Article 6 Assessment of Aquaculture and Fisheries in Roaringwater Bay

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June 27th 2013

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1 Preface

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

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

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

2 Executive summary

2.1 The SAC

Roaringwater Bay in west Cork 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. 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), seagrass and kelp reefs. The area is also designated for and supports significant numbers of grey seal, harbour porpoise and otter. Seal and porpoise in the Bay are likely to be components of the larger Celtic Sea populations of these species. Conservation Objectives for these habitats and species were identified by NPWS (2011a) 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.

2.2 Activities in the SAC

There is a diverse range of fishing and aquaculture activities in the Bay. There is an intensive autumn pot fishery for shrimp. Lobster and crab are fished throughout the year. Crayfish and demersal fish are targeted with tangle nets and gill nets in the outer Bay and beyond. Scallop are fished in the upper part of the Bay in winter and spring. Demersal trawling occurs in the outer part of the Bay throughout the year and there is sporadic mid-water trawling for pelagic fish. Line fishing for mackerel and Pollack is common in summer.

The main aquaculture activity is rope culture of mussels. Mussel spat are also collected on ropes seaward of the mussel grow-out areas. Pacific oyster are cultured on trestles in intertidal areas and there are proposals for bottom culture of this species in the upper Bay. The profile of the aquaculture industry in the Bay, used in this assessment, is derived from the list of licence applications received by DAFM and provided to the MI for assessment in September 2011.

2.3 The appropriate assessment and risk assessment process

The function of the 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 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 (2011b) 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 screening stage and appropriate assessment or risk assessment proper. The assessment begins by screening out those activities which cannot have, because they do not spatially overlap with a given habitat, any impact. This is a conservative screening in that other activities which may overlap with habitats but which may have very benign effects are retained for full assessment. In the case or risk assessments consequence and likelihood of the consequence occurring are scored categorically as separate components of risk. Risk scores are used to indicate the requirement for mitigation.

2.4 Data supports

Distribution of habitats and species population data are provided by NPWS. Fishing data are compiled from various sources including hard data and expert knowledge. Information on Aquaculture licences and applications are provided by DAFM. 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. The following are the exceptions:

- Scallop fishing on reefs, maerl, seagrass and mixed sediments: This fishery impinges on a range of sedimentary and reef habitats in the Bay. The fishing method impacts benthic communities in soft sediments and particularly biogenic reefs. It is seasonal, however, and fauna in soft sediments can probably recover between fishing seasons. Recovery capacity of reefs, however, is lower than the frequency of impact and the fishery is, therefore, expected to have a persistent disturbing effect on these reefs and as the fishery overlaps more than 15% of reef habitat the conservation objectives may not be met. There is some uncertainty about the actual footprint of the fishery and its presence on reef habitat. Nevertheless there is moderate risk that over time scallop fishing activity on reef may lead to deterioration of reefs.

- Pot fisheries for shrimp on maerl, seagrass and *Laminaria* reef: Although shrimp pots are generally non-disturbing to habitats and have benign effects compared to towed fishing gears the intensity of shrimp potting activity on sensitive maerl habitat in particular and to a lesser extent on seagrass may be beyond the capacity of such habitats to recover from impacts due to potting. The main effect of this fishery is physical i.e. abrasion of the seabed and scarring that may result during deployment and hauling of gear. There is a moderate risk that over time intensive shrimp potting activity may lead to deterioration of maerl and possibly seagrass. The risk to *Laminaria* reef communities is lower.
- Gill nets, tangle nets and trammel nets effects on grey seal, harbour porpoise and otter: There is a high risk of capture of grey seal and porpoise in set nets in RWBay and outside the Bay on the south and south west coasts. The level of by-catch, if it occurs, is unknown as limited data exists. The risk is lowest for trammel nets, which are set in shallow water, and where the risk may be more relevant to otter. Only a very limited by-catch of these species, leading to mortality, can be tolerated if the Conservation Objectives are to be achieved. This allowable by-catch, calculated as a function of the population growth capacity of seal and porpoise, and using the number of animals using the site, is very low and numbering less than 10 individuals per species per annum. The effects of the three gears, and other gears such as mid-water trawling where there is a risk of by-catch, are additive in combination.
- Demersal trawling on mixed sediments and reefs: Depending on the intensity and frequency of the activity there is a risk of persistent disturbance to sedimentary habitats due to demersal trawling. However, it is unlikely that persistent disturbance will occur as the intensity of the activity is low and the activity is seasonal. Trawling is unlikely to occur on reefs >20m or in *Laminaria* reefs although the edge of reefs or reef patches may be affected if rock hopper gear is used.
- Extensive culture of Pacific oyster on the seabed and all habitats: This activity poses a risk to habitats in the bay as there is a higher likelihood that this culture method could lead to spawning of this non-native species which reaches higher condition levels in sub-tidal culture than on intertidal trestle culture. Naturalisation of this non-native species could alter community structure and function in affected habitats. There is also a risk of introduction of other non-native species with imported half grown oysters which would be used in this case.
- In combination effect of rope mussel grow-out, demersal trawling and bottom culture of Pacific oysters and the shallow sand/mud community: These activities are each disturbing to the shallow sand/mud community. Individually they spatially overlap with less than 15% of this

community and are therefore not significantly disturbing as such. Collectively, however, these activities occur on approximately 15% of the shallow sand/mud community and significant effects cannot, therefore, be discounted. Mussel grow-out is disturbing to underlying sedimentary habitats through enrichment of the sea bed. In RWBay this activity also occurs very close to, but not on, maerl and seagrass which are highly sensitive to enrichment and sedimentation. Given the proximity of licenced activities to this sensitive habitat consideration might be given to imposing a buffer between this activity and maerl habitat. 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 in-benthic community. Trawling is physically disturbing and will cause mortality of certain species in this community. The actual footprint of this activity, however, is very low.

- Suggested mitigating actions for Aquaculture include
    - Use of triploid Pacific oyster to reduce risk of naturalization of this species
    - Monitoring importation of ½ grown oysters for alien species
    - Use of buffer zones around the main long line mussel culture area to minimize deposition of organic material onto maerl and seagrass habitats
    - Allowing suitable distances between licences and grey seal haul out locations
- Mitigating actions for fisheries that pose a moderate or high risk to habitats and species are required. Such mitigations should reduce the nature, scale, frequency or intensity of the activity and its impact.
- For fisheries some risk scores estimated are precautionary, in the absence of convincing information on absence of significant effects of these fisheries. Improved data provision and demonstration of lower risk, than indicated in this assessment, within a defined and limited time frame could reduce the number of fisheries requiring mitigating actions.

3 Introduction

This document assesses the potential ecological impacts of fishing and aquaculture activities in and adjacent to Roaringwater Bay and Islands (site code 000101) Special Area of Conservation (SAC) on the Conservation Objectives for the site (COs). The information upon which this assessment is based is a profile of fishing activity compiled for the site in 2011 and a definitive list of applications and extant licences for aquaculture received by DAFM and forwarded to the Marine Institute as of end of September 2011. The activities include fishing for shrimp, lobsters, crabs, scallops, demersal and pelagic fish using various mobile and fixed fishing gears, growing of mussels and seaweed on long lines and intertidal and sub-tidal culture of pacific oysters.

4 Details of the proposed plans and projects

4.1 Fisheries

4.1.1 Fishing metiers

Details of the proposed fishery activities in the Bay were profiled in 2010. Ten fishing 'metiers' occur in the bay targeting at least 13 species with particular types of mobile and static fishing gear (Table 1). Some species are targeted by more than one gear; pollack for instance is targeted by bottom otter trawl, gill nets and hooks and lines. Nevertheless most of the metiers are discrete single/double species – single gear combinations and include shrimp-pots, scallop-dredges, lobster/crab-creels, crayfish/turbot-tangle nets, pollack/mackerel-hook and line, herring/sprat-pelagic trawl, whitefish-otter trawl fisheries.

A summary of the current status of the fisheries considered in this assessment, the fishing pattern and the likelihood of escalation of activity is presented in Table 2. Generally the status of the commercial stocks in the bay is unknown. Licencing policy allows for open access to each metiers and the risk of significant fishing effort escalation is in such cases related to stock availability, profitability, space for new entrants and entry costs.

4.1.2 Spatial extent of fishing métiers

The spatial distribution and extent of each métier was mapped by compiling expert knowledge of the likely distribution of each activity and by interviewing each fishermen operating in the Bay using a pre-defined questionnaire. Some fisheries such as the trap fishery for shrimp occurs throughout the Bay while other fisheries such as tangle netting or gill netting tends to occur in discrete areas in the outer part of the Bay (Figures 1 and 2, Table 1). The actual footprint of the fishing pressure from each métier is less than the spatial extent and depends on the intensity of effort within the spatial extent polygon, the type of gear and the operation of the fishery. Estimates of fishing pressure footprints depend on the resolution of the fishing activity data.

Table 1. Target species, gears and fishing metiers in RW Bay.

Metier	Metier description	Target species	Scientific name	Gears	Gear	Spatial extent (Ha)
1	Shrimp pot – demersal	Shrimp	*Palaemon serratus*	Shrimp pots	Static	9300
2	Creel - demersal	Lobster	*Homarus gammarus*	Side and top entrance creels	Static	10500
		Crab	*Cancer pagurus*			
		Velvet crab	*Necora puber*			
3	Tangle net – demersal	Crayfish	*Palinurus elephas*	Tangle nets	Static	2200
		Turbot	*Psetta maximus*			
4	Dredge – benthic	Scallop	*Pecten maximus*	Dredges	Mobile	2792
5	Mid-water trawl – pelagic	Mackerel	*Scomber scombrus*	Mid-water trawl,	Mobile	3090
		Herring	*Clupea harengus*			
6	Hooks and Lines – Pelagic	Mackerel	*Scomber scombrus*	Hooks and lines	Mobile	2470
		Pollack	*Pollachius pollachius*			
7	Gill net – demersal	Pollack	*Pollachius pollachius*	Gill nets	Static	7100
8	Otter trawl - demersal	Pollack	*Pollachius pollachius*	Bottom Otter trawl	Mobile	23000
		Prawns	*Nephrops norvegicus*			
		Hake	*Merluccius merluccius*			
		Monkfish	*Lophius spp*			
		Haddock	*Melanogrammus aeglefinus*			
		Whiting	*Merlangius merlangus*			

9	Hand picking – benthic	Periwinkle	*Littorina littorea*	Hand picking	Mobile	Unknown
10	Trammel nets-bait	Various fish		Trammel nets	Static	Sub-set of creel fishery

Table 2. Summary of Roaringwater Bay fisheries and their current status, frequency and the likelihood of escalation of activity

METIER	STATUS	FREQUENCY	POSSIBILITY OF ESCALATION
Shrimp Pot - Demersal	Active	Seasonal	Yes. No input or output controls. Competition for space increases effort. Price is generally high and the fishery is profitable
Creel – lobster,crab	Active	Year round	Yes. No input or output controls. Price is poor however which may limit increases in effort
Tangle net-demersal	Active	Seasonal	Yes. No input or output controls. However, cray stocks are low although price is high. Passive fishing with long soak times. Easy to increase effort.
Scallop dredge-benthic	Active	Seasonal	Yes. No input or output controls for vessels under 10m. Availability of market seems to be the main curtailing factor in the fishery
Mid-water trawl-pelagic	Active	Seasonal	Yes. Effort is sporadic and depends on presence of fish
Hooks and Lines-pelagic	Active	Seasonal	Yes. Diversification opportunity for potting and dredging vessels.
Gill net - demersal	Active	Seasonal	Yes. Depending on quota availability mainly
Otter trawl - demersal	Active	Year round	Yes. Depending on quota availability mainly
Hand picking - benthic	Active	Seasonal	Yes. No controls and subject to episodic increases by gangs of pickers
Bait fishing-trammel nets	Active	Year round	Yes. Correlated with potting activity

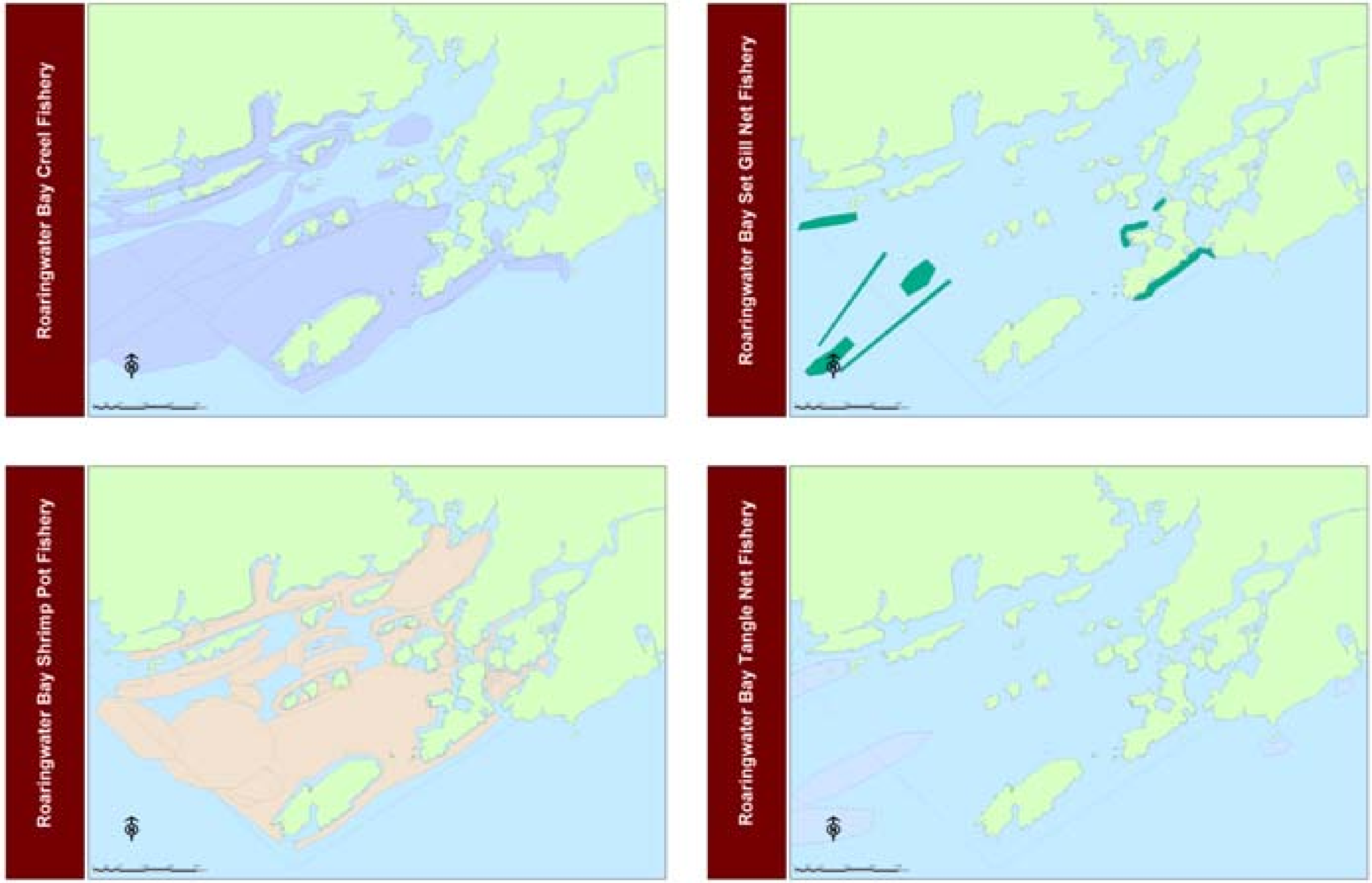

Figure 1. Distribution of fisheries using static fishing gear in Roaringwater Bay

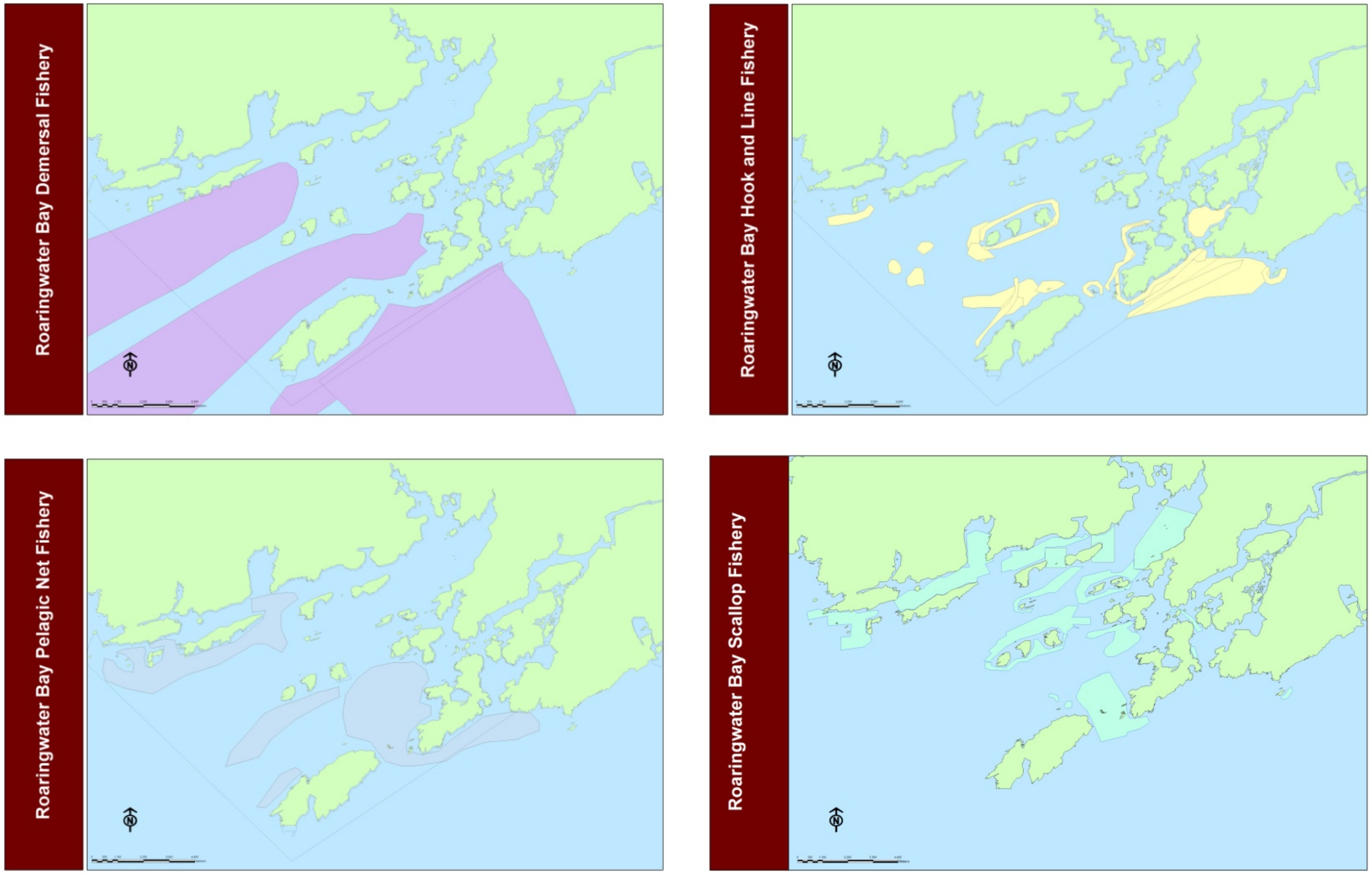

Figure 2. Distribution of fisheries using mobile fishing gears in Roaringwater Bay.

4.2 Aquaculture

4.2.1 Aquaculture practices

Aquaculture is conducted in a number of locations within Roaringwater Bay and Island SAC. The majority of culture is conducted in three broad areas, Roaringwater Bay where the majority of mussel cultivation occurs, and both the Illen Estuary and Sherkin Island where the majority of oyster culture is carried out. In addition, other activities, such as the suspended culture of seaweed, occur at discrete locations through out the bay.

The aquaculture activities or applications pending can be broadly divided according to species cultured and method of culture (on-bottom or suspended/off-bottom) as well as licence status (licenced or application).

Mussel culture is primarily conducted in the NE corner of the SAC. As it currently stands the licenced areas range in size from 0.8 to 45 ha with a total licensed area of approx 278ha with another 22 ha as applications pending (Figures 3 and 4) In addition, there are approximately 66 ha, for which application have been submitted, proposed as spat collection sites. The average water depth in the areas where licenced mussel culture takes place is approximately 4m. Other locations where shellfish are cultured are in the vicinity of the Illen Estuary and around Sherkin Island (Figure 3b). Here, oysters are cultured, predominantly on sedimentary habitats in the intertidal zone. More detailed descriptions of culture operations follow.

4.2.2 Mussel Culture

Seed Collection Stage – Typically 5 months

All of the operators source their seed through natural settlement on collector ropes within the bay. This technique was trialled over a number of years in Roaringwater Bay and has been universally employed since 2006. Collector ropes are attached to lines deployed specifically for the purpose of seed collection at the end of May / beginning of June each year. Between September and November the collectors are gathered and re-deployed to the on-growing areas. However, varying growth rates, weather conditions and harvest times for existing stocks can force operators to delay re-deployment, meaning the collectors may remain in place for longer. Currently spat collection is effected in licenced sites in the inner part of Roaringwater Bay proper. It is proposed, taking a collective view of the applications, to partition out the culture phases so that spat collection is carried out in areas seaward of the traditional culture areas (Figure 3).

The process of transplanting of seed to on-growing areas is as follows: Collectors are harvested from the water, mechanically stripped and fed through a de-clumping machine and sometimes a grader on board. The seed is then re-packed at lower stocking densities onto on-growing rope and deployed. The line drop length is pre-determined by the water depth at the site. Lines are kept at least 0.5m above the seabed at low tide to minimise predation. Starfish and crabs can access the lines if they touch the seabed but are not problematic in this area. Roaringwater Bay has very shallow water depths compared with other mussel growing areas in Ireland. Water depths across the main culture areas are typically between 3.5m and 6m.

Ongrowing Stage – Typically 14 – 18 months

During the on-growing stage mussels may be thinned, and / or graded and re-packed once or twice prior to harvest. This usually takes place in May / June after the first year of growth but may also be carried out in the previous autumn upon initial transfer of the seed to the on-growing areas.

Harvesting

Mussels are generally harvested from Roaringwater Bay in the winter and are sold fresh to markets in mainland Europe. Mussels harvested in the summer are generally sold to processing plants in Ireland and transformed into frozen / vac packed value added products. Yields are typically 7-8 tonnes per line.

Culture Systems

A number of the mussel growers in Roaringwater Bay have changed their growing methods in recent years to what is known as the continuous rope system. Adapted from practices developed in New Zealand, this methodology facilitates better product handling through faster and more efficient packing and harvesting, as well as saving energy and reducing waste. The system uses a continuous rope (compared with numerous drop lines individually tied onto the head rope). This is reusable and is “hairy” to increase the surface area upon which the mussels can attach themselves. The rope together with mussels, are packed into a cotton mesh. The cotton degrades naturally as the mussels grow and attach themselves to the hairy rope (compared with polyethylene pergolari mesh used in the past for the single droppers and which created a significant waste stream because it was not reusable). The introduction of the New Zealand System to the bay has instigated new and strengthened existing collaborations in the industry. The mussel growers who have not invested in this system have adopted alternative reusable rope and packing systems meaning that the use of pergolari is now almost completely eliminated from operations. Some farmers grow their mussels on the same rope and mesh from collection through to harvest, with no thinning or re-packing, simply transferring the collected seed to the on-growing areas. Other reusable ropes, sourced in Europe, are also used. These provide additional surface area for settlement and on-growing also but tend to be used to grow crop from collection right through to harvest. They can be bought in shorter coils and are then deployed individually. This provides easier handling and lower investment for less mechanised farmers while still reducing waste

There are two boats in Roaringwater Bay equipped with the New Zealand harvesting and packing system. Other operators contract these boats so that they too can use the system.

Mussel lines are generally deployed in an NE-SW orientation. The lines are made up of, on average, 21–23 floats per 110m long headrope. In accordance with licence conditions there are no more than 3 longlines per hectare. The standard 210L grey floats dominate and farmers have availed of the BIM Barrel Replacement Scheme to reduce the visual impact of their operations. Some operators are trialling 130L floats which are better suited to the lower biomass on the longlines due to the shallow water (4-5m). They reduce the effect of wave action on the headropes which can cause ‘dropoff’ (loss of mussels) from the top metre or so of the dropper.

Site Access

Laharatanvalla pier is used to service the main culture sites in Roaringwater Bay and access to the culture sites is during daylight hours only.

Predator Control

Predators do not cause a problem in Roaringwater Bay. Continuous monitoring and subsequent management ensures that lines do not touch the seabed.

General Farm Management

Most of the operators store equipment at their homes in designated storage areas. There is storage of materials on Laharatanvalla Pier. The pier is owned by Cork County Council and is subject to bye-laws restricting storage to 48 hours within a 72 hour period. It is very much a working pier and is not generally used for leisure access or visited by tourists. Various maintenance work is carried out by the farmers and fishermen on the pier.

Five growers are members of the Irish Quality Mussel Scheme. Another three are members of ECOPACT and all are members of the Roaringwater Bay CLAMS group.

4.2.3 Intertidal Oyster Culture

In Roaringwater Bay and Islands SAC there are currently18 sites licenced for the intertidal culture of the Pacific oyster (*Crassostrea gigas*) and 4 applications are pending. Pacific oysters are grown in plastic mesh bags secured to metal trestles predominantly on sedimentary habitat. Wire-mesh 'trays' are also available. Average annual production of Pacific oysters in the area under consideration is in the region of 100 tonnes p.a.

Seeding/ Seed Source

Seed or 'spat' oysters are purchased from hatcheries. They are available in a variety of size grades, usually from 4mm – 30mm shell length. The size grade quoted by suppliers generally refers to the size of mesh used to sort the oyster seed (3 – 14 mm mesh). Seeding is generally carried out in Spring when seed (> 5 g or 10-15mm) becomes available from hatchery. The majority of seed oysters in Roaringwater Bay are sourced from UK hatcheries. Wild seed from France is also used, which is transported into Roaringwater Bay via Ballymacoda Bay.

Grading and Thinning and Growout

Where oysters are grown in bags to harvest, the size of the mesh in the bags is increased progressively as the oysters grow. Oyster seed between 4 - 8mm shell-length is generally placed in 2mm mesh bags. At 8 – 15mm shell-length 4mm mesh is used. From 15 – 25mm shell-length the bag is usually of 7 – 8mm mesh and above 25 mm shell-length 14mm mesh is used. By final harvest the bags are generally of 18 – 25mm mesh. As a general rule largest mesh that will still retain all the stock is used as this promotes good water flow and optimises growth.

The density of the stock within the bags is also reduced progressively as the animals grow. The dimensions of the bags may vary between operators, but as a general rule, stocking densities are approximately: up to 15 mm, 2,000 – 3,000 m^2; > 25 mm, 1,500 m^2; > 50 mm, 500 m^2. Optimal stocking densities for best growth vary from site to site and must be determined by trials. Typically, oysters close to harvest size are stocked at a density of up to 250 per bag.

Harvesting

Harvesting is carried out during the months of November, December and January. The stock is harvested when they attain suitable size and condition. This can be from 75g (>85mm) upwards. It can take 2.5 – 3 years to first harvest.

Access

All sites (bar one) are accessed by boat. A combination of small boats and barges are used to service the sites i.e. transport stock, equipment and facilitate grading and harvesting. One site on Sherkin Island is accessed using a tractor. This site is used as a staging area for operations and a hardening area for stock grown at other sites licenced to the grower.

4.2.4 Subtidal Oyster Culture

Two applications are currently pending for the sub-tidal culture of oysters directly on the seabed. This culture method involves the placement of oysters, uncontained, on the seabed after a nursery phase in the intertidal zone. It is proposed that suitably sized oysters (>15g) are spread within the licenced area. Growth and mortality of the oysters will be monitored and intervention will be necessary if anomalies are discovered. For example, oysters may need 'turning-over' if excessive fouling or siltation is noted on the animals. Such intervention, as well as harvesting, when oysters are approximately 100g, will be carried out using oyster dredges deployed from boats. The dredges are typically 1.5m wide and have contact with the substrate via a flat blade. Harvest is expected 24-36 months after initial seeding. This may be shorter depending upon the size of the seed and the productivity of the area in question.

4.2.5 Seaweed Aquaculture

Applications are pending for two adjacent sites, within Roaringwater Bay SAC, to culture a range of seaweed species (i.e., *Chondrus crispus, Mastocarpus stellatus, Palmaria palmara, Alaria Laminaria and Porphyra*). Culture will be effected by using floats and long lines similar to those employed by rope mussel operators. Seeding of the lines is conducted by attaching fragments of adult plants, juvenile plants, sporelings, or spores directly onto ropes and the plants are on-grown to maturity at sea. The seeding material to be used will be dependent on the species cultured, e.g. fragments of plants cannot be used for Kelp species as there is a high degree of specialization in these species and fragments will not regenerate. Red algal species do not demonstrate similar levels of specialization at the cellular level and therefore, are suitably on-grown from fragments. Growth rates are variable for different species but production is expected to be continuous. The sites will be serviced using boats only.

4.2.6 Oyster Fishery Orders

Currently there are two oyster fishery orders in Roaringwater Bay and Islands SAC. One order area is located within Kinnish Harbour on Sherkin Island. This order area is predominantly intertidal and oysters are cultured here using bags and trestles (as described above).

The second order area is located at the mouth of the Illen River. Currently no oyster production is carried out within this order area with the exception of activities carried out in licenced areas that overlap the fishery order area. These licensed areas are considered under the intertidal oyster culture section below.

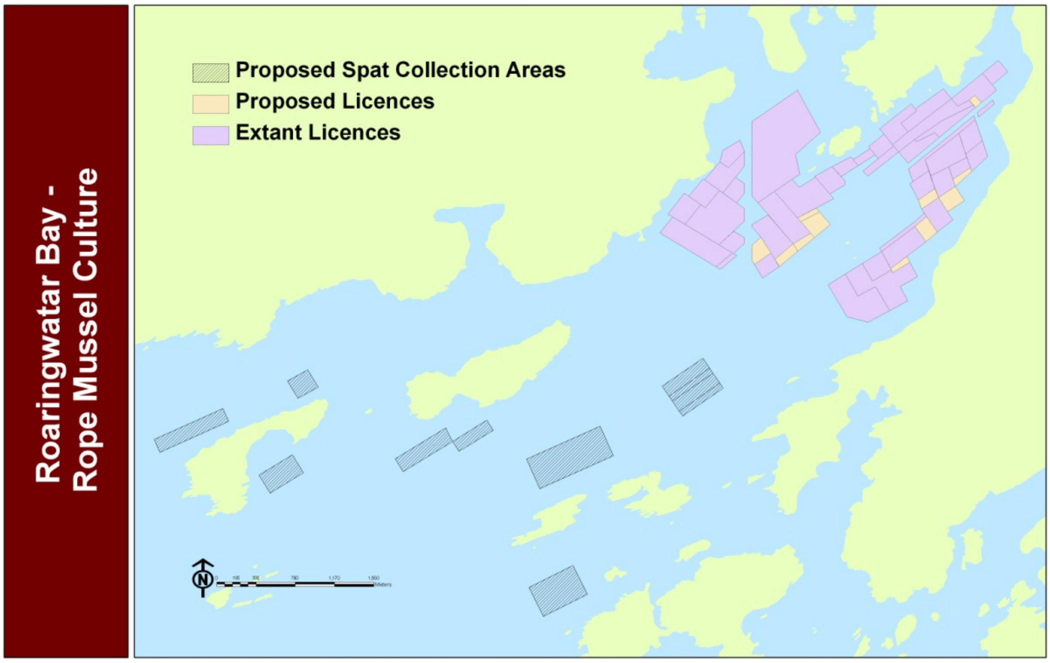

Figure 3. Extant and proposed rope mussel culture sites within Roaringwater Bay and Islands SAC**.**

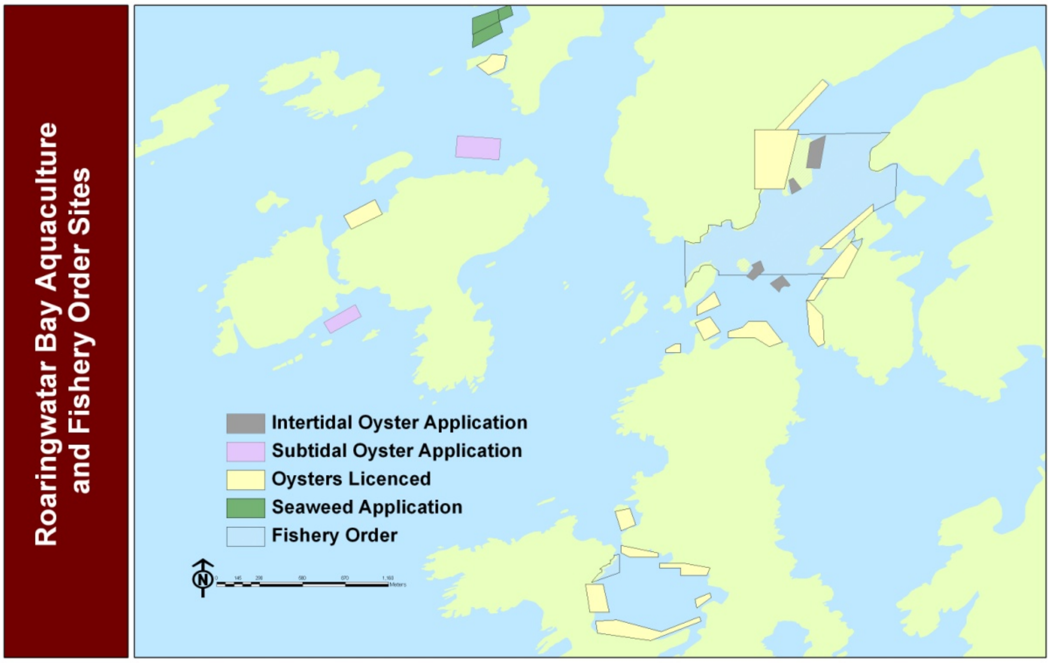

Figure 4. Oyster culture (licenced and applications), seaweed culture (applications) and oyster fishery order areas within Roaringwater Bay and Islands SAC.

4.2.7 Spatial Extent of Aquaculture Activities.

The spatial extent of existing and proposed aquaculture activities within the SAC were calculated using coordinates of activity areas in a GIS. In some instances for intertidal oyster culture, where mapping would have been conducted prior to the advent of accurate global positioning systems and software, the extent of the areas licensed overlap terrestrial habitat. In addition, some areas were deemed to also overlap sub-tidal habitat (as defined by NPWS habitat maps – see below) when this activity (intertidal oyster culture) clearly has no sub-tidal component. Where this overlap with unsuitable habitat was identified, this area was filtered out and only the area suitable for the activity was estimated. This filtering was carried out in order to accurately present the likely overlap on activity on habitats and features of interest to the conservation of the SAC. A summary of the spatial extent of the various aquaculture activities is presented in Table 3.

Table 3. Spatial extent of aquaculture activities in Roaringwater Bay and Islands SAC presented according to species, method of cultivation, location and licence status.

Species	***Tidal Zone***	***Licence Status***	***Spatial Extent (ha)***
Oysters	**Intertidal**	**Application**	**9.45**
Oysters	**Intertidal**	**Licensed**	**32.68**
Oysters	**Subtidal**	**Application**	**6.30**
Oysters (Fishery Order)	**Subtidal**	**Licensed**	**63.98**
Oysters (Fishery Order)	**Intertidal**	**Licensed**	**9.40**
Seaweed	**Subtidal**	**Application**	**4.05**
Scallops	**Subtidal**	**Licenced**	**7.98**
Rope Mussels	**Subtidal**	**Application**	**22.47**
Rope Mussels	**Subtidal**	**Licenced**	**289.80**
Rope Mussels-spat collection	**Subtidal**	**Application**	**95.71**

5 Conservation Objectives for Roaringwater Bay

The appropriate assessment of fisheries and aquaculture activities in relation to the Conservation Objectives is based on version 1.0 of the objectives as produced by NPWS (2011a).

5.1 The SAC extent

The SAC extends from the upper reaches of Roaringwater Bay, south west along the north shore to Castle point and seaward in a south east direction to Cape Clear and north east to the entrance to Baltimore Harbour (Figure 5).

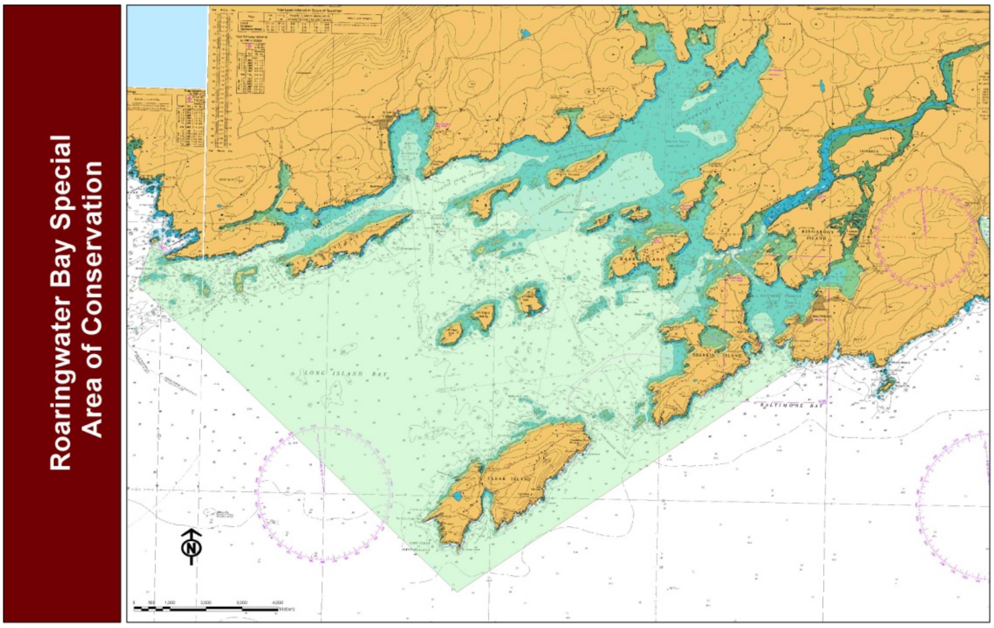

Figure 5. The extent of Roaringwater Bay and Islands SAC (site code 000101).

5.2 Qualifying interests in the SAC

The SAC is designated for the following qualifying interests: Constituent communities and community complexes for habitats 1160 and 1170 (5) are listed in NPWS (2011b):

- 1160 Large shallow inlets and bays (Figure 6)
    - Zostera dominated communities
    - Maerl dominated communities
    - Muddy sand with bivalves and polychaetes community complex
    - Mixed sediment community complex
    - Shallow sand/mud community complex

- 1170 Reefs
    - o Exposed / moderately exposed intertidal reef community complexes
    - o Exposed / moderately exposed sub-tidal reef community complexes >20m depth
    - o Sheltered reef communities
    - o *Laminaria* dominated communities
- 1230 Vegetated sea cliffs of the Atlantic and Baltic coasts
- 1351 Harbour porpoise (*Phocoena phocoena*)
- 1355 Otter (*Lutra lutra*)
- 1364 Grey seal (*Halichoerus grypus*)
- 4030 European dry heaths
- 8330 Submerged or partly submerged sea caves

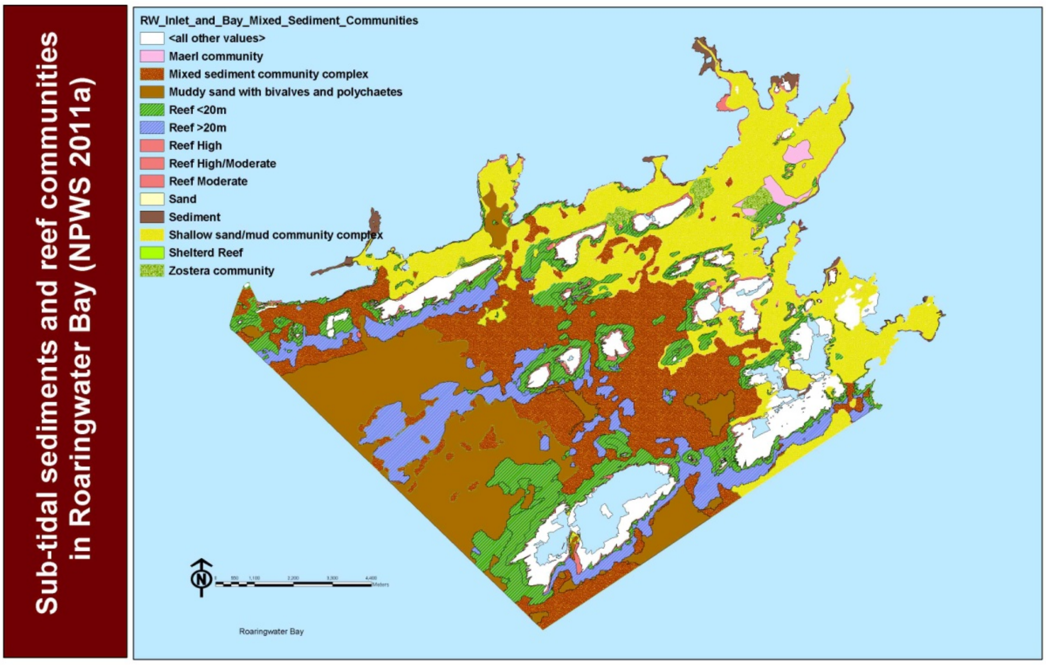

Figure 6. Marine sedimentary and reef habitats in Roaringwater Bay (NPWS 2011a).

5.3 Conservation objectives for the marine Habitats and Species in the SAC

The conservation objectives for the qualifying features were identified by NPWS (2011a). The natural condition of the designated features should be preserved with respect to their extent, distribution and characterizing species. Habitat availability should be maintained for designated species and human disturbance should not adversely affect such species.

Specifically, for marine habitats and species, the attributes shown in Figure 6 and listed in Table 4 should be conserved.

Table 4. Conservation objectives and targets for marine habitats and species in Roaringwater Bay. Adapted from NPWS (2011a)

FEATURE	OBJECTIVE	TARGET
Large shallow inlet and bay	Maintain favourable conservation condition	Stable permanent area and distribution
Zostera dominated communities	Maintain extent	119ha
	Maintain quality	Shoot density as measured in 2007
Maerl dominated communities	Maintain extent	96ha, avoid significant disturbance
Muddy sand with bivalves and polychaetes community complex	Maintain extent and quality	2047ha, persistent disturbance to ecology <15% of area
Mixed sediment community complex	Maintain extent and quality	3205ha, persistent disturbance to ecology <15% of area
Shallow sand/mud community complex	Maintain extent and quality	3335ha, persistent disturbance to ecology <15% of area
Reefs	Maintain favourable conservation condition	Distribution
		Permanent area

Exposed to moderately exposed intertidal reef	Maintain distribution, extent, structure and function	327ha, persistent disturbance to ecology <15% of area
Exposed to moderately exposed subtidal reef below 20m	Maintain distribution, extent, structure and function	1286ha, persistent disturbance to ecology <15% of area
Sheltered reef	Maintain distribution, extent, structure and function	39ha, persistent disturbance to ecology <15% of area
Laminaria community	Maintain extent	1846ha
	Conserve biology	Flora and fauna
Sea caves	Maintain favourable conservation condition	Distribution stable
Harbour porpoise	Maintain favourable conservation condition	Maintain species range within the site
		Minimise human disturbance
Grey seal	Maintain favourable conservation condition	Maintain species range within the site
		Conserve breeding sites
		Conserve moult haul-out sites

		Conserve resting haul-out sites
		Maintain cohort structure
		Minimise disturbance
Otter (in the marine habitat)	To restore favourable conservation condition	88% positive survey sites
	Maintain extent of marine habitat	1562ha
	Maintain couching sites and holts	Minimise disturbance
	Maintain fish biomass	No significant decline in marine fish species in otter diet
	Maintain connectivity	Minimise obstruction to movements

6 Natura Impact Statement for the proposed activity

The potential ecological effects on the conservation objectives for the site relate to the physical and biological effects of fishing gears or aquaculture structures and human activities on designated species, intertidal and sub-tidal habitats and invertebrate communities and biotopes of those habitats. The effects will depend on the spatial and temporal profile of fishing and aquaculture activities during the lifetime of the proposed activities, plans and projects and the nature of each of these activities. In the case of fishing the main pressures caused are due to physical contact between fishing gears and habitats/species and to the biological extraction of commercial species. In addition aquaculture involves, in some cases, increased sedimentation and enrichment.

6.1 Fisheries

The fishing activities cause physical disturbance to habitats through the use of various fishing gears, targeted extraction of fish and shellfish and potential by-catch of designated species.

The degree to which habitats are disturbed by fishing depend on the scale, intensity and frequency of fishing activity and the type of fishing gear used relative to the sensitivity of the receiving habitat. A number of fishing gears used in Roaringwater Bay have direct contact with the seabed and can therefore impact epi-benthic communities and in some cases, where the gear penetrates the sediment, can disturb in-benthic fauna. Designated species, such as grey seal, porpoise and otter can become entangled in static gears, such as tangle nets, gill nets and trammel nets and a lesser risk of by-catch in towed demersal and pelagic gears. All fisheries involve the extraction of fish biomass including both the target species and other species caught as by-catch which potentially disturbs the ecology of the site and its designated features.

6.2 Aquaculture

Filter feeding organisms, for the most part, feed at the lowest trophic level, usually relying primarily on ingestion of phytoplankton. The process in extractive in that it does not rely on the input of feedstuffs in order to produce growth. Suspension feeding bivalves such as oysters and mussels can modify their filtration to account for increasing loads of suspended matter in the water and can increase the production of faeces and pseudofaeces (non-ingested material) which result in the transfer of both organic and inorganic particles to the seafloor. This process is a component of benthic-pelagic coupling (Table 5). One aspect to consider in relation to the culture of shellfish is the potential risk of alien species among consignments of seed or stock sourced from outside of the area under consideration. When the seed is sourced locally (e.g. mussel culture) the risk is likely zero. When seed is sourced at a small size from hatcheries in Ireland the risk is also small. When seed is sourced from hatcheries outside of Ireland (this represents the majority of cases particularly for oyster culture operations) the risk is also considered small, especially if the nursery phase has been short. When ½-grown stock (usually oysters) is introduced from another area (e.g. France) the risk of introducing alien species is considerably greater given that the oysters will have been grown in the wild for a prolonged period.

Suspended cuture: 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 rafts) 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. maerl and seagrasses which need sun light for production. Rafts or lines will to a degree limit light penetration to the sea bed and may therefore reduce production of photosynthesising species. However, such effects have not been demonstrated for seagrass.

Intertidal 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 dependant 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 cages. 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.

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

Sub-tidal oyster culture: 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.

Seaweed culture: The primary effect relating to the culture of seaweed relate to the impacts of the structures and subsequent culture stock on the lines. It is likely that shading and current alteration will be the primary impacts in and near the culture systems.

Table 5. Potential indicative environmental pressures of fishing activities and aquaculture activities in Roaringwater Bay

METIER/ ACTIVITY	PRESSURE CATEGORY	PRESSURE	POTENTIAL EFFECTS	FISHING GEARS OR AQUACULTURE EQUIPMENT	DURATION (DAYS)	TIME OF YEAR	FACTORS CONSTRAINING THE ACTIVITY
Fisheries							
Potting,for shrimps	Physical	Surface disturbance	Abrasion at the sediment surface	Shrimp pots	240	August to March	catch rate, weather, market
Potting,for shrimps	Biological	Extraction	Removal of shrimp	Shrimp pots	240	August to March	catch rate, weather, market
Potting,for shrimps		By-catch	Mortality of species in by-catch	Shrimp pots	240	August to March	catch rate, weather, market
Lobster and crab potting	Physical	Surface disturbance	Abrasion at the sediment surface	Soft eye side entrance creels and top entrance pots	Approx 240	Mainly March to October	catch rate, weather, market
Lobster and crab potting	Biological	Extraction	Removal of lobster and crab	Soft eye side entrance creels and top entrance pots	Approx 240	Mainly March to October	catch rate, weather, market
Lobster and crab potting		By-catch	Mortality of species in by-catch	Soft eye side entrance creels and top entrance pots	Approx 240	Mainly March to October	catch rate, weather, market
Tangle netting	Physical	Surface disturbance	Abrasion at the sediment surface	Tangle nets	Unknown	Mainly May to Sept	catch rate, weather,
Tangle netting	Biological	Extraction	Removal of crayfish and other commercial fish species	Tangle nets	Unknown	Mainly May to Sept	catch rate, weather,

METIER/ ACTIVITY	PRESSURE CATEGORY	PRESSURE	POTENTIAL EFFECTS	FISHING GEARS OR AQUACULTURE EQUIPMENT	DURATION (DAYS)	TIME OF YEAR	FACTORS CONSTRAINING THE ACTIVITY
		By-catch	Potential by-catch of designated species grey seal, porpoise and otter.				
Dredging for scallops	Physical	Surface disturbance	Abrasion at the sediment surface	Fixed toothed dredges (DRB), ICES code 04.1.1	unknown	Mainly winter and spring	catch rate, weather, market, spatial closures
		Shallow disturbance	Sub-surface disturbance to 25mm				
	Biological	Extraction	Removal of scallops				
		By-catch mortality	Mortality of organisms captured or disturbed during the fishing process, damage to structural fauna of reefs				
Midwater (pelagic) trawling	Biological	Extraction	Removal of pelagic fish (Herring and sprat)	Pelagic trawls, OTM, ICES 03.2.1.	Approx 80 days	Sept to March	Quota
		By-catch	Potential by-catch of designated species grey seal, porpoise and otter.				
Hook and line pelagic	Biological	Extraction	Removal of pelagic and demersal fish	Hooks and lines, LHP, ICES 09.1.0, LHM, ICES 09.2.0, LTL, ICES 09.6.0	Unknown	All year	Quota, weather

METIER/ ACTIVITY	PRESSURE CATEGORY	PRESSURE	POTENTIAL EFFECTS	FISHING GEARS OR AQUACULTURE EQUIPMENT	DURATION (DAYS)	TIME OF YEAR	FACTORS CONSTRAINING THE ACTIVITY
Bottom set gill nets	Physical	Surface disturbance	Abrasion at the sediment surface	Gill nets, GNS, ICES 07.1.0	Unknown	All year	Quota, weather
	Biological	Extraction	Removal of demersal fish				
		By-catch	Potential by-catch of designated species grey seal, porpoise and otter.				
Mixed fisheries demersal trawling	Physical	Surface disturbance	Abrasion at the sediment surface	Demersal single bottom otter trawls (OTB, ICES code 03.1.2	Unknown	All year	Weather, quota restrictions
		Shallow disturbance	Sub-surface abrasion by trawl doors				
	Biological	Extraction	Removal of fish				
		By-catch mortality	Mortality of organisms in contact with fishing gear				
Hand gathering (periwinkles)	Physical	Surface disturbance	Trampling and compaction of fauna		Unknown	Winter and Spring	Market
	Biological	Extraction	Removal of periwinkles				

METIER/ ACTIVITY	PRESSURE CATEGORY	PRESSURE	POTENTIAL EFFECTS	FISHING GEARS OR AQUACULTURE EQUIPMENT	DURATION (DAYS)	TIME OF YEAR	FACTORS CONSTRAINING THE ACTIVITY
Trammel nets (bait fishery)	Physical	Surface disturbance	Abrasion on sediment surface or on reefs	GTR, ICES 07.5.0	Unknown	All year	Availability and price of bait
	Biological	Extraction	Removal of non-commercial fish species				
		By catch	Potential catch of designated species otter, porpoise and seal				
Aquaculture							
Rope Mussel Culture	Physical	Current alteration	Baffling effect resulting in a slowing of currents and increasing deposition onto seabed changing sedimentary composition	Floats, longlines, continuous ropes (New Zealand system) and droppers	365	All year	Location (sheltered location for year round activity)
	Biological	Organic enrichment	Faecal and pseudofaecal deposition on seabed potentially altering community composition				
		Shading	Prevention of light penetration to seabed potentially impacting light sensitive species				

METIER/ ACTIVITY	PRESSURE CATEGORY	PRESSURE	POTENTIAL EFFECTS	FISHING GEARS OR AQUACULTURE EQUIPMENT	DURATION (DAYS)	TIME OF YEAR	FACTORS CONSTRAINING THE ACTIVITY
		Fouling	Increased secondary production on structures and culture species. Increased nekton production				
		Seston filtration	Alteration of phytoplankton and zooplankton communities and potential impact on carrying capacity				
		Nutrient exchange	Changes in ammonium and Dissolved inorganic nitrogen resulting in increased primary production. Nitrogen (N_2) removal at harvest.				
		Alien species	Introduction of non-native species with culture organism transported into the site				
Intertidal Oyster Culture	Physical	Current alteration	Structures may alter the current regime and resulting increased deposition of fines or scouring.	Trestles and bags and service equipment	365	All year	At low tide only
		Surface disturbance	Ancillary activities at sites, e.g. servicing, transport increase the risk of				

METIER/ ACTIVITY	PRESSURE CATEGORY	PRESSURE	POTENTIAL EFFECTS	FISHING GEARS OR AQUACULTURE EQUIPMENT	DURATION (DAYS)	TIME OF YEAR	FACTORS CONSTRAINING THE ACTIVITY
			sediment compaction resulting in sediment changes and associated community changes.				
		Shading	Prevention of light penetration to seabed potentially impacting light sensitive species				
	Biological	Non-native species introduction	Potential for non-native species (*C. gigas*) to reproduce and proliferate in SAC. Potential for alien species to be included with culture stock (hitch-hikers).				
		Disease risk	In event of epizootic the ability to manage disease in uncontained subtidal oyster populations is compromised.				
		Organic enrichment	Fecal and pseudofecal deposition on seabed potentially altering community composition				
Subtidal	Physical	Surface disturbance	Abrasion at the sediment surface and redistribution of	Oyster dredge	Once quarterly	Seasonal	Weather for site access. Size of

METIER/ ACTIVITY	PRESSURE CATEGORY	PRESSURE	POTENTIAL EFFECTS	FISHING GEARS OR AQUACULTURE EQUIPMENT	DURATION (DAYS)	TIME OF YEAR	FACTORS CONSTRAINING THE ACTIVITY
Oyster culture			sediment				oysters and market constraints
		Shallow disturbance	Sub-surface disturbance to 25mm				
	Biological	Monoculture	Habitat dominated by single species and transformation of infaunal dominated community to epifaunal dominated community.				
		By-catch mortality	Mortality of organisms captured or disturbed during the harvest or process, damage to structural fauna of reefs				
		Non-native species introduction	Potential for non-native species (*C. gigas*) to reproduce and proliferate in SAC (oysters only). Potential for alien species to be included with culture stock (hitch-hikers) (scallop and oysters).				
		Disease risk	In event of epizootic the ability to manage disease in uncontained subtidal oyster populations would likely be				

METIER/ ACTIVITY	PRESSURE CATEGORY	PRESSURE	POTENTIAL EFFECTS	FISHING GEARS OR AQUACULTURE EQUIPMENT	DURATION (DAYS)	TIME OF YEAR	FACTORS CONSTRAINING THE ACTIVITY
			compromised. The risk introduction of disease causing organisms by introducing seed originating from the 'wild' in other jurisdictions				
		Nutrient exchange	Increased primary production. N_2 removal at harvest or denitrification at sediment surface.				
Longline seaweed culture	Physical	Shading	Prevention of light penetration to seabed potentially impacting light sensitive species				Sheltered areas necessary
	Biological	Nutrient removal	N_2 removal at harvest. N_2 (among others) assimilated to facilitate seaweed growth.				

7 Appropriate Assessment and Risk Assessment screening

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

In this assessment screening of the qualifying interests against the proposed activities is based solely on spatial overlap i.e. if the qualifying interests overlap spatially with the proposed activities then significant impacts due to these activities on the conservation objectives for the qualifying interests is not discounted (not screened out) except where there is absolute and clear rationale for doing so. Where there is relevant spatial overlap appropriate assessment (aquaculture) and risk assessment (fisheries) proper is undertaken. Likewise if there is no spatial overlap then the possibility of significant impact is discounted and further assessment of possible effects is deemed not to be necessary. Such non-overlapping activities are also considered not to contribute to in-combination effects.

7.1 Fishery Activity Screening

The following features-activity combinations (**shaded cells in** Table 6) are screened out and are not considered further in the Risk Assessment of fisheries

- Table 6 provides an overview of spatial overlap of fishing activities and habitat features identified from Conservation Objectives (NPWS 2011a).
- None of the fisheries activities overlap with coastal features 1230 (Vegetated sea cliffs) or 4030 (European dry heaths) or the marine sea caves feature (8330).
- Other than winkle picking none of the fishing metiers overlap with intertidal reef features

7.2 Aquaculture Activity Screening

- Table 7 provides an overview of spatial overlap of aquaculture activities and habitat features identified from Conservation Objectives (NPWS 2011a).
- None of the aquaculture activities overlap with coastal features 1230 (Vegetated sea cliffs) or 4030 (European dry heaths) or the marine sea caves feature (8330).

- Aquaculture activity – designated feature combinations that are retained for AA (Section 6) are indicated by shaded cell in Table 9.

Table 6. Habitat utilisation (spatial overlap, km^2) by fishing metier in RWBay based on 2011 fishing activity. Shaded cells indicate no spatial overlap. These activity-feature combinations are not considered further in the risk assessments. LSIB = large Shallow Inlet and Bay

	Designations 1170 and 1160									1230	4030	1351	1364	1355	8330	
Metiers	*Reef - exposed to moderately exposed intertidal*	*Reef - exposed to moderately exposed below 20m subtidal*	*Reef - sheltered intertidal and subtidal*	*Reef-Laminaria dominated communities*	*LSIB - Zostera dominated community*	*LSIB - Maerl dominated community*	*LSIB - Muddy sand with bivalves and polychaetes*	*LSIB - Mixed sediment*	*LSIB - Shallow sand/mud*	*Vegetated sea cliffs of the Atlantic and Baltic coasts*	*European dry heaths*	*Harbour porpoise*	*Grey seal*	*Otter*	*Sea caves*	*Total foot print*
Habitat area	**3.25**	**12.78**	**0.06**	**18.89**	**1.19**	**0.96**	**24.07**	**32.05**	**33.35**							
Shrimp Potting	0.00	10.74	0.01	10.72	1.09	0.88	19.01	23.45	21.10	0.00	0.00	All metiers potentially overlap with all designated species but the spatial overlap is not fixed and cannot be calculated			0	87.0
Crab Lobster potting	0.00	11.76	0.01	10.83	0.41	0.09	21.34	22.14	10.17	0.00	0.00				0	76.7
Crayfish tangle nets	0.00	1.78	0.00	0.66	0.00	0.00	0.32	0.98	0.00	0.00	0.00				0	3.7
Scallop dredging	0.00	2.64	0.05	2.83	0.10	0.04	1.16	7.56	7.92	0.00	0.00				0	22.3
Pelagic Jigging	0.00	3.41	0.00	2.83	0.00	0.00	0.56	3.33	2.54	0.00	0.00				0	12.7
Pelagic mid water trawl	0.00	4.89	0.00	3.00	0.00	0.00	5.05	12.67	2.81	0.00	0.00				0	28.4
Whitefish gill netting	0.00	2.27	0.00	0.56	0.00	0.00	0.75	0.81	0.30	0.00	0.00				0	4.7
Demersal trawling	0.00	5.47	0.00	3.48	0.00	0.00	20.24	16.89	1.65	0.00	0.00				0	47.7

Table 7. **Habitat utilisation (spatial overlap, km^2) by Aquaculture activities in RWBay based on licence database provided by DAFM. Shaded cells indicate no spatial overlap. These activity-feature combinations are not considered further in the appropriate assessment.**

	Designations 1170 and 1160									1230	4030	1351	1364	1355	8330	
Activity	*Reef - exposed to moderately exposed intertidal*	*Reef - exposed to moderately exposed below 20m subtidal*	*Reef - sheltered intertidal and subtidal*	*Reef- Laminaria dominated communities*	*LSIB - Zostera dominated community*	*LSIB - Maerl dominated community*	*LSIB - Muddy sand with bivalves and polychaetes*	*LSIB - Mixed sediment*	*LSIB - Shallow sand/mud*	*Vegetated sea cliffs of the Atlantic and Baltic coasts*	*European dry heaths*	*Harbour Porpoise*	*Grey seal*	*Otter*	*Sea caves*	*Total foot print*
Habitat area	**3.25**	**12.78**	**0.06**	**18.89**	**1.19**	**0.96**	**24.07**	**32.05**	**33.35**							
Rope Mussel Culture (licenced)	0.0000	0	0	0.0000	0	0	0	0.0000	2.8953	0	0				0	2.895
Rope Mussel Culture (application)	0.0000	0	0	0.0027	0	0	0	0.0000	0.2247	0	0				0	0.227
Rope mussel seed collection (application)	0.0000	0	0	0.0258	0	0	0	0.2655	0.6658	0	0				0	0.957
Intertidal oyster Culture (licenced)	0.0868	0	0	0.0000	0	0	0	0.0000	0.0000	0	0	All activities potentially overlap with all designated species but the spatial overlap is not fixed and cannot be calculated			0	0.086
Intertidal oyster Culture (application)	0.0042	0	0	0.0000	0	0	0	0.0000	0.0000	0	0				0	0.004
Subtidal oyster/scallop culture (application)	0.0000	0	0	0.0162	0	0	0	0.0636	0.0630	0	0				0	0.142
Seaweed culture (application)	0.0000	0	0	0.0007	0	0	0	0.0000	0.0000	0	0				0	0.000
*Fishery Order**	0.0487	0	0	0.0000	0	0	0	0.0000	0.6490	0	0				0	0.697

Table 8. Habitat utilisation (spatial overlap,%) by fishing metiers in RWBay based on 2011 fishing activity. Shaded cells represent fishing metiers where the spatial overlap of the metier with the conservation feature is >15%. LSIB = large Shallow Inlet and Bay

<table>
<tr><td></td><td colspan="9">Designations1170 and 1160</td><td>1230</td><td>4030</td><td>1351</td><td>1364</td><td>1355</td><td>8330</td></tr>
<tr><td>Metiers</td><td>Reef - exposed to moderately exposed intertidal</td><td>Reef - exposed to moderately exposed below 20m subtidal</td><td>Reef - sheltered intertidal and subtidal</td><td>Reef- Laminaria dominated communities</td><td>LSIB - Zostera dominated community</td><td>LSIB - Maerl dominated community</td><td>LSIB - Muddy sand with bivalves and polychaetes</td><td>LSIB - Mixed sediment</td><td>LSIB - Shallow sand/mud</td><td>Vegetated sea cliffs of the Atlantic and Baltic coasts</td><td>European dry heaths</td><td>Harbour porpoise</td><td>Grey seal</td><td>Otter</td><td>Sea caves</td></tr>
<tr><td>Shrimp Potting</td><td></td><td>84</td><td>10</td><td>57</td><td>92</td><td>92</td><td>79</td><td>73</td><td>63</td><td></td><td></td><td rowspan="8" colspan="3">All metiers potentially overlap with all designated species but the spatial overlap is not fixed and therefore cannot be calculated</td><td>0</td></tr>
<tr><td>Crab Lobster potting</td><td></td><td>92</td><td>22</td><td>58</td><td>34</td><td>9</td><td>89</td><td>69</td><td>30</td><td></td><td></td><td>0</td></tr>
<tr><td>Crayfish tangle nets</td><td></td><td>14</td><td>0</td><td>3</td><td>0</td><td>0</td><td>1</td><td>3</td><td>0</td><td></td><td></td><td>0</td></tr>
<tr><td>Scallop dredging</td><td></td><td>21</td><td>73</td><td>14</td><td>6</td><td>4</td><td>5</td><td>23</td><td>17</td><td></td><td></td><td>0</td></tr>
<tr><td>Pelagic Jigging</td><td></td><td>27</td><td>0</td><td>15</td><td>0</td><td>0</td><td>2</td><td>10</td><td>8</td><td></td><td></td><td>0</td></tr>
<tr><td>Pelagic mid water trawl</td><td></td><td>38</td><td>0</td><td>16</td><td>0</td><td>0</td><td>21</td><td>40</td><td>8</td><td></td><td></td><td>0</td></tr>
<tr><td>Whitefish gill netting</td><td></td><td>18</td><td>0</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td><td>1</td><td></td><td></td><td>0</td></tr>
<tr><td>Demersal trawling</td><td></td><td>43</td><td>0</td><td>18</td><td>0</td><td>0</td><td>84</td><td>53</td><td>5</td><td></td><td></td><td>0</td></tr>
</table>

Table 9. Aquaculture activity (species, by status and location) and habitat overlap measured in hectares. Shaded cells are those taken further in appropriate assessment. Numbers in italics represent the percentage overlap of activity with relevant habitat.

Species	*Tidal Zone*	*Licence Status*	*Marine Habitats relevant to Aquaculture activities*			
			Mixed sediment community complex	*Reef <20m*	*Intertidal Reef High/ Moderate*	*Shallow sand/mud community complex*
		Extent of marine Habitat in SAC:	**3205 ha**	**1846 ha**	**327 ha**	**3335 ha**
Oysters	**Intertidal**	**Application**	**0**	**0**	**0.4193**	**0**
					0.0013	
Oysters	**Intertidal**	**Licensed**	**0**	**0**	**8.6782**	**0**
					0.0265	
Oysters	**Subtidal**	**Application**	**0**	**0**	**0**	**6.3036**
						0.0019
Oysters (Fishery Order)	**Subtidal**	**Licensed**	**0**	**0**	**0**	**63.9828**
						0.0192
Oysters (Fishery Order)	**Intertidal**	**Licensed**	**0**	**0**	**4.8661**	**0.9196**
					0.0149	*0.0003*
Seaweed	**Subtidal**	**Application**	**0**	**0.0723**	**0**	**3.9817**
				0.0000		*0.0012*
Scallops	**Subtidal**	**Licenced**	**6.3598**	**1.6211**	**0**	**0**
			0.0020	*0.0009*		
Rope Mussels	**Subtidal**	**Application**	**0**	**0**	**0**	**22.4706**
						0.0067
Rope Mussels	**Subtidal**	**Licensed**	**0**	**0.2716**	**0**	**289.5315**
				0.0001		*0.0868*
Rope Mussels-spat collection	**Subtidal**	**Application**	**26.5457**	**2.5753**	**0**	**66.5846**
			0.0083	*0.0014*		*0.0200*

8 Appropriate Assessment and Risk Assessment Methodology

8.1 Appropriate Assessment

8.1.1 Determining significance

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

Habitats 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 Roaringwater Bay these habitats include

1. Sea grass (*Zostera*) beds
2. Maerl (coralline algae) beds
3. Kelp (*Laminaria*) beds

Significant disturbance is interpreted in this assessment as indicated in Figure 7. For broad sedimentary communities significance of impact is determined in relation to spatial overlap, disturbance and the persistence of disturbance as follows

1. The degree to which the activity will disturb the qualifying interest. By disturb is meant change in the characterising species, as listed in the Conservation Objective guidance (NPWS 2011b) for constituent habitats. The likelihood of change depends on the sensitivity of the characterising species to the aquaculture activities. Sensitivity results from a combination of tolerance (resilience) to the activity and recoverability from the effects of the activity
2. The persistence of the disturbance in relation to the sensitivity of the habitat. If the activities are persistent (high frequency, high intensity) and the receiving habitat has a low resilience to the activity (i.e. the characterising species of the habitats are impacted) then such habitats could be said to be persistently disturbed. If activities are infrequent but resilience is low and recovery rates are low (i.e. high sensitivity) then such habitats may also be persistently disturbed.
3. The area of habitats or proportion of populations disturbed. In the case of habitats disturbance of less than 15% of the habitat area is deemed to be insignificant

(NPWS 2011b).

In relation to designated species 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 COs on a case by case basis.

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

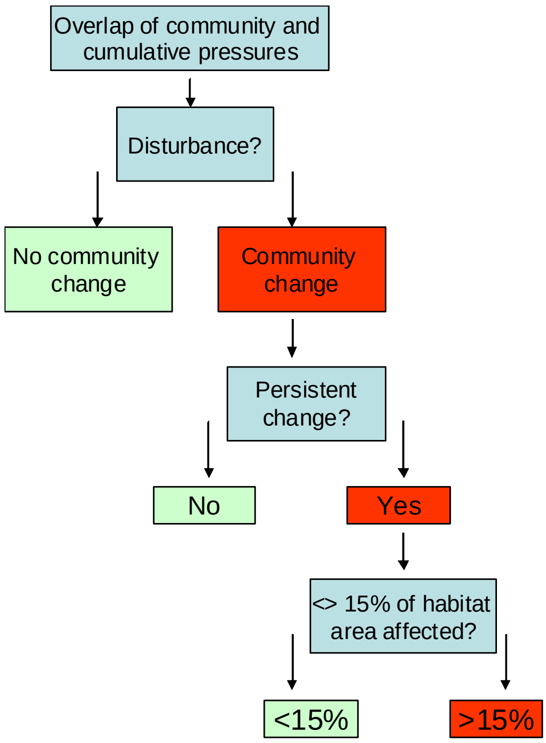

Figure 7. Determination of significant effects on community distribution, structure and function (following NPWS 2011b).

8.1.2 Supporting evidence and confidence in conclusions

There are various levels of supporting evidence and therefore confidence for conclusions on the effects of activities on the conservation objectives for each qualifying interest. The degree of confidence with respect to findings of significant or no significant effects is categorised as high, medium or low (Table 10).

Table 10. Level of confidence, based on supporting evidence, in relation to significance of effects and the implication for management decisions.

<table>
<tr><th rowspan="2">Level of confidence</th><th rowspan="2">Supporting evidence</th><th colspan="2">Implication in relation to significance</th></tr>
<tr><td>Significant

Where effects are found to be significant (>15% of any community type is persistently disturbed).

In the case of designated species where effects may cause a decline in the attributes of the population</td><td>Non significant

Where effects are found to be insignificant (<15% of any community type is persistently disturbed or where the activity occurs on >15% of the area but is not persistent or activity that is persistent in >15% of the area but is not disturbing).

In the case of designated species where effects will not cause a decline in the attributes of the population</td></tr>
<tr><td>High</td><td>Targeted scientific studies at the site</td><td rowspan="2">The impacting activity is unlikely to be allowed until the effects can be mitigated (i.e. brought below agreed thresholds). These mitigations would be subject to further assessment.</td><td>The activities can proceed without mitigation</td></tr>
<tr><td>Moderate</td><td>Targeted scientific studies at other sites</td><td>The activities can proceed but precautionary mitigation may be introduced.</td></tr>
<tr><td>Low</td><td>Limited observations at the site or at similar sites, expert judgement, ecological theory and expectation</td><td>The impacting activity may not be allowed until direct measurements of effects at the site shows evidence of non-significant effects</td><td>The activities can proceed, at existing levels, with agreement to provide stronger evidence of non-significant effects within an agreed time scale and provided that the consequence of false negative findings are deemed to be low and reversible</td></tr>
</table>

8.2 Risk Assessment

The risk assessment framework follows, where feasible, EC guidance (2012) and includes elements of risk assessment from Fletcher (2004, 2005). The qualitative and semi-quantitative framework is described in Marine Institute (2013) and criteria for risk categorization is shown in Tables 11 and 12 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 11. Risk categorization for fisheries and designated habitat interactions (Marine Institute 2013). High risk (12-20) interactions require mitigation, moderate risk (6-10) probably require mitigation, low risk (1-5) interactions should be reviewed individually to determine if mitigation is needed.

Habitats		**Consequence criteria**				
		Activity is not disturbing to habitat	Up to 15% of habitat disturbed seasonally	Over 15% of habitat disturbed through fixed or roving fishing activity seasonally	Over 15% of habitat disturbed persistently leading to cumulative impacts	Impact is effectively permanent due to severe habitat alteration
		No change in characterising species	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		**0**	**1**	**2**	**3**	**4**
Highly likely	**5**	0	5	10	15	20
Probable	**4**	0	4	8	12	16
Possible	**3**	0	3	6	9	12
Unlikely	**2**	0	2	4	6	8
Rare or none	**1**	0	1	2	3	4

Table 12. Risk categorization for fisheries and designated species interactions (Marine Institute 2013)

Species		Consequence criteria				
		Non disturbing to individuals in the population	Direct or indirect mortality or sub-lethal effects caused to individuals but population remains self-sustaining	In site population depleted but regularly subvented by immigration. No significant ex situ pressure	Population depleted by ex situ and/or in situ fishing pressures	Population depleted and supporting habitat significantly depleted and unable to support population
Likelihood		**0**	**1**	**2**	**3**	**4**
Highly likely	**4**	0	4	8	12	16
Probable	**3**	0	3	6	9	12
Possible	**2**	0	2	4	6	8
Unlikely	**1**	0	1	2	3	4
None	**0**	0	0	0	0	0

9 Risk Assessment of fishing activities on the conservation objectives for Roaringwater Bay

9.1 Sensitivity of benthic species and communities in relation to physical disturbance by fishing gear

- NPWS (2011b) 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 2011b).
  - 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 www.marlin.ie and in Table 13.
- In cases where the sensitivity of a characterising species (NPWS 2011b) has not been reported this appropriate assessment adopts the following guidelines
  - Resilience of certain taxonomic groups such as emergent sessile epifauna to physical pressures due to all fishing gears is expected to be generally low or moderate because of their form and structure (Roberts *et al.*. 2010).
  - Resilience of benthic infauna (eg bivalves, polychaetes) to surface pressures, caused by pot fisheries for instance, is expected to be generally high as such fisheries do not cause sub-surface disturbance
  - Resilience of benthic infauna to sub-surface pressures, caused by toothed dredges and to a lesser extent bottom otter trawls using doors, may be high in the case of species with smaller body sizes but lower in large bodied species which have fragile

shells or structures. Body size (Bergman and van Santbrink 2000) and fragility are regarded as indicative of resilience to physical abrasion caused by fishing gears

- Recovery of species depends on biological traits (Tillin *et al.*. 2006) such as reproductive capacity, recruitment rates and generation times. Species with high reproductive capacity, short generation times, high mobility or dispersal capacity may maintain their populations even when faced with persistent pressures but such environments may become dominated by these (r-selected) species. Slow recovery is correlated with slow growth rates, low fecundity, low and/or irregular recruitment, limited dispersal capacity and long generation times

9.1.1 Maerl communities

- The dominant species in the maerl community are slow growing structural species with very low recovery capacity from physical damage/abrasion that may be caused by fishing gear. In RWBay the rare species, *Lithothamnium dentatum*, is important. The living thalli of *L dentatum* may be 30-100 years old (Jones *et al*.. 2000). Emergent sessile species such as *Sabella pavonina* are associated with maerl in RWBay
- Maerl communities are subject to temporal (seasonal, annual) changes due to storm events with increasing diversity in the maerl community in summer months when water column stability is higher (Jones *et al*.. 2000) and are sensitive to sediment and phytoplankton deposition, changes in turbidity, burial and physical contact
- Resilience and recoverability of maerl and associated epifauna from physical disturbance are both very low (i.e. the community is highly sensitive to disturbance)

9.1.2 Zostera communities

- Species associated with Zostera in RWBay includes sensitive species such as *Sabella pavonina* and *Asperococcus compressus*. These species have low resilience to physical abrasion and low recoverability.
- *Zostera* has moderate recoverability to physical abrasion. The physical abrasion caused by fishing gear may directly cause loss of leaf blades and reduce shoot density. Recoverability may be protracted but will depend on conditions at the site. Nevertheless fragility of *Zostera* is moderate, maturity and generation times are 1-2 years and there is, potentially, annual reproduction during the summer (Table 13).

9.1.3 Laminaria communities

- The main characterising and structural species in this community is *Laminaria* spp. *Laminaria* plants although large are flexible and are not fragile, have high fecundity and growth rates and short (3-5yrs) generation time. Its resilience to physical disturbance is moderate and recoverability is high (Table 13).
- Nevertheless the community associated with *Laminaria* may take a number of years to recover to a mature state following physical removal of the *Laminaria* plants.
- Species associated with *Laminaria* in RWBay include species sensitive to physical abrasion such as *Alcyonium digitatum* and *Echinus esculentus*. Life history traits of *Echinus* suggests high recoverability. *Alcyonium* has medium body size, is fragile and has an erect form suggesting low resilience but short generation times (1-2 years) and age at maturity of 2-3 years but relatively low fecundity indicates moderate recoverability.

9.1.4 Exposed moderately exposed Reef > 20m

- These reefs (20-65m) in RWBay have variable substrates including bedrock, boulder, cobble and pebbles.
- Substrates such as cobble and pebble may be altered by persistent forceful physical abrasion leading to reduction in pebble size and homogenization of habitat. These substrates are unlikely to the altered by static gears (Thrush *et al*.. 1998).
- Species associated with these reefs include species sensitive to physical abrasion such as the erect hydroids *Caryophyllia smithi* and *Corynactis viridis*. Biological traits for these species are not available. The crinoid *Antedon bifida* is fragile and gregarious and matures in 1-2 years and may reproduce throughout the year. Resilience may be low but recoverability of this species is probably moderate or high (Table 13).

9.1.5 Mixed sediment communities

- The broad sedimentary communities in RWBay are characterised by polychaetes and bivalves. The biotic traits of these species indicate high recoverability from disturbance. Generally they are small, robust, have short generation times, high fecundity and pelagic larvae. Species whose sensitivity has been classified (Table 13) have moderate resilience and high recoverability to physical disturbance.

9.1.6 Shallow sand/mud community complex

- This community complex is predominantly confined to the shallow sub-tidal in the north and east of the site and to the south of Sherkin Island. The substrate is predominantly fine material, but fractions of medium sand or gravel may also be present. It is recorded from depths of 0-15m.
- The list of distinguishing species reflects the gradation from a mud to a sand community with the bivalves *Abra nitida, A. alba, Thyasira flexuosa* and the polychaete *Melinna palmata* being indicative of sands whilst the bivalve *Fabulina fabula* reflects more gravelly sediments.
- These species characterizing this site are typically infaunal with short generation times and exhibiting a high degree of tolerance to sedimentation and organic enrichment. They are potentially sensitive to physical disturbance by virtue of the fragile nature of the shell/body parts, however, surface scraping activities may not impact them unduly as they can occur deep in the sediment and avoid physical contact with gear. As indicated above, their recoverability is high given their short generation time.
- They have high resilience and recoverability to sedimentation and organic enrichment.

Table 13. Sensitivities (disaggregated to resilience and recoverability components) of species and dominant taxonomic groups, characteristic of communities which have spatial overlap with fisheries and aquaculture in RWBay. Shaded habitats have no overlap with any fishing or aquaculture activity causing physical abrasion and disturbance. Sensitivity assessments for species is reported in www.marlin.ac.uk. No sensitivity assessment is available for species names in black. Species names in red are emergent, to varying degrees, sessile epifauna which may be considered sensitive to surface pressures at the seabed.

	Characterising species						Dominant taxonomic groups			
Community	1	2	3	4	5	6	1	2	3	4
Maerl community	Lithophyllum dentatum	Spyridia filimentosa	Lithophyllum coralloides	Phymatolithon calcareum	Xantho spp	Sabella pavonina	Corraline algae	Red algae	Crustaceans	
Mixed sediment community complex	Spiophanes bombyx	Phaxas pellucidus	Pariambus typicus	Pisione remota	Protodorvillea kefersteini	Mysella bidentata	Polychaetes	Bivalves	Cumaceans	
Muddy sand with bivalves and polychaetes	Amphiura filiformis	Mysella bidendata	Spiophanes bombyx	Abra alba	Thyasira flexuosa	Nucula turgida	Echinoderms	Bivalves	Polychaetes	Amphipods
Exposed to moderately Exposed intertidal Reef	Fucoids	Semiballanus balanoides	Patella vulgata	Littorina littorea			Green seaweeds	Crustaceans	Gastropods	
Laminaria	Laminaria digitata	Laminaria hyperborea	Alcyonium digitatum	Cliona celeta	Echinus esculentus		Brown seaweeds			
Reef >20m	Ophiocomina nigra	Cliona celeta	Caryophyllia smithi	Corynactis viridis	Alcyonium digitatum	Echinus esculentus	Echinoderms	Sponges	Hydroids	Anenomes
Shallow sand/mud community complex	Abra nitida	Thyasira flexuosa	Melinna palmate	Fabulina fabula	Caprella, Aora, Phtisica	Zostera	Bivalves	Polychaetes	Amphipods	Sea grasses
Shelterd Reef	Laminaria hyperborea	Ascophyllum nodosum	Halydris siliquosa	Saccorhiza polyschides	Furcellaria lumbricalis	Ulva	Brown seaweeds			
Zostera community	Zostera marina	Asperococcus compressus	Ceramium rubrum	Glycymeris glycymeris	Sabella pavonina	Venus verruscosa	Seagrass	Bivalves	Polychaetes	Crustaceans

Sensitivity to physical abrasion and disturbance :

(bright green)	high resilience, high recoverability	(pale yellow)	low resilience, high recoverability		
(light green)	medium resilience, high recoverability	(orange-yellow)	moderate resilience, moderate recoverability	(red)	low resilience, low or none recoverability

9.2 Risk assessment of the impacts of individual fisheries on benthic communities

The effects of individual fisheries on habitats and designated species, indicated in Table 4, are assessed below using the risk framework outlined in Table 11 and 12 for habitats and species respectively. Risk scores are provided in Table 18.

9.2.1 Shrimp potting

- The area over which the shrimp fishery is proposed is 9300ha (Table 1,Figure 8). Of this, 8745 (94%) occurs within the SAC. Footprint or overlaps on individual habitats are in Table 6 and 8, the amount of gear used per month and the intensity of use (km^{-2}) of habitat is in Table 14 and Table 15 respectively.

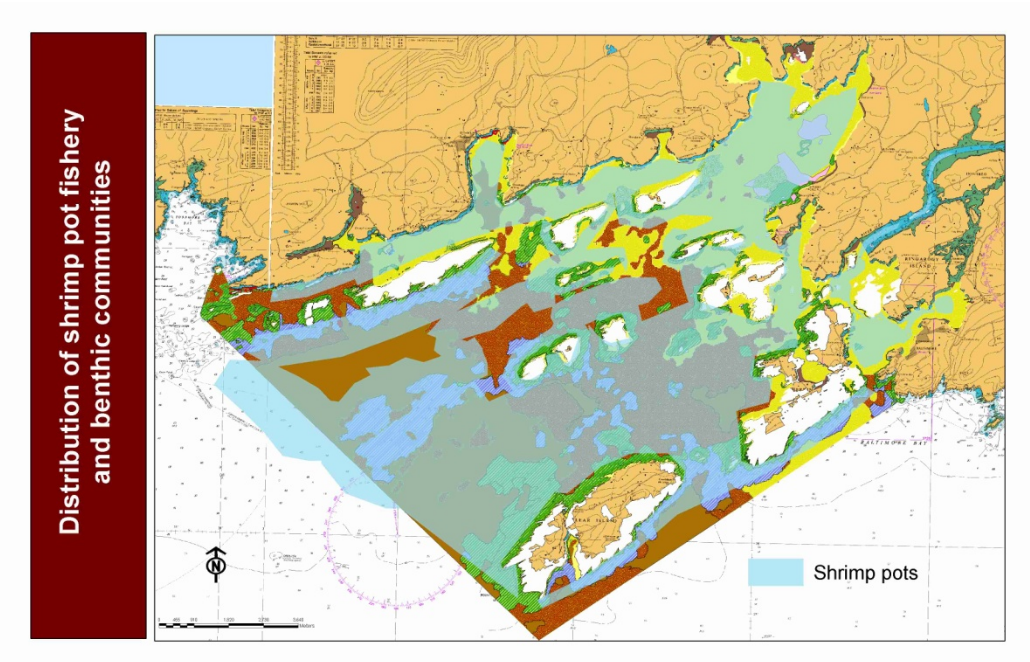

Figure 8. Distribution of shrimp pot fishery in relation to benthic communities in RWBay. See Fig 6 for marine community descriptions.

- The fishery exerts surface disturbance pressure on benthic habitats
- The pressures caused by potting on benthic habitats is due to ‘direct hit’ of the pot on the seabed, the effect of movements of ropes connecting pots, the effects of anchoring the gear, the effects of dragging pots and ropes along the seabed during hauling and passive dragging or movement of gear along the seabed in strong tides or during stormy weather. Lost gear may entangle and move some distances along the seabed. Fishing with strings of pots, which is the common practice in

RWBay, is expected to have greater effects than fishing with single pots due to dragging effects during hauling of gear (references in Barnette 2001). The effects of the pressure will depend on the habitat the gear is fished in as habitats have difference resilience and recoverability to the pressures. Epibenthic species may have some resilience to pressures caused by pot fishing (Eno 2000).

- Shrimp pots are light in weight, neutrally buoyant and may 'sit off' the seabed when fishing depending on tidal conditions.

The fishery has greater than 15% overlap with 7 communities including *Zostera*, maerl, *Laminaria* reefs and with the 3 main sub-tidal soft sediment community complexes in the Bay (Table 6, Table 8). The response of these communities to pressures caused by potting for shrimp will vary depending on the physical and biological characteristics of the community

- **Maerl community:**
    - The shrimp fishery overlaps with 92% of the maerl community
    - Although the physical force of shrimp pots and ropes falling onto maerl is likely to be insufficient to cause significant damage to living maerl thalli or to significantly reduce the complexity of the algal matrix the process of anchoring and hauling gear could damage the algal matrix and emergent epi-faunal species.
    - The intensity and duration of activity within year and the persistence of this activity across a number of years may lead to cumulative effects and modification of the habitat because the recovery capacity of sensitive species is lower than the spatial extent and frequency of the footprint of the fishery.
- **Zostera community:**
    - The shrimp fishery overlaps with 92% of the *Zostera* community
    - Although Zostera has moderate recoverability from physical abrasion the epifaunal species, *Sabella pavonina* and *Spyridia filimentosa* are highly sensitive (low resilience and low recoverability). These species may be negatively impacted by shrimp fishing gear.
- **Laminaria reef:**
    - The shrimp fishery overlaps with 57% of the *Laminaria* reef community. The contact occurs mainly in October-December as the shrimp fishery moves into these deeper areas later in autumn.

- *Laminaria* has low resilience but high recoverability to physical disturbance.
- The physical disturbance to *Laminaria* cause by shrimp pots is likely to be lower than towed gear. Resilience is probably high to shrimp fishing gear and overall sensitivity to shrimp pots can be considered low
- Although species such as *Echinus* and *Alcyonium* are classified as sensitive to physical disturbance caused by fishing gear they are unlikely to be impacted by shrimp pots and ropes to any extent in that the abrasive effect is unlikely to cause significant mortality of these species.

- **Reef > 20m:**
  - The shrimp fishery overlaps with 84% of the Reef>20m community. The contact occurs mainly in October-December as the shrimp fishery moves into these deeper areas in autumn.
- **Mixed sediment community complex:**
  - The shrimp fishery overlaps with 73% of the mixed sediment community complex.
  - Species associated with the mixed sediment community complex include small bodied infaunal species of polychaetes and bivalves.
  - Infaunal species of polychaetes and bivalves are likely to be insensitive to seabed surface pressures caused by shrimp pots.
- **Muddy sand with bivalves and polychaetes:**
  - The shrimp fishery overlaps with 79% of the muddy sand community. The contact occurs mainly in October-December.
  - Species associated with the muddy sand community complex include small bodied infaunal species of polychaetes and bivalves.
  - Infaunal species of polychaetes and bivalves are likely to be insensitive to seabed surface pressures caused by shrimp pots.
- **Shallow sand mud community complex:**
  - The shrimp fishery overlaps with 63% of the shallow sand mud community.
  - Species associated with the shallow sand mud community complex include small bodied infaunal species of polychaetes and bivalves.

- Infaunal species of polychaetes and bivalves and epibenthic amphipods are likely to be insensitive to seabed surface pressures caused by shrimp pots. *Zostera* is a minor component of this community and is unlikely to be significantly impacted is areas where plant density is naturally low

9.2.2 Lobster and crab potting

- The area over which the lobster fishery is proposed is 10500 ha (Table 1, Figure 9). Of this 7706ha (73%) occurs inside the SAC. Footprint or overlaps on individual habitats are in Table 6 and 8, the amount of gear used per month and the intensity of use (km^{-2}) of habitat is in Table 14 and Table 15 respectively.

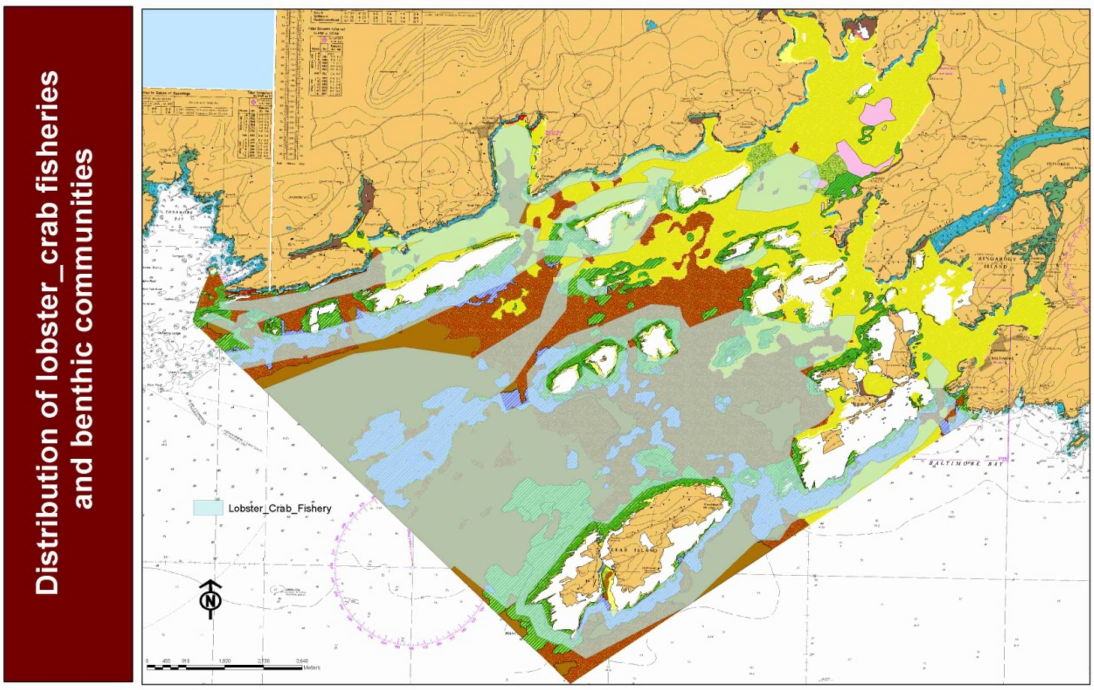

Figure 9. Distribution of lobster and crab pot fishery in relation to benthic communities in RWBay. See Fig 6 for marine community descriptions.

- The fishery exerts surface disturbance pressure on benthic habitats as described for the shrimp métier except that the lobster gear is heavier and sits directly on the seabed
- **Maerl community:**
  - The lobster and crab fishery overlaps with 9% of the maerl community. The contact occurs mainly in summer months but extends from spring to autumn.

- It is probable that the calculated overlap may be incidental and related to approximations in the fishing polygon data used to derive the spatial extent. Maerl is not typical lobster habitat

- **Zostera community:**
  - The lobster and crab fishery overlaps with 34% of the *Zostera* community. The contact occurs mainly in summer months but occurs from spring to autumn.
  - Although Zostera has moderate recoverability from physical abrasion the epifaunal species, *Sabella pavonina* and *Spyridia filimentosa* are highly sensitive (low resilience and low recoverability). These species may be negatively impacted by lobster/crab fishing gear.
  - The calculated overlap may be incidental and related to approximations in the fishing polygon data from the questionnaires used to derive the spatial extent.
- **Laminaria community:**
  - The lobster and crab fishery overlaps with 58% of the *Laminaria* community.
  - The nature of the disturbance/abrasion may be sufficiently benign to allow recovery of *Laminaria* which has low resilience (to towed gears) and high recoverability from physical abrasion that may be caused by pots and ropes. Resilience to static gear is likely to be high as the holdfasts and plants are not uprooted. The effect is likely to be limited to abrasion of the fronds.
  - The intensity of gear use may be sufficiently low to allow emergent sessile epifauna such as *Alcyonium, Cliona* and *Echinus* to recover from physical abrasion caused by lobster pots. These species have medium resilience and high recoverability to physical abrasion.
- **Reef>20m:**
  - The lobster and crab fishery overlaps with 92% of the Reef>20m community. The contact occurs mainly in summer months but extends from spring to autumn.
  - The intensity of gear use is sufficiently low to allow recovery of *Reef>20m* which may have low resilience, to towed gears, but higher resilience and high recoverability from physical abrasion that may be caused by pots and ropes. Static gear will not uproot plants or significantly impact the physical structure of the reef.

- The intensity of gear use is sufficiently low to allow emergent sessile epifauna such as *Alcyonium, Cliona* and *Echinus* to recover from physical abrasion caused by lobster pots. These species have medium resilience and high recoverability to physical abrasion.

- **Mixed sediment community complex, Muddy sand with bivalves and polychaetes and Shallow sand mud community complex**
    - The lobster and crab fishery overlaps with
        - 73% of the mixed sediment community complex.
        - 89% of the muddy sand with bivalves and polychaetes community.
    - 30% of the shallow sand mud community.
    - Characterising infaunal species of polychaetes and bivalves have high resilience and high recoverability (low sensitivity) to physical abrasion caused by lobster pots.
    - Exposure to the fishing gear is low or absent i.e these infaunal characterising species do not come into contact with the gear
    - Static fishing gear is highly unlikely to modify the sedimentary habitat and therefore will not lead to any change in benthic community structure or function

9.2.3 Scallop fishing

- The area over which the scallop fishery is proposed is 2792 ha (Table 1, Figure 10). All of the activity, occurs in the upper Bay inside the SAC. Footprint or overlaps on individual habitats are in Table 6 and 8, the amount of gear used per month and the intensity of use (km^{-2}) of habitat is in Table 14 and Table 15 respectively.

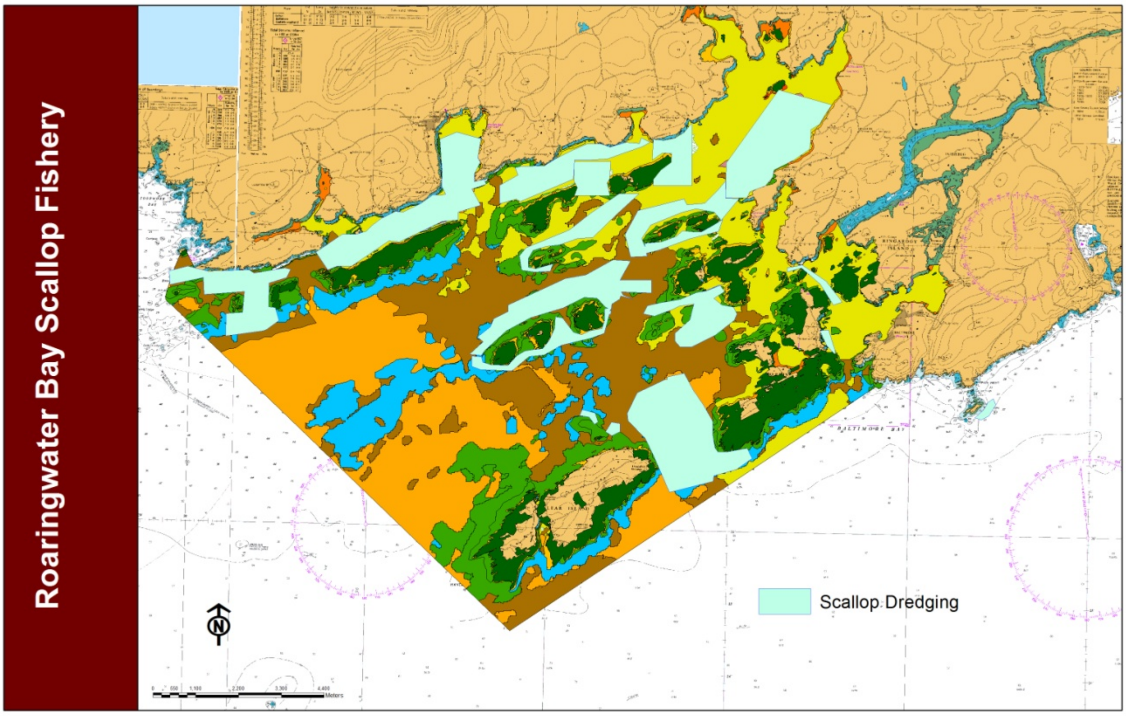

Figure 10, Distribution of scallop fishery in relation to benthic communities in RWBay. See Fig 6 for marine community descriptions.

- The fishery exerts surface and sub-surface disturbance pressure on benthic habitats. The generic effects of scallop dredging on benthic habitats are well known and unequivocal. They include homogenization of habitat with loss of structural feature (Thrush *et al.*. 1998, 2001, Collie *et al.*. 1996), increased dominance of smaller species and increased physical stress as shown by abundance biomass curves (Kaiser *et al.*. 2000), short term increase in scavenging (Caddy 1973), sediment mounding (Chapman *et al.*. 1977), decline in epifauna (Sewell *et al.*. 2007), loss of fine materials from sediments and reduction in burrowing megafauna (Langton and Robinson 1990). Recovery from impact is slow but habitat dependent (Foden *et al.* 2010). Impacts on fauna of soft sediments are less conclusive; infauna may be unaffected (Bullimore 1985), infaunal communities change substantially following experimental dredging in closed areas (Bradshaw *et al.*. 2000), infaunal bivalves and peracarid crustaceans may be unaffected but polychaetes and amphipods (peracarids) are reduced (Eleftheriou and Robertson 2002). Significant impacts to benthic environments can, therefore, be caused by scallop dredging. This impact will depend on the frequency of dredging relative to habitat sensitivity. In soft sediments the frequency of dredging is likely to be more important than intensity or quantity of dredging as the initial dredge tows are likely to cause most impact although in reef habitat damage may be incremental (Boulcott and Howell 2011).

- The majority of dredging occurs in the 4 months Dec-March
- Scallop fishing overlaps with 8 communities and exceeds 15% overlap in the case of 6 communities (*Laminaria* reef, moderately exposed reef >20m, mixed sediment community complex, shallow sand/mud community complex, Zostera and Maerl).
- **Zostera**
  - The scallop fishery overlaps with practically 100% of Zostera habitat.
  - Seagrass beds are not physically robust. Their root systems are located within the top 20cm of sediment and therefore can easily be dislodged by a range of activities (Fonseca, 1992). *Zostera* beds are vulnerable to physical disturbance of the sediment; as such activities such as trampling, anchoring, digging, dredging, power boat and jet-ski wash are likely to damage rhizomes and cause seeds to be buried too deeply to germinate (Fonseca, 1992). Physical disturbance and removal of plants can lead to increased patchiness and destabilization of the seagrass bed, which in turn can lead to reduced sedimentation within the seagrass bed, increased erosion, and loss of larger areas of *Zostera* (Davison & Hughes, 1998).
  - Fonseca et al (1984) showed that scallop dredging in the USA (using 'toothless' dredges) in *Zostera marina* beds grown in soft mud substrate resulted in a greater loss of vegetation biomass than dredging in beds grown in hard sand. Increased dredging (i.e. increased number of tows of the gear) resulted in a significant reduction in vegetation biomass and number of shoots.
  - Physical disturbance and removal of plants can lead to increased patchiness and destabilization of the seagrass bed, which in turn can lead to reduced sedimentation within the seagrass bed, increased erosion, and loss of larger areas of *Zostera* (Davison & Hughes, 1998). Therefore, the impact from a scallop dredge is likely to remove a proportion of the population and result in increased erosion of the bed. Grazing gastropods and other epifauna attached to the leaves of *Zostera* are small but likely to be displaced or removed. Reduction in numbers of grazers may potentially result in smothering by growth of epiphytes and other algae, especially in the spring and summer months. Recovery is dependant on the size of the area affected (Tyler-Walters and Wilding, 2008).

- Given the probable impact of scallop dredging on seagrass and the frequency of fishing cumulative and persistent disturbance of the habitat is likely to occur

- **Maerl**

  - The scallop fishery overlaps with practically 100% of Maerl habitat.
  - Single tow of Newhaven scallop dredges resulted in live maerl being buried up to 8cm below sediment surface with maerl thalli being crushed and compacted, (Hall-Spencer and Moore 2000a, 2000b). Hall-Spencer and Moore (2000b) found that five months after a single tow of a scallop dredger there were 70-80% fewer live maerl thalli compared to pre-impact, there were no discernible signs of recovery over the 4-year monitoring period. Areas of high trawling frequency have less coverage of maerl and the maerl are smaller (Bordehore et al. 2003). MacDonald et al. (1996) calculated that maerl was highly sensitive to single encounters with high impact fishing gears due to fragility and long recovery times.
  - Given the probable impact of scallop dredging on maerl and the frequency of fishing cumulative and persistent disturbance of the habitat is likely to occur

- **Laminaria reef**

  - The scallop fishery overlaps with 15% of the *Laminaria* reef. All of this 15% is expected to come in contact with scallop gear each year.
  - Physical changes and impacts depend on the topography of the reef in relation to the action and contact of the dredge. Spring loaded scallop dredges are designed to operate on ‘rough’ ground with boulder and cobble. Contact between the dredge and the reef may be intermittent. The rate at which impact, to encrusting and emergent epifauna, occurs is less predictable (monotonic) than for sedimentary habitats. Nevertheless, as shown by Boulcott and Howell (2011) impact to reef occurs. Species characteristic of *Laminaria* reef in Roaringwater including Laminaria spp and *Alcyonium digitatum* are damaged by scallop dredges. *Laminaria* and associated encrusting and emergent epifauna has low resilience to towed fishing gears including scallop dredges. *Laminaria* spp. and *Alcyonium digitatum* has high recoverability to physical disturbance
  - The frequency of fishing events is beyond the capacity of the reef to recover and the reef is, therefore, expected to exist in a modified state.

- **Reef > 20m:**

- The scallop fishery overlaps with 21% of the Reef>20m community.
- The reef is a mix of bedrock, boulders and bedrock, cobbles and pebbles (NPWS 2011b)
- Characterising species of the reef include emergent and encrusting epifauna which are expected to have low resilience to scallop dredging. Recoverability of some of these species, at least, may be high.
- Expected impact on this reef is as described for *Laminaria* reef. Encrusting and emergent epifauna are expected to be reduced as the dredge will overturn boulders and stones, cause abrasive damage to epifauna and will tend to homogenise the structure of the habitat. The impact is likely to be cumulative as the activity is sufficiently persistent and beyond the recoverability capacity of some of the characterising species of the reef.

- **Mixed sediment community complex, Muddy sand with bivalves and polychaetes and Shallow sand mud community complexes**
  - The scallop fishery overlaps with 22% of the mixed sediment community, 5% of the muddy sand with bivalves and polychaetes community and with 18% of the shallow sand/mud community complex.
  - These communities are characterised by bivalves, polychaetes, peracarid crustaceans and echinoderms
  - The characterising species in these communities have moderate resilience and high recoverability to physical disturbance caused by fishing gear
  - Scallop fishing is concentrated in winter months when populations of characterising species are at their lowest. There is no or little fishing during summer and autumn when recruitment to the populations of the characterising species is highest. The seasonal pattern of activity relative to recruitment dynamics of characterising species will aid recovery. Disturbance is not therefore expected to be cumulative.

9.2.4 Demersal trawling

- Four vessels fish demersal otter trawls in the SAC. The area over which the fishery occurs is 23000ha (Table 1, Figure 11). Of this 4637ha (20%) occurs within the SAC. The trawlers use rock hopper trawls which are trawls modified to allow trawling on rough ground. Footprint or overlaps on individual habitats are in Table 6 and 8, the amount of gear used per month and the intensity of use (km^{-2}) of habitat is in Table 14 and Table 15 respectively.

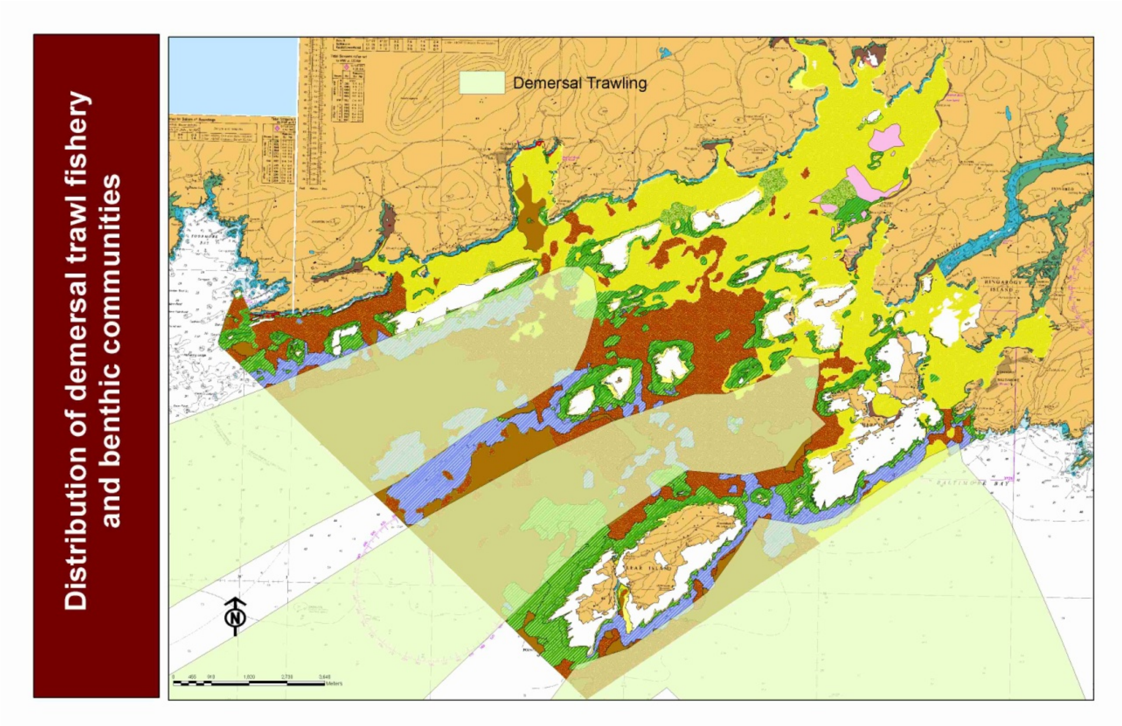

Figure 11. Distribution of demersal trawl fishery in relation to benthic communities in RWBay. See Fig 6 for marine community descriptions.

- Demersal otter trawling exerts, primarily, surface, rather than sub-surface, disturbance pressure on benthic habitats although the doors of the trawls will also disturb sub-surface habitat. The effects of bottom trawling on benthic environments are well documented (reviewed in Linnane *et al.*. 2000, Hiddink *et al.*. 2007). Trawl penetration depth (sub-surface disturbance) depends on gear type and weight, towing speed and warp-depth ratio, the substratum and tidal conditions. The main sub-surface disturbance is due to the doors which keep the net open during towing (depth up to 20cm), and the bobbins on the footrope (2-5cm depth). Trawl tracks may be visible for 18 months in stable sheltered mud habitats but for less time in coarse sand areas subject to wave action. Sediment is re-suspended during trawling due to the action of the tickler chains and the doors. Loss of fine material may occur and there is a loss of fine scale habitat complexity. Benthic communities may become dominated by opportunistic species and there is a loss of diversity and a reduction or loss of epifauna especially. Fauna may be dislodged, damaged and killed. Scavengers may increase in the trawled areas in the short term. Different taxa suffer varying degrees of damage and mortality depending on body size and morphology in relation to gear configuration, the number of tickler chains and the habitat.

- VMS data indicates that demersal trawl fishing by vessels over 15m is less expansive than shown in Fig 11. The frequency of vessel position reporting in these data is 2hrs however and there is some uncertainty about what represents fishing activity and steaming.
- Demersal trawling overlaps with 5 communities. This overlap is greater than 15% in the case of 4 communities; mixed sediment community complex, muddy sand with bivalves and polychaetes, *Laminaria* reef <20m and reef >20m depth (Table 6, Table 8) although the VMS suggests that the overlaps are less.
- **Laminaria reef:**
    - The demersal trawl fishery overlaps with 18% of the *Laminaria* community. The VMS data shows a more restricted distribution and as normally bottom trawlers would avoid reef habitat the actual footprint on *Laminaria* reef may be incidental
    - Characterising species of the reef include emergent and encrusting epifauna which are expected to have low resilience to demersal trawling. Recoverability of some of these species, at least, may be high.
    - Although the activity is persistent and disturbing the VMS data and the expectation is that trawlers avoid, as they cannot fish effectively, on *Laminaria* reef. The footprint is highly unlikely to be higher than 15% of the reef area and is likely to be close to zero although this has not been demonstrated.
- **Reef > 20m:**
    - The demersal trawl fishery overlaps with 43% of the *Reef>20m* community.
    - VMS data shows a more restricted distribution and although the rock hopper gear used by the vessels would enable these trawlers to fish on cobble and boulder type habitat the VMS fishing data shows a concentration of activity on sedimentary habitat
    - Characterising species of the reef include emergent and encrusting epifauna which are expected to have low resilience to demersal trawling. Recoverability of some of these species, at least, may be high.
- **Mixed sediment community complex, Muddy sand with bivalves and polychaetes and Shallow sand mud community complex**
    - The demersal trawl fishery overlaps with 53% of the mixed sediment community, 84% of the muddy sand with bivalves and polychaetes community and with 5% of the shallow

sand/mud community complex. However, VMS data suggest the overlap is lower than this.

- These communities are characterised by bivalves, polychaetes, peracarid crustaceans and echinoderms
- Characterising species have moderate resilience and high recoverability to physical disturbance caused by fishing gear.
- Although the activity is persistent (occurs throughout the year) and the fishing polygons indicate that overlaps exceed 15% of habitat the VMS data indicates that in 2006-2009, at least, the actual annual footprint occurred on less than 15% of any of the 3 main sedimentary communities.

9.2.5 Tangle netting for crayfish

- The area over which the fishery occurs is 2200 ha (Table 1, Figure 12). Of this 381ha (17%) is within the SAC. Footprint or overlaps on individual habitats are in Table 6 and 8, the amount of gear used per month and the intensity of use (km^{-2}) of habitat is in Table 14 and Table 15 respectively.

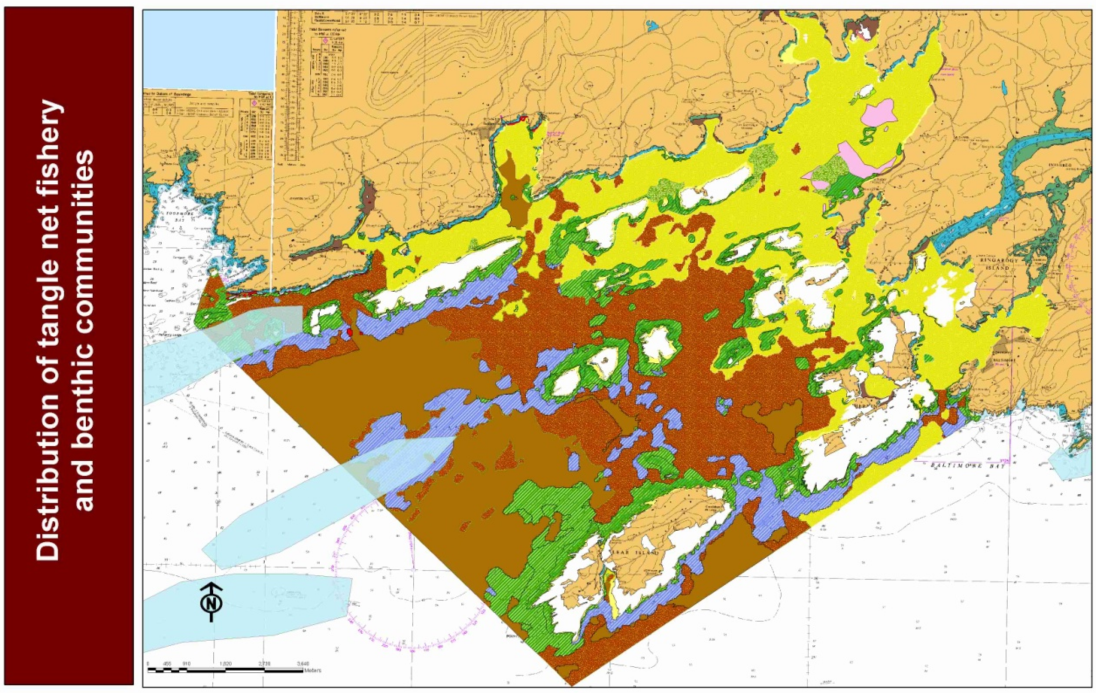

Figure 12. Distribution of proposed tangle net fishery (blue) in relation to benthic communities in RWBay. See Fig 6 for benthic community descriptions.

- Six vessels were involved in the fishery in 2010. Power *et al.* (2007) indicate that approximately 38km of tangle nets may be used in the outer RWBay area.

- The tangle net fishery overlaps with 14% of the reef >20m habitat. There are minor overlaps with mixed sediments and *Laminaria*. The fishery is not expected to affect benthic habitats other than the footprint of the anchors and the footrope of the net.

- The footprint of the fishery on benthic communities is limited to anchors and the lead line of the net.

- The actual footprint of the fishery on benthic habitats is expected to be minor

9.2.6 Gill netting for whitefish

- For vessels fishing gill nets in the SAC the area over which the gill net fishery for whitefish occurs is 710ha (Table 1, Figure 13). Of this 467ha (66%) occurs inside the SAC. Footprint or overlaps on individual habitats are in Table 6 and 8, the amount of gear used per month and the intensity of use (km^{-2}) of habitat is in Table 14 and Table 15 respectively.

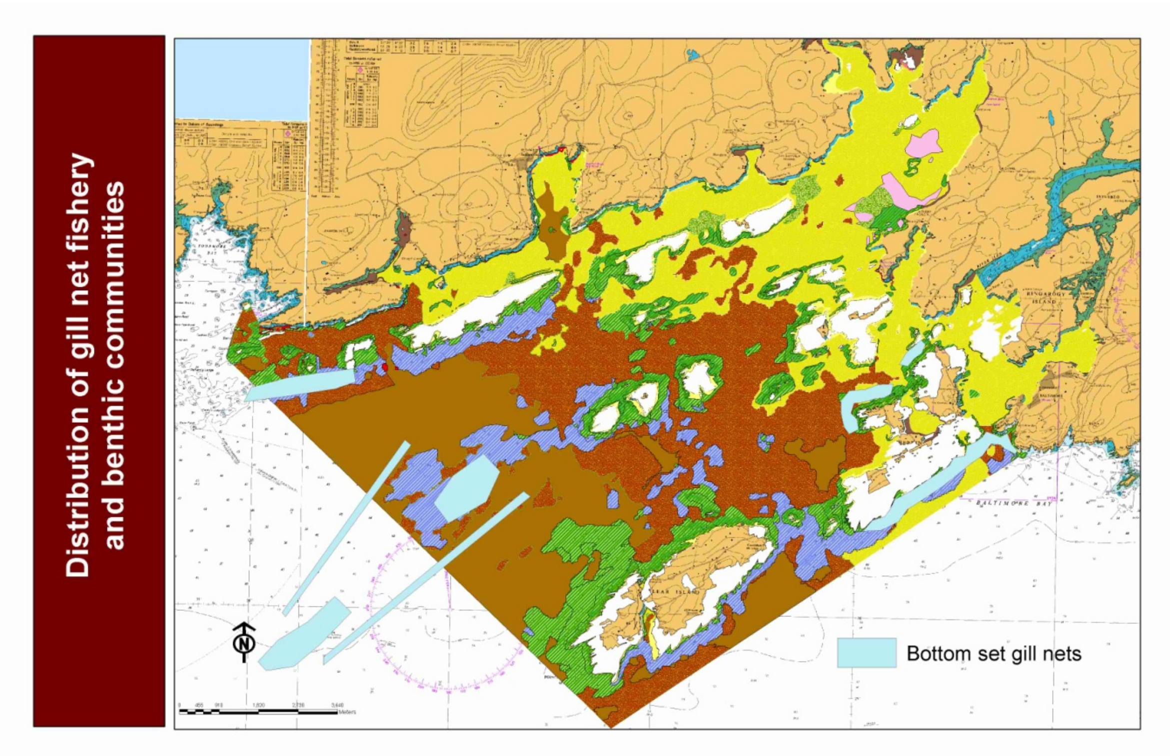

Figure 13. Distribution of proposed bottom set gill net fishery in relation to benthic communities in RWBay. See Fig 6 for benthic community descriptions.

- Seven vessels use gill nets. The quantity of gear is unknown. The fishery is active throughout the year. Gill netting overlaps with 18% of the reef>20m habitat and has minor overlaps with mixed sediments and *Laminaria*.
- Although the fishery overlaps with 18% of the reef>20m habitat the actual footprint of the fishery on reef habitat is expected to be minor.

9.2.7 Pelagic trawling

- The area over which pelagic trawling for herring and sprat occurs is 3096ha (Table 1, Figure 14). Of this, 2873ha (92%) of the fishing area occurs inside the SAC. Footprint or overlaps on individual habitats are in Table 6 and 8, the amount of gear used per month and the intensity of use (km^{-2}) of habitat is in Table 14 and Table 15 respectively.

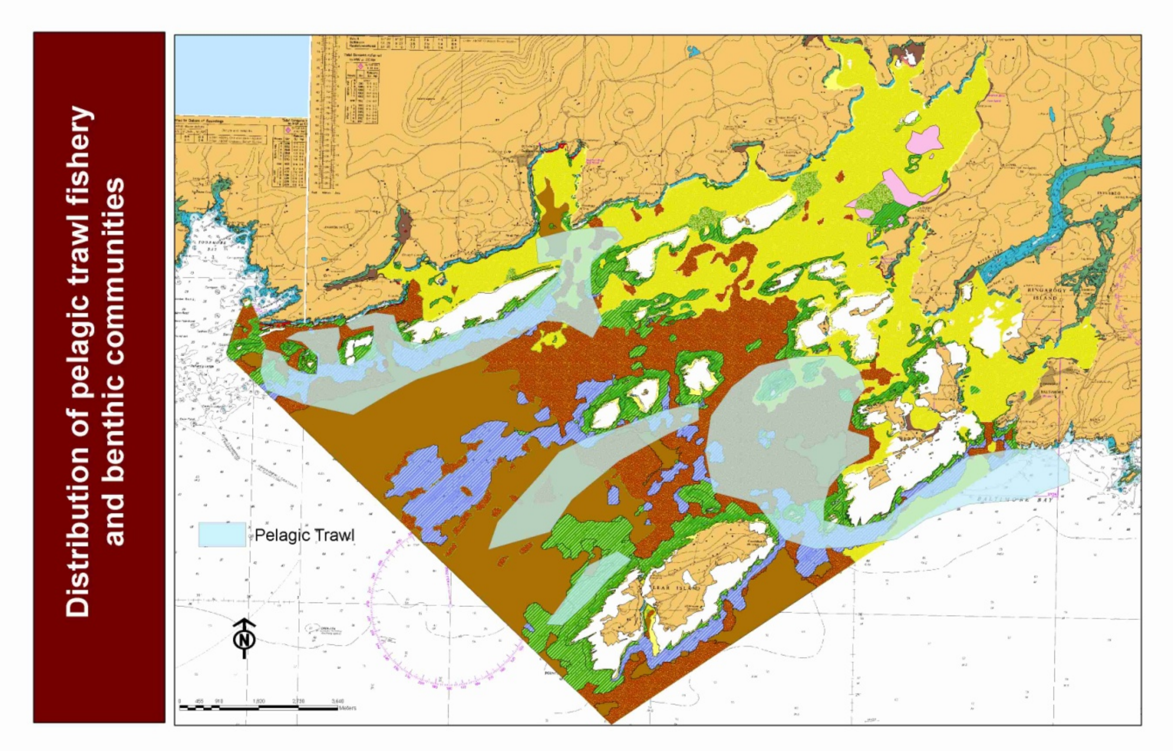

Figure 14. Distribution of proposed pelagic trawl fishery in relation to benthic communities in RWBay. See Fig 6 for benthic community descriptions.

- The pelagic mid water trawl fishery spatially overlaps with 8 benthic communities. This overlap exceeds 15% for sloping bedrock, mixed sediments, muddy sand, *Laminaria*, and reef>20m. In reality the overlaps with *Laminaria* and reef is unlikely and may be an artifact of the way in which the pelagic fishing polygons are drawn. VMS data indicate that pelagic fishing is uncommon in the Bay but this varies annually.

- Pelagic fishing gear does not usually come in direct contact with benthic communities and will not have an impact on the characterising species of these communities

9.2.8 Hook and line fishery for Pollack and mackerel

- The area over which hook and line fishery for Pollack and mackerel is proposed is 2470 ha (Table 1, Figure 15). Footprint or overlaps on individual habitats are in Table 6 and 8, the amount of gear used per month and the intensity of use (km^{-2}) of habitat is in Table 14 and Table 15 respectively.

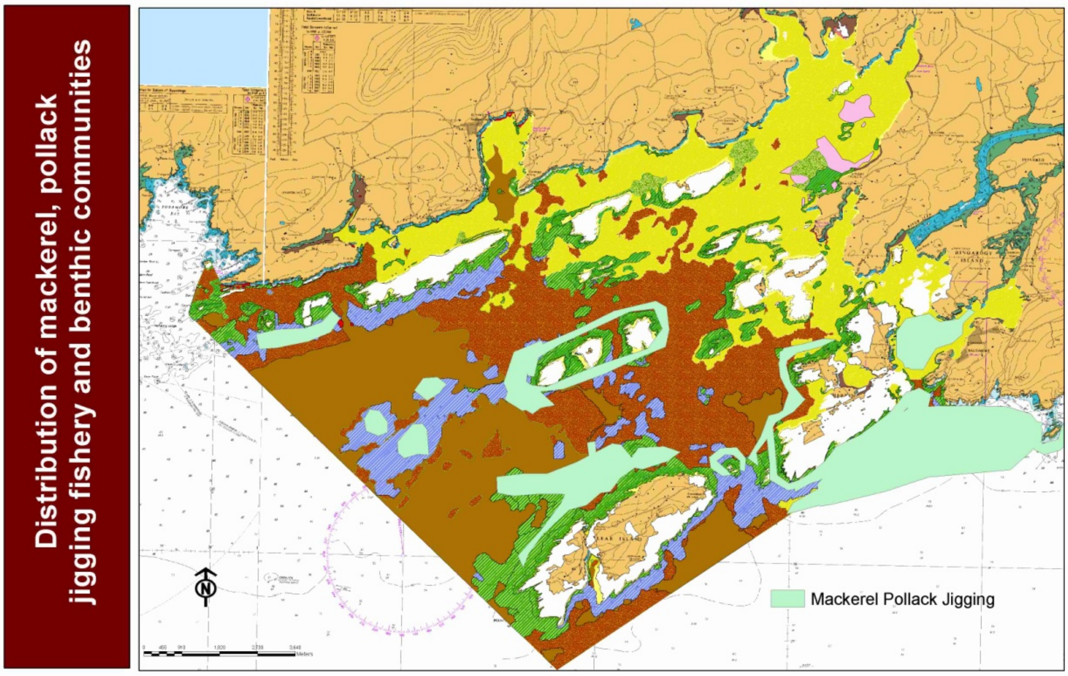

Figure 15. Distribution of hook and line (jigging) fishery for mackerel and Pollack in relation to benthic communities in RWBay. See Fig 6 for benthic community descriptions.

- The pelagic fishery is not in direct contact with benthic communities and will not have an impact on the characterising species of these communities
- The spatial footprint (not calculated) of the fishery is expected to be very low

9.2.9 Trammel net fishery for bait

- The area over which the trammel net fishery occurs is unknown. Four vessels use trammel nets to collect bait fish for pots.

- The trammel net fishery is not expected to have any impact on characterising species, which are in the main infaunal species, of broad sedimentary communities
- Although trammel nets may come into contact with reefs and in particular emergent epi-benthic species the spatial footprint of the activity, which involves 4 small vessels, is highly unlikely to exceed 15% of any community.

9.2.10 Hand gathering

- The area, location and extent of hand gathering activity is unknown.
- It will, by definition, occur on intertidal sedimentary and reef communities. RWBay is not designated for intertidal sedimentary habitats.
- Hand gathering cold be locally intensive on moderately exposed shores as this is a likely habitat for the target species *Littorina littorea*.

Table 14. Indicators of fishing effort per metier and month for fisheries in RWBay. Note the effort indicators / units are different for each metier

			Units per month												
Metiers	**Units**	**Active months**	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average units per active month
Shrimp Potting	*Pots*	8	9250	10400	7000	0	0	0	0	13468	13335	13482	13513	12526	11622
Crab Lobster potting	*Pots*	12	2700	2700	5376	6225	7097	7779	7774	7259	7259	7258	7258	6824	6292
Crayfish tangle nets	*Boats*	12	1	1	1	4	6	5	5	5	5	4	3	2	4
Scallop dredging	*Dredges*	9	18	20	19	9	3	0	0	0	3	7	9	14	11
Pelagic Jigging	*Boats*	12	2	3	3	7	10	12	12	10	10	3	2	2	6
Pelagic mid water trawl	*Boats*	7	3	3	2	0	0	0	0	0	2	2	3	3	3
Whitefish gill netting	*Boats*	12	6	6	6	7	5	3	4	4	5	6	4	4	5
Demersal trawling	*Boats*	12	4	4	4	4	4	4	4	4	4	4	4	4	4

Table 15. Intensity (gear units per km^2) of fishing activity per metier and month in RWBay.

Metiers	Units	Active months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Shrimp Potting	*Pots*	8	106.3	119.5	80.5					154.8	153.3	155.0	155.3	144.0	133.6
Crab Lobster potting	*Pots*	12	35.2	35.2	70.0	81.1	92.5	101.4	101.3	94.6	94.6	94.6	94.6	88.9	82.0
Crayfish tangle nets	*Boats*	12	0.3	0.3	0.3	1.1	1.6	1.3	1.3	1.3	1.3	1.1	0.8	0.5	0.9
Scallop dredging	*Dredges*	9	0.8	0.9	0.9	0.4	0.1				0.1	0.3	0.4	0.6	0.5
Pelagic Jigging	*Boats*	12	0.2	0.2	0.2	0.6	0.8	0.9	0.9	0.8	0.8	0.2	0.2	0.2	0.5
Pelagic mid water trawl	*Boats*	7	0.1	0.1	0.1						0.1	0.1	0.1	0.1	0.1
Whitefish gill netting	*Boats*	12	1.3	1.3	1.3	1.5	1.1	0.6	0.9	0.9	1.1	1.3	0.9	0.9	1.1
Demersal trawling	*Boats*	12	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

9.3 Risk assessment of impact of fishing metiers on designated species grey seal, harbour porpoise and otter

9.3.1 Habitat use by designated species in RWBay.

Roaringwater Bay is designated for Grey seal (*Halichoerus grypus*, qualifying interest 1364), Harbour Porpoise (*Phocoena phocoena*, qualifying interest 1351) and Otter (*Lutra lutra*, qualifying interest 1355) (Figure 16).

The entire SAC area is regarded as habitat for Grey seal and Harbour Porpoise (NPWS 2011b). Finer spatial scale information on how these species use the SAC area is not available other than the use of haul out sites, by Grey seal, for the purpose of resting, breeding and moulting. Otter use the coastline habitat of the mainland and Islands. NPWS (2011b) advise that marine foraging habitat for otter is mainly within 80m of the coastline and a wider band of habitat, 250m from the coast, may be used for commuting between feeding sites, couching sites and holts. Otters may swim between islands and between the mainland and islands.

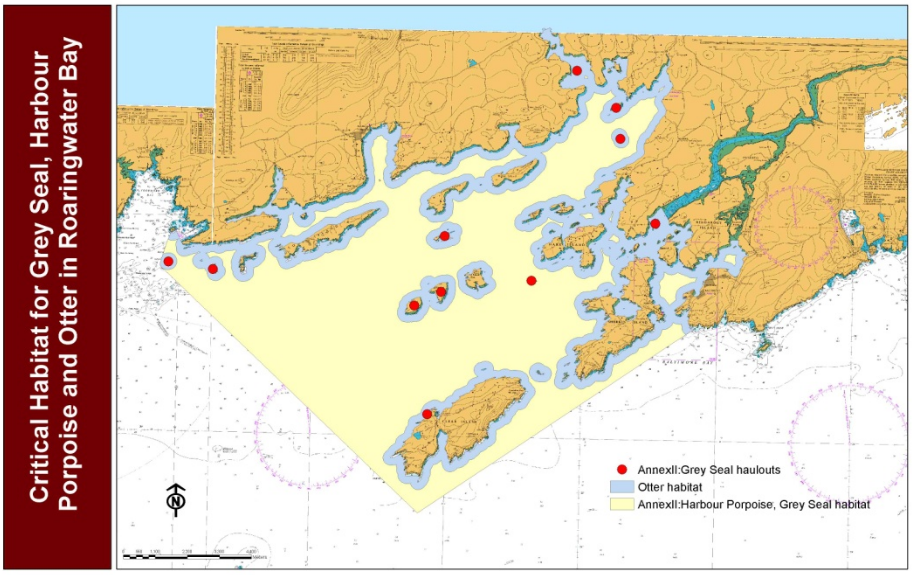

Figure 16. Critical habitat for designated species, grey seal, harbour porpoise and otter in Roaringwater Bay. Otter habitat is a 250m buffer on all coastlines.

9.3.2 Status of designated species in the RWBay area

Grey Seal:

The breeding population of grey seal in Ireland in 2005 was 5509-7083 seals (O'Cadhla and Strong 2007) representing 5% of the British and Irish population. The species is increasing throughout most of its range (IUCN red list report for Grey seal). A moult season assessment reported 5343 seals nationally in 2007 (O'Cadhla and Strong 2007). RWBay is one of 3 SACs on the south coast, including the Saltees Is and Blasket Is designated for grey seal and as such is an important local and regional (Celtic Sea) site for this species. The minimum population estimate for grey seals in RWBay, derived from pup production data, is 116-149 seals (NPWS 2011b). A minimum of 254 seals were recorded at the site during the moult season in 2007.

Harbour porpoise:

Survey data in 2008 indicated a population of harbour porpoise in RWBay of 159±95-689 (95% confidence limits), (NPWS 2011b). Harbour porpoise density in the outer part of the site is reported to be 0.72-2.7 animals.km^{-2}.

Otter:

No population estimates for otter are available for RWBay (NPWS 2011a).

9.3.3 By catch limits

Human induced mortality in marine mammal populations, which are the focus of management targets or conservation objectives, must be limited and within the productive capacity of the populations to maintain themselves. The allowable mortality limits will depend on the population size, the *per capita* population growth rate and also on what the management target is. In RWBay the COs (management objectives) for Grey Seal, Harbour Porpoise and Otter require that the populations be stable or increasing and not subject to significant disturbance that could affect population size, cohort structure and the capacity of the populations to maintain themselves (NPWS 2011b). Mortality limits, consistent with the COs, are estimated below for each species. The risk (of exceeding the mortality limit) posed by fishing activities is then estimated.

9.3.3.1 Population structure

Neither Grey seal nor Harbour Porpoise exist as isolated populations in RWBay.

Harbour Porpoise within the Bay are members of widely distributed populations of these species in the Celtic Sea area and are likely to be part of the widely distributed Celtic Sea-Irish Sea population which are in turn a component of a larger single NE Atlantic population (DEHLG 2009). There is, therefore, immigration and emigration of animals between RWBay and the widely distributed population. In this assessment, and for the purpose of assessing allowable mortality limits, the

RWBay population is, however, assumed to be isolated. This is a conservative approach which assumes that the wider population outside of the Bay is subject to human induced mortality at the mortality limit and, therefore, that this wider population is incapable of supporting, through immigration, the RWBay stock. In that case the population within the Bay would need to be self-supporting (recruiting) and as such should not be subjected to mortality rates above the mortality limit relevant to a local population. Without this conservative assumption an argument could be made that mortality of animals within the site is irrelevant as they would be replaced by immigration from the wider population. This approach has not been taken here.

In the case of Grey seal the population may neither be completed isolated or very wide ranging. The RWBay population may be linked to other breeding and haul out sites in the Saltee Is to the east and Blasket Is to the north west and smaller sites along the south coast. There may be some site fidelity with individuals using one or more sites for haul out and breeding. Fisheries in RWBay and outside the Bay in south and south west coastal waters may, therefore, affect grey seal traversing from RWBay to other south coast sites. The total set net (gill net and tangle net) fishing activity is therefore relevant to the assessment of effects on the RWBay grey seal population.

9.3.3.2 Harbour porpoise by-catch limits

Wade (1998) presents a method for calculating mortality limits for cetaceans and seals, based on population size, the net productivity rate of the population and a recovery factor which can be weighted to management targets.

PBR (potential biological removal) or Mortality Limits = $N_{min}*0.5(R_{max})*F_R$

where N_{min} is an estimate of the minimum population size, R_{max} is the maximum productivity or rate of population increase and F_r is a recovery factor (0.1-1) which can be adjusted to management targets for depleted populations. Using population estimates of 100-400 porpoise in the RWBay area, a value of 0.04 for maximum productivity and a recovery factor value of 0.5, as recommended by Wade (1998), indicates a mortality limit, or a limit to allowed by-catch if the objective is to maintain the long term stability of the porpoise population in RWBay, of 1-4 porpoise by year.

For the Celtic Sea, Wades method, indicates the mortality limit for Porpoise is 363 animals per year given a population estimate of 36280 (Hammond *et al.*. 2002) or 156 animals if N_{min} is taken to be 1 standard deviation below the mean. More recent estimates (Hammond and MacLeod 2006) indicate a population of 80613 porpoise in the Celtic Sea and a mortality limit of 806 for a recovery factor of 0.5 and 1612 using a recovery factor of 1.0 which is appropriate as the population is increasing.

If F_R is taken at 1.0 rather than 0.5 then the mortality limit for a closed RWBay population would be 2-8 animals per year. The mortality limits calculated by the method of Wade (1998), above, is consistent with ASCOBANS (2003) who set mortality limits at 1.7% of the best available abundance estimate but revised this down to 1%, on a precautionary basis, in 2006.

9.3.3.3 Grey Seal

Minimum population estimates for grey seal in RWBay is 116-149. A best estimate of R_{max} for pinnipeds is 0.12 (Wade 1998). Based on Wade's (1998) formula, used above to calculate by catch limits for porpoise, these values indicate a by-catch limit for RWBay grey seal of 3-4 seals per year, if F_r of 0.5 and 7-9 seals per year if F_r is 1.0. A value of 1.0 for F_r may be justified as grey seal populations are generally increasing which would give a mortality limit of 7-9 seals per year.

9.3.3.4 Otter

By catch limits cannot be calculated. There are no population estimates or population growth rate figures for otters in RWBay.

9.3.4 Risk of capture of Harbour porpoise, Grey Seal and otter in fishing gear

The main risk to grey seal, porpoise and otter is to the conservation objective attributes distribution, disturbance and population composition as defined by NPWS (2011a). According to the COs human activities at the site, in this case fisheries, should not adversely affect populations of the species at the site. The main effects to disturbance and population composition arise from the risk of capture (and mortality) in certain fishing gears but mainly tangle nets and gill nets. Trammel nets and lobster pots pose the highest risk for otters.

9.3.4.1 Tangle nets

The likelihood of capture of Grey Seal and Harbour Porpoise in static nets is high. The consequence for the populations concerned depends on the total by-catch.

In the tangle net fishery soak times of 1 week are not uncommon and the nets are generally left fishing throughout the season which is, operationally, limited to the spring to autumn period. Hauling may be restricted to periods of neap tide. These nets generally target crayfish (*Palinurus elephas*) and Turbot (*Psetta maximus*).

The quantity of tangle net fishing gear within and in the region of RW Bay SAC is not completely known. Power *et al.*(2007) presented information on the quantity of tangle nets used by 6 vessels in the RWBay area in 2007 (Table 16). The total length of tangle net in use in the area at that time was approximately 38km. Given the seasonal profile of the fishery from May to October and given that tangle nets are generally left at sea for the season (6 months) the total net immersion effort is approximately 188,000km.hrs.

More broadly, along the Cork and Kerry coasts up to 41 vessels possessed approximately 308 km of tangle net. This is approximately 8 times higher than the quantity of nets used in the RWBay area and may represent over 1 million km.hrs of immersed effort. However, the actual pattern of use of nets by the 41 vessels concerned is uncertain and may be significantly lower than this

Table 16. Quantity of tangle nets used by 6 vessels in the RWBay region (a) and in coastal waters of Cork and Kerry (b) in 2007 (from Power *et al.* 2007).

(a)	Vessel length	Miles of net	Strings
Union Hall to Cape Clear	11.09	4	8
Castletownshend to Baltimore	7.02	2	4
Cape Clear to Fastnet	8	5	20
Fastnet to Mizzen Hd.	5.3	1	5
Fastnet to Mizzen Hd.	5.94	1.5	7
Fastnet to Mizzen Hd.	9.25	10	25
Total		23.5	69

(b)	**Number of Vessels**	**Nautical miles of tangle-nets**
Cork	23	84
Kerry	18	110
Total	41	**194**

Harbour Porpoise

Harbour porpoise, together with short beaked common dolphin, seem to be the species most susceptible to capture in static gill nets (Evans and Hintner 2010). Juvenile porpoise seem more vulnerable than adults. By catch rates of Harbour Porpoise in the Celtic Sea gill net fishery in 1994-1996 was 7.7 animals / 10^4 km.h of immersed net effort (Tregenza *et al.*. 1997) with a total estimated by-catch in the Celtic Sea of 2200 porpoise. More recently (references in Evans and Hunter 2010) the by-catch of Harbour Porpoise in the Irish and Celtic Sea gill net and tangle net fisheries was put at 498-1409 individuals. Cosgrove and Browne (unpublished) report a catch rate of 8.08 / 10^4km.hrs which is higher than Tregenza's estimate. Cosgrove and Browne (unpublished) indicate that the increase in by-catch in the peak period of March – June between their study and Tregenzas is proportional to the increase in population size of porpoise between 1994 and 2005 (Hammond *et al.*. 2002, Hammond and MacLeod 2006).

- For the 6 tangle netters fishing in RW Bay and surrounding waters the immersed net effort per season is 188,000 km.h. If the catch rate is 7.7 animals per 10000km.h (Tregenza 1997), then 144 porpoise may be caught in the RW Bay area per year.
- Tregenza (1997) calculated a 'lethality index' of 4.5 for Celtic Sea gill nets in relation to porpoise by-catch. This index assumes that risk of capture is directly proportional to the net immersion time and the density of harbour porpoise or

B=kED where

B = by-catch, k=constant, E = net immersion effort and D = porpoise density. Using a value of 4.5 for k indicates an expected by-catch of 609 porpoise if density is 0.27 porpoise.km^{-2} (NPWS 2011a) and effort is 188000 km.hours.

The population of size of Harbour porpoise in RWBay is estimated at 159 (NPWS 2011a). NPWS (2011a) also indicate that population densities in the outer part of the Bay may be 0.72-2.7 porpoise.km^{-2}. This translates to a local 'population of between 100-400 animals in a sea area of 150 square kms which is an approximate sea area for the outer bay and waters in proximity to it.

Extrapolating RWBay by-catch from the Celtic Sea gill net fishery obviously may overestimate the by-catch rates of porpoise in the tangle net fishery in RWBay. Observations in the RW Bay area in 2007 and 2011 indicated no porpoise by-catch in 14 day trips (Table 17). This observation effort represents about 3% of the total immersed net effort in RWBay. These data suggest that the likelihood of capture is low in RWBay and that the consequences for porpoise may be insignificant. However, the data is insufficient to conclude that the risk is low and higher weighting must be given to the published data on by catch rates in the nearby Celtic Sea. It is possible, therefore, that the local population may be depleted by tangle net fisheries operating in the region of RWBay and that it is sub-vented by immigration into the area.

Grey Seal

There is thought to be a significant interaction between grey seals and static net (gill net, tangle net) fisheries on the south west coast involving both depredation of fish from nets (Cronin *et al.*. 2011) and capture of seals in nets (BIM 1997, 2001). Seals captured in static nets appear to be mainly juveniles (BIM 1997). Twelve percent and 1.6% of juvenile seals, tagged on the west coast, were subsequently reported captured in tangle nets on the west coast in 1997 and 1999 respectively (BIM 2001). This by-catch profile may be biased downwards if seals, particularly adult seals, are lost from nets during hauling (Kiely *et al.*. 2000). The risk of capture of seals in static nets, including tangle and gill nets, can therefore be regarded as high (Evans and Hinter 2010).

There are few observations on the rate of capture of grey seals in different fishing métiers in RWBay. Three observer days in the tangle net fishery in 2007, 2 in 2011 and 8 industry self sampling days in 2011 all indicate zero capture of grey seals (Table 17). Nine Marine Institute discard observer trips, off the south east and south west coasts, in spring 2011, did not detect any seal by-catch but seal depredation was significant in 1 of these trips. A single common Dolphin was captured on 1 trip.

However, given previous reports on by-catch rates, that seals move between haul out sites in RWBay and other Bays on the south coast, thereby increasing the possibility of exposure to the 308km of set nets off the Cork and Kerry coasts, that the RWBay population is probably less than 500 animals and, therefore, that the annual tolerable by-catch limit is less than 10 animals there is at least a possibility that the RWBay population could be depleted by interaction with the tangle net fisheries in the Bay and in coastal waters of Cork and Kerry.

Otter

Risk of capture of otter in tangle nets in RWBay is regarded as very low because the nets are set in waters deeper than waters used by otter whose foraging habitat is limited to a coastal band 80m from land.

The tangle net fishery will not have a significant impact on the conservation attributes for otter.

Table 17. Observations on grey seal, Harbour Porpoise and Otter by catch in gill nets and tangle nets on the south coast in 2007 and 2011 (source: Marine Institute). Records in bold are in or in proximity to RWBay.

Metier	Days	Pier	Date	soak	Nets hauled	net length hauled(m)	Common Dolphin	Harbour Porpoise	Grey Seal	Seal Depredation
Gill net	1	Slade	01/03/2011	24	2		1	0	0	
Gill net	1	Dunabratin	15/03/2011	24	4		0	0	0	
Gill net	1	Dunabratin	28/02/2011	24	5		0	0	0	
Gill net	1	Dunmore	15/03/2011	24	3		0	0	0	

Gill net	1	Dunmore	16/03/2011	24	3		0	0	0	
Gill net	1	Tramore	03/03/2011	24	4		0	0	0	
Gill net	1	Dunmore	05/03/2011	24	3		0	0	0	
Gill net	**1**	**CTBere**	**27/02/2011**	**24**	**15**		**0**	**0**	**0**	**Extensive**
Gill net	1	Dunmore	15/03/2011	24			0	0	0	
Tangle net	**2**	**Schull**	**Aug-11**	**>24hrs**	**6**	**2400**	**0**	**0**	**0**	
Tangle net	**3**	**Schull**	**Jul-07**	**>24hrs**		**2950**	**0**	**0**	**0**	
Tangle net	**8***	**Schull**	**Aug-11**	**>24hrs**			**0**	**0**	**0**	
***industry sampling**										

9.3.4.2 Gill nets

Gill net fishing effort is poorly quantified and there is no independent source of data on the amount of gill net effort in the area. The total net immersion effort is likely to be substantially lower than for tangle nets as net soak times are much lower and nets are generally not left in the water during the fishing season.

Grey seal and porpoise

The risk of capture of grey seals and porpoise per unit effort of gill net activity is probably the same as for tangle nets. There was no observed by catch (Table 17) in 2011 on the south coast but the observation effort is a very small percentage of overall effort.

9.3.4.3 Mid-water trawling

Pelagic fishing effort described from VMS data indicates that the fishery is not very active in RWBay and surrounding waters. VMS data for 2009 suggests a maximum of 24 hours of activity.

Harbour porpoise

Harbour porpoise are not usually captured in pelagic trawls (Evans and Hintner 2010). None were captured in the Celtic Sea herring fishery by-catch study reported by Morizur (1999). Cetacean capture in mid-water trawls is more prevalent at night than during the day (references in Evans and Hintner 2010, page 68). Given the low level of mid-water pelagic activity in RWBay and the low risk of capture of this species in mid-water trawls the risk to harbour porpoise from mid-water trawls is low.

Grey Seal

Grey seals are captured in mid-water trawls (Morizur *et al.*. 1999). Catch rates, reported in Morizur 1999, of grey seal in the Celtic Sea herring fishery were 0.0513 seals per tow and 0.0396 seals per hour of tow. However, these rates were calculated from by-catch or just 4 seals. At 1 tow per day this could result in 133 tows per year and a potential by-catch of 8-10 grey seals per annum. The VMS data suggests a capture of approximately 1 seal per annum. This risk posed by mid-water trawling to grey seal is low.

Otter

The risk of capture of otter in pelagic trawls can be discounted as the activity occurs in sub-surface open water

9.3.4.4 Demersal trawling

Grey seal and porpoise

Moore (2003) reported that 91% of fishermen in the Clyde caught a seal in their trawl rarely or occasionally. There are no data on seal or porpoise by-catch in demersal trawls in RWBay or the Celtic Sea.

The risk posed by demersal trawling to harbour porpoise and grey seal can be regarded as low given the intensity of trawling in the area.

Otter

Otters are not expected to be captured in demersal trawls as this activity occurs in deep water in the outer part of the Bay. The risk of significant effects of the demersal trawl fishery on otter is very low.

9.3.4.5 Lobster, crab and shrimp potting

Harbour Porpoise

Larger cetaceans may become entangled in ropes associated with lobster creels. Pierce and Santos (2000) reported mortality of common dolphins in creels in Galicia. There have been no published reports of porpoise mortality associated with crustacean potting. The risk of significant effects of potting on Harbour Porpoise is low.

Grey seal

Seals interact with lobster creels. Seals may damage creels to steal bait (Moore 2003) but are unlikely to be caught in soft-eye creels used in the Irish industry. The risk of significant effects of potting on grey seal is low.

Otters

Otters can be trapped in creels. This risk depends on the creel design and in particular its size, the design of the eye entrance and whether parlours or double chambers are used inside the pot. Female otters are more susceptible because of their smaller size (Twelves 1983). The risk of otter capture in creels in RWBay can be regarded as low because lobster/crab creeling occurs in deeper water inaccessible to otters.

Shrimp pots are unlikely to catch otters as the entrance is too small to allow otters to enter the pot.

9.3.4.6 Trammel nets

Trammel nets are used by lobster/crab fishermen to catch fish for bait. Bait species may include wrasse and rockling among other species. Four vessels may use trammel nets for bait. The majority of pot fishermen now purchase bait which is usually frozen scad or fish 'frames' from factories.

Trammel nets pose a risk to otter as they are used in shallow reef areas and as such it is possible that local populations of otter may be depleted due to by-catch. The local population is small and tolerable by-catch is likely to be very low.

9.3.4.7 Scallop dredging

Scallop dredging does not pose a risk to grey seals, porpoise or otter.

9.3.4.8 Pelagic jigging

Pelagic jigging for Pollack and mackerel does not pose a risk to grey seals, porpoise or otter.

9.4 Risk profile

Consequence, likelihood and risk scores for 94 fisheries – habitat/species interactions (incidents) are provided in Table 18 and summarized by risk category in Table 19 and Figure 17. 62 incidents are estimated to pose no risk, 27 pose low risk, 7 pose moderate risk and 5 potentially pose high risk. In addition some cumulative effects are possible (Table20).

Table 18. Risk assessment outcome for individual fishing activity * designated feature combinations. Risk categories are colour coded and signal a requirement or not for mitigation. Red – mitigation required. Orange – mitigation probably needed and assessed on a case by case basis, Yellow – low risk no mitigation required, Green – no risk.

Metier	Feature	Habitat species	Consequence	Likelihood	Risk	Risk evaluation
Shrimp Potting	Reef - exposed to moderately exposed intertidal	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	2	3	6	Non-cumulative disturbance probable
	LSIB - Zostera dominated community	*H*	2	3	6	Non-cumulative disturbance probable
	LSIB - Maerl dominated community	*H*	4	2	8	Cumulative disturbance possible
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	0	4	0	No risk
	Grey seal	*S*	0	4	0	No risk
	Otter	*S*	1	1	1	Likelihood of individual capture unlikely
	Sea caves	*H*				
Crab Lobster potting	Reef - exposed to moderately exposed intertidal	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	2	3	6	Non-cumulative disturbance probable

	LSIB - Zostera dominated community	*H*	3	1	3	Cumulative disturbance unlikely
	LSIB - Maerl dominated community	*H*	4	1	4	Cumulative disturbance unlikely
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	0	4	0	No risk
	Grey seal	*S*	0	4	0	No risk
	Otter	*S*	1	1	1	Likelihood of individual capture unlikely
	Sea caves	*H*				
Crayfish tangle nets	Reef - exposed to moderately exposed intertidal	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	0	4	0	No risk
	LSIB - Zostera dominated community	*H*	0	4	0	No risk
	LSIB - Maerl dominated community	*H*	0	4	0	No risk
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	3	2	6	Likelihood of population depletion possible
	Grey seal	*S*	3	2	6	Likelihood of population depletion possible
	Otter	*S*	0	4	0	No risk. Nets in deep water
	Sea caves	*H*				
Scallop dredging	Reef - exposed to moderately exposed intertidal	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	3	3	9	Cumulative disturbance probable

	Reef - sheltered intertidal and subtidal	*H*	0	3	0	No risk
	Reef- Laminaria dominated communities	*H*	3	3	9	Cumulative disturbance probable
	LSIB - Zostera dominated community	*H*	4	3	12	Cumulative disturbance and habitat loss probable
	LSIB - Maerl dominated community	*H*	4	3	12	Cumulative disturbance and habitat loss probable
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk. Does not occur in this habitat
	LSIB - Mixed sediment	*H*	2	3	6	Non-cumulative disturbance probable
	LSIB - Shallow sand/mud	*H*	0	3	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	0	4	0	No risk
	Grey seal	*S*	0	4	0	No risk
	Otter	*S*	0	4	0	No risk
	Sea caves	*H*				
Pelagic Jigging	Reef - exposed to moderately exposed intertidal	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	0	4	0	No risk
	LSIB - Zostera dominated community	*H*	0	4	0	No risk
	LSIB - Maerl dominated community	*H*	0	4	0	No risk
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	0	4	0	No risk
	Grey seal	*S*	0	4	0	No risk
	Otter	*S*	0	4	0	No risk
	Sea caves	*H*				

Pelagic trawl	Reef - exposed to moderately exposed intertidal	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	0	4	0	No risk
	LSIB - Zostera dominated community	*H*	0	4	0	No risk
	LSIB - Maerl dominated community	*H*	0	4	0	No risk
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	1	2	2	Likelihood of individual capture possible
	Grey seal	*S*	1	2	2	Likelihood of individual capture possible
	Otter	*S*	1	0	0	No risk
	Sea caves	*H*				
Whitefish gill netting	Reef - exposed to moderately exposed intertidal	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	0	4	0	No risk
	LSIB - Zostera dominated community	*H*	0	4	0	No risk
	LSIB - Maerl dominated community	*H*	0	4	0	No risk
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	3	2	6	Likelihood of population depletion possible

	Grey seal	*S*	3	2	6	Likelihood of population depletion possible
	Otter	*S*	0	3	0	No risk, nets in deep water
	Sea caves	*H*				
Demersal trawling	Reef - exposed to moderately exposed intertidal	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	3	2	6	Cumulative disturbance possible
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	3	2	6	Cumulative disturbance possible
	LSIB - Zostera dominated community	*H*	0	4	0	No risk
	LSIB - Maerl dominated community	*H*	0	4	0	No risk
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	3	2	6	Cumulative disturbance possible
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	1	1	1	Likelihood of individual capture rare
	Grey seal	*S*	1	1	1	Likelihood of individual capture rare
	Otter	*S*	1	0	0	No risk
	Sea caves	*H*				
Trammel netting	Reef - exposed to moderately exposed intertidal	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	1	1	1	Disturbance unlikely
	LSIB - Zostera dominated community	*H*	4	1	4	Cumulative disturbance unlikely
	LSIB - Maerl dominated community	*H*	4	1	4	Cumulative disturbance unlikely
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				

	European dry heaths	*H*				
	Harbour porpoise	*S*	1	2	2	Likelihood of individual capture possible
	Grey seal	*S*	1	2	2	Likelihood of individual capture possible
	Otter	*S*	3	2	6	Likelihood of population depletion possible
	Sea caves	*H*				

Table 19. Summary risk assessment outcome showing the number of incidences (fishing activity * designated feature combination) at each risk level and the requirement for mitigation.

Risk	Incidences	Mitigation requirement
0	69	No mitigation required
1	5	Review mitigation requirement
2	4	
3	1	Review mitigation requirement
4	3	Review mitigation requirement
5	0	
6	12	
7	0	
8	1	Mitigation probably required
9	2	Mitigation probably required
10	0	
11	0	
12	2	Mitigation required
13	0	
14	0	
15	0	
16	0	Mitigation required

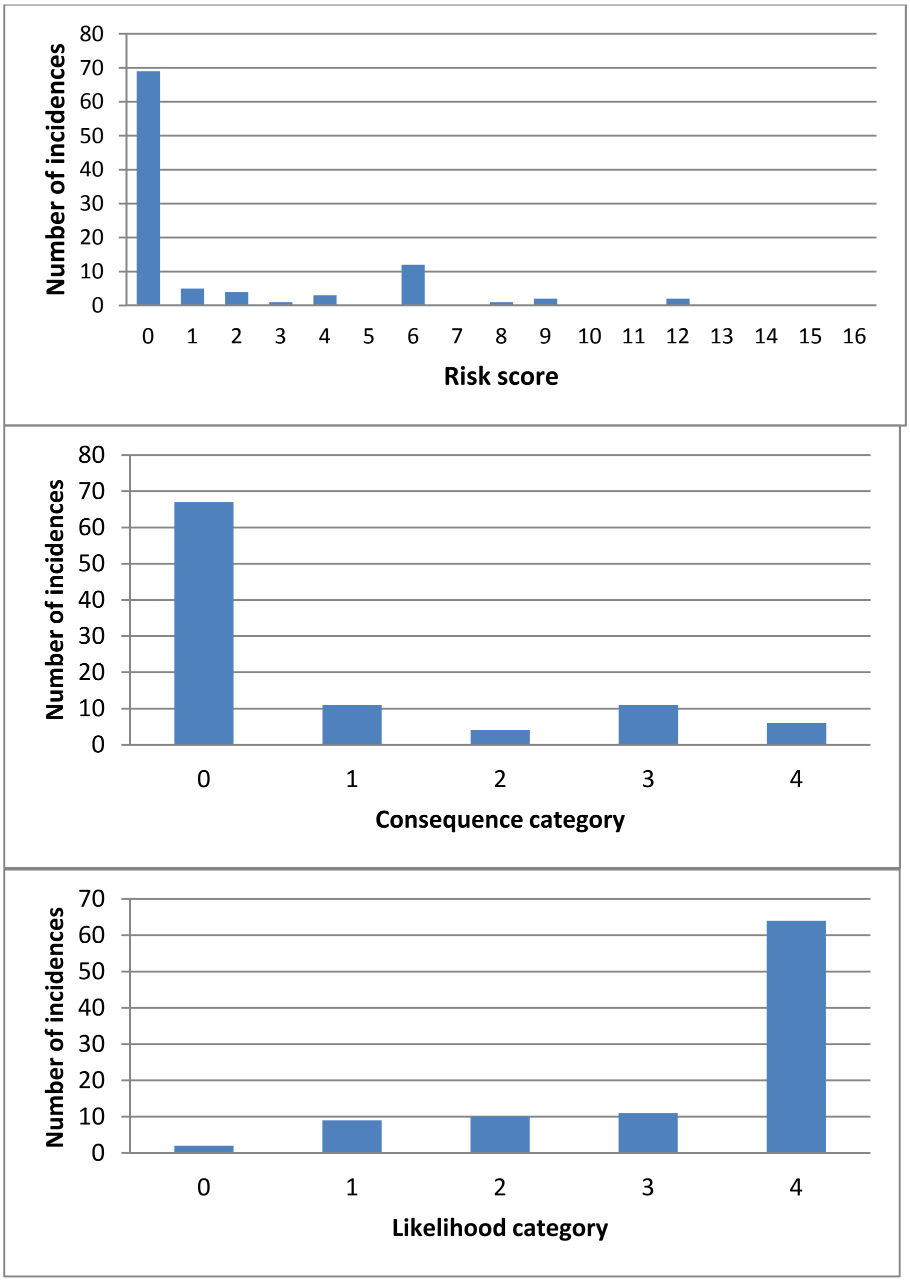

Figure 17. Profile of risk, consequence and likelihood for fishing activity – designated feature combinations in RWBay.

9.4.1.1 Cumulative effects of fishing

Cumulative effects of different fishing activities can arise when the consequences of two individual activities combine to increase the consequence to a higher category. This would be particularly relevant where individual consequence scores of 1, either for species or habitats, combine to have higher consequences for that habitat or species. This will depend on the likelihood of the consequences arising. Such cumulative effects therefore are unlikely if the likelihood of the individual consequences are extremely low.

Taking consequence scores of >0 (some individual risk) and likelihood scores of >2 (ignoring very unlikely or rare occurrences) the possible cumulative effects occur in the following features (Table 20);

Grey seal and Harbour Porpoise – the cumulative effect of gill netting, tangle netting, trammel netting and pelagic trawling will be additive and related to the total amount of activity of each métier and the by catch per unit of effort of each métier. This should be considered against the low tolerable by-catch for small populations.

Maerl – scallop dredging is the main effect but there is likely to be a much smaller additive effect of shrimp potting. The possibility of an additive effect of crab and lobster potting on maerl can be ignored because it is unlikely to occur

Mixed sediments – demersal trawling and scallop dredging may combine to increase the consequences for mixed sediments. However, although the demersal trawl fishery may occur throughout the year, the level of activity is low. The scallop fishery is seasonal and occurs in winter and spring.

Zostera **-** scallop dredging is the main effect but there is likely to be a much smaller additive effect of shrimp potting. The possibility of an additive effect of crab and lobster potting on *Zostera* can be ignored because it is unlikely to occur

Reef > 20m – persistent disturbance is possible due to trawling and probable due to scallop dredging in this habitat. As such the cumulative effect is unlikely to increase the consequence but the likelihood of such consequence will increase with the total fishing effort of the combined activities

Laminaria – scallop dredging, demersal trawling, crab / lobster potting and shrimp potting occur on *Laminaria* reef. Demersal trawling may not be prevalent in this habitat however and potting may occur on the edges of *Laminaria* reef rather than in the reef. Cumulative effects however may occur depending on the intensity of each activity.

Table 20. Risk assessment outcomes for scores where for habitat consequence is >0 and likelihood is >2 and where for species consequence is >0 and likelihood is >1.

Metier	Feature	Habitat species	Consequence	Likelihood	Risk	Risk evaluation
Shrimp Potting	Reef- Laminaria dominated communities	*H*	2	3	6	Non-cumulative disturbance probable
Shrimp Potting	LSIB - Zostera dominated community	*H*	2	3	6	Non-cumulative disturbance probable
Shrimp Potting	LSIB - Maerl dominated community	*H*	4	2	8	Cumulative disturbance possible
Crab Lobster potting	Reef- Laminaria dominated communities	*H*	2	3	6	Non-cumulative disturbance probable
Scallop dredging	Reef - exposed to moderately exposed below 20m subtidal	*H*	3	3	9	Cumulative disturbance probable
Scallop dredging	Reef- Laminaria dominated communities	*H*	3	3	9	Cumulative disturbance probable
Scallop dredging	LSIB - Zostera dominated community	*H*	4	3	12	Cumulative disturbance and habitat loss probable
Scallop dredging	LSIB - Maerl dominated community	*H*	4	3	12	Cumulative disturbance and habitat loss probable
Scallop dredging	LSIB - Mixed sediment	*H*	2	3	6	Non-cumulative disturbance probable
Demersal trawling	Reef - exposed to moderately exposed below 20m subtidal	*H*	3	2	6	Cumulative disturbance possible
Demersal trawling	Reef- Laminaria dominated communities	*H*	3	2	6	Cumulative disturbance possible
Demersal trawling	LSIB - Mixed sediment	*H*	3	2	6	Cumulative disturbance possible
Crayfish tangle nets	Harbour porpoise	*S*	3	2	6	Likelihood of population depletion possible
Crayfish tangle nets	Grey seal	*S*	3	2	6	Likelihood of population depletion possible
Pelagic trawl	Harbour porpoise	*S*	1	2	2	Likelihood of individual capture possible
Pelagic trawl	Grey seal	*S*	1	2	2	Likelihood of individual capture possible
Whitefish gill netting	Harbour porpoise	*S*	3	2	6	Likelihood of population depletion possible
Whitefish gill netting	Grey seal	*S*	3	2	6	Likelihood of population depletion possible
Trammel netting	Harbour porpoise	*S*	1	2	2	Likelihood of individual capture possible
Trammel netting	Grey seal	*S*	1	2	2	Likelihood of individual capture possible
Trammel netting	Otter	*S*	3	2	6	Likelihood of population depletion possible

9.5 Appropriate assessment of the impacts of Aquaculture activities on benthic communities and habitats

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

- Section 8.2.1 above highlights the generalised response of habitats and species to likely physical disturbance caused by gear associated with fishing activity. The interactions highlighted above would also include the interactions with seabed habitats for sub-tidal bottom culture of oysters and scallops (which represent an overlap with habitats of 14.28 ha) by virtue of the fact that dredging is used to service and harvest these bivalve species. The conclusions presented below for this culture method are derived from information presented in Section 8.2.1 and subsequent sections above.
- The majority of activities and pressures arising from shellfish aquaculture relate to the structures associated with the culture method and the presence of high densities of the culture organism.
- As with fishing activities, aquaculture pressures on a given habitat will also be related to vulnerability (spatial overlap or exposure of the habitat to the equipment combined with the sensitivity of the habitat) to the pressures induced by shellfish culture activities. To this end the location and orientation of structures associated with the culture organism, the density of culture organisms and the duration of the culture activity are all important considerations when considering risk of disturbance to habitats.
- Different species and habitats will have different tolerance to the pressures associated with shellfish aquaculture activities. Sensitivity of a species or habitat to a given pressure is the product of the resilience (resistance or tendency not to be affected by) 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. Life history and biological traits are important determinants of sensitivity of species to pressures from fishing and aquaculture.
- NPWS (2011b) provide lists of species characteristic of benthic communities that are defined in the Conservation Objectives. As above, the methodology and guidelines applied for fisheries activities are also applied to aquaculture; whereby, the sensitivity of habitats (and their component species) to pressures associated with shellfish aquaculture are derived from an understanding of the life history characteristics of the species such that resilience and recoverability can be estimated in light of the pressures exerted.

- Table 21 identifies the species characterising the habitats in Roaringwater Bay and Islands SAC and classifies their sensitivities to organic enrichment and sedimentation. These classifications are derived from the sensitivity analysis conducted on habitats and species by Marine Life Information Network for Britain and Ireland (www.marlin.ac.uk).

Table 21. Sensitivities to sedimentation and organic enrichment (disaggregated to resilience and recoverability components) of species and dominant taxonomic groups, characteristic of communities which have spatial overlap or are proximate to aquaculture activities in RWBay. Sensitivity assessments for species is as reported in www.marlin.ac.uk. No sensitivity assessment is available for non-shaded species.

	Characterising species						**Dominant taxonomic groups**			
Community	1	2	3	4	5	6	1	2	3	4
Maerl community	*Lithophyllum dentatum*	*Spyridia filimentosa*	*Lithophyllum coralloides*	*Phymatolithon calcareum*	*Xantho spp*	*Sabella pavonina*	Corraline algae	Red algae	Crustaceans	
Mixed sediment community complex	*Spiophanes bombyx*	*Phaxas pellucidus*	*Pariambus typicus*	*Pisione remota*	*Protodorvillea kefersteini*	*Mysella bidentata*[1]	Polychaetes	Bivalves	Cumaceans	
Exposed to moderately Exposed intertidal Reef	*Fucoids*	*Semiballanus balanoides*	*Patella vulgata*	*Littorina littorea*			Green seaweeds	Crustaceans	Gastropods	
Laminaria	*Laminaria digitata*	*Laminaria hyperborea*	*Alcyonium digitatum*	*Cliona celeta*	*Echinus esculentus*					
Shallow sand/mud community complex	*Abra nitida*	*Thyasira flexuosa*	*Melinna palmate*	*Fabulina fabula*	*Caprella, Aora, Phtisica*	*Zostera*	Bivalves	Polychaetes	Amphipods	Sea grasses
Zostera community	*Zostera marina*	*Asperococcus compressus*	*Ceramium rubrum*	*Glycymeris glycymeris*	*Sabella pavonina*	*Venus verruscosa*	Seagrass	Bivalves	Polychaetes	Crustaceans

Key to sensitivity to ***sedimentation and organic enrichment:***

(bright green)	high resilience, high recoverability
(light green)	medium resilience, high recoverability
(light yellow)	low resilience, high recoverability
(orange)	moderate resilience, moderate recoverability
(red)	low resilience, low or none recoverability

9.5.1.1 Rope Mussel Spat collection

- The applications in total cover 95.71 ha of the SAC (Figure 18).
- Currently there are 11 applications pending for operations designed to capture mussel spat on ropes. These proposed operations are located in the outer portion of Roaringwater Bay to the southwest and seaward of existing rope mussel culture operations.
- The areas are chosen on the basis of their greater water depth (in order to maximise dropper length for collection), yet they are proximate to the existing grow-out operations in the inner Bay so that servicing the sites can be achieved more easily.
- These applications overlap with three different habitats types i.e. Mixed Sediment Community Complex, *Laminaria* community (Reefs <20m) and Shallow Sand/Mud Community complex (Figure 21).
- The potential impacts of the operation relate to the deposition on the seabed of mussel faeces and pseudofeces. The production of biodeposits by mussels is a function of, (1) The level of seston in the water column (Tenore and Dunstan 1973; Kautsky and Evans 1987; Navarro and Thompson 1997) and, (2) the size of the mussel, such that larger mussels will produce greater quantities of bio-deposits in absolute terms (Callier *et al.* 2006). The likely size of mussels to be collected and transported away from each of the sites (to the inner growout area) is in the region of 20-30mm shell length. The physical structures (dropper lines with mussels) will also increase the risk of sedimentation from the water column. Callier *et al.* (2006) demonstrated that the physical presence of mussels on lines (as identified by empty shell material) was responsible for measureable levels of sedimentation (range 14%-35% of total sedimentation observed) presumably related to the physical presence of mussel lines, whereas Weise *et al.* (2009) demonstrated that deposition rates near mussel lines were broadly similar to background levels.
- Dispersion of material away from the site is a function of the depth of water and the hydrographic conditions in and around the structures as well as the quantity and size of deposits (faecal pellet diameter). The stock at these proposed locations will be considered a 0+ cohort (young of the year) and will therefore, likely produce modest to low amounts of faeces and pseudofaeces (Callier *et al.* 2006; 2007). In addition, the total deposition to the seabed will depend on the duration of the activity.

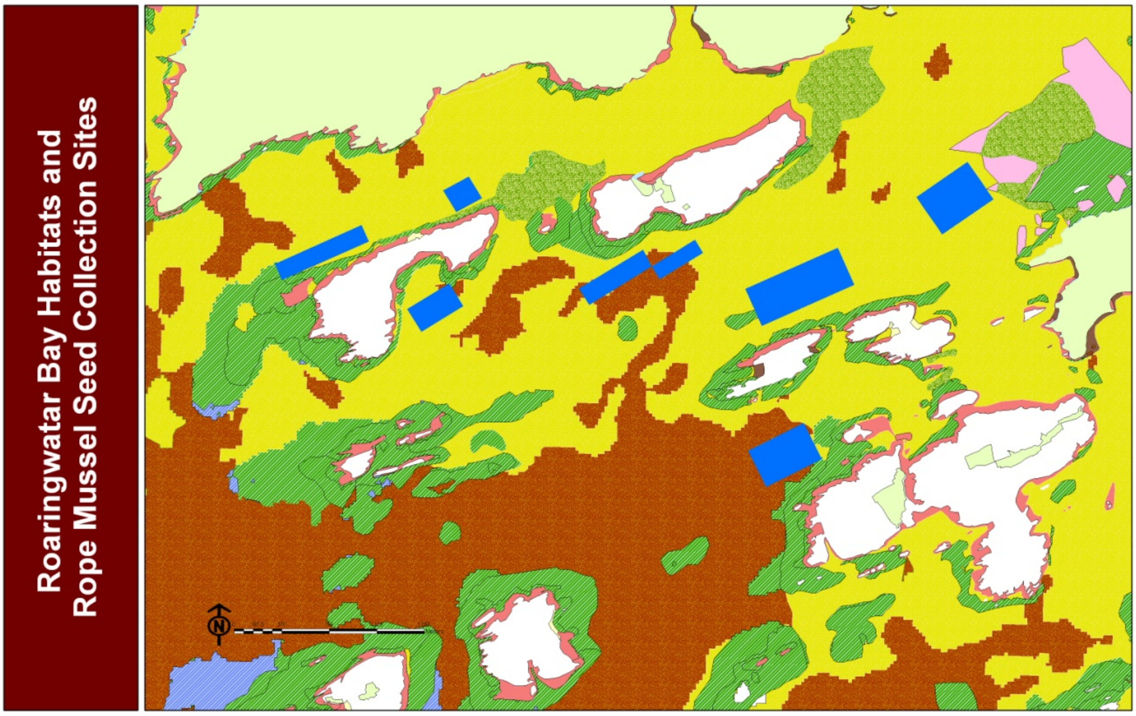

Figure 18. Spatial overlap between rope mussel spat collection sites (blue rectangles) and habitats within the Roaringwater Bay SAC. Habitat legend as per Figure 6.

- ***Laminaria* reef (<20m):**

- The proposed spat mussel collection sites overlap with 2.57ha of the *Laminaria* reef community. This overlap constitutes 0.14% of the habitat area for this community type in the SAC.

<u>Significant impact of spat collection for mussels on the *Laminaria* community **can** be discounted for the following reasons:</u>

- The duration of the activity is confined to 5 months per year and intensity of bio-deposition resulting from this activity is considered low by virtue of the age profile of the mussels on the lines.
- Notwithstanding the previous comments, *Laminaria* has high resilience and high recoverability to sedimentation which is considered the primary disturbance resulting from this type of activity.

- The other characterising species for this habitat (*Alcyonium digitatum, Cliona celeta, Echinus esculentus*) will have moderate resilience but high recoverability to sedimentation.
- It is likely that given the configuration of sites (they are dispersed within the bay) and the density of longlines within the sites (3 per hectare) that the risk of impact on the *Laminaria* resulting from shading caused by the structures is low.
- The spatial overlap between the activity and *Laminaria* reef is insignificant.

- **Mixed sediment community complex:**

  - The proposed spat collection sites in the Bay overlaps with 26.5ha of the mixed sediment community complex. This comprises 0.8% of this habitat type within the SAC.
  - Species predominantly associated with the mixed sediment community complex include small bodied infaunal species of polychaetes and bivalves.

<u>Significant impact of spat collection of mussels on the mixed sediment community complex **can** be discounted for the following reasons</u>

- The duration of the activity is confined to 5 months per year and intensity of biodeposition resulting from this activity is considered low by virtue of the age profile of the mussels on the lines.
- The majority of characterising species would be considered relatively tolerant to disturbance caused by sedimentation and organic enrichment. Other characterising species (*Phaxas pellucidus, Pisione remota*) would be considered sensitive to organic enrichment, but as stated above the exposure to this pressure is considered to be low.
- The degree of spatial overlap is insignificant

- **Shallow sand/mud community complex:**

  - The proposed spat collection sites overlaps with 66.6 ha of the shallow sand mud community. This equates to 2% of this habitat type within the SAC.

- The species associated with the shallow sand mud community complex include small bodied infaunal species of polychaetes and bivalves.

Significant impact of spat collection of mussels on the shallow sand mud community **can** be discounted for the following reasons

- The duration of the activity is confined to 5 months per year and intensity of biodeposition resulting from this activity is considered low by virtue of the age profile of the mussels on the lines
- The majority of the infauna listed are considered tolerant of moderate amounts of deposition. Other species listed (*Fabulina fabula and Zostera* sp.) while sensitive are unlike to be exposed to considerable organic enrichment given the relatively short duration of the activity in the SAC and the fact that *Zostera* comprises a very small proportion of the habitat.
- It is likely that given the configuration and location of sites (they are dispersed within the bay and are found in deeper water) that the risk of impact on the *Zostera* as a result of shading by the structures is low.
- The overlap between the habitat and activity is low at 2%

9.5.1.2 Rope Mussel Culture (Growout)

- There are currently 39 sites licenced for the culture of mussels on ropes in Roaringwater Bay, comprising approximately 290ha of the SAC (Figure 19).
- In addition, there are 11 unoccupied sites that are set aside for future expansion within the bay (Figure 22).
- All operations are confined to the northeast corner of the SAC within Roaringwater Bay proper.
- These production areas overlap only with the Shallow Sand/Mud Community complex (see Figure 4, 23). While mapping indicates that the activity may overlap with *Laminaria* reef habitat, it is likely this is a mapping artefact given the overlap is so small (i.e 0.27 ha or 0.01% of this habitat type). No further consideration is given to this interaction.
- The potential impacts of the operation are similar to those highlighted in Sections 6.2 and 8.3.11 above.

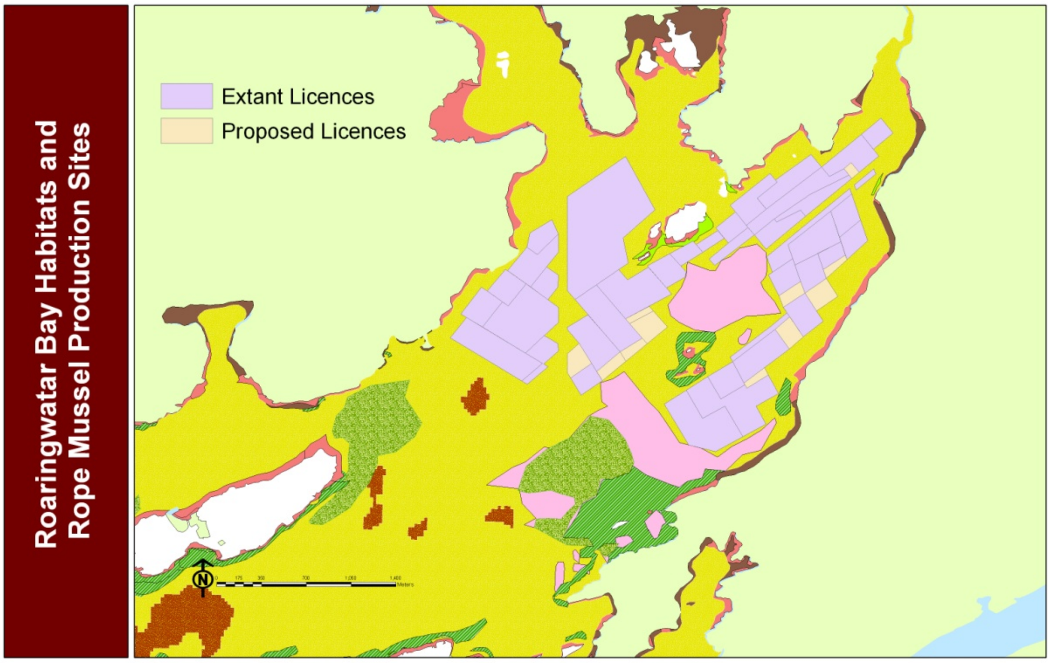

Figure 19. Spatial overlap between rope mussel production sites, proposed productions sites and habitats within the Roaringwater Bay SAC. Habitat legend as per Figure 4.

- **Shallow sand/mud community complex:**

  - The production sites overlap with 289.5ha of the shallow sand/mud community. This equates to 8.7% of this habitat type within the SAC.
  - The proposed production sites overlap with 22.5 ha of the shallow sand/mud community. This equates to 0.67% of this habitat type within the SAC.
  - In total, all mussel activities, both existing and proposed, comprise **9.37%** of this habitat type within the SAC.

- The species associated with the shallow sand/mud community complex include small-bodied infaunal species of polychaetes and bivalves. While the majority of characterising species are relatively tolerant to disturbance caused by sedimentation and organic enrichment, other characterising species (*Phaxas pellucidus*, *Pisione remota*) are sensitive to organic enrichment.
- The duration of the activity is year-round resulting in a risk of chronic enrichment of the seafloor. This will be exacerbated by the presence of older and larger mussels which are capable of production large amounts of faeces and pseudofaeces. In addition, the close proximity of each of the production sites to each other is such that cumulative effects can not be discounted. It is likely that any potential for dispersion of material away from the production area is greatly reduced by virtue of baffling effects of structures suspended in the water column.
- The activities are proximate to habitats of high conservation value (Maerl and seagrass beds). These habitats are highly sensitive to organic enrichment and sedimentation and to shading by structures particularly given the relatively shallow nature (≈5m) of the area in question. However, filtration by the shellfish in this area may also provide benefit to the aforementioned photo-autotrophic species by increasing water clarity.

Impact of rope mussel grow-out on the shallow sand mud community **can** be discounted for the following reason:

- Notwithstanding the above identified impacts the activity occurs on less than 15% of the shallow sand mud community which is below the threshold for significant effects.

9.5.1.3 Subtidal (bottom) Oyster Culture

- **Shallow sand/mud community complex**
- Two applications are pending for the culture of the Pacific oyster, *Crassostrea gigas*, in the SAC. These applications are located in 6.3 ha around Hare Island.
- The sub-tidal oyster applications overlap the shallow sand/mud community complex by 0.2%. This habitat is characterized by a range of infaunal bivalves and polychaetes.

- The activities associated with this culture practice (dredging of the seabed) are considered disturbing which can lead to removal and/or destruction of infaunal species and changes to sediment composition. In addition, the location of large numbers of a single epifaunal species onto what is, in essence, an infaunal dominated system will likely result in a change to the habitat. Nevertheless the % of the habitat that will be thus affected is 0.2%.

Impact of bottom culture of oysters on the shallow sand mud community **cannot** be discounted for the following reasons:

- The location of the oysters in an uncontained fashion sub-tidally on the seabed will present risks if removal has to be effected. Such removal might be necessary in the event there is a disease outbreak or if oysters (a non-native) species demonstrate reproductive capabilities. In effect, 100% removal will not be possible if it is deemed necessary.
- There is a risk associated with the introduction of ½ grown or 'wild' seed from outside Ireland although the risk of introduction of listed diseases in the target organism are monitored and mitigated under legislation (Council Directive 2006/88/EC which deals with the health of aquaculture animals and the prevention and control of certain aquatic diseases). However, this practice presents the risk of establishment and spread of species that are associated with the introduced bivalves (Carlton 1989, 1999). These species may include both "hitchhiking" species i.e., animals and plants that grow associated with the bivalves and both listed and potentially non-listed diseases or parasites that may cause outbreaks in the same or other species (Barber 1996). If this occurs habitat structure and function may change
- In recent years, Pacific oyster spatfall has been recorded at number of locations in Ireland. This is thought to be related to a warming trend of waters and increased acclimation to conditions by oysters. Oysters held sub-tidally have been demonstrated to have higher condition indices than those held inter-tidally in Ireland (MagAoidh, 2011). Condition index is directly correlated with the ability to produce gametogenic material in oysters (Crosby and Gale 1990). The culture of oysters sub-tidally will, therefore, likely increase the risk of successful reproduction. This is further exacerbated by higher densities of the oysters that generally prevail under culture conditions resulting in the increasing probability of successful larval formation (Allee effect). To date, no instances of pacific oyster settlement have been recorded in Roaringwater Bay. In addition, calculations on residence time in a portion of the inner

bay have demonstrated that the time for full refresh of water within the bay ranges from 1.5 to 8 days (Tomasz Dabrowski, Marine Institute – personal communication). Given the larval phase of oysters can be anything from 2-4 weeks (and perhaps longer) this could mitigate against successful recruitment in the bay.

9.5.1.4 Intertidal oyster culture

Roaringwater Bay is not designated for intertidal sedimentary habitats. The majority of intertidal oyster culture, 71% (36.6 of 51.5 ha), in the bay is carried out on this habitat type. The bay is designated for intertidal reef habitat. Intertidal oyster culture does occur on this habitat type and is assessed below. However, one aspect of intertidal culture that may impact on all habitat features is the risk of introduction of non-native species with ½-grown seed from other locations (i.e. wild seed from France) or the successful recruitment of the non-native Pacific oyster, *Crassostrea gigas*, which would increase the risk of establishment of a wild or naturalized population of this species in the Bay. Although the risk of introduction of listed diseases in the target organism are monitored and mitigated under legislation (Council Directive 2006/88/EC which deals with the health of aquaculture animals and the prevention and control of certain aquatic diseases). However, this practice presents the risk of establishment and spread of species that are associated with the introduced bivalves (Carlton 1989, 1999). These species may include both "hitchhiking" species i.e., animals and plants that grow associated with the bivalves and both listed and potentially non-listed diseases or parasites that may cause outbreaks in the same or other species (Barber 1996). If this were to occur habitat structure and function may change.

Reef Moderate/High exposure (intertidal)

- Intertidal oyster culture is licenced over 13.5 ha of this habitat type. This constitutes 4.14% of this habitat in the SAC.
- In addition, intertidal oyster culture applications cover 0.42 ha of this habitat type comprising 0.1% of this habitat type.

<u>Significant impact of oyster culture on the reef moderate/high exposure (intertidal) can be discounted for the following reasons</u>

- The activity is confined to areas of moderate to high exposure such that accumulation of biodeposits originating from oysters underneath structures is unlikely.

- Access to the sites are by boats and therefore the risk of compaction by service vehicles is negligible. Compaction by footfall on this habitat is a risk but given the relatively small area covered, the risk to the overall habitat is also small.
- By virtue of the fact that the oysters are contained in the intertidal area, complete removal of stock can be achieved in the event of a disease epizootic or if oyster reproduction is observed. In such an event, alternative stock (disease free or resistant oysters and/or triploid) may be utilised in the bay.

9.5.1.5 Seaweed Aquaculture

- There are 2 applications pending for the culture of seaweed using longlines in Roaringwater Bay. Both applications are adjacent on a sheltered embayment near Cunnamore.
- The applications cover approximately 4ha in total.
- The spatial analysis highlights that this activity will likely cover two habitat types i.e. shallow san/mud community and *Laminaria* reef. However, given the coverage of the reef habitat is so low (<0.001), the interaction between seaweed aquaculture and *Laminaria* reef habitat will not be considered further.

Shallow sand/mud community complex

- The 4 ha covered by the two applications cover approximately, 0.12% of the habitat shallow sand/mud community complex.

Significant impact of culture of seaweed on longlines on the shallow sand mud community **can** be discounted for the following reasons:

- The practice is extractive only and relies primarily on ambient sunlight and nutrient levels. There is no harmful waste material deriving from the culture of seaweed species.
- The source of stock is for this culture practice is derived from within the bay or from hatchery production.
- The species cultured are indigenous to the bay.

9.5.1.6 Summary of Aquaculture interactions with Habitats

Of the aquaculture activities considered in this assessment those that are considered disturbing are the growout stage of rope mussel production in the inner part of Roaringwater Bay and the proposed subtidal oyster culture operations near Hare Island. These activities constitute persistent disturbance to one habitat type within the SAC, i.e. shallow sand/mud community complex. However, this disturbance occurs on **9.5**% of this habitat type in the SAC which is less than the 15% threshold for significance (Table 21).

Table 21. Summary of % spatial overlaps of aquaculture and benthic communities

Designation	**Habitat**	Mussel spat collection	Mussel growout	Sub-tidal oyster	Inter-tidal oyster	Seaweed
1170 and 1160	*Mixed sediment community complex*	0.8				
	Laminaria	0.14				
	Reef High/Moderate				4.5	
	Shallow sand/mud community complex	2	9.5	0.2		0.12

9.5.2 Appropriate assessment of impact of aquaculture practices and designated species grey seal, harbour porpoise and otter.

As indicated in section 8.2.3.1 above Roaringwater Bay is designated for Grey seal (*Halichoerus grypus)*, Harbour Porpoise (*Phocoena phocoena*) and Otter (*Lutra lutra*).

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?

Rope mussel culture (spat collection and growout) and Oyster Culture (intertidal)

Roaringwater Bay and Islands SAC is designated for the Grey Seal (*Halichoerus grypus*). The conservation objectives for this species are listed in Table 1 and can be found in detail in NPWS (2011a; 2011b). While the conservation status of the species is considered favourable at the site, the interactions between Grey seals and the features and activities of aquaculture carried out in the SAC must be ascertained.

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

- Access to suitable habitat
- 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 Grey 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. 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 aquaculture (e.g., longlines and bags on trestles) may form a physical barrier to seals when both submerged and exposed 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 impact of these disturbances at the population level have not been studied more broadly in seal populations (NRC 2009).

Within the Roaringwater Bay and Island SAC, the current or proposed activities do not physically overlap with any breeding, moulting or resting locations identified in the SAC (NPWS 2011a). Furthermore, it is considered that, given the favourable conservation status of Grey Seals within the SAC (NPWS 2011a) tthat the current production levels (and activities associated with them) do not appear to interfere with the current conservation status.

However, there are three areas where aquaculture activities might be considered to influence the habitat use by Grey seals. These sites are Roaringwater Bay (Figure 20), Inisleigh (Figure 21) and Castle Island (Figure 22). The extent of mussel culture operations around the sites in Roaringwater Bay might present a barrier to movement to seals. However, it should be noted that the mussel longlines have been on-site, at current densities, for approximately 20 years (BIM, personal communication) suggesting that the structures do not pose a physical barrier or the culture activities do not adversely disturb the molting and/or resting of seals at the sites. At the Inisleigh seal resting site, oyster culture is licenced on the West side of the island. Two applications to culture oysters may present a barrier to movement of seal to and from the Island (Figure 21). Precaution should apply when taking a licencing decision in relation to the applications at this site. Castle Island is an important breeding site for seals. Seal populations are sensitive to disturbance at this time. It is proposed to use a site adjacent to this seal breeding site for the capture of mussel seed. While the structures used may not present a risk to seals, there is a possibility that activities associated with the museel culture may cause a disturbance during this sensitive period. Furthermore there is likely considerable temporal overlap between the use of this location by seal (August – December) and aquaculture operators. (September and November) when the lines are retrieved. Therefore, precaution should apply when taking a licence decision in relation to the seed collection site north of Castle Island.

Other mussel culture and intertidal oyster culture licences and application do not appear to cause disturbance to seals. Impacts at these sites **can** be discounted.

Otters – 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 Roaringwater Bay. Impacts **can** be discounted

Porpoises – no information is available on likely negative interaction between porpoises (or dolphins) and rope mussel structures. Given their echolocation ability it is likely that the structures do not pose a collision risk to porpoises. The level of activity in relation to mussel culture is considered low and is unlikely to pose a disturbance risk to porpoises. They occur in higher densities in the outer part of the Bay distant from the proposed activity. Impacts **can** be discounted

Oyster culture (subtidal)

Seals, otters and porpoise – it is unlikely that the marine mammals will be at risk during the dredging operations given the low frequency of dredging and the size of the dredge that is proposed be used. Impacts **can** be discounted.

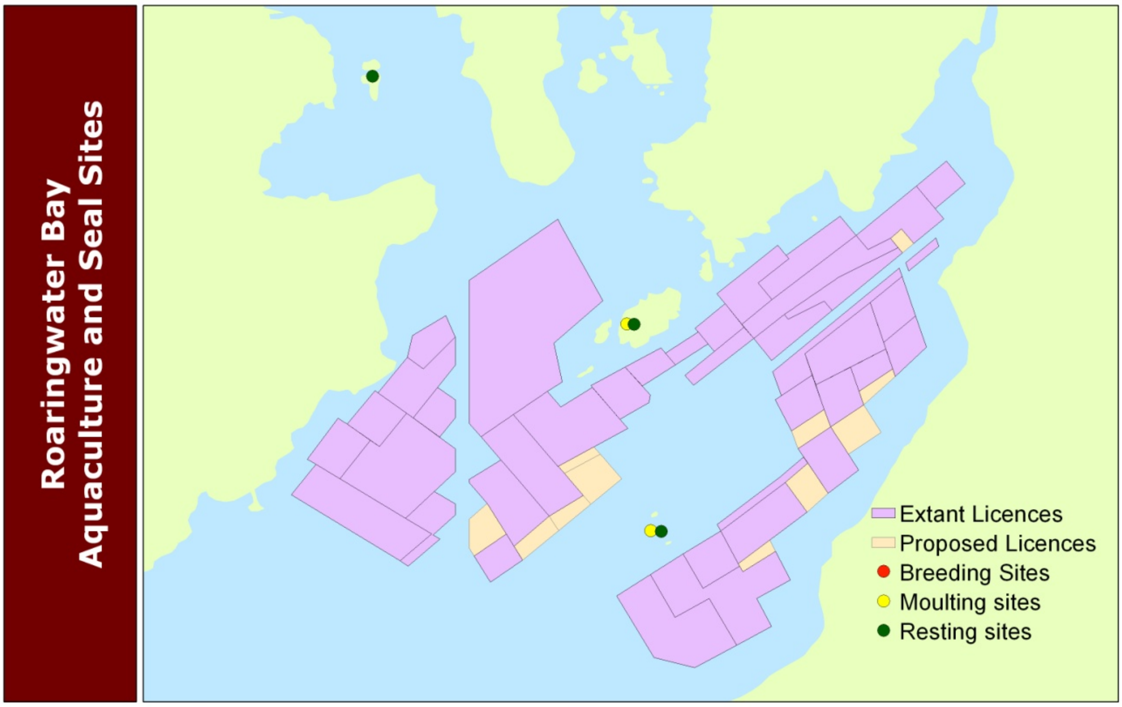

Figure 20. Longline mussel culture extent and Grey seal sites in Roaringwater Bay.

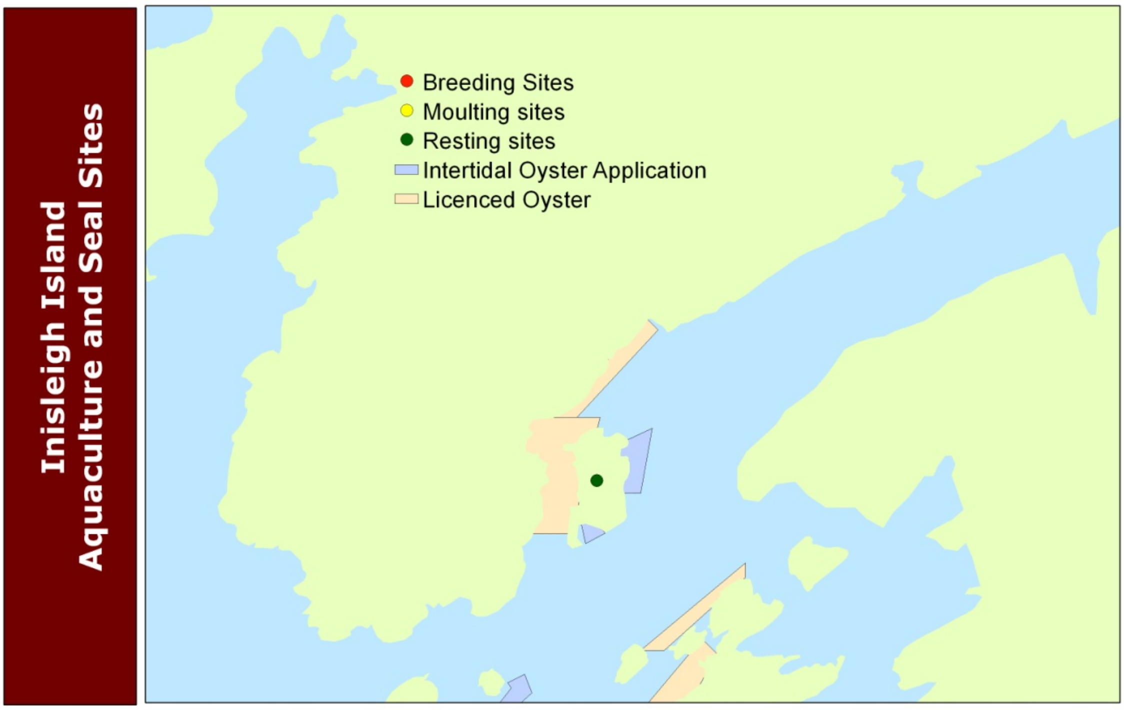

Figure 21. Oyster culture and Grey seal resting site at Inisleigh Island.

Figure 22. Proposed longline spat collection site and Grey seal breeding site at Castle Island.

9.6 In combination effects of fisheries and aquaculture on individual habitats

There are few additional effects relating to the combined activities of fishing and aquaculture to be considered over and above the individual and cumulative effects of these activities already described. There are no in combination issues for designated species.

- **Shallow sand mud**: *Demersal trawling* and *mussel grow-out* are considered to have disturbing effects on this habitat. The footprint of the demersal fishery may be less than indicated. The in combination % overlap is 14.3% and under the 15% threshold.

10 Risk Assessment (fisheries) conclusion statement

The existing fishing activities in Roaringwater Bay SAC pose varying risks to the conservation objectives identified by NPWS (2011a) for the site. The risk profile for fisheries habitat/species interactions is as follows:

- 69 potential habitat/species fisheries interactions pose no risk
- 12 interactions are estimated to pose a moderate or high risk to designated habitats. These are
    - Scallop dredging on exposed to moderately exposed reefs >20m depth
    - Scallop dredging on *Laminaria* reef
    - Scallop dredging on *Maerl*
    - Scallop dredging on sea grass
    - Scallop on mixed sedimentary habitats
    - Shrimp potting on maerl communities
    - Shrimp potting on zostera
    - Shrimp potting on Laminaria reef
    - Crab and lobster potting on Laminaria reef
    - Demersal trawling on reef >20m depth
    - Demersal trawling on Laminaria communities
    - Demersal trawling on mixed sediments

- 9 interactions are estimated to pose a moderate or high risk to designated species. These are
    - By-catch of Harbour porpoise in tangle nets
    - By-catch of Grey Seal in tangle nets
    - By-catch of Harbour porpoise in gill nets
    - By-catch of Grey Seal in gill nets
    - By-catch of Harbour porpoise in pelagic trawls
    - By-catch of Grey Seal in pelagic trawls
    - By-catch of Harbour porpoise in trammel nets
    - By-catch of Grey Seal in trammel nets
    - By-catch of Otter in trammel nets
- Mitigations may need to be put in place to reduce the risk posed by these activities. In some cases the risk scores may be biased upwards due to poor data on the scale of fishing

activity while in other cases the risk may be real. Mitigating actions may therefore be classified as those which would

- Realistically reduce the risk by modifying the nature, frequency, intensity or range of the activity or
- Show that the risk is in fact lower than estimate in this assessment through provision of data within a limited time frame

11 Appropriate Assessment (Aquaculture) Conclusion Statement and Recommendations

The existing and proposed aquaculture activities in Roaringwater Bay SAC are in the main compliant and consistent with the conservation objectives identified by NPWS (2011a) for the site. The exceptions are as follows:

- **Trawling, mussel grow-out and sub-tidal oyster culture on shallow sand community**: The cumulative footprint of persistent and disturbing activities such as trawling, mussel growout and sub-tidal oyster culture may be close to the 15% threshold for significant effects on the shallow sand/mud community complex.

- **Proximity of activities to sensitive habitat** – given the sensitivity of maerl and seagrass habitats, consideration should be given to minimising the impact of activities on these habitats. Such measures may take the form, for example, of introducing buffers zones around these habitats in order to minimise dispersion of organic matter onto the sensitive areas.

- **Use of ½-grown oysters** – the use of stock that might have been cultivated in areas outside of the SAC in question might present a risk of introducing non-native 'hitchhiker' species. Precautionary measures may be put in place, e.g., monitoring for alien species with consignments and subsequent management actions.

- **Bottom culture of oysters** – given that oysters are cultured in an uncontained fashion on the seabed, a potential risk presents in the event of a disease outbreak, successful oyster reproduction (if diploid stock are introduced) or an alien species introduction into subtidal habitat with ½ grown oysters. Precaution (in the form of mitigation measures) must be used if this activity is to be considered. Such mitigation may take the form of utilising hatchery reared, triploid seed which will reduce the risk in relation to alien species introduction and successful oyster reproduction, respectively.

- **Aquacultre and Grey seal interactions** -.Precaution should apply when licening aquaculture activities in the vicinity of Inisleigh and Castle Islands.

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