensitivity of these species to various types of pressures varies and the species list varies across habitats.
- Pressures due to fishing are mainly physical in nature i.e. the physical contact between the fishing gear and the habitat and fauna in the habitat causes an effect.
- Physical abrasive/disturbing pressures due to fishing activity of each metier maybe classified broadly as causing disturbance at the seabed surface and/or at the sub-surface.
- Fishing pressures on a given habitat is related to vulnerability (spatial overlap or exposure of the habitat to the gear), to gear configuration and action, frequency of fishing and the intensity of the activity. In the case of mobile gears intensity of activity is less relevant than frequency as the first pass of the gear across a given habitat is expected to have the dominant effect (Hiddink *et al.*. 2007).
- Sensitivity of a species or habitat to a given pressure is the product of the resilience of the species to the particular pressure and the recovery capacity (rate at which the species can recover if it has been affected by the pressure) of the species. Morphology, life history and biological traits are important determinants of sensitivity of species to pressures from fishing and aquaculture.
- The separate components of sensitivity (resilience, recoverability) are relevant in relation to the persistence of the pressure
    - For persistent pressures, i.e. fishing 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 reduction caused by fishing. In all but these cases, and if resilience is moderate or low, then the species may be negatively affected and will exist in a modified state. Such interactions between fisheries and species/habitats represent persistent disturbance. They become significantly disturbing if more than 15% of the community is thus exposed (NPWS 2012b).
    - In the case of episodic pressures i.e. fishing activities that are seasonal or discrete in time both the resilience and recovery components of sensitivity are relevant. If resilience is low but recovery is high, relative to the frequency of application of the pressure, than the species/community will be in favourable conservation status for a given proportion of time
- The sensitivities of some species, which are characteristic (as listed in the COs) of benthic communities, to physical pressures similar to that caused by fishing gears, are described in Table 7.

- In cases where the sensitivity of a characterising species (NPWS 2011b) has not been reported this risk assessment adopts the following guidelines
    - Resilience of certain taxonomic groups such as emergent sessile epifauna to physical pressures due to all fishing gears is expected to be generally low or moderate because of their form and structure (Roberts *et al.* 2010).
    - Resilience of benthic infauna (eg bivalves, polychaetes) to surface pressures, caused by pot fisheries for instance, is expected to be generally high as such fisheries do not cause sub-surface disturbance
    - Resilience of benthic infauna to sub-surface pressures, caused by toothed dredges and to a lesser extent bottom otter trawls using doors, may be high in the case of species with smaller body sizes but lower in large bodied species which have fragile shells or structures. Body size (Bergman and van Santbrink 2000) and fragility are regarded as indicative of resilience to physical abrasion caused by fishing gears
    - Recovery 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

9.4 Risk assessment of impact of fishing gears on marine benthic communities

- The list of fishing activities (métiers) operating in Valencia Harbour / Portmagee Channel is described above
- The sensitivity of marine communities, which are the subject of the COs to physical disturbance that may be caused by fishing gears is in Table 7.
- The risk assessment framework outlined in Table 12 and Table 13 for habitats and species respectively provides a rationale for assessing and scoring risk posed by fishing activities to the conservation objectives. More detailed explanation is provided in Marine Institute (2013).
- One of the risk assessment criteria for habitats is the % overlap of the activity and each habitat. These % overlaps of fisheries with qualifying interests are presented in Table 14. The overlap of fisheries and marine community types within those qualifying interests in presented in Table 15.
- Risk scores for effects of individual fisheries on marine community types and species are in Table 16.

9.5 Fisheries risk profile

9.5.1 Marine Community types

9.5.1.1 Shrimp fisheries

- Overlap of the shrimp fishery on mud and sand flats (Table 14) is spurious and related to the low resolution of the fishing information
- The shrimp fishery overlaps with 82% of large shallow inlet and bay and 73% on reefs.
- The fishery overlaps with sedimentary habitats, Maerl and *Zostera* communities and with various reef communities (Table 15)
- Risks to sedimentary habitats from shrimp pot fisheries is low
- Shrimp pots and associated ropes and anchors may impact Maerl and Seagrass. Although fishing with pots is unlikely to pose significant risk to the *Edwardsia* community this community is endemic to Valencia. A higher level of precaution with respect to impacts is therefore appropriate.

9.5.1.2 Lobster and crab fisheries

- Lobster and crab fisheries do not occur to any extent within the Valencia-Portmagee Channel but in reef areas north east of Valencia Is and west of Portmagee
- The fishery overlaps with 8% of large shallow inlet and bay and 12.3% of reef mainly on coarse sand and echinoderm dominated reef marine communities and on *Laminaria* reef
- Lobster pots and associated ropes and anchors could degrade epifauna of reef depending on the sensitivity of associated fauna and on the intensity of the activity.
- Trammel netting for bait may be associated with lobster and crab fishing. These nets may capture seabirds from nearby SPAs. Nets and anchors may impact epifauna of reef. The level of trammel netting is unknown although it is unlikely to occur at levels which would cause any impacts to reef habitat in this location.

9.5.1.3 Tangle netting for crayfish

- Tangle netting for crayfish occurs mainly west of Portmagee on reef habitat
- This activity is unlikely to pose a risk to reef habitat in this area.

Table 15. Percentage spatial overlap between fisheries and qualifying interests.

Qualifying interest	Trap - lobster	Trap - crab	Trap - shrimp	Tangle net crayfish	Trammel netting bait	Hand gathering winkles
Mudflats and sandflats not covered by seawater at low tide [1140]			76			
Large shallow inlets and bays [1160]	8.6	8.6	82	4.6	8.6	Unknown
Reefs [1170]	12.3	12.3	73	10.7	12.3	Unknown

Table 16. Percentage spatial overlap between fisheries and marine communities within each qualifying interest.

Qualifying interest	Marine Community Type	Fishing current	Trap - lobster	Trap - crab	Trap - shrimp	Tangle net crayfish	Trammel netting bait	Hand gathering winkles
Mudflats and sandflats not covered by seawater at low tide [1140]	Intertidal sand with nematodes and polychaetes community complex	Yes	0	0	80	0	0	0
Mudflats and sandflats not covered by seawater at low tide [1140]	Medium to fine sand with *Nephtys cirrosa* and *Spiophanes bombyx* community complex	Yes	0	0	37	0	0	0
Large shallow inlets and bays [1160]	Intertidal sand with nematodes and polychaetes community complex	Yes	0	0	80	0	0	0
Large shallow inlets and bays [1160]	Medium to fine sand with *Nephtys cirrosa* and *Spiophanes bombyx* community complex	Yes	10	10	78	6	10	0
Large shallow inlets and bays [1160]	Maërl-dominated community	Yes	0	0	94	0	0	0
Large shallow inlets and bays [1160]	*Zostera* dominated community	Yes	0	0	83	0	0	0
Large shallow inlets and bays [1160]	*Edwardsia delapiae* associated community	Yes	0	0	99	0	0	0
Large shallow inlets and bays [1160]	Coarse sediment with *Pisione remota* community complex	Yes	61	61	25	0	61	0
Large shallow inlets and bays [1160]	Sandy mud to mixed sediment with *Melinna palmata* community complex	Yes	0	0	96	0	0	0
Large shallow inlets and bays [1160]	Mixed sediment with *Chaetozone gibber* community complex	Yes	0	0	97	0	0	0

Qualifying interest	Marine Community Type	Fishing current	Trap - lobster	Trap - crab	Trap - shrimp	Tangle net crayfish	Trammel netting bait	Hand gathering winkles
Large shallow inlets and bays [1160]	Fucoid-dominated intertidal reef community complex	Yes	0	0	0	0	0	1
Large shallow inlets and bays [1160]	*Laminaria*-dominated community	Yes	5	5	85	1	5	0
Large shallow inlets and bays [1160]	Echinoderm-dominated reef community complex	Yes	25	25	68	27	25	0
Large shallow inlets and bays [1160]	Maerl/*Zostera* dominated community	Yes	0	0	100	0	0	0
Reefs [1170]	Fucoid-dominated intertidal reef community complex	Yes	0	0	50	0	0	1
Reefs [1170]	*Laminaria*-dominated community	Yes	5	5	85	0	5	0
Reefs [1170]	Echinoderm-dominated reef community complex	Yes	25	25	68	27	25	0

Table 17. Risk scores (refer to Table 12 for interpretation) for fisheries in relation to marine communities within qualifying interests.

Qualifying interest	Marine Community Type	Fishing current	Trap - lobster	Trap - crab	Trap - shrimp	Tangle net crayfish	Tramme netting bait	Hand gathering winkles
Mudflats and sandflats not covered by seawater at low tide [1140]	Intertidal sand with nematodes and polychaetes community complex	Yes			4			
Mudflats and sandflats not covered by seawater at low tide [1140]	Medium to fine sand with *Nephtys cirrosa* and *Spiophanes bombyx* community complex	Yes			4			
Large shallow inlets and bays [1160]	Intertidal sand with nematodes and polychaetes community complex	Yes			4			
Large shallow inlets and bays [1160]	Medium to fine sand with *Nephtys cirrosa* and *Spiophanes bombyx* community complex	Yes	4	4	4	4	4	
Large shallow inlets and bays [1160]	Maërl-dominated community	Yes			16			
Large shallow inlets and bays [1160]	*Zostera* dominated community	Yes			12			
Large shallow inlets and bays [1160]	*Edwardsia delapiae* associated community	Yes			12			
Large shallow inlets and bays [1160]	Coarse sediment with *Pisione remota* community complex	Yes	4	4	4		4	

Qualifying interest	Marine Community Type	Fishing current	Trap - lobster	Trap - crab	Trap - shrimp	Tangle net crayfish	Tramme netting bait	Hand gathering winkles
Large shallow inlets and bays [1160]	Sandy mud to mixed sediment with *Melinna palmata* community complex	Yes			4			
Large shallow inlets and bays [1160]	Mixed sediment with *Chaetozone gibber* community complex	Yes			4			
Large shallow inlets and bays [1160]	Fucoid-dominated intertidal reef community complex	Yes						6
Large shallow inlets and bays [1160]	*Laminaria*-dominated community	Yes	6	6	9	6	6	
Large shallow inlets and bays [1160]	Echinoderm-dominated reef community complex	Yes	9	9	9	9	9	
Large shallow inlets and bays [1160]	Maerl/*Zostera* dominated community	Yes			16			
Reefs [1170]	Fucoid-dominated intertidal reef community complex	Yes			9			6
Reefs [1170]	*Laminaria*-dominated community	Yes	6	6	9		6	
Reefs [1170]	Echinoderm-dominated reef community complex	Yes	9	9	9	9	9	

10 In-combination effects of aquaculture, fisheries and other activities

Of the fishery activities carried out in the SAC, there is only one (Trap-shrimp) that is considered impacting on a number of sensitive community types found within Valentia Harbour/Portmagee Channel SAC. These community types are:

1. ***Zostera*-dominated community**
2. **Maerl-dominated community / *Zostera*-dominated community**
3. **Maerl-dominated community**
4. ***Edwardsia delapiae* associated community**

There are no shellfish activities that interact with these community types. On this basis there are no likely in-combination effects between shellfish culture activities and fishery activities.

Other activities leading to potential impacts on conservation features relate to harvest of seaweed on intertidal reef communities. There is little known concerning the level of harvest from these intertidal reef communities. The impact is likely two-fold, direct impact upon the reefs by removal of a constituent species and impact upon intertidal sediments as a consequence of travel across the shore to the harvest sites. The likely overlap between these activities and intertidal shellfish culture is considered small as the (reef) habitat is not considered suitable for shellfish culture. Seaweed harvesting requires a foreshore licence administered by the Department of

Environment, Community and Local Government. At the time of this report there are no known foreshore applications for the removal of seaweed from intertidal areas.

There are a number of activities which are terrestrial in origin that might result in impacts on the conservation features of the Valentia Harbour/Portmagee Channel SAC. Primary among these are point source discharges from municipal and industrial units (Shellfish Pollution Reduction Programme, DHPLG). There are three urban waste water treatment plants in the general vicinity of the SAC. These are found in Cahersiveen, Knightstown and Portmagee. The pressure derived from these facilities is a discharge that may impact upon levels of dissolved nutrients, suspended solids and some elemental components e.g. aluminium in the case of water treatment facilities. It should be noted that the pressures resulting from fisheries and aquaculture activities are primarily morphological in nature. It was, therefore, concluded that given the pressure resulting from say, a point discharge location (e.g. urban waste-water treatment plant or combined sewer overflow) would likely impact on physico-chemical parameters in the water column, any in-combination effects with aquaculture or fisheries activities are considered to be minimal or negligible. In addition, the most recent Water Framework Directive water quality monitoring data from Valentia Harbour is classified as High for general conditions (nutrients etc..) and High for biological conditions (EPA).

No other activities resulting in morphological pressures were identified or could be quantified.

11 SAC Aquaculture Appropriate Assessment Concluding Statement and Recommendations

In Valentia Harbour/Portmagee Channel SAC intertidal oyster culture is the only aquaculture activity currently being carried out or proposed. Based upon this and the information provided in the aquaculture profiling (Section 5), the likely interaction between the culture methodologies employed and conservation features (habitats) of the site were considered.

An initial screening exercise resulted in a number of habitat features being excluded from further consideration by virtue of the fact that no spatial overlap or likely interactions of the culture activities was expected to occur.

A full assessment was carried out on the likely interactions between aquaculture operations (as proposed) and the features of the Annex 1 habitats 1140 (Mudflats and sandflats not covered by seawater at low tide), 1160 (Large Shallow Inlets and Bay) and 1170 (Reefs). The likely effects of the aquaculture activities (Species, structures, transport routes) were considered in light of the sensitivity of the constituent habitats of the Annex 1 habitats.

In relation to in-combination effects with other activities, there are no community types likely to be considered impacted in-combination with the aquaculture activities.

In summary, the scale of spatial overlap and the relatively high tolerance levels of the habitats and species therein, the general conclusions relating to the interaction between current and 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).

This assessment is based upon the seed source being triploid from hatcheries and, as such, does not present a major risk to conservation features from recruitment of non-native oysters (i.e. *Crassostrea gigas*) and other hitchhike species. If the source or type of seed were to change this would require a separate assessment.

It is recommended that there be strict adherence to the access routes identified and that density of culture structures within the sites be maintained at current levels.

The movement of stock in and out of Valentia Harbour/Portmagee Channel SAC should adhere to relevant fish health legislation and follow best practice guidelines.

12 References

ABPMer. 2013a. Tools for appropriate assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report VIII: Vegetation dominated communities (Saltmarsh and Seagrass). Report No. R. 2053 for Marine Institute, Ireland.

ABPMer. 2013b. Tools for appropriate assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report VI: Biogenic reefs (*Sabellaria*, Native oyster, Maerl). Report No. R. 2068 for Marine Institute, Ireland.

ABPMer. 2013c. Tools for appropriate assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report I: Intertidal and Subtidal Muds. Report No. R. 2069 for Marine Institute, Ireland.

ABPMer. 2013d. Tools for appropriate assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report II: Intertidal and Subtidal Sands. Report No. R. 2070 for Marine Institute, Ireland.

ABPMer. 2013e. Tools for appropriate assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report III: Intertidal and Subtidal muddy sands and sandy muds. Report No. R. 2071 for Marine Institute, Ireland.

ABPMer. 2013f. Tools for appropriate assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report IV: Intertidal and Subtidal mixed sediments. Report No. R. 2072 for Marine Institute, Ireland.

ABPMer. 2013g. Tools for appropriate assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report IV: Intertidal and Subtidal coarse sediments. Report No. R. 2073 for Marine Institute, Ireland.

ABPMer. 2013h. Tools for appropriate assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report VII: Intertidal and Subtidal reefs. Report No. R. 2074 for Marine Institute, Ireland.

Bergman, M.J.N. and vanSantbrink, J.W. 2000. Mortality in megafaunal benthic populations caused by trawl fisheries on the Dutch continental shelf in the North Sea 1994. *ICES Journal of Marine Science* 57(5), 1321-1331.

Black, K.D. (2001). Environmental impacts of aquaculture. Sheffield Biological Sciences, 6. Sheffield Academic Press: Sheffield. 214 pp

Cranford, Peter J., Pauline Kamermans, Gesche Krause, Alain Bodoy, Joseph Mazurié, Bela Buck, Per Dolmer, David Fraser, Kris Van Nieuwenhove, Francis X. O'Beirn, Adoración Sanchez-Mata, Gudrun G. Thorarinsdóttir, and Øivind Strand. 2012. An Ecosystem-Based Framework for the Integrated Evaluation and Management of Bivalve Aquaculture Impacts. *Aquaculture Environment Interactions*. 2:193-213

Fletcher, W.J. 2005. The application of qualitative risk assessment methodology to prioritize issues for fisheries management. ICES Journal of Marine Science, 62, 1576-1587.

Fletcher, W. et al (2002).National ESD reporting framework for Australian fisheries. The 'How To' guide for wild capture fisheries. FRDC Project, 2000/145, Canberra, Australia, 120pp.

Forde, J., F.X. O'Beirn, J.P.J. O'Carroll, A. Patterson, R. Kennedy. 2015. Impact of intertidal oyster trestle cultivation on the Ecological Status of benthic habitats. Marine Pollution Bulletin 95: 223–233

Forrest, B.M., Keeley, N.B., Hopkins, G.H. 2009. Synthesis of the Ecological Effects of Intertidal Oyster Aquaculture. Cawthron Report No. 1476.

Hall, K., Paramor, O.A.L., Robinson L.A., Winrow-Giffin, A., Frid C.L.J., Eno, N.C., Dernie, K.M., Sharp, R.A.M., Wyn, G.C.& Ramsay, K. 2008. Mapping the sensitivity of benthic habitats to fishing in Welsh waters-development of a protocol. CCW [Policy Research] Report No: [8/12], 85pp.

Hiddink, J.G., Jennings, S. and Kaiser, M.J. 2007. Assessing and predicting the relative ecological effects of disturbance on habitats with different sensitivities. Journal of Applied Ecology, 44, 405-413.

Kochmann J, Carlsson J, Crowe TP, Mariani S (2012) Genetic evidence for the uncoupling of local aquaculture activities and a population of an invasive species—a case study of Pacific oysters (Crassostrea gigas). *Journal of Hereditary* 103:661–671

Kochmann, J. F. O'Beirn, J. Yearsley and T.P. Crowe. 2013. Environmental factors associated with invasion: modeling occurrence data from a coordinated sampling programme for Pacific oysters. *Biological Invasions* DOI 10.1007/s10530-013-0452-9.

Mallet, A.L., C.E. Carver, T. Landry. 2006. Impact of suspended and off-bottom Eastern oyster culture on the benthic environment in eastern Canada. Aquaculture 255: 362–373.

Mallet, A.L., C.E. Carver, M. Hardy. 2009. The effect of floating bag management strategies on biofouling, oyster growth and biodeposition levels. Aquaculture 287: 315–323.

Marine Institute and Bord Iascaigh Mhara 2012. Shellfish Stocks and Fisheries, Review 2012. An assessment of selected stocks.81 pp ISBN: 978-1-902895-57-4

National Research Council, 2009. Shellfish Mariculture in Drakes Estero, Point Reyes National Seashore, California. National Academy Press, Washington, DC.

National Research Council, 2010. Ecosystems Concepts for Sustainable Bivalve Culture. National Academy Press, Washington, DC.

NPWS. 2012a. Valentia Harbour/Portmagee Channel SAC (001482): Conservation Objectives Department Arts, Heritage and the Gaeltacht. Version 1 (October 2012); 9pp.

NPWS. 2012b. Valentia Harbour/Portmagee Channel SAC (001482): Conservation Objectives supporting document – marine habitats and species. Department Arts, Heritage and the Gaeltacht. Version 1 (August 2012); 29pp.

McKindsey, CW, Landry, T, O'Beirn, FX & Davies, IM. 2007. Bivalve aquaculture and exotic species: A review of ecological considerations and management issues. *Journal of Shellfish Research* 26:281-294.

O'Beirn, F.X., C. W. McKindsey, T. Landry, B. Costa-Pierce. 2012. Methods for Sustainable Shellfish Culture. 2012. pages 9174-9196 In: Myers, R.A. (ed.), *Encyclopedia of Sustainability Science and Technology. Springer Science, N.Y.*

O'Carroll J, Quinn C, Forde J, Patterson A, O'Beirn F.X, Kennedy R. 2016 Accepted Impact of prolonged storm activity on the Ecological Status of intertidal benthic habitats within oyster (Crassostrea gigas) trestle cultivation sites. Marine Pollution Bulletin.

Roberts, C., Smith, C., Tillin, H., Tyler-Walters, H. 2010. Evidence. Review of existing approaches to evaluate marine habitat vulnerability to commercial fishing activities. Report SC080016/R3. Environment Agency,UK. ISBN 978-1-84911-208-6.

Shellfish Pollution Reduction Programme - As required by Article 5 of the Shellfish Water Directive 2006/113/EC and Section 6 of the Quality of Shellfish Waters Regulations, 2006 (S.I. No. 268 of 2006) - Characterisation Report Number VI

Tillin, H.M., Hiddink, J.G., Jennings, S and Kaiser, M.J. 2006. Chronic bottom trawling alters the functional composition of benthic invertebrate communities on a sea basin scale. *Marine Ecology progress Series*, 318, 31-45.