



AP2/2013

Killary Mussel Licence Renewal Appeal

Site T9/388

Technical Advisors Report

Produced by

AQUAFACT International Services Ltd

On behalf of

Aquaculture Licences Appeals Board

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1 Executive Summary

Description	Objection to the renewal of Shellfish Aquaculture Licences in Killary Harbour
Appeal Reference	AP2/2013
Licence Applications	T9/388
Department Reference Number	
Applicants	Peter Nee, Feenone, Carrowniskey, Westport, Co. Mayo
Minister Decision	Licence granted
Appeal	
Type of Appeal	
Appellant	Simon Kennedy, Killary Fjord Shellfish Ltd., Bunowen, Leenane, Co. Galway
Observers	
Technical Advisor	AQUAFACT International Services Ltd.
Site inspection	

2 Appeals Details & Observer Comment/Submission

Date Appeal Received: 6th February 2013 Simon Kennedy

Killary Fjord Shellfish Ltd.

Table 2.1 Location and Applicants of Sites Appealed

Ref. Site No.	Applicant location Killary Harbour, Co. Galway
T9/388	Peter Nee, Feenone, Carrowniskey, Westport, Co. Mayo

Table 2.1 lists the location of the licence renewal under appeal as well as the identity of the applicant.

2.1 Appeal Timeframe

Publication notice of the decision to grant the renewal of aquaculture licences and grant foreshore licences was published in The Connacht Tribune on Friday January 11th, 2013. The appeal was submitted within the statutory timeframe of one month from the date of the publication notice in the Connacht Tribune as set out under Section 40 of the Fisheries (Amendment) Act, 1997.

Killary Fjord Shellfish Ltd. submitted the appeal on 4th February 2013. The Appeal was received by ALAB on 6th February 2013.

2.2 Name of Appellant

Mr Simon Kennedy,

Killary Fjord Shellfish Ltd.,

Bunowen,

Leenane,

Co. Galway.

2.3 Name of Observers

There have been no further submissions or observations since the appeal has been submitted.

2.4 Grounds for Appeal

AP2/2013

The Appellant has raised concerns about the over licensing of Killary Harbour.

Substantive Issues

The appellant maintains that over-licensing in Killary Harbour has resulted in a culture of overstocking resulting in diminished phytoplankton food supply for some producers, stating that with the proliferation of licences, some farms have been surrounded by others and as such, a fair and equitable access to food supply is precluded.

The appellant feels that the proposed phased 15% reduction in floatation (reduction of 5% of floatation per annum over a three year period, from the date of renewal) considered by the Department of Agriculture Food and the Marine is not a solution to the over licensing problems documented in Killary Harbour.

The appellant claims that the proposed reduction will not improve production, stating that production increases since 2000 were confined to those outer sites with better access to the phytoplankton food supply with inner sites experiencing a reduction in productivity. In addition, the appellant claims that in comparison to conditions prior to the issuing of an increased number of licences in 1999/2000, Killary Harbour is experiencing a decrease in growth rate with poor meat yields and an increase in the grow-out period.

The appellant states that the proposed reduction will only benefit those licences in open waters and would have little impact on those inner sites that have experienced a slowdown in growth from 18 to 36 months with the increase in growth period resulting in poorer meat quality, higher shell fouling and limited markets.

The appellant highlights that while some farmers in Killary have implemented substantial cutbacks of stocking density on their farms, they still cannot grow mussels to a marketable size in an acceptable period of time as they are surrounded by other farms thereby reducing their access to food.

The appellant illustrates that the 70% increase in licensed area since 2000 does not translate into a comparative increase in production.

The appellant feels that the UISCE carrying capacity report (2010) commissioned by BIM for Killary Harbour is not ideal as it takes the year 2000 (when the extra licences were issued) as the starting point rather than 1990 when he claims that aquaculture was sustainable in the harbour. Contrary to the report's statement that "it is very hard to identify one specific reason for the slow growth problem and come up with an easy solution on how to fix it but it is clear that there is overstocking", the appellant suggests that it would be logical, based on the evidence of diminished nutrients within the report, that the revocation of all licences post-2000 and the subsequent use of the UISCE carrying capacity model to re-issue a sustainable number of licences on Killary Harbour be implemented.

Non-substantive issues

There were no non-substantive issues in relation to this appeal.

2.5 Minister's Submission

Section 44 Part 2 of the Fisheries (Amendment) Act 1997 states that *'The Minister and each other party except the appellant may make submissions or observations in writing to the Board in relation to the appeal within a period of one month beginning on the day on which a copy of the notice of appeal is sent to that party by the Board and any submissions or observations received by the Board after the expiration of that period shall not be considered by it'*.

The Minister has made no further submissions since the appeals were made.

2.6 Applicant Response

As per Section 44 Part 2 of the Fisheries (Amendment) Act 1997 which states that *'The Minister and each other party except the appellant may make submissions or observations in writing to the Board in relation to the appeal within a period of one month beginning on the day on which a copy of the notice of appeal is sent to that party by the Board and any submissions or observations received by the Board after the expiration of that period shall not be considered by it'*, all licence applicants were given the opportunity to reply in writing to the appeal against the granting of their licences. However, no correspondence was received in this regard.

3 Consideration of Non-Substantive issues

There were no non-substantive issues in relation to this appeal.

4 Oral Hearing Assessment

In line with Section 49 of the Fisheries (Amendment) Act 1997 an oral hearing may be conducted by the ALAB regarding the licence appeals.

An oral hearing has been requested by the appellant and the fee paid within the stipulated time period.

5 Minister's file

In line with the particulars of Section 43 of the Fisheries (Amendment) Act 1997 the following documented items were sent to the ALAB from the Minister:

Copy of Aquaculture Licence Application Form

Copy of Aquaculture licence with maps, charts, co-ordinates and drawings

Copy of Foreshore Licence

Copy of E.I.A. Screening Assessment

Copy of Submission to the Minister

Copy of Notification to Applicant of Minister's Decision

Copy of Advertisement of Minister's Decision

6 Context of the Area

6.1 Physical Description

Killary Harbour is a fjörd-like inlet situated between the county boundaries of Mayo to the north and Galway to the south (see Figure 6.1). It is approximately 15km long and 0.75km wide with an average depth of 15m and an average volume of $4.5 \times 10^9 \text{ m}^3$. A maximum depth of 45m has been recorded at the mouth, which opens out onto the Atlantic Ocean. From the west, the harbour initially runs in a south-easterly direction until it reaches the dogleg or turn, which is located halfway along its overall length, after which it then proceeds in an easterly direction. Its floor has very few rocky outcrops and the main sediment is of soft/fine mud that contains a high organic content. Situated towards the head of the harbour is the village of Leenane, the main population centre in the immediate vicinity. The population in and around Killary and Leenane is approximately 2500.



Figure 6.1 Killary Harbour. Aquaculture licensed areas within the harbour.

The catchment area of Killary Harbour is approximately 250 km^2 and has an extreme Atlantic climate with predominantly S.W. winds and a high rainfall ($2000 \text{ to } 2800 \text{ mm year}^{-1}$). As high mountainous ground surrounds the water body, freshwater runoff is a significant factor in its hydrography. The average freshwater input to the system is $6.0 \text{ m}^3 \text{ s}^{-1}$. Around 90% of this input is contributed by the Bundorragha and Erriff on the Mayo side of the harbour and the Bunowen River on the Galway side. Many streams also discharge into the inlet which account for the remainder of the freshwater input.

As a result, both coastal and brackish estuarine water conditions are found with the water column being stratified or partially mixed and a pronounced halocline can occur between 3 and 10m depths during winter and summer. The halocline is more evident in the Inner Killary; however, it can be quickly broken up when strong winds occur. There is a mean net flow of water out of the harbour, the net flow at the mouth being equal to the freshwater input. Killary Harbour is largely sheltered from wind and wave action making it an ideal area for aquaculture. Predominant prevailing south-westerly winds usually attain wind speeds of force 4-6 for most of the year; however, the surrounding hills and mountains provide shelter thus reducing the force and direction of these winds. The tidal range is 3.7m with currents strongest at the narrow mouth of the inlet with velocities of 50 and 30cm s⁻¹ being attained at depths of 1 and 10m respectively. Hartnett *et al.* (2011) applied a numerical model to 9 Irish bays and estuaries in order to determine basin-averaged residence times and found that in Killary Harbour the residence time was up to 60 days. The system is a net sink of phytoplankton which is imported from the catchment and ocean boundaries. Mussels feed by filter-feeding phytoplankton and other suspended particulate matter from the water column. Results from models on circulation in the harbour (Nunes *et al.*, 2011) suggest a pattern whereby phytoplankton is imported from the ocean by a subsurface boundary, moving upwards into the system and then being exported back to the ocean at the surface. The harbour has relatively uniform current speeds and directions throughout the outer western half due to its relatively even depth and shape. This pattern changes in the inner harbour where currents are variable in both direction and speed due to shallower depths, a back-up of tidal water and stronger influence of freshwater runoff (Costelloe *et al.*, 1998).

Background information on farming process

According to Killary CLAMS report (2002), the mussel farming cycle is as follows:

In early April, farmers in Killary begin checking the water column for the presence of mussel larvae. The larvae are collected by means of plankton nets or pumping water through a sieve. The contents of the sieve or net are then washed into a container and preserved. The samples are then checked under a microscope for the presence of mussel larvae. The growth of the larvae in the water is monitored on a weekly basis as they develop from an early or D-shape stage to a pre-settlement or Eye Spot stage. This whole process takes 4-6 weeks and depends on temperature and food availability. Various methods are employed in Killary for seed collection. Prior to settlement (usually May-early June) farmers deploy material that will provide a surface for the spat or seed to collect on – *i.e.* hairy rope, pergolari and rope, black collector mesh, old fishing net mesh with rope *etc.* Traditionally, the collecting of spat mainly occurs in the Inner Killary where the greatest numbers of larvae are concentrated. If settlement is poor in May and June, farmers usually attempt to collect sufficient seed from a later second settlement that usually occurs in August – September. Each year's mussel spat fall is different. In the past if the spat fall is poor, producers have bought in rock seed from Co. Mayo or Co. Clare. While most of the seed collected is in Inner Killary, in recent years some producers have collected in Outer Killary as spat fall was good there. Typically from August to December farmers uncoil and transfer the collectors from Inner to Middle and Outer Killary.

In July the following year, the droppers can be thinned and the excess mussels are sometimes repacked in a biodegradable cotton mesh sock (pergolari), which is then hung on the longline. Longlines (of 100 to 150m length) with double head rope are suspended from specially made plastic barrels. The plastic barrels have a floatation volume of 210, 300 or 400 litres. It has been proposed, as a condition of the current license renewals, to limit the floatation volume in Killary Harbour to 18,000 litres per hectare. A heavy re-useable dropper rope (8m in length) with the mussels attached is suspended from the double head rope. The reduction in floatation would, in addition to reducing stocking density, decrease the incidence of drop off whereby mussels are lost from the lines due to excessive agitation of droppers in rough weather.

Each producer in Killary may employ different methods of thinning. Some thin the seed collectors by hand – *i.e.* take mussels off droppers thereby thinning and then they either repack the thinned-off seed (or half-grown mussels) into pergolari and rehang on the same longline or at another site in the harbour. If a producer has too much seed, he may just discard the thinned stock. Thinning usually takes place only once. If the seed collection is poor one year or if seed has fallen off the dropper, then thinning is sometimes not carried out. Additionally some producers completely strip the dropper of seed then grade and repack them into pergolari. If thinning of seed mussels is not carried out, the mortality can be over 85% as the ropes can only hold a certain amount or biomass of mussels. This can be even higher in heavy settlement years. The stocking density and mortality of mussels is one of the biggest factors affecting growth rate and production in the harbour (UISCE, 2010). The practice of thinning decreases the mortality and competition for food, increases production and shortens the production cycle which in turn increases the quality of the product as there is less fouling on the shells.

In Killary Harbour, a number of the licensed sites are split in two, with one site being in Inner Killary and the second site in Middle or Outer Killary. Licences were designated in this manner as Inner Killary is best suited for the collection of mussel seed which is then transferred to Middle and Outer Killary for on-growing.

Before the increase in stocking density as a result of the issuing of new licences in 1999/2000, mussels settled during the May-June period (1st Settlement) took typically 18-20 months to reach market size while those settled out in August-September (2nd Settlement) usually took 24 months to attain a similar size. Growing time to market size in Killary in the current licensing regime can now take up to 36 months in some of the areas surrounded by other farms.

Table 6.1 lists the total annual production in tonnes of mussels in suspended culture in Killary Harbour. The licences that are the subject of the current appeal were issued in 1999/2000. As highlighted by the appellant, the increase in the number of licences in the harbour has not resulted in a commensurate increase in annual total production. The peak tonnage was 1394 in 2008. However, a similar tonnage of 1378 was achieved in 1997 prior to the increase in licensed area.

Table 6.1 Annual total production (tonnes) of suspended culture mussels in Killary Harbour (data supplied by BIM Office)

Year	Annual Mussel Production (tonnage)
1996	220
1997	1378
1998	719
1999	836
2000	668
2001	487.6
2002	1196
2003	1249
2004	1179
2005	621
2006	1281
2007	777
2008	1394
2009	1173
2010	1003.5
2011	1147.5
2012	876

Market data

Rope mussels grown in Killary Harbour are produced for both the fresh and the processed market. While prices are better for the fresh market, the harvest is labour intensive as all mussels must be hand graded and trained (mussels that are grown in suspended culture, unlike those in the intertidal zone, have not experienced daily emersion. In order to 'train' them to keep their valves shut on exposure, they are placed in 25kg bags and left on the shore for 5 tidal cycles.). In addition, as the market is only open from December to March/April, there is an increased risk of loss of stock through drop off in storms.

The processed market has a longer harvest period (Sept to March) giving producers a longer time to sell their produce. Mussels can also be harvested more quickly than fresh market mussels. However, due to quality checks by processors and competition with continental markets, there can be a high level of rejection. Longer growth periods, particularly those into a third year in the water, increase fouling on the shells. As a result of this high rejection rate, licence operators with some of the smaller sites would find it very hard to break even, particularly in light of the intense competition for the food resource due to over-stocking.

Table 6.2 lists the market price per tonne of mussels to the fresh market and how it has changed since 1985 (these mussels are of high quality, but the mussels must be cleaned by hand and the Irish market is only open from December to March /April leaving the possibility of loss to storms). The first column shows the year, the second the price quoted; the third the value of €539 in the following years in real terms with the consumer price index taken into account (Cush, 2012). The final column shows the percentage change in real terms over the 12 year period. Table 6.3 lists the

market price for the processed mussels in a similar manner. Prices have decreased because of overseas competition and an increase in mussel rejection as only the best quality is selected for purchase (market is open from Sept to March).

Table 6.2 Historical comparison of market prices per tonne of fresh mussels. 1985 is taken as the base year when commercial mussel production commenced in Killary Harbour (Cush, 2012)

Year	Price €	Value of €539 in real terms	% change in real terms
1985	€539	Base Year	Base Year
1988	€535	€590	↓ 9%
1998	€700	€759	↓ 8%
2002	€850	€897	↓ 5%
2011	€700	€1044	↓ 33%

Table 6.3 Historical comparison of market prices per tonne of processed mussels. 1998 is taken as the base year when processed mussel production commenced in Killary Harbour (Cush, 2012).

Year	Price €	Actual Price € with reject level	Value of €609 in real terms.	% change in real terms
1998	609	590.73	Base year	Base year
2001	760	737.2	701.84	↑ 5.03%
2006	800	656	827.75	↓ 20.7%
2010	560	434	854.61	↓ 49%

Therefore in order to resolve the issue of equitable and beneficial licensing for all licence holders, it is necessary to consider the implementation of suitable measures to achieve the following priorities – the increase in growth rate and product quality and the decrease in growth time to market.

6.2 Resource Users

Aquaculture Activity

Rosroe Salmon Company Ltd. operates in an Atlantic salmon fish farm in Killary Harbour with two cage locations – Inishdeighil at the mouth of the harbour and Rosroe on the southern shore of Outer Killary (see Figure 6.1). At present, salmon are approaching harvest in the Rosroe cages.

There are 33 licences for mussel cultivation in Killary Harbour that are being renewed. 19 of them, including the subject of this report, are under appeal. The remaining 14 licence renewals are not under appeal.

Angling Activity

Delphi Fishery and the Erriff Fishery are two prestigious wild Atlantic salmon angling locations, both within the Killary Harbour catchment area. The Delphi is located on the northern shore of Killary about 10km east of the mouth of the harbour, some 12km from Leenane and 16km from Louisburgh.

The fishery itself consists of the Bundorragha River and Loughs Fin, Doo and Glencullin. The Bundorragha River enters Killary Harbour at Bundorragha Pier. The Erriff is some 14km from the mouth of Killary Harbour 5km from Leenane and approximately 12 miles from Westport. This fishery consists of the River Erriff and Loughs Tawnyard and Derrintin, while two smaller inaccessible loughs Glenawough and Lugacollivee are situated on the upper reaches of the fishery. The Erriff River enters Killary Harbour at Ashleigh Falls.

Tourism

No statistics were available for this specific area; however, Fáilte Ireland statistics reported in 2012 for the year 2010 report approximately 860,000 visitors to County Galway during the year with associated revenue of circa 269 million euros.

Connemara National Park is, according to Fáilte Ireland, one of the top 30 visited attractions in Ireland from 2007 to 2011 with visitor numbers consistently over 110,000 people and over 200,000 visitors in 2011.

Kylemore Abbey and Gardens is one of the top fee-charging attractions in Ireland with over 180,000 visitors in 2008.

Additionally there is much driving tourism throughout Connemara and Galway taking in Killary such as the 'Great Figure of Eight Full Day tour' which includes Galway - Oughterard - Maam Cross - Clifden - Letterfrack - Kylemore - Leenane - Maam - Screeb - Casla - Spiddal - Barna and back to Galway again.

Tourism in the West of Ireland included over one million overseas tourists in 2010, a region particularly popular for European and British visitors. Galway was by far the most visited county, attracting almost 90% of European visitors. Three quarters of visitors to the West of Ireland visited historical attractions, with 45% visiting National Parks, 37% gardens of which Connemara has a very strong cluster and 10% attending festivals and other cultural events. Historical attractions can further be subdivided into historic houses/castles (visited by 67% of respondents), monuments (60%), heritage centres (47%) and museums/art galleries (46%). Activity holidays, especially both on and off road walking, are increasingly popular (The Leenane Mountain Walking Festival takes place in May each year). While a quarter of all overseas tourists visited the West of Ireland, 40% of those engaged on activity breaks visited the region (Connemara Infrastructure and Implementation Plan, Fáilte Ireland, 2012).

Leisure users of the water body and surrounding area

Killary Cruises operate the Connemara Lady from Nancy's Point, Leenane and provide several cruises daily during tourist season along Killary Harbour.

Killary Adventure Company is based in Leenane, Co. Galway and is an outdoor adventure centre with a wide range of outdoor activities centres around Killary Harbour including kayaking, windsurfing, water skiing, speed boat rides and sailing.

Delphi Mountain Resort, Leenane also provides land and water activities such as kayaking on the Killary.

Scubadive West in Lettergesh, Renvyle, Co. Galway operates a diving school in the area and some of its regular dive sites include outer Killary Harbour.

Rosroe Pier in outer Killary is popular with dive clubs throughout the country. Dives including shore dives from Rosroe Pier and boat dives off Inishbearna, Doonee and Inisdegil Mor.

Agricultural Activity

Farming is extensive within the region with mountain pastures grazed by sheep, small numbers of cattle grazing lower slopes and intensive production of grassland and hay. Unlike the greater Connemara region where commonages are widespread, most of the land around Killary is privately owned and this affords some protection from overgrazing. There are approximately 5,000 cattle and 77,000 sheep in the catchment area.

Inshore Fishing Activity

Shrimp

Fishing for shrimp (*Palaemon serratus*) in Killary is carried out at different times of the year (there is a prohibition on all shrimp fishing from 1st May until 1st August in all Irish waters) and involves about 4 skippers. According to BIM's shrimp fishery analysis (Kelly *et al.*, 2008) for the years 2003–2007, the total catch for the year 2007–2008 was 501kg. The fishing gear consists of a cylindrical trap, which is covered with 7.5mm rigid plastic mesh with a conical entrance at either end. These traps are usually baited with fish and left submerged for at least one night before being hauled.

Atlantic Salmon

Draft netting for salmon is an age-old traditional fishery in Killary that dates back to the 1600's. In 2011 the draft net fishery salmon catch in Killary Harbour (including Erriff and Bundorragha) was 377 fish which was 94% of the Total Allowable Catch for (TAC) commercial salmon fishing in that fishery. There were 16 commercial salmon licence holders in the Ballinakill district at that time. Ballinakill District includes Killary, Dawros, Culphin and Owenglin fisheries (Inland Fisheries Ireland, 2011). The Control of Fishing for Salmon Order 2013 (S.I. No. 75 of 2013) sets the maximum number of draft net licences for the commercial fishing of salmon in the Ballinakill district at 16.

Mackerel

Mackerel fishing is seasonal, usually August/September, and consists of 4 boats, operating hand lines. The fishing is primarily for leisure and on average 300 kg is landed per boat. On occasion, very large shoals of mackerel enter the Harbour and they are fished for by the large pelagic tank boats,

which operate out of Rossaveal Port in south Galway. In good years over a 1000 tonnes of mackerel are caught.

Shellfish

Scallop dredging and the hydraulic dredging for clams takes place outside Killary Harbour. Additionally lobster is caught in pots in Outer Killary.

Bait fishing

During the main fishing period, crab and lobster boats net for fish as a source of bait for pots. Fish caught include sand dog, ray, conger, pollack and wrasse.

6.3 Environmental Data

Water Quality

Killary Harbour is a designated shellfish area and must comply with the Shellfish Directive (2006/113/EC) and the Quality of Shellfish Waters Regulations 2006.

The ASSETS model employed by Nunes *et al.* (2011) gives a eutrophication rating for Killary Harbour based on a variety of factors including human and oceanic influence on nutrient inputs, ability to flush and dilute incoming nutrient loads, dissolved oxygen concentrations, phytoplankton concentrations, presence of nuisance/toxic algal blooms *etc.* It considers the new waste water treatment plant will offset any increase in nutrient input due to population increase in the future. ASSETS classified the eutrophication status of Killary harbour as Moderate Low due to the occurrence of nuisance and toxic blooms.

6.4 Statutory Status

6.4.1 Nature Conservation Designations

While Killary Harbour itself does not lie within a candidate Special Area of Conservation (cSAC) the vast majority of its catchment area is contained within 3 extensive cSAC's. Two of these, the Maumturk Complex (cSAC 002008) and the Twelve Bens/Garraun Complex (cSAC 002031) border on its southern side in Co. Galway while the Mweelrea/Sheeffry/Erriff Complex (cSAC 001932) borders on its northern Mayo side.

Table 6.4 Natura 2000 sites in the vicinity of Killary Harbour including their qualifying features.

Natura 2000 site	Qualifying features	Other features of interest
Mweelrea/Sheeffry/Erriff Complex (cSAC 001932)	<i>Vertigo geyeri</i> [1013] <i>Vertigo angustior</i> [1014] Freshwater pearl mussel (<i>Margaritifera margaritifera</i>) [1029] Salmon (<i>Salmo salar</i>) [1106]	Irish Heath (<i>Erica Erigena</i>) <i>Spiranthes romanzoffiana</i> Alpine Saw-wort (<i>Saussurea alpina</i>) Pearson's bazzania (<i>Bazzania pearsonii</i>)

Natura 2000 site	Qualifying features	Other features of interest
	Coastal lagoons [1150] Annual vegetation of drift lines [1210] Atlantic salt meadows (<i>Glaucopuccinellietalia maritimae</i>) [1330] Otter (<i>Lutra lutra</i>) [1355] Petalwort (<i>Petalophyllum ralfsii</i>) [1395] Mediterranean salt meadows (<i>Juncetalia maritimi</i>) [1410] Slender naiad (<i>Najas flexilis</i>) [1833] Embryonic shifting dunes [2110] Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes) [2120] Atlantic decalcified fixed dunes (<i>Calluno-Ulicetea</i>) [2150] Dunes with <i>Salix repens</i> ssp. <i>argentea</i> (<i>Salix arenariae</i>) [2170] Machairs [21A0] Oligotrophic waters containing very few minerals of sandy plains (<i>Littorelletalia uniflorae</i>) [3110] Oligotrophic to mesotrophic standing waters with vegetation of the <i>Littorelletea uniflorae</i> and/or of the <i>Isoëto-Nanojuncetea</i> [3130] Natural dystrophic lakes and ponds [3160] Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitricho-Batrachion</i> vegetation [3260] Northern Atlantic wet heaths with <i>Erica tetralix</i> [4010] European dry heaths [4030] Alpine and Boreal heaths [4060] <i>Juniperus communis</i> formations on heaths or calcareous grasslands [5130] Blanket bog (*active only) [7130] Transition mires and quaking bogs [7140] Depressions on peat substrates of the <i>Rhynchosporion</i> [7150] Petrifying springs with tufa formation (<i>Cratoneurion</i>) [7220] Alkaline fens [7230] Calcareous rocky slopes with chasmophytic vegetation [8210] Siliceous rocky slopes with chasmophytic vegetation [8220]	Carrington's featherwort (<i>Plagiochila carringtonii</i>) Irish Crisp-moss (<i>Oxystegus hibernicus</i>) Knight's plume moss (<i>Ptilium crista-castrensis</i>) Golden bog-moss (<i>Sphagnum pulchrum</i>) Pale Bog-moss (<i>Sphagnum strictum</i>) Holly-fern (<i>Polystichum lonchitis</i>) Narrow-leaved Helleborine (<i>Cephalanthera longifolia</i>) Beaked Tasselweed (<i>Ruppia maritima</i>) Northern lapwing (<i>Vanellus vanellus</i>) Dunlin (<i>Calidris alpina</i>) Irish hare (<i>Lepus timidus hibernicus</i>) Common frog (<i>Rana temporaria</i>) Brown trout (<i>Salmo trutta</i>) <i>Megasternum obscurum</i> Irish Octhebius (<i>Ochthebius punctatus</i>) <i>Palaemonetes varians</i> <i>Sigara stagnalis</i> <i>Neomysis integer</i> <i>Jaera nordmanni</i>
Twelve Bens/Garraun Complex (cSAC 002031)	Freshwater pearl mussel (<i>Margaritifera margaritifera</i>) [1029] Salmon (<i>Salmo salar</i>) [1106] Otter (<i>Lutra lutra</i>) [1355] Slender naiad (<i>Najas flexilis</i>) [1833] Oligotrophic waters containing very few	Pilwort (<i>Pilularia globulifera</i>) Alpine Saw-wort (<i>Saussurea alpina</i>) Heath Cudweed (<i>Omalotheca sylvatica</i>) Parsley Fern (<i>Cryptogramma</i>)

Natura 2000 site	Qualifying features	Other features of interest
	minerals of sandy plains (<i>Littorelletalia uniflorae</i>) [3110] Alpine and Boreal heaths [4060] Blanket bog (*active only) [7130] Depressions on peat substrates of the <i>Rhynchosporion</i> [7150] Siliceous scree of the montane to snow levels (<i>Androsacetalia alpinae</i> and <i>Galeopsietalia ladani</i>) [8110] Calcareous rocky slopes with chasmophytic vegetation [8210] Siliceous rocky slopes with chasmophytic vegetation [8220] Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> in British Isles [91A0]	<i>crispa</i> Corncockle (<i>Agrostemma githago</i>) Marsh Clubmoss (<i>Lycopodiella inundata</i>) Holly-fern (<i>Polystichum lonchitis</i>) Large marsh grasshopper (<i>Stethophyma grossum</i>) <i>Conops vesicularis</i> Flower Fly (<i>Epistrophe nitidicollis</i>) Cranefly (<i>Ctenophora atrata</i>) Arctic Char (<i>Salvelinus alpinus</i>) Irish hare (<i>Lepus timidus hibernicus</i>) Common frog (<i>Rana temporaria</i>)
The Maumturk Complex (cSAC 002008)	Salmon (<i>Salmo salar</i>) [1106] Slender naiad (<i>Najas flexilis</i>) [1833] Oligotrophic waters containing very few minerals of sandy plains (<i>Littorelletalia uniflorae</i>) [3110] Northern Atlantic wet heaths with <i>Erica tetralix</i> [4010] Alpine and Boreal heaths [4060] Blanket bog (*active only) [7130] Depressions on peat substrates of the <i>Rhynchosporion</i> [7150] Siliceous rocky slopes with chasmophytic vegetation [8220]	Slender cottonsedge (<i>Eriophorum gracile</i>) Holly-fern (<i>Polystichum lonchitis</i>) Marsh Clubmoss (<i>Lycopodiella inundata</i>) Wood Bitter-vetch (<i>Vicia orobus</i>) Purple Saxifrage (<i>Saxifraga oppositifolia</i>) Arctic Char (<i>Salvelinus alpinus</i>) Irish hare (<i>Lepus timidus hibernicus</i>) Common frog (<i>Rana temporaria</i>)
West Connacht Coast (cSAC 002998)	Bottlenose dolphin (<i>Tursiops truncatus</i>)	

6.4.2 Protected Species

Cetacean survey records

Bottlenose dolphins are listed in Annex II of the EU Habitats Directive and are protected in Ireland under the Irish Wildlife Acts of 1979 and 2000. To date, only one candidate Special Area of Conservation (cSAC) has been designated for bottlenose dolphins in Irish waters, in the lower Shannon estuary. Bottlenose dolphins are frequently sighted between Killybegs Harbour and Mannin Bay and also extending into the upper reaches of Killybegs Harbour. Ingram's *et al.* (2009) study of bottlenose dolphins in the area concluded that Connemara is clearly used by a large number of animals and the estimate exceeds all previous estimates of the number of bottlenose dolphins using the lower Shannon SAC. In 2012 the Minister for Arts, Heritage and the Gaeltacht, Jimmy Deenihan TD, proposed the designation of the area as the West Connacht Coast cSAC to protect this large

population. Table 6.5 lists the cetacean species recorded by the Irish Whale and Dolphin Group for the last ten years within the vicinity of Killary Harbour. Most of the records are for bottlenose dolphins but there are records of harbour porpoise also and sightings of Risso's dolphins off Inishboffin.

Table 6.5 List of cetacean species recorded by the Irish Whale and Dolphin Group for the last ten years within the vicinity of Killary harbour. Results were obtained from the IWDG website www.iwdg.ie

Date	Species	Animals	Location	Latitude	Longitude
20/06/2012	Bottlenose Dolphin	6	Killary Harbour, Galway	53.632	-9.884
18/06/2012	Bottlenose Dolphin	12	Killary Harbour, Galway	53.625	-9.906
24/04/2011	Dolphin species	2	Killary Harbour, Galway	53.626	-9.864
09/05/2010	Bottlenose Dolphin	2	Killary Harbour, Galway	53.627	-9.867
18/04/2010	Bottlenose Dolphin	4	Killary Bay, Mayo	53.631	-9.927
17/04/2010	Bottlenose Dolphin	3	Killary Harbour, Galway	53.621	-9.868
23/08/2009	Bottlenose Dolphin	15	Killary Harbour, Galway	53.63	-9.879
12/08/2009	Bottlenose Dolphin	15	Killary Bay, Mayo	53.623	-9.911
12/08/2009	Bottlenose Dolphin	2	Killary Harbour, Galway	53.63	-9.903
24/06/2009	Bottlenose Dolphin	10	Killary Harbour, Galway	53.65	-9.916
22/06/2009	Bottlenose Dolphin	16	Killary Bay, Mayo	53.626	-9.8627
20/08/2008	Dolphin species possibly Harbour Porpoise	3	Killary Harbour, Galway	53.625	-9.95
18/05/2008	Bottlenose Dolphin	1	Killary Harbour, Galway	53.636	-9.895
29/06/2007	Dolphin species	3	Killary Harbour, Galway	53.604	-9.923
09/07/2007	Bottlenose Dolphin	15	Killary Bay, Mayo	53.626	-9.8653
24/06/2005	Bottlenose Dolphin	14	Killary Harbour, Galway	53.6241	-9.8876
16/06/2005	Bottlenose Dolphin	1	Killary Harbour, Galway	53.63	-9.889
09/08/2004	Bottlenose Dolphin	10	Killary Bay, Mayo	53.6333	-9.9167
17/05/2004	Bottlenose Dolphin	6	Killary Bay, Mayo	53.625	-9.95
07/04/2004	Dolphin species	10	Killary Harbour, Galway	53.6333	-9.95
05/09/2003	Common Dolphin	60	Killary Harbour, Galway	53.6333	-10

Seals

Inishshark and Inishgort are two important breeding sites for Grey seals in the area. Both islands are located to the west of Inishboffin. Other records include Killary Harbour and Inishboffin. Harbour seals are recorded from Mannin Bay, Ballinakill Harbour and Roonagh Quay, Co. Mayo.

Otters

The otter (*Lutra lutra*) is protected under the Irish Wildlife Acts (1976 & 2000) and is also listed on Annexes II and IV of the EU Habitats Directive. Both The Twelve Bens/Garraun Complex (SAC No.

2031) and Mweelrea/Sheeffry/Erriff Complex (SAC No. 1932) are designated for otters which breed in both of the SACs.

Atlantic Salmon

The Atlantic salmon (*Salmo salar*) is a species listed in Annex (II) of the Habitats. As previously outlined, Delphi Fishery and the Erriff Fishery are two prestigious wild Atlantic salmon angling locations, both within the Killary Harbour catchment area. Salmon are found in rivers in each of the three cSACs in the area. It is important to note that Atlantic Salmon play an important part in the life cycle of another protected species in the catchment area – the pearl mussel. Juvenile salmon act as a host to the mussel larvae known as glochidia. The glochidia attach themselves to the gills of the salmon from June to September and remain in this oxygenated environment until the following spring when they drop off and settle to the river bed.

Pearl Mussel

The freshwater pearl mussel (*Margaritifera margaritifera*) is a highly threatened animal, recently categorised as critically endangered across Europe. Owing to its threatened status and dramatic decline, the freshwater pearl mussel is listed on Annex II and Annex V of the Habitats Directive. The status of the species across the EU was assessed in 2007 and found to be bad throughout. In Ireland, all populations of the species were considered unfavourable bad. The main cause of the poor status and the ongoing decline of the species across Ireland and Europe is sedimentation and enrichment (eutrophication) of its habitat (www.npws.ie). Pearl mussels are found in the Dawros and Bundorragha rivers of the Twelve Bens/Garraun cSAC Complex and the Mweelrea/Sheeffry/Erriff cSAC Complex respectively.

6.4.3 Statutory plans

Killary Harbour does not appear to be included in any Local Area Plan, either in County Galway or County Mayo. Galway County Development Plan 2009-2015 does not contain any specific references to the Killary harbour area other than a plan to improve the N59 road through Leenane. Mayo County Development Plan Draft 2014 – 2020 specifies the creation of a Greenway from Croagh Patrick, Co. Mayo to Leenane via Louisburgh as a Priority infrastructure Project

6.4.4 Water Quality Status

Killary Harbour is a designated shellfish area, with the area covering 9.9 km² and running the entire length of the Harbour, from the high water mark at Ashleigh at the head to Dooneen at the mouth of the harbour, which opens to the Atlantic Ocean.

Article 5 of the Shellfish Directive (2006/113/EC) and section 6 of the Quality of Shellfish Waters Regulations (S.I. No. 268 of 2006) require the development of Pollution Reduction Programmes

(PRPs) for designated shellfish areas in order to support shellfish life and growth and to contribute to the high quality of directly edible shellfish products. Shellfish PRPs relate to bivalve and gastropod molluscs, including oysters, mussels, cockles, scallops and clams.

Waterbodies designated as shellfish areas are strictly monitored for pH, temperature, colouration after filtration, suspended solids, salinity, dissolved oxygen, petroleum hydrocarbons, organohalogenated substances, dissolved metals, faecal coliforms, substances affecting the taste of shellfish and saxitoxin (produced by dinoflagellates).

The 2009 classification of shellfish production areas in Ireland classified Killary Harbour bivalve production as 'Class B' for the purposes of EC Regulation 854/2004. Monitoring of shellfish flesh for food hygiene purposes indicated faecal contamination in this shellfish area. A 'Class B' classification indicates that the shellfish harvested must be depurated, heat treated or relayed to meet a 'Class A' requirements ('A' indicates shellfish may go directly for human consumption). The code of practice allows for seasonal classification to be given in areas where the data shows a clear seasonal trend in *E. coli* levels over the three year period (www.sfpa.ie).

The Leenane waste water treatment plant, which was constructed in 2010, discharges treated effluent into a local stream which flow into Killary Harbour approximately 240m downstream.

In addition, according to the Shellfish Pollution Reduction Characterisation Report for Killary Harbour (2010), there are 530 systems in the contributing catchment and their density is slightly higher than the national average. The risk to surface and groundwater from pathogens and phosphorus is also high throughout the catchment as is the likelihood of inadequate percolation. The majority of the systems are therefore located in hydrologically unsuitable conditions. Most of them are located in the coastal region of the catchment, many in the direct vicinity of the shellfish area. Therefore, it is likely that a substantially smaller number than the total number of systems in the catchment are posing a risk to surface and groundwater. Shellfish monitoring indicates the possibility of faecal contamination in this shellfish area. These systems could possibly be affecting shellfish water quality in this shellfish area.

Approximately 40% of the area of this catchment is farmed land. Estimates of livestock density and fertiliser usage are much lower than the national averages. The prevalence of wet soil types in the catchment and the high slopes means that there is a potential risk of agricultural runoff in the catchment. Agriculture is a possible source of the faecal contamination indicated by shellfish monitoring and therefore, agriculture could possibly be affecting shellfish water quality in this shellfish area.

Ecological water quality status

In terms of ecological status, as defined under the Water Framework Directive, Killary Harbour has been assigned a 'Moderate Status'. This status is attached to Killary harbour based on the monitoring of benthic invertebrates which were still in recovery following an exceptional phytoplankton bloom (of the dinoflagellate *Karenia mikimotoi*) during the summer of 2005 which resulted in a substantial elimination of certain benthic communities along the western seaboard

(Silke *et al.*, 2005). Recovery from this event has yet to show up in the WFD classification (Integrated Water Quality Report. EPA, 2011).

The Erriff Estuary is considered to be a Transitional water body with a WFD ecological status of 'High'. Table 6.6 lists the WFD status assigned to waterbodies within the area (Data from the EPA ENVISION website <http://gis.epa.ie/Envision/> accessed 29/05/2013).

Table 6.6 Water Framework Directive ecological status and ecological risk score for waterbodies in the vicinity of Killary harbour.

Waterbody Type	Location	WFD status	WFD risk score
Coastal Water	Killary Harbour	Moderate	2b
Transitional Water	Erriff Estuary	High	2b
Rivers	Erriff	Good	2a
	Glendavock/Erriff	Good	2a
	Bundorragh	Good	1b
	Bundorragh/Owenaglogh	Not monitored	1a
	Glennumera /Bundorragh	High	1a
	Bunowen	Pass	2a
Lakes	Lough Doo	Good	2b
	Tawnyard Lough	Not monitored	2b
	Fin Lough	Not monitored	2a

The Ecological risk status for water bodies categories as listed in Table 6.6 above are as follows:

- 1a – at risk of not achieving a 'Good' status
- 1b – possibly at risk of not achieving a 'Good' status
- 2a – expected to achieve a 'Good' status
- 2b – strongly expected to achieve a 'Good' status

Bathing water quality

There are no specific bathing areas within Killary Harbour. The nearest beaches for bathing are Lettergesh beach, Renvyle beach in Co. Galway and Silver Strand, Doovila Beach, Co. Mayo. Blue Flag designated beaches (as of 2013) are not located in the vicinity of Killary Harbour. There are Blue Flag beaches both in Galway and Mayo with the closest being at Carrowmore near Louisburgh, and Bertra Strand in Westport Harbour Co. Mayo.

6.5 Man-made heritage

According to the 'Archaeological Survey of Ireland', there are numerous site of archaeological interest located around Killary Harbour including settlements, cairns and megalithic tombs, holy wells, churches, mass rocks, forts, promontory forts, and graveyards. There are no features of archaeological interest recorded for Killary Harbour itself. The Department of Arts, Heritage and the Gaeltacht (DAHG) raised no objections to the development from an underwater archaeological perspective.

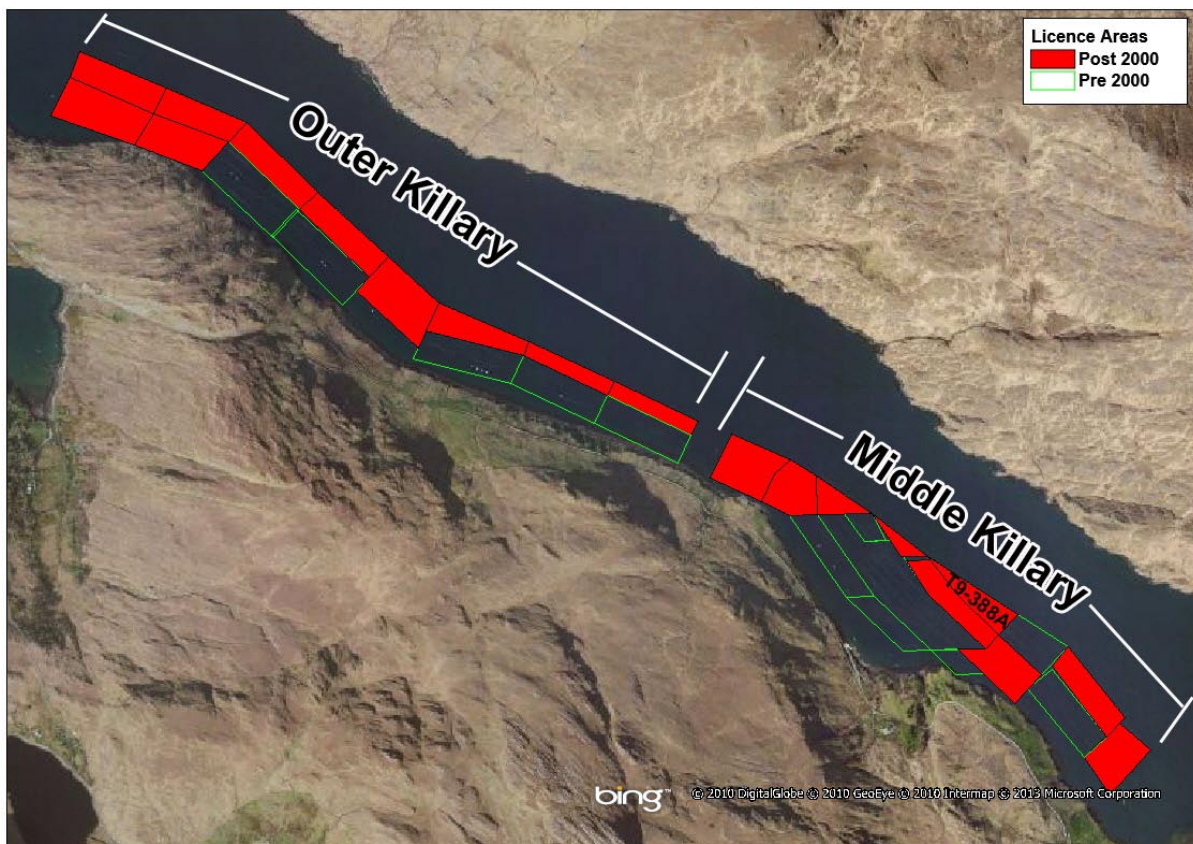
7 Section 61 Assessment

7.1 Site Suitability

The sites under appeal have been licensed since 1999/2000. Although they have been successfully producing mussels for market, the current appeal cites over-licensing and overstocking of Killary Harbour as having a detrimental effect on mussel production and the availability of phytoplankton food in the harbour. The T9/388 licence is split between two locations, one in Middle Killary (388A) and one in Inner Killary (388B). Licences were designated in this manner as Inner Killary is best suited for the collection of mussel seed which is then transferred to Middle and Outer Killary for ongrowing. Figure 7.1 shows the location of the site under appeal (T9/388A) in Middle Killary and Figure 7.2 shows the location of the site under appeal (T9/388B) in Inner Killary. The 388A site covers an area of 2.19Ha and the 388B site covers an area of 1Ha.

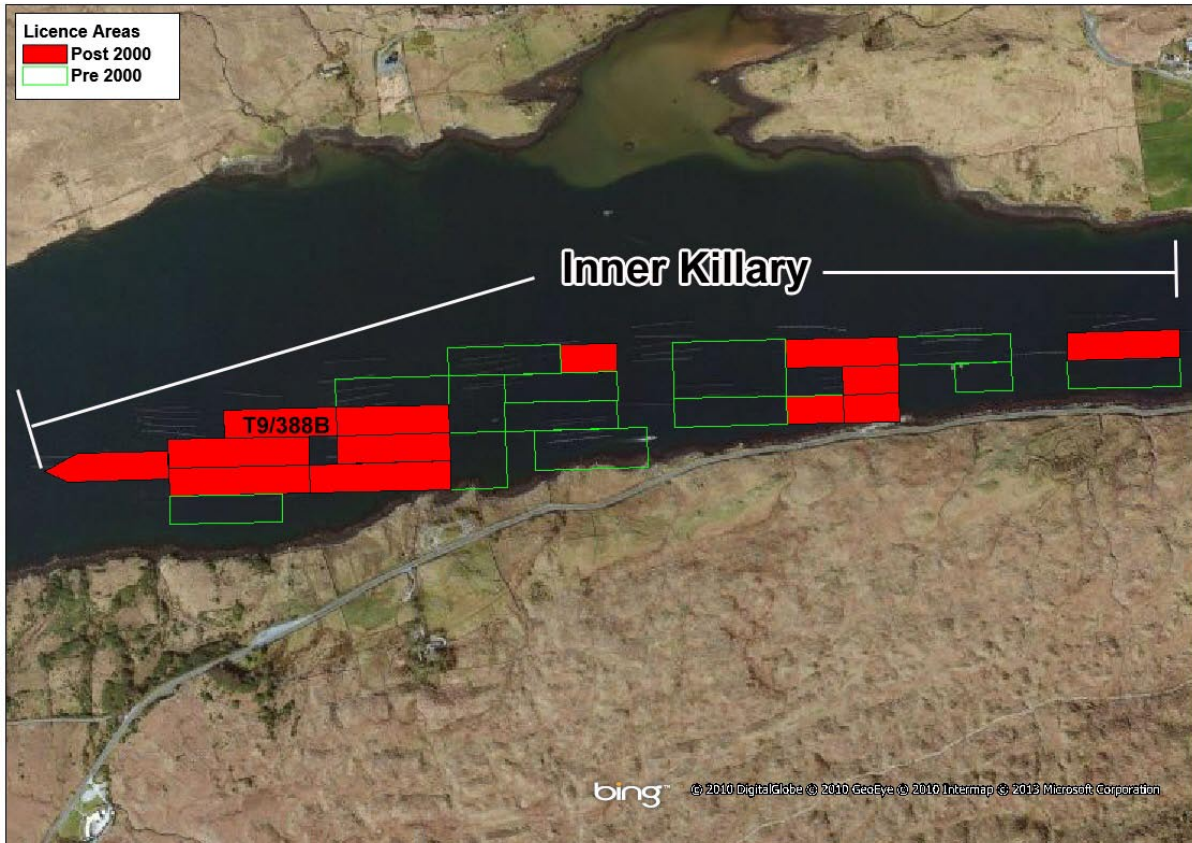
Inland Fisheries Ireland, during the statutory consultation phase prior to granting the licences by the Minister, raised concerns about the excessive number of licences issued resulting in decreased growth rates being achieved in the harbour. It called on the Department to commission a new study to ascertain the correct carrying capacity of the harbour in terms of annual production that the harbour can sustain and to licence the correct number of operators and tonnage accordingly.

Figure 7.1 Location of the Licence Renewal Site (T9/388A) under appeal in Middle Killary. The sites in red which are those sites under appeal which were granted licences post 2000 and those outlined in green are the sites of the appellants and other mussel farmers who held licences before 2000.



An Taisce raised a number of concerns in respect of general issues relating to aquaculture operations in Killary Harbour including ecological issues, carrying capacity studies, benthic impacts and indirect effects to birds. As part of the Environmental Impact Assessment pre-screening process, all environmental issues, including those referred to above were considered and screened out.

Figure 7.2 Location of the Licence Renewal Site (T9/388B) under appeal in Inner Killary. The sites in red which are those sites under appeal were granted licences post 2000 and those outlined in green are the sites of the appellant and other mussel farmers who held licences before 2000.



7.1.1 Previous Assessment of Licensing Issues in Killary Harbour

A number of studies were commissioned and discussions held in order to try to solve the problem of over-licensing, over-stocking and poor mussel production rates in Killary Harbour. They are as follows:

1. UISCE (Understanding Irish Shellfish Culture Environments) 2010 carrying capacity study
2. Engineer's report on a proposed new layout of mussel lines in Killary Harbour (Keady, 2005)
3. Engineer's report on a survey of mussel lines in Killary Harbour in 2009 (Forde, 2009)
4. Nunes *et al.*, 2011
5. CLAMS Group Plans 2008-2009.

7.1.1.1 UISCE Report

BIM was commissioned by the Department of Agriculture, Fisheries and Food to carry out the UISCE (Understanding Irish Shellfish Culture Environments) project with respect to carrying capacity and

aquaculture and water quality scenarios in several bays in Ireland including Killy Harbour. The report highlighted the problems of over-licensing and longline positioning in the harbour.

In order to accurately represent the current mussel production regime within Killy Harbour and to develop management scenarios with the potential to improve the production, growth time and quality of mussels grown in the harbour it was necessary to quantify numerous parameters such as hydrological conditions, availability of food, culture practice, stocking density etc.

Figure 7.3 illustrates the UISCE model tidal simulation for the Killy Harbour demonstrating the regions with the strongest flow. The harbour has relatively uniform current speeds and directions throughout the outer western half due to its relatively even depth and shape. This pattern changes in the inner harbour where currents are variable in both direction and speed due to shallower depths, a back-up of tidal water and stronger influence of freshwater runoff (Costelloe *et al.*, 1998). Figures 7.4 and 7.5 show the outputs from the UISCE model for and ebb and flood tidal flow in Middle Killy respectively and clearly illustrate areas of reduced flow when compared to the main channel.

Figure 7.6 is a chlorophyll map with simulated spatial variation of chlorophyll throughout the harbour. Mussels feed by filter-feeding phytoplankton and other suspended particulate matter. As chlorophyll is found in phytoplankton, a measurement of the concentration of chlorophyll will give a good indication as to how much food is available. In conjunction with the hydrodynamic models, this can predict the best areas within the harbour for potential growth (UISCE, 2010). Figure 7.7 illustrates the growth potential prediction from the UISCE ShellSIM model based on the conditions if there were no farms in the harbour. It clearly shows that prior to the granting of additional licences in 1999/2000, the areas in Middle Killy were ideally suited for good growth potential. However, this is no longer the case and licensed sites (particularly in the sites closer to the shore) are now showing poor growth potential.

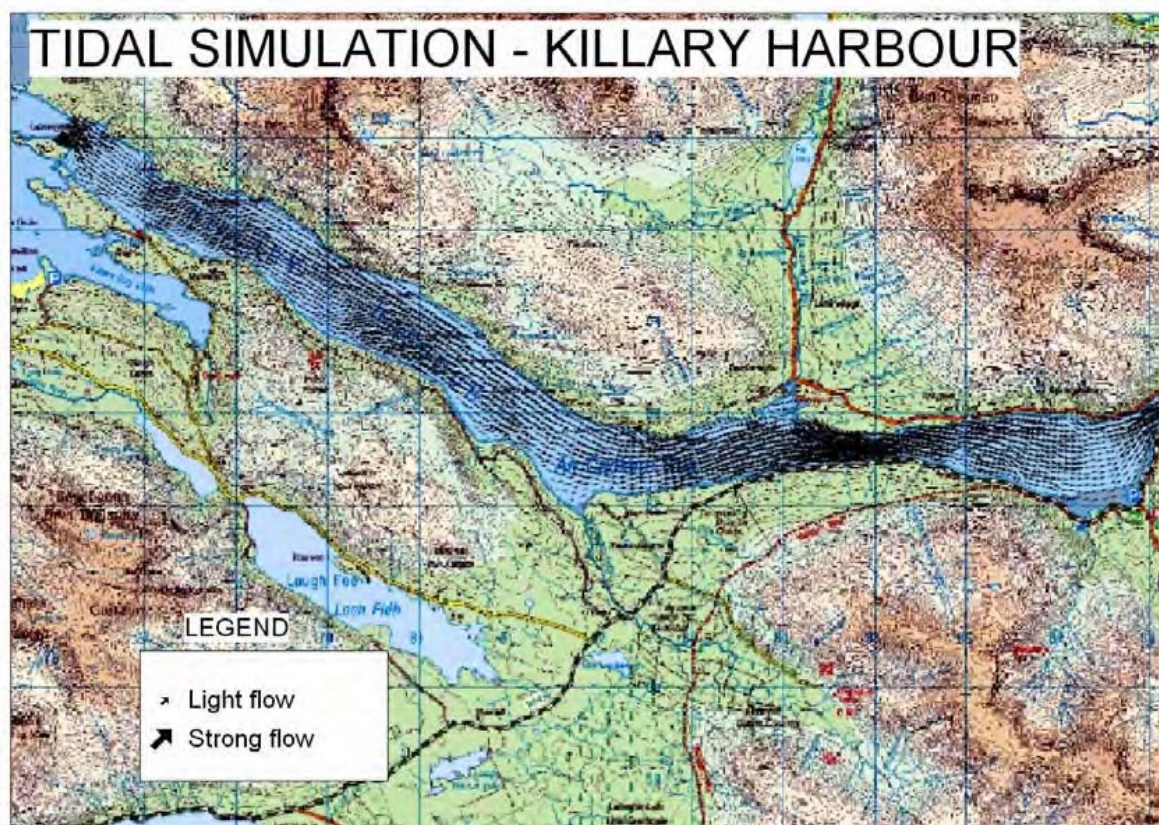


Figure 7.3 UISCE hydrodynamic model total flow simulation for the whole harbour (UISCE, 2010)

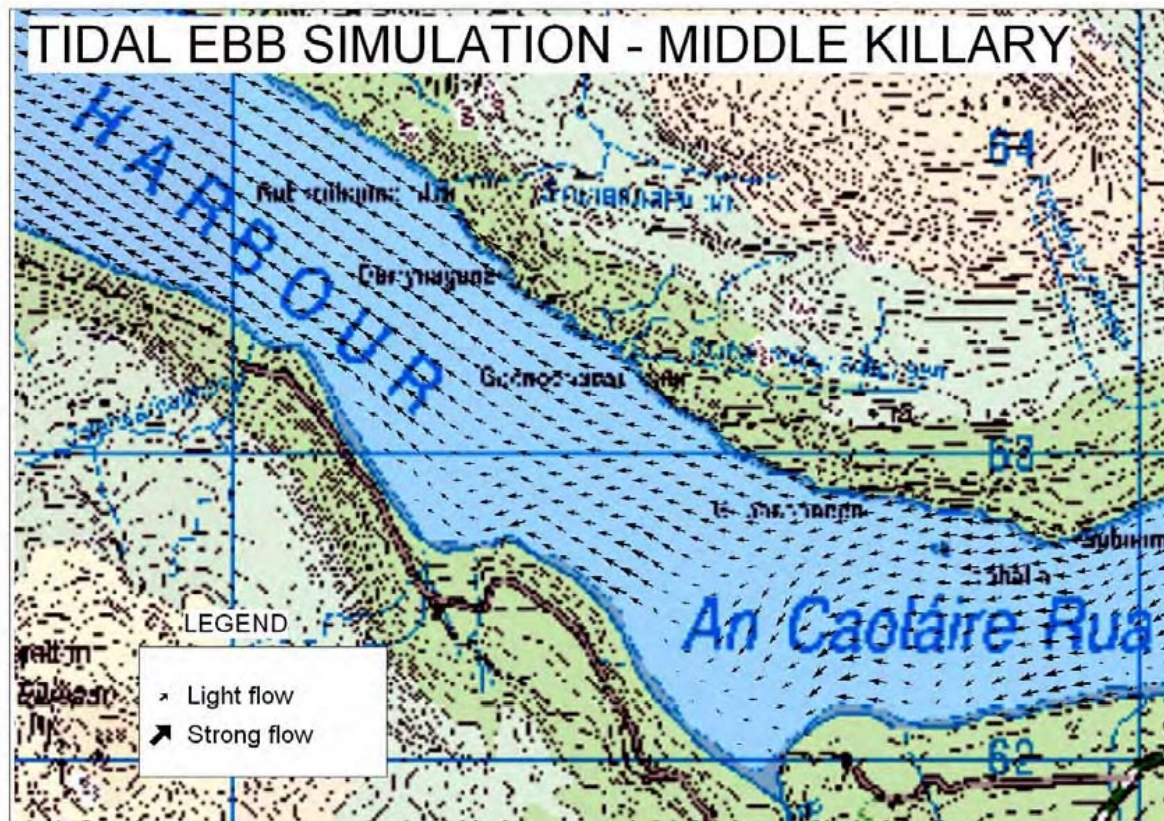


Figure 7.4 UISCE hydrodynamic model for an ebb flow in Middle Kill (UISCE, 2010)

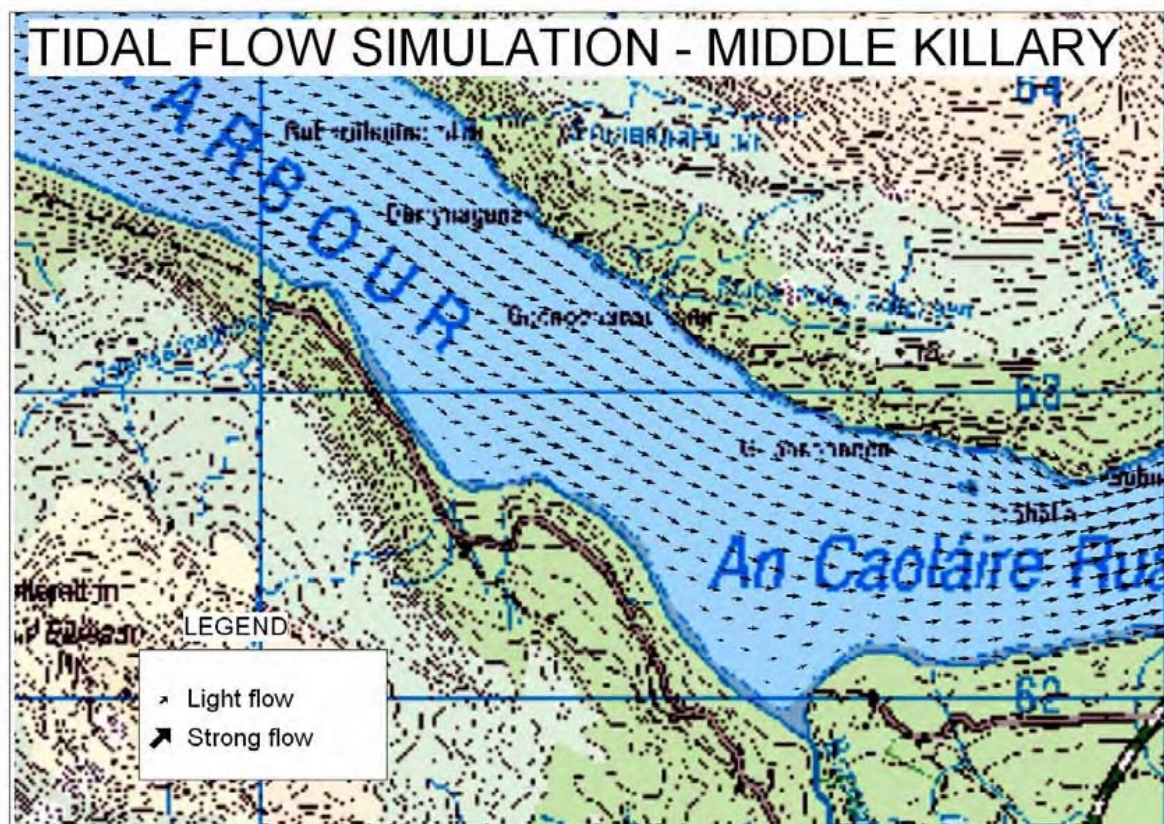


Figure 7.5 UISCE hydrodynamic model for the flood tidal flow for Middle Killary (UISCE, 2010)

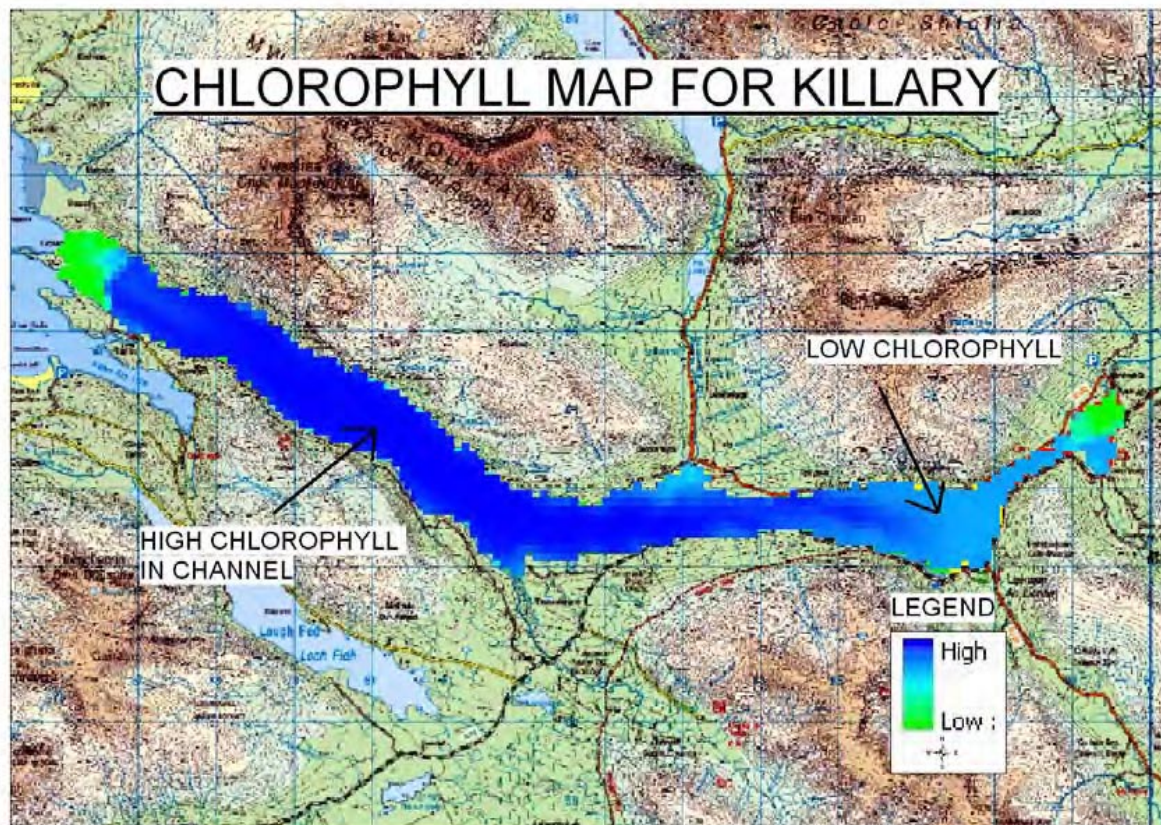


Figure 7.6 UISCE model of the chlorophyll distribution in the Killary Harbour (UISCE, 2010).

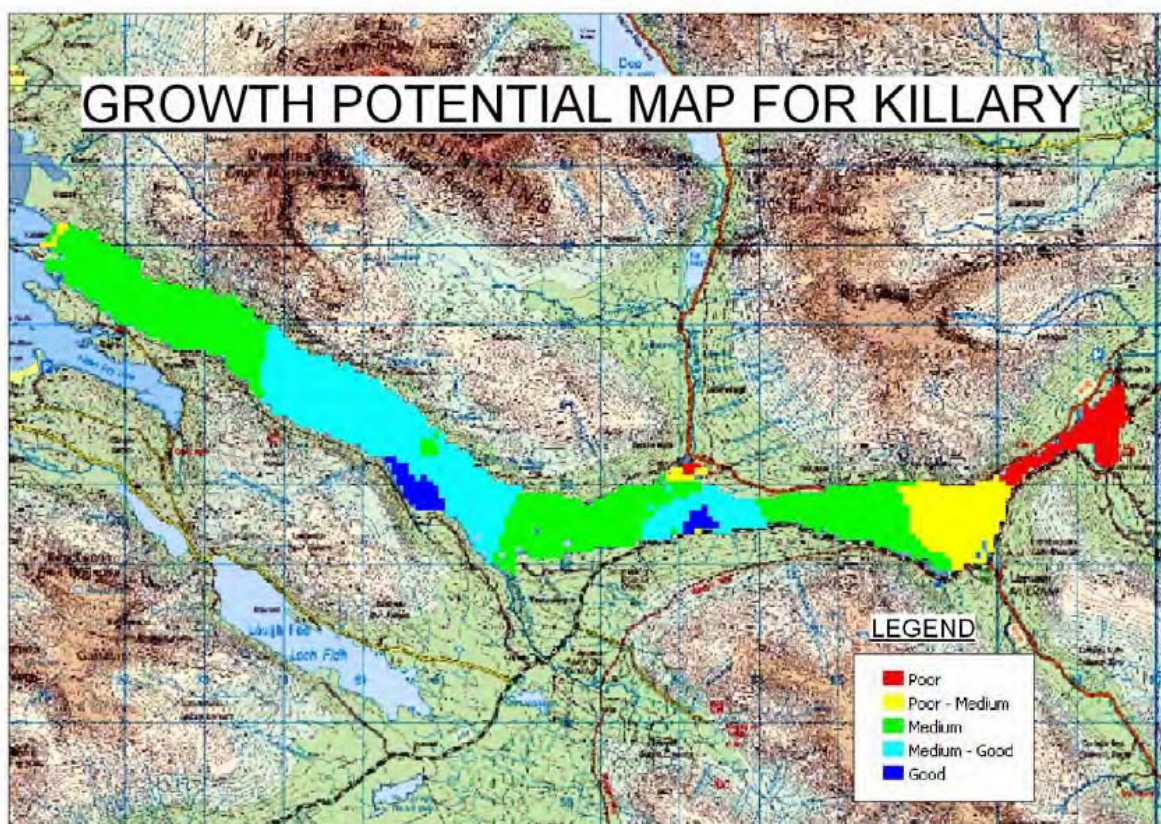


Figure 7.7 ShellSIM prediction for areas of growth potential in an 'empty' Killary Harbour (UISCE, 2010)

Table 7.1 lists the stock and harvest in Killary Harbour as surveyed during the project. Farms in other bays have a harvest production per hectare from 10.6t for areas that do not thin to 16 to 24t/ha for areas that practice thinning (see section 6.1 above) (UISCE, 2010). As the figures show, the average harvest in the harbour is 12.1 tonnes per hectare. It is also apparent that some areas have better growing conditions than other areas in the harbour. However, it is important to note that these average production figures do not illustrate the growing conditions in the sites closer to the shore which are surrounded by other farms as compared to those in the channel with better access to food. These farms have less access to phytoplankton than those sites in the channel as the food source has been substantially depleted by the concentration and arrangement of mussel longlines in these outer sites.

Table 7.1 Average stock and harvest of suspended culture mussels (tonnes per hectare) (2009/2010) (UISCE report).

	Av Tot. Stock/Ha	Av. Harvest/Ha
Outer Killary	24	13.7
Middle Killary	19.2	11.8
Inner Killary	24.8	9.2
Average	22.4	12.1

The recommendations of the UISCE report are as follows:

- Reduction of the total floatation within Killary Harbour to 18,000 litres/hectare (which is equivalent to a reduction of 15% in the floatation). The current floatation within Killary is almost twice as much as is required to hold current stocks. Much mussel drop-off is caused by an excess of floatation. UISCE states that the 18000 l/ha figure is an overestimate of the floatation necessary. It reports that only 10360 l/ha would be conservatively needed given the existing potential stock (surveyed tonnage plus calculated tonnage that would be present if empty lines were filled at present stocking capacity) of 2869 tonnes per annum. Some of the farms in Middle Killary have (since 2007) have already reduced their floatation and are currently 27.6% lower than they would be at 18000 l/ha. However, as there has been no corresponding reduction in Outer and Inner Killary there has not been a significant change in production and growth rates. Nearly all other growing areas in the country operate at or below the limit of 18,000 l/ha.
- In addition to that, UISCE recommended that the number of droppers should be reduced to 800/ha. This would mean a reduction of 15% of droppers in Outer Killary and 34% in Inner Killary. Some farms in Middle Killary, the area worst affected by overstocking, have already reduced their droppers to 24% less than 800/ha.
- Move all longlines and anchors to within the licensed area. The reduction in floatation and droppers is essential when anchors and lines are moved within the licensed sites, otherwise the relative densities within the site will increase which could lead to further growth rate and production problems.
- Implement the practice of thinning throughout all licensed sites in Killary. Without thinning, mortality is generally in the range of 80–95% (with mortality at the higher end of the range

when there is higher settlement of seed), whereas with thinning mortality can be reduced to 25–40%. Mussels that die and/or drop off have been feeding and taking up space and thereby increasing the competition for food.

- Improve methods of seed collection as the correct amount of seed/m² means less mortality. New methods employed in Ardgroom are achieving this. Rather than leave all mussel seed on lines as they have settled until harvest, seed should be thinned and re-rope at the optimal density. Thinning and improved seed collection improves the growth rate of mussels. In Roaringwater Bay, the method of seed collection is as follows: 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. When seed is ready to transplant to on-growing areas, the collectors are harvested from the water, mechanically stripped and fed through a de-clumping machine and sometimes a grader on board the boat. The seed is then re-packed at lower stocking densities onto on-growing rope and deployed. (Some of the producers in Killary are currently employing some of these improved methods).
- As the conditions for mussel growth are worse in Middle Killary (due to competition for food), in particular for those sites located closer to the shore, UISCE recommends that a reconfiguring of all licence sites should be considered.
- A monitoring programme in respect of growth rates and production should be established to monitor the outcome of changes made.

Of the above recommendations, only the proposal to limit the floatation to 18000 l/ha (a reduction of 15% to be phased in over three years by about 5% each year) and the stipulation that all structures including anchors be placed with the licensing area were recommended as a solution to the problems of over-stocking and over-licensing in Killary Harbour. As this was to be applied to all farms equally, it does not address the fact that some farms located in inner shore sites will not have equal access to the phytoplankton food source.

7.1.1.2 Engineering Report (Keady, 2005)

A 2005 engineering report highlighted the problem with previous licence conditions in that it did not specify how lines should be arranged within a licensed site nor did the size of the site take into account the anchors that could be 25–40m away from the end of mussel lines. It specified 3 longlines per hectare which resulted in lines squeezed together to fit in areas, which in turn affects the flow of water and the availability of food. In addition, many of the lines and anchors were not within the designated licensed area.

Report Recommendations:

- Densities of mussel lines to be reduced in Killary to:
 - (1) 3 lines per 1.5 hectares for 100m lines
 - (2) 3 lines per 2.5 hectares for 150m lines
 - (3) 3 lines per 3 hectares for 200m lines

This should allow for a minimum 25m spacing between each line within a site (with anchors) and 25m between the outer line and the adjacent boundary which would ensure 50m

between lines on different sites and this will increase the flow of water. Dampers should be placed on anchor lines to ensure drag rather than lift in heavy swell.

- Some of the licence boundaries should be redrawn to accommodate the new lines as the dimensions of the existing licensed areas are not sufficient for optimum layout.
- All lines and anchors to be within the licensed site.
- These proposals were to follow what the engineer presumed the licence conditions originally intended. The engineer stated that if the UISCE report suggested reducing the densities further then that should be carried out when issuing new licences.

7.1.1.3 Engineering Report (Forde, 2009)

A survey of all mussels farm structures in Killary carried out in Sept/Oct 2009 indicated that the situation with regard to longline locations had not changed since the 2005 report with large numbers of lines located outside their licence sites (with many of them squeezed together rather than 25m apart) and lines in adjacent sites often very close to each other.

Report Recommendations:

- That the original 2005 recommendations still stood as production rates in Killary are only half the production rate of what it is in other bays.
- That a solution be achieved through discussions between CLAMS, operators and BIM.

The recommendations by the Engineers' reports to implement a strict lay out which would result in 50m space between adjacent farms is borne out by results from the Flow-3D model within the UISCE report. This model simulates a series of conditions in relation to water flow and phytoplankton availability through longline structures in Killary (including increase/decrease in stocking density and change in orientation to tidal flow for the longlines). Results from the model indicate that the orientation of the lines (approximately 0° to water flow) is fairly optimal and that changing the angle of orientation would not improve growth. When examining the buffer zone though (*i.e.* how far after the water has flown through a mussel line will it be before the food levels return to near what they were before entering the line) in general, within Killary, after 50m there is a 90% recovery and after 100 to 150m there nearly a 95% recovery in phytoplankton concentrations.

7.1.1.4 Nunes et al., 2011 (*Towards an ecosystem approach to aquaculture: Assessment of sustainable shellfish cultivation at different scales of space, time and complexity*)

This research paper on Killary Harbour is on the assessment of sustainable shellfish cultivation at different scales of space, time and complexity. It was based on the UISCE project. Its results indicated that:

- (1) The system's eutrophication status was classified as Moderate Low with a future trend of No Change
- (2) There is a large influence of ocean boundary conditions on shellfish food resources in the system
- (3) The maximum mussel production of the system is 4200 tonnes/year but that achieving this level would lead to lower harvest weights and longer growth cycles
- (4) A scenario of lower stocking densities proposed for the system should lead to lower productions, but could result in benefits such as higher mussel weight at harvest and/or shorter growth cycles.

Carrying capacity

Production carrying capacity – The absolute maximum long term yield that can be produced within a region (4200 tonnes/year, see below).

Ecological carrying capacity – The yield that can be produce without leading to significant changes to ecological processes, species, population or communities (estimated by Rodhouse & Roden (1987) 3000 tonnes/year, see below).

Economic carrying capacity – The biomass that investors are willing to establish and maintain.

Social carrying capacity – The biomass/water space of culture that the community will allow. (Gibbs, 2009).

Nunes *et al.* (2011) considered several different stocking densities and applied their combined carrying capacity models to each scenario. In doing so they considered the projected final harvest (the Total Physical Product (TPP)) and the productivity (the Average Physical Product (APP) which is the ratio between harvested biomass (output) and seeded weight (input)).

As stocking density increased, there was an increase in TPP, but with smaller gains per increase, illustrated by the decrease in productivity (APP) as an increase in shellfish led to a greater competition for food resources in the system. As stocking density increased beyond a certain threshold (7.5 x current density), this competition became large enough to prevent an increase in TPP.

The models also showed that an increase in stocking density and competition for food led to slower growth rates, with a stocking density above 7.5 times current values preventing mussels from reaching a harvestable weight in 27 months thus requiring longer growing cycles and an extra generation of mussels in the harbour. However, this does not take into account that growers might prefer a lower TPP with larger individual mussel weight (more marketable) or shorter growth cycles (reducing possibility of losses due to storms or fouling).

For decreasing stocking density (0.53 times current density – a scenario being considered by growers when paper went to press), the model predicted a decrease in TPP (-39%) but with an increase in

APP (15%) and an increase in individual mussel weight (20%). The increase in mussel weight would bring added value for growers by virtue of increase in sale price or alternatively, the possibility of shorter growth cycles if mussels are harvested at the same weight as current practices.

Nunes *et al.* (2011) also looked at extreme stocking densities (2 to 20 times current stocking densities) and predicted that the maximum predicted TPP was 26.6 tonnes ha⁻¹ year⁻¹, 2.3 times current values which led to a maximum production of 4200 ton year⁻¹. This would be considered the production carrying capacity (see above). Rodhouse & Roden (1987) predicted that at a level of 3000 tonnes year⁻¹, the mussel production would begin to have a significant impact on ecological processes in the harbour such as increased sedimentation and changes in the nitrogen cycle within the water body. This is similar to the ecological carrying capacity (see above). According to the UISCE report, based on the existing potential stock, if the Killary Harbour growers were to reduce their floatation within the harbour to 18,000 l/ha, then the potential tonnage capable of being supported by longlines in the harbour was predicted to be 4,966 tonnes year⁻¹; higher than the predicted maximum of 4200 tonnes year⁻¹, above which competition for food would become large enough to prevent an increase in TPP.

A scenario whereby a suitable stocking density is selected, the growth period is reduced and quality and weight of the final produce is increased, is obviously desirable. The proposed reduction in floatation by 5% per year over three years is not sufficient to deliver these results.

It would seem in this instance that this scenario (as conditions of the current licence renewals) considers Killary Harbour as a whole and does not consider the growing conditions of the sites located towards the shore inside of, or surrounded by, other farms. Currently, some of the licensed sites on the outside near the channel are very productive. The proposed phased 15% reduction in floatation in conjunction with the movement of all anchors and lines within the licensed area would seem to be less than the minimum action recommended in the UISCE and engineers reports. It is unlikely to increase production in all sites, it will benefit some sites over others, it will not allow an equitable access to phytoplankton and many of the farms on the inner near shore sites will find operation unsustainable.

7.1.1.5 Killary CLAMS Group

In 2008-2009 the Killary CLAMS Group decided after discussions to draw up plans to improve the management of Killary for the mussel growers. The main details of the plan are as follows:

- (1) All anchor blocks are to be placed within the boundaries of the licence.
- (2) The length of a longline (on the surface) is limited to 220m per hectare. Typically with two lines of 110m per hectare. However, it is up to the producer to decide whether two 110m lines or four 55 m lines is preferred). From a visual perspective, two 110m lines parallel to the shore was the preferred option.
- (3) The total number of droppers that can be hung on a 110m longline is 400; therefore the maximum number of droppers per hectare is limited to 800. These droppers are limited to 8m in length (information from BIM).

As the CLAMS process is a non-statutory management system, the implementation of the above CLAMS plan was a voluntary process that some of the producers agreed to do. Not all of the producers agreed to this plan however.

7.1.1.6 Summary of main recommendations of previous studies and reports

On reviewing the historical and current assessments of the licensing issues within Killary Harbour, it is apparent that the harbour is significantly over-licensed and over-stocked. The resulting competition for food within Killary has resulted in a poor production yield, a lower product quality and a longer growing time for many producers. This is especially true in some of the licensed sites that are located closer to the shore and must try to grow mussels on a phytoplankton food source that has been substantially depleted passing through other licensed sites. Other sites, as a result of their location and access to phytoplankton, have very productive growing conditions. Since the granting of additional licences in the harbour in 1999/2000 (an increase of over 70% in licensed area), there has been no evidence of a commensurate increase in productivity. Annual production figures supplied by BIM (pers. comm.) indicate that while peak tonnage in the harbour was reached in 2008 (1394 tonnes), this peak had almost been reached in 1997 (1378 tonnes) prior to the issuing of the extra licences. In addition to this, the time necessary to reach harvest weight in 1997 was 18-24 months whereas it can take up to 36 months today.

It was the assessment of the various reports and studies that short of re-designing all of the sites within the harbour based on the results of the carrying capacity studies, the following recommendations should be considered for implementation in order to improve the growing conditions:

1. Reduction of the total floatation within Killary Harbour to a maximum of 18,000 litres per hectare.
2. Reduction in the number of droppers to 800 per hectare (This in conjunction with recommendation (1) will have the effect of reducing stocking density and is essential once anchors and longlines are moved within sites).
3. Move all anchors and longlines to within their licensed area.
4. Reduction in the surface length of longlines per hectare to 220m.
5. Longlines should have a minimum of 25m spacing between each line with a licensed site and 25m between the outer line and the site boundary so that adjacent sites would have 50m between lines in one site and those of the next site. This should allow the more equitable access to food particularly at lower stocking densities.
6. Implement the practice of thinning throughout the harbour. This should be carried out following spat fall and during the ongrowing phase to ensure the optimum stocking density, reduce unnecessary competition for food and reduce mortality.
7. Establish a monitoring programme to assess the results any changes in practice.

In light of these assessments, it would seem that the suggestion to have a phased reduction in floatation (15% over 3 years to 18,000 l/ha) and to move all anchors and lines within sites is less than what is needed to improve growing conditions within the harbour. While all of the above

recommendations have been previously considered in discussions between BIM, CLAMS and producers, their implementation is entirely voluntary and so some will adopt the measures and others will not.

The transformation of the harbour into sustainable shellfish production waters would need the participation of all producers in co-ordination with BIM and CLAMS.

7.2 Other Uses

As highlighted in section 6.2, there are numerous other users operating within Killary Harbour including inshore fisheries, salmon farming, cruising vessels and various leisure activities. The proposed licensed sites are candidates for renewal and have been operating in their current locations since 2000. The management of Killary Harbour by the CLAMS and the operation of a navigational safety management plan have ensured that the proposed sites have had minimal impact on most other users of the area over the last decade.

The Marine Survey Office stated it had no objection to this development from a navigational point of view, neither had the Commissioner of Irish Lights.

The Sea Fisheries Protection Authority stated it had no objection to the development.

Galway Harbour Commissioners had no objection to this development.

However, as outlined in the section above (7.1), the renewal of the proposed licences will have an impact on other mussel farmers, namely those whose sites are located closer to the shore inside those sites in the channel. These sites have experienced a reduction in productivity, an increase in length of growing time (into three years) and a decrease in quality due to fouling by barnacles and other epibionts. This is despite effort to increase food availability through reductions in stocking density.

7.3 Statutory Status

Killary Harbour is not located in any Natura 2000 designated sites. It is however in the vicinity of the following sites: Maumturk Complex (cSAC 002008) and the Twelve Bens/Garraun Complex (cSAC002031) border on its southern side in Co. Galway while the Mweelrea/Sheeffry/Erriff Complex (cSAC 001932) borders on its northern Mayo side. In addition, the new cSAC West Connacht Coast is located to the mouth of Killary Harbour as an SAC for bottlenose dolphins. It is considered unlikely that the proposed renewal of licences will have a significant effect on any of the aforementioned designated sites.

As stated above (section 6.4), Killary Harbour does not appear to be included in any Local Area Plan, either in County Galway or County Mayo. Galway County Development Plan 2009-2015 does not contain any specific references to the Killary Harbour area other than a plan to improve the N59 road through Leenane.

Mayo County Development Plan Draft 2014 – 2020 specifies the creation of a Greenway from Croagh Patrick, Co. Mayo to Leenane via Louisburgh as a Priority infrastructure Project.

Galway County Council had no objection to the proposed development provided that normal standard environmental issues are addressed and requirements met.

7.4 Economic Effects

While tourism is considered to have the greatest economic impact within the area, the mussel farms within Killary Harbour have contributed to the employment in the area since the 80s. The licensed area under appeal foresees employing 1 part time person which may increase to 1 full time person after 4 years.

7.5 Ecological Effects

Each of the proposed licence renewal sites were pre-screened by the EIA Screening group in order to consider on a case by case basis whether the proposed aquaculture developments were likely to have a significant impact on the environment. The EIA Pre-Screening Assessment concluded that the environmental effects from the proposed activity will be minimal and not significant and that an Environmental Impact Assessment is not required.

7.6 General Environmental Effects

Results of the Shellfish Waters Directive do not indicate any water quality issues in the vicinity of the proposed licensed areas.

The production of faeces and pseudofaeces by mussels and the impact of the deposition of same on the seafloor is likely to be minimal. This is because the sites are deep and well flushed enough that this organic matter should be deposited across a larger area.

The implementation of proper waste management procedures will ensure the removal of any old ropes, floatation devices and other material associated with the cultivation process.

Emissions associated with the husbandry and harvesting of mussels from boats and other machinery is not expected to have a significant effect.

There is likely to be no significant general environmental effects as a result of the proposed renewal of the licence.

7.7 Effect on Man-made heritage

As previously stated in Section 6.5, there are no features of archaeological interest recorded for Killary Harbour itself. The Department of Arts, Heritage and the Gaeltacht (DAHG) raised no objections to the development from an underwater archaeological perspective.

8 Section 61 Conclusions

Site Suitability

The sites under appeal are not ideally suitable for sustainable mussel farming in Killary Harbour as they exist at present due to the following reasons:

- (1) The overstocking and over-licensing of Killary Harbour has resulted in increased competition for a limited food resource in the harbour, namely phytoplankton.
- (2) This in turn has resulted in the increase of the time needed to grow mussels to a harvestable size from 18 -24 months prior to first issuing the current licences in 2000 to 36 months at the present. This was particularly true in those licensed sites that were on the inner shore or were surrounded by other sites.
- (3) The increase in growing time increases the fouling on the mussels and a higher proportion of mussels are rejected by purchasers.
- (4) The geographical location of some sites actively result in the reduced production at less favourably located sites.

Other Uses

The proposed licence renewals will have a significant adverse impact on the mussel farmers growing mussels in those licence sites operating on inner shore of Killary Harbour as discussed above (Section 7.1) because of the lack of equitable access to phytoplankton food supply as licensed sites on outside are more favourably located.

The proposed renewal of the licence has a non-significant impact on some of the possible other uses or users of the area for the following reasons:

- (1) As an existing development (the licence renewal sites have been in operation since 2000) the licensed sites have been operating without impact on commercial and leisure users of the harbour
- (2) The management of Killary Harbour by the CLAMS and the operation of a navigational safety management plan have ensured that the proposed sites have had minimal impact on most other users of the area over the last decade

Statutory Status

The proposed development has a non-significant impact on the statutory status of the area for the following reasons:

- (1) Killary Harbour is not located in any Natura 2000 designated area (SPA, cSAC). It is bordered by 3 cSACs – The Twelve Bens/Garraun Complex (Site Code: 002031), The Mweelrea/Sheeffry/Erriff Complex (Site Code: 001932) and the Maumturk Mountains (Site Code: 002008) and the recently proposed West Connacht Coast (Site Code: 002998). The Marine Institute on behalf of the Department completed a screening assessment under

Article 6 of the Habitats Directive for shellfish culture in Killary harbour and concluded that the cultivation of mussel in Killary Harbour is not likely to affect the adjoining Natura 2000 sites.

- (2) The proposed sites are located within Killary Harbour Shellfish Designated Waters
- (3) Killary Harbour does not appear to be included in any Local Area Plans, or either Galway or Mayo County Development Plans.

Economic Effects

There will be a positive effect on the economy of the area for the following reasons:

- (1) The potential for 1 part time job which may increase to 1 full time job after 4 years. These workers will be employed directly in the production and harvest of mussels in Killary Harbour
- (2) Additional support industry jobs will be generated by a productive industry in the harbour.

Ecological Effects

There is a non-significant effect on the natural habitats, wild fisheries and fauna and flora of the area as a result of the proposed development. An EIA pre-screening assessment was carried out by the EIA screening group and it concluded that the environmental effects from the proposed activity would be minimal and not significant and that an Environmental Impact Statement would not be required for the proposed licence renewal.

General Environmental Effects

There are non-significant general environmental effects as a result of the proposed development for following reasons:

- (1) There are no significant effects on the general environment of the foreshore as a result of the proposed development provided proper waste management procedures are followed
- (2) The production of faeces and pseudofaeces by cultivation of mussels in suspension should not impact the benthic environment as the sites are well flushed and deep enough that depositions should be spread over a larger area.
- (3) There are likely to be no significant emissions from machinery used in harvesting and husbandry.

Man-made Heritage

There is no effect on the man-made heritage of value in the area as a result of the proposed renewal of the licences for the following reasons:

- (1) While there are numerous sites of man-made heritage in the environs of Killary Harbour, the Archaeological Survey of Ireland identifies no sites of importance within the harbour itself.
- (2) The Department of Arts, Heritage and the Gaeltacht raised no objections to the development from an underwater archaeological perspective.

9 Recommendations

It is the opinion of the Technical Advisor that the appellant is correct in his claims regarding the over-licensing, over-stocking and inequitable access to phytoplankton in Killary Harbour.

In accordance with Section 59 of the Fisheries (Amendment) Act 1997 and amendments the Technical Advisor **only recommends granting** the licence for the site reference number T9/388 subject to the following conditions:

In order to improve the food availability, growth rate, meat quality and growing time within Killary Harbour, it is recommended to subject the licence renewal to the following conditions:

- (1) All anchors and lines must be located entirely with the licensed site as per the Engineers' reports, including the spacing regime whereby individual longlines are 25m apart within the licensed site and there is a 50m distance between longline of adjacent sites. (This may necessitate that site boundaries be redrawn).
- (2) A reduction in the number and length of longlines as recommended within the Engineers' reports. Limit the total surface length of longlines within a site to 220m per hectare.
- (3) Reduction of the floatation within Killary Harbour to a maximum of 18,000 litres/hectare. However, it is recommended that this be implemented with immediate effect rather than a three year phased approach.¹
- (4) Reduction in the number of droppers to a maximum of 800 per hectare. This is recommended in addition to the reduction in floatation.
- (5) Thinning and repacking of mussel lines to be carried out across all licensed sites at least once per growing cycle.
- (6) An annual monitoring programme should be initiated to assess adherence to the licence conditions and measure stocking density, production values and growth rates.
- (7) It is recommended to reduce the duration for which a licence is valid from 10 years to 3 years and to subsequently renew licences subject to the results of the monitoring programme and adherence to the licensing conditions.

The annual monitoring of the growing conditions and site management within Killary Harbour are essential in evaluating the sustainability of the licensed areas. If, at the end of the 3 year licensed period, the results achieved by implementing the above recommendations are not satisfactory, further site redesign must be considered.

However, if it is the case that these recommendations cannot be agreed upon or less than adequate means for the creation of the sustainable management of Killary Harbour are implemented, then the Technical Advisor would advise that the **appeal be upheld and the licence revoked** and future licences in Killary be issued in a sustainable manner with recourse to the UISCE carrying capacity model.

¹ Depending on the time of licence renewal, producers should be allowed to harvest mussels this year if they are approaching harvest weight.

The above recommendations are conditions to be attached to the licence renewals under appeal and as such, have not been attached to those licences already granted in Killary Harbour. It is therefore crucial to emphasise that conditions 1 to 7 above are equally important for all producers if a sustainable Killary Harbour is to be achieved. This should be a priority in discussions between licence holders, CLAMS and BIM.

Ideally, the solution to establishing and managing a sustainable Killary Harbour for mussel farming is to redesign all of the licensed sites (including those not under appeal) in the following manner:

- The locations and boundaries of licensed sites within Killary Harbour should be redrawn (with full consideration of the carrying capacity report) so that no licensee should be surrounded or blocked in by another site. In other words, rather than the current layouts, each licensee's site should stretch from the shore on the inside out into the channel. This way producers could, if necessary, rotate the longlines within their sites so that each line would have access to an area with high phytoplankton concentration.
- The possibility of site rotation could then also be considered following site redesign, whereby management of the best growing sites in the harbour would be shared by rotation.
- Implementation of second thinning would further reduce mortality, increase production and shorten production cycle.
- Conditions 1 to 7 above would still be valid management policies in the event of a redesign of all sites.

10 Conclusions

- The sites under appeal (T9/388A & T9/388B) are *not* ideally suitable for sustainable mussel farming. They may be considered suitable once the site management recommendations are implemented and the sites have attained the projected production and growth rate improvements.
- The renewal of the licence will have an *insignificant* impact on other uses of the area (recreational, agricultural, fishing etc.)
- The renewal of the licence will have a *significant* impact on other users of the area (namely the other mussel farms experiencing reduced production)
- The proposed licence have a *non-significant impact* on the statutory status of the area
- The proposed licence will have a *positive* effect on the economy of the area
- The proposed licence will have *no significant* effects on wild fisheries, natural habitat and flora and fauna populations provided the recommendations are implemented.
- There are no significant general environmental effects expected as a result of the licence renewal
- There are no effects anticipated on the man-made heritage of value in the area as a result of the renewal of the licence.

In conclusion, we would advise to grant the licence renewal under appeal (T9/388) provided the aforementioned recommendations are implemented. However, if it is the case that these recommendations cannot be agreed upon or less than adequate means for the creation of the sustainable management of Killary Harbour are implemented, then we would advise that the appeal be upheld and the licence revoked and future licences in Killary be issued in a sustainable manner with recourse to the UISCE carrying capacity model.

11 References

- CLAMS (2002) Co-ordinated Local Aquaculture Management Systems. Killary Harbour, Co. Galway. 93pp.
- Costelloe, M., Costelloe, J., O'Donohoe, G., Coghlan, N. J., Oonk, M., & Heijden, V. D. 1998. Planktonic distribution of sea lice larvae, *Lepeophtheirus salmonis*, in Killary Harbour, west coast of Ireland. *Journal of the Marine Biological Association of the United Kingdom*, **78**(03), 853-874.
- Cush, P. 2012. The Rise and Fall of Cooperative Resource Management: A Case Study of Mussel Farming in Killary Harbour. PhD thesis, NUI, Galway. (<http://aran.library.nuigalway.ie/xmlui/handle/10379/3025>).
- EPA, 2011. Integrated Water Quality Report. Galway, Mayo and Sligo. 66pp. http://epa.ie/pubs/reports/water/waterqua/iwq/SligoGalwayMayoFinal%20Draft%20Complete_sm_all.pdf
- Failete Ireland, 2012. Connemara Infrastructure and Implementation Plan. 189pp. http://www.failteireland.ie/FaileteIreland/media/WebsiteStructure/Documents/2_Develop_Your_Business/Key%20Projects/ConnemaraReport_Final_LowRes-1.pdf
- Forde, E. 2009 Survey of mussel lines in Killary, 2009. Engineering report to the Department (12/10/2009).
- Gibbs, M.T. 2009. Implementation barriers to establishing a sustainable coastal aquaculture sector. *Marine Policy*. **33**, 83–89.
- Hartnett, M., Dabrowski, T., & Olbert, A. I. 2011. A new formula to calculate residence times of tidal waterbodies. *Proceedings of the ICE-Water Management*, **164**(5), 243-256.
- Inland Fisheries Ireland, 2011. Wild Salmon and Sea Trout Fisheries Statistics Report 2011. Wild Salmon and Sea Trout Fisheries Statistics Report 2011. 108pp <http://www.fisheriesireland.ie/Salmon-Management/wild-salmon-and-sea-trout-statistics.html>
- Keady, K. 2005. Killary Harbour. Proposed new layout of mussel lines. Engineering report to the Department (11/02/2005).
- Kelly, E., Tully, O., Lehane, B. & Breathnach, S. 2008. The shrimp (*Palaemon serratus*) fishery: analysis of the resource in 2003-2007. BIM Fisheries resource series. Vol. 8. 55pp.
- Ingram, S., Kavanagh, A., Englund, A. & Rogan, E. 2009. Site assessment of the waters of northwest Connemara. A survey of bottlenose dolphins (*Tursiops truncatus*). *Report for the National Parks and Wildlife Service of Ireland*. 1-34.
- Inland Fisheries Ireland, 2011. Wild Salmon and Sea Trout Fisheries Statistics Report. 2010-2011. <http://www.fisheriesireland.ie/Salmon-management/salmon-management.html>
- Nunes, J. P., J. G. Ferreira, S. B. Bricker, B. O'Loan, T. Dabrowski, B. Dallaghan, A. J. S. Hawkins, B. O'Connor, and T. O'Carroll. Towards an ecosystem approach to aquaculture: Assessment of

sustainable shellfish cultivation at different scales of space, time and complexity. *Aquaculture* **315**, no. 3 (2011): 369-383.

Rodhouse, P.G. & Roden, C.M. 1987. Carbon budget for a coastal inlet in relation to intensive cultivation of suspension-feeding molluscs. *Marine Ecology Progress Series*. **36**, 225–236.

Shellfish Pollution Reduction Programme. Characterisation Report Number XI. KILLARY HARBOUR SHELLFISH AREA COUNTY GALWAY/MAYO (2010).

<http://www.environ.ie/en/Publications/Environment/Water/PublicConsultations-ShellfishWatersDirective/FileDownload,22069,en.pdf>

Silke, J., O'Beirn, F., & Cronin, M. 2005. *Karenia mikimotoi*: an exceptional dinoflagellate bloom in western Irish waters, summer 2005.

UISCE. 2010. UISCE report for DAFF on Killary Harbour, August 2010. Prepared by Aquaculture Technical Section, BIM. 24pp.

