Report supporting Appropriate Assessment of Aquaculture in Galway Bay Complex SAC

(Site Code: 000268)

July 2019

1 Preface 6
2 Executive Summary 7
2.1 The SAC 7
2.2 Aquaculture Activities in the SAC 7
2.3 The appropriate assessment and risk assessment process 8
2.4 Data supports 9
2.5 Findings 9
2.6 Annex II Species 10
3 Introduction 13
3.1 Conservation Objectives for Galway Bay Complex SAC (000268) 13
3.2 The SAC extent 13
3.3 Qualifying interests (SAC) 14
3.4 Conservation objectives for Galway Bay Complex SAC 17
3.5 Screening of Adjacent SACs 23
4 Aquaculture Activities 34
4.1 Oyster Culture 34
4.1.1 Intertidal Oyster Culture 34
4.2 Mussel culture 36
4.3 Scallop Culture 36
4.4 Seaweed Culture 36
5 Natura Impact Statement for the proposed activities 39
5.1 Aquaculture and habitat interactions 39
5.2 Aquaculture and marine mammal interactions 47
6 Appropriate Assessment Screening 51
6.1 Aquaculture Activity Screening 51
7 Appropriate Assessment-Aquaculture 56
7.1 Determining significance 56
7.2 Sensitivity and Assessment Rationale 57
7.3 Assessment of the effects of aquaculture production on the Conservation Objectives for habitat features in Galway Bay Complex SAC. 64
7.4 Assessment of the effects of shellfish production on the Conservation Objectives for Harbour Seal (*Phoca vitulina*) in Galway Bay Complex SAC. 75
7.5 Assessment of the effects of shellfish production on the Conservation Objectives for the Otter (*Lutra lutra*) in Galway Bay Complex SAC. 77
8 Risk Assessment of Fishing Activities 79

8.1 Fisheries Activities 79
8.1.1 Pot fisheries 79
8.1.2 Dredge fisheries 80
8.1.3 Set Net fisheries 81
8.1.4 Pelagic and demersal fisheries 81
8.2 Determining fisheries risk to the conservation objectives 83
8.3 Sensitivity of characterizing species and marine communities to physical disturbance by fishing gears 86
8.4 Risk assessment of impact of fishing gears on marine benthic communities 87
8.4.1 Fisheries risk profile 88
8.4.2 Marine Community types 88
8.4.3 9.4.2 Designated species 90
9 In combination effects of activities 95
10 Aquaculture Appropriate Assessment Concluding Statement 97
10.1 Annex I Habitats 97
10.2 Annex II Species 98
11 References 100

List of Figures

Figure 1 The extent of Galway Bay Complex SAC (Site Code 000268) and qualifying habitats. 14

Figure 2 Principal benthic communities recorded within the qualifying interests of Galway Bay Complex SAC (Site Code 000268) (NPWS, 2013a). 15

Figure 3 Harbour Seal (*Phoca vitulina*) locations in Galway Bay SAC (Site Code 000268) (NPWS, 2013a). 17

Figure 4. Natura 2000 sites adjacent to the Galway Bay Complex SAC. 23

Figure 5. Proposed and existing shellfish culture activity within the northern portion of Galway Bay Complex SAC (Site Code 000268) 37

Figure 6. Proposed and existing shellfish culture activity within the southern portion of Galway Bay Complex SAC (Site Code 000268) 37

Figure 7. Determination of significant effects on community distribution, structure and function. In relation to designated species (Harbour Seal, Otter) the capacity of the population to maintain itself in the face of anthropogenic induced disturbance or mortality at the site will need to be taken into account in relation to the Conservation Objectives (CO's) on a case-by-case basis. 57

Figure 8. Harbour Seal Sites and Aquaculture Sites (licenced and applications) southern portion of the Galway Bay Complex (Site Code 00268). 77

Figure 9. Spatial extent of pot fisheries in the Galway Bay Complex SAC (Site Code 000268). 79

Figure 10. Spatial extent of dredge fisheries in the Galway Bay Complex SAC (Site Code 000268). Oyster fishery orders are shown in relation to survey data showing the distribution of oyster beds. 80

Figure 11. Spatial extent of set net fisheries in the Galway Bay area. 81

Figure 12. Spatial extent of bottom trawl fisheries in the Galway Bay area. 82

Figure 13. Spatial extent of pelagic fisheries in the Galway Bay area. 82

Figure 14. Oyster fishery order areas within Galway Bay complex SAC. 96

List of Tables

Table 1 Conservation objectives and targets for marine habitats and species in Galway Bay Complex SAC (Site Code 000268) (NPWS 2013a). 18

Table 2: Natura Sites adjacent to Galway Bay Complex SAC and qualifying features with initial screening assessment on likely interactions with fisheries and aquaculture activities 24

Table 3: Spatial extent (ha) of aquaculture activities overlapping with the qualifying interests in Galway Bay Complex SAC (Site Code 000268), presented according to culture species, method of cultivation and license status..... 38

Table 4 Potential indicative environmental pressures of aquaculture activities within Galway Bay Complex SAC (Site Code 000268)..... 44

Table 5 Potential interactions between aquaculture activities and the Annex II species Harbour Seal (*Phoca votulina*), Otter (*Lutra lutra*) within the Galway Bay Complex SAC (000268)..... 50

Table 6 Habitat utilisation i.e. spatial overlap in hectares and proportion of specific community type (%) by aquaculture activity within the qualifying interest 1140 of Galway Bay Complex SAC. (Based on licence database provided by DAFM. Habitat data provided in NPWS 2013a, 2013b). 53

Table 7. Habitat utilisation i.e. spatial overlap in hectares and proportion of specific community type (%) by aquaculture activity within the qualifying interest 1160 of Galway Bay Complex SAC. (Based on licence database provided by DAFM. Habitat data provided in NPWS 2013a, 2013b).; (Status: L-Licensed, A-Application). 54

Table 8. Habitat utilisation i.e. spatial overlap in hectares and proportion of specific community type (%) by aquaculture activity within the qualifying interest 1170 of Galway Bay Complex SAC. (Based on licence database provided by DAFM. Habitat data provided in NPWS 2013a, 2013b). (L-Licensed, A-Application) 55

Table 9. Matrix showing the sensitivity to pressure scores (ABPMer 2013a-h) of communities recorded within Galway Bay Complex SAC (Site Code 000268). 60

Table 10 Matrix showing the sensitivity to pressure scores (ABPMer 2013a-h) of characterising species recorded within Galway Bay Complex SAC (Site Code 000268). (Note: Table 11 provides the code for the various categorisation of sensitivity and confidence.)..... 62

Table 11 Codes of sensitivity and confidence applying to species and pressure interactions. 64

Table 12 Assessment of effect of aquaculture activities on 1160 community types recorded within Galway Bay Complex (Site Code 000268). 70

Table 13 Assessment of effect of aquaculture activities on 1140 community types recorded within Galway Bay Complex (Site Code 000268) 73

Table 14 Assessment of effect of aquaculture activities on 1170 community types recorded within Galway Bay Complex (Site Code 000268) 74

Table 15. 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) 84

Table 16. Risk categorization for fisheries and designated species interactions (Marine Institute 2013) 85

Table 17. Percentage spatial overlap between fisheries and qualifying interests. 91

Table 18. Percentage spatial overlap between fisheries and marine communities within each qualifying interest. 91

Table 19. Risk scores (refer to Table 15 for interpretation) for fisheries in relation to marine communities within qualifying interests. 93

Table 20. Risk scores for fisheries in relation to designated species in Galway Bay SAC 94

1 Preface

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

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

The process of identifying existing and proposed activities and submitting these for assessment is, in the case of fisheries projects and plans, outlined in S.I. 290 of 2013. Fisheries projects or plans are taken to mean those fisheries that are subject to annual secondary licencing or authorization. Here, the industry or the Minister may bring forward fishing proposals or plans which become subject to assessment. These so called Fishery Natura Plans (FNPs) may simply be descriptions of existing activities or may also include modifications to activities that mitigate, prior to the assessment, perceived effects to the ecology of a designated feature in the site. In the case of other fisheries, that are not projects or plans, data on activity are collated and subject to a risk assessment against the COs. Oyster fisheries, managed by DCENR, do not come under the remit of S.I. 290 of 2013 but are defined as projects or plans as they are authorized annually and are therefore also subject to AA.

In the case of aquaculture, DAFM receives applications to undertake such activity and submits a set of applications, at a defined point in time, for assessment. The FNPs and aquaculture applications are then subject to AA. If the AA or the RA process finds that the possibility of significant effects cannot be discounted or that there is a likelihood of negative consequence for designated features then such activities will need to be mitigated further if they are to continue. These assessments 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

Galway Bay Complex is designated as a Special Area of Conservation (SAC) under the Habitats Directive. The marine area is designated as a large shallow inlet and bay and for intertidal mud and sand flats not covered by seawater at low tide. 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 fishing and aquaculture, such as maerl (corraline algae) and seagrass beds. The area is also designated for and supports significant numbers of Harbour Seal and Otter while salmon and sea lamprey, designated in the Lough Corrib SAC which flows into the north east corner of the Bay, migrate through the Bay as smolts and as mature animals returning from sea. Conservation Objectives for these habitats and species (within the Galway Bay Complex SAC) were identified by NPWS (2013a) 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 (2013b).

2.2 Aquaculture Activities in the SAC

The main aquaculture activities are intertidal oyster culture and subtidal suspended mussel culture. The Pacific oyster (*Crassostrea gigas*) is cultured on trestles in intertidal areas. Mussels (*Mytilus edulis*) are cultured using droppers from longlines held by floats or rafts. In addition is it proposed to culture seaweed and scallops at single sites. The profile of the aquaculture industry in the Bay, used in this assessment, was prepared by BIM and is derived from the list of licence applications received by DAFM and provided to the MI for assessment in April 2019.

2.3 The appropriate assessment and risk assessment process

The function of an appropriate assessment and risk assessment is to determine if the ongoing and proposed aquaculture and fisheries activities are consistent with the Conservation Objectives for the Natura site or if such activities will lead to deterioration in the attributes of the habitats and species over time and in relation to the scale, frequency and intensity of the activities. NPWS (2013b) 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 a disturbing activity and a habitat is given in the NPWS guidance. Below this threshold disturbance is deemed to be non-significant. Disturbance is defined as that which leads to a change in the characterizing species of the habitat (which may also indicate change in structure and function). Such disturbance may be temporary or persistent in the sense that change in characterizing species may recover to pre-disturbed state or may persist and accumulate over time.

The appropriate assessment and risk assessment process is divided into a number of stages consisting of a preliminary risk identification, and subsequent assessment (allied with mitigation measures if necessary) which are covered in this report. The first stage of the AA process is an initial screening wherein activities which cannot have, because they do not spatially overlap with a given habitat or have a clear pathway for interaction, any impact on the conservation features and are therefore excluded from further consideration. The next phase is the Natura Impact Statement (NIS) where interactions (or risk of) are identified. Further to this, an assessment on the significance of the likely interactions between activities and conservation features is conducted. Mitigation measures (if necessary) will be introduced in situations where the risk of significant disturbance is identified. In situations where there is no obvious mitigation to reduce the risk of significant impact, it is advised that caution should be applied in licencing decisions. Overall the Appropriate Assessment is both the process and the assessment undertaken by the competent authority to effectively validate this

Screening Report and/or NIS. It is important to note that the screening process is considered conservative, in that other activities which may overlap with habitats but which may have very benign effects are retained for full assessment unless otherwise indicated. In the case or risk assessments consequence and likelihood of the consequence occurring are scored categorically as separate components of risk. Risk scores are used to indicate the requirement for mitigation.

2.4 Data supports

Distribution of habitats and species population data are provided by NPWS[1]. Fishing data are compiled from various sources including survey data, questionnaire data and expert knowledge. 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

The appropriate assessment and risk assessment finds that the majority of activities, at the current and proposed or likely future scale and frequency of activity are consistent with the Conservation Objectives for the SAC. Some general conclusions and recommendations follow:

In Galway Bay Complex SAC there are a range of aquaculture activities currently being carried out and proposed. Based upon this and the information provided in the aquaculture profiling (Section 5), the likely interaction between aquaculture methodology and conservation features (habitats and species) of the site was considered.

Annex I Habitats

In relation to habitats 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 of the culture activities was expected to occur.

The habitats and species excluded from further consideration were:

- 1150 Coastal lagoons
- 1220 Perennial vegetation of stony banks
- 1310 Salicornia and other annuals colonising mud and sand
- 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

[1] NPWS Geodatabase Ver: September 2013 - http://www.npws.ie/mapsanddata/habitatspeciesdata/

[2] DAFM Aquaculture Database version Aquaculture: 30th Aug 2013

- 1410 Mediterranean salt meadows (*Juncetalia maritimi*)

A full assessment was carried out on the likely interactions between aquaculture operations (as proposed) and the features Annex 1 habitats Mudflats and sandflats not covered by seawater at low tide (1140), Large Shallow Inlets and Bay (1160) and Reefs (1170). The likely effects of the aquaculture activities were considered in light of the sensitivity of the constituent communities of these Annex 1 habitats. A number of issues were highlighted in Section 8.3 and relate to certain aquaculture and habitat interactions the conclusions of which are presented below.

Conclusion 1: Aquaculture activity is deemed disturbing on two community types, Maërl-dominated community and *Zostera*-dominated community complex. The risk to the conservation status of sensitive habitats (i.e. Mearl and *Zostera*) posed by number of overlapping or adjacent aquaculture locations therefore, cannot be discounted. These impacts are potentially exacerbated by fishing activities. All efforts should be made to avoid overlap with these sensitive areas and a suitable buffer zone be applied in order to allow for mapping anomalies and enforcement measures.

Conclusion 2: The presence of non-native species *Didemnum* sp. in Galway Bay is acknowledged and in particular, is associated with structures used to culture oysters (trestles). Best practice should be employed to ensure that structures and netting are kept clean at all times and that any biofouling be dealt and disposed of in a responsible manner such that it is removed from the marine environment and does not pose a risk to the conservation features of the site.

Conclusion 3: Notwithstanding that current levels of feral Pacific oyster recruitment in Galway Bay are considered relatively low, it is recommended that operators be encouraged to increase their use of triploid oysters in order to mitigate the risk of successful reproduction. This is recommended on the basis that oyster recruitment has been recorded in Galway Bay and that it is proposed to increase the levels of oyster production in the bay and hence the potential for spawning and recruitment will increase.

Conclusion 4: It is recommended that acceptable sources of seed (in terms of alien species risk) are identified for aquaculture culture operations and that all future movements of all shellfish stock (mussels, oysters and clams) in and out of Galway Bay Complex SAC should adhere to relevant fish health legislation and follow best practice guidelines.

2.6 Annex II Species

The likely interactions between the proposed aquaculture activities and the Annex II Species Harbour Seal (*Phoca vitulina*) and Otter (*Lutra lutra*) were also assessed. The objectives for these species in the SAC focus upon maintaining the good conservation status of the population. It is

concluded that the activities proposed in the areas that potentially overlap with otter habitat do not pose a threat to the conservation status of this species.

It is acknowledged in this assessment that the favourable conservation status of the Harbour seal (*Phoca vitulina*) has been achieved given current levels of aquaculture production within the SAC. The aspect of the culture activities that could potentially disturb the Harbour seal status relates to movement of people and vehicles within the sites as well as accessing the sites over intertidal areas and via water.

Conclusion 1: The current levels of licenced aquaculture (existing) are considered non-disturbing to harbour seal conservation features in all areas of the SAC. Operators should note sensitive times of years for seals and continue to tailor their activities to minimise potential disturbance.

Conclusion 2: In relation to new licence applications, given the potential broad range of Harbour Seal within the SAC, the risk of disturbance to Harbour Seals should be assessed on the basis of the nature of the culture type and location relative to seal sites. For example, a site may pose a greater risk of disturbance than others on the basis of blocking potential egress routes available to seals and the proposed levels of activity at the sites. To this end, one site (T09/499A) appears to block access to a deep channel for seals. On the basis of licenced sites nearby, there does not appear to be any mitigating features to prevent disturbance to seals.

Conclusion 1: Aquaculture activity is deemed disturbing on two community types, Maërl-dominated community and *Zostera*-dominated community complex. The risk to the conservation status of sensitive habitats (i.e. Mearl and *Zostera*) posed by number of overlapping or adjacent aquaculture locations therefore, cannot be discounted. These impacts are potentially exacerbated by fishing activities. All efforts should be made to avoid overlap with these sensitive areas and a suitable buffer zone be applied in order to allow for mapping anomalies and enforcement measures.

Conclusion 2: The presence of non-native species *Didemnum* sp. in Galway Bay is acknowledged and in particular, is associated with structures used to culture oysters (trestles). Best practice should be employed to ensure that structures and netting are kept clean at all times and that any biofouling be dealt and disposed of in a responsible manner such that it is removed from the marine environment and does not pose a risk to the conservation features of the site.

Conclusion 3: It is recommended that acceptable sources of seed (in terms of alien species risk) are identified for aquaculture culture operations and that all future movements of all shellfish stock (mussels, oysters and clams) in and out of Galway Bay Complex SAC should adhere to relevant fish health legislation and follow best practice guidelines.

Annex II Species

The likely interactions between the proposed aquaculture activities and the Annex II Species Harbour Seal (*Phoca vitulina*) and Otter (*Lutra lutra*) were also assessed. The objectives for these species in the SAC focus upon maintaining the good conservation status of the population. It is concluded that the activities proposed in the areas that potentially overlap with otter habitat do not pose a threat to the conservation status of this species.

It is acknowledged in this assessment that the favourable conservation status of the Harbour seal (*Phoca vitulina*) has been achieved given current levels of aquaculture production within the SAC. The aspect of the culture activities that could potentially disturb the Harbour seal status relates to movement of people and vehicles within the sites as well as accessing the sites over intertidal areas and via water.

Conclusion 1: The current levels of licenced aquaculture (existing) are considered non-disturbing to harbour seal conservation features in all areas of the SAC. Operators should note sensitive times of years for seals and continue to tailor their activities to minimise potential disturbance.

Conclusion 2: In relation to new licence applications, given the potential broad range of Harbour Seal within the SAC, the risk of disturbance to Harbour Seals should be assessed on the basis of the nature of the culture type and location relative to seal sites. For example, a site may pose a greater risk of disturbance than others on the basis of blocking potential egress routes available to seals and the proposed levels of activity at the sites. To this end, one site (T09/499A) appears to block access to a deep channel for seals. On the basis of licenced sites nearby, there does not appear to be any mitigating features to prevent disturbance to seals.

Conclusion 3: The aquaculture activities proposed do not pose a threat to otter in the Galway Bay Complex.

3 Introduction

This document assesses the potential ecological interactions of aquaculture and fisheries activities within Galway Bay Complex SAC (Site Code 000286) on the Conservation Objectives of the site (COs).

The information upon which this assessment was carried out was based upon 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 in April 2019, as well as aquaculture profiling information provided on behalf of the operators by Bord Iascaigh Mara (BIM). The spatial extent of aquaculture licences was derived from a database managed by the DAFM[3] and shared with the Marine Institute.

3.1 Conservation Objectives for Galway Bay Complex SAC (000268)

The appropriate assessment of aquaculture in relation to the Conservation Objectives for Galway Bay Complex SAC (Site Code 000268) is based on Version 1.0 of the objectives (NPWS 2013a -16, April -2013) and supporting documentation (NPWS 2013b - March, 2013). The spatial data for conservation features was also provided by NPWS[4].

3.2 The SAC extent

Galway Bay Complex SAC (Figure 1) is a large site situated on the west coast of Ireland, comprising the entire marine area of inner Galway Bay, extending from the north shore (Silverstrand west of Galway city) to Tawin in the middle of the bay to a point on the south shore west of Ballyvaughan in Co Clare.

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, reefs and coastal lagoons. Coastal lagoons, a priority habitat listed on Annex I of the EU Habitats Directive, occur in isolated areas throughout the SAC the largest being located in Lough Atalia, close to Galway City. A number of coastal habitats can also be found within the SAC, including Perenial vegetation of stony Banks, *Salicornia* and other annuals colonising mud and sand, Atlantic salt meadows (G*lauco-Puccinellietalia maritimae*) and Mediterranean salt meadows (*Juncetalia maritimi*). The SAC is also considered an important site for the two mammal species - the harbour seal (*Phoca vitulina*) and the otter (*Lutra lutra*). The boundary of the SAC and the qualifying habitats within is shown in Figure 1 below.

[3] DAFM Aquaculture Database version Aquaculture: 30th Aug 2013

[4] NPWS Geodatabase Ver: September 2013 - http://www.npws.ie/mapsanddata/habitatspeciesdata/

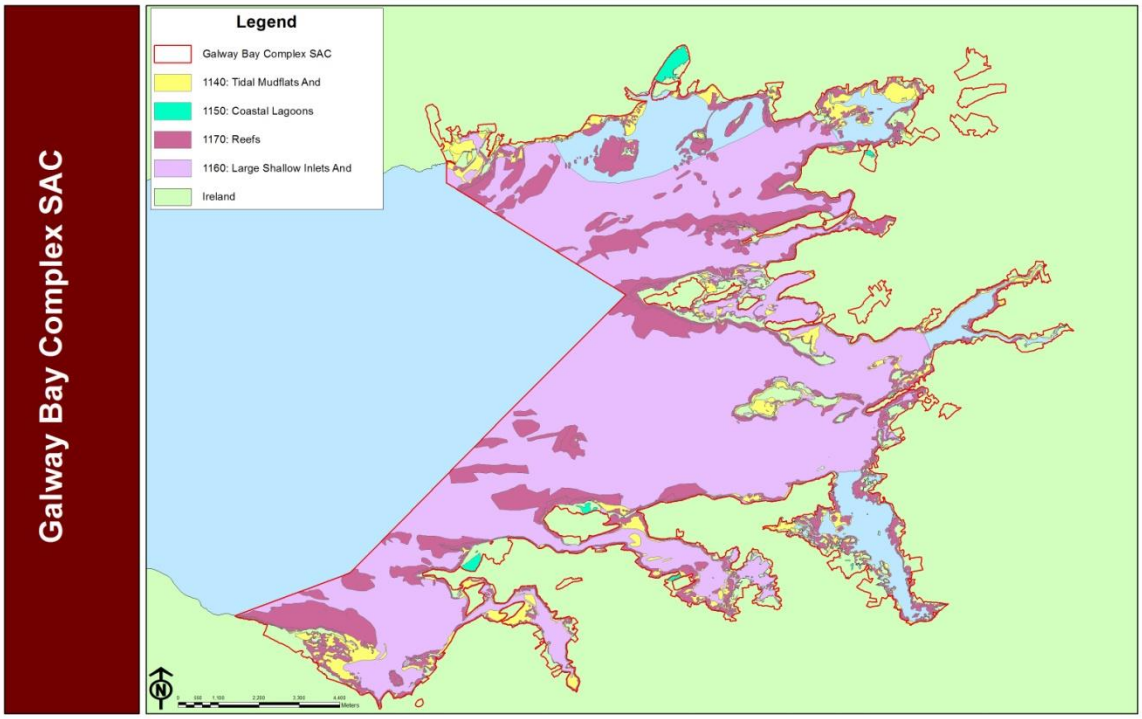

Figure 1 The extent of Galway Bay Complex SAC (Site Code 000268) and qualifying habitats.

3.3 Qualifying interests (SAC)

The SAC is designated for the following habitats and species (NPWS 2013a), as listed in Annex I and II of the Habitats Directive:

- 1140 Mudflats and sandflats not covered by sea water at low tide
- 1150 Coastal lagoons
- 1160 Large shallow inlets and bays
- 1170 Reefs
- 1220 Perennial vegetation of stony banks
- 1310 *Salicornia* and other annuals colonising mud and sand
- 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- 1355 Otter *Lutra lutra*
- 1365 Harbour Seal *Phoca vitulina*
- 1410 Mediterranean salt meadows (*Juncetalia maritimi*)
- 3180 Turloughs*
- 5130 *Juniperus communis* formations on heaths or calcareous grasslands
- 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia) (*important orchid sites)
- 7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae**

- 7230 Alkaline fens

Constituent community complexes recorded within the qualifying interests of Mudflats and sandflats not covered by seawater at low tide (1140), Large shallow inlets and bays (1160) and Reefs (1170) are listed below (NPWS 2013a Ver 1) and illustrated in Figure 2.

- Intertidal sandy mud community complex
- Intertidal sand community complex
- Maerl-dominated community
- *Zostera* dominated community complex
- Fine to medium sand with bivalves community complex
- Sandy mud to mixed sediment community complex
- Mixed sediment dominated with Mytilidae community complex
- Shingle
- Fucoid-dominated community complex
- *Laminaria*-dominated community complex
- Shallow sponge-dominated reef community complex
- *Mytilus*-dominated reef community

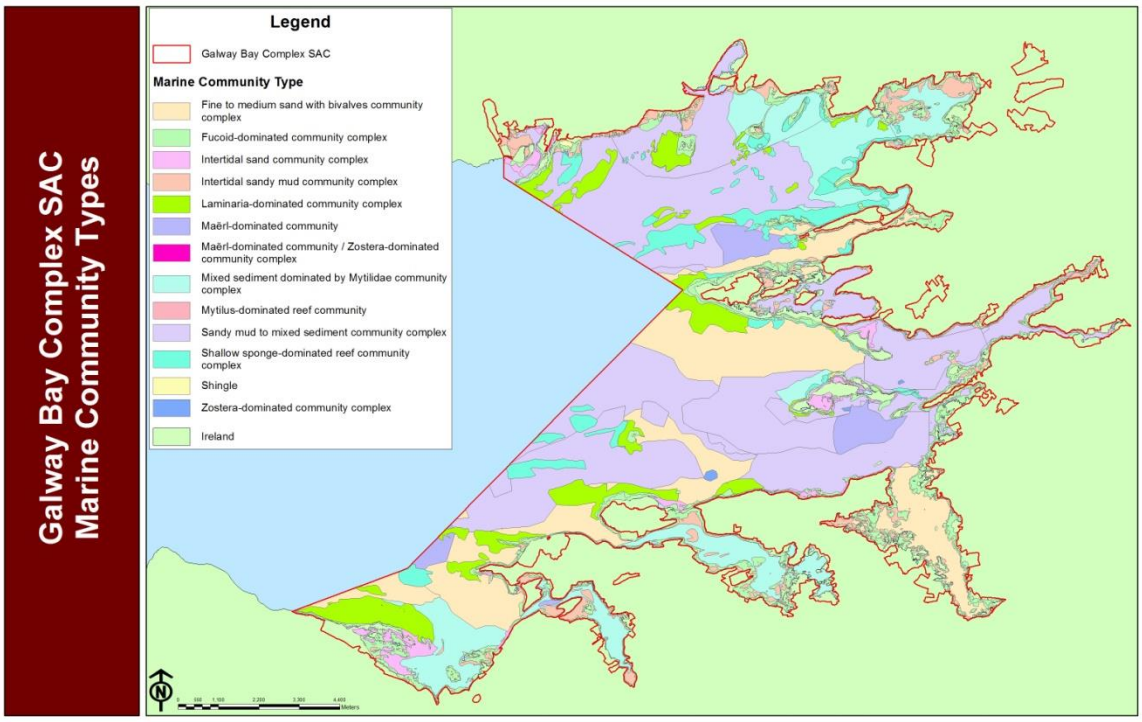

Figure 2 Principal benthic communities recorded within the qualifying interests of Galway Bay Complex SAC (Site Code 000268) (NPWS, 2013a).

The Galway Bay SAC is designated for the Harbour seal (*Phoca vitulina*) and has been the subject of a number of monitoring surveys since 2009 (NPWS 2010; 2011; 2012). Two sites surveyed within the SAC are Oranmore Bay and Kinvara Bay; recent estimates of seal populations at these sites, respectively, range from 105 and 109 in 2009, to 122 and 113 in 2010 and rising to 159 and 130 in 2011 (NPWS 2010, 2011, 2012). The Kinvara Bay estimate in 2010 was likely an underestimate based upon restricted visibility during surveying, according to the authors. In total, 221 Harbour seals were counted in inner Galway Bay during and aerial survey in 2012 (Duck and Morris 2013).

A number of different locations have been identified within the SAC and are considered important to the overall welfare and health of the populations at the site. Figure 3 identifies these locations and distinguishes between breeding, moulting and resting sites. Both moulting and breeding locations are considered particularly sensitive periods in the life cycle of the seals, i.e. NPWS. The pupping season (May-July) and moulting season (August-September) and are clearly defined and important to the overall health of the population in the SAC and that any disturbance during these times should be kept to a minimum. Less information is known about resting period (October-April) and resting areas throughout the SAC. However, the resting locations provided on Figure 3 are identified on the basis of sightings; however, all sheltered areas within the entire SAC are considered suitable habitat for resting (NPWS, 2013a). The importance of the resting sites are likely a function of the abundance of seals using the site and/or the degree of shelter afforded the location.

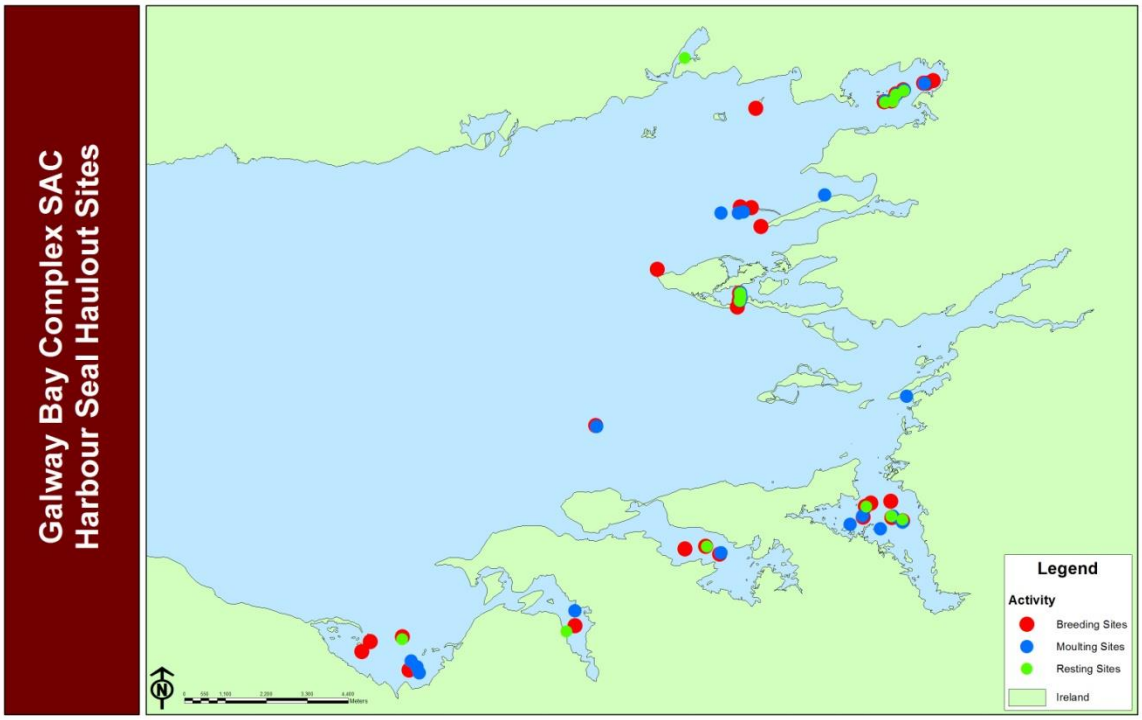

Figure 3 Harbour Seal (*Phoca vitulina*) locations in Galway Bay SAC (Site Code 000268) (NPWS, 2013a).

3.4 Conservation objectives for Galway Bay Complex SAC

The conservation objectives for the qualifying interests of the Galway Bay Complex (000268) were identified by NPWS (2013a). 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.

Table 1 Conservation objectives and targets for marine habitats and species in Galway Bay Complex SAC (Site Code 000268) (NPWS 2013a).

Annex I and II features listed in bold.

FEATURE (COMMUNITY TYPE)	**OBJECTIVE**	**TARGET**
1140 MUDFLATS AND SANDFLATS NOT COVERED BY SEAWATER AT LOW TIDE	Maintain favourable conservation condition	744ha; Permanent habitat is stable or increasing, subject to natural processes
INTERTIDAL SANDY MUD COMMUNITY COMPLEX		513ha; Conserved in a natural condition, significant continuous or ongoing disturbance should not exceed <15% of area
INTERTIDAL SAND COMMUNITY COMPLEX		232ha; Conserved in a natural condition, significant continuous or ongoing disturbance should not exceed <15% of area
1150 COASTAL LAGOONS	Restore favourable conservation condition	76.7ha; Targets are identified that focus on a wide range of attributes with the ultimate goal of maintaining function and diversity of favourable species and managing levels of negative species.
1160 LARGE SHALLOW INLETS AND BAYS	Maintain favourable conservation condition	10,825ha; Permanent habitat is stable or increasing, subject to natural processes.
ZOSTERA DOMINATED COMMUNITY COMPLEX		12ha; Maintain the extent and conserve the high quality of the community subject to natural processes
MAERL-DOMINATED COMMUNITY		350ha; Maintain the extent and conserve the high quality of the community subject to natural processes
INTERTIDAL SANDY MUD COMMUNITY COMPLEX		264ha; Conserved in a natural condition, significant continuous or ongoing disturbance should not exceed <15% of area

1160 LARGE SHALLOW INLETS AND BAYS CONT'D	Maintain favourable conservation condition	10,825ha; Permanent habitat is stable or increasing, subject to natural processes.
INTERTIDAL SAND COMMUNITY COMPLEX		230ha; Conserved in a natural condition, significant continuous or ongoing disturbance should not exceed <15% of area
FINE TO MEDIUM SAND WITH BIVALVES COMMUNITY COMPLEX		1879ha; As Above
SANDY MUD TO MIXED SEDIMENT COMMUNITY		4560ha; As Above
MIXED SEDIMENT DOMINATED WITH MYTILIDAE COMMUNITY COMPLEX		1139ha; As Above
SHINGLE		55ha; As Above
FUCOID-DOMINATED COMMUNITY COMPLEX		835ha; As Above
LAMINARIA-DOMINATED COMMUNITY COMPLEX		824ha; As Above
SHALLOW SPONGE-DOMINATED REEF COMMUNITY COMPLEX		596ha; As Above

FEATURE (COMMUNITY TYPE)	OBJECTIVE	TARGET
1170 REEFS	Maintain favourable conservation condition	2773ha; The distribution and permanent area is stable or increasing, subject to natural processes.
MYTILUS-DOMINATED REEF COMMUNITY		Maintain extent (>1ha) and conserve high quality of community subject to natural processes
FUCOID-DOMINATED COMMUNITY COMPLEX		1227ha; Conserved in a natural condition, significant continuous or ongoing disturbance should not exceed <15% of area
LAMINARIA-DOMINATED COMMUNITY COMPLEX		906ha; Conserved in a natural condition, significant continuous or ongoing disturbance should not exceed <15% of area
SHALLOW SPONGE-DOMINATED REEF COMMUNITY COMPLEX		640ha; Conserved in a natural condition, significant continuous or ongoing disturbance should not exceed <15% of area
1220 PERENNIAL VEGETATION OF STONY BANKS	Maintain favourable conservation condition	Area unknown; Targets are identifies 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.
1310 SALICORNIA AND OTHER ANNUALS COLONISING MUD AND SAND	Maintain favourable conservation condition	1.347ha; Targets are identifies that focus on a wide range of attributes with the ultimate goal of maintaining function and diversity of favourable species and managing levels of negative species.

FEATURE (COMMUNITY TYPE)	OBJECTIVE	TARGET
1330 ATLANTIC SALT MEADOWS (*GLAUCO-PUCCINELLIETALIA MARITIMAE*)	Restore favourable conservation condition	263.80ha; Unsurveyed areas may exist within the site; Targets are identified that focus on a wide range of attributes with the ultimate goal of increasing area subject to natural processes maintaining function and diversity of favourable species and managing levels of negative species.
1410 MEDITERRANEAN SALT MEADOWS (JUNCETALIA MARITIMI)	Restore favorable conservation conditions	19.887ha; Targets are identified that focus on a wide range of attributes with the ultimate goal of increasing area subject to natural processes maintaining function and diversity of favourable species and managing levels of negative species.
1355 OTTER *LUTRA LUTRA*	Restore favorable conservation conditions	Maintain distribution - 88% positive survey sites, No significant decline in extent of marine habitat; Couching sites and holts - no significant decline and minimise disturbance: Fish biomass - No significant decline in marine fish species in otter diet. Barriers to connectivity - No significant increase.
1365 HARBOUR SEAL *PHOCA VITULINA*	Maintain favourable conservation condition	The range of use within the site should not be restricted by artificial barriers; all sites (breeding, moult haul-out, resting) should be maintained in natural condition; human activities should occur at levels that do not adversely affect harbour seal population at the site.
3180 TURLOUGHS	Maintain favourable conservation condition	59ha: Targets are identified that focus on a wide range of attributes with the ultimate goal of mainting high quality conditions (hydrological, nutrient regimes etc..) subject to natural processes, maintaining function and

		diversity of characteristic taxa.
5130 *JUNIPERUS COMMUNIS* FORMATIONS ON HEATHS OR CALCAREOUS GRASSLANDS	Restore favorable conservation conditions	1.4 ha: Targets are identified that focus on a wide range of attributes with the ultimate goal of increasing area subject to natural processes maintaining function and diversity of favourable species i.e., *Juniperus communis* and managing levels of negative species.
6210 SEMI-NATURAL DRY GRASSLANDS AND SCRUBLAND FACIES ON CALCAREOUS SUBSTRATES (*FESTUCO BROMETALIA*) (*IMPORTANT ORCHID SITES)	Maintain favourable conservation condition	Unknown area: Targets are identified that focus on a wide range of attributes with the ultimate goal of increasing area subject to natural processes maintaining function and diversity of favourable species and managing levels of negative species and bare ground.
7210 CALCAREOUS FENS WITH CLADIUM MARISCUS AND SPECIES OF THE CARICION DAVALLIANAE*	Maintain favourable conservation condition	Unknown area: Targets are identified that focus on a wide range of attributes with the ultimate goal of increasing area subject to natural processes maintaining function and diversity of favourable species and managing water quality (nutrients) as well as levels of negative species and bare ground.
7230 ALKALINE FENS	Maintain favourable conservation condition	Unknown area: Targets are identified that focus on a wide range of attributes with the ultimate goal of increasing area subject to natural processes maintaining function and diversity of favourable species and managing levels of negative species and bare ground.

3.5 Screening of Adjacent SACs

In addition to the Galway Bay Complex SAC there are a number of other Natura 2000 sites proximate to the proposed activities (Figure 4). The characteristic features of these sites are identified in Table 2 where a preliminary screening is carried out on the likely interaction with aquaculture and fishery activities based primarily upon the likelihood of spatial overlap or other interactions. In addition, species migrating to and from the site may be affected by activities, such as fisheries, operating outside the site (*ex-situ* effects). Qualifying features that do not screen out because of *ex situ* effects or because of effects on features in adjacent SACs are carried forward for further assessment in Sections 5 and 7. These include Atlantic Salmon, Sea lamprey and Otter.

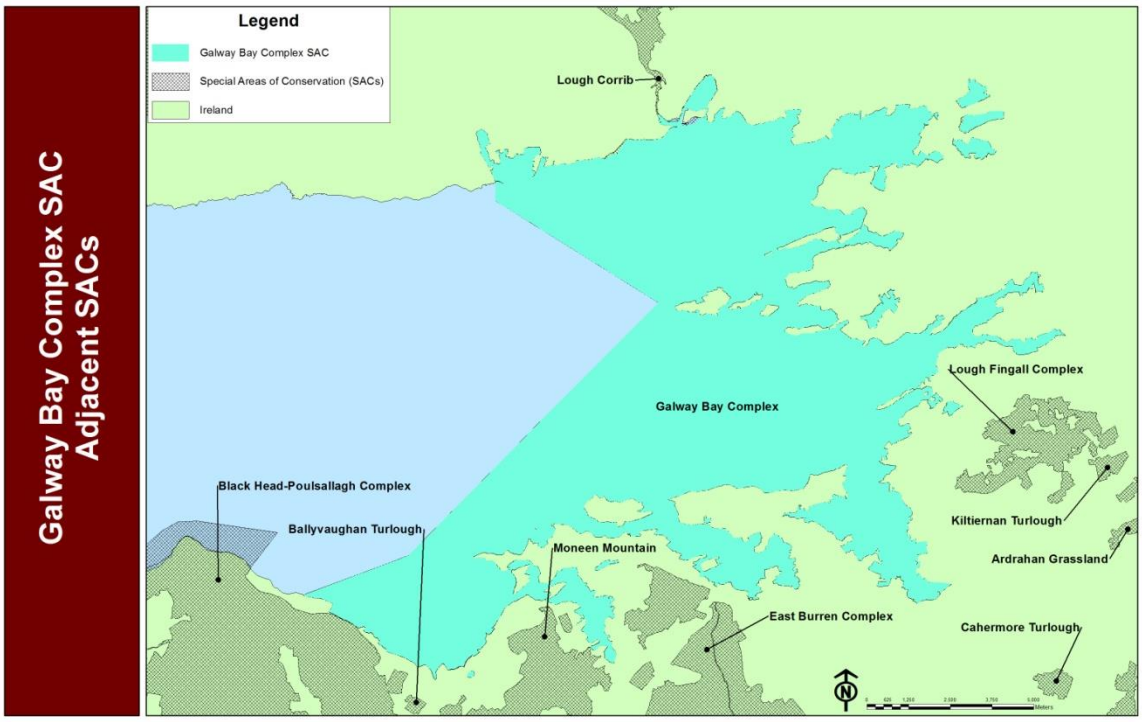

Figure 4. Natura 2000 sites adjacent to the Galway Bay Complex SAC.

Table 2: Natura Sites adjacent to Galway Bay Complex SAC and qualifying features with initial screening assessment on likely interactions with fisheries and aquaculture activities

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
Lough Corrib SAC (000297)	Freshwater pearl mussel (*Margaritifera margaritifera*) [1029]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	White-clawed crayfish (*Austropotamobius pallipes*) [1092]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Sea lamprey (*Petromyzon marinus*) [1095]	Migrating lamprey passing through Galway Bay Complex SAC and could interact with activities covered in this assessment- **carry forward to Section 7.**
	Brook lamprey (*Lampetra planeri*) [1096]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Salmon (*Salmo salar*) [1106]	Migrating salmon passing through Galway Bay Complex SAC and could interact with activities covered in this assessment- **carry forward to Section 7.**
	Lesser horseshoe bat (*Rhinolophus hipposideros*) [1303]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
	Otter (*Lutra lutra*) [1355]	Potential for otter to link between this SAC and Galway Bay Complex SAC. Otter also a feature of Galway Bay Complex SAC - **carry forward to Sections 5 and 7.**
	Shining sickle moss (*Drepanocladus vernicosus*) [1393]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Slender naiad (*Najas flexilis*) [1833]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. [3140]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*)(*important orchid sites) [6210]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
	Molinia meadows on calcareous, peaty or clavey-silt-laden soils (*Molinion caeruleae*) [6410]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Active raised bogs [7110]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Degraded raised bogs still capable of natural regeneration [7120]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Depressions on peat substrates of the Rhynchosporion [7150]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [7210]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Petrifying springs with tufa formation (Cratoneurion) [7220]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Alkaline fens [7230]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Limestone pavements [8240]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
	Old sessile oak woods with Ilex and Blechnum in British Isles [91A0]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Bog woodland [91D0]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
Lough Fingall Complex (000606)	Lesser horseshoe bat (*Rhinolophus hipposideros*) [1303]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Turloughs [3180]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Alpine and Boreal heaths [4060]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Juniperus communis formations on heaths or calcareous grasslands [5130]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) [6210]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [7210]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
	Limestone pavements [8240]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Lesser horseshoe bat (*Rhinolophus hipposideros*) [1303]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
Kiltiernan Turlough SAC (001285)	Turloughs [3180]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
Cahermore Turlough SAC (002294)	Turloughs [3180]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
Ardrahan Grassland SAC (002244)	Alpine and Boreal heaths [4060]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Juniperus communis formations on heaths or calcareous grasslands [5130]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Limestone pavements [8240]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
Black Head-Poulsallagh Complex SAC 000020	Reefs [1170]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
	Perennial vegetation of stony banks [1220]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Petalwort (*Petalophyllum ralfsii*) [1395]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Alpine and Boreal heaths [4060]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Juniperus communis formations on heaths or calcareous grasslands [5130]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*)(*important orchid sites) [6210]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) [6510]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Petrifying springs with tufa formation (Cratoneurion) [7220]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
	Limestone pavements [8240]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Submerged or partly submerged sea caves [8330]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
Ballyvaughan Turlough SAC 000996	Turloughs [3180]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
Moneen Mountain SAC 000054	Marsh fritillary (*Euphydryas aurinia*) [1065]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Lesser horseshoe bat (*Rhinolophus hipposideros*) [1303]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Turloughs [3180]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Alpine and Boreal heaths [4060]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Juniperus communis formations on heaths or calcareous grasslands [5130]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
	Calaminarian grasslands of the Violetalia calaminariae [6130]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*)(*important orchid sites) [6210]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Petrifying springs with tufa formation (Cratoneurion) [7220]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Limestone pavements [8240]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
East Burren Complex SAC 001926	Marsh fritillary (Euphydryas aurinia) [1065]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Lesser horseshoe bat (*Rhinolophus hipposideros*) [1303]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Otter (*Lutra lutra*) [1355]	Potential for otter to link between this SAC and Galway Bay Complex SAC. Otter also a feature of Galway Bay Complex SAC - **carry forward to Sections 5 and 7 .**

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp. [3140]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Turloughs [3180]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Water courses of plain to montane levels with the *Ranunculion fluitantis* and Callitricho Batrachion vegetation [3260]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Alpine and Boreal heaths [4060]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Juniperus communis formations on heaths or calcareous grasslands [5130]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia)(*important orchid sites) [6210]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) [6510]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae [7210]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis

NATURA SITE	QUALIFYING FEATURES [HABITAT CODE]	FISHERY AND AQUACULTURE INITIAL SCREENING
	Petrifying springs with tufa formation (Cratoneurion) [7220]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Alkaline fens [7230]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Limestone pavements [8240]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Caves not open to the public [8310]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis
	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) [91E0]	No spatial overlap or likely interaction with fisheries and aquaculture activities Galway Bay Complex SAC – excluded from further analysis

4 Aquaculture Activities

Aquaculture in Galway Bay Complex SAC focuses solely on shellfish species (oysters and mussels; Figures 5 and 6). Spatial extents of existing and proposed activities within the qualifying interests (Mudflats and sandflats not covered by sea water at low tide (1140), Large shallow inlets and bays (1160), Reefs (1170)) within the Galway Bay Complex SAC were calculated using coordinates of activity areas in a Geographic Information System (GIS). The spatial extent of the various aquaculture activities (current and proposed) overlapping the habitat features is presented in Table 3.

4.1 Oyster Culture

4.1.1 Intertidal Oyster Culture

The Pacific oyster, *Crassostrea gigas* is the primary species under cultivation in the Inner Galway Bay complex. There are two primary production methods; suspended culture and remote setting. The first of these, suspended culture, involves culture of seed bought from one of several hatcheries, either at Redbank, Streamstown Bay, Morecambe Bay or Guernsey Seafarms. Approximately 15 million gigas seed are grown or are intended to be grown on in the bay every year. Of these, approximately 46% is diploid seed from Irish hatcheries, 37% is diploid seed from Seasalter in Morecambe Bay or Guernsey Seafarms and 17% is triploid from the same two foreign hatcheries. It is generally bought in the summer months.

Seed was previously grown in one of two ways: either using bags and trestles or in floating trays. The latter method is no longer being used for several reasons. Instead there is a move to adaptations of the traditional bag and trestle method, or to growing oysters in swinging baskets on longlines.

The bag and trestle method uses steel table-like structures which rise from the shore to just above knee height on the middle to lower intertidal zone, arrayed in double rows with wide gaps between the paired rows to allow for tractor access. The trestles hold HDPE bags approximately 1m by 0.5m by 10cm, using rubber and wire clips to close the bags and to fasten them to the trestles. When first put to sea, there may be up to 2000 oysters in a single bag, but as they grow and are graded this number is gradually reduced. Over the course of the two or three years that it takes an oyster to reach saleable size, the density is reduced until market ready oysters, of approximately 100g each (when grown to full size) are being grown in bags of approximately 100 oysters per bag. The bags need to be shaken, turned and re-secured occasionally to prevent build-up of fouling and to ensure the growing oysters maintains a good marketable shape. This usually takes place once on each tidal cycle, when maximum exposure of the shore allows safe access to all trestles. It is most important

during the summer months when plankton, the oysters' food, is abundant and oyster growth rates are at their optimum. Oysters are grown on in these bags for up to three years,and will be graded two or three times each year. Summer grading is now looked upon unfavourably by growers as it stresses the oysters and makes them more susceptible to pathogens which are most common during the warm summer months and can lead to high mortality.

New adaptations of the traditional bag and trestle method are gaining favour nationally and internationally, and some of the applications currently under consideration propose using these methods. The first is the floating bag method. This differs from bag and trestle in that the bags are secured along one of the long sides and a small, purpose-built float is attached to the other side. As the tide rises and falls over the intertidal sites, the buoyant side of the bag rises, and it falls again with the outgoing tide. So essentially, the oysters are turned twice a day, every day. This can result in a more marketable oyster in terms of shape and meat yield. It also means that there are fewer labour inputs. The bags no longer need to be turned but instead only brought back to the packing shed for grading and re-bagging before being replaced on the trestles.

A second, more innovative method uses baskets to grow oysters. These hang from wires strung between poles on the intertidal. water movements cause the baskets to rock, again providing a better shaped oyster with a higher meat yield. This method has the added advantage that baskets can be deployed and retrieved at either high water, using a boat, or low water, using a tractor.

The pacific oyster is a bivalve mollusc that filter feed plankton and other nutrients from the sea when submerged during high tide periods. All the Galway Bay pacific oysters farms are positioned between mean Low water spring and mean Low water neap, allowing on average between 2 and 5 hours exposure depending on location, tidal and weather conditions. Maintenance activities on-site include shaking and turning of bags, and hand removal of fouling and seaweed to ensure maintenance of water flow through the bags when submerged. This ensures that the growing oyster maintains a good marketable shape and usually takes place once on each tidal cycle, when maximum exposure of the shore allows safe access to all trestles. It is most important during the summer months when plankton, the oysters' food, is abundant and oyster growth rates are at their optimum. Oysters are on-grown in these bags to half grown or full grown size for up to three years, and will be graded two or three times over the course of each summer. Subtidal Oyster culture

The subsidiary of Clarinbridge Co-Op which carried out subtidal *C gigas* production has ceased trading, so no Pacific oysters are being farmed subtidally in the bay at present. A single licence is used to culture the Native oyster, *Ostrea edulis* on the seabed in a shallow subtidal/low intertidal site near the mouth of the Dunkellin Estuary.

4.2 Mussel culture

Mussels (*Mytilus edulis*) are currently grown in suspended culture in two areas within Galway Bay Inner. The farm at Muckinish is in two adjacent locations. The bivalves are cultured on droppers suspended from longlines. Seed is collected by natural settlement on ropes, and these are spread out over both locations in late summer. Harvesting takes place on a year round basis, by boat. The second mussel-growing operation is at the mouth of Kinvara Bay with a second site between Eddy and Deer islands. The outer site is used for collection of natural settlement mussels. The collectors are moved to the inner site for on-growing. This farm uses rafts from which droppers are hung to grow the mussels. Each farm is accessed by boat, the former from the pier at Muckinish East, the latter from the Kinvara Harbour. Activity on each site continues year round.

4.3 Scallop Culture

There is a single application for a licence to grow scallops *Pecten maximus* in the bay. Like the mussel sites, it is intended to exploit a depression in the bedrock to allow for subtidal cuture of these bivalves. Anchor blocks are deployed at either end of the site and several metres down ropes headropes are put in place, suspended from buoys. Scallop seed may be sourced locally, and this is put into lantern nets which hang from the headrope. Scallops are harvested after three or four years in cultivation.

4.4 Seaweed Culture

There is a single application for a seaweed licence in Muckinish Bay, growing the native species *Alaria esculenta*, *Palmaria palmata* and *Porphyra umbilicalis*. The infrastructure for a seaweed farm is similar to that of a mussel farm. Longlines are suspended one to two metres below the water surface, kept in place by anchor blocks at either end. String that has been seeded at a seaweed hatchery is wound around the headrope and secured in place. This usually takes place in mid-winter. The crop can be harvested by boat in early summer and the site left fallow for the next crop.

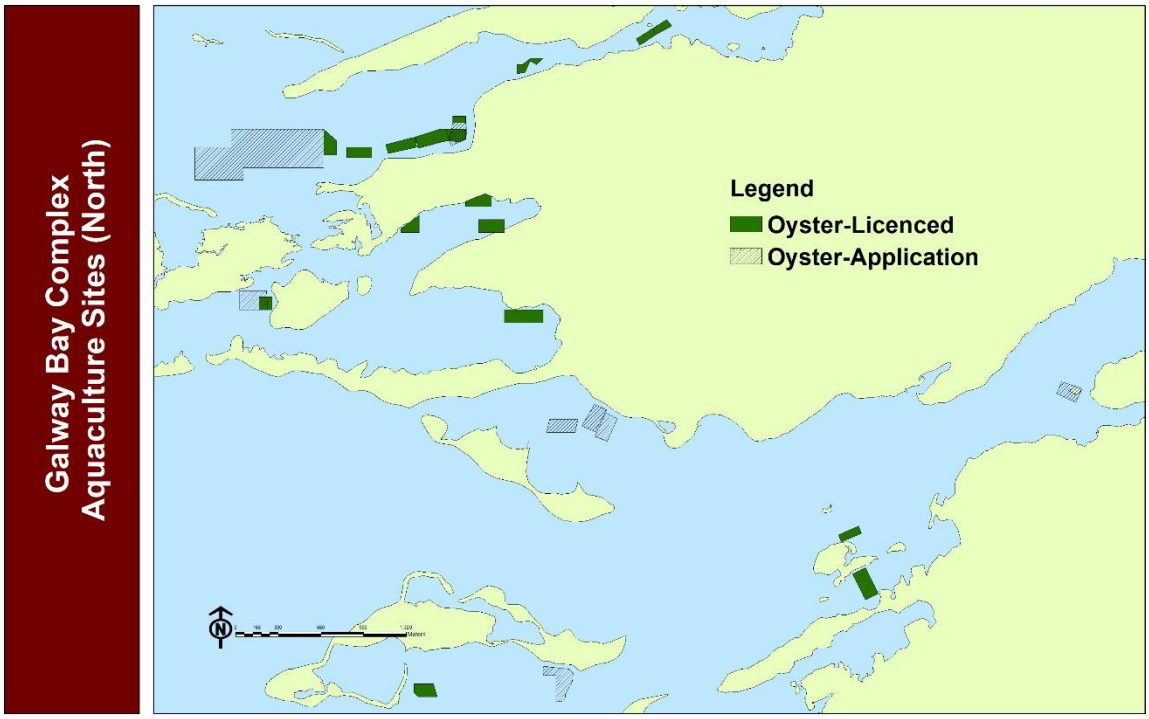

Figure 5. Proposed and existing shellfish culture activity within the northern portion of Galway Bay Complex SAC (Site Code 000268).

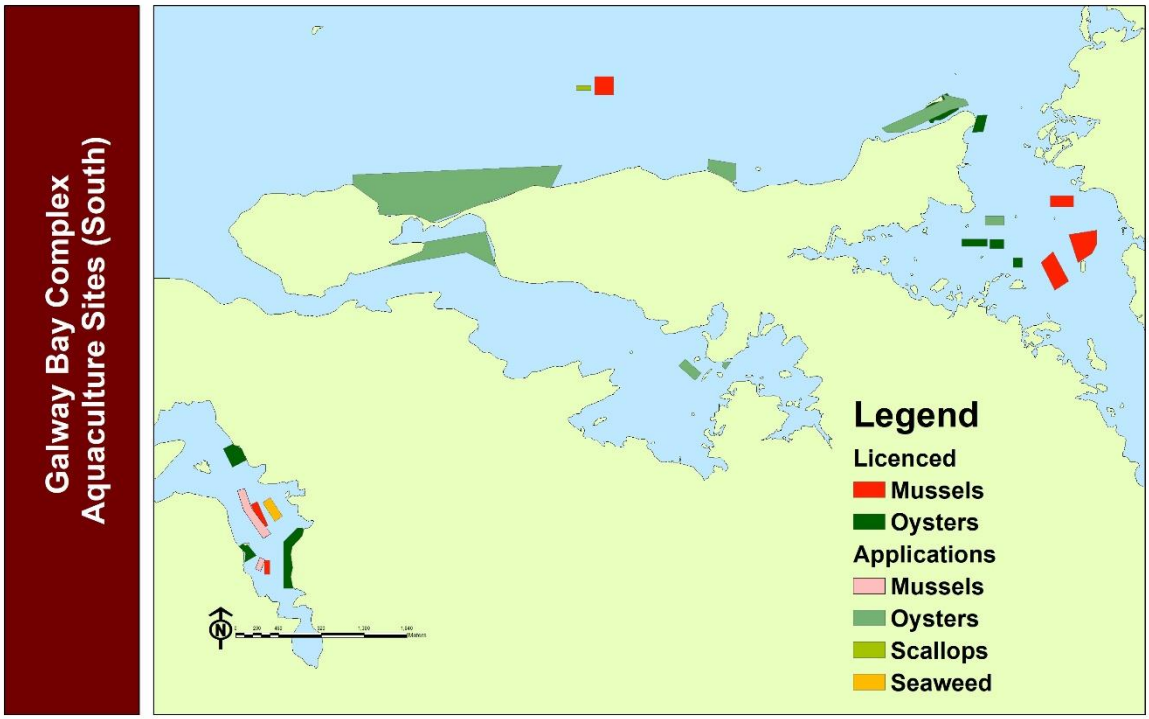

Figure 6. Proposed and existing shellfish culture activity within the southern portion of Galway Bay Complex SAC (Site Code 000268).

Table 3: Spatial extent (ha) of aquaculture activities overlapping with the qualifying interests in Galway Bay Complex SAC (Site Code 000268), 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 (743.97ha)		1160 Large shallow inlets and Bays (10819.84ha)		1170 Reefs (2771.51ha)	
			Area (ha)	% Feature	Area (ha)	% Feature	Area (ha)	% Feature
Oysters	Licensed	Intertidal (Intensive)	4.87	0.65	42.79	0.4	7.22	0.26
Oyster (native)	Licensed	Extensive	0.13	0.017			0.83	0.03
Oysters	Application	Intertidal (Intensive)	27.14	3.6	158.03	1.46	41	1.5
Mussels	Licensed	Subtidal (Intensive)			6.96	0.06		
Mussels	Application	Subtidal (Intensive)			5.79	0.05		
Scallop	Application	Subtidal (Intensive)			0.72	0.01		
Seaweed	Application	Subtidal			2.37	0.02		
Access routes			0.9	0.12	0.39	<0.01	2.5	0.1

5 Natura Impact Statement for the proposed activities

The potential ecological effects of activities on the conservation objectives for the site relate to the physical and biological effects of fishing gears or aquaculture structures and human activities on designated species, intertidal and sub-tidal community types within the habitat features (e.g., 1140, 1150, 1160 and 1170). 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.

5.1 Aquaculture and habitat interactions

Within the qualifying interest of Galway Bay Complex SAC, the species cultured are:

1. Oysters (*Crassostrea gigas*) in suspended culture (bags & trestles, remote setting) confined primarily to intertidal areas.
2. Oysters (*Ostrea edulis*) subtidally on the seafloor.
3. Mussels (*Mytilus edulis*) in suspended culture (Longlines).
4. Scallop in suspended culture (Longlines)
5. Seaweed in suspended culture (Longlines)

Details of the potential biological and physical effects of these aquaculture activities on the habitat features, their sources and the mechanism by which the impact may occur are summarised in Table 4 below**.** The impact summaries identified in the table are derived from published primary literature and review documents that have specifically focused upon the environmental interactions of shellfish culture (e.g. Black 2001; McKindsey et al. 2007; National Research Council 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 (Brenner et al., 2014). When the seed is sourced locally (e.g. suspended 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 considerably greater given that the stock will have been grown in the wild for a prolonged period (i.e. ½-grown stock).

Furthermore, the culture of a non-native species (e.g. the Pacific Oyster - *Crassostrea gigas*) also presents a risk of establishment of this species in the SAC. Recruitment of *C. gigas* has been documented in a number of bays in Ireland (including Inner Galway Bay) and appears to have become naturalised (i.e. establishment of a breeding population) in two locations (Kochmann et al 2012; 2013). Factors deemed to influence the successful recruitment of *C. gigas* include; residence time, presence of suitable habitat (hard substrata and/or biogenic reef) and large intertidal areas (Kochmann et al., 2013). However, a recent study (Kochmann and Crowe, 2014) has identified heavy macroalgal cover as a potential factor governing successful recruitment, with higher cover resulting in lower recruitment? The culture of large volumes of Pacific oysters, particular uncontained on the seafloor, may increase the risk of successful reproduction in Galway Bay Complex SAC especially given that oysters grown subtidally have been shown to mature earlier and have higher condition (Mag Aoidh 2011). The use of triploid (putatively non-reproducing) stock is the main method employed to manage this risk of successful reproduction, however only 17% of the oyster seed brought into Galway Bay is triploid.

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

1. Hydrography – will governs how quickly the wastes disperse from the culture location and the density at which they will accumulate on the seafloor.
2. Turbidity in the water - the higher the turbidity the greater the production of pseudo-faeces and faeces by the filter feeding animal and the greater of risk of accumulation on the seafloor.

3. Density of culture – suspended mussel culture is considered a dense culture method with high densities of culture organisms over a small area. The greater the density of organisms the greater the risk of accumulations of material. The density of culture organisms is a function of:
    a. depth of the site (shallow sites have shorter droppers and hence fewer culture organisms),
    b. the husbandry practices – proper maintenance will result in optimum densities on the lines in order to give high growth rates as well as reducing the risk of drop-off of culture animals to the seafloor and sufficient distance among the longlines to reduce the risk of cumulative impacts in depositional areas.

In addition placement of structures associated with mussel culture can influence the degree of light penetration to the seabed. This is likely important for organisms and habitats e.g. macroalgae, maerl and seagrasses which need sun light for production. Rafts or lines will to a degree limit light penetration to the seabed and may therefore reduce production of photosynthesising species.

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 are responsible for reducing water flow and allowing suspended material (silt, clay as well as faeces and pseudo-faeces) to fall out of suspension to the seafloor. The build-up of material will typically occur directly beneath the trestle structures and can result in accumulation of fine, organically rich sediments. These sediments may result in the development of infaunal communities distinct from the surrounding areas. Whether material accumulates is dictated by a number of factors, including:

1. Hydrography – low current speeds (or 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 resuspend and disperse material beneath the trestles.

Shading may also be an issue as a consequence of the structures associated with intertidal oyster culture and impact on sensitive species (e.g. sea grasses) found underneath (Skinner et al., 2014).

The structures used for culture of shellfish (subtidal and intertidal) may facilitate the introduction and establishment and of some non-native species. For example, the sea squirt, *Didemnum vexillum,* has been recorded on aquaculture structures (trestles) in Galway Bay (NPWS 2014 - unpublished report). This invasive species has been implicated in harm to habitats and species (Valentine et al, 2007) in addition to aquaculture activities, particularly at earlier culture stages (e.g., Fletcher et al 2013). This species can extend from structures to hard substrates (seabed habitats) and potentially occlude other species. While the movement of shellfish stock may facilitate the spread of this species, most occurrences in Ireland and the UK appear have been associated with marinas and vessel movements.

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.

Seaweed culture: Suspended culture of seaweed while considered extractive and relatively benign may impact on photosynthesising species relying located beneath the structures as shading may be an issue.

Sub-tidal oyster: This activity involves relaying oysters on the seabed. There may be increased enrichment due to production of faeces and pseudofaeces. The existing in-faunal community may be changed as a result. Seabed habitat change may also result as a result of dredging during maintenance and harvesting. Uncontained sub-tidal oyster culture will lead to change in community structure and function through the addition, at high % cover, of an epi-benthic species (living on the seabed) to an infaunal sedimentary community.

The activities associated with this culture practice (dredging of the seabed) are considered disturbing which can lead to removal and/or destruction of infaunal species and changes to sediment composition. In addition, the location of large numbers of a single epifaunal species onto what is, in essence, an infaunal dominated system will likely result in a change to structure and function of the habitat. Finally, the transfer of seed stock from one broad geographic location to another presents a risk of introduction of non-native species (hitch-hikers) or other threats (Brenner et al., 2014).

Table 4 Potential indicative environmental pressures of aquaculture activities within Galway Bay Complex SAC (Site Code 000268).

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

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

CULTURE METHOD	PRESSURE CATEGORY	PRESSURE	POTENTIAL EFFECTS	EQUIPMENT	DURATION (DAYS)	TIME OF YEAR	FACTORS CONSTRAINING THE ACTIVITY/EFFECTS
			communities and potential impact on carrying capacity				
		Introduction of non-native species	Potential for non-native culture and 'hitchhiker' species become naturalized and proliferate. Potential for structures to act as habitat for non-native species				Screening; Culture/structure density; best practice guidelines - managing non-native species.
		Disease risk	Potential for disease introduction and uncontrolled spread				Screening
	Physical	Surface disturbance	Ancillary activities at sites increase the risk of sediment compaction resulting in sediment changes and associated community changes.	Site services, human & vehicular traffic	365?	All year	Single established route; Good site practices
		Sub-surface disturbance	Shallow and deep disturbance, Epifaunal and infaunal community disturbance	Dredge	Seed collection, relaying spat, harvesting	Summer - Autumn; Nov. - Apr	

5.2 Aquaculture and marine mammal interactions

Potential interactions between mariculture and marine mammals are broadly summarized in Table 5. It should be noted that direct demonstrations of these impacts are rare, and in most cases, potential effects are therefore predicted from the best existing information (National Research Council, 2010). Furthermore, none of the studies published to explore impacts on marine mammals and in particular Harbour Seals, were specifically designed to detect ecological impacts on this species (National Research Council 2009; Becker et al., 2009, 2011). Even where studies have been carried out around shellfish farms, uncertainty over spatial and temporal variation in both the location of structures (Watson-Capps and Mann, 2005) and levels of disturbance (Becker et al., 2009; 2011) constrain the conclusions that can be drawn about the impacts of mariculture on critical life functions such as reproduction and foraging.

Mariculture operations are considered a source of marine litter (Johnson, 2008). Ingestion of marine litter has also been shown to cause mortality in birds, marine mammals, and marine turtles (Derraik, 2002). Mariculture structures can provide shelter, roost, or haul-out sites for birds and seals (Roycroft et al., 2004). This is unlikely to have negative effects on bird or seal populations, but it may increase the likelihood that these species cause faecal contamination of mollusc beds.

Harbour seals (*Phoca vitulina*)

Little information is available on the potential interactions between seals and the activities in question (see National Research Council 2009). There has been no targeted research conducted in similar ecosystems that has directly assessed the impact of this type of aquaculture on harbor seals or indeed any other seal populations. There has, however, been considerable research on short-term responses of harbor seals to disturbance from other sources, and these can be used to inform assessments the potential impacts of disturbance from aquaculture activities currently underway and proposed in Galway Bay Complex SAC. These disturbance studies have focused on impacts upon groups of seals that are already ashore at haul-out sites. Sources of potential disturbance have varied widely, and include people and dogs (Allen et al., 1984; Brasseur & Fedak, 2003), recreational boaters (Johnson & Acevedo-Gutierrez, 2007; Lelli & Harris, 2001; Lewis & Mathews, 2000), commercial shipping (Jansen et al., 2006), industrial activity (Seuront & Prinzivalli, 2005) and aircraft (Perry et al., 2002). A harbor seal's response to disturbance may vary from an increase in alertness, movement towards the water, to actual entering into the water, i.e. flushing (Allen et al., 1984) and is typically governed by the location and nature of the disturbance activity. For example, kayaks may elicit a stronger response than power boats (Lewis & Mathews, 2000; Suryan & Harvey, 1999), and stationary boats have been shown to elicit a stronger response than boats moving along a predictable (or predetermined) route (Johnson & Acevedo-Gutierrez, 2007). Furthermore, the mean

distance at which seals are flushed into the water by small boats and people ranges between 80m and 530m, with some disturbances recorded at distances of over 1000m. In certain areas, these empirical studies have been used to inform management actions in marine protected areas, for example where a 1.5km buffer is set around harbor seal haul-out sites in the Dutch Wadden Sea to exclude recreational disturbance (Brasseur & Fedak, 2003).

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

In the Galway Bay Complex SAC it would appear that the overall Harbour Seal numbers (population) has been stable or increasing between 2003 and 2012 (NPWS, 2010, 2011, 2012) coincident with static levels of mariculture production. While no definitive conclusions can be drawn regarding the population status of harbour seals in Galway Bay and more widely around Ireland, based upon survey reports from 2009-2011 (as no baseline reference values are provided), it isnoted that from a conservation perspective, the population is considered 'favourable' (NPWS, 2013a and c).

Otter (*Lutra lutra*)

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

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

suggest that disturbance by recreation is a significant pressure". Recreation in the NPWS report is defined as angling, boating and mariculture.

Table 5 Potential interactions between aquaculture activities and the Annex II species Harbour Seal (*Phoca votulina*), Otter (*Lutra lutra*) within the Galway Bay Complex SAC (000268).

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

6 Appropriate Assessment Screening

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

In this assessment, screening of the qualifying interests against the proposed activities is based primarily on spatial overlap i.e. if the qualifying interests overlap spatially with the proposed activities then significant impacts due to these activities on the conservation objectives for the qualifying interests is not discounted (not screened out) except where there is absolute and clear rationale for doing so. Where there is relevant spatial overlap full assessment is warranted. Likewise, if there is no spatial overlap and no obvious interaction is likely to occur, then the possibility of significant impact is discounted and further assessment of possible effects is deemed not to be necessary. Table 3 provides spatial overlap extent between designated habitat features and aquaculture activities within the qualifying interests of Galway Bay Complex SAC.

6.1 Aquaculture Activity Screening

Table 3 highlights the spatial overlap between (existing and proposed) aquaculture activities and Qualifying Interests of the site (i.e. Coastal Lagoons (1150), Mudflat and sandflats not covered by seawater at low tide (1140), Large shallow inlets and bays (1160), Reefs (1170)).

Tables 6, 7 and 8 provides an overview of overlap (ha, %) of aquaculture activities and specific community types within the broad habitat features (identified from Conservation Objectives, NPWS, 2013a). Where the overlap between an aquaculture activity and a feature is zero, and no interaction is considered likely, it is screened out and not considered further.

None of the aquaculture activities overlaps with the following features, and therefore these nine habitats are excluded from further consideration in this assessment:

1. **1220 Perennial vegetation of stony banks**
2. **1310 *Salicornia* and other annuals colonising mud and sand**
3. **1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae)**
4. **1410 Mediterranean salt meadows (Juncetalia maritimi)**
5. **3180 Turloughs***
6. **5130 *Juniperus communis* formations on heaths or calcareous grasslands**
7. **6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia)(*important orchid sites)**
8. **7210 Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae***
9. **7230 Alkaline fens**

Of the eleven community types (see Table 1) recorded from the remaining four qualifying Interests (1140 - Table 6**,** 1150, 1160 - Table 7 and 1170 - Table 8) only one (***Mytilus*-dominated reef community**) had no spatial overlap between it and aquaculture activities (Table 8). On this basis, the community type *Mytilus*-dominated reef community was excluded from further spatial analysis.

The **Atlantic salmon (*Salmo salar*)** migrates through inner Galway Bay both to and from the Lough Corrib SAC. Given the nature of the activities proposed for aquaculture in inner Galway Bay, it is unlikely that aquaculture activities will impact on the conservation attributes for Salmon, which are:

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

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

The **Sea lamprey (*Petromyzon marinus*)** migrate through Galway Bay into the Lough Corrib SAC system. Given the activities carried out in Galway Bay are away from potential access channels to River Corrib and predominantly intertidal in nature, it is unlikely that they will impact upon the attributes and their targets for Sea lamprey[5], which are freshwater in nature. The attributes are:

- Extent of anadromy
- Population structure of juveniles
- Juvenile density in fine sediment
- Extent and distribution of spawning habitat
- Availability of juvenile habitat

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

[5] Given that detailed Conservation objectives have not been published for Lough Corrib SAC, the CO's for Sea lamprey were obtained from the Castlemaine Harbour SAC (http://www.npws.ie/media/npwsie/content/images/protectedsites/conservationobjectives/CO000343.pdf)

Table 6 Habitat utilisation i.e. spatial overlap in hectares and proportion of specific community type (%) by aquaculture activity within the qualifying interest 1140 of Galway Bay Complex SAC. (Based on licence database provided by DAFM. Habitat data provided in NPWS 2013a, 2013b).

			1140 - Mudflats and sandflats not covered by seawater at low tide (743.97ha)			
Species	Status	Method	Intertidal sand comm. complex (231.64ha)		Intertidal sandy mud comm. complex (512.34ha)	
Oysters	Licensed	Intertidal (Intensive)	0.28	0.12	4.66	0.91
Oysters	Licenced	Extensive	-	-	0.134	0.03
Oysters	Application	Intertidal (Intensive)	14.67	6.33	12.48	2.44
Access routes			0.35	0.15	0.57	0.11

Table 7. Habitat utilisation i.e. spatial overlap in hectares and proportion of specific community type (%) by aquaculture activity within the qualifying interest 1160 of Galway Bay Complex SAC. (Based on licence database provided by DAFM. Habitat data provided in NPWS 2013a, 2013b).; (Status: L-Licensed, A-Application).

1160 – Large shallow inlets and bays (10819.84ha)																						
Culture Species	**Method**	**Status**	**Maërl-dominated com. (350 ha)**		**Intertidal sandy mud com. Complex (264 ha)**		**Mixed sediment dominated by Mytilidae community complex (1139 ha)**		**Fine to medium sand with bivalves community complex (1879 ha)**		***Laminaria*-dominated com. Complex (824 ha)**		**Sandy mud to mixed sediment com. Complex (4560 ha)**		**Shallow sponge-dominated reef com. Complex (596 ha)**		**Intertidal sand com. Complex (230 ha)**		**Fucoid-dominated com. Complex (835 ha)**		**Shingle (55 ha)**	
			Ha	**%**	**Ha**	**%**	**Ha**	**%**	**Ha**	**%**	**Ha**	**%**	**Ha**	**%**	**Ha**	**%**	**Ha**	**%**	**Ha**	**%**	**Ha**	**%**
Oysters	**Intertidal Intensive**	**L**	**<0.001**	**-**	**2.39**	**0.9053**	**8.16**	**0.7164**	**8.30**	**0.4417**			**16.48**	**0.3614**	**3.19**	**0.5352**			**3.47**	**0.4156**		
Oysters	**Intertidal Intensive**	**A**	**0.46**	**0.1314**	**12.20**	**4.6212**	**3.36**	**0.2950**	**58.8**	**3.1277**	**18.16**	**2.2039**	**24.37**	**0.5344**	**1.83**	**0.3070**	**14.67**	**6.3783**	**20.68**	**2.4766**	**1.64**	**2.9818**
Mussels	**Subtidal Intensive**	**L**					**2.96**	**0.2599**	**0.42**	**0.0224**			**3.58**	**0.0785**								
Mussels	**Subtidal Intensive**	**A**							**5.79**	**0.3081**												
Scallop	**Subtidal Intensive**	**A**											**0.72**	**0.0158**								
Seaweed	**Subtidal**	**A**					**2.37**	**0.2081**														
Access routes					**0.06**	**0.0216**	**0.001**	**0.0001**	**0.04**	**0.0021**			**0.03**	**0.0006**	**0.00**	**0.0005**	**0.04**	**0.0152**	**0.25**	**0.0299**	**0.04**	**0.0782**

Table 8. Habitat utilisation i.e. spatial overlap in hectares and proportion of specific community type (%) by aquaculture activity within the qualifying interest 1170 of Galway Bay Complex SAC. (Based on licence database provided by DAFM. Habitat data provided in NPWS 2013a, 2013b). (L-Licensed, A-Application)

1170 Reefs (2771.51ha)								
Culture Species	**Location**	**Status**	***Laminaria*-dominated community complex (906 ha)**		**Shallow sponge-dominated reef community Complex (640ha)**		**Fucoid-dominated community complex (1227 ha)**	
Oysters	**Intertidal (Intensive)**	**L**	**18.16**	**2**	**3.19**	**0.5**	**4.03**	**0.4**
Oysters-native	**Subtidal (Extensive)**	**L**	**-**	**-**	**-**	**-**	**0.83**	**0.03**
Oysters	**Intertidal (Intensive)**	**A**	**-**	**-**	**1.83**	**0.29**	**21**	**1.7**
Access routes			**-**	**-**	**0.003**	**<0.001**	**0.25**	**0.02**

7 Appropriate Assessment-Aquaculture

7.1 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 2013a, b).

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 Galway Bay these habitats include:

- **1160 Zostera dominated community complex**
- **1160 Maerl dominated community**

Within the Galway Bay Complex SAC the qualifying habitats/species considered further in this assessment are:

- **1140 Mudflats and sandflats not covered by seawater at low tide**
- **1160 Large shallow inlets and bays**
- **1170 Reefs**
- **1355 Otter *Lutra lutra***
- **1365 Common (Harbour) seal *Phoca vitulina***

For broad habitats and sedimentary community types (Figures 1 and 2) significance of impact is determined in relation to, first and foremost, spatial overlap (see Section 7 and Figure 12). Subsequent disturbance and the persistence of disturbance are considered as follows:

1. The degree to which the activity will disturb the qualifying interest. By disturb is meant change in the characterising species, as listed in the Conservation Objective guidance (NPWS 2013b) for constituent communities. The likelihood of change depends on the sensitivity of the characterising species to the aquaculture activities. Sensitivity results from a combination of intolerance to the activity and recoverability from the effects of the activity (see Section 8.2 following).
2. The persistence of the disturbance in relation to the intolerance of the community. If the activities are persistent (high frequency, high intensity) and the receiving community has a high intolerance to the activity (i.e. the characterising species of the communities are sensitive and consequently impacted) then such communities could be said to be persistently disturbed.

3. The area of communities or proportion of populations disturbed. In the case of community disturbance (continuous or ongoing) of more than 15% of the community area it is deemed to be significant.

Effects will be deemed to be significant when cumulatively (or in-combination with other similarly disturbing activities) they lead to long term change in communities in greater than 15% of the area of any constituent community listed.

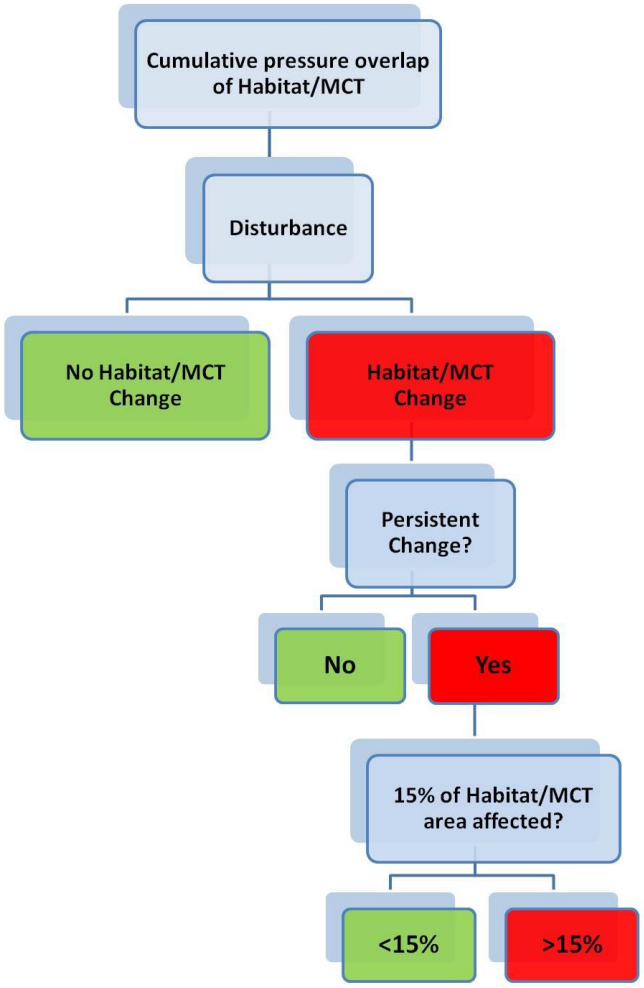

Figure 7. Determination of significant effects on community distribution, structure and function. In relation to designated species (Harbour Seal, Otter) the capacity of the population to maintain itself in the face of anthropogenic induced disturbance or mortality at the site will need to be taken into account in relation to the Conservation Objectives (CO's) on a case-by-case basis.

7.2 Sensitivity and Assessment Rationale

This assessment primarily employed a number of sources of information in assessing the sensitivity of the characterising species of each community recorded within the benthic habitats of Galway Bay Complex 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 fisheries) 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 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- 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 2013b).
- 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 Galway Bay Complex SAC to pressures similar to those caused by aquaculture (e.g. smothering, organic enrichment and physical disturbance) are listed, where available, in Table 9. The sensitivities of species which are characteristic (as listed in the Conservation Objective supporting document) of benthic communities to pressures similar to those caused by aquaculture (e.g. smothering, organic enrichment and physical disturbance) are listed, where available, in Table 10. 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).

Table 9. Matrix showing the sensitivity to pressure scores (ABPMer 2013a-h) of communities recorded within Galway Bay Complex SAC (Site Code 000268).

(Note: Table 11 provides the code for the various categorisation of sensitivity and confidence.)

Pressure Type	***Physical Damage***						***Change in 'Habitat' Quality***								***Biological Pressures***								***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 of sediments-sedimentation	Increased removal of primary production-phytoplankton	Decrease in oxygen levels- sediment	Decrease in oxygen levels-water column	Introduction of non-native species	Removal of Target Species	Removal of Non-target species	Ecosystem Services-Loss of biomass		Prevention of light reaching seabed/features
Intertidal sandy mud community complex (A2.24)	NS (***)	L (*)	L (***)	NS (*)	L (*)	L-M (*)	L-M (*)	L-M (*)	L-M (*)	NS (*)	L-M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	M (*)	L (*)	H (***)	NS (*)	NS (*)	NA	NS (*)
Intertidal sand 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 (*)	NA	NS (*)
Maerl-dominated community (A5.51)	H (***)	H-VH (***)	H (***)	H (***)	H (***)	H-VH (***)	H-VH (***)	H-VH (***)	NS (*)	NS (*)	NS (*)	H (*)	NS (*)	H (*)	H (***)	NS (*)	H (**)	H (**)	H (***)	VH (***)	NS (*)	NE	VH (*)
Zostera dominated community complex (A2.6, A5.5)	M-H (***)	M-VH (***)	M-VH (***)	M-H (***)	M-H (***)	M-VH (***)	VH (***)	VH (***)	M (*)	M (***)	M (*)	H (***)	NS (*)	H (***)	H (***)	NS (*)	H-VH (*)	H-VH (*)	H (**)	NS (*)	NS (*)	NA	H-VH (**)

Fine to medium sand with bivalves community complex (Subtidal A5.23)	NS (*)	L (*)	L (*)	NE	NE	L-M (*)	L-M (*)	L-M (*)	L-M (*)	M (*)	L-M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (*)	NS (*)	NA	NS (*)
Sandy mud to mixed sediment community complex (Subtidal A5.33)	NS (*)	L (*)	L (*)	NE	NE	L- (*)	L (*)	L-M (*)	L-M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	L (*)	NS (*)	L (*)	L (*)	H (*)	NS (*)	NS (*)	NA	NS (*)
Fucoid-dominated community complex (Intertidal A1.21)	NS (*)	NA	NA	NS (*)	NE	NA	L(*)	M-VH (*)	NA	NA	NS (*)	NS (*)	NS (*)	NS (*)	NE	NS (*)	NE	NS (*)	NS (*)	NS (*)	NS (*)	NA	NS (*)
Laminaria-dominated community complex (A3.21)	NS (*)	NA	NA	NE	NE	NA	NS (*)	M-VH (*)	NA	NA	NS (*)	NS (*)	NS (*)	NS (*)	NE	NS (*)	NE	NS (*)	NS (*)	NS(*)	NS (*)	NA	NS (*)
Shallow sponge-dominated reef community complex (A3.2;4.2)	NS (*)	NA	NA	NE	NE	NA	NS (*)	M-VH (*)	NA	NA	NS (*)	NS (*)	NS (*)	NS (*)	NE	NS (*)	NE	NS(*)	NS (*)	NS (*)	NS (*)	NA	NS (*)

Table 10 Matrix showing the sensitivity to pressure scores (ABPMer 2013a-h) of characterising species recorded within Galway Bay Complex SAC (Site Code 000268).

(Note: Table 11 provides the code for the various categorisation of sensitivity and confidence.)

Pressure Type	***Physical Damage***								***Change in 'Habitat' Quality***										***Biological Pressures***		
Pressure	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
Abra alba	L (*)	L (***)	L (*)	L (*)	L (*)	M (*)	NS (***)	M (*)	L (*)	N (*)	NS (*)	L (*)	L (*)	NS (*)	NS (*)	NS (*)	L (***)	L-M (***)	L-M (*)	NS (*)	NS (*)
Bathyporeia spp.	NS (*)	L (***)	L (***)	NS (*)	L (*)	L-M (*)	L (***)	L-M (*)	L-M (*)	L-M (*)	NS (*)	NS (*)	NS (*)	L-M (*)	L-M (*)	NS (*)	L-M (***)	L-M (***)	L-M (*)	NS (*)	NS (*)
Capitella spp.	L (*)	L (**)	L (**)	L (***)	L (*)	L (*)	L (*)	NS (*)	NS (*)	NS (***)	NS (*)	NS (*)	NS (*)	NS (***)	NS (***)	NS (*)	L (***)	L (***)	NS (*)	NS (*)	NS (*)
Cerastoderma edule	L (*)	L-M (*)	L-M (***)	L-M (***)	L-M (*)	L-H (*)	L (***)	L-M (*)	L-H (*)	NS (*)	L (*)	NS (*)	NS (*)	NS (*)	NS (*)	L-NS (*)	L-M (*)	L-M (*)	M (*)	M (*)	NS (*)
Lanice conchilega	NS (*)	NS-L (***)	NS-L (***)	NS (*)	NS-L (*)	M-H (*)	NS (*)	M-H (*)	NS (*)	NS (***)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	M (*)	M (*)	M-H (*)	NS (*)	NS (*)
Nephtys cirrosa	NS (*)	L (***)	L (***)	NS (*)	L (*)	L (*)	NS (***)	NS (*)	L (*)	NS (*)	L (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	M (*)	M (*)	NS (*)

Pygospio elegans	L (*)	L (**)	M (***)	L (*)	L (*)	L-M (*)	L (***)	L-M (***)	L-M (*)	NS (**)	L-M (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (*)	L (**)	L (**)	M (*)	NS (*)	NS (*)
Scoloplos armiger	NS (*)	L (*)	L-M (*)	NS (*)	L (*)	H (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (***)	NS (*)	M (***)	M (***)	M (*)	M (**)	NS (*)
Tubificoides spp.	NS (*)	NS (*)	L (***)	L (*)	L (*)	M (*)	NS (*)	L (*)	NS (*)	NS (*)	NS (***)	NS (*)	NS (*)	NS (***)	NS (***)	NS (*)	NS (***)	NS (***)	NS (*)	NS (*)	NS (*)
Hydrobia ulvae	L-NS (*)	L (***)	L (*)	L-NS (*)	L-NS (*)	M (*)	NS (***)	L (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (*)	L (*)	L (*)	L (*)	NS (*)	NS (*)
Corophium volutator	L (***)	L (***)	L (***)	L (*)	L (*)	L (*)	L (***)	L (***)	M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (***)	NS (*)	L (***)	L (***)	Nev	NS (*)	NS (*)
Nematoda	NS (***)	NS (***)	NS (***)	NS (***)	NS (*)	L (*)	NS (*)	NS (***)	NS (***)	NS (***)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (*)	L (***)	L (***)	NS (***)	NS (*)	L (*)
Notomastus sp	NS (*)	L (***)	L (***)	NS (*)	L (*)	L-M (*)	L (**)	L (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (**)	NS (*)	L (*)	L (*)	M (*)	NS (*)	NS (*)
Melinna palmata	NS (***)	NS (***)	NS (***)	NS (*)	NS (*)	M (*)	L (***)	M (*)	NS (*)	NS (*)	NS (*)	L (*)	NS (***)	NS (***)	NS (***)	NS (*)	NS (***)	NS (***)	L (*)	NS (*)	NS (*)
Prionospio spp.	NS (*)	NS (***)	NS (*)	NS (*)	NS (*)	L (*)	L (***)	L (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	N (***)	NS (*)	NS (***)	NS (***)	L (*)	NS (*)	NS (*)
Mysella bidentata	NS (*)	NS (*)	L-M (*)	NE	NE	M (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (**)	NS (**)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	L-M (*)
Thyasira flexuosa	L (*)	L (***)	L (*)	L (*)	L (*)	M-H (*)	NS (*)	M-H (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (*)	NS (***)	NS (*)	M (***)	M (***)	M (*)	NS (*)	NS (*)
Angulus sp. (Moerella)	NS (*)	L (*)	L (***)	NS (*)	L (*)	M (*)	NS (*)	H (*)	M-H (*)	NS (*)	L-M (*)	L (*)	NS (*)	NS (*)	Nev	L-NS (*)	NEv	NEv	M (*)	NS (*)	NS (*)

Table 11 Codes of sensitivity and confidence applying to species and pressure interactions.

NA	Not Assessed
Nev	No Evidence
NE	Not Exposed
NS	Not Sensitive
L	Low
M	Medium
H	High
VH	Very High
*	Low confidence
**	Medium confidence
***	High Confidence

7.3 Assessment of the effects of aquaculture production on the Conservation Objectives for habitat features in Galway Bay Complex SAC.

The constituent community types identified in the **Annex 1 feature**, **Large Shallow Inlets and Bays (1160)** are:

1. **Intertidal sand community complex**
2. **Intertidal sandy mud community complex**
3. **Maërl-dominated community**
4. ***Zostera*-dominated community complex**
5. **Fine to medium sand with bivalves community complex**
6. **Sandy mud to mixed sediment community complex**
7. **Mixed sediment dominated by Mytilidae community complex**
8. **Shingle**
9. **Fucoid-dominated community complex**
10. ***Laminaria*-dominated community complex**
11. **Shallow sponge-dominated reef community complex**

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

1. **Habitat Area –** it is unlikely that the activities proposed will reduce the overall extent of permanent habitat within the feature Large Shallow Inlet and Bays. The habitat area is likely to remain stable.
2. **Community Distribution - (conserve a range of community types in a natural condition).**

   This attribute considered interactions with 11 of the community types listed below and exclude two sensitive communities (i.e., *Zostera*-dominated community, Maerl-dominated community). The following community types, found within the qualifying interest 1160 of the SAC have overlap with aquaculture activities:

   1. **Intertidal sand community complex**
   2. **Intertidal sandy mud community complex**
   3. **Fine to medium sand with bivalves community complex**
   4. **Sandy mud to mixed sediment community complex**
   5. **Mixed sediment dominated by Mytilidae community complex**
   6. **Shingle**
   7. **Fucoid-dominated community complex**
   8. ***Laminaria*-dominated community complex**
   9. **Shallow sponge-dominated reef community complex**

   The community types listed above will be exposed to differing ranges of pressures from aquaculture activities. Some of these may result in more chronic and long-term changes in community composition, which were considered during the assessment process. Such activities in dredging for oyster and mussels which will result in physical disturbance to infanal communities and longline mussel culture which results in organic loading on the seabed resulting in biogeochemical changes to sediment and a likely change in faunal compositions – whether this results in permanent change to the community type is unclear. Table 9 lists the community types (or surrogates) and Table 10 lists the constituent taxa and both provide a commentary of sensitivity to a range of pressures. The risk scores in Table 9 and 10 are derived from a range of sources identified above. The pressures are listed as those likely to result from the primary aquaculture activities carried out in the Galway Bay Complex SAC. Aquaculture activities in the Galway Bay Complex SAC comprises shellfish production. Considered in the assessment are intertidal oyster culture (bag and trestle), subtidal on-bottom culture of native oysters, subtidal (suspended) rope mussel, scallop and seaweed culture.

Table 12 below identify the likely interactions between the relevant aquaculture activities and the broad habitat feature (1160) and their constituent community types, with a broad conclusion and justification on whether the activity is considered disturbing to the feature in question. Within each cell in Table 12 (and subsequent tables) a commentary is provided on whether the activity and community type interaction is considered disturbing to the community type under consideration, using the broader pressure categories identified in Table 4. It must be noted that the sequence of distinguishing disturbance is as highlighted above, whereby activities with spatial overlap on habitat/community type features are assessed further for their ability to cause persistence disturbance on the habitat/community type. If persistent disturbance is likely, then the spatial extent of the overlap is considered further. If the proportion of the overlap exceeds a threshold of 15% disturbance, then any further licencing should be informed by interdepartmental review and consultation (NPWS 2013b). While some activities might result in long-term change to the community types identified above; in all cases, no activity (individually or combined) extends beyond 15% of the community type (Tables 7 and 12).

It must be noted that a number of activities have been identified whereby, the risk of proliferation of non-native species in inner Galway Bay cannot be discounted without specific management actions. Given that successful reproduction of the Pacific oyster (*Crassostrea gigas*) has been documented in areas where this species is cultured in Ireland (Kochmann et al 2013) it is, therefore, acknowledged that a risk of successful reproduction might also present in Galway Bay. Oysters have been found in intertidal areas in Galway Bay (Kochmann et al 2013). Kochmann et al (2013) identified a series of hydrological and morphological characteristics that facilitate Pacific oyster settlement, including residence time, which in the case of Galway Bay, was calculated as approximately 25 days (T. Dabrowski, Marine Institute - personal communication). Any residence time greater than 21 days would be considered likely to result in an increased risk of settlement. An additional factor potentially contributing to successful recruitment is availability of suitable substrate (i.e. hard substrate or biogenic features, e.g., mussel shell). However, a negative association with macroalgae was speculated. Therefore, intertidal areas with high levels of macroalgal cover would appear to mitigate against successful recruitment of Pacific oysters (Kochmann et al 2013; Kochmann and Crowe, 2014). In addition, recent surveys noted little or no recruitment throughout the Bay (Tully et al., 2019). Notwithstanding, certain habitats may be susceptible to recruitment by *C. gigas* and given it is proposed to increase the production

of *C. gigas* in the bay and hence, potential spawning stock, the risk cannot be fully dismissed. On this basis the risk of establishment of *C. gigas* cannot be discounted.

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

Finally, the colonial tunicate, *Didemnum* sp., has been recorded in Galway Bay and appears to be specifically associated with aquaculture structures (oyster trestles). The risk of further proliferation of this species, particularly in susceptible community types (i.e. intertidal reef and biogenic habitats), in the absence of targeted management actions, cannot be discounted.

3. **Community Extent and Structure – focusing upon Mearl and *Zostera* communities**

   The focus of these attributes are primarily upon the 2 community types, *Zostera*-dominated community complex and Maerl-dominated community. These communities are considered highly diverse and sensitive community types which host a wide range of taxa. The 'keystone' species in each community type (Maerl and *Zostera*) is considered important and sensitive in their own right.

   Overlap is likely in a number of areas, specifically at the mouth of Mweeloon Bay (Mearl) and near Aughinish (unmapped eel grass beds) from Sites T09/520A and T09/519A, respectively. Given the highly sensitive natures of these community types and constituent taxa (Table 9 and 10) it is highly likely that aquaculture activities of any type which overlap these community type and the pressures may result in long-term or permanent change to the extent of these community types and the impact upon their structure and function cannot be discounted. This effect will come about by the physical removal or damage caused by the activities on any of the highly diverse taxa associated with these community types (Table 12). The risk posed to these community type from aquaculture operations cannot be discounted.

The constituent communities identified in the broad **Annex 1 Feature Mudflats and Sandflats not Covered by Seawater at Low Tide (1140)** are:

1. **Intertidal sand community complex**
2. **Intertidal sandy mud community complex**

For **Mudflats and Sandflats not Covered by Seawater at Low Tide (1140)** there are a number of attributes (with associated targets) relating to the following broad habitat features as well as constituent community types;

1. **Habitat Area** – it is unlikely that the activities proposed will reduce the overall extent of permanent habitat within the feature Mudflats and Sandflats not Covered by Seawater at Low Tide. The habitat area is likely to remain stable.
2. **Community Distribution - (conserve a range of community types in a natural condition).**

   The following community types, found within the qualifying interest 1140 of the SAC have overlap with aquaculture activities:

   1. **Intertidal sand community complex**
   2. **Intertidal sandy mud community complex**

   The community types listed above will be exposed to differing ranges of pressures from aquaculture activities. Specifically, intertidal oyster culture (bag and trestle) and transport routes from terrestrial bases to the aquaculture sites which may result in some disturbance to intertidal communities.

   While combined spatial overlap of current and proposed oyster cultivation sites and the constituent community types, identified for the Qualifying Feature habitats of 1140 is 4.65% (**Table 3**) and for access routes is 0.12%. Published literature (Forde *et al*., 2015; O'Carroll *et al.,* 2016) suggests that the presence of bags on trestles is considered non-disturbing to similar intertidal habitats. Consequently, adverse impacts of activities occurring at oyster cultivation sites within the Qualifying Interest (1140) of Mudflats and sandflats not covered by seawater at low tide can be discounted.

   Table 13 below identify the likely interactions between the relevant aquaculture activities and the broad habitat feature (1140) and it's constituent community types, with a broad conclusion and justification on whether the activity is considered disturbing to the feature in question.

   A risk presents in relation to the proliferation of non-native species (both *Crassostrea gigas* and *Didemnun* sp.) as identified above.

The constituent communities identified in the Annex 1 feature **Reefs (1170)** are:

1. **Fucoid-dominated community complex**
2. ***Laminaria*-dominated community complex**
3. **Shallow sponge-dominated reef community complex**

4. ***Mytilus* dominated reef community - No spatial overlap with aquaculture**

The reef communities are typical of intertidal cobble (and mixed sediment communities) as well as subtidal communities dominated by Fucoids, large macro algal (kelp) and shallow faunal turf (sponges and hydrozoans).

For **Reef (1170)** there are a number of attributes (with associated targets) relating to the following broad habitat features as well as constituent community types;

1. **Distribution of Reef -** the distribution of reef habitat within the SAC are unlikely to be altered by shellfish culture activities and are considered stable.
2. **Habitat Area -** the habitat area of reef is unlikely to be changed as a consequence of shellfish culture activities and is considered stable.
3. **Community Extent and Structure (*Mytilus* dominated reef community) –** given there is no spatial overlap between this community type and aquaculture activities (existing or proposed), it is ulikely that direct impact will be realised on this community type, thus impacting on the attribute 'extent'. However, a risk does present in relation to the proliferation of non-native species (both *Crassostrea gigas* and *Didemnun*) which may impact on the structure and function of the community type, as identified above.
4. **Community Structure (conserve a range of community types in a natural condition) -** The sensitivity scores of the community types and the characterising species to a range of pressures are listed above (Tables 9 and 10). The risk scores are derived from a range of sources identified in Section 7.1.2. The pressures are listed as those likely to result from the aquaculture activities (shellfish production) carried out in Galway Bay Complex SAC over Reef (1170) communities, i.e. suspended (oyster, mussels) and bottom culture (oysters). More specifically, the potential impacts of the operation on the communities of Galway Bay Complex SAC are identified in Section 5.1 and summarised in Table 4 above.

   Table 14 below assesses whether the aquaculture activity is considered disturbing to the habitat features for Reef (1170) and it's constituent community types and outlines a broad justification for this assessment.

   A risk presents in relation to the proliferation of non-native species (both *Crassostrea gigas* and *Didemnum* sp.) as identified above.

Table 12 Assessment of effect of aquaculture activities on 1160 community types recorded within Galway Bay Complex (Site Code 000268).

1160 – Large shallow inlets and bays (10819.84ha)		
Culture Type	**Maërl-dominated community**	**Intertidal sandy mud community complex**
Suspended Culture		
Oysters (*C. gigas*) Bags & trestles	**Disturbing:** Yes **Justification:** This community is highly sensitive to smothering, siltation and shading. Also highly sensitive to trampling by foot and vehicle. Spatial overlap is 0.13% of this community type (<15% threshold). A further risk to this habitat type has been identified from the colonial sea squirt that has been observed on oyster trestles.	**Disturbing:** Yes **Justification:** The community is considered tolerant to biological and physical pressures from the activity. The species have high recoverability and are tolerant. The stock is confined in bags, is sourced from hatcheries and is 17% triploid. The risk of proliferation of non-native oyster persists.

1160 – Large shallow inlets and bays (10819.84ha)			
Culture Type	**Mixed sediment dominated by Mytilidae community complex**	**Fine to medium sand with bivalves community complex**	***Laminaria*-dominated com. complex**
Suspended Culture			
Oysters (*C. gigas*) Bags & trestles	**Disturbing:** Yes **Justification:** The community type is considered tolerant to the majority of pressures from the activity. Spatial overlap is 1.02% of this community type. However, a risk to this community type has been identified from the colonial sea squirt that has been observed on oyster trestles. The risk of proliferation of non-native oyster persists..	**Disturbing:** No **Justification:** The community type is considered tolerant to all pressures from this activity. The species have high recoverability and are tolerant. The stock is confined in bags, is sourced from hatcheries and up to 17% triploid. The risk of proliferation of non-native oyster persists.	**Disturbing:** Yes **Justification:** The community type is considered sensitive to pressures from activity (i.e. shading). Spatial overlap is 2.2% of this community type. The risk of proliferation of non-native oyster persists.
Mussels (*M. edulis*) Longlines	**Disturbing:** Yes **Justification:** The community type is considered sensitive to pressures from activity (i.e. organic enrichment). Spatial overlap is 0.26% of this community type. .	**Disturbing:** Yes **Justification:** The community type is considered sensitive to pressures from activity (i.e. organic enrichment). Spatial overlap is 0.33% of this community type	
Seaweed	**Disturbing:** No **Justification:** The community type is considered tolerant to pressures from this activity. The culture process is extractive with no discharges resulting.		

1160 – Large shallow inlets and bays (10819.84ha)					
Culture Type	**Sandy mud to mixed sediment community complex**	**Shallow sponge-dominated reef com. complex**	**Intertidal sand community complex**	**Fucoid-dominated com. complex**	**Shingle**
Suspended Culture					
Oysters (*C. gigas*) Bags & trestles	**Disturbing:** Yes **Justification:** The community type is considered tolerant to pressures from activity. The species have high recoverability and are tolerant. The stock is confined in bags, is sourced from hatcheries and is 17% triploid. The risk of proliferation of non-native oyster persists. A risk to this community type has been identified from the colonial sea squirt that has been observed on oyster trestles.	**Disturbing:** Yes **Justification:** The community type is considered sensitive to pressures from activity (i.e. organic enrichment). Spatial overlap is 0.83% of this community type. The risk of proliferation of non-native oyster persists. A risk to this community type has been identified from the colonial sea squirt that has been observed on oyster trestles.	**Disturbing:** Yes **Justification:** The community type is considered tolerant to pressures from activity. The species have high recoverability and are tolerant. The stock is confined in bags, is sourced from hatcheries and is 17% triploid. The risk of proliferation of non-native oyster persists. A risk to this community type has been identified from the colonial sea squirt that has been observed on oyster trestles.	**Disturbing:** Yes **Justification:** The community type is considered sensitive to pressures from activity (i.e. shading). Spatial overlap is 2.9% of this community type. In addition, a risk to this community type has been identified from the colonial sea squirt that has been observed on oyster trestles. The risk of proliferation of non-native oyster persists.	**Disturbing:** No **Justification:** The community type is considered tolerant to pressures from this activity . Spatial overlap is 3.0% of this community type .
Mussels (*M. edulis*) Longlines	**Disturbing:** Yes **Justification:** The community type is considered sensitive to pressures from activity (i.e. organic enrichment). Spatial overlap is 0.08% of this community type..	-	-	-	-
Scallop	**Disturbing:** No **Justification:** The community type is considered tolerant to pressures from activity. The density of culture organism are low resulting in little or no pressure on seabed.	-	-	-	-

Table 13 Assessment of effect of aquaculture activities on 1140 community types recorded within Galway Bay Complex (Site Code 000268)

1140 - Mudflats and sandflats not covered by seawater at low tide (743.97ha)		
Culture Type	**Intertidal sandy mud comm. complex (512.34ha)**	**Intertidal sand comm. complex (231.64ha)**
Suspended Culture		
Oysters (*C. gigas*) Bags & trestles	**Disturbing:** No **Justification:** The community type is considered tolerant to pressures from activity. The species have high recoverability and are tolerant. The stock is confined in bags, is sourced from hatcheries and is 17% triploid. Spatial overlap is 1.27% of this community type (<15% threshold). The risk of proliferation of non-native oyster persists.	**Disturbing:** No **Justification:** The community type is considered tolerant to pressures from activity. The species have high recoverability and are tolerant. The stock is confined in bags, is sourced from hatcheries and is 17% triploid. Spatial overlap is 0.16% of this community type (<15% threshold). The risk of proliferation of non-native oyster persists.
Bottom Culture		
Oysters (*O. edulis*)	-	**Disturbing:** Yes **Justification:** The community type might be considered sensitive to physical disturbance as a result of harvesting practices. The spatial overlap is 0.03% of this community type.

Table 14 Assessment of effect of aquaculture activities on 1170 community types recorded within Galway Bay Complex (Site Code 000268)

1170– Reefs (2771.51ha)			
Culture Type	***Laminaria*-dominated com. complex**	**Shallow sponge-dominated reef com. complex**	**Fucoid-dominated com. complex**
Suspended Culture			
Oysters (*C. gigas*) Bags & trestles	**Disturbing:** Yes The community type is considered sensitive to pressures from activity (i.e. shading and organic enrichment). Spatial overlap is 2 % of this community type. The risk of proliferation of non-native oyster persists. However, a risk to this community type has been identified from the colonial sea squirt that has been observed on oyster trestles.	**Disturbing:** Yes **Justification**: It is unlikely that this community type will have overlap from this activity. The risk of proliferation of non-native oyster persists. However, a risk to this community type has been identified from the colonial sea squirt that has been observed on oyster trestles. Spatial overlap is 0.50% of this community type.	**Disturbing:** Yes **Justification:** The community type is considered sensitive to pressures from activity (i.e. shading and organic enrichment). Spatial overlap is 2.1 % of this community type. The risk of proliferation of non-native oyster persists. However, a risk to this community type has been identified from the colonial sea squirt that has been observed on oyster trestles.
Bottom Culture			
Oysters (*O edulis*)	-	-	**Disturbing:** Yes **Justification:** The community type might be considered sensitive to physical disturbance as a result of harvesting practices (i.e. dredging). Spatial overlap is 0.03% of this community type (<15% threshold).

7.4 Assessment of the effects of shellfish production on the Conservation Objectives for Harbour Seal (*Phoca vitulina*) in Galway Bay Complex SAC.

Galway Bay Complex SAC is designated for the Harbour Seal (*Phoca vitulina*). The distribution of harbour seal habitat and site use are summarised in Figure 3. The conservation objectives for this species are listed in Table 1 and can be found in detail in NPWS (2013a; 2013b). While the conservation status of the species is considered favourable at the site (NPWS 2013c), the interactions between harbour seals and the features and aquaculture activities carried out in the SAC must be ascertained.

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

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

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

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

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

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

disturbances at the population level have not been studied more broadly (National Research Council 2009).

Shellfish production has been conducted in and around Galway Bay for many years. The current level of production (41 licensed sites) is represented as licenced activities in Figures 5 and 6. It is considered that, given the favourable conservation status of Harbour Seals in Ireland (NPWS 2013c) and by stable numbers observed since 2009 (NPWS 2010, 2011, 2012; Duck and Morris 2013) that the current shellfish production levels (and activities associated with them) are conducive with the favourable conservation status. Furthermore, it is noted that the concentration of haul out sites in the southern portion of Galway Bay are proximate to licenced and active aquaculture sites. Other seal sites around the inner part of the bay are broadly similar (sheltered and proximate to extant aquaculture sites) to the sites represented in Kinvara Bay. It would appear that the current configuration of the aquaculture installations does allow for access to open waters from the intertidal seal sites. It might be assumed that there is some disturbance to the seal population by activity involved in these culture operations in these bays. This would be especially true at the sensitive times of the year (breeding and moulting, i.e. May to September). However, it must also be noted that it is expected that seals will become habituated or at the least, tolerant of regular/predictable activities (including aquaculture operations) and as a consequence disturbance is minimised. While the scientific literature on this issue is relatively scarce, Roycroft et al (2004) concluded no negative interaction between suspended mussel culture and seal behaviour (including site usage), while also suggesting a potential positive interactions whereby the structures provide a refuge/haul out and potential food source as a consequence of secondary production on or near the mussel lines (Roycroft et al, 2004).

Conclusion 1: The current levels of licenced aquaculture (existing) are considered non-disturbing to harbour seal conservation features in all areas of the SAC. Operators should note sensitive times of years for seals and continue to tailor their activities to minimise potential disturbance.

Conclusion 2: In relation to new licence applications, given the potential broad range of Harbour Seal within the SAC, the risk of disturbance to Harbour Seals should be assessed on the basis of the nature of the culture type and location relative to seal sites. For example, a site may pose a greater risk of disturbance than others on the basis of blocking potential egress routes available to seals and the proposed levels of activity at the sites. To this end, one site (T09/499A) appears to block access to a deep channel for seals. On the basis of licenced sites nearby, there does not appear to be any mitigating features to prevent disturbance to seals. Notwithstanding recommendations specific to individual sites, all operators should note sensitive times of years for seals and tailor their activities to minimise any potential disturbance.

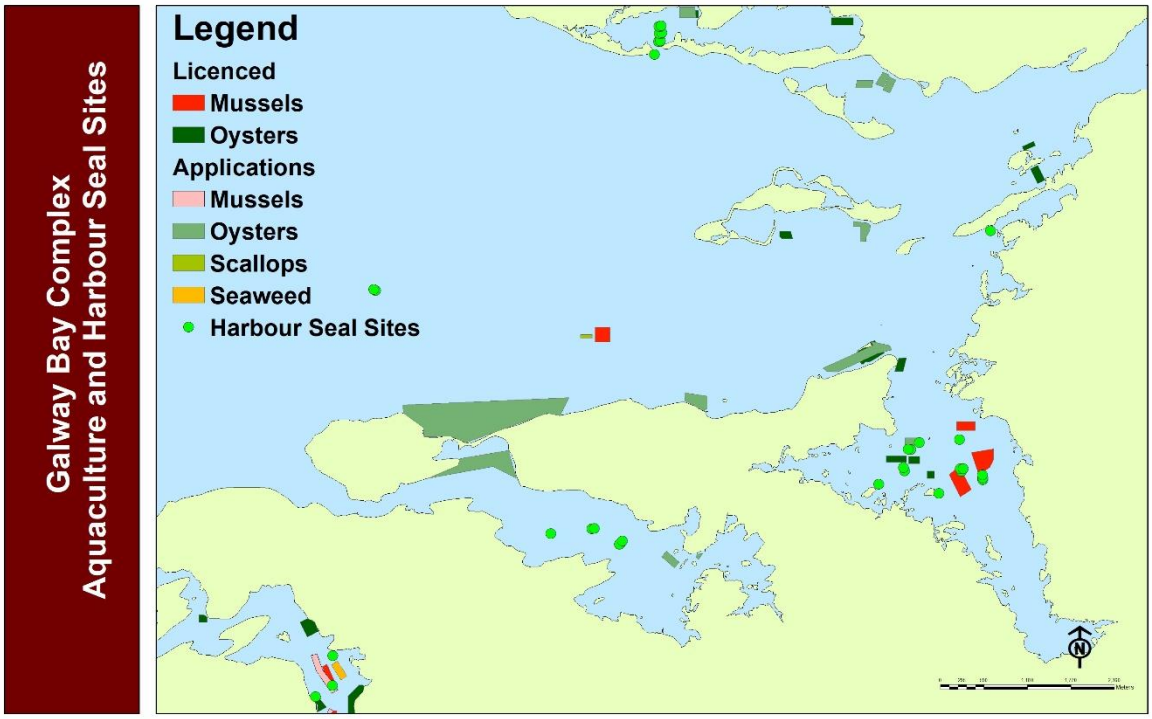

Figure 8. Harbour Seal Sites and Aquaculture Sites (licenced and applications) southern portion of the Galway Bay Complex (Site Code 00268).

7.5 Assessment of the effects of shellfish production on the Conservation Objectives for the Otter (*Lutra lutra*) in Galway Bay Complex SAC.

Galway Bay Complex SAC is designated for the Otter (*Lutra lutra*); the conservation objectives for such are listed in Table 1 and can be found in detail in NPWS (2013a). The otter is known to forage within an 80m of the shoreline. As the aquaculture production activities within the SAC spatially overlap with otter these activities may have negative effects on the abundance and distribution of populations of these species.

The risk of negative interactions between aquaculture operations and aquatic mammal species is a function of:

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

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

Bottom culture (Oysters)

Given that this culture type does not entail any structures and all operations are likely to be carried out in daylight hours, while the otter foraging is primarily crepuscular, the interaction with bottom

culture operators/operations with the otter is likely to be minimal. It is unlikely that this culture type poses a risk to otter populations in Galway Bay. Impacts can be discounted.

Suspended culture (Oyster)

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

Suspended culture (Mussels)

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

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

- Extent of terrestrial habitat,
- Extent of marine habitat or freshwater habitat.
- The activity involves net input rather than extraction of fish biomass so that no negative impact on the essential food base (fish biomass) is expected
- The number of couching sites and holts or, therefore, the distribution, will not be directly affected by aquaculture activities.
- Shellfish production activities are unlikely to pose any risk to otter populations through entrapment or direct physical injury.
- Disturbance associated with vessel and foot traffic could potentially affect the distribution of otters at the site. However, the level of disturbance is likely to be very low given the likely encounter rates will be low dictated primarily by tidal regime.

Conclusion 1: The current and proposed levels of aquaculture are considered non-disturbing to otter conservation features in all areas of the SAC.

8 Risk Assessment of Fishing Activities

8.1 Fisheries Activities

In inner Galway Bay there are a number of inshore fisheries activities that may result in in-combination impacts on conservation features. These activities are listed below.

8.1.1 Pot fisheries

Approximately 14 vessels, using 2400 pots for an average of 118 days per vessel per year, fish for lobster in the SAC or in proximity to the SAC in the inner Galway Bay area east of Black Head – Spiddal.

A fishery for velvet crab occurs in inner Galway Bay and especially along the south shore. Up to 10 vessels catch velvet crab either as a targeted catch or as a by-catch in the lobster fishery.

Up to 15 vessels may fish for brown crab (*Cancer pagurus*) in the outer Galway Bay using up to 3000 traps. Brown crab are not targeted in the SAC.

Shrimp is an important shrimp fishery in inner Galway Bay. There are 22 vessels and 6350 potential pot hauls per day from September to January. The regulated closed season is June and July but the fishery also remains closed in Galway during August by voluntary agreement. See Figure 7.

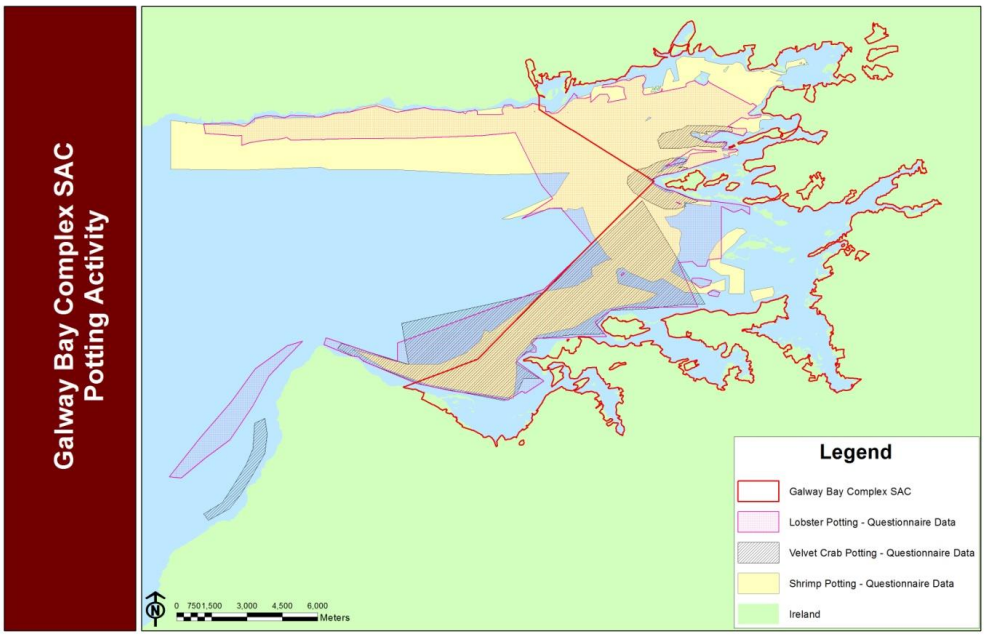

Figure 9. Spatial extent of pot fisheries in the Galway Bay Complex SAC (Site Code 000268).

8.1.2 Dredge fisheries

Scallop may be fished episodically and at small scale west of the SAC. The fishery is regulated by minimum size of 100mm.

The Galway Bay native oyster fishery is partly regulated by the Clarinbridge Oyster Co-operative through Fishery Orders issued in 1978 and 1980. However, not all of the native oyster beds are within the order areas. The current distribution of oysters is known from recent MI surveys and occurs in an area north east of Eddy Island and east to the Clarin River. As specified in the Fishery Order the fishery opens in December only. However, there have been no oyster fisheries carried out since 2016 (Marine Institute and BIM, 2019).

There is a discrete bed of surf clam in inner Galway Bay, just north of Eddy Is., which is fished regularly by 1 vessel.

A razor clam bed is thought to occur along the north shore of inner Galway Bay within the SAC. This bed is not classified for production of Razor clams and is not fished. See Figure 8.

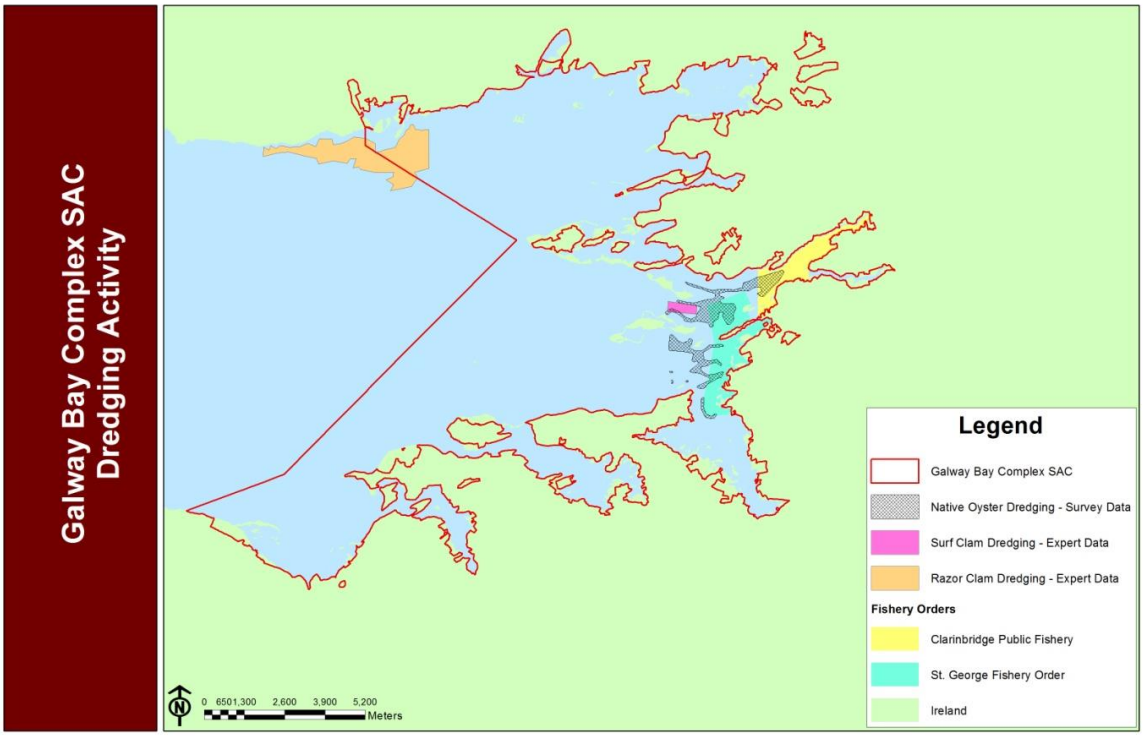

Figure 10. Spatial extent of dredge fisheries in the Galway Bay Complex SAC (Site Code 000268). Oyster fishery orders are shown in relation to survey data showing the distribution of oyster beds.

8.1.3 Set Net fisheries

Tangle netting for crayfish and to a lesser extent turbot, occurs in the outer Bay and Connemara coast. Up to 32 vessels may be involved from May-Nov. The amount of gear used is unknown. Tangle netting also occurs on the Clare coast.

A proportion of vessel operators fishing with pots for crustaceans may also use trammel nets to catch bait (dogfish, wrasse). The level of activity is unknown. Potting vessels (with a pot licence only) are not entitled to fish trammel nets. Also it is more common for polyvalent potters, who are entitled to fish with trammels, to purchase bait. For instance questionnaire data for Galway Bay in 2010 indicated that 3/26 (11%) of vessels fished for bait.

In this assessment the spatial extent of trammel netting is presumed to be the same as the spatial extent of the lobster fishery. See Figure 9.

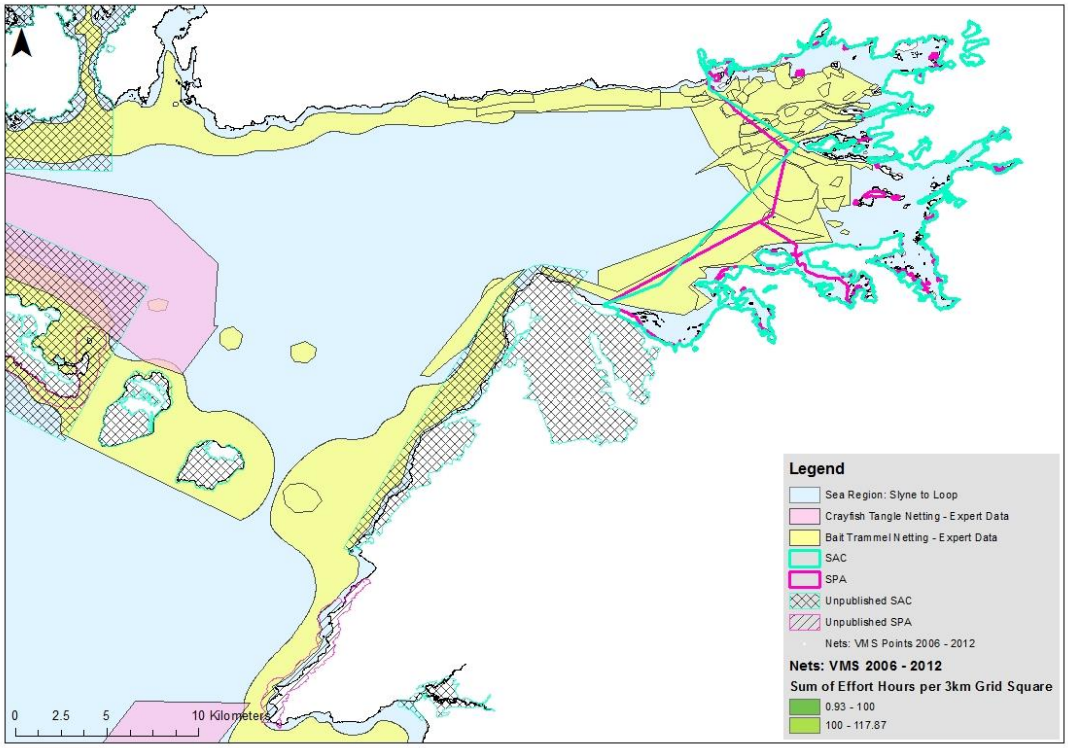

Figure 11. Spatial extent of set net fisheries in the Galway Bay area.

8.1.4 Pelagic and demersal fisheries

Fishing for sprat may occur in winter and spring in inner Galway Bay. Reported VMS activity is very low in inner Galway Bay however. Demersal trawling occurs in the outer Bay and particularly on the north shore from Spiddal west to Golam Hd where *Nephrops* is targeted. See Figures 10 and 11.

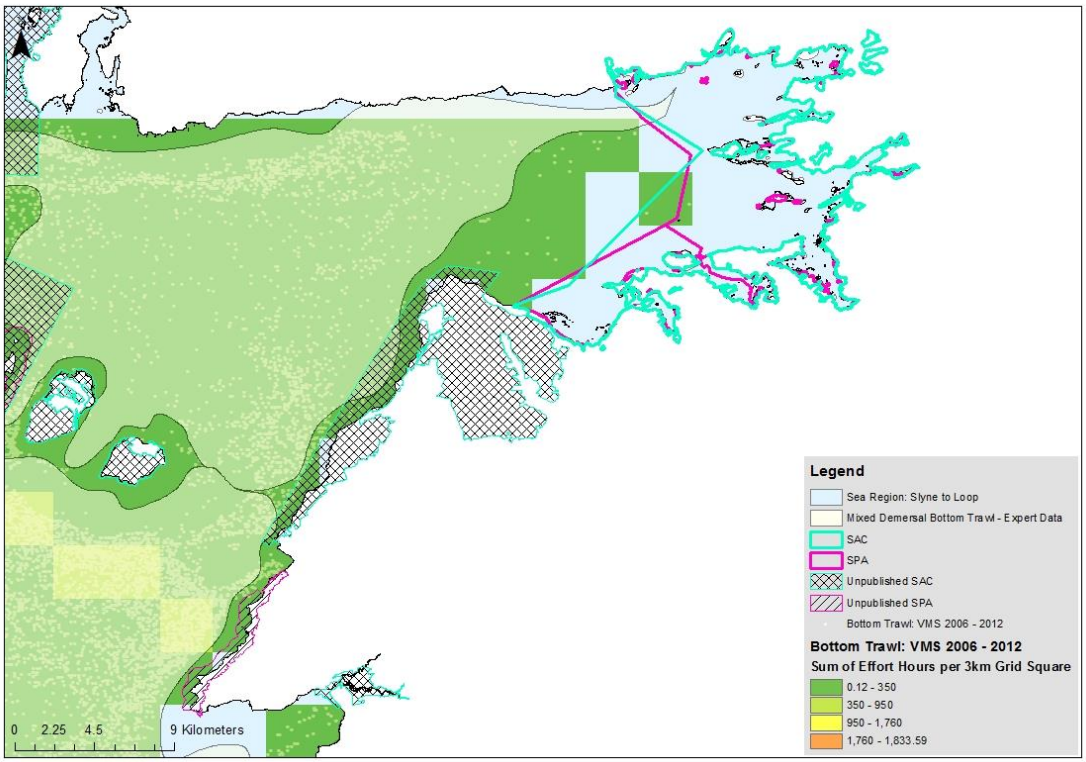

Figure 12. Spatial extent of bottom trawl fisheries in the Galway Bay area.

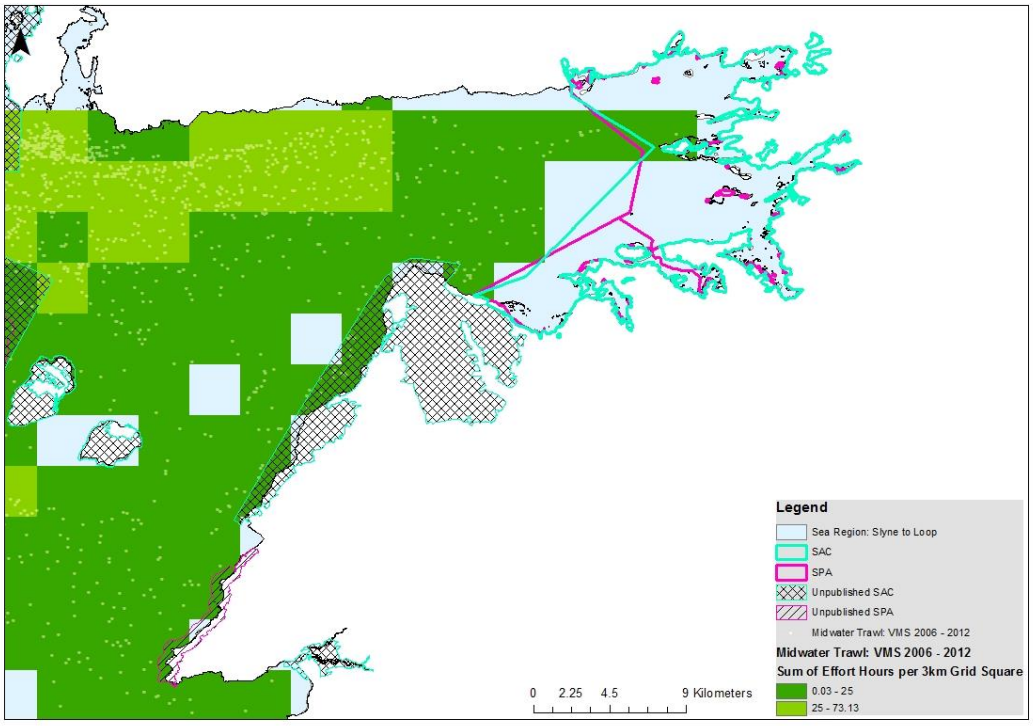

Figure 13. Spatial extent of pelagic fisheries in the Galway Bay area.

8.2 Determining fisheries 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 15 and 16 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 15. 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 16. 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**

8.3 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 ((NPWS 2013a -16, April -2013) and supporting documentation (NPWS 2013b - March, 2013) 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 2013b).

- 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 9 and 10.

- 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

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

- The list of fishing activities (métiers) operating in Galway Bay SAC 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 9 and 10.
- The risk assessment framework outlined in Table 15 and Table 16 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 15. The overlap of fisheries and marine community types within those qualifying interests in presented in Table 16.
- Risk scores for effects of individual fisheries on marine community types are in Table 15 and for designated species in Table 16.

8.4.1 Fisheries risk profile

8.4.2 Marine Community types

8.4.2.1 Shrimp fisheries

- The shrimp fishery has a high overlap with QI 1160 and 1170
- The fishery occurs on maerl (51% overlap) and on sedimentary habitats (35-60% overlap), *Laminaria* reef (65%) and Shallow sponge dominated reef (66%)
- Anchors, ropes and pots may pose a risk to Maerl habitat and to a lesser extent to *Laminaria* and Shallow sponge dominated reef (73%)

8.4.2.2 Lobster fisheries (pot fishery and trammel netting for bait)

- The lobster fishery overlaps with 52% of QI 1160 and with 41% of QI 1170
- The fishery overlaps with Maerl (47%), Seagrass (65%), sedimentary communities (11-72%), *Laminaria* reef (75%) and and Shallow sponge dominated reef (73%)
- Anchors, ropes and pots may pose a risk to Maerl and Seagrass habitats and to a lesser extent to *Laminaria* and Shallow sponge dominated reef.

8.4.2.3 Velvet crab fisheries

- The velvet crab fishery overlaps with 30% of QI 1160 and with 25% of QI 1170
- The fishery overlaps with Maerl (28%), Seagrass (64%), sedimentary communities (7-44%), *Laminaria* reef (58%) and Shallow sponge dominated reef (73%)

- Anchors, ropes and pots may pose a risk to Maerl and Seagrass habitats and to a lesser extent to *Laminaria* and Shallow sponge dominated reef.

8.4.2.4 Native oyster fisheries

- The native oyster fishery overlaps with 2.1% of QI 1160
- The fishery overlaps with Maerl (8%), Seagrass (10%), sedimentary communities (4%) and Shallow sponge dominated reef (1%)
- Dredging for oysters is incompatible with the conservation objectives of maerl and seagrass habitat. These habitats have low resistance to dredging pressure and maerl in particular has a low recoverability.
- The fishery is also likely to pose a risk to Shallow sponge dominated reef habitat.

8.4.2.5 Surf clam fisheries

- The surf clam fishery overlaps with 0.3% of QI 1160
- The fishery overlaps with Sandy mud to mixed sediment community complex (0.3%)
- The fishery is sporadic and is unlikely to pose a significant risk to sedimentary communities.

8.4.2.6 Razor clam fisheries

- The razor clam fishery overlaps with 1.4% of QI 1160 and 2.8% of QI 1170.
- The fishery overlaps with Sandy mud to mixed sediment community complex (2.0%)
- The fishery is inactive

8.4.2.7 Demersal trawl fisheries

- The demersal trawl fishery occurs to the west of the SAC. Calculated spatial overlap is likely to be spurious.
- The fishery does not pose a risk to habitats or community types within the SAC

8.4.2.8 Periwinkle fisheries

- Hand gathering of periwinkle occurs on intertidal rocky shores at low tides throughout the area
- This fishery causes trampling pressure in these habitats
- The extent and intensity of the fishery is not well known.

8.4.3 9.4.2 Designated species

8.4.3.1 Harbour Seal

The Harbour seal population in Galway Bay increased from 366 to 470 between 2003 and 2011

There is a low risk of by-catch of Harbour Seal in the pelagic sprat fishery. The tangle net fishery is too far west of the site to pose a risk to Harbour seals from Galway Bay. The demersal trawl fishery is also primarily in outer Galway Bay and risk of by-catch in these fisheries is in any case low. There is a low risk of by-catch in trammel nets used for bait in the lobster fishery. Cumulative risk posed by fisheries may result in sub-lethal and lethal effects on individual seals but the risk to the population may be relatively low. However, total annual by-catch of Harbour Seal in the Galway Bay area is unknown. By-catch of individual seals is possible in the trammel net fisheries.

The pelagic fishery for sprat (which is irregular) may cause local prey depletion for seal populations. It is unlikely to have population level effects.

8.4.3.2 Otter

There is a potential risk of by-catch of otter in lobster pots and associated trammel nets. The risk of otter capture is higher in creels deployed in depths of 2-5m as the preferred dive depths of otter is 1-3m. In the Irish lobster fishery gear deployment depth is almost universally greater than this depth. By-catch and mortality risk is also higher in parlour pots than in pots without parlours (second chambers). Although parlour pots are used in the lobster fishery the common pot is single chambered.

Trammel nets may be deployed in shallow reef habitat to collect bait for creels. This is usually also greater than 2-5m and outside of the depth range of diving otters.

Although by-catch of individuals may occur this is thought to be unlikely (risk = 4).

Table 17. Percentage spatial overlap between fisheries and qualifying interests.

Qualifying interest	Velvet crab	Lobster	Shrimp	Oyster	Razor clam	Surf clam	Trammel net	Demersal
1160	30.5	52.0	96.0	2.1	1.4	0.3	52.0	1.3
1170	25.2	41.0	99.0	0.0	2.8		41.0	0.4

Table 18. Percentage spatial overlap between fisheries and marine communities within each qualifying interest.

QI/SCI	MCT	Trap - lobster	Trap - crab	Trap-velvet crab	Trap - shrimp	Dredge - scallop	Dredge oyster	Dredge - razor clam	Dredge surf clam	Tangle net crayfish	Trammel netting bait	Otter trawl - demersal	Mid-water trawl	Hand gathering winkles
Mudflats and sandflats not covered by seawater at low tide [1140]	Intertidal sandy mud community complex	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Mudflats and sandflats not covered by seawater at low tide [1140]	Intertidal sand community complex	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Large shallow inlets and bays [1160]	Intertidal sandy mud community complex	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Large shallow inlets and bays [1160]	Intertidal sand community complex	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Large shallow inlets and bays [1160]	Maërl-dominated community	**47**	**0**	**28**	**51**	**0**	**8**	**0**	**0**	**0**	**47**	**0**	**0**	**0**
Large shallow inlets and bays [1160]	Zostera dominated community	**65**	**0**	**64**	**0**	**0**	**10**	**0**	**0**	**0**	**65**	**0**	**0**	**0**
Large shallow inlets and bays [1160]	Fine to medium sand with bivalves community complex	**72**	**0**	**44**	**41**	**0**	**0**	**0**	**0**	**0**	**72**	**0**	**0**	**0**
Large shallow inlets and bays [1160]	Sandy mud to mixed sediment community complex	**65**	**0**	**35**	**60**	**0**	**4**	**2**	**0.6**	**0**	**65**	**3**	**0**	**0**
Large shallow inlets and bays [1160]	Mixed sediment dominated by Mytilidae	**11**	**0**	**7**	**35**	**0**	**0**	**0**	**0**	**0**	**11**	**0**	**0**	**0**

QI/SCI	MCT	Trap - lobster	Trap - crab	Trap-velvet crab	Trap - shrimp	Dredge - scallop	Dredge oyster	Dredge - razor clam	Dredge surf clam	Tangle net crayfish	Trammel netting bait	Otter trawl - demersal	Mid-water trawl	Hand gathering winkles
	community complex													
Large shallow inlets and bays [1160]	Shingle	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Large shallow inlets and bays [1160]	Fucoid-dominated community complex	**2**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**1**
Large shallow inlets and bays [1160]	Laminaria-dominated community	**75**	**0**	**58**	**65**	**0**	**0**	**0**	**0**	**0**	**75**	**1**	**0**	**0**
Large shallow inlets and bays [1160]	Shallow sponge-dominated reef community complex	**73**	**0**	**36**	**66**	**0**	**0**	**0**	**0**	**0**	**73**	**0**	**0**	**0**
Reefs [1170]	Mytilus-dominated reef community	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Reefs [1170]	Fucoid-dominated community complex	**2**	**0**	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**1**
Reefs [1170]	Laminaria-dominated community	**75**	**0**	**53**	**67**	**0**	**0**	**0**	**0**	**0**	**75**	**1**	**0**	**0**
Reefs [1170]	Shallow sponge-dominated reef community complex	**71**	**0**	**33**	**66**	**0**	**1**	**0**	**0**	**0**	**71**	**1**	**0**	**0**

Table 19. Risk scores (refer to Table 15 for interpretation) for fisheries in relation to marine communities within qualifying interests.

Site name	COs	QI/SCI	MCT	Fishing current	Trap - lobster	Trap - crab	Trap-velvet crab	Trap - shrimp	Dredge - scallop	Dredge oyster	Dredge - razor clam	Dredge surf clam	Tangle net crayfish	Tramme netting bait	Otter trawl - demersal	Mid-water trawl	Hand gathering winkles
Galway Bay complex	Published	Large shallow inlets and bays [1160]	Maërl-dominated community	Yes	=4*4		=4*4	=4*4		=5*4				=4*4			
Galway Bay complex	Published	Large shallow inlets and bays [1160]	Zostera dominated community	Yes	=4*3		=4*3			=4*4				=4*3			
Galway Bay complex	Published	Large shallow inlets and bays [1160]	Fine to medium sand with bivalves community complex	Yes	=1*4		=1*4	=1*4						=1*4			
Galway Bay complex	Published	Large shallow inlets and bays [1160]	Sandy mud to mixed sediment community complex	Yes	=1*4		=1*4	=1*4		=2*4	=2*4	=2*4		=1*4	=2*2		
Galway Bay complex	Published	Large shallow inlets and bays [1160]	Mixed sediment dominated by Mytilidae community complex	Yes	=1*4		=1*4	=1*4						=1*4			
Galway Bay complex	Published	Large shallow inlets and bays [1160]	Fucoid-dominated community complex	Yes	=1*4		=1*4	=1*4						=1*4			=3*3
Galway Bay complex	Published	Large shallow inlets and bays [1160]	Laminaria-dominated community	Yes	=3*3		=3*3	=3*3						=3*3	=2*2		
Galway Bay complex	Published	Large shallow inlets and bays [1160]	Shallow sponge-dominated reef community complex	Yes	=3*3		=3*3	=3*3						=3*3			
Galway Bay complex	Published	Reefs [1170]	Fucoid-dominated community complex	Yes	=1*4		=1*4	=1*4						=1*4			=3*3
Galway Bay complex	Published	Reefs [1170]	Laminaria-dominated community	Yes	=3*3		=3*3	=3*3						=3*3	=2*2		
Galway Bay complex	Published	Reefs [1170]	Shallow sponge-dominated reef community complex	Yes	=3*3		=3*3	=3*3		=4*3				=3*3	=2*2		

Table 20. Risk scores for fisheries in relation to designated species in Galway Bay SAC

	Tangle net			Trammel net			Pelagic trawl			Demersal trawl			Pots			Dredges		
	By-catch	Prey depletion	Disturbance	By-catch	Prey depletion	Disturbance	By-catch	Prey depletion	Disturbance	By-catch	Prey depletion	Disturbance	By-catch	Prey depletion	Disturbance	By-catch	Prey depletion	Disturbance
Site name																		
Harbour seal	=0*3	=0*3	=0*3	=2*3	=1*4	=2*2	=1*3	=2*3	=1*3	=1*3	=1*3	=1*3	=1*3	=1*3	=2*2	=1*1	=1*1	=1*1
Otter	=0*3	=0*3	=0*3	=2*2	=1*3	=1*3	=1*3	=1*3	=1*3	=0*3	=0*3	=0*3	=2*2	=1*3	=1*3	=1*1	=1*1	=1*1

9 In combination effects of activities

There are a number of Oyster Fishery Order areas within the SAC (Figure 14). Oyster Fishery Orders are licenced and administered by the Department of Communications, Energy and Natural Resources. There are no specific fishery plans available at the time of publication of this report as the subsidiary of Clarinbridge Co-op which carried out *C gigas* production in the OFO has ceased trading, so no Pacific oysters are being farmed subtidally in the bay at present. All other activities in the St. Georges Fishery focus on the fishery of the native oyster, *Ostrea edulis*. However, it should be noted that this fishery has not operated in 2 years and it's opening will be subject to survey in addition to a number of administrative issues.

Impacts associated with the bottom culture of *the native oyster, O edulis* are summarised in Tables 4 and 6 and 8. In the immediate vicinity of the culture operations dredging activities may impact on integrity of the seabed community types. However, there are no disturbing fishing activities that overlap these habitats types (Table 19) and therefore the risk of cumulative disturbance from fisheries and aquaculture can be discounted.

A number of fisheries activities (potting, netting and dredging) also overlap with some sensitive community types, which if considered in-combination with aquaculture activities would likely exacerbate the extent of disturbance. These community types are, Maërl-dominated community and *Zostera*-dominated community complex and to a lesser extent, Shallow sponge-dominated reef community complex. The cumulative risk of these activities cannot be discounted as they relate to these sensitive community types.

Other activities that may occur in the SAC are primarily recreational activities (sailing, boating, fishing and beach activities). In summary, there are no likely in-combination effects between these other activities and aquaculture.

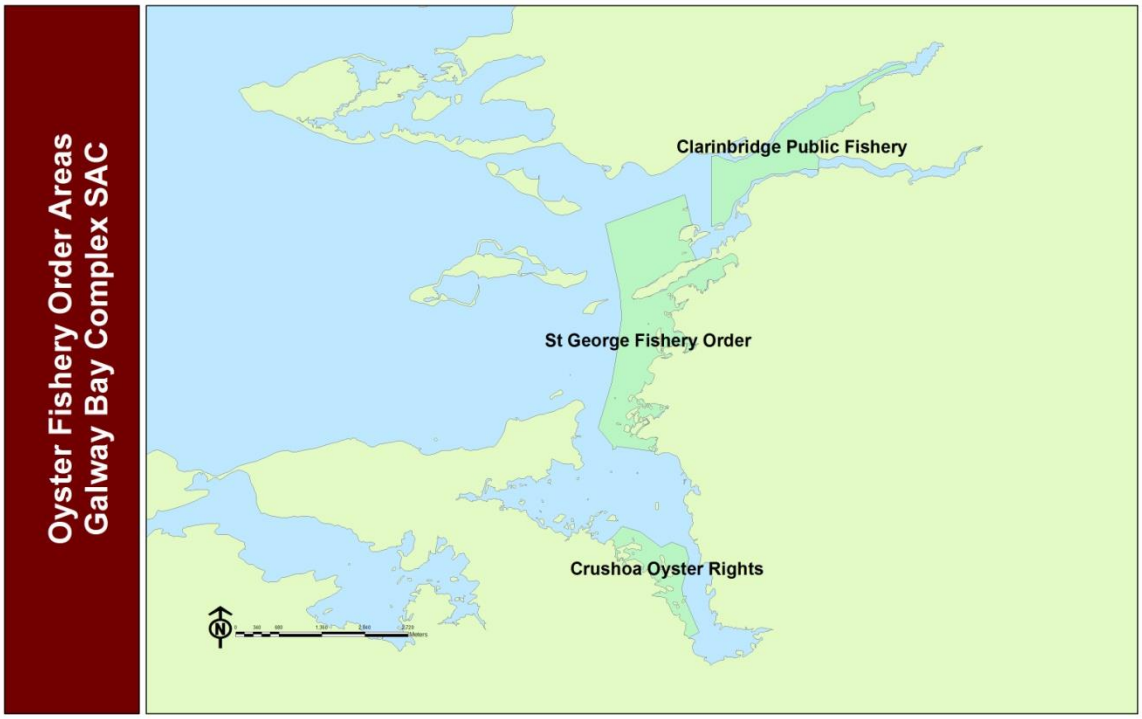

Figure 14. Oyster fishery order areas within Galway Bay complex SAC.

10 Aquaculture Appropriate Assessment Concluding Statement

In Galway Bay Complex SAC there are a range of aquaculture activities currently being carried out and proposed. Based upon this and the information provided in the aquaculture profiling (Section 5), the likely interaction between aquaculture methodology and conservation features (habitats and species) of the site was considered.

10.1 Annex I Habitats

In relation to habitats 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 of the culture activities was expected to occur.

The habitats and species excluded from further consideration were:

- 1150 Coastal lagoons
- 1220 Perennial vegetation of stony banks
- 1310 Salicornia and other annuals colonising mud and sand
- 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- 1410 Mediterranean salt meadows (*Juncetalia maritimi*)

A full assessment was carried out on the likely interactions between aquaculture operations (as proposed) and the features Annex 1 habitats Mudflats and sandflats not covered by seawater at low tide (1140), Large Shallow Inlets and Bay (1160) and Reefs (1170). The likely effects of the aquaculture activities were considered in light of the sensitivity of the constituent communities of these Annex 1 habitats. A number of issues were highlighted in Section 7.3 and relate to certain aquaculture and habitat interactions the conclusions of which are presented below.

Conclusion 1: Aquaculture activity is deemed disturbing on two community types, Maërl-dominated community and *Zostera*-dominated community complex. The risk to the conservation status of sensitive habitats (i.e. Mearl and *Zostera*) posed by number of overlapping or adjacent aquaculture locations therefore, cannot be discounted. These impacts are potentially exacerbated by fishing activities. All efforts should be made to avoid overlap with these sensitive areas and a suitable buffer zone be applied in order to allow for mapping anomalies and enforcement measures.

Conclusion 2: The presence of non-native species *Didemnum* sp. in Galway Bay is acknowledged and in particular, is associated with structures used to culture oysters (trestles). Best practice should be employed to ensure that structures and netting are kept clean at all times and that any biofouling be dealt and disposed of in a responsible manner such that it is removed from the marine environment and does not pose a risk to the conservation features of the site.

Conclusion 3: Notwithstanding that current levels of feral Pacific oyster recruitment in Galway Bay are considered relatively low, it is recommended that operators be encouraged to increase their use of triploid oysters in order to mitigate the risk of successful reproduction. This is recommended on the basis that oyster recruitment has been recorded in Galway Bay and that it is proposed to increase the levels of oyster production in the bay and hence the potential for spawning and recruitment will increase.

Conclusion 4: It is recommended that acceptable sources of seed (in terms of alien species risk) are identified for aquaculture culture operations and that all future movements of all shellfish stock (mussels, oysters and clams) in and out of Galway Bay Complex SAC should adhere to relevant fish health legislation and follow best practice guidelines.

10.2 Annex II Species

The likely interactions between the proposed aquaculture activities and the Annex II Species Harbour Seal (*Phoca vitulina*) and Otter (*Lutra lutra*) were also assessed. The objectives for these species in the SAC focus upon maintaining the good conservation status of the population. It is concluded that the activities proposed in the areas that potentially overlap with otter habitat do not pose a threat to the conservation status of this species.

It is acknowledged in this assessment that the favourable conservation status of the Harbour seal (*Phoca vitulina*) has been achieved given current levels of aquaculture production within the SAC. The aspect of the culture activities that could potentially disturb the Harbour seal status relates to movement of people and vehicles within the sites as well as accessing the sites over intertidal areas and via water.

Conclusion 1: The current levels of licenced aquaculture (existing) are considered non-disturbing to harbour seal conservation features in all areas of the SAC. Operators should note sensitive times of years for seals and continue to tailor their activities to minimise potential disturbance.

Conclusion 2: In relation to new licence applications, given the potential broad range of Harbour Seal within the SAC, the risk of disturbance to Harbour Seals should be assessed on the basis of the nature of the culture type and location relative to seal sites. For example, a site may pose a greater risk of disturbance than others on the basis of blocking potential egress routes available to seals and

the proposed levels of activity at the sites. To this end, one site (T09/499A) appears to block access to a deep channel for seals. On the basis of licenced sites nearby, there does not appear to be any mitigating features to prevent disturbance to seals.

Conclusion 3: The aquaculture activities proposed do not pose a threat to otter in the Galway Bay Complex.

11 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.

Allen, S.G., Ainley, D.G., Page, G.W., & Ribic, C.A. (1984) The effect of disturbance on harbor seal haul out patterns at Bolinas Lagoon,California. *Fishery Bulletin*, 82(3), 493-500.

Bailey, M. & Rochford J. (2006) Otter Survey of Ireland 2004/2005. Irish Wildlife Manuals, No. 23. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Barber, B.J. 1996. Impacts of Shellfish introductions on local communities. In Exotic species workshop: issues relating to aquaculture and biodiversity. Edited by J. Pedersen. MIT Sea Grant College Program (MITSG 96-15), Cambridge. pp. 18-21.

Crosby, M. P. & L. D. Gale. 1990. A review and evaluation of bivalve condition index methodologies with a suggested standard method. J Shellfish Res 91:233-237.

Becker, B.H., D.T. Press, and S.G. Allen. 2009. Modeling the effects of El Niño, density-dependence, and disturbance on harbor seal (*Phoca vitulina*) counts in Drakes Estero, California: 1997-2007. *Marine Mammal Science* 25(1):1-18.

Becker, B.H., D.T. Press, and S.G. Allen. 2011. Evidence for long-term spatial displacement of breeding and pupping harbour seals by shellfish aquaculture over three decades. *Aquatic conservation: Marine and Freshwater Ecosystems* 21: 247-260

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.

Borja, A., Franco, J. & Pérez, V. 2000. A marine biotic index of establish the ecological quality of soft-bottom benthos within European estuarine and coastal environments. *Marine Pollution Bulletin*. 40: 1100 – 1114.

Bouchet VMP, Sauriau P-G. 2008. Influence of oyster culture practices and environmental conditions on the ecological status of intertidal mudflats in the Pertuis Charentais (SW France): a multi-index approach. *Marine Pollution Bulletin* 56: 1898-1912

Brasseur, S. & Fedak, M. (2003) Habitat use of harbour seals in relation to recreation, fisheries and large infra-structural works. In: Managment of North Sea Harbour and Grey Seal Populations. Common Wadden Sea Secretariat, Ecomare, Texel, The Netherlands.

Brenner, M., D. Fraser, K. Van Nieuwenhove, F. O'Beirn, B.H. Buck, J. Mazurié, G. Thorarinsdottir, P. Dolmer, A. Sanchez-Mata, O. Strand, G. Flimlin, L. Miossec, P. Kamermansm. 2014. Bivalve aquaculture transfers in Atlantic Europe. Part B: Environmental impacts of transfer activities. Ocean & Coastal Management 89: 139-146

Carlton, J.T. 1989. Man's role in changing the face of the ocean: biological invasions and implications for conservation of near-shore environments. Conserv. Biol. 3: 265-273.

Carlton, J.T. 1999. Molluscan invasions in marine and estuarine communities. Malacologia 41: 439-454.

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

Derraik, J.G.B. 2002. The pollution of the marine environment by plastic debris: A review. *Marine Pollution Bulletin* 44:842-852.

Duck, C. & Morris, C. (2013) An aerial survey of harbour seals in Ireland: Part 2: Galway Bay to Carlingford Lough. August-September 2012. Unpublished report to the National Parks & Wildlife Service, Department of Arts, Heritage & the Gaeltacht, Dublin.

Fletcher, L.M., B. M. Forrest, J. J. Bell. 2013. Impacts of the invasive ascidian *Didemnum vexillum* on green- lipped mussel *Perna canaliculus* aquaculture in New Zealand. Aquaculture Environment Interactions 4: 17–30, 2013

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.

Jansen, J., Bengtson, J., Boveng, P., Dahle, S., & Ver Hoef, J. (2006). Disturbance of harbor seals by cruise ships in Disenchantment Bay Alaska: an investigation at three temporal and spatial scales., Rep. No. ASFS Processed Report 2006-02. Alaska Fisheries Science Center.

Johnson, A. & Acevedo-Gutierrez, A. (2007) Regulation compliance by vessels and disturbance of harbour seals (*Phoca vitulina*). *Canadian Journal of Zoology*, 85, 290-294.

Johnson, D. (2008). Environmental indicators: Their utility in meeting the OSPAR Convention's regulatory needs. *ICES Journal of Marine Science* 65:1387-1391.

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 15: 2265-2279

Kochmann J., T.P. Crowe. (2014). Effects of native macroalgae and predators on survival, condition and growth of non-indigenous Pacific oysters (*Crassostrea gigas*). Journal of Experimental Marine Biology and Ecology 451: 122–129

Lelli, B. & Harris, D.E. (2001) Human disturbances affect harbour seal haul-out behaviour: can the law protect these seals from boaters? In: Macalester Environmental Review, pp. 1-16.

Lewis, T.M. & Mathews, E.A. (2000). Effects of human visitors on the behaviour of harbour seals (*Phoca vitulina richardsi*) at McBride Glacier Fjord, Glacier Bay National Park. University of Alaska Southeast & Glacier Bay National Park, Juneau & Gustavus, Alaska.

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 (2009) Threat Response Plan: Otter (2009-2011). National Parks & Wildlife Service, Department of the Environment, Heritage & Local Government, Dublin.

NPWS. 2010. Harbour Seal population monitoring 2009-2012: Report No. 1 – Report on a pilot monitoring study carried out in southern and western Ireland. Department Arts, Heritage and the Gaeltacht. June 2010 11pp.

NPWS. 2011. Harbour Seal pilot monitoring Project, 2010. Department Arts, Heritage and the Gaeltacht. June 2011. 15pp.

NPWS. 2012. Harbour Seal pilot monitoring Project, 2011. Department Arts, Heritage and the Gaeltacht. January 2012 15pp.

NPWS. 2013a. Conservation Objectives for Galway Bay Complex SAC (000268). Version 1.0. Department Arts, Heritage and the Gaeltacht. Version 1 (16th April 2013); 25pp.

NPWS. 2013b. Galway Bay Complex SAC (000268): Conservation Objectives supporting document – marine habitats and species. Department Arts, Heritage and the Gaeltacht. Version 1 (March 2013); 34pp.

NPWS (2013c) The Status of EU Protected Habitats and Species in Ireland. Species Assessments Volume 3, Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Marine Institute and Bord Iascaigh Mhara. 2011. Shellfish Stocks and fisheries; Review 2011- An Assessment of selected stocks. ISBN: 978-1-902895-52-9. 64pp

Marine Institute and Bord Iascaigh Mhara. 2011 (2019). Shellfish stocks and Fisheries Review 2018. Marine Institute, RInville Oranmore, Galway. ISBN: 978-1-902895-63-5. 70pp.

MagAoidh, R. 2011. Reproduction of *Crassostrea gigas* in Irish Waters: An analysis of gametogenesis and condition comparing tidal location and ploidy level. MSc Thesis, University College Dublin, Ireland. 84pp.

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.

McNeill, G., J. Nunn, D. Minchin. 2010. The slipper limpet *Crepidula fornicata* Linnaeus, 1758 becomes established in Ireland. Aquatic Invasions 5 (Supplement 1): S21-S25

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.*

Perry, E.A., Boness, D.J., & Insley, S.J. (2002) Effects of sonic booms on breeding grey seals and harbour seals on Sable Island, Canada. J. Acoust. Soc. Am., 111(1), 599-609.

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.

Roycroft, D., T.C. Kelly, L.J. Lewis. 2004. Birds, seals and the suspension culture of mussels in Bantry Bay, a non-seaduck area in Southwest Ireland. Estuarine, Coastal and Shelf Science 61: 703–712

Seuront, L.J.J. & Prinzivalli, P. (2005) Vulnerability of harbour seals, *Phoca vitulina*, to transient industrial activities in the Strait of Dover. *Journal of the Marine Biological Association UK*, 85, 1015-1016.

Skinner, M.A., S.C. Courtenay, C.W. McKindsey, C. E. Carver, A.L.Mallet. 2014. Experimental determination of the effects of light limitation from suspended bag oyster (*Crassostrea virginica*) aquaculture on the structure and photosynthesis of eelgrass (*Zostera marina*). Journal of Experimental Marine Biology and Ecology. 459:169-180.

Suryan, R.M. & Harvey, J.T. (1999) Variability in reactions of Pacific harbor seals, *Phoca vitulina* richardsi, to disturbance. *Fishery Bulletin*, 97, 332-339.

Tebble, N. 1976. British bivalve seashells. Royal Scottish Museum. 212pp

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.

Tully, O, Clarke S, O'Halloran G, Kelly D, O'Dowd C. 2019. The distribution of native oyster (*Ostrea edulis*) and other bivalves on the intertidal zone in Galway Bay in 2018. Unpublished report. Marine Institute.

Valentine, P.C., M.R. Carman, D.S. Blackwood, E.J. Heffron. 2007. Ecological observations on the colonial ascidian *Didemnum* sp. in a New England tide pool habitat. Journal of Experimental Marine Biology and Ecology 342 (2007) 109–121

Watson-Capps, J.J. & Mann, J. (2005) The effects of aquaculture on bottlenose dolphin (*Tursiops* sp.) ranging in Shark Bay, Western Australia. *Biological Conservation*, 124, 519-526.