Report supporting Appropriate Assessment of Aquaculture in Clonakilty Bay SAC (Site code: 000091)

Produced by

AQUAFACT International Services Ltd

On behalf of

Marine Institute

July 2020

AQUAFACT INTERNATIONAL SERVICES LTD.,
12 KILKERRIN PARK,
LIOSBAUN, TUAM RD., GALWAY.
www.aquafact.ie
info@aquafact.ie
tel +353 (0) 91 756812

Table of Contents

List of Figures

List of Tables

1. Preface

Articles 3 to 9 of the European Community (EC) Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (commonly known the Habitats Directive) provide the legislative means to protect habitats and species of Community interest through the conservation of an EU-wide network of protected sites known as Natura 2000 sites. Following the requirements of Article 6(3) of the Habitats Directive, implemented into national law under Regulation 31 of the Habitats Regulations SI 94/1997 and subsequently amended and consolidated in the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended), if a plan or project is not connected with, or necessary for the management of a protected site and is likely to have a significant effect on the features for which the site is designated either individually or in combination with other plans or projects, an Appropriate Assessment (AA) is required to assess whether a plan or project will have any adverse effect on the integrity of Natura 2000 site(s) in view of the Conservation Objectives set for the features (habitats and/ or species) for which the site(s) is designated.

Natura 2000 sites in Ireland that form part of the Natura 2000 network of protected sites include Special Areas of Conservation (SACs) designated due to their significant ecological importance for species and habitats protected under Annex I and Annex II respectively of the Habitats Directive, and Special Protection Areas (SPAs), designated for the protection of populations and habitats of bird species protected under the EU Birds Directive (Council Directive 2009/409/EEC on the conservation of wild birds). The features for which SACs and SPAs are designated are respectively called Qualifying Interests and Special Conservation Interests (also referred to herein as conservation features). The NPWS are the competent authority for the management of Natura 2000 sites in Ireland.

Aquaculture operations existed in coastal areas prior to the designation of areas as SACs and/ or SPAs under the Directives. Ireland is undertaking AA of existing and proposed aquaculture activities in SACs and SPAs. This is an incremental process, as agreed with the EU Commission in 2009, and will eventually cover all aquaculture activities in all Natura 2000 sites. AA of aquaculture operations are carried out against the Conservation Objectives for the conservation features of the Natura 2000 site. The Conservation Objectives are defined by the NPWS.

Aquaculture activities are licenced by the Department of Agriculture, Food and Marine (DAFM). For aquaculture operations, DAFM receives applications to undertake such activity and submits a set of applications and existing licences, at a defined point in time, for AA. If the AA process finds that the possibility of significant adverse effect cannot be discounted or that there is a likelihood of negative consequence for the conservation features for which a site is designated then such activities will

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

2. Executive Summary

2.1. The SAC

The Clonakilty Bay Special Area of Conservation (SAC) (site code: 000091) located in west Cork is an intertidal expanse that stretches from Clonakilty to the open sea and comprises two small estuaries separated by Inchydoney Island (NPWS, 2013[1]). The site which includes adjacent sand dunes and inland marshes has a good diversity of habitats. The SAC is designated for the following Annex I habitats (* = priority habitat; numbers in brackets are Natura 2000 codes):

- [1140] Tidal Mudflats and Sandflats
- [1210] Annual Vegetation of Drift Lines
- [2110] Embryonic Shifting Dunes
- [2120] Marram Dunes (White Dunes)
- [2130] Fixed Dunes (Grey Dunes)*
- [2150] Decalcified Dune Heath*

2.2. Activities in the SAC

An *Appropriate Assessment Profiling* report of aquaculture activity in the Clonakilty Bay SAC was prepared by BIM and provided to the Marine Institute for assessment. The BIM profile is derived from a list of licences (existing and proposed) held by DAFM. The profile reports that there is currently no existing licenced aquaculture within Clonakilty Bay, while there is one application for intertidal aquaculture of oysters on an intertidal site north of Inchadoney island in the inner harbour (aquaculture site reference T05/603A). The proposed oyster aquaculture site measures approximately 22.7ha lies and is located within the boundaries of the Clonakilty Bay SAC. The likely interaction of the proposed aquaculture activity occurring at this application site with conservation features (habitats and species) of the site was considered.

2.3. The Appropriate Process

The function of this *Report supporting the Appropriate Assessment (AA)* is to determine if the aquaculture activities proposed at the Clonakilty Bay SAC are consistent with the Conservation

[1] NPWS (2013) Site Synopsis. Site Name: Clonakilty Bay SAC. Site Code: 000091. Version date: 08.07.2013 https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY000091.pdf

Objectives for the site or if such activities will lead to deterioration in the attributes of the conservation features for which the site is designated over time due to the scale, frequency and intensity of the aquaculture activities.

NPWS (2014a[2]) is a guidance document that details the Conservation Objectives defined for Clonakilty Bay SAC. Specifically, the document provides guidance on interpretation of the Conservation Objectives which are, in effect, management targets for the habitats, community types and species in the SAC. The guidance is scaled relative to the anticipated sensitivity of habitats and species to disturbance by activities. Some activities are deemed to be wholly inconsistent with long term maintenance of certain sensitive habitats while other habitats can tolerate a range of activities.

For the practical purpose of management of sedimentary habitats, a 15% threshold of overlap between a disturbing activity and a habitat is given in the NPWS guidance (NPWS 2014a). Below this threshold disturbance is deemed to be non-significant. Disturbance is defined as that which leads to a change in the characterising 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 characterising species may recover to pre-disturbed state or may persist and accumulate over time. Information on the distribution of habitats and species are provided by NPWS 2014a and NPWS 2014b[3]).

The AA process is divided into two stages.

The first stage of the process is an initial Screening wherein activities that cannot have, because they do not spatially overlap with a given habitat or have a clear pathway for interaction, any impact on the features for which the site is designated and are therefore excluded from further consideration.

The next stage is the Natura Impact Statement (NIS) where interactions (or risk thereof) are identified and an assessment of the significance of the likely interactions between activities and conservation features is conducted. Mitigation measures (if necessary) are 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 licensing decisions.

[2] NPWS (2014a) Conservation Objectives: Clonakilty Bay SAC 000091. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000091.pdf

[3] NPWS (2014b) Conservation Objectives supporting document - Marine Habitats Clonakilty Bay SAC 000091https://www.npws.ie/sites/default/files/publications/pdf/Clonakilty%20Bay%20SAC%20(000091)%20Conservation%20objectives%20supporting%20document%20-%20Marine%20habitats%20[Version%201].pdf

Overall, AA is both the process and the assessment undertaken by the competent authority to effectively validate the Screening for AA 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

Data on the distribution of habitats and species populations are provided by NPWS. Scientific reports on the potential effects of various activities on habitats and species have been compiled by the Marine Institute and provide the evidence base for assessment findings. The data supporting the assessment of activities vary and provides for varying degrees of confidence in the findings.

2.5. Findings

The assessment considered potential effects to the conservation features of the Clonakilty Bay SAC and adjacent SACs. The adjacent SACs are the Courtmacsherry Estuary SAC (site code: 001230) (NPWS 2014c) and, the Kilkeran Lake and Castlefreke Dunes SAC (site code: 001061) (NPWS 2016). The adjacent SACs are designated for Annex I habitats (see **Table 2.1** below).

With the exception of Mudflats and sandflats not covered by seawater at low tide [1140] of the Clonakilty Bay SAC, potential effects to the conservation features of the SACs were excluded at the screening stage (*i.e.* potential effects screened out). A full assessment was carried out on the likely interactions of the proposed aquaculture activities with the Annex I habitat 1140 with respect to its constituent marine community type 'Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex'.

The assessment of interaction was based on spatial overlap of the proposed aquaculture site and the vehicle access route (with an estimated width of 10m) with the marine community type within the marine community type 1140; the spatial overlap is outlined in **Table 2.2**. Based on the scale of spatial overlap and the relatively high tolerance levels of the habitat and associated species, the general conclusion is that if approved the proposed aquaculture activities will be non-disturbing to the Annex I habitat Qualifying Interest and constituent community type (**Table 2.2**).

Table 2.1: Conservation features

Clonakilty Bay SAC	Courtmacsherry Estuary SAC	Kilkeran Lake and Castlefreke Dunes SAC
Mudflats and sandflats not covered by seawater at low tide [1140] Annual vegetation of drift lines [1210] Embryonic shifting dunes [2110] Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120] Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130] Atlantic decalcified fixed dunes (Calluno-Ulicetea) [2150]	Estuaries [1130] Mudflats and sandflats not covered by seawater at low tide [1140] Annual vegetation of drift lines [1210] Perennial vegetation of stony banks [1220] Salicornia and other annuals colonising mud and sand [1310] Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330] Mediterranean salt meadows (Juncetalia maritimi) [1410] Embryonic shifting dunes [2110] Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120] Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	Coastal lagoons [1150] Embryonic shifting dunes [2110] Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120] Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]

Table 2.2: Annex I habitat constituent community type of the Clonakilty SAC overlapped by proposed aquaculture site T05/603A (22.7ha) and vehicle access route.

Annex I Habitat	Marine Community Type	%age of Community Type Area Overlapped (Area of Community Type Overlapped)	
		Proposed Site	Proposed Vehicle Access Route
Mudflats and sandflats not covered by seawater at low tide (1140) [313ha]	Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex [313ha]	7.235% (22.646ha)	0.067% (0.210ha)

Recommendations

This *Report supporting the Appropriate Assessment (AA)* has concluded that the proposed aquaculture activities in the Clonakilty Bay SAC will not lead to deterioration in the attributes of the habitats of species of the SAC or of adjacent SACs over time and in relation to the scale, frequency and intensity of the activities. The proposed aquaculture activities are consistent with the Conservation Objectives set for the SACs.

It should be noted, that if the aquaculture activities are approved at Clonakilty Bay the site will be at risk from the introduction of non-native (alien) invasive species on and among culture stock. To manage the risk of introduction of alien species into the SAC all movement of stock in and out of the bay should adhere to relevant legislation and follow best practice guidelines (*e.g.* http://invasivespeciesireland.com/cops/aquaculture/).

3. Introduction

Overview

This document assesses the potential ecological interactions of proposed aquaculture activities within the Clonakilty Bay Area of Conservation (SAC) (Site code: 000091) on the Conservation Objectives of the site. The document also assesses potential effects to adjacent SACs. The assessments are based on the spatial extent of proposed license site area and vehicle access route, and the information on the activities proposed as included in an *Appropriate Assessment Profiling* report provided to the Marine Institute by BIM. The *Appropriate Assessment Profiling* report outlines that there currently no ongoing aquaculture occurring at Clonakilty Bay SAC while there is one application for intertidal oyster cultivation. The location of the proposed application site is shown in **Figure 4.1**. The site will either be accessed by boat from nearby piers or by tractors across the foreshore; the location of the piers and vehicle access route are shown in **Figure 4.1**. The width of the access route is estimated to be 10m.

4. Screening

The AA of aquaculture in relation to the Conservation Objectives for Clonakilty Bay SAC is based on:

- NPWS (2014a[4]) Conservation Objectives: Clonakilty Bay SAC 000091 and NPWS (2014b[5]) Conservation Objectives supporting document - Marine Habitats Clonakilty Bay SAC 000091.
- Spatial data[6] for conservation features.
- Location, the spatial extent and activities proposed at the aquaculture site.

4.1. The SAC Extent

The Clonakilty Bay Special SAC (site code: 000091) is located in west Cork is an intertidal expanse that stretches from Clonakilty to the open sea, and comprises two small estuaries separated by

[4] NPWS (2014a) Conservation Objectives: Clonakilty Bay SAC 000091. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000091.pdf

[5] NPWS (2014b) Conservation Objectives supporting document - Marine Habitats Clonakilty Bay SAC 000091https://www.npws.ie/sites/default/files/publications/pdf/Clonakilty%20Bay%20SAC%20(000091)%20Conservation%20objectives%20supporting%20document%20-%20Marine%20habitats%20[Version%201].pdf

[6]NPWS spatial GIS data https://www.npws.ie/maps-and-data/habitat-and-species-data

Inchydoney Island (NPWS, 2013[7]) (**Figure 4.1**). The site includes adjacent sand dunes and inland marshes.

[7] NPWS (2013) Site Synopsis. Site Name: Clonakilty Bay SAC. Site Code: 000091. Version date: 08.07.2013 https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY000091.pdf

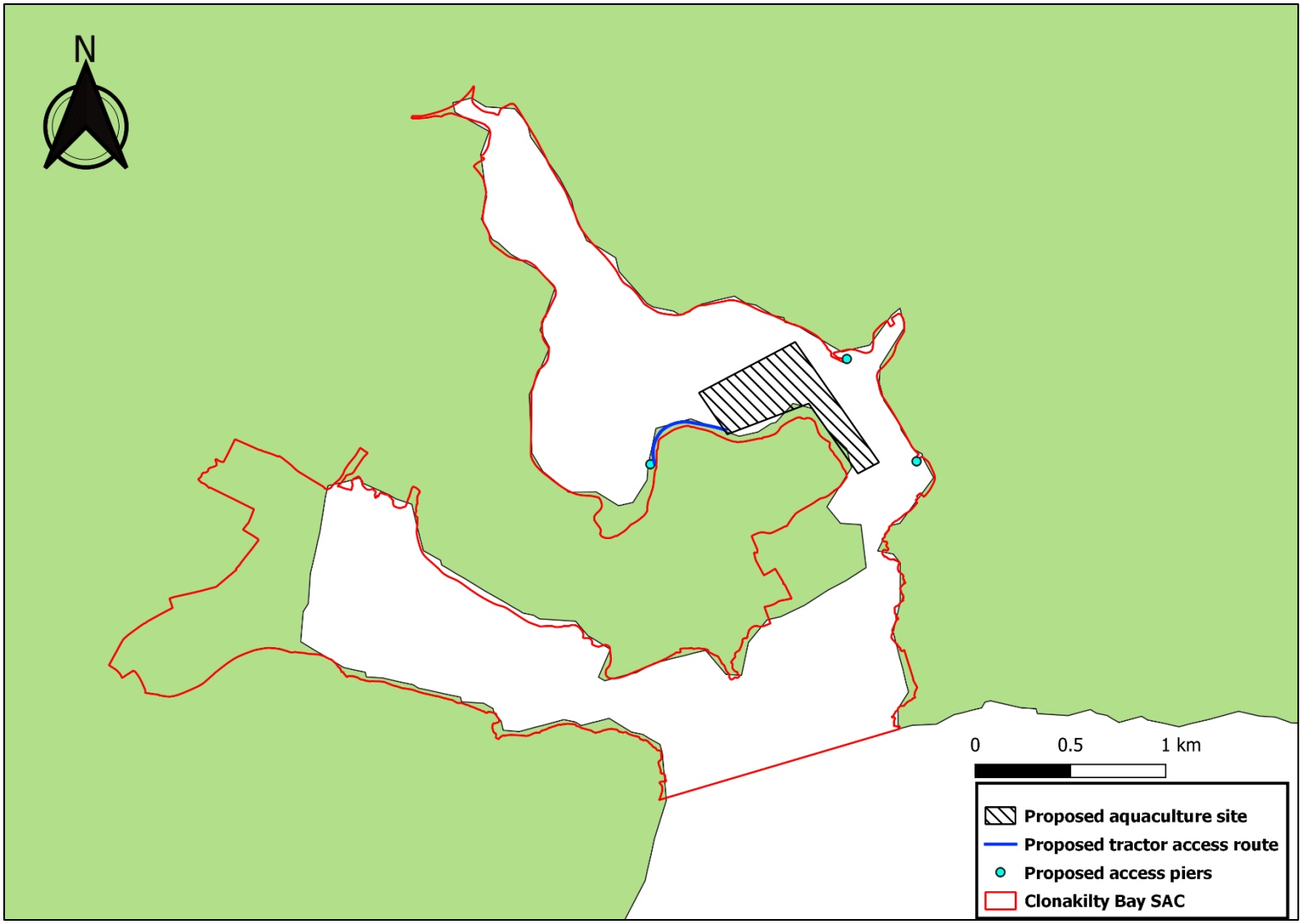

Figure 4.1: Clonakilty Bay SAC relative to the proposed aquaculture site T05/603A, vehicle access routes and piers.

4.2. Qualifying Interests

The SAC is designated for the following Annex I habitats (* = priority habitat; numbers in brackets are Natura 2000 codes):

- [1140] Tidal Mudflats and Sandflats
- [1210] Annual Vegetation of Drift Lines
- [2110] Embryonic Shifting Dunes
- [2120] Marram Dunes (White Dunes)
- [2130] Fixed Dunes (Grey Dunes)*
- [2150] Decalcified Dune Heath*

The spatial extent of the Qualifying Interest Annex I marine habitat 1140 is illustrated in **Figure 4.2**. Within habitat 1140, one community type was identified (NPWS, 2014) (see **Table 4.1**). The spatial extent of the community type is shown in **Figure 4.3**.

The proposed aquaculture site is largely located within the Annex I habitat 1140 and its constituent community type. The proposed vehicle route that will be used by tractors to access the site also overlaps Annex I habitat 1140 and its constituent community type (**Figure 4.3**).

The Annex I coastal habitats 1210, 2110, 2120, 2130 and 2150 are on the seaward side of Inchydoney Island (see NPWS 2013a).

Table 4.1: The community type recorded in Clonakilty Bay SAC and their occurrence in the Annex I habitats and the adjacent SPA

	SAC Annex I Habitats	**SPA**
Community Type	**Mudflats and sandflats not covered at low tide (1140) [313ha] (NPWS 2014a)**	
Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex [313ha] (NPWS 2014b)	✓	✓
Shingle [10.53ha] (NPWS GIS spatial data)		✓

The Annex I habitat 1140 and its constituent community type is bordered by shingle habitat along the north and southern shore of Inchydoney Island and along the eastern shore of Clonakilty Harbour (**Figure 4.3**). The shingle habitat is not an Annex I habitat of the Clonakilty Bay SAC. NPWS spatial GIS

data indicates that the total shingle habitat area in Clonakilty Bay area is approximately 10.53ha. The proposed aquaculture site and route overlap a small part of the shingle habitat (0.054ha and 0.325ha respectively).

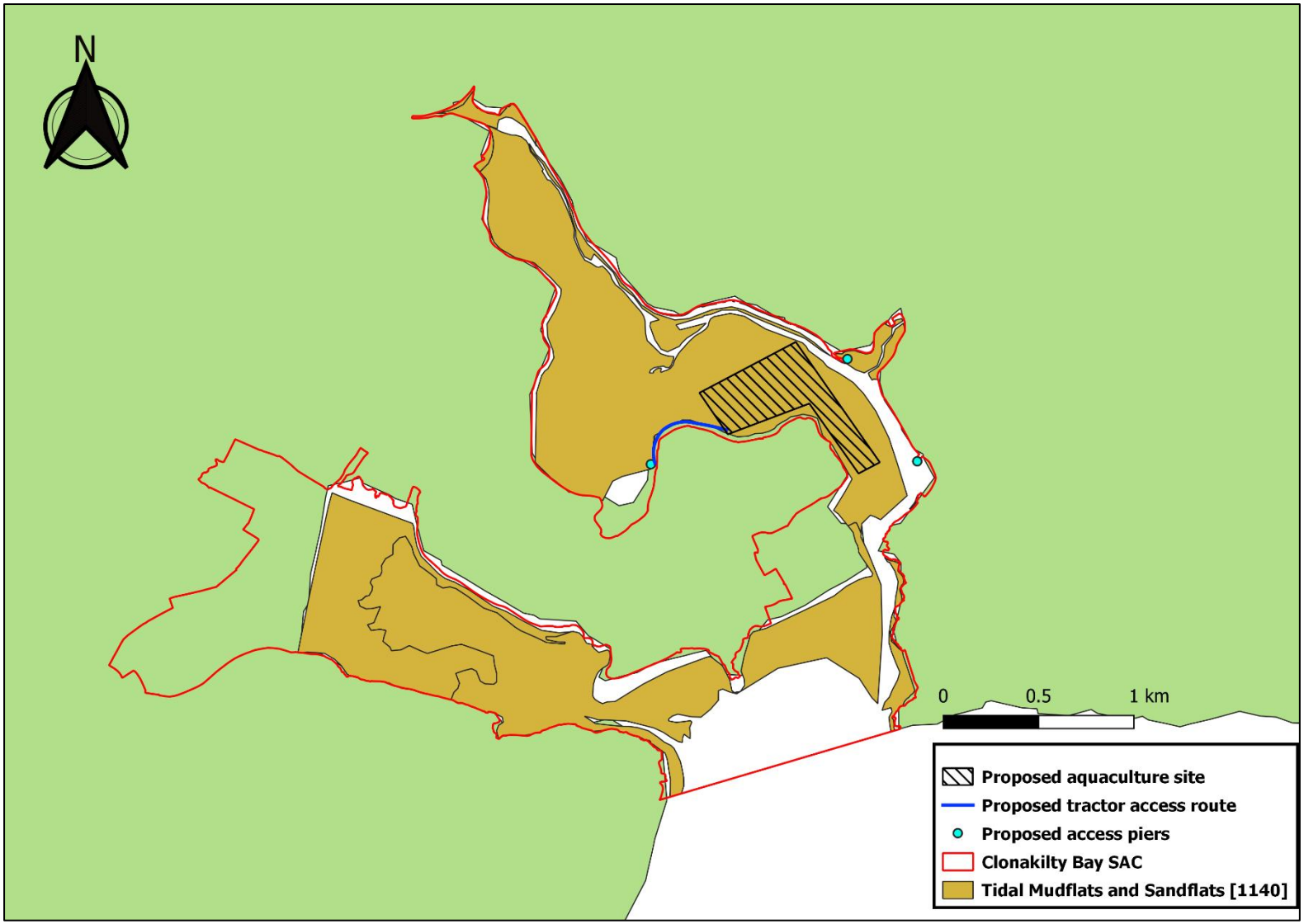

Figure 4.2: **Spatial extent of the Annex I Habitat 1140 of Clonakilty Bay SAC relative to the proposed aquaculture site T05/603A and site access points.**

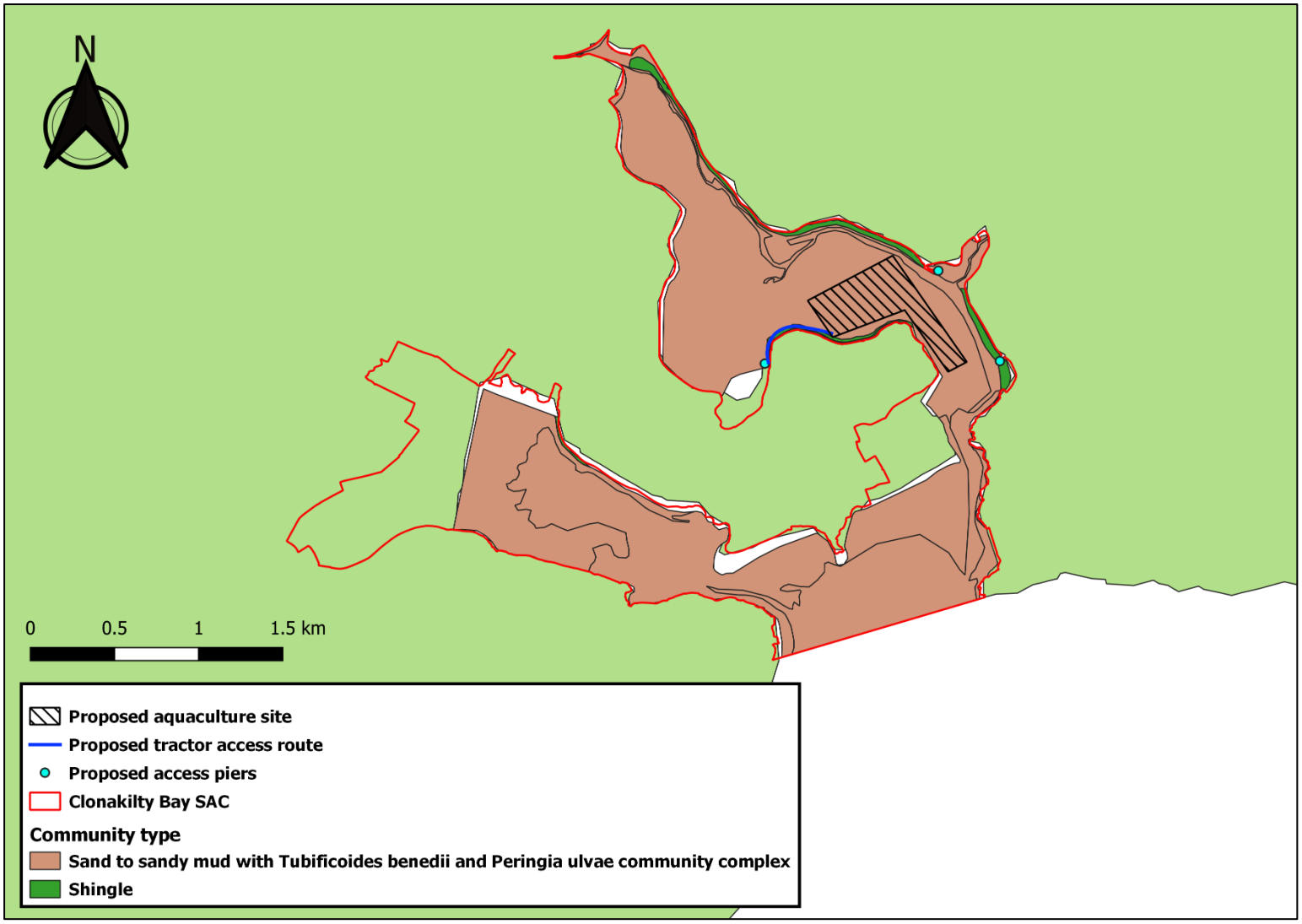
N
0
0.5
1
1.5 km
Proposed aquaculture site
Proposed tractor access route
Proposed access piers
Clonakilty Bay SAC
Community type
Sand to sandy mud with Tubificoides benedii and Peringia ulvae community complex
Shingle

Figure 4.3: **Community type recorded within the Annex I Habitat of 1140 of Clonakilty Bay SAC relative to the proposed aquaculture site and site access points.**

4.3. Conservation Objectives

The Conservation Objectives for the Qualifying Interests identified for Clonakilty Bay SAC state that the natural condition of the designated features should be preserved with respect to their area, distribution, extent and community distribution (see NPWS 2014a, b). The Conservation Objectives of the Qualifying Interests of the Clonakilty Bay SAC are listed in **Table 4.2** below. Conservation objective targets relevant to the current assessment are also detailed.

Table 4.2: Conservation objectives for marine habitats and species in Clonakilty Bay SAC (NPWS 2014a,b). Details of the conservation objectives targets relevant to the assessment are provided.

Feature Community Type	**Objective**	**Targets**
Mudflats and sandflats not covered by seawater at low tide (1140)	Maintain Favorable Conservation Condition	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. Habitat area was estimated using OSI data as 313ha. The permanent habitat area is stable or increasing, subject to natural processes.
Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex	Maintain Favorable Conservation Condition	313ha: Conserve community type in a natural condition
Annual vegetation of drift lines (1210)	Maintain Favorable Conservation Condition	Target that focus on a habitat distribution with the ultimate goal of maintaining function and diversity of favourable species and managing levels of negative species.
Embryonic shifting dunes (2110)	Maintain Favorable Conservation Condition	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
Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	Restore Favorable Conservation Condition	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
Fixed coastal dunes with herbaceous vegetation (grey dunes)	Maintain Favorable Conservation Condition	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
Atlantic decalcified fixed dunes (Calluno-Ulicetea) (2150)	Maintain Favorable Conservation Condition	Targets are identified that focus on a wide range of attributes with the ultimate goal of maintaining function and diversity of favourable species and managing levels of negative species

4.4. Screening of Adjacent SACs for Ex-Situ Effects

A total of 2 SACs are located within 15km of the proposed aquaculture sites at Clonakilty Bay SAC (see

Figure 4.4). The sites are:

- Courtmacsherry Estuary SAC (site code: 001230) (NPWS 2014c)
- Kilkeran Lake and Castlefreke Dunes SAC (NPWS 2016)

The conservation features of the above SAC sites are identified in **Table 4.3** where a preliminary screening is carried out on the likely interaction with aquaculture activities within Clonakilty Bay SAC.

Table 4.3: The SAC sites adjacent to the Clonakilty Bay SAC and qualifying features with initial screening assessment on likely interactions with aquaculture activities.

Site Code	Site name	Qualifying Interests	Aquaculture Initial Screening
SAC 001230	Courtmacsherry Estuary SAC	Estuaries [1130]	No spatial overlap or likely interactions with aquaculture activities in Clonakilty Bay SAC – conservation features excluded from further analysis
		Mudflats and sandflats not covered by seawater at low tide [1140]	
		Annual vegetation of drift lines [1210]	
		Perennial vegetation of stony banks [1220]	
		Salicornia and other annuals colonising mud and sand [1310]	
		Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330]	
		Mediterranean salt meadows (Juncetalia maritimi) [1410]	
		Embryonic shifting dunes [2110]	
		Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120]	
		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130	
SAC 001061	Kilkeran Lake and Castlefreke Dunes SAC	Coastal lagoons [1150]	No spatial overlap or likely interactions with aquaculture activities in Clonakilty Bay SAC – conservation features excluded from further analysis
		Embryonic shifting dunes [2110]	
		Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120]	

Site Code	Site name	Qualifying Interests	Aquaculture Initial Screening
		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	

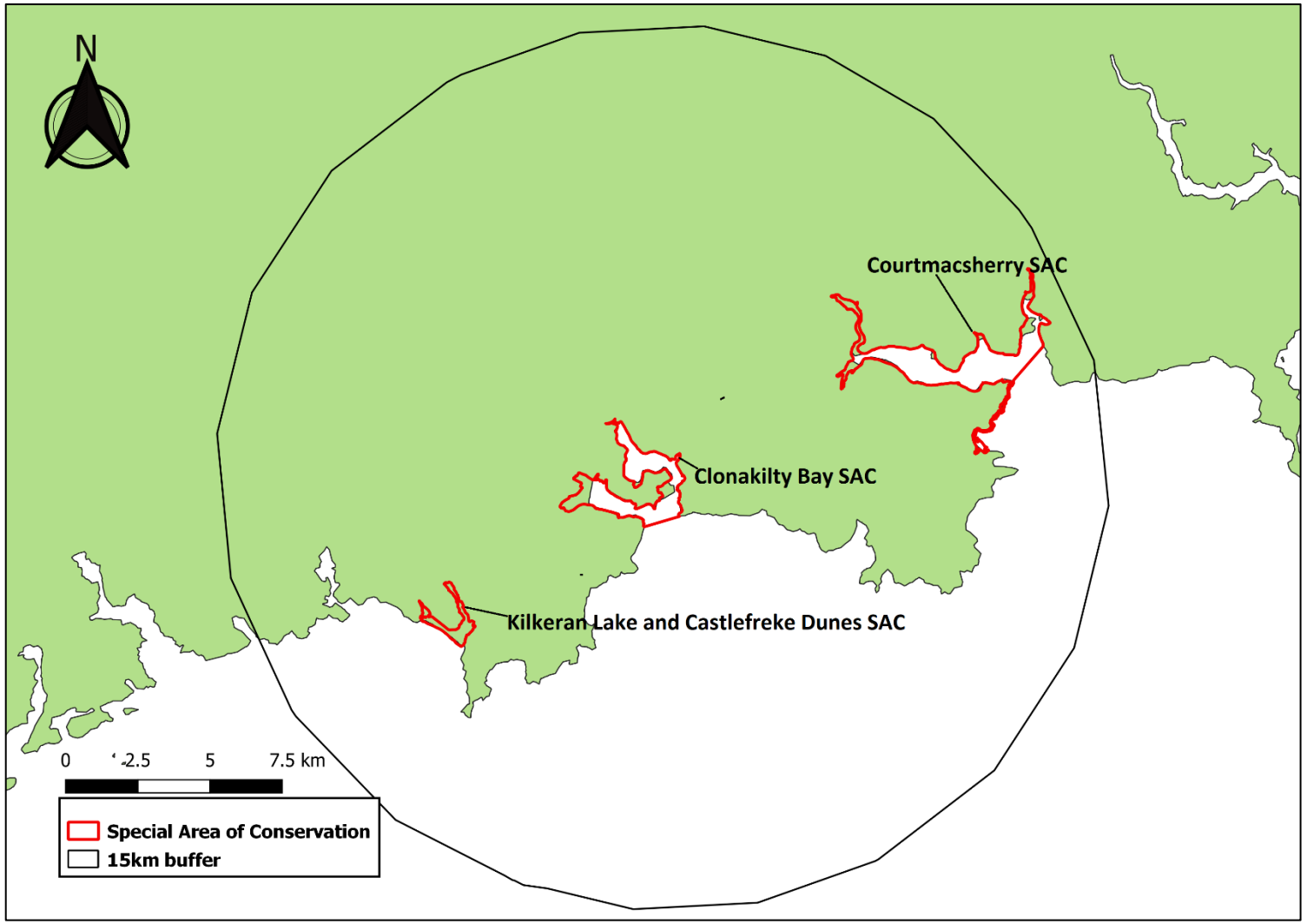

Figure 4.4: **SACs adjacent to Clonakilty Bay SAC.**

5. Details of the Proposed Plans and Projects

Overview

A description of the proposed aquaculture activities is provided in **Section 5.1** while descriptions of the spatial extent of proposed aquaculture activities overlapping the Annex I habitat for which the SAC is designated is presented in **Section 5.2**.

5.1. Description of Proposed Aquaculture Activities

The current assessment relies on information included in an *Appropriate Assessment Profiling* report prepared by BIM and provided to the Marine Institute. With respect to the applications the *Appropriate Assessment Profiling* report outlines the following:

Background

There is currently no licensed aquaculture within Clonakilty Bay. There is one application to farm oysters on a site north of Inchydoney in the inner harbour. This site is 22.7ha.

Methods of production proposed are bags on trestle for oysters.

Oyster production

Oyster production has a life cycle from seed input to harvest for market of 2½ years. Oysters are sold fully grown at a size range from 60-140 grams, or as half grown for ongrowing elsewhere.

The oyster seed is either bought in from other farms in Ireland, oyster nurseries in Ireland the UK and France or from wild seed stocks in France.

It is not indicated in the application whether diploid or triploid seed is proposed.

Bag and Trestle Method

It is proposed that the oysters will be grown in trestles and bags. Trestles are typically 1m in height, 3 metres long and carry 5-6 bags, but this can vary.

Seed is generally imported in the spring and in the autumn of each year. The intake size ranges, packed in oyster bags at a predetermined density and taken to the inter-tidal zone, where the bags are attached to trestles for the growing process to begin.

Packing densities of seed is individually determined by each producer.

Oysters are thinned out and graded as the oysters grow. As the oysters grow, they are taken to a handling / sorting facility or foreshore area for splitting and re-packing, and returned to the trestles. The seed will be split following a few months once growth starts. Producers generally split the oysters either once or twice over the growth cycle. Again the density following splitting varies from producer to producer.

Oyster Site Layouts

The trestles are arranged in rows and blocks on site. Again this is not determined on the application. Rows are often set out in pairs with sufficient gap between pairs for flat-bottomed vessels or tractors to pass, allowing servicing. Other producers will arrange trestles in blocks e.g. block of 40 trestles where there are 4 trestles deep and 8 trestles long. There are generally gaps left between blocks for access and servicing.

The site will either be accessed by boat from a nearby pier or by tractor across the foreshore.

Turning Oyster Bags.

Producers generally turn each bag on site once a month. Turning takes place when the oysters are growing. This means turning takes place from March up to Oct/Nov depending on growth. Both spring tides of each month are generally used by producers to get out to their sites.

Site Access

Access to the site is across the foreshore from the west by tractor and at three point for potential boat access.

The following, adapted from Gittings and O'Donoghue (2012), provides further detail of typical intertidal oyster aquaculture practices in Ireland:

Oyster trestles vary in height but are typically do not exceed 0.5 m height and their height above the sediment is often less as they sink into the sediment. The trestles are usually arranged in single or paired rows with a separation of around 4 m between rows and with wider (10-20 m) access lanes. Where the trestles occur on open sandflats the rows are usually orientated more or less perpendicularly to the tideline.

Oyster spat is supplied by hatcheries and is placed in mesh bags. Generally, only a proportion of the trestles hold oyster bags at any one time. The bags are placed on top of the trestles, where they are on-grown until they are ready for harvesting. The function of the trestles is to keep the animals off the seabed, preventing grit getting inside the oysters,

providing increased water flow and allowing suitable shell growth. The mesh bags facilitate stock handling and prevent predation.

Oyster husbandry activities mainly take place during spring low tides. Workers usually access the trestles by driving tractors across the beach and will often drive through shallow water on the receding tide to make the most use of the time available. Husbandry activities involve turning the mesh bags every spring tide to rid the bags of any settled silt, stop the growth of oyster shell into the mesh and destroy fouling organisms.

5.2. Proposed Oyster Cultivation and Overlap with Conservation Features

Given the size and the location of the aquaculture site and the location of the site on the lower intertidal means that husbandry activity is only likely to take place on a proportion of low tides, rather than on every low tide.

The proposed cultivation site and access route overlaps approximately 7.235% and 0.067%, respectively, the Annex I habitat 1140 Mudflats and sandflats not covered by seawater at low tide (see **Table 5.1** and **Figure 4.2**).

Table 5.1: Spatial extent of aquaculture site (T05/603A) and access route overlapping with the Annex I habitat 1140 in Clonakilty Bay SAC.

Mudflats and sandflats not covered by seawater at low tide (1140) [313ha] (NPWS 2014a)	
%age of Annex I Habitat Overlapped (Area of Annex I Habitat Overlapped)	
Proposed Site	**Proposed Vehicle Access Route**
7.235% (22.646ha)	0.067% (0.210ha)

6. Natura Impact Statement for the Activities

Overview

The potential ecological effects of activities on the Conservation Objectives for the sites relate to the physical and biological effects of aquaculture cultivation structures and activities on designated species, intertidal 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 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.

It is proposed to culture the Pacific oyster, *C. gigas,* in bags on trestles in the intertidal areas within the Annex I habitat 1140 of the Clonakilty Bay SAC. Cultivation of oysters on intertidal trestle can alter the surrounding environment, both physically and biologically, not only due to the presence of the culture organisms (e.g. increased deposition, disease, shading, fouling, alien species) but also due to the activities associated with the culture mechanisms (e.g. structures resulting in current alteration, sediment compaction).

Details of the potential biological and physical effects of aquaculture activities, their sources and the mechanism by which the impact may occur are summarised in **Table 6.1** below. The predominant environmental effects of intertidal trestle cultivation are briefly discussed in **Section 6.1** to **Section 6.4.** The impacts identified in the table and discussed below, are derived from published primary literature and review documents that have specifically focused upon the environmental interactions of mariculture (e.g. Black 2001; Forrest *et al*., 2009, McKindsey *et al*., 2007; O'Beirn *et al*., 2012; Cranford *et al*., 2012; ABPMer, 2013a - h).

A detailed screening assessment of potential effects identified in **Section 6.1** to **Section 6.4** is presented in **Section 7**. Where significant effects of an impact mechanism on a receptor cannot be discounted (screened out) at the screening stage, the impact mechanism and receptor combination is brought forward in the assessment (see **Section 8**).

6.1. Physico-chemical Effects

Filter feeding organisms, for the most part, feed at the lowest trophic level, usually relying primarily on the 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. Faeces and pseudofaeces can accumulate on the seafloor beneath aquaculture installations and can alter the local sedimentary habitat type in terms of organic content and particle size which has, in certain circumstances, been shown to alter the resident faunal communities.

Moderate enrichment due to deposition can lead to increased diversity due to increased food availability; however further enrichment can lead to a change in sediment biogeochemistry (*e.g.* oxygen levels decrease and sulphide levels increase) which can result in a reduction in species richness and abundance resulting in a community dominated by specialist species. In extreme cases of protracted organic enrichment, anoxic conditions may occur where no fauna survives, and the sediment may become blanketed by bacterial mats. Changes to the sedimentary habitat due to deposition are indicated by a decrease in oxygen levels, increased sulphide reduction, decrease in REDOX depth (*i.e.* the depth of the boundary between oxic and anoxic sediments) and particle size changes.

Oysters are typically cultured in the intertidal zone in plastic mesh bags on 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. Any effect to habitats 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. The accumulation of material beneath oyster trestles is dictated by a number of factors, including:

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

- Density of culture – the density of oysters in a bag and 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 effect can be realised with resultant accumulations. Close proximity may also result in impact on shellfish performance due to competitive interactions.
- 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.

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.

6.2. Shading Effects

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

6.3. Non-Native Species

Non-native (alien) species may be introduced to environments accidentally or deliberately. Aquaculture activities, as well as shipping (commercial and recreational), are the main vectors for the introduction of alien species. Aquaculture is responsible for the introduction of alien species intended for culture and as a result of unintended transmissions arising from imports or movements of aquaculture stock.

Oyster culture poses a risk in terms of the introduction of the non-native species Pacific oyster (*C. gigas*). Wild recruitment of *C. gigas* has been documented in a number of bays on the west and north coasts of Ireland and the species appear to have become naturalised in these areas (*i.e.* establishment of a breeding population) (Kochmann *et al*., 2012, 2013; Zwerschke *et al.,* 2017). Naturalised population may compete with the native species for space and food. The culture of large volumes of Pacific oysters may increase the risk of successful reproduction and the establishment of 'wild' breeding populations.

Aquaculture presents a risk for the introduction of alien species as 'hitchhikers' on and among culture stock. There is potential that alien species may spread or proliferate to a degree that can result in environmental damage.

6.4. Disease Risk

As a generalisation, marine farmed organisms are affected by a range of disease, much as other domesticated agriculture stock. Due to the nature of the (high density) of shellfish culture methods there is potential for risk of transmission of disease within the cultured stock, and between the stock and wild populations.

Table 6.1: Potential indicative environmental pressures of aquaculture activities within the Annex I habitats at the Clonakilty Bay SAC.

Activity	Pressure Category	Pressure	Potential Effects	Equipment/ Gear	Duration (days)	Time of Year	Factors constraining the Activity
Intertidal Oyster Culture	Physical	Current alteration	Structures may alter the current regime and resulting increased deposition of fines or scouring.	Trestles and bags and service equipment	365	All year	At low tide only
		Surface disturbance	Ancillary activities at sites, *e.g.* servicing, transport increase the risk of sediment compaction resulting in sediment changes and associated community changes.				
		Shading	Prevention of light penetration to seabed potentially impacting light sensitive species				
	Biological	Non-native (alien) species introduction	Potential for non-native species (*C. gigas*) to reproduce and proliferate in SAC. Potential for alien species to be included with culture stock (hitch- hikers).				
		Disease risk	In event of epizootic the ability to manage disease in uncontained subtidal oyster populations is compromised				
		Organic enrichment	Fecal and pseudofaecal deposition on seabed potentially altering community composition				
	Physical	Current alteration	Structures may alter the current regime and resulting increased deposition of fines or scouring				
		Shading	Prevention of light penetration to seabed potentially impacting light sensitive species				
		Fouling	Increased secondary production on structures and culture species. Increased nekton production.				
		Seston filtration	Alteration of phytoplankton and zooplankton communities and potential impact on carrying capacity				

7. Screening of Aquaculture Activities

A screening assessment is an initial evaluation of the possible impacts that activities may have on the Qualifying Interests. The screening is a filter, which may lead to exclusion of combinations of activities (or impact mechanisms) and Qualifying Interests from AA proper, thereby simplifying the assessments, if this can be justified unambiguously using limited and clear-cut criteria.

Screening is a conservative filter that minimises the risk of false negatives.

7.1. Physico-chemical Effects

The screening of potential physico-chemical impacts of the proposed activities is based primarily on spatial overlap. Where Qualifying Interests overlap spatially with the proposed activities then significant effects 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 effect is discounted, and further assessment of possible effects is deemed not to be necessary.

Where the overlap between an aquaculture activity (*i.e.* the cultivation site and the access route) and a Qualifying Interest is zero and there is no likely interaction identified; the Qualifying Interest and aquaculture activity combination is screened out and not considered further. Therefore, on this basis, the following habitats and species of Clonakilty Bay SAC are excluded from further consideration in this assessment:

- [1210] Annual Vegetation of Drift Lines
- [2110] Embryonic Shifting Dunes
- [2120] Marram Dunes (White Dunes)
- [2130] Fixed Dunes (Grey Dunes)*
- [2150] Decalcified Dune Heath*

As described in **Section 5.2** the aquaculture site and vehicle access route overlap the Annex I habitat of Mudflats and sandflats not covered by seawater at low tide [1140] at Clonakilty Bay SAC.

Within the Annex I habitat 1140 at Clonakilty Bay SAC the proposed aquaculture site and vehicle access route overlaps the constituent community type - Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex' (see **Figure 7.1** and **Table 7.1**).

Conclusion: given the spatial overlap there is potential for significant physico-chemical effects exist. The assessment of significance of potential effects is presented in **Section 8.1**.

Table 7.1: Annex I habitat constituent community type of the Clonakilty SAC overlapped by proposed aquaculture site T05/603A (22.7ha) and access route.

Annex I Habitat	Marine Community Type	%age of Community Type Area Overlapped (Area of Community Type Overlapped)	
		Proposed Site	Proposed Vehicle Access Route
Mudflats and sandflats not covered by seawater at low tide (1140) [313ha]	Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex [313ha]	7.235% (22.646ha)	0.067% (0.210ha)

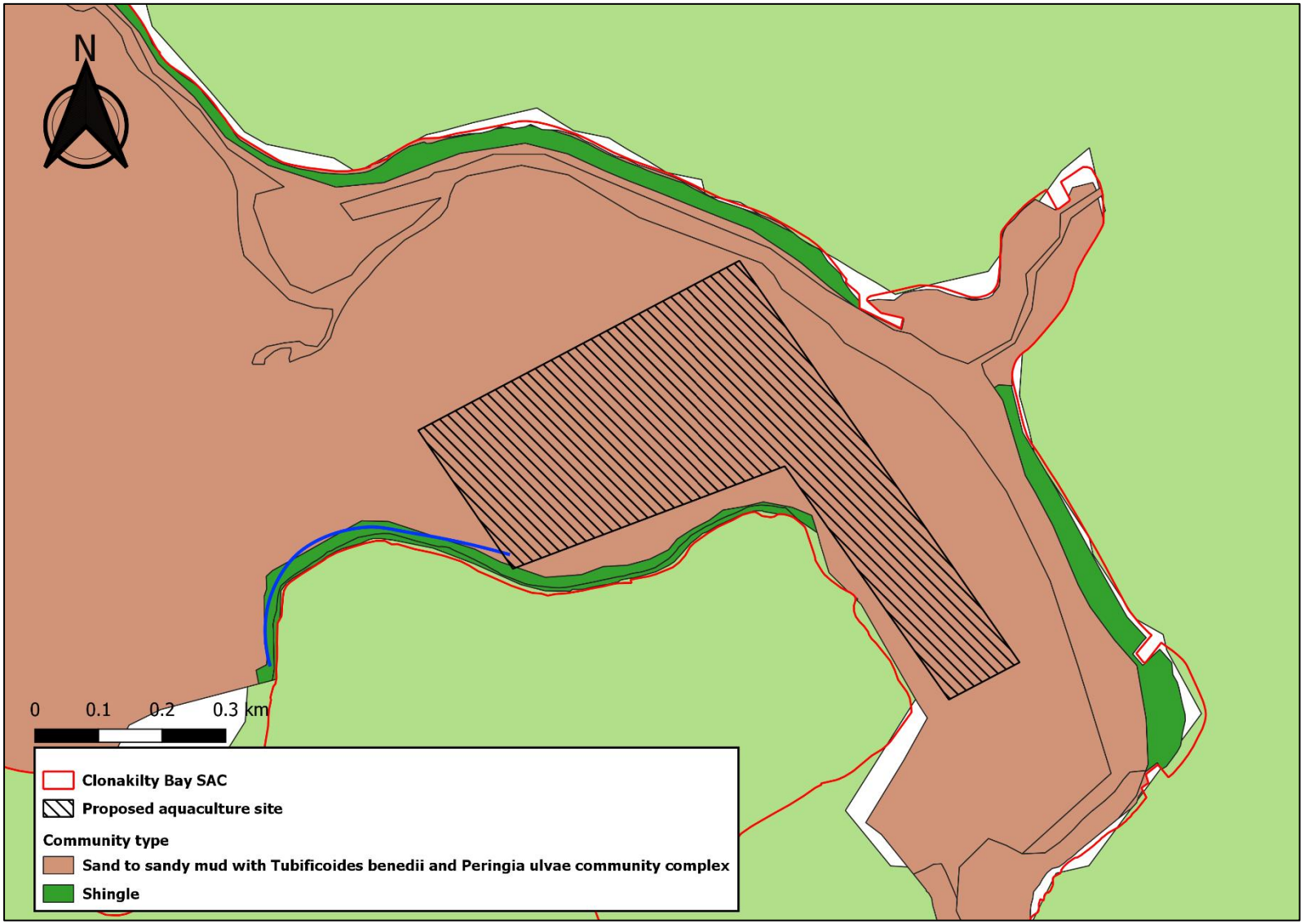

Figure 7.1: **Spatial overlap of aquaculture sites with marine community type within Clonakilty Bay SAC.**

7.2. Shading Effects

Shading is considered not to be an issue as the species characterising the benthic habitats under the cultivation structures are not shade sensitive species.

Conclusion: potential significant shading effects are unlikely to occur – effects are screened out.

7.3. Non-Native Species

7.3.1. Naturalisation of *Crassostrea gigas*

As outlined above oyster culture presents a risk in terms of the establishment of breeding populations of Pacific oyster. Factors contributing to the successful establishment of oysters in Irish bays include the high-density cultivation of the species, long residence times of embayment waters and large intertidal areas. There is no oyster production at Clonakilty Bay sites and the hydrography of the area do not fulfil these criteria, therefore the risk of successful establishment of 'wild' populations of Pacific oyster is considered low.

Conclusion: potential significant effects are unlikely to occur - effects screened out.

7.3.2. Introduction of Non-Native Species

The introduction of non-native species as 'hitchhikers' on and among culture stock is also considered a risk, the extent of which is dependent upon the duration of time the stock has spent outside of the Clonakilty Bay SAC.

Invasive species can have serious negative consequences on their environment and cause damage to ecosystem functions and services by outcompeting native species. This would be of particular concern for any aquaculture activity within a SAC site, but also any aquaculture with connectivity to a SAC sites e.g. hydrological connectivity.

Conclusion: potential significant effects from the introduction of non-native species; see Section 8.2 for assessment of significance of effects.

Section 8.2 also outlines the measures that are to be implemented to manage the risk of introduction of non-native species.

7.4. Disease Risk

As outlined above, Kochmann *et al.* (2012; 2013) reported naturalised populations on the west and north coast of Ireland may result in disease transmission effects. Given that the Clonakilty Bay SAC are located on the south coast away from established populations of 'wild' *C. gigas* population, disease transmission risk is considered negligible.

Conclusion: potential significant effects are unlikely to occur - effects screened out.

8. Assessment of Aquaculture Activities

The objective of this AA is to determine whether the proposed aquaculture activities in Clonakilty Bay SAC are consistent with the Conservation Objectives for the 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.

8.1. Physico-chemical Effects to Habitats

8.1.1. Overview

For Clonakilty Bay SAC, NPWS (2014b) provides guidance on the interpretation of the Conservation Objectives (NPWS 2014a) which are, in effect, management targets for the Qualifying Features in the SAC. The guidance is scaled relative to the anticipated sensitivity of habitats and species to disturbance by the proposed activities. Some activities are deemed to be wholly inconsistent with long term maintenance of certain sensitive habitats while other habitats can tolerate a range of activities.

For the practical purpose of management of sedimentary habitats, a 15% threshold of overlap between a disturbing activity and a habitat is given in the NPWS guidance. Below this threshold disturbance is deemed to be non-significant. Disturbance is defined as that which leads to a change in the characterizing species of the habitat (which may also indicate change in structure and function). Such disturbance may be temporary or persistent in the sense that change in characterizing species may recover to pre-disturbed state or may persist and accumulate over time.

8.1.2. Determining Significance

The significance of the possible effects of the proposed activities on habitats, as outlined in **Section 6** and the subsequent screening exercise in **Section 7,** is determined here in the assessment. The significance of effects is determined on the basis of guidance for the constituent marine community type of the Anne I habitat 1140 (NPWS 2014b) in particular the disturbance thresholds set for marine community type.

A schematic outlining the determination of significant effects on habitats and marine community types is presented in **Figure 8.1.**

For the Annex I habitat and their constituent community type, potential effects are identified in relation to, first and foremost, the spatial overlap.

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

1. **The degree to which the activity will disturb the Annex I habitat**. Disturbance is meant as a change in the characterising species, as listed in the Conservation Objective guidance (NPWS 2014a, b) of the constituent marine community types.

   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.
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.

For the assessment, the threshold detailed in **3** above applies to the constituent community type that are overlapped by the aquaculture activity.

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.

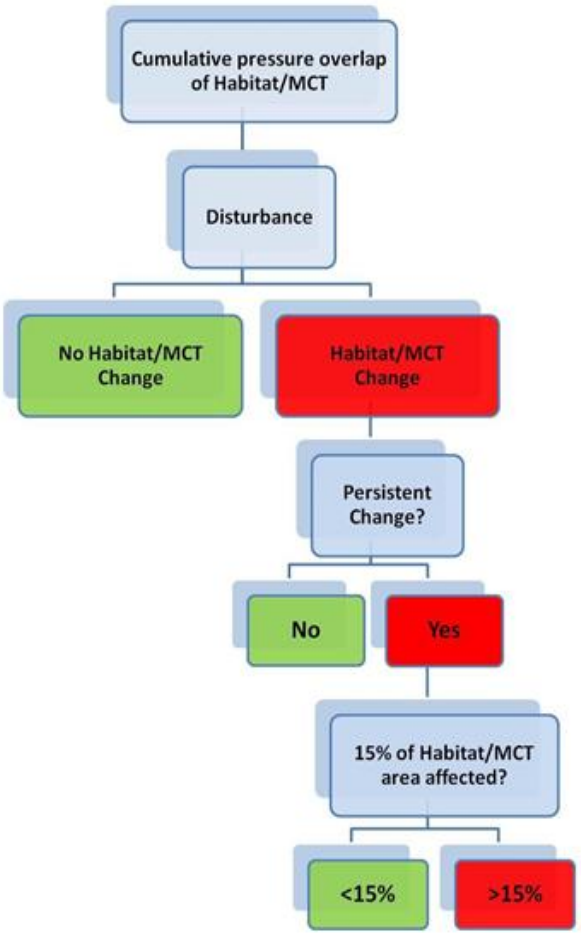

Figure 8.1: **Schematic outlining the determination of significant effects on habitats and marine community types.**

8.1.3. Sensitivity and Assessment Rationale

This assessment used a number of sources of information in assessing the sensitivity of the characterising species of the marine community type recorded within the Annex I habitat 1140 of Clonakilty Bay SAC.

One source of information is a series of reviews commissioned by the Marine Institute which identify habitat and species sensitivity to a range of pressures that are 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.

It must be noted that the NPWS have acknowledged that given the wide range of community types that can be found in marine environments, the application of conservation targets to these would be difficult. On this basis, they have proposed broad community complexes as management units. These

complexes (for the most part) are very broad in their description and do not have clear surrogates which might have been considered in targeted studies and thus reported in the scientific literature. On this basis, the confidence assigned to likely interactions of the community types with anthropogenic activities are by necessity relatively low, with the exception of community types dominated by sensitive taxa, e.g. Maerl and *Zostera*. Directed research investigating the effect of aquaculture on intertidal environment does provide a greater degree of confidence in conclusions; for example, the output of Forde *et al*. (2015) has provided greater confidence in terms of assessing likely interactions between intertidal oyster culture and marine habitats.

The 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 conservation features (species, habitats, and communities) the separate components of sensitivity (intolerance, recoverability) are relevant 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 2014b).
- 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 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). Sensitivity is also expected to be high for species 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.

- 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 and Desrocher, 2004) cited in Hall *et al*., 2008).

The community type identified within the Annex I habitat 1140 of Clonakilty Bay SAC is Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex (NPWS 2014b). The distinguishing species of this complex are detailed in NPWS (2014b) and summarised in **Table 8.1** below. In addition to the distinguishing species listed in **Table 8.1**, NPWS (2014b) outlined that the marine community type comprised the polychaete *Arenicola marina* to the north of Inchydoney Island. The bivalve *Cerastoderma edule* was also recorded in low abundances to the north of Inchydoney Island, and locally abundant on the shore to the north of Inchydoney Island. The sensitivities of the community type to pressures caused by aquaculture (*e.g.* smothering, organic enrichment and physical disturbance) are similar to those identified for the surrogate communities identified in **Table 8.2.**

Table 8.1: Distinguishing species of the Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex (from NPWS 2014a)

Species		
Tubificoides benedii	*Deshayesorchestia deshayesii*	*Pygospio elegans*
Peringia ulvae	*Talitrus saltator*	

Hediste diversicolor	*Scoloplos (Scoloplos) armiger*	

Table 8.2: Matrix showing the sensitivity scores x pressure categories for habitats (or surrogates) in the Clonakilty Bay SAC (ABPMer 2013a-h) (Table 8.3 provides the codes for the various categorisation of sensitivity and confidence.)

Pressure	Physical Damage								Change in Habitats Quality									Biological Pressures					Chemical Pollution			Light
	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 to the surface)	Changes to sediment composition- increased coarseness	Changes to sediment composition- increased fine sediment proportion	Changes to water flow	Decrease in turbidity/ increased suspended sediment	Changes in turbidity/ decreased suspended sediment	Organic enrichment of sediments- sedimentation	Increased removal of primary production- phytoplankton	Decrease in oxygen levels- sediment	Decrease in oxygen levels-water column	Genetic impacts	Introduction of non-native species	Introduction of parasites/pathogen	Removal of Target Species	Removal of Non-target species	Introduction of antifoulants	Introduction of medicines	Introduction of hydrocarbons	Prevention of light reaching seabed/ features
Habitat A2.23 Polychaete/ amphipod dominated fine sand	H (*)	M (*)	M (*)	H (*)	M - H (*)	N - L (*)	L - M (*)	N - L (*)	N - L (***)	N - L (***)	L - M (*)	H (*)	H (*)	H (*)	H (*)	H - M (*)	H - M (*)	NE	H (***)	NE	H (*)	H (*)	NA	H (*)	M (*)	H (*)
Habitat A5.23 Polychaete/ bivalve dominated muddy sand shores	H (*)	M (*)	M (***)	NE	NE	N - L (*)	L - M (*)	N - L (*)	N - L (*)	N - L (*)	L - M (*)	H (*)	H (*)	H (*)	H (*)	H - M (***)	H - M (***)	NE	H (***)	NE	H (*)	H (*)	NA	H (*)	M (***)	H (*)

Table 8.3: Codes of sensitivity and confidence applying to species and pressure interactions.

Pressure interaction codes for Table 8.2	
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

8.1.4. Assessment of Effects

Aquaculture pressures on a given habitat are related to vulnerability to the pressures induced by culture activities. Consequently, the following are important factors to be considered assessing risk of disturbance to habitats and species:

- type of activity.
- location and orientation of structures associated with the culture organism.
- density of culture organisms.
- duration of the culture activity.

As described in **Section 8.1.3** NPWS (2014b) provide lists of distinguishing species characteristic of benthic community that is 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.

As described in the Conservation Objectives document for the sites (NPWS 2014a), Favourable Conservation Condition are defined by targets set for attributes of the Annex I habitat. The attributes are 1) Habitat Area and 2) Community distribution. Assessment of the potential effects to the Annex I habitat with respect to attribute 1) and attribute 2) are presented in **Section 8.1.5** and **Section 8.1.5.**

8.1.5. Habitat Area

For attribute 1, the target for Annex I habitat 1140 (Mudflats and sandflats not covered by seawater at low tide) is to ensure that the permanent habitat area is stable or increasing, subject to natural processes.

It is unlikely that the activities proposed will reduce the overall extent of permanent habitat within the Annex I habitat 1140.

Conclusion: no likely significant adverse effects to Habitat Area.

8.1.6. Community Distribution

Attribute 2 relates to the Distribution of communities identified within the Annex I habitat. The constituent communities of the Annex I habitat 1140 of Clonakilty Bay SAC overlapped by the proposed aquaculture sites and access routes are outlined in **Table 8.4** alongside assessments of the likely interactions with aquaculture activities.

Short summaries of the assessments together with broad conclusions and justifications on whether the activities are considered disturbing are provided below.

Assessment Summaries

The proposed oyster cultivation sites overlap one community type identified within Annex I habitat 1140; with respect to the community type, NPWS (2014b) outlines that '*significant continuous or ongoing disturbance of communities should not exceed an approximate area of 15% of the interpolated area*'. As the overlap of the site with the community type in Annex I habitat 1140 is the 15% threshold, significant disturbance is unlikely to occur (see **Table 8.4**). In addition, published literature (Forde et al., 2015; O'Carroll *et al*., 2016) indicates that, with the exception of heavy vehicle movement along access routes, intertidal oyster cultivation is non-disturbing to intertidal habitats. The spatial overlap of the access route with the marine community type of the Annex I habitat 1140 is below the 15% disturbance threshold identified in NPWS (2014b) (see **Table 8.4**)..

Conclusion: No likely significant adverse effects to habitat communities.

8.1.7. Conclusion Summary

Based upon the spatial overlap and sensitivity analysis, it is concluded that aquaculture activities at sites do not pose a risk of significant disturbance to the conservation of the Annex I habitats of Clonakilty Bay SAC or the associated constituent community type.

Table 8.4: Interactions between the relevant aquaculture activities and the constituent community type of 1140 in Clonakilty Bay SAC.

Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex [313ha]		**Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex [313ha]**	
Proposed aquaculture site T05/603A		**Proposed access route**	
Area Overlap (ha)	**% Overlap**	**Area Overlap (ha)**	**% Overlap**
22.646ha	7.235%	0.210ha	0.067%
Justification: 1) Published literature (Forde *et al*., 2015, O'Carroll *et al*., 2016) indicate that activities occurring at trestle culture sites are not disturbing. 2) Given that the overlap of disturbing activity with the marine community type is less than the 15% threshold, significant adverse impacts of activities on the community type can be discounted			

8.2. Effect of Non-Native Species to Habitats

8.2.1. Overview

Aquaculture activity has the potential to act as a significant vector for the introduction of non-native species to the SAC. It should be noted, however, that the cultivation of oysters grown in other bays in Ireland and 'finished' at the Clonakilty Bay SAC do not present a significant risk of introduction of non-native species.

In contrast, on-growing in the bay of half-grown stock which have been grown for extended periods in places outside of Ireland present a higher risk.

8.2.2. Determining Significance

As outlined in **Table 8.2** intertidal and subtidal sand are sensitive to the introduction of non-native species. Aquaculture has been identified as a vector for the introduction and/ or spread of a number of non-native species in Irish waters that have the potential to impact Qualifying Interest habitats and species for which SACs are designated.

Non-native species accidentally introduced/ spread to bays include the slipper-limpet *Crepidula fornicata*[8] and the leathery (or club) sea squirt *Styela clava*[9] and the carpet squirt *Didemnum vexillum*[10]. While these non-native species have not been recorded at the SAC, their potential introduction presents a risk of the Annex I habitat 1140 for which the SACs are designated. Specifically, there is potential that the invasive species may alter community structure thus impacting the attributes defined for habitats in the Conservation Objective.

C. fornicata can effect change in community structure by out-competing resident benthic species for food and space (JNCC 2002). Slipper limpet can also act to alter sediment characteristics through the removal of huge volumes of suspended organic material from the water column and depositing filtered material on the bottom as pseudofaeces (Thieltges *et al*., 2003). Similar to slipper limpet effects on the microbenthic communities, the tunicate species *S. clava* and *D. vexillum* can impact resident benthic communities by out-competing resident flora and fauna. At these high densities, the species can significantly impact on native and aquaculture species through competition for space and food, as well as predation of larvae from the water column. The species form large colonies

[8] Global Invasive Species Database http://www.iucngisd.org/gisd/species.php?sc=600

[9] Global Invasive Species Database http://www.iucngisd.org/gisd/species.php?sc=951

[10] Global Invasive Species Database http://www.iucngisd.org/gisd/species.php?sc=951

significant over rocks and gravels, aquaculture equipment (trestle, bags, ropes, netting *etc.*) and vessel hulls. The tunicate species can smother benthic organisms and change community structure.

8.2.3. Management Measure

To manage potential risk of introduction of alien species into the SAC as a result of aquaculture activities all movement of stock in and out of the bay should adhere to relevant legislation and follow best practice guidelines (*e.g.* http://invasivespeciesireland.com/cops/aquaculture/).

Conclusion: with strict adherence to relevant legislation and best practice guidelines, there will be no likely significant adverse effects.

8.2.4. Conclusion Summary

The site is at risk from the introduction of non-native species on and among culture stock. To manage the risk of introduction of alien species to the Annex I habitat Mudflats and sandflats not covered by seawater at low tide (1140) and associated constituent community type, all stock movement in the bay follow should strictly adhere to relevant legislation and follow best practice guidelines.

9. In-Combination Effects of Fisheries and other Activities

9.1. Fisheries

There are no known applications for a fishery or proposed fishery plans for the Clonakilty Bay SAC. On this basis, there are not likely to be any in-combination impacts between fishery and aquaculture activities.

9.1.1. Conclusion

As there are no other licenced fisheries in the vicinity of the proposed aquaculture sites at Clonakilty Bay SAC, in-combination effects of fisheries with aquaculture activities on fisheries can be discounted

9.2. Pollution Pressures

There are a number of activities which are terrestrial in origin that might result in impacts on the conservation features of the Clonakilty Bay SAC. Primary among these are point source discharges from domestic sewage outfalls located adjacent to the SAC. The pressure derived from these point sources may have very localised impacts upon dissolved nutrients, suspended solids, and some elemental components.

9.2.1. Conclusion

Pressures resulting from aquaculture activities are the localised compaction of sediment along access routes and the potential introduction of non-native species. Pressures resulting from point discharge location would not significantly impact chemical parameters in the water column, any in-combination effects with aquaculture activities are considered to be minimal or negligible.

10. SAC Aquaculture Appropriate Assessment Concluding Statement and Recommendations

An *Appropriate Assessment Profiling* report of aquaculture activity in the Clonakilty Bay SAC prepared by BIM and provided to the Marine Institute indicates that there is currently no existing licenced aquaculture within Clonakilty Bay, while there is one application for intertidal aquaculture (using bags and trestles) of oysters on an intertidal site to the north of Inchydoney island in the inner harbour (aquaculture site reference T05/603A). Based on the information provided in the *Appropriate Assessment Profiling* report (see **Section 5**), the likely interaction between this culture methodology and conservation features of the site were considered.

Habitats

Given the location of the proposed aquaculture site at Clonakilty Bay, an initial screening exercise resulted in the conservation features of adjacent SAC being excluded from further consideration by virtue of there was no viable pathway for interaction.

In addition, the screening exercise resulted in the following conservation features of Clonakilty Bay SAC being excluded from being excluded from further consideration by virtue that there was no spatial overlap with the culture activities was expected to occur;

- [1210] Annual Vegetation of Drift Lines
- [2110] Embryonic Shifting Dunes
- [2120] Marram Dunes (White Dunes)
- [2130] Fixed Dunes (Grey Dunes)*
- [2150] Decalcified Dune Heath*

In contrast, spatial overlap of activities with the Annex I habitat and constituent community type of the Clonakilty Bay SAC was shown to exist. In light of the sensitivity of constituent community type of the Annex I habitat 1140 a full assessment was carried out on the likely interactions between the proposed culture operations at the proposed site and vehicle access route.

Based upon the scale of spatial overlap of proposed aquaculture activities (*i.e.* the site and access route) and the relatively high tolerance levels of the habitats and associated species, the general conclusion is that if approved the proposed activities will be non-disturbing to the habitat Qualifying Interests and their constituent communities (see **Table 10.1**).

Table 10.1: Constituent community type within Clonakilty Bay SAC overlapped by proposed aquaculture sites

Marine Community Type	%age of Community Type Area Overlapped (Area of Community Type Overlapped)	
	Proposed Site	Proposed Vehicle Access Route
Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex [313ha] (NPWS 2014a)	7.235% (22.646ha)	0.067% (0.210ha)

Conclusions and Recommendations

This *Report supporting the Appropriate Assessment (AA)* has concluded that the proposed aquaculture activities in the Clonakilty Bay SAC will not lead to deterioration in the attributes of the habitats and species of the SACs or of adjacent SACs over time and in relation to the scale, frequency and intensity of the activities. The proposed aquaculture activities are consistent with the Conservation Objectives set for the Clonakilty Bay SAC.

The SAC sites are at risk from the introduction of non-native species on and among culture stock (*e.g.* slipper limpet, leathery sea squirt and carpet sea squirt). To manage the risk of introduction of alien species into the SAC all movement of stock in and out of the bay should adhere to relevant legislation and follow best practice guidelines[11].

[11] http://invasivespeciesireland.com/cops/aquaculture/.

11. References

ABPMer. 2013a. Tools for Appropriate Assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report I: Intertidal and Subtidal Muds

ABPMer. 2013b. Tools for Appropriate Assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report II: Intertidal and Subtidal Sands.

ABPMer. 2013c. 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

ABPMer. 2013d. Tools for Appropriate Assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report IV: Intertidal and Subtidal Mixed Sediments.

ABPMer. 2013e. Tools for Appropriate Assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report V: Intertidal and Subtidal Coarse Sediments

ABPMer. 2013f. Tools for Appropriate Assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report VI: Biogenic Reef (Sabellaria, Native Oyster, Maerl)

ABPMer. 2013g. Tools for Appropriate Assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report VII: Intertidal and Subtidal Reefs.

ABPMer. 2013h. Tools for Appropriate Assessment of fisheries and aquaculture activities in Marine and Coastal Natura 2000 sites. Report VIII: Vegetation dominated communities (Saltmarsh and Seagrass).

Anand, M. and Desrochers, R.E., 2004. Quantification of restoration success using complex systems concepts and models. Restoration Ecology, 12(1), pp.117-123.

Aquaculture Stewardship Council. 2012. ASC Salmon Standard. Version1.0 June 2012. 103pp

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

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

Borja, A., Franco, J. and Pérez, V., 2000. A marine biotic index to establish the ecological quality of soft-bottom benthos within European estuarine and coastal environments. Marine Pollution Bulletin, 40(12), pp.1100-1114.

Cranford, P.J., Kamermans, P., Krause, G., Mazurié, J., Buck, B.H., Dolmer, P., Fraser, D., Van Nieuwenhove, K., Francis, X.O., Sanchez-Mata, A. and Thorarinsdóttir, G.G., 2012. An ecosystem-based approach and management framework for the integrated evaluation of bivalve aquaculture impacts. Aquaculture Environment Interactions, 2(3), pp.193-213.

De Grave, S., Moore, S.J. and Burnell, G., 1998. Changes in benthic macrofauna associated with intertidal oyster, Crassostrea gigas (Thunberg) culture. Journal of Shellfish Research, 17(4), pp.1137-1142.

Forde, J., Francis, X.O., O'Carroll, J.P., Patterson, A. and Kennedy, R., 2015. Impact of intertidal oyster trestle cultivation on the Ecological Status of benthic habitats. Marine Pollution Bulletin, 95(1), pp.223-233.

Forrest, B., Keeley, N. B., Hopkins, G. A., Webb, S. C. and Clement, D. M., 2009. Bivalve aquaculture in estuaries: Review and synthesis of oyster cultivation effects. Aquaculture, 298, pp.1-15

Finstad, B., Kroglund, F., Strand, R., Stefansson, S.O., Bjørn, P.A., Rosseland, B.O., Nilsen, T.O. and Salbu, B., 2007. Salmon lice or suboptimal water quality—Reasons for reduced postsmolt survival?. Aquaculture, 273(2-3), pp.374-383.

Friedland, K.D., Chaput, G. and MacLean, J.C., 2005. The emerging role of climate in post-smolt growth of Atlantic salmon. ICES Journal of Marine Science, 62(7), pp.1338-1349.

Friedland, K.D., Hansen, L.P., Dunkley, D.A. and MacLean, J.C., 2000. Linkage between ocean climate, post-smolt growth, and survival of Atlantic salmon (Salmo salar L.) in the North Sea area. ICES Journal of Marine Science, 57(2), pp.419-429.

Gittings, T. & O'Donoghue, P. (2012). The effects of intertidal oyster culture on the spatial distribution of waterbirds. Report prepared for the Marine Institute. Atkins, Cork.

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. and Ramsay, K., 2008. Mapping the sensitivity of benthic habitats to fishing in Welsh waters-development of a protocol. CCW [Policy Research] Report, (8/12), pp.85.

Jackson, D., Cotter, D., ÓMaoiléidigh, N., O'Donohoe, P., White, J., Kane, F., Kelly, S., McDermott, T., McEvoy, S., Drumm, A. and Cullen, A., 2011. An evaluation of the impact of early infestation with the salmon louse Lepeophtheirus salmonis on the subsequent survival of outwardly migrating Atlantic salmon, Salmo salar L., smolts. Aquaculture, 320(3-4), pp.159-163.

Jones, S.R.M., 2009. Controlling salmon lice on farmed salmon and implications for wild salmon. Perspectives in Agriculture, Veternary Science, Nutrition and Natural Resources 4 no. 048, 13pp

Kochmann, J., Carlsson, J., Crowe, T.P. and 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 Heredity, 103(5), pp.661-671.

Kochmann, J., O'Beirn, F., Yearsley, J., and Crowe, T.P., 2013. Environmental factors associated with invasion: modelling occurrence data from a coordinated sampling programme for Pacific oysters. Biological Invasions, 15(10), pp.2265-2279.

Marine Institute (2015). Report supporting Appropriate Assessment of Aquaculture in Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (Site Code: 000627), Marine Institute, Oranmore, Galway.

McKindsey, C.W., Landry, T., O'Beirn, F.X. and Davies, I.M., 2007. Bivalve aquaculture and exotic species: a review of ecological considerations and management issues. Journal of Shellfish Research, 26(2), pp.281-294.

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

NPWS (2013) Site Synopsis. Site Name: Clonakilty Bay SAC. Site Code: 000091. Version date: 08.07.2013 https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY000091.pdf

NPWS (2014a) Conservation Objectives: Clonakilty Bay SAC 000091. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000091.pdf

NPWS (2014b) Conservation Objectives supporting document - Marine Habitats Clonakilty Bay SAC 000091 National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht https://www.npws.ie/sites/default/files/publications/pdf/Clonakilty%20Bay%20SAC%20(000091)%20Conservation%20objectives%20supporting%20document%20-%20Marine%20habitats%20[Version%201].pdf

NPWS (2014c) Conservation Objectives: Courtmacsherry Estuary SAC 001230. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, and the Gaeltacht. https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO001230.pdf

NPWS (2016) Conservation Objectives: Kilkeran Lake and Castlefreke Dunes SAC 001061. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO001061.pdf

O'Beirn, F.X., C. W. McKindsey, T. Landry, B. Costa-Pierce. 2012. Methods for Sustainable Shellfish Culture. 2012. Encyclopedia of Sustainability Science and Technology. Springer Science, N.Y. pp.-9174-9196.

O'Carroll, J.P., Quinn, C., Forde, J., Patterson, A., O'Beirn, F.X. and Kennedy, R., 2016. Impact of prolonged storm activity on the Ecological Status of intertidal benthic habitats within oyster (Crassostrea gigas) trestle cultivation sites. Marine Pollution Bulletin, 110(1), pp.460-469.

Ó Maoiléidigh, N., McGinnity, P., Prévost, E., Potter, E.C.E., Gargan, P., Crozier, W.W., Mills, P. and Roche, W., 2004. Application of pre-fishery abundance modelling and Bayesian hierarchical stock and recruitment analysis to the provision of precautionary catch advice for Irish salmon (Salmo salar L.) fisheries. ICES Journal of Marine Science, 61(8), pp.1370-1378.

Roberts, C., Smith, C., Tillin, H.M. and Tyler-Walters, H., 2010. 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.

Sharples, R.J., Moss, S.E., Patterson, T.A. and Hammond, P.S., 2012. Spatial variation in foraging behaviour of a marine top predator (Phoca vitulina) determined by a large-scale satellite tagging program. PLoS one, 7(5).

Zwerschke, N., Kochmann, J., Ashton, E.C., Crowe, T.P., Robert, D. and O'Connor, N.E. 2018. Co-occurrence of native Ostrea edulis and non-native Crassostrea gigas revealed by monitoring of intertidal oyster populations. J Mar Biol. Assoc United Kingdom 98, pp.2029–2038

Thieltges, D., Strasser, M., Reise, K., 2003. The American slipper limpet Crepidula fornicata (L.) in the northern Wadden Sea 70 years after its introduction. Helgoland Marine Research 3, 1.

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, pp.31-45.