A study of the prospects and opportunities for shellfish farming in Scotland

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FRONT COVER: During the period of this study children at Head of Muir Primary School, Falkirk District, enjoyed mussels from the West coast and Shetland as part of a healthy diet. The trail will hopefully lead to wider uptake.
The photograph is courtesy of Alan Peebles.

Acronyms

AFP	Aquaculture Framework Plan
ASP	Amnesic Shellfish Poisoning
ASSG	Association of Scottish Shellfish Growers
BIM	Bord Iascaigh Mhara
DA	Domoic Acid
DSP	Diarrhetic Shellfish Poisoning
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organisation
FCF	fresh chilled frozen
FOS	Friends of the Sea
FRS	Fisheries Research Services
FSAS	Food Standards Agency Scotland
HIE	Highlands and Islands Enterprise
HPLC	high performance liquid chromatography
HRC	Highland Regional Council
ICZM	integrated coastal zone management
IFA	Irish Farmers Association
IOS	Isle of Shuna
IQF	individually quick frozen
IRR	internal rate of return
ISA	Irish Shellfish Association
LA	Local Authority
LC-MS	liquid chromatography-mass spectrometry
LEC	Local Enterprise Company
LFO	Loch Fyne Oysters
LLE	longline equivalent
MAP	modified atmosphere pack
MBA	Mouse bioassay
MGA	Ministerial Group on Aquaculture
MPL	Maximum Permitted Level
MPP	Marine Planning Partnership
MSC	Marine Stewardship Council
MSP	Marine Spatial Plan
MSSC	Molluscan Shellfish Safety Committee
NAFC	North Atlantic Fisheries College
NV	Norovirus
NZ	New Zealand
PESTLE	political, economic, social, technological, legal, environmental
PGI	Protected Geographical Indication
PSP	Paralytic Shellfish Poisoning
RBMP	River Basin Management Plan
RT-PCR	reverse transcription PCR
SAGB	Shellfish Association of Great Britain
SARF	Scottish Aquaculture Research Forum
SEPA	Scottish Environment Protection Agency
SFIA	Sea Fish Industry Authority
SIC	Shetland Islands Council
SNH	Scottish Natural Heritage
SPP	Scottish Planning Policy
SSMG	Scottish Shellfish Marketing Group
STP	Sewage Treatment Plant
SWOT	Strengths, weaknesses, opportunities, threats
UK	United Kingdom
WFD	Water Framework Directive
WIC	Western Isles Council
WTW	Water Treatment Works
WWF	World Wildlife Fund

Executive summary

1 Background and objectives

The study was commissioned by the Scottish Government following the recent publication of the renewed "Strategic Framework for Scottish Aquaculture". The objectives were to:

- provide Ministers with a better understanding of the industry
- develop policy thinking for the new Strategic Framework for Scottish Aquaculture
- provide evidence for the Strategic Framework Shellfish Sub Group
- develop policy priorities for European Fisheries Fund awards
- develop priorities for Research and Development
- assist businesses with their own development efforts

2 Prospects for mussel farming

2.1 Background

Mussel farming has been the shellfish sector with the strongest growth in Scotland over the past 10 years, with production increasing from 1,400t in 1999 to 5,800t in 2008, largely as a result of a rapid increase in production in Shetland. Nevertheless production remains low relative to the rest of the European Union (EU) and there is thus substantial scope for increasing production without significantly impacting total market supply. Pricing will however need to be increasingly competitive if higher volumes are to be sold on the market.

2.2 UK market

Annual UK consumption of mussels is less than 0.3 kg per capita compared with 2kg in France and 4-5kg in Belgium, and thus has significant potential for further growth. The UK market is divided approximately 80% retail and 20% foodservice.

The higher value retail sector presently accounts for 80-90% of Scottish mussels, with volumes split 50/50 between live and cooked (vacuum packed) product. Retail sales have seen strong recent growth (+28% 2008/09), but have been driven by price promotions and reduced unit prices. Live retail sales are static and mostly to traditional consumers. Cooked sales are increasing, key attributes being convenience and shelf life, and thus most likely to attract new consumers. The cooked product offers the best immediate prospects for Scottish mussels.

The Scottish Shellfish Marketing Group (SSMG) is the main UK supplier to the retail sector and accounts for around 70% of Scottish production. There is competition from other Scottish suppliers especially for live sales, and from overseas producers for cooked product. A key strength of the SSMG is its proximity to market and ability to service customers quickly and efficiently with cooked and live product. Product from overseas e.g. Netherlands and Ireland has further to travel and thus limits competition mainly to the cooked sector, where however there are significant price pressures due to the lower raw material costs of such producers.

The foodservice sector is also growing but is of lower value compared with retail and is thus less attractive for Scottish suppliers, especially in the widely sold frozen format. Product from Shetland dominates the live wholesale sector, having economies of scale in serving markets and strong product attributes. Such dominance is however at the expense of smaller mainland producers who are not SSMG members.

2.3 Continental market

The continental market is considerably larger than in the UK (in excess of 500,000t) and is already well supplied despite the significant decline in domestic production over the past decade, which has been largely made up for by the rapid increase in Chilean imports. The opportunities for Scottish suppliers are by no means clear, although there are

indications of a swing towards more sustainable sourcing in Belgium, with rope grown mussels likely to be favoured over bottom grown. The spring market (post bouchot) for bulk supplies from France is likely to remain an important although unpredictable and relatively low value outlet for some Scottish producers. Further information on continental markets is essential to highlight the opportunities for Scottish product.

2.4 Production capacity

Existing Marine Spatial Plans suggest there is limited scope for new development on inshore sites, especially for those of an economically viable scale. Offshore development is considered unlikely in the short term due to planning uncertainties, higher costs, and greater risks, although links with the offshore renewables sector may offer opportunities. There have been few if any recent planning applications for new shellfish sites, suggesting that in any case at the present time there is no major demand for additional capacity.

Growth in production in the short to medium term is considered most likely to come from existing sites, the average production of which in 2008 was the equivalent of only 9t/200m longline, compared with typical industry yields for active sites of around 40t/line. This discrepancy is indicative of both unused capacity and poor production efficiency, both of which if addressed could lead to significant growth in production subject to market demand and other constraints.

2.5 Competitiveness

Any gains in market volume will depend on reduced production costs, which are relatively high in Scotland due to slower growth and higher labour costs. In addition, the production costs of rope culture are significantly greater than bottom culture as widely practised elsewhere in Europe.

The use of New Zealand (NZ) technology could reduce costs significantly, but has yet to be proven in Scottish conditions. Greater cooperation in the use of workboats and on-shore facilities and the harvesting and processing of product could also lead to cost reductions, as in geographically compact areas such as Shetland. However, it is likely that costs of production in Scotland will remain relatively high compared with other industries.

2.6 Finance and investment

The business poses significant barriers to new entrants, especially at a larger scale, being characterised by high capital costs and extended working capital requirements due to the three year production cycle. Other difficulties include the lack of suitable assets to act as security for loan finance, and the questionable viability of stock insurance. With regard to regional variations, the investment climate in Shetland has been more favourable than in other areas of Scotland, partly due to the influence of oil funds, and this appears likely to continue.

The return on investment for a potential traditional new farm appears to be poor given the risks and uncertainties associated with production, and business plans are barely viable without EFF grant on capital expenditure. The best prospects for improved viability lie with greater economies of scale, and the adoption of new technologies and production strategies to shorten production cycles and improve labour efficiency.

With regard to future investment in the business, it is not thought to be attractive to salmon farming companies other than to gain multi-trophic benefits on certain sites. Investment by Dutch mussel processors is also considered unlikely in the short term, despite their extensive ownership of production operations outwith the Netherlands. Such ownership is almost exclusively in bottom culture, which produces a more robust product than rope culture at lower cost, and is better suited to their highly mechanised processing operations. The investment case for other large scale new entrants with no sector experience is also far from clear, and past cases of venture capital investment have met with limited success.

Future investors in the industry are thus considered most likely to be existing growers, especially those with proven business models and strong track records, and having the experience, site capacity, facilities, and market access. There is further scope for the optimisation of operations within specific regions through consolidation of smaller growers and/or the setting up of contract harvesting and marketing arrangements between larger and smaller farms.

The prospects for smaller growers outwith Shetland who do not belong to the SSMG appear to be poor, given their reliance on wholesale markets which are increasingly dominated by Shetland product. Such growers will need to

cooperate wherever possible in both production and marketing if they are to have any chance of surviving on an independent basis.

2.7 Regulation

Regulation of the industry is focussed on two main issues, site availability and water quality. As discussed, site availability is not considered a constraint in the short to medium term given the potential capacity of existing sites. However, it will be essential for the industry to play a full part in the new marine planning process to ensure that new capacity of adequate scale is allocated in any new Marine Spatial Plans. Existing plans, especially in Argyll and Highland, do not give grounds for optimism, with presumptions in favour of development, if at all, being mostly for small and medium scale sites. Visual impact remains a major issue.

With regard to water quality issues, the industry has major concerns regarding the interpretation and implementation of legislation by regulators, although they are mostly an irritation rather than an overriding constraint. There is a need to achieve a balance acceptable to both industry and regulators, and to iron out anomalies between the UK and other countries on issues such as classification. The establishment of the Shellfish Forum has been a welcome development and there are encouraging signs of progress e.g. proposals for the Shellfish Hygiene System.

2.8 Summary of prospects

There is ample capacity for increased production from existing sites, and from potential new sites assuming favourable recognition in the planning process. Concentration of production is likely in areas with the best characteristics for viability, and it is probable that Shetland will continue to dominate production at least in the short to medium term.

The uncertainties of production however continue to be a major challenge, with irregular spatfall, tubeworm, predation, and water quality issues all posing significant threats. Prospects for the industry depend to a large extent on how growers are able to overcome such uncertainties, and to improve the consistency of production from year to year.

Development of production capacity will need to go hand in hand with market development, which is considered to offer good potential given the positive outlook for seafood consumption generally and the present low consumption of mussels in the UK. Carefully targeted efforts will however be needed to continue to secure premium outlets matching the higher production cost and particular attributes of Scottish rope grown mussels. As production grows, further price erosion is likely and it will need an equivalent response in the reduction of the cost base, through consolidation, economies of scale, and the adoption of new production technologies. Improvements to the regulatory environment will also need to remain a top priority.

3 Prospects for oyster farming

3.1 Market

Scotland is a minor producer of oysters in global and EU terms, producing 300t (3.8 million shells) in 2008, and the industry has grown only slightly during the past ten years. Overall UK production of Pacific oysters fluctuates between 800 and 1,400t, with Scottish supply in 2008 representing around 25%. Market prospects for Scottish oysters are positive, with strong demand reported throughout the industry and prices having risen by around 20% over the past 5 years, due in part to disease problems in France and Ireland. Scottish distributors of oysters presently have to import around 2 million shells per year from outwith Scotland to meet demand, stock that would preferentially be sourced from Scottish growers if available. The greatest demand is from the upmarket foodservice sector, with more limited retail sales.

3.2 Production capacity

Existing sites are at or near capacity, and there is limited scope to develop new sites especially on the West Coast, due to planning constraints and lack of suitable foreshore. Ideal sites with large areas of foreshore e.g. as found in the Solway appear to be constrained by conservation interests.

3.3 Competitiveness

The production cost of oysters in Scotland is relatively high due to slow growth and limited scale economies. Competition on the basis of quality attributes related to the environment such as cooler waters, slower growth, and the higher energy environment is thus considered the best option. There is scope to make better use of provenance and quality as a promotional tool, and to improve the role of oysters in local food and drink initiatives.

3.4 Threats

The industry is faced with a number of major threats. Seed supply presently comes from only two hatcheries and availability can be a problem. The business case for a Scottish hatchery is not clear given the small size of the Scottish industry and the likely need to also service the wider European market to achieve a viable economy of scale. A better option might be to encourage production through an existing Scottish marine hatchery facility. A second threat is that the disease causing widespread losses in France and Ireland could find its way to Scotland. Of further concern is the non-native status of Pacific oysters and their increasing propensity to spawn in the UK, albeit not yet in Scotland, which may in future limit their acceptance for culture.

3.5 Finance and investment

Existing production is mostly from small and medium size growers exhibiting marginal financial viability, despite an ex-farm price that is around 20% higher than volume producers in England and Ireland. The activity covers the labour costs of owners but leaves little scope for a return on investment. The scope for developing larger sites with better economies is limited, whilst new technologies which could reduce costs have not yet been proven in Scottish conditions. However, oyster farming does provide a valuable source of income in rural areas especially if linked to local food initiatives or other compatible enterprises.

3.6 Native oysters

The production of native oysters in Scotland is limited to the Loch Ryan fishery (20t production in 2008), and is targeted at high value foodservice outlets. Whilst stock numbers are increasing, management emphasis is on stock preservation and production is likely to remain low. Elsewhere in Scotland, the emphasis is on conservation and enhancement of existing stocks.

3.7 Summary of prospects

There appears to be limited site capacity for increased oyster production, business viability at the smaller scale is marginal, and the industry is subject to a number of ongoing threats. However, despite these limitations, there is clearly a strong market demand for Scottish oysters which will help support smaller business models, and if such limitations can be addressed, further growth in the industry should be possible.

4 Prospects for scallop farming

4.1 Market

The EU market is dominated by supplies from the wild fishery and imports from South America and Asia. Farmed production in Scotland is insignificant at 27t of queen and 2t of king scallops in 2008, although the country is the only European producer of farmed queen scallop. There are niche markets for the farmed product, mainly upmarket foodservice outlets, based on a highly differentiated product form e.g. fresh whole or IQF frozen on the half-shell queen scallops, and hand-dived, in-shell king scallops.

4.2 Production

Production in Scotland is limited to one Argyll grower of queen scallops and one Highland grower of king scallops. A major constraint on the industry is limited seed supply due to poor spatfall in recent years, the reasons for which are

unknown. There are 11 Several Orders in Scotland for scallops but only one of these is actively producing, with theft being a major problem.

4.3 Summary of prospects

Overall the scallop sector does not appear to have sufficient critical mass for it to be a major focus for further development. This could pick up if some of the fundamentals change, such as the development of one or more shellfish hatcheries in Scotland, greater priority for integrated aquaculture operations, innovations in culture technology, or greater willingness by the authorities to protect Several Orders.

5 Prospects for alternative shellfish species

Although there is interest in the cultivation of alternative shellfish species, and indeed already culture activity for some e.g. sea urchins and lobsters, there are no obvious prospects for the culture of an alternative species on the same scale as mussels or oysters. Lobsters will continue to be an important candidate for restocking programmes as in Orkney and Shetland, and sea urchins have potential, either cultured in combination with other species or on a stand-alone basis.

6 Opportunities

The opportunities for shellfish farming in Scotland are seen mainly as building on industry strengths and addressing the needs and constraints that have been identified throughout the study. Around 60 opportunities have been summarised in tabular form for individual species and for the sector as a whole. For each opportunity, the relevant Strategic Framework thematic objective has been identified, together with the suggested participation of key industry stakeholders. The main areas of opportunity are summarised as follows:

6.1 Mussels

- Development of the UK market with the primary focus on cooked convenience products for the retail market aimed at the "grey pound" consumer
- Research to better understand the wants of consumers in UK and European markets
- Research among non-consumers, especially young people, to establish whether they might be receptive to mussel consumption given appropriate products and promotion
- Development of mechanisms to allow a better match between supply and demand and avoid under/over supply situations
- Product development in relation to packaging and tubeworm affected mussels
- Adoption and refinement of new technologies to reduce costs, increase site productivity and maximise return on investment
- Development of contract services and equipment sharing to minimise capital investment
- Identify optimal areas for new development and ensure recognition in Marine Spatial Plans, and consolidate existing smaller sites

6.2 Oysters

- Production of up to 2 million additional oysters p.a. to satisfy market demand
- Encourage additional seed supply from existing Scottish marine hatchery operators
- Expansion/rationalisation of existing sites where possible and production is economically viable
- Identify potential new sites and ensure recognition in Marine Spatial Plans

6.3 Scallops

- Ensure greater protection of Several Orders by the relevant authorities
- Development of an easily applied non-harmful "tag" to allow identification of stolen stock

6.4 Shellfish sector as a whole

- Recognition of, and support for, shellfish farming in the Marine Bill
- Recognition by Local Authorities of the need for site rationalisation/consolidation in accordance with carrying capacity and economic viability constraints
- Improved mechanism for classification of shellfish harvesting waters to ensure a level playing field with the rest of the EU and that food safety risks are realistically assessed
- Development and adoption of a better method for measuring norovirus in shellfish, with a view to replacement of *E. coli* as an indicator species - this could give a significant marketing advantage to Scottish growers given Scottish waters are amongst the least polluted in Europe with regard to human pathogens
- Development of clear and unambiguous criteria for depuration with agreement between all interested parties
- Improvement of the biotoxin monitoring regime with greater industry participation, and replacement of the official reference method
- Optimisation of the uptake of EFF support for industry development, and highlighting the availability of the Enterprise Finance Guarantee for loan security
- Better characterisation of different business models and associated business plans to highlight investment potential (mussels and oysters)
- Improve industry performance through adoption of knowledge exchange programmes e.g. monitor farms, benchmarking, farm visits, study tours, advice to new entrants
- Revision of the annual Marine Scotland shellfish survey to give improved level of production information
- Support for research and development (R&D), in particular with regard to improvements in production efficiency and reducing production costs
- Strengthen existing industry representative bodies and widen remit to deal with marketing initiatives, funded by a combination of industry levy and government/EU support
- Further develop cooperation between industry and regulators through the Shellfish Forum

7 Recommendations

7.1 To government

The Scottish shellfish industry is small and operates in the most economically fragile rural coastal regions of Scotland. Despite its present relatively small size, the industry has significant scope for growth especially in mussel farming, although such growth will only be achieved with the continued backing of government at national and local level. The need for supporting services and especially for simplification of the regulatory burdens is considerable.

The key opportunities for government and associated agencies to support the development of the industry relate mainly to policy, planning, water quality, financing, and R&D.

The Strategic Framework for Aquaculture and associated working groups including the Shellfish Forum are all positive developments, but much further work needs to be done to ensure that regulatory issues particularly those relating to planning and water quality do not hold the sector back. There needs to be greater recognition in policy development of the ecosystem goods and services provided by shellfish culture, and less emphasis on perceived negative traits such as visual impact.

There is an overriding need to secure ongoing funding support for industry representation. Whilst this is partly met in Shetland through local funding, it continues to be a major issue for the rest of Scotland. The small size of the industry makes it difficult to generate sufficient funding from growers alone, and given the disproportionate and often complex volume of legislative and other matters that have to be dealt with, emanating from government at local, national and EU levels, there would appear to be a strong case for ongoing funding support from government.

7.2 To industry

The study findings suggest that the industry will need to develop a more coherent and strategic market focus coupled with a drive to improve production efficiency and competitiveness if it is to continue to grow and play an important role in the Scottish coastal economy. It is therefore recommended that the industry prepare an over-arching development strategy based on the findings of this study covering both marketing and production and tying in with the Strategic Framework for Scottish Aquaculture, the UK Shellfish Industry Development Strategy (SIDS), and other

relevant initiatives. Within such a strategy, there is a specific need to carry out further research on markets, both in the UK and on the continent.

The key opportunities for growers to participate in the development of the industry relate mainly to market and product development, production capacity, production efficiency, regulation, financing, and R&D.

There is scope for the Scottish industry to learn from practices in other shellfish industries relating to representation, biotoxin monitoring, processor/grower links, marketing, and production methods, as highlighted by the benchmarking exercise carried out in the study.

The recently established Shellfish Forum is a major advance in bringing together industry and regulators and should continue to be actively supported.

With regard to industry representation, there is a clear need for a more substantial staffing input, with a high degree of core funding. Achievement of ongoing funding at the required scale will need a firm financial commitment from industry participants.

1 Introduction

1.1 Background and objectives

In May 2009, the Scottish Government published the renewed "Strategic Framework for Scottish Aquaculture", with the stated desire for an aquaculture industry that is ambitious, thriving, growing, diverse, profitable and sustainable, in keeping with its over-riding objective of sustainable economic development.

This study has been commissioned by the Scottish Government in response to that desire, but focussing specifically on the "prospects and opportunities for shellfish farming in Scotland". The brief for the study is provided in Appendix 1.

The study is intended to help:

- provide Ministers with a better understanding of the industry
- develop policy thinking necessary to aid the implementation of a new Strategic Framework for Scottish Aquaculture
- provide evidence for the Strategic Framework Shellfish Sub Group
- develop policy priorities for European Fisheries Fund (EFF) funding
- develop priorities for Research and Development.
- assist businesses with their own development efforts by identifying where their own investment and grant aid could be used to optimal advantage.

1.2 Approach to the study

The shellfish species farmed in Scotland and which are the subject of this study are mussels (*Mytilus spp*), Pacific oysters (*Crassostrea gigas*), native oysters (*Ostrea edulis*), king scallops (*Pecten maximus*) and queen scallops (*Chlamys operculatis*). The relative ex-farm value of these species in 2008 was 85% mussels, 13% Pacific oysters, and 2% native oysters and scallops. This relative value is reflected in the coverage given to each species in the report, with mussels showing the greatest potential for further growth, Pacific oysters more limited scope and the other species likely to remain a relatively small niche sector in the short to medium term. Alternative species which may assume greater importance in future are also considered.

The shellfish farming industry in Scotland is still in relative infancy, despite having its beginnings over three decades ago. During the same time frame, the ex-farm value of Scottish farmed salmon is approaching £400m, compared with around £7m for farmed shellfish. Yet over the past 10 years that value has increased more than 5 fold and the mussel industry at least has shown that it is capable of significant growth. The expectation is that the shellfish industry has further to grow, but by how much, under whose initiative, in which areas, and according to which constraints is not clear. It is the aim of this study to shed further light on such prospects.

The prospects for the industry are assessed in terms of five major themes, in order (to some extent) of relative importance:

Markets: a growing and sustainable industry depends first and foremost on fully satisfying existing consumer demand and potentially expanding its value. Here at least the demographics and trends for seafood consumption are favourable: driven in part by an increasing "grey pound", perceived health benefits and recent trends showing a significant increase in mussel consumption in the retail sector. Thus significant emphasis is given in the report in assessing the market prospects for Scottish farmed shellfish, both in the UK and for export.

Competitiveness: With increasing consumer demand however also comes the threat of competition from other producers in the EU and elsewhere in the world, so the question of how Scotland rates against such imports in terms of cost of production, unique product attributes, and delivery of customer values must be considered, together with an assessment of how it might best defend and indeed enhance its position.

Sites and production capacity: Assuming a favourable market and the ability to service that market cost effectively and competitively, the next most limiting factor is the availability of suitable production sites and their capacity. The potential for the industry has sometimes been based on a comparison of the relative length of the Scottish coastline in relation to its EU neighbours and their shellfish production. The reality however is that whilst there may in theory be many physically suitable sites, planning and regulatory constraints suggest that in many areas there may be little scope

for further development. This however need not be a constraint for production growth at least in the short term, given the possible scope to improve production at existing sites.

Finance: Assuming a viable business plan and available sites, finance is required to take production forward. For existing growers with an established business not wishing to expand, finance may only become an issue if for example a crop is lost or harvest delayed due to toxins and cash flow is affected. Whilst capital grants may be available for those with expansion plans, funding the producer contribution and the cash flow associated with production of new stock are likely to prove the main challenge. For new entrants needing finance, the challenge is likely to be convincing funders of the business case given the uncertainties of production and market demand.

Production constraints and regulatory issues: Finally, there are a range of production constraints and regulatory issues which face shellfish farmers on a day to day basis, which when taken individually may not appear to amount to much, but when taken together pose a formidable additional challenge to running a successful business. Production constraints include variable mussel spatfall, shortage of oyster seed supplies, predation, and fouling, any one of which if serious enough can cause a business to fail. On the regulatory side, water quality issues and hygiene regulations prove a constant concern.

These themes are to some extent mirrored in the renewed Strategic Framework for Scottish Aquaculture, the key themes of which cover health, licensing, containment, marketing, and finance. In particular, licensing, marketing and finance show a good fit with the needs of the shellfish industry. The emphasis in the Framework is however on finfish (and salmon in particular) given the relative importance of that industry, and there are issues relating to shellfish such as competitive production and constraints which are not clearly identified. It is one of the purposes of this study to highlight such issues so that they may be given due attention in taking the shellfish industry forward.

Whilst the above themes govern the prospects for the industry as a whole, there are significant regional influences which determine prospects in those regions. Such influences include socioeconomic background, availability of finance, labour supply and costs, planning constraints, local stock characteristics, food supply, toxin incidence, time to harvest, logistics and cost of getting product to market. Such regional differences and their implications are considered where appropriate throughout the report.

In the final section, the prospects for each species sector are summarised, followed by identification of the opportunities for mussel and oyster farming and the sector as a whole. Such opportunities have been prioritised and linked where possible with thematic objectives in the Strategic Framework and potential stakeholder roles. Whilst it is not the remit of this study to develop an industry strategy, the themes for a potential industry "roadmap" are indicated together with the possible role of key organisations. Finally, recommendations to government are given with respect to priorities for support.

2 Methodology

2.1 Steering group

The study was guided throughout by a Steering Group, the members of which were as follows:

- Paul Shave (Marine Scotland) (Chairman)
- Walter Speirs (Association of Scottish Shellfish Growers (ASSG))
- Ruth Henderson (Seafood Shetland)
- Stephen Cameron (Scottish Shellfish Marketing Group (SSMG))
- Alex Adrian (The Crown Estate)
- Craig Burton (Seafish)
- Iain Sutherland (Highlands and Islands Enterprise)

The Group met initially at Stirling on 13th November 2009 to discuss the key issues facing the industry and expectations for the study. A second meeting was held by conference call on 19th January 2010 at which a progress report was given and a draft reporting structure discussed. A third meeting was held on 5th March 2010 by conference call at which preliminary comment on the draft report was made. A final face to face meeting was held at Stirling on 29th April 2010.

General points arising from Steering Group discussions have been incorporated into the report as appropriate.

2.2 Study team

The Stirling Aquaculture study team and their responsibilities were as follows:

- John Bostock (project manager)
- David Scott (lead researcher and senior report author)
- Anton Immink (researcher)
- Professor James Young (marketing advisor)
- Doug Macleod (external advisor)
- Dr Janet Brown (industry advisor)

2.3 Identification of key industry issues

An initial SWOT (strengths, weaknesses, opportunities and threats) and PEST (political, economic, social and technological) analysis was carried out to highlight key issues facing the industry and to guide the approach to the remainder of the study. The results of this analysis were discussed with the Steering Group and subsequently refined.

2.4 Secondary data analysis

Secondary data of relevance to the study was gathered from a variety of sources including the aquaculture media, scientific literature, Scottish Aquaculture Research Forum (SARF) results, industry reports, Food and Agriculture Organisation (FAO), Scottish and UK Government statistics, Seafish publications, and market research reports. A full list of references is provided at the end of the report.

2.5 Stakeholder consultations

A list of industry stakeholders for consultation was drawn up in consultation with the Steering Group, which included marketing organisations, shellfish buyers, producers, industry representative bodies, regulators, local authorities, and industry support organisations. A full list of consultees is given in Appendix 2.

Members of the ASSG and Seafood Shetland were approached by email explaining the background to the study and inviting them to make contact with the study team to make their views known. In addition, letters were sent to all producers listed on the Fisheries Research Services (FRS) database of registered shellfish farming businesses not contacted by email. Finally, an article was published in The Grower magazine in January 2010 similarly inviting interested stakeholders to make contact.

Face to face meetings were held with the three main marketing organisations, namely the SSMG, Isle of Shuna (IOS) and Loch Fyne Oysters (LFO). A visit by the study team was made to Shetland in December 2009, and meetings were held with Seafood Shetland, the Shetland Islands Council (SIC) economic development unit, the SIC planning department, and the producers themselves. The latter took place at a meeting organised by Seafood Shetland at the North Mainland Leisure Centre, Brae, and through visits to individual growers in Shetland (3 on the mainland and one on Yell).

Contact with growers in the remainder of Scotland was carried out by extensive phone interviews. This included most of the major mussel and oyster growers, and some of the smaller producers. The interviews were carried out on a semi-structured basis working to a list of key issues, including business history, viability, aspirations, markets, sites, production technology, production problems, employment, water quality, legislation, R&D needs, and finance. This provided an effective mechanism to enable meaningful comparison whilst affording the opportunity for individual respondents to highlight more individual concerns.

2.6 Shellfish Forum

Short presentations on the study were made at the first two meetings of the newly formed Shellfish Forum in Edinburgh, at which contact was also made with regulatory bodies.

2.7 Reporting

A draft report was circulated prior to the 3rd Steering Group meeting on 5th March 2010 and a final draft prior to the last meeting on 29th March 2010.

At the last meeting, it was proposed that circulation of the full report should be restricted for a period of 2 years on the basis of commercial sensitivity, but that the executive summary could be made more widely available. In addition, the results of the study could be presented at the annual ASSG conference in the autumn and other fora as appropriate.

3 National policy context

3.1 Strategic Framework for Scottish Aquaculture

The current framework for aquaculture policy in Scotland is defined in "A Fresh Start: The renewed strategic framework for Scottish aquaculture" (The Scottish Government, 2009a). This was developed from an extensive programme of consultations and an earlier Strategic Framework (The Scottish Government, 2003). The strategic framework takes as a starting point, the need for sustainable growth. This is defined with respect to economic, environmental and social criteria. It also draws strongly on the Scottish Government's economic strategy (The Scottish Government, 2007) which established five thematic objectives for Government policy, namely:

- Wealthier and fairer
- Smarter
- Healthier
- Safer and stronger
- Greener

Other important policy initiatives underpinning the aquaculture framework are the Scottish Government Economic Recovery Programme, the Marine Bill for Scotland and the establishment of Marine Scotland, the European Common Fisheries Policy and European Fisheries Fund, and emerging policy on climate change. Account is also taken of the National Food and Drink Policy and recent legislation such as the Aquatic Animal Health Directive and Aquaculture and Fisheries (Scotland) Act 2007. Industry and other stakeholder initiatives are also important, particularly the Salmon Industry Code of Good Practice (2006) and Tripartite Working Group on Area Management Agreements.

Taking this background into consideration, the strategic framework for aquaculture is developed around five main objectives:

- Healthier fish and shellfish
- Improved systems for licensing aquaculture developments
- Improved containment
- Better marketing and improved image
- Improved access to finance

These are further defined in relation to the 5 economic objectives listed above. With salmon farming the dominant aquaculture industry in Scotland, the challenges of this sector tend to predominate in the framework although most of the key themes are shared with the shellfish sector. Table 3.1 highlights the objectives of the Strategic Framework that are relevant to shellfish farming.

To work further on specific policy that will develop legislation, the Scottish Government has formed a Ministerial Group on Aquaculture (MGA) and six sub-groups to work on these themes. The sixth sub-group is specifically for shellfish (The Shellfish Forum). Each sub-group has a champion with responsibility to manage and facilitate the key actions identified under that theme and to deliver and report back to the MGA. With the support of the sub-groups the MGA will develop and update action plans for each theme. Since the sub-groups will be relatively small, only involving the most closely involved stakeholders, a wider National Aquaculture Forum is being formed to provide a platform for wider consultation. This will be chaired by Marine Scotland with a remit to feed into thematic action plans and ensure actions remain relevant and accommodate new issues of concern which may arise, or when there is lack of progress.

Table 3.1. Scottish Government Strategic Framework – as appropriate to shellfish farming

Thematic objective	Objectives relevant to shellfish farming					Desired outcomes
	Wealthier & Fairer	***Smarter***	***Healthier***	***Safer and Stronger***	***Greener***	
Healthier fish and shellfish	Protect valuable assets by high standards of biosecurity and husbandry	Continual research into emerging diseases	Ensuring food safety	Controlling disease	Appropriate disposal of diseased stock if necessary	A secure long-term future for the industry by protecting the assets through disease control and minimising impacts on the environment
Improved systems for licensing aquaculture developments	Making optimal use of space available	Develop and retain skilled and knowledgeable decision-makers and workforce	Sites located to ensure optimum production of high quality and safe shellfish	Certainty and clarity in future plans underpinning downstream activities and benefits to local communities	The right sites in the right places through streamlined and proportionate regulatory framework	Development of the right sites in the right places through transparent, streamlined and proportionate regulations and processes to minimise adverse impacts on other users of the marine and freshwater environments
Improved containment	n/a	n/a	n/a	n/a	n/a	n/a
Better marketing and improved image	Maximising profitability by promoting a positive image of the industry, making best use of the Scottish quality brand to secure markets at home and abroad and retain and attract the best innovators	Ensuring favourable conditions for both commodity and niche market production, better integration with transport and processing infrastructure and improved staff training and development	Promoting the health and nutritional benefits of farmed shellfish	Strong industry with strong brand through well-established markets and developing new markets for higher value and niche products	Enhancing the industry's reputation for respecting the environment	Maximised profitability for commodity and niche market producers by promoting a positive image of the industry and making best use of the Scottish quality brand to secure markets at home and abroad and provide sustainable employment opportunities
Improved access to finance	Develop a climate to improve investor confidence, supporting and underpinning the long-term future and competitiveness of the sector	Facilitate best use of technology and resources to make aquaculture attractive to investors	Produce high quality, safe and nutritious shellfish	Securing finance to support the long-term stability and development of the industry	Invest in best practice and technologies to minimise impacts on the environment	An investment climate which supports and underpins the long-term future and competitiveness of the sector with investment in best practice and new technologies

3.2 National Food and Drink Policy

"Recipe for Success – Scotland's National Food and Drink Policy" (The Scottish Government, 2009b) provides a wider policy context, especially for the image and marketing aspirations of the aquaculture strategy. The policy is based on the same five thematic objectives as the economic policy: Wealthier and fairer, Smarter, Healthier, Safer and stronger, and Greener. The policy sets out how the Scottish Government plans to:

- support the growth of (the Scottish) food and drink Industry;
- build on (Scotland's) reputation as a land of food and drink;
- ensure (Scottish consumers) make healthy and sustainable choices;
- make (the Scottish) public sector an exemplar for sustainable food procurement;
- ensure (Scottish) food supplies are secure and resilient to change;
- make food both available and affordable to all; and
- ensure that (Scottish) people understand more about the food they eat.

Much of the policy is directly relevant to shellfish with government funding for specific initiatives. In particular, in 2007 the Scottish Government supported the establishment of Scotland Food and Drink, an industry led group to provide strategic leadership and support to the Scottish food and drink sector. Generic promotion of Scottish produce is carried out under the message "Scotland is a Land of Food and Drink". The group are able to provide a variety of support to smaller Scottish food producers and also work with the Scottish Retailers' Forum to help producers find new markets through the supermarkets.

The policy is particularly supportive of sustainable and healthy foods where shellfish should feature strongly. Initiatives include training support for staff and educational campaigns in schools and other organisations. Overseas markets are also being targeted and food tourism to Scotland promoted. With local provenance becoming more important the Scottish Government are also working to ensure public organisations take a lead through their food procurement policies and practices. This policy is reinforced by the objective of increased resilience and strengthening of food security.

3.3 Shellfish Industry Development Strategy (SIDS)

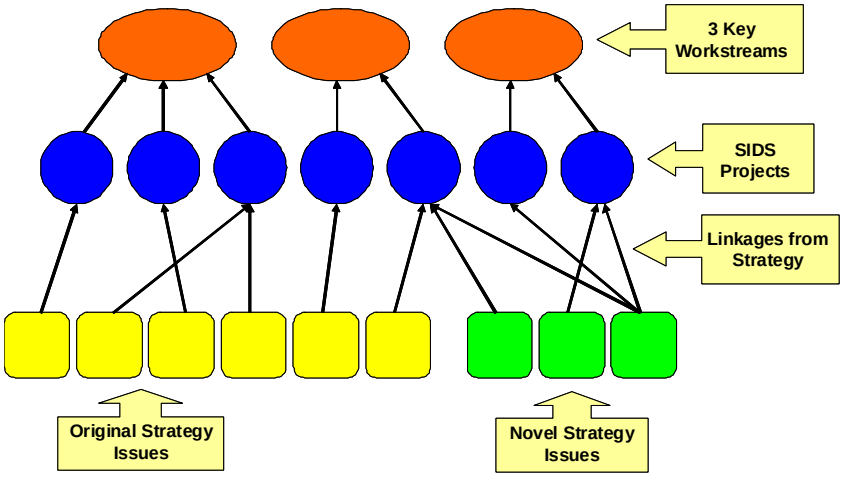
This is an initiative of the Shellfish Association of Great Britain (SAGB) with UK government support and assistance from Seafish. The genesis of the initiative was in the response of the shellfish sector to the UK Fisheries Project (Cabinet Office, 2004). This led to the commissioning of a report by Seafish (2006) entitled "Towards a National Development Strategy for Shellfish in England" which was also supported by Defra as an activity of the English Inshore Fisheries Working Group. The full strategy for England was then developed and published by SAGB (Lake and Utting, 2007).

Whilst the origin of SIDS was in England, subsequent implementation has broadened to the whole of Britain, although mainly involves organisations that are members or partners of SAGB. The underlying expectation of SIDS is that production volumes can be increased for most species and that value can be increased for all species, especially cultivated product. As with the Scottish policy, sustainability is a core objective that underlies all of the specific actions envisaged. Overall, the strategy identifies 45 issues facing the shellfish sector ranging from technical issues such as habitat availability for lobsters, through policy issues such as implementation of the water framework directive, to responding to changes in market demand. Many of the issues being dealt with by SIDS are common to the Scottish sector, although there are also many that are specific to England and Wales.

Implementation of SIDS is organised into three key workstreams, each managing several specific projects (25 in total in phase 1), which in turn deal with sub-sets of the 45 identified issues (or initiative areas), plus additional issues identified since the original strategy document. The three workstreams are:

- Giving managers the ability to manage shellfisheries appropriately
- Raising the profile of UK shellfish
- Security of tenure

Figure 3-1. Shellfish Industry Development Strategy implementation



Source: SAGB

Given the different legal framework in Scotland, perhaps the most important area of synergy is in marketing and industry image. Enhanced reputation for UK shellfish would be expected to benefit Scottish producers at least through increased sales opportunities. Outputs to date include YouTube videos, a printed oyster tasting guide and promotional events such as the World's largest prawn cocktail. The initiative also includes further market research, particularly for niche products.

3.4 Linkages between policy context and opportunities for the Scottish industry

Participants in the Scottish shellfish sector are concerned about the potential impact of regulatory changes e.g. through the Water Framework Directive, the EU Bird and Habitat Directive or Marine Bill as a result of higher level policy priorities such as climate change. However, there are also clear opportunities for the industry to be part of the solution (Table 3.2). Active engagement with policy development could provide greater confidence in the shellfish aquaculture sector which in turn would encourage further investment.

Table 3.2. Potential contribution of shellfish farming to policy objectives

Example policy objective	**Potential contribution of shellfish aquaculture**
Improve social nutrition, particularly the consumption of seafood	Increases the variety of seafood available – potential to attract non fish eating consumers?
Reduce public sector carbon footprint	Offer low-input locally produced seafood for food service procurement
Reduce carbon input to food production	Shellfish play an important carbon sequestration role and have a lower carbon footprint than most intensive meat production systems
Reduce industrial and other polluting discharges to natural waters	Provide substantive rationale for ensuring unpolluted coastal waters for food production
Reduce the impact of algal blooms in coastal waters	Shellfish production helps to balance nutrient cycles and remove microalgae
Economic development of coastal and peripheral areas	Offers a more sustainable livelihood activity with potential for multiplier effects through value adding processes and purchasing
Protection of habitats and promotion of biodiversity	Shellfish aquaculture has a role in the ecosystem and hence provides an opportunity to help with ecosystem monitoring and management
Economic growth through food and drink exports	Contribution to Scottish reputation for high quality and sustainably produced food

4 Initial analysis of the Scottish shellfish industry

4.1 Characterising the Scottish shellfish sector

4.1.1 Production performance

Scottish shellfish production is monitored by Marine Scotland through an annual survey of producers. The following summary is based on the 2008 Survey (Marine Scotland, 2009), which is the latest available.

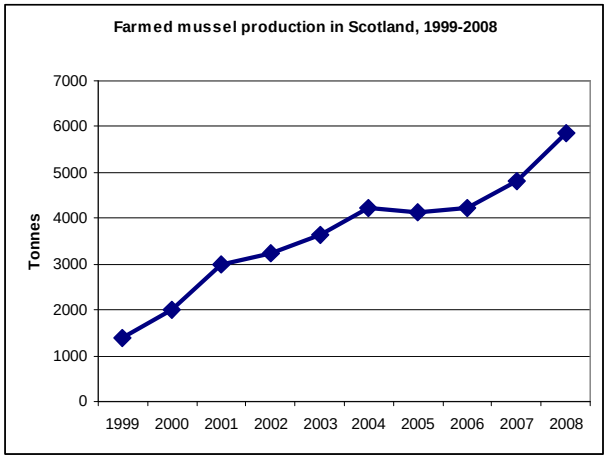
The industry produces four species as shown in Table 4.1. Mussels are the dominant sub-sector with Pacific oysters also significant. The overall value of £7.55 million is modest in comparison with fin-fish aquaculture

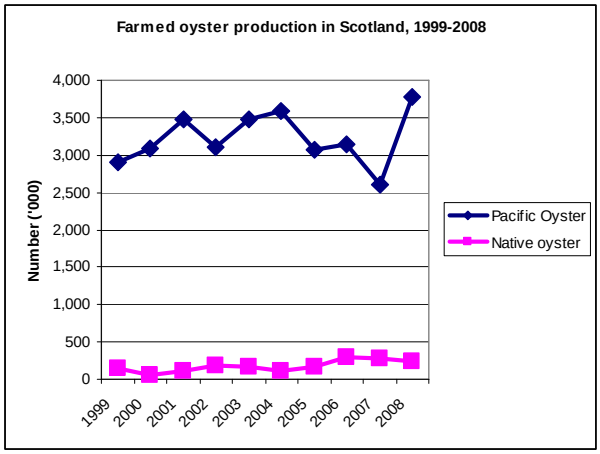
Table 4.1. Overview of Scottish farmed shellfish production and value in 2008

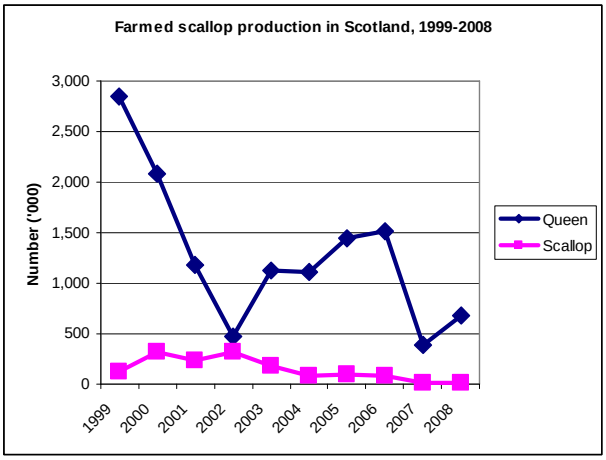
Common name	Scientific name	Production (tonnes)	Production ('000)	Approximate first sale value (£ million)
Mussel	*Mytilus spp*	5,869		5.9
Pacific oyster	*Crassostrea gigas*		3,785	1.5
Native oyster	*Ostrea edulis*		250	0.09
Queen (Queen scallop)	*Chlamys opercularis*		687	0.05
Scallop (King scallop)	*Pecten maximus*		15	0.01

Mussel production has grown steadily over the past 10 years, whilst oyster production has been more variable, with only slight growth overall. Queen and king scallop production have also been variable, but with a declining trend.

Figure 4-1. Scottish bivalve production 1999-2008 by species







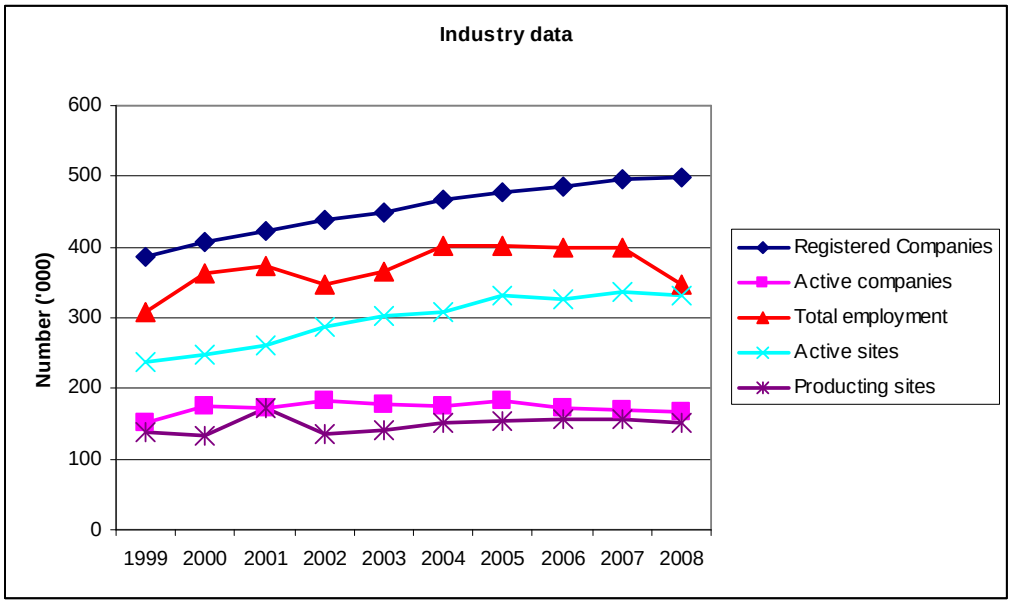
Source: Marine Scotland (2009). (Note: figures exclude shellfish recorded as cultured for ongrowing)

Scotland also has a significant alternative source of mussels from the Tain mussel fishery in the Dornoch Firth. Strictly speaking however this is not culture as the fishery is for wild, unmanaged stock, and the production is not therefore included in the farming statistics. Production is normally in the range of 800-1000t p.a., although has declined in recent years.

4.1.2 Industry structure

The same survey recorded 497 registered shellfish companies of which 33% (168) were classed as active in 2008 and 88 recording sales. These utilised 332 sites (approximately two active sites per active company). With 348 people employed in the sector, there is an average of around two people per company, or one per active site. However, only 43% of these are full time jobs, with 16% of the remaining jobs classed as casual. Trends in this data over the 10 years to 2008 are shown in Figure 4-2. This shows a rise in the number of active sites and some rise in employment, although there appears to have been some reduction of the latter in 2008.

Figure 4-2. Key Scottish shellfish industry statistics 1999-2008



Source: Marine Scotland (2009)

There were 52 companies with sales of mussels in 2008. Of these, twenty (38%) produced over 100t tonnes of mussels, representing 81% of total Scottish production. Eight companies (out of 32) (25%) produced more than 100,000 Pacific oysters, representing 66% of the Scottish total. Overall the sector may be considered fragmented with minimal consolidation.

4.1.3 Technology employed

4.1.3.1 Mussel farming

The predominant technology used for mussel farming is based on suspending ropes in coastal waters which are naturally colonised by mussel spat (waterborne juveniles) which feed and grow by filtering naturally occurring plankton and other nutrients from the seawater. The farming technology is designed to maximise the success of spatfall, protect the stock from predators and other hazards, and reduce manpower required for husbandry and harvesting.

The most common approach in Scotland is the use of horizontal longlines suspended either at or just below the water surface, supported by floats at regular intervals. These are moored in sea lochs where depths are between 15 and 40 metres and are fitted with vertical ropes (droppers) upon which the spat settle. These ropes have plastic pegs placed through them at regular intervals to prevent the mussels sliding off as they grow, and to increase the surface area for settlement. A standard longline is 200 metres in length and modern practice is to have two headropes running either side of flotation buoys, which are arranged at intervals along the lines, generally around 4 metres apart. Some farms are now using a continuous rope or ladder that loops between the surface and bottom of the installation as this can provide efficiency gains in deployment and harvesting. The use of lines suspended from moored rafts are common in Spain, but have limited uptake in Scotland. Other variations on suspended mussel culture systems include large mesh

nets suspended from polythene tubes (Norway), and modified longlines with submerged headropes for use in exposed conditions (France). Elsewhere in Europe the majority of mussels are produced from bottom culture – essentially enhanced fisheries for mussels (e.g. England, Wales, parts of Ireland and especially the Netherlands). In France, the use of vertical poles on tidal beaches ("bouchot") is more common.

In Scotland, mussels take between 2 and 3 years to reach market size. The stock is typically left undisturbed until harvesting. At that point, the mussels are stripped from the line, cleaned and graded. Mussels that are too small for the market will often be put back on the droppers using a variety of methods and cultured for a further period. Stock can also be moved from one site (e.g. that is good for spatfall) to another for ongrowing to harvest size. Harvested mussels often require depuration where they are flushed with sterilised seawater in land-based stations for a defined period to ensure they do not harbour any pathogens.

4.1.3.2 Scallop farming

The cultivation of scallops follows a broadly similar pattern to mussels in that seed stock is obtained from the wild using mesh bags attached to longlines as collectors. These are transferred into lantern nets (stacked trays within a lantern-shaped net suspended from a long-line or raft), or into trays supported off the sea bed on trestles for on-growing. Queen scallops are usually harvested after 2-3 years whilst king scallops can take up to 6 years and are often transferred to the sea bed for final grow out.

4.1.3.3 Oyster farming

The culture technology used for oyster farming typically uses growing bags supported on trestles located on shore between high and low water levels. Unlike mussels and scallops, oyster juveniles are obtained from specialised hatcheries. The culture cycle is in the region of 2-3 years and requires periodic grading and separation to allow oysters sufficient space to develop. Harvested oysters may require depuration depending on the area of cultivation.

4.2 SWOT and PESTLE analysis

In response to the requirements of the study brief, and in order to highlight the key issues facing the industry at an early stage in the study, SWOT (strengths, weaknesses, opportunities and threats) and PEST (political, economic, social and technological) analyses were carried out. The PEST analysis was expanded to include legal and environmental headings as below.

The PESTLE analysis provides a scan of the macro-environment in which the industry operates, whilst the SWOT analysis identifies the internal and external factors that are favorable and unfavorable to achieving a successful industry, namely one that is "ambitious, thriving, growing, diverse, profitable and sustainable". Critically the SWOT should help identify factors that may be of comparative advantage or weakness.

The analyses were carried out by the study team in conjunction with the Steering Group. The results are given in Table 4.2 and Table 4.3, and key factors are discussed in detail in later sections of the report as appropriate.

Table 4.2. PESTLE analysis - shellfish farming in Scotland

PESTLE analysis factors	**Notes**	**Potential Impact**	**Implication and importance**			
External factors that may affect the environment in which the industry operates	**How might the factors listed on the left impact the industry ?**	**High - H Med - M Low - L Undet - U**		**Type: Positive + Negative – Unknown U**	**Impact: Increasing > Unchanged = Decreasing < Unknown U**	**Relative importance: Critical C Important I Un-imp. UI Unknown U**
POLITICAL						
Government policy for aquaculture	Strategic Framework for Scottish Aquaculture broadly supportive, but shellfish element needs development	H		+	>	C
Government leadership	Present Minister for Environment very supportive	M		+	>	I
Political trends	Trend to devolution should be beneficial	M		+	>	I
Government departments responsible for aquaculture	Need for joined-up thinking	U		U	U	I
Planning policy	Needs further work to improve site availability	H		-	>	C
European Commission relations	Lack of co-operation may impact development (DGs MARE, SANCO, R&D in particular)	M		-	>	C
International pressure groups	Environmental NGOs have potential to positively support industry (ASSG-WWF concordat, mollusc dialogue)	M		+	U	U
Funding for industry representation (ASSG)	Lack of funding seriously compromises ability of industry to engage with regulators & others	H		-	>	C
EFF grant funding	Significant funds available for capital expenditure (20-40%), subject to scheme priorities & limits	H		+	>	C
Government top-up grants	Top up funds of up to 20% on capex	H				
National Food & Drink Policy	Positive promotion of the industry	M		+	>	I
ECONOMIC						
Market factors						
Generic promotion	Increased demand	M		+	=	I
Brand identity & association with other Scottish products	Increased demand	M		+	=	I
Impact of recession on market	Less eating out affects foodservice market	M		-	D	I
Market information: access & awareness – espec. re. export mkt.	Lack of awareness limits market access	M		-	U	I
Supply chain logistics	Distance from markets increases complexity & cost	M		-	=	I
Processing/product development/value adding	Increased demand	H		+	>	I
Finance						
Lack of private sector funding	Holds back development of sector	H		-	=	C
Lack of credit facilities	Holds back development of sector	M		-	=	C
Euro exchange rate for exports	Current rate favours exports	M		+	U	I
Availability of insurance	Lack of stock insurance affects access to finance	L		+	U	U

PESTLE analysis factors	Notes	Potential Impact		Implication and importance		
External factors that may affect the environment in which the industry operates	**How might the factors listed on the left impact the industry ?**	**High - H Med - M Low - L Undet - U**		**Type: Positive + Negative – Unknown U**	**Impact: Increasing > Unchanged = Decreasing < Unknown U**	**Relative importance: Critical C Important I Un-imp. UI Unknown U**
Other						
Cost of securing sites (planning costs, EIAs)	Increased planning & other costs hinders start-ups, esp. for smaller operators	H		-	>	I
Closer co-operation with EU mollusc industries (bilateral and via EMPA)	Beneficial influence on EU regulation	L		+	=	I
Impact of disease e.g. oyster virus (?) from France	Limits seed imports, could devastate Scottish industry	H		-	=	C
SOCIAL						
Market factors						
Health benefits of eating seafood	Increased demand for shellfish	M		+	>	I
Increasing seafood consumption	Increased demand for shellfish	M		+	>	I
Ageing population	Widely travelled, health conscious, like fish & shellfish, increased demand for shellfish	M		+	>	I
Brand image	Scottish provenance a key asset	M		+	>	I
Availability & quality of end product	Customer satisfaction	M		+	=	C
Relative split of in-home / foodservice consumption for shellfish	Will determine preferred product forms	M		U	U	U
Trend to sustainable sourcing	Should favour shellfish production but better accreditation may be necessary	M		+	>	I
Marketing cooperatives	Beneficial (essential ?) to bring together smaller producers	M		+	=	I
Human resource factors						
Availability of labour	Quality labour often difficult to source in rural areas	M		-	=	I
Negative attitudes to outdoor work	Limits uptake of available posts	L		-	=	UI
Training/qualifications & education	Needed to develop and retain skilled workforce	M		+	=	I
TECHNOLOGICAL						
Cost of production	Higher costs limit competitive position esp. on export markets	H		-	>	C
New production technologies	Offer scope for reduced production costs of mussels	H		+	>	C
Site availability	Lack of suitable sites (esp. oysters) and difficulties in obtaining them limit expansion	H		-	>	C
R&D funding	Limited funding affects ability of industry to adopt new technologies & overcome existing production issues	H		-	=	C
Contracting sector	Development of a contracting sector would improve production efficiency (e.g. NZ)	M		+	>	U

PESTLE analysis factors	**Notes**	**Potential Impact**		**Implication and importance**		
External factors that may affect the environment in which the industry operates	**How might the factors listed on the left impact the industry ?**	**High - H Med - M Low - L Undet - U**		**Type: Positive + Negative – Unknown U**	**Impact: Increasing > Unchanged = Decreasing < Unknown U**	**Relative importance: Critical C Important I Un-imp. UI Unknown U**
Hatchery development	Greater self sufficiency in oyster (& possibly mussel) seed, scope for genetic improvement and out of season production	M		+	=	I
LEGAL						
Marine Bill	Impact of MPAs, (partially) centralised planning controls	M		U	>	I
Water Framework Directive (WFD)	Implications for Shellfish Growing Waters; RBMPs	H		U	>	C
Shellfish Hygiene Directive (91/492/EEC)	Classification of shellfish harvesting areas; phytoplankton monitoring; biotoxin testing	M		U	=	C
Aquatic Animal Health Directive (2006/88/EC)	Disease monitoring & control of deposit/ translocation management	M		U	=	C
Crown Estate lease terms	May affect investor/ creditor sentiment	L		U	<	I
ENVIRONMENTAL						
Scottish Water investment in water treatment	Quality of shellfish growing waters	H		U	>	I
Non native species	E.g. *Didemnum*, threaten productivity	H		-	>	I
Status of C Gigas as non native species	Possible re-designation as an invasive non-native species could threaten Pacific oyster industry	H		-	U	C
Regulation – microbiological, biotoxin & other contaminants	Increasing regulation hinders development of industry	M		-	>	I
Climate change	Impacts on phytoplankton production, growth, diffuse pollution	M		U	U	U

Table 4.3. SWOT analysis - shellfish farming in Scotland

STRENGTHS	**WEAKNESSES**
Market factors	***Environmental factors***
Scottish provenance/positive image	Industry uniquely vulnerable to environmental factors outwith its control (spatfall, growth, fouling, predation, water quality, biotoxins)
Health benefits of eating shellfish	Classification of shellfish harvesting areas: disadvantageous UK system compared with overseas competitors
Increasing consumption of seafood, "green" product	Management of microbiological contamination (on going)
Cooperative marketing through SSMG	Toxin testing methodology and overall management of biotoxin events
Marketing through integrated chain (e.g. LFO)	***Market factors***
Marketing through multiple source/focussed market (e.g. IOS/Demlane)	Industry is production led rather than market led
Market diversification – via EU 27 & beyond – close proximity & trade advantages	Dependence on wholesale markets
Consumer confidence in product	Limited portfolio of added value products
Other factors	B grade mussels have to be discarded (only limited processing)
Govt. commitment to aquaculture	Quality & cost of market information
Good water quality	Limited access to market intelligence (e.g. prices in European markets)
Good potential sites	Limited efforts to fully identify growth opportunities (volume &/or price)
Availability of EFF funds	***Production factors***
Strong Scottish science base (individuals & Institutions)	Slower growth & higher production costs than competitors
	Small scale of industry and constituent businesses limits scale economies
	Limited uptake of novel production technology (mussels)
	Lack of Scottish hatchery supply of oyster seed
	Lack of hatchery supply of mussel seeded ropes
	Finance
	Limited availability of capital (investment & working)
	Poor understanding of the sector by banks/financiers
	Farm assets (excluding land) typically not acceptable as security by lenders
	R&D
	Lack of applied research
	Limited research funding
	Other factors
	Industry representation difficult due to small size of industry & lack of funding
	Limited availability of labour in rural areas
	Limited industry engagement with trainers despite opportunity
	Transport logistics – distance from markets
	Planning constraints limit site availability

OPPORTUNITIES	THREATS
Market factors	***Market factors***
Domestic (UK) market expansion	Failure of market for Scottish produce to expand as expected (demographics; lack of added value products; cheaper imports)
Export market potential	***Production factors***
New product development	Predation e.g. eider ducks, starfish
Increased market share if production cost reduced	***Environmental factors***
Accreditation to satisfy customer desires e.g. Marine Stewardship Council (MSC)	Spread of oyster disease from France
Improved generic promotion (but who pays ?)	Deteriorating water quality esp. diffuse pollution
Better use of B grade mussels	Non native species e.g. *Didemnum*
Chance to "sell the story" re. sustainability, carbon sequestration, biodiversity etc	Spread of *M.trossulus*
Production factors	Production problems e.g. tubeworm fouling
Large scale possibly offshore operations may offer scope for economies of scale and reduced production costs	Impact of climate change e.g. increased rainfall could increase diffuse pollution
New production technologies e.g. continuous mussel culture	***Regulation***
Greater self sufficiency in seed supply (oysters)	Increasing burden of regulation
Climate change: e.g. increased temperatures may improve growth	Planning process and cost
Other factors	Complexity of regulations regarding depuration of shellfish
Better planning policy to improve site availability	***Other factors***
Use of unused salmon sites to improve site availability for mussels	Competition from other industries / suppliers of the same species e.g. Chile
Better water quality assessment to aid harvesting	Competition for limited supplies of oyster seed (e.g. Irish & French purchases from UK hatcheries)
River Basin Management Plans (RBMPs) should lead to better control of diffuse pollution	Shrinking employment leading to reduction in the 'skill pool' (-14% in 2008)
Better communication between industry and regulators	

5 International context

5.1 Introduction

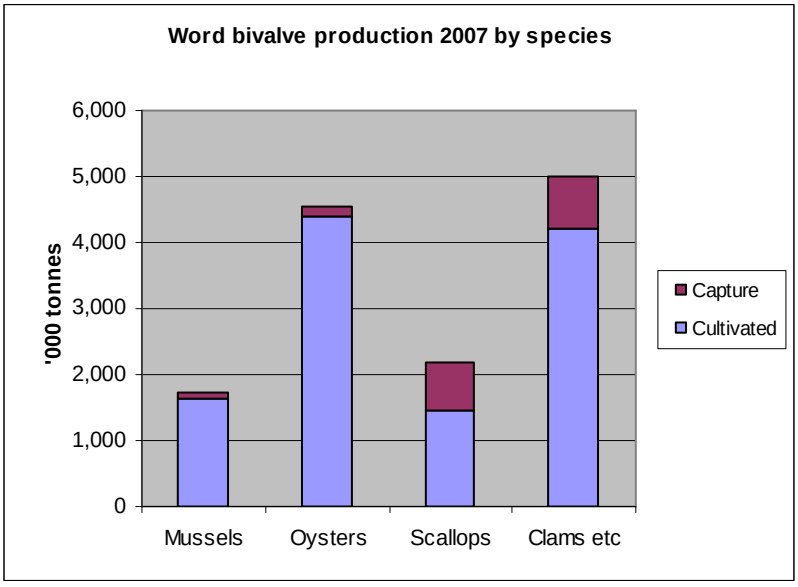
In determining the prospects and opportunities for Scottish farmed shellfish, it is necessary to take into account production elsewhere, both globally and in the EU, and in particular how that production might impact on the markets that the Scottish industry supplies or aspires to supply.

5.2 Global production context

Worldwide production of the shellfish species of particular interest to the Scottish industry (primarily mussels, oysters and scallops) is difficult to quantify with great precision, particularly after the recent downward revision of China's aquaculture production for 2006 by 13.5%.

Nevertheless, on the basis of the FAO (Fishstat Plus) 2007 estimates, total bivalve production reached 13.5 million metric tonnes, of which 11.7 million tonnes were cultivated and 1.8 million tonnes were from capture fisheries. This total output was made up of around 1.7 million tonnes of mussels (94% cultivated), some 4.6 million tonnes of oysters (96.7% cultivated), 2.2 million tonnes of scallops (66% cultivated) and 5 million tonnes of clams/cockles/ark shells (84% cultivated), with an average 87% of total production from cultivation (see Figure 5-1).

Figure 5-1. World bivalve production in 2007 by species

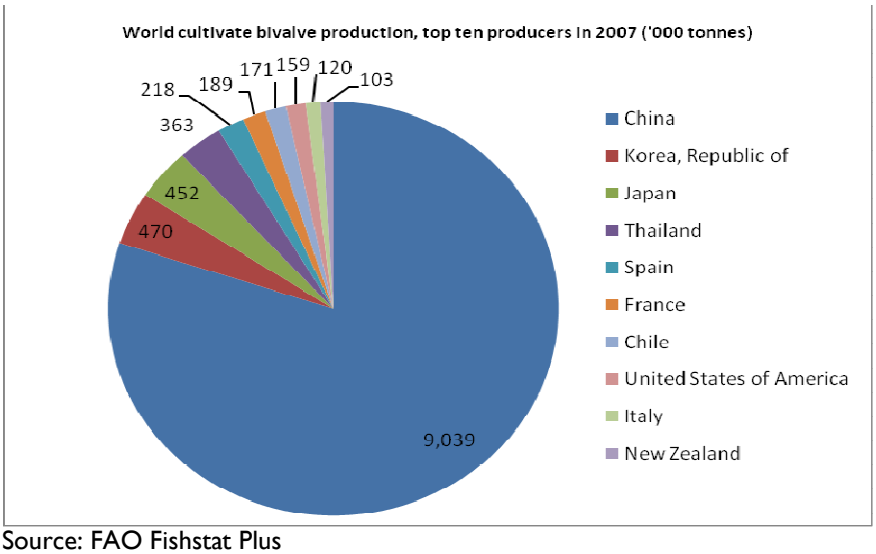


Source: FAO Fishstat Plus

Cultivated bivalve production is dominated by China with a reported (and revised) 9.0 million tonnes, some 80% of the global total (see Figure 5-2), whilst Asia in total supplied almost 10.5 million tonnes (93%). The EU contributed an estimated 686,000t (6%), followed by Latin America with 207,000t (1.8%), North America with 198,000t (1.7%) and Oceania with 120,000t (1.0%).

In the context of the global or even EU context, Scottish farmed shellfish production of around 6,000t is clearly relatively insignificant.

Figure 5-2. World cultivated bivalve production 2007 by major producer



Source: FAO Fishstat Plus

5.3 International trade

International trade in Fresh, Chilled and Frozen (FCF) bivalve molluscs (Source: Globefish summarisation of FAO Fishstat Plus) continues to remain remarkably limited, even including intra-regional trade, such as between EU Member States. Global FCF imports in 2006 totalled 463,000t, including 277,000t for mussels (15.9% of total global production), 42,000t for oysters (1%), 106,000t for scallops (4.8%) and 38,000t for clams *et al* (0.8%), with no specific country dominating trade in any species. Exports of mussels appear to be the only expanding sector, with steadily rising volumes during recent years, whereas exports of oysters and clams have declined from peaks reached in 2003 and 2001 respectively.

However, overall exports for 2006 (all forms, including FCF, canned, marinaded, etc) reported in the FAO Yearbook (Fishery and Aquaculture Statistics) totalled just over 1.92 million tonnes, including 791,000t for mussels, 148,000t for oysters, 761,000t for scallops and 223,000t for clams. Preliminary data for 2007 indicates aggregate bivalve exports totalled 1.88 million tonnes, an overall decline of 2%, largely due to a decline to 670,000t (-15%) for mussels (Table 5.1).

Table 5.1. World export trade in bivalves by volume ('000 tonnes)

	2006	2006	2007
	Fresh, chilled frozen	All product forms	All product forms
Oysters	42	148	219 (+48%)
Mussels	277	791	670 (-15%)
Scallops	106	761	733 (14%)
Clams, etc	38	223	262 (+17%)
Total	463	1,923	1,884 (-2%)

Source: Fresh, Chilled, Frozen: Globefish Fishstats Plus; all forms: FAO Yearbook

Nevertheless, there is a widespread perception in many countries that international trade in bivalves is poised to 'take off', to follow the rapid growth in volume that has been enjoyed by New Zealand (Greenshell Mussels), Chile (Blue Mussels) and various producers of scallops (Argentina, Chile, Thailand and Vietnam).

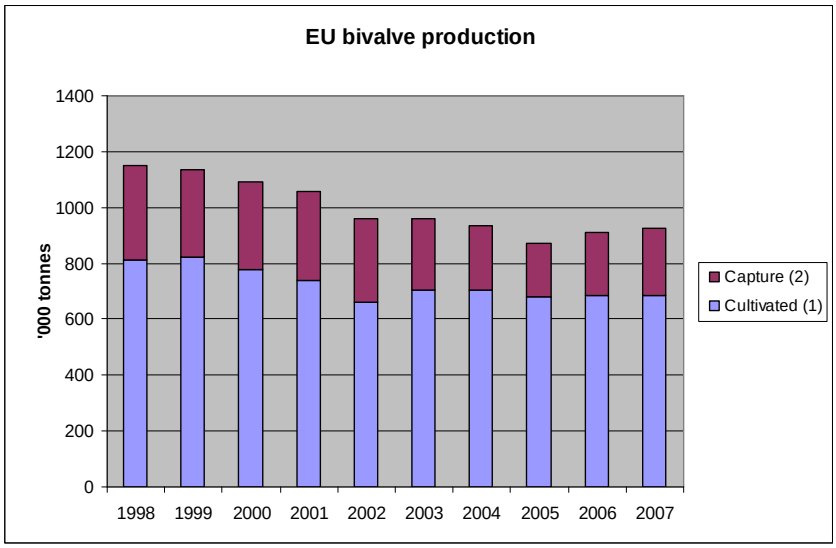
5.4 EU context

Although there may well be niche market opportunities for Scottish shellfish exports around the globe - partly a reflection of the Scottish diaspora - the more realistic international context for commercial assessment must be within Europe and the EU specifically. This is particularly true when the overall EU experience in terms of supplying the 'domestic' market for the bivalve sector is assessed over the past decade.

There are a number of high level issues in the European arena, some national and some more international:

- Total EU production of bivalves, including both cultivated and capture supplies, appears to have entered a period of long term secular decline (see Figure 5-3). Having achieved a level of around 1.15 million tonnes in 1998-99 (after a steady expansion from around 400,000t in 1970), output has declined to around 920,000t in 2007, a contraction of almost 20% from the peak. Declines were recorded for both cultivated and capture supplies, from around 820,000t at the end of the 'nineties to around 690,000t in 2006-07 for cultivated production (reduction of 16%) and from just over 300,000t to just over 200,000t by 2006-07 for capture volumes (decline of around 29%). Partly as a result of this contraction, there has been an increase in imports (27% or around 60,000t) over the period 1998 – 2006, giving the EU a 56% share of global imports. However, a majority of these imports are from intra-EU trade;

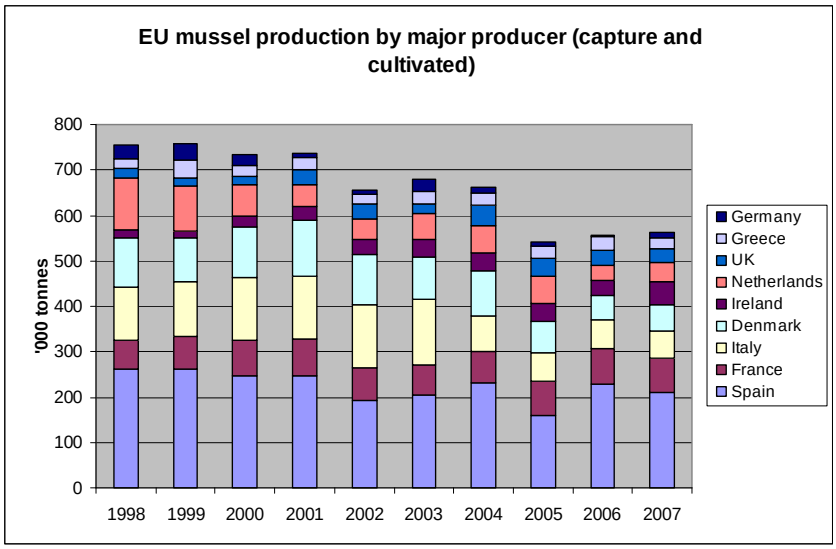
Figure 5-3. EU bivalve production 1998 to 2007



Source: FAO Fishstat Plus

- The cultivation sectors of the mature producing nations of mainland Europe are all either at effective capacity and can be expected to contract in size (in light of tighter environmental restrictions, planning constraints and competition for space) or are already in decline as a result of these pressures (see Figure 5-4). Although Scottish bivalve production volumes are currently marginal in scale even in the regional European context, the Scottish industry is clearly underdeveloped and has the potential to expand;

Figure 5-4. EU mussel production by major producer 1998 to 2007



Source: FAO Fishstat Plus

- An increase in production in peripheral European areas in the recent past (Scotland, Ireland, Norway, Denmark, Greece) and in imports from third countries (Chile, New Zealand, various Asia nations) has led to:
    - Displacement effects within the European market e.g. Spanish mussels expanding into new markets (both national and type of product), expanding Greek volumes of commodity mussels into Italy, growth of Danish exports (mussels and oysters) as the cultivation sector has expanded;
    - A more varied offering to consumers, e.g. some eight sources of frozen scallop meats in French supermarkets (at eight price points), low cost Chilean mussel meats in European supermarket freezers. How they react to such variety will strongly influence the future market opportunities for Scottish bivalve exports;
- There are a number of radical volumetric events which are having fundamental effects on European marketing channels, e.g. the major decline in volumes of Dutch mussels, the projected (2010) significant reduction in production of French marketable oysters, the rapid rise in imports of frozen Chilean mussel meats, the recent contraction in Greek mussel production;
- The implementation of the Habitats Directive, the Hygiene Regulation (852/3/4 2004) and the Water Framework Directive, and the associated issue of rising costs to improve/safeguard water quality for shellfish waters;
- The costs, and interruption to supply, associated with biotoxin management and microbial classification/management of Harvesting Areas.

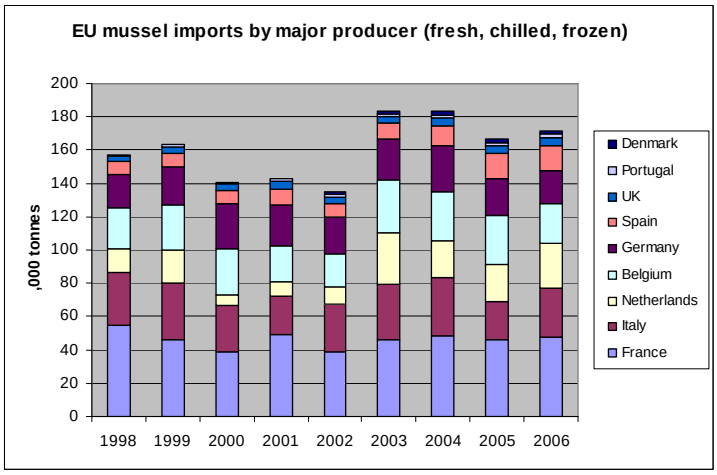
These issues are influencing all bivalve markets across Europe, and, indeed, influencing marketing strategies in many third country suppliers, such as Chile, Australia, New Zealand and Peru.

However, the market situation differs for each species, and in each EU Member State, as outlined below:

Mussels

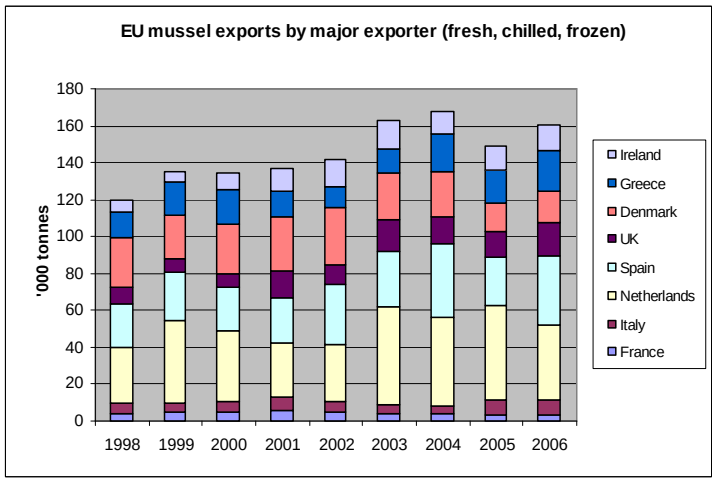
- In Spain, Europe's leading mussel producer, output has averaged around 205,000t in the last five years, a significant drop from the 1998 – 2003 average of 254,000t p.a.. Imports of competitively priced frozen mussel meats from Chile have risen in recent years, driving an overall rise in imported volumes from around 8,000t p.a. to over 15,000t p.a. into Spain (see Figure 5-5). This has led to a downstream impact on exports, so that, in contrast to previously stable levels of around the mid-20,000t p.a., export volumes have become more erratic, with year-on-year changes of +31% (2004), -36% (2005) and +43% (2006) (see Figure 5-6). During years when domestic production has exceeded the output of the previous year, such as 2004 and 2006 (around 230,000t in each year), Spanish exports have risen significantly (+10 and + 11 thousand tonnes respectively), being marketed primarily into France and Italy.

Figure 5-5. EU mussel imports by major producer 1998-2006



Source: FAO Fishstat Plus

Figure 5-6. EU mussel exports by major exporter



Source: FAO Fishstat Plus

- In the Netherlands, cultivated mussel production has been in decline for some time, from levels of over 100,000t p.a. in the 'nineties to around 30-40,000t in recent years, largely as a result of restricted access to seed mussels on conservation/environmental/ avian requirement grounds. Interpretation of the Habitats Directive relating to Natura 2000 sites has been more restrictive than in most other Member States, with a significant impact on the mussel industry (and indeed, the cockle sector). As a result, given the large scale of the processing industry, imports have increased from around 15,000t p.a. to around 30,000t p.a., while exports to France (the second largest export market for Dutch mussels) have declined from close to 30,000t in 1998 to around 10,000t in 2007 and 2008. Mussel processors in the Netherlands are actively seeking strategic supplies from other Member States such as Ireland and third countries such as Chile, including negotiating long term contractual purchases to purchasing existing farms and establishing new Dutch owned cultivation operations.

- Belgium is not a significant producer of mussels, but represents an important established and reasonably stable market for Dutch and French suppliers, with the highest per capita consumption in Europe. FAO statistics for the period 2003-2005 give imports of around 30,000t p.a., contracting to 23,000t in 2006. Anecdotal evidence however suggests that the actual size of the Belgian market is significantly larger, perhaps around 50-60,000t p.a., with the principal supplier being Holland. One of the market dynamics here is the relatively high income levels enjoyed in Brussels, where there is a large restaurant sector and strong demand for the traditional dish of mussels – however, equally strong are the wishes to see the traditional form of mussels (colour, shape, meat content) supplied in the correct season. These wishes create two potential constraints for new suppliers (unless overcome by innovative marketing strategies).

- In France, mussel production has remained reasonably stable over the past decade, at just over 70,000t p.a. for cultivated volumes (including some 6,000t p.a. from the Mediterranean) and 5-6,000t p.a. for capture supplies. Imports, particularly live volumes, also appear reasonably stable, at around 40,000t p.a., although there are indications of a possible change to a long term contraction in recent years, with reductions to 36,000t in 2007 and an estimated 31,000t in 2008. As the Dutch contribution to mussel imports has declined, from 60% in 1998 to around 30% in 2008 (see above), Spanish live supplies have filled the gap, rising from 6,000t (12%) in 1998 to 11,000t (30%) in 2008. In addition, there has been a steady increase in imports of processed mussels, both from traditional suppliers, such as Denmark and the Netherlands, and from Chile. Chilean mussel exports to France (mainly frozen meats) reached around 8,000t in 2007, representing almost 45% of total processed imports of 17,000t (a doubling of the 2005 share of 22%).

- In Italy, production is recorded as declining significantly over the past decade, from around a consistent 90,000t p.a. (peaking at 100,000t in 2003) to close to 60,000t p.a. in 2005-07. This decline may have been due to competition from cheap Greek imports and problems with toxins. Imports have not recorded any particular increase, remaining in the range 25-30,000t p.a. during this period, with strongest growth shown in volumes from Chile and Spain at the expense of other traditional exporters (Denmark, Netherlands, Turkey and Greece). Exports appear to have remained relatively stable at close to the long term average level of around 7,000t p.a..

- In Greece, production expanded fairly steadily from 14,000t p.a. in 1998 to 28,000t in 2006; however in more recent years output has declined and it is unclear whether the sector will regain its growth momentum of earlier years. However, the driver here is the export market, and in light of declining output from the Netherlands, Spain and Italy, a strong demand 'pull' is likely to remain in place (although imports of frozen meats from Chile remain major competition).

- In Ireland, total mussel production appears to have plateaued at 35-40,000t p.a. (the majority of these volumes are from the bottom grown 'ranching' sector, with around 9,000t from the rope cultivation sector), and it is unclear whether higher target levels will be reached in future years, in light of the many issues restraining the expansion of the sector. A review of the rope mussel sector (PricewaterhouseCoopers, 2006) identified major issues involving biotoxin management, licensing arrangements and the interrelationships between the production and processing segments of the industry. The report also noted the low and declining profitability of the sector, which may be an element in reported sales of production operations to Dutch processors. As in Greece, the main driver for expansion of production volumes is the export market, and similarly potential demand in other EU markets may be impacted by the rising volume of imports of frozen mussel meats from Chile.

- No review of the European mussel sector would be complete without noting the impact of imports from two particular countries, namely New Zealand and Chile.

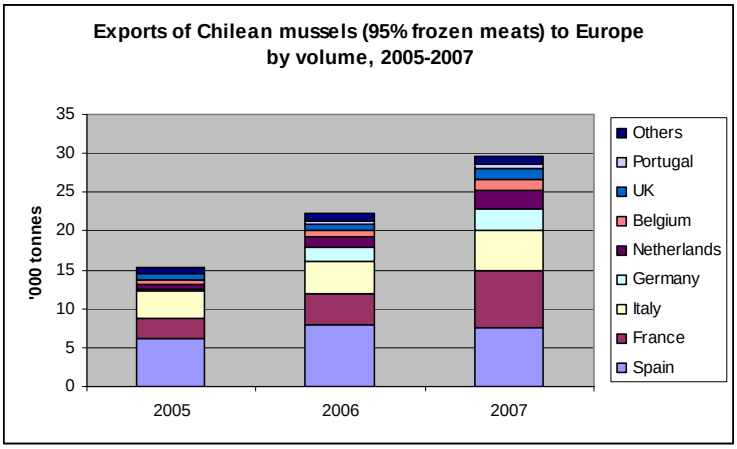
Imports of 'Greenshell Mussels' (originally 'Greenlip Mussels') from New Zealand have had a dual impact: they have added a novel and exotic dimension to the mussel sector, stimulating interest and overall consumption; also, they are not a direct competitor with normal blue/black European mussels, due to size and format (frozen, half-shell).

Chile has recorded production increases from little more than 15,000t p.a. in the late 'nineties to 60,000t in 2003 and 150,000t in 2007, a remarkable expansion for a new, and clearly dynamic, industry. Chilean imports to the EU are much closer to a direct competitor with domestic European products. Although a frozen meat product, many consumers fail to detect significant differences in flavour/texture between a frozen mussel meat and a fresh meat when they are an ingredient in prepared meals such as paella, risotto, pizza, or casserole. In these purchasing situations, price becomes the main determinant of choice, and Chilean mussels, despite the distance, at a price of US$0.20/kg [2005] delivered to the processing plant (Flores, 2006), are competitively priced in European retail outlets and catering establishments e.g. in January 2010 chilled previously frozen Chilean mussel meats were selling at £5.55/kg in Tesco UK.

Exports of mussels from Chile to Europe doubled between 2005 and 2007 from 15,000 to 30,000t (see Figure 5-7), with significant increases to all countries except Spain, the largest importer, where exports declined slightly in 2007. 95% of Chilean exports are frozen meats, which assuming a meat yield of 25% suggests a live weight equivalent of around 120,000t in 2007 for exports to the EU. In the context of EU production of 560,000t in 2007, this is clearly very significant. The increase in export volumes to the EU was reflected by an equivalent increase in values, which in 2007 reached €55 million, or €1800/t. In live-weight-equivalent terms, this amounts to €450/t (around £400/t), suggesting a UK delivered price pre retail margin of around £250/t. This indicates the nature of the challenge posed by Chilean supply to EU producers, whose production costs are for the most part likely to be significantly greater than this.

Whilst most Chilean exports to the EU are presently of frozen meats, there is potential in the future for other product forms e.g. frozen whole vacuum packed mussels to enter the EU market and to compete more directly with similar Irish and Scottish products. Indeed, the Irish company Bantry Bay Seafoods which has a joint venture processing operation in Chile is already offering frozen whole Chilean mussels.

Figure 5-7. Exports of Chilean mussels to Europe by volume, 2005 to 2007



Source: GTIS (US customs database)

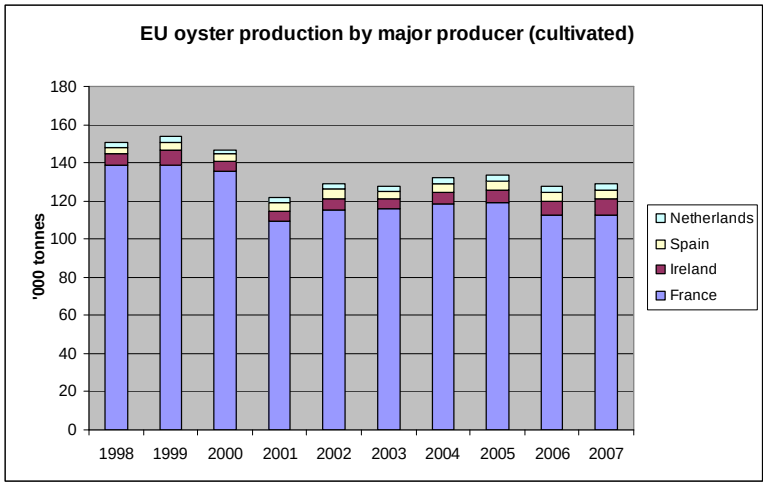
Oysters

- In France, the main oyster producer and consumer within the EU, oyster production has remained reasonably stable in the period 2001 to 2007 at between 110-120,000t p.a., including around 8-9,000t p.a. from the Mediterranean (see Figure 5-8). However, the impact of the herpes virus, which led to extremely high mortalities in spat and juvenile oysters in 2008 and 2009, is projected to impact upon market-size output in 2010, potentially leading to major supply shortfalls and elevated market prices, in turn creating a major increase in imports above the normal level of around 3,000t p.a. from various producers around the globe. Exports of French oysters have been rising in recent years, from around 6,000t p.a. to almost 10,000t in 2008, however this trade may decline in the near future, as a result of the expected domestic supply shortfall, thereby creating a further marketing opportunity for other producers.

- In the Netherlands, oyster production has remained stable at around 3,000t p.a. and is not expected to exhibit any significant growth in future years.

- In Ireland, production in 2007 rose by 16% to 8,000t, after several years of stability at between 5,000 and 6,000t p.a.. It is uncertain if this growth will be maintained, as the oyster sector is constrained by biotoxin management and licensing issues, in a similar fashion to the mussel industry. However, interest from French growers and wholesalers in supporting or buying out Irish growers and establishing French owned farms may enable the sector to continue expanding. 85% of Irish oyster production is exported to France, and demand is likely to increase further in view of the disease situation. This in turn will ease pressure on the UK market.

Figure 5-8. EU oyster production by major producer, 1998 to 2007



Source: FAO Fishstat Plus

Scallops

- In France, Europe's largest market for scallops (king scallop [*Pecten maximus*] and other species), production has increased steadily over the past decade, from 14,000t in 1998 to 32 to 33,000t in 2005 - 07, while over the same period imports have risen from 15 to 26,000t. One of the outstanding features of the growth in imports has been the strong increase, from 11,000 to almost 22,000t in frozen product and, in contrast, a general stability in live/fresh volumes in the range of 4 to 5,000t p.a.. Another striking characteristic has been the expansion of countries supplying the French market, and the growing importance of Vietnam and South American producers (the latter supplying in excess of 50% of frozen imports in recent years). The 13% increase in frozen imports in 2006 to 21,700t created a situation of over-supply and led to a sharp fall in imports in 2007 to 17,000t, a decline of 22%, and below the level of 2004. Live/fresh imports have historically been dominated by the UK, however in 2007 and 2008 the USA achieved virtual parity of volume at around 2,000t p.a..

- In the UK, production has remained generally around the mid-20,000t p.a. throughout the period, while exports have remained similarly stable (around 8,000t p.a.). Imports have risen marginally, from 1- 2,000t over the decade;

- Spain and Italy have reasonably sized scallop markets, both largely dependent on imports, which have broadly doubled over the period 1998 – 2006, from 5 –10,000t p.a. and 3 – 6,000t p.a. respectively. The Spanish market currently absorbs some 1,500t p.a. of frozen scallops from France (approximately 30% of the total market) and around 1,000t p.a. of Italian and UK frozen scallops, plus a limited volume from the UK of fresh king scallops.

5.5 Conclusion

This brief contextualisation of the international bivalve sector indicates that there may be a number of different market opportunities for Scottish exports, which will – in terms of commercial scale – largely be in European markets. The declining production of core producers (long term for mussels – Spain, Netherlands – and short term for oysters - France) and the apparent plateauing of competitive peripheral producers (Greece and Ireland in terms of mussels, Ireland in terms of oysters) appears to offer a unique chance for Scottish producers to move beyond the beachhead that has already been established by initial exporters and to develop a substantive export trade with mainstream markets in continental Europe, although the competitive influence of Chilean frozen mussel meats must always be kept in mind. The market opportunities might not only be in those Member States where production is contracting but also in the export markets that those suppliers are being forced to surrender.

Although it will always be helpful to establish a clear national identity and corporate brand, it is clear that consumers are highly motivated by price, particularly when allied to perceived quality (size and texture – taste is more 'personal'). This explains the supermarket success of Chilean frozen mussel meats and Vietnamese and Argentinean frozen scallop meats. Therefore it will be essential for production, transportation and marketing costs to be minimised, particularly in view of Scotland's distance from European markets. Whether Scotland is in a position to profitably service such markets will be examined in a later section.

6 The market for Scottish farmed shellfish

6.1 Introduction

The prospects for Scottish farmed shellfish are generally considered to be most dependent on market demand, and thus a major part of this study has been devoted to this aspect. The initial PESTLE and SWOT analyses highlighted a range of factors relating to the market, and these are examined in more detail in this section.

An attempt has been made to assess the market for key species, especially mussels and oysters, in terms of market size, consumption trends, consumer profiles, market channels, sources of Scottish supply, competing suppliers, product forms, logistics, and export opportunities. Finally, factors relating to all species are considered, including provenance and branding, trends to sustainable sourcing, accreditation and promotion.

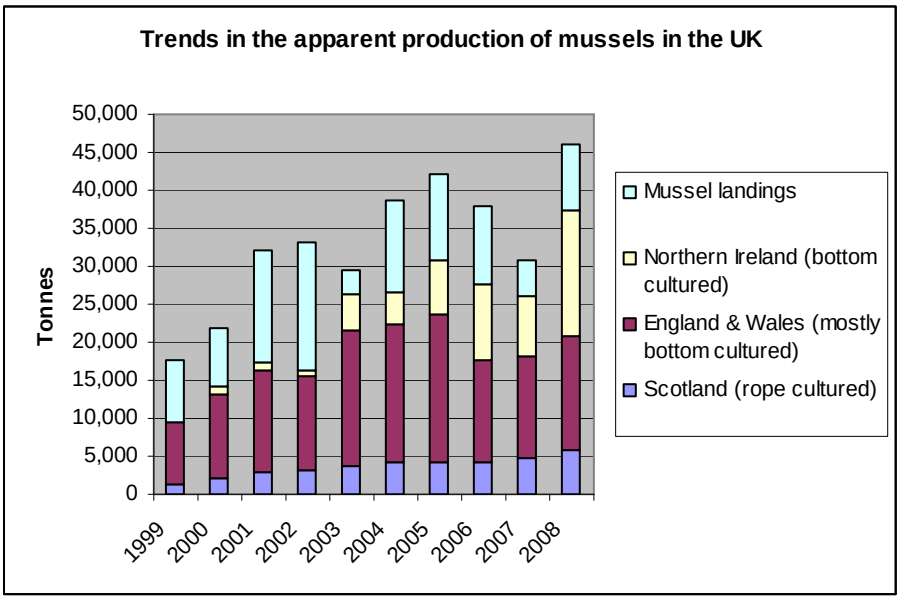
6.2 The UK market for Scottish mussels

6.2.1 UK supply of mussels

Production of mussels in the UK from all sources over the period 1999 to 2008 years has grown from around 17,000 to 46,000t p.a., the latter figure being achieved in 2008 (see Figure 6-1).

Caution must however be exercised in taking these figures at face value as it is likely that there is considerable overlap between "landings" and bottom culture production. Even removing landings from the picture, production has grown steadily and was over 35,000t in 2008, of which Scottish rope cultured mussels made up 5,870t (15%). The remainder were predominantly bottom cultured mussels from a variety of fisheries (both managed and wild) in England, Wales and N Ireland. The Northern Irish fishery has grown substantially over the past 10 years.

Figure 6-1. Trends in the production of mussels in the UK



Source: Cefas, 2009

6.2.2 UK trade in mussels

Mussel exports in 2008 were recorded as 13,757t (Cefas, 2009), with nearly 90% being live or chilled, and 85% of which were exported to the Netherlands.

However, it is known that in practice almost all of the bottom grown mussels from Northern Ireland, England and Wales (over 30,000t in 2008) are exported to the Netherlands, thus the official export figures are greatly underestimated.

Mussel imports in 2008 were recorded as 3,651t, 95% of which were in frozen or otherwise preserved form. 90% of the import trade was from 5 countries (New Zealand 25%, Ireland 26.5%, Germany 17%, Denmark 7.5%, Netherlands 17.3%). Imports of cooked meats from Chile are increasing and in 2009 are said to have reached 1078t.

6.2.3 Size of the UK market for mussels

Given the statistical anomalies, it is difficult to determine the exact size of the UK market for mussels. There is understood to be considerable overlap between so called "landings" and bottom cultured production. Furthermore, most bottom cultured stock is exported. There is certainly little or no evidence of bottom cultured mussels in wholesale or retail markets in the live or cooked in shell form. Industry sources suggest that the size of the UK market is between 15 and 20,000t for all product categories, of which 3 to 4,000t is frozen product. On this basis, Scottish farmed mussels make up a significant proportion of supplies, with imports likely to make up most of the balance.

6.2.4 Channels to market for Scottish mussels

Around 70% of Scottish production (around 4,000t) is marketed through the SSMG, a marketing cooperative owned by its grower members, of which 90% is to retail multiple outlets in fresh or vacuum packed form, and 10% to foodservice. Around 75% of supplies come from Shetland and the rest from the West Coast.

A further 15% of Scottish production is marketed via Isle of Shuna (IOS), a public limited company which has its own farm in Shetland (Demlane) and also has a supply agreement with Hebridean Mussels (Western Isles). Sales are split evenly between retail and foodservice.

The balance of Scottish production (around 15%) goes directly to wholesale markets, with a limited volume sold in bulk for export. Wholesale supply comes increasingly from Shetland, with the smaller established producers in the rest of Scotland finding it difficult to compete.

Overall, the market for Scottish rope cultured mussels is split around 80% to retail and 20% to foodservice by value. Around 15-25% of Scottish mussels by volume are said to pass through wholesale markets.

6.2.5 Retail markets

Retail sales are mainly to the multiple retailers, of which the main buyers are Tesco, Morrison, Asda, Sainsbury, Waitrose and Marks and Spencer (M&S). Lesser buyers include Aldi, Lidl, Coop, Somerfield and Iceland.

According to the latest Nielsen report (Nielsen, 2009), the UK retail trade accounted for just over 4,000t mussels in the year to end October 2009 (see Table 6.1), an increase of 28% on the previous year, albeit at slightly reduced unit value.

Table 6.1. Sales of mussels (ambient, fresh, frozen) to UK retail multiples y/e 31 10 09

Volume (000's kg)		Value (£000's)		Price per kg	
MAT	% change year	MAT	% change year	MAT	% change year
4,127	+28%	22,792	+19%	£5.52	-7%
MAT= moving annual total as at 31.10.09					

Source: Nielsen, 2009

This was however a strong performance against a background of a 7.4% decline in value of overall shellfish consumption in the year. Other notable indicators for mussels were increased frequency of purchase, spend per trip, and weight purchased per buyer.

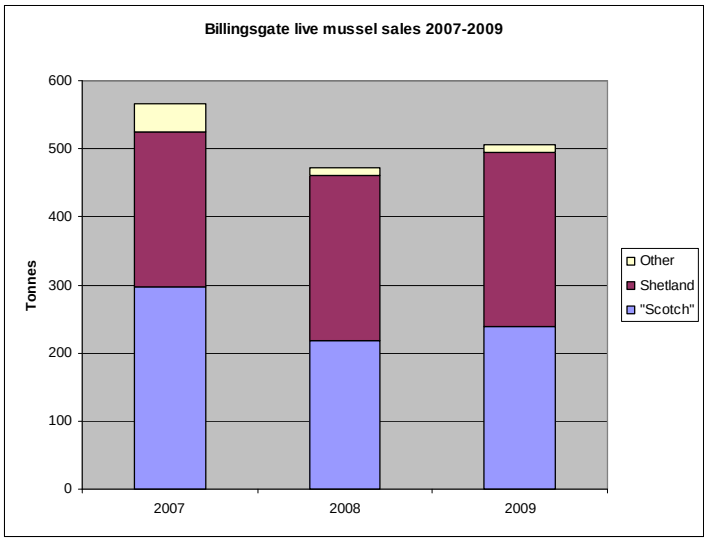
The breakdown between fresh, ambient and frozen mussel sales (by volume) was around 93%, 6% and 1% respectively. It is assumed that fresh sales includes both sales of live mussels from the fresh fish counter and cooked vacuum packed sales from the chilled counter, as well as chilled (previously frozen) cooked mussel meats. The relatively high price per kg suggests that most sales are of cooked products rather than fresh live (see Table 6.3).

The very low volume of frozen mussels suggests a very strong consumer preference for fresh/chilled over the frozen format. This is of further interest given that Irish rope grown mussels are typically only seen in UK retail outlets in the whole vacuum packed frozen format, but raises the question as to why that is the case and why they do not have a greater presence in the chilled (fresh) sector.

6.2.6 Wholesale markets

The size of the UK wholesale market is estimated to be 1,000-1,500t pa, of which around 500t passes through Billingsgate (see Figure 6-2). Supply to Billingsgate is almost exclusively Scottish rope grown, split 50/50 between Shetland and the rest of Scotland. Feedback from wholesale markets suggests that the Shetland product which tends to be larger and with better meat yield than from elsewhere is increasingly favoured.

Figure 6-2. Sales of live mussels through Billingsgate wholesale market 2007-2009



Source: Fishmongers' Company

It is difficult to get sales data for other UK wholesale markets. The Glasgow market at Blochairn was visited during the course of the study, and it was clear that the trading area now only covers a small area and has limited throughput, being used more as an office space/trading hub for product not necessarily passing through the market. John Vallance is the main trader of farmed mussels in the market, selling on average a tonne a week. On the day of the visit, mussels for sale were from IOS (1kg bags) and Seaspray (5kg bags), both of Shetland origin. Purchase costs were said to be £1.40-2.00/kg, selling out at £2-3.50/kg. Another trader was selling mussels from Blueshell (also Shetland) at £10 for 5kg and £11 de-byssed. Seasonal summer supply problems as experienced in the past were said to be reducing. The main reason that Shetland mussels were favoured was said to be consistency of supply.

6.2.7 Foodservice markets

Foodservice sales account for around 20% of production and are mostly to the restaurant trade either via wholesale markets or directly from producers/processors. The foodservice market is increasing, with M&J Seafood, part of the Brakes Group (the largest UK Foodservice sector supplier) experiencing a doubling in sales to 900t over the past 2 years, 50% of which was vacuum packed and 50% live (Berthet, 2009). Supply however tends to be from Irish/Dutch sources at prices with which Scottish suppliers find it hard to compete.

The most likely target for Scottish suppliers are middle and upper tier chain restaurants such as Café Rouge, Belgo, and Brewers Fayre. One specialist UK seafood chain with around 40 branches sells around 6t p.a. per branch, whilst another specialist Scottish outlet is said to use up to a tonne a week in peak season, indicating the potential for such sales.

Other sectors of the foodservice market such as institutional catering have not hitherto been considered to have much potential, although there is some interest in developing the school meals sector given the link with healthy eating and local food initiatives. However these are notoriously cost-focussed markets with attendant implications for profitability.

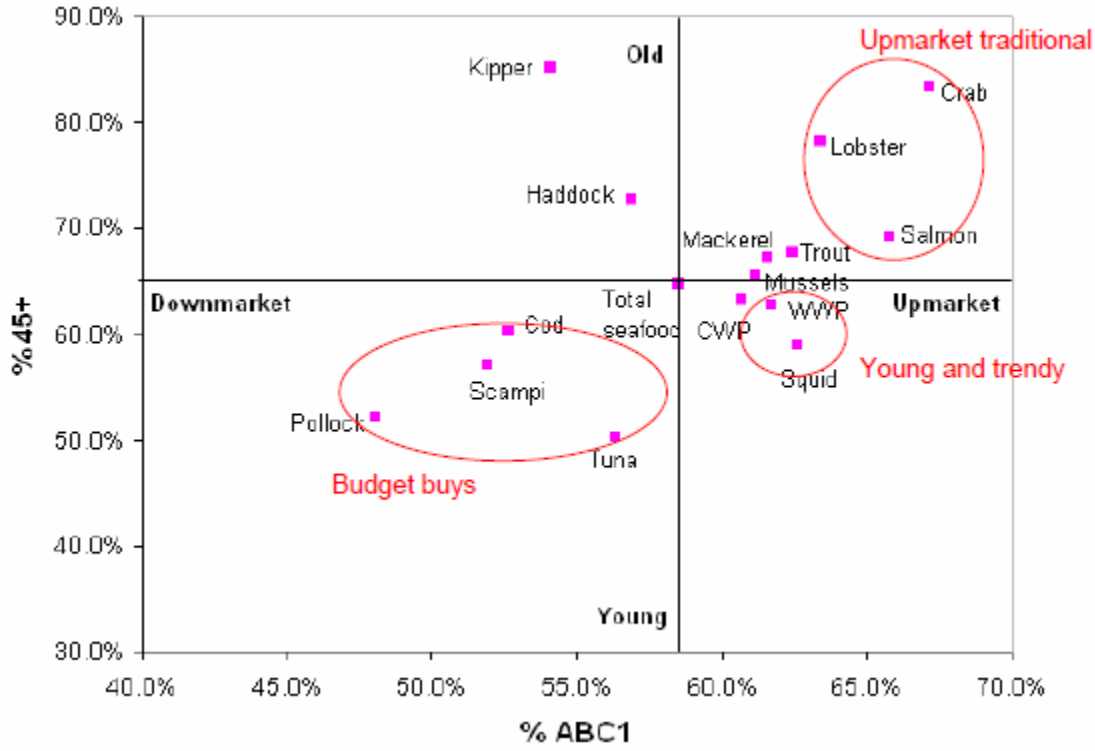
6.2.8 Consumption trends and consumer profiles for mussels

The growth in consumer demand for fish and seafood has been widely documented, but per capita consumption of mussels in the UK is still relatively low when compared with other EU countries. Belgium for example has the highest per capita consumption in the EU of around 4-5kg, many times the apparent UK level of less than 0.3 kg. Nevertheless, consumption in the UK is increasing, and over the past year sales of mussels have shown the strongest growth in the retail shellfish sector (see previous Nielsen data).

Market research has indicated that the typical seafood consumer is middle aged or older, part of a generational group (sometimes referred to as "the grey pound") which is not only increasing in size and living longer but also has substantial spending power, time available, an interest in healthy eating and a desire to eat out. The demographic trend is therefore very much in favour of increased seafood consumption including shellfish.

Data from Nielsen on consumer demographics based on % share of expenditure for the year ending 21.02.09, showed that purchasers of mussels were 63% ABC1, putting them firmly in the upmarket category, whilst 65% were aged 45+ (see Figure 6-3).

Figure 6-3. Consumer demographics for UK seafood consumption, year ending 21 February 2009



Source: Nielsen Home Scan Panel Data
http://www.seafish.org/upload/file/market_insight/Seafood%20Demogs%20210209.pdf

This is further confirmed by data from Dunhumby (see Figure 6-9 and Figure 6-10).

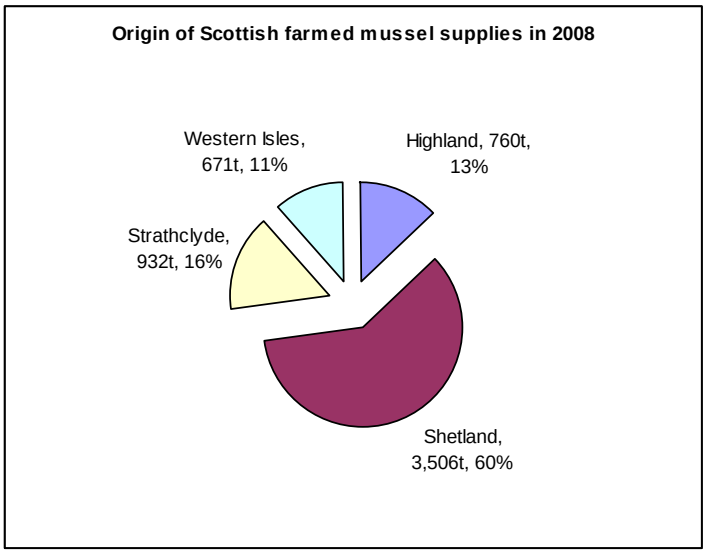
There is generally less seafood consumption by younger age groups, although recent research by Seafish (www.seafish.org/upload/file/market_insight/Changing%20demogs_0708.pdf) indicates growing consumption in the 16-24 age group, with growth in the chilled sector up 43% in the past year. Although this age group only accounts for 3% of seafood consumption and the latter covers a range of species, mussels were amongst those showing increased sales by volume and value.

6.2.9 Sources of supply of Scottish farmed mussels

The origin and volumes of Scottish farmed shellfish in 2008 are shown in Figure 6-4. The majority of production comes from around 12 producers in Shetland, 2 in Highland, 5 in Strathclyde and 1 in Western Isles. There are significant differences in the way that spawning affects ability to harvest in different areas. Whilst spatfall, which takes

place around 4-8 weeks after spawning, typically occurs in late May/June in most areas, Shetland stock can be harvested for longer into the spring perhaps because of cooler temperatures, whilst in other areas e.g. Argyll, shock spawning due to handling can occur as early as February and lead to product rejection.

Figure 6-4. Origin of Scottish farmed mussel supplies in 2008



Source: FRS

Some areas are known for better growth and stock is thus available for harvest sooner. Most farms aim to harvest all stock by the end of the third year after initial spatfall, typically by the end of April at the latest to allow time to install the next batch of spat collectors. If June is month one, then harvest typically takes place from months 27 (September) to 34 (April). Some farms with better growth are able to start harvesting within 24 months and be finished after 30. Toxins also have a major influence on harvest period, with closures most likely in the period April to August. Shetland appears to be particularly vulnerable to closures due to Diarrhetic Shellfish Poisoning (DSP), whilst some other areas appear to be relatively trouble free.

Scotland also has a significant alternative source of mussels from the Tain mussel fishery in the Dornoch Firth. The ownership of the mussel scalps and the right to fish them was granted to the Royal Burgh of Tain by King James VI of Scotland in 1612. The fishery is now managed by Highland Fresh Mussels Ltd (a Highland Council Company) (www.highlandmussels.com) and relies solely on the fishing to order of mussels from wild, unmanaged beds. Production is normally in the range of 800-1000t p.a., but has declined in recent years due to lack of demand due to the low quality of the product - meat yields are typically only around 12%. This is reflected in the low price of the product achieved of £200-300/t. Most sales are to the French market.

6.2.10 Product characteristics and regional differences

The species of mussels cultured in Scotland are those of the genus *Mytilus,* namely *Mytilus edulis, Mytilus galloprovincialis and Mytilus trossulus* and hybrids of the same. Aside from the features that might be attributable to any one species, which in the case of *M.trossulus* are highly detrimental for culture, there appear to be significant differences in the characteristics of mussel stocks in different areas, such as growth, appearance, meat yield, resistance to handling, post harvest gaping and shelf life, all of which have a bearing on marketability and over which the grower often has little control. Such differences are likely to be due to adaptation to local environmental factors such as food supply, water salinity and temperature. Mussels from Shetland appear to grow better, have bigger meat yields and better post harvest handling characteristics than elsewhere. This has obvious benefits in terms of marketability, whereby Shetland mussels can be graded, cleaned, debyssed and not need rewatering and still have a shelf life in chilled storage of 12-14 days. In contrast, such a process carried out on mussels from some areas of south Argyll would generally not be possible without significant losses, and/or result in reduced shelf life.

Shell fouling especially tubeworm is another feature which varies from area to area and year to year, but is typically absent from sites with low salinity e.g. Loch Etive. The problem is worse on older sites with higher salinity and poor water exchange. Shetland mussels have in the past been relatively free of fouling, but there are now said to be indications of higher tubeworm levels.

Regional product differences assume even greater importance when considered in the international context, particularly when looking at export opportunities for Scottish mussels. For example, the French market is based mainly on the bouchot cultured mussel, which is small, has high meat yield and keeps well (intertidal culture). Bottom cultured mussels have poorer meat yield, thick shells and also keep well.

6.2.11 Processing of raw material (facilities, location, processes)

The extent to which product is processed on farm depends on the marketing arrangements of the farm in question. Most larger farms now harvest directly off the line into bulk bags or bins which are then brought ashore to be cleaned, graded and rewatered in bulk bins in purpose built facilities meeting the necessary hygiene standards. Product for onward processing e.g. to SSMG is transported in the same bulk bins. Product for direct dispatch to market may be subject to further size grading and in some cases debyssing before packing in 1kg or 5kg net bags within an outer waxed cardboard or polystyrene box taking 20-25kg. Ice may or may not be added.

For those farms without onshore grading facilities, grading is usually carried out on the harvest vessel or raft, before transfer ashore for rewatering and/or dispatch.

Rewatering facilities usually incorporate UV treatment so that depuration can also be carried out if required.

In Shetland, two of the largest production companies have substantial shorebase facilities allowing them to carry out all the above processes. These companies also harvest, grade, pack and dispatch product for many of the smaller Shetland farmers. The largest of these companies, Blueshell Mussels Ltd, is able to handle over 2,500t of product a year, much of which is transported to SSMG for further processing.

Processing facilities at SSMG are split into two lines, one for fresh mussels and one for cooked vacuum packed and other products. Oysters are held in individual depuration tanks before packing and dispatch.

IOS has its own processing unit in Shetland, allowing it to produce a smoked whole vacuum packed product. Product for fresh live sales is transported to the mainland for packing and dispatch.

6.2.12 Product forms and packaging

Sales of Scottish mussels in the UK market are now thought to be 60% value added and 40% fresh (by value), and 50%/50% by volume, with the proportion of value added increasing all the time. The principal retail value added product is a chilled vacuum pack of whole cooked mussels with sauce in a cardboard outer, ranging from 450 to 500g weight. This product only needs minimal reheating in microwave or pan prior to consumption and is easy and convenient to prepare. Shelf life is 14-21 days. The most popular sauce flavours are white wine and garlic butter sauce, and although Thai and Mediterranean flavours are also available. However they are rarely seen in store, not least as the introduction of one new line commonly meets with the demand that another be removed thus making market expansion difficult.

Modified atmosphere packs (MAP) for fresh live mussels have been developed for the UK market by the major processors but as yet they are not in widespread use despite their versatility, possibly due to a lack of acquaintance with the product and a preference to inspect live mussels before purchase on the wet fish counter, where they are typically sold in 0.5 or 1 kg bags. One source believes there is an opportunity for a MAP product for the foodservice market, whereby a fresh live cleaned and debyssed product with good shelf life could be promoted as "ready to cook".

Sales to wholesale markets are typically made in 5kg bags packed within an outer waxed cardboard or polystyrene box, often with ice. Whilst the polystyrene box is widely used in Shetland and is accredited with allowing a long shelf life when iced, disposal of boxes is a major issue for many customers. A trial delivery of mussels by one Shetland producer to Belgium was very favourably received, but the cost of box disposal was reputedly a major factor in holding back further business. There would appear to be a clear need therefore for an alternative form of insulated outer packaging for fresh mussels for such markets.

At present, very little Scottish product is frozen, other than a certain proportion of vacuum packs to cover times of the year when fresh product may be limited. In contrast, most of the Irish farmed mussels seen in the UK market are in frozen format (see Bantry Bay Seafoods website http://www.bantrybayseafoods.com/products/foodservice1.html).

With regard to new product development for the retail sector, there are said to be few incentives given the limited availability of shelf space, which is in any case declining due to better returns from ambient space which do not incur the energy costs of chilled and frozen.

Examples of the range of further mussel products that could be developed can be seen on the Bantry Bay Seafoods website. Such products include half shell mussels with and without topping, and both plain and breaded meats (nuggets). The potential cost of a half shell line is however likely to be prohibitive for anything other than a substantial throughput.

A number of producers in this study suffering from tubeworm have expressed the need for a meat product, given that affected mussels mostly have to be discarded. Whilst the technology for cooking and meat extraction clearly exists and may not be too costly, the fundamental question is one of end market and comparative cost when faced with competition from Chilean meats, which presently retail in Tesco at £5.55/kg. Assuming a 25% meat yield, this equates to £1.38/kg whole weight equivalent, which is 4x less than that for vacuum packed mussels. However, most producers with tubeworm affected mussels that would otherwise have to be discarded would be prepared to accept a significantly lower price, although how much lower is unclear. Ultimately producers need to decide if the marginal revenue gained from their otherwise wasted product would cover their marginal costs; whilst taking into consideration any scope that might exist to attach a premium for their meats compared to imports.

One option might be the development of a high value product for niche markets. Certainly given the marginal revenue gains that might be realised from stock that would otherwise be discarded, there may be some merit in exploration of products using mussel meat in combination with other fish and non-fish ingredients. Whilst the development of such added value and ready-meal-oriented products demands resources there could be opportunities for processors able to source from a variety of sites and realise scale economies.

6.2.13 Distribution logistics and costs

We have not had the chance to establish costs of transport from relevant transport companies, but feedback from producers for various routes is summarised in Table 6.2.

Table 6.2. Indicative transport costs for Scottish farmed mussels

Route	Cost per tonne	Comments
Yell to Lerwick	£80	2t load
Lerwick to Glasgow	£70	Palletised boxes, regardless of volume
Lerwick to mainland	£130	
Skye to Glasgow	£130	
Glasgow to France	£150	20t chilled container
Glasgow to UK wholesale markets	£150-500	
Aberdeen to London	£500	

With regard to transport from Shetland, the cost (surprisingly) from Lerwick to Glasgow is comparable or possibly less than that from Skye. The daily Northlink ferry service from Lerwick to Aberdeen is however heavily subsidised by central government, partly due to the volume of seafood exports including farmed salmon. Shetland feels very vulnerable to the loss or reduction of this service in view of the prospect of government cutbacks, and mussel producers are concerned that should salmon production fall or fail for any reason e.g. disease, then the cost of transport would rise substantially.

What is also apparent from these costs is the relatively high proportion of the cost of delivered product taken up by transport when compared with higher value products such as farmed salmon. For example transport cost of mussels if £150/t would represent 15% of delivered cost at an ex-farm value of £800/t, whilst the same figure for farmed salmon would only be around 5% at an ex-farm value of £3000/t. This again highlights the added importance of transport subsidy for shellfish product from the outer isles.

6.2.14 Pricing

6.2.14.1 Ex-farm and ex processor prices

The ex-farm price for mussels varies according to quality, seasonal demands, and marketing agreements. It is further complicated by the degree of grading and cleaning undertaken on farm. For mussels destined for processing/packing by another company that have been pre graded and cleaned on farm, ex-farm price can vary between £750 and £900/tonne, although this would only be paid for product which meets quality criteria for the top grade after further grading in the factory. Second grade product suffering from excess shell fouling e.g. tubeworm attracts a lower price, assuming that a market can be found.

For small farms selling "off the line" to contract harvesters, one price given in Shetland was £500/tonne in the water.

For farms selling to the French market, in bulk bags with no grading in 20t container, the ex-farm price may be equivalent to only £500-600/tonne ex-farm, depending on transport costs and grade out percentages at the French buyer.

Prices for fresh live mussels packed and ready for the market ex-packing plant are in the range of £1-1.40/kg.

6.2.14.2 Retail pricing

Irish rope grown mussels are typically only seen in UK retail outlets in the whole vacuum packed frozen format, and at a lower price point than the very similar chilled Scottish version. For example, Aldi's frozen own brand "The Fishmonger" 450g pack of cooked Irish mussels in garlic butter sauce (supplied by Bantry Bay Seafoods) was on sale in December 2009 for £1.99 (£4.44/kg), compared with the similar Scottish chilled 500g product from SSMG at £2.66/pack (£5.32/kg) in Sainsbury (see Table 6.3).

6.2.15 Mussel marketing difficulties

As in any primary production industry, there are difficulties matching supply and demand, especially given the rapid increase in production from Shetland. During the 2008/09 harvest season, supply exceeded demand, some producers were left with crop they could not sell, and prices especially to the wholesale market fell by around 20%. Long established producers on the West Coast who have traditionally supplied UK wholesale markets are finding it increasingly difficult to compete with Shetland suppliers, who have access to greater volumes (allowing more frequent deliveries), more sophisticated processing lines (allowing debyssing), and a favoured product (larger, better meat yield, debyssed). More recently established producers, both large and small, who are not members of the SSMG, and who do not have established links with wholesale buyers, find it very difficult to sell product. In the present 2009/10 season, the supply position has eased, to the extent that SSMG are now purchasing stock from non-members on a temporary basis.

Some larger producers sell in bulk to France after the local bouchot season has ended. This option has some attractions in that large volumes can be harvested rapidly into bulk bags "straight from the line" i.e. without grading. On the downside however it only suits large producers with rapid harvesting capability and sufficient boat capacity and who can fill a 20t container in a day. In addition, the volume paid for may only be 70-80% of that originally loaded taking into account water and grading losses, and the price paid relatively low (around £700-900/tonne before transport). Finally, the time of harvest depends on when French supply dries up, so that in a good year that may not be until quite late in the spring when there is increasing risk of spawning and thus product rejection.

Table 6.3. Examples of mussel products and pricing in Stirling retail outlets, Dec 2009- Mar 2010

Product	Product form	Store	Branding	Supplier	Pack wt (g)	£/pack	£/kg	Offers
Vac. pack (White wine)	Chilled	Sainsbury	SSMG	SSMG	500	£2.66	£5.32	
Vac. pack (Garlic butter)	Chilled	Tesco	Own	Dutch	560	£3.00	£5.36 (£4.46)	2 for £5.00
Vac. pack (Garlic butter & shallot)	Chilled	M&S	Own	Dutch	500	£2.99	£5.98	
Vac. pack (oak smoked)	Chilled	Morrisons	Isle of Shuna	Isle of Shuna	300	£1.99	£6.63	Save £1, down from £2.99
Vac. pack (Garlic butter)	Chilled	Morrisons	Morrisons	SSMG	500	£2.75	£5.50	
Vac pack (garlic butter)	Frozen	Aldi	Own	Irish (Bantry Bay)	450	£2.00	£4.44	
Live, net bag	Chilled	Sainsbury	Loch Roag	Seafood Company (W Isles)	800 (1000)	£3.49	£3.49	25% xtra free
Live, net bag	Chilled	Tesco	West Coast	SSMG	454	£2.00	£4.40 (£3.30)	2 for £3.00
Live, net bag	Chilled	Tesco	Shetland (Lindsay Angus)	SSMG	1000	£3.43	£3.43	
Meats, MAP pack	Chilled, prev. frozen	Sainsbury	Own	Chile	250	£2.00	£7.96	
Meats, MAP pack	Chilled, prev. frozen	Tesco	Own	Chile	180	£1.00	£5.55	

6.2.16 Competitive market pressures for Scottish farmed mussels

It is clear that at present Scottish farmed mussels have a dominant position in UK markets, especially in the retail sector. However, that position is continually under threat from other suppliers in Ireland and the Netherlands, and this threat is likely to increase the larger the market gets. Competition in the retail sector is already said to be intense, and although the Scottish product is generally preferred, this is only the case if it is equivalent in terms of quality and price. Those in the front line of marketing are concerned that the Scottish industry must strengthen its position for when such competition increases.

A recent example of the pressure faced by a Scottish supplier was the loss of the Tesco chilled vacuum packed contract to a Dutch supplier, said to be partly on the grounds of price and partly to the lack of other products with which to incentivise the deal. The product in question is Tesco own brand and labelled as "responsibly farmed", with product originating from the North East Atlantic and the Mediterranean. Whilst product from the Mediterranean is most likely rope cultured, that from the NE Atlantic i.e. Holland is almost certainly bottom cultured. This latter being the case, the production costs of bottom cultured mussels are significantly lower than rope cultured, giving the Dutch a clear competitive advantage.

A further possibility is that Welsh growers of bottom cultured mussels which are presently exported to the Netherlands may retain some or all of their product for processing and sale in the UK, which could again pose a major threat to the Scottish industry. Whilst the meat yields tend to be on the low side as for most bottom grown mussels, they can reach 30% at certain times of the year, easily comparable with most Scottish rope grown stock.

In addition, both the Dutch and Welsh producers have applied for MSC accreditation which may counteract to some extent the promotion of rope cultured mussels as having superior sustainability credentials.

With regard to competition from Irish rope grown product, the main Irish grower and processor is Bantry Bay Seafoods established in 1991 and now selling over 6,500t mussels pa. The company supplies major multiples in France, UK, Italy, Germany, Austria, Hungary, Sweden and USA, as well as foodservice customers in many different countries. Products are all frozen and include their "sauce" range (vacuum packed whole in a range of sauces), their "topless" range (half shell with and without toppings), meats, and nuggets (breaded meats). The company has a processing joint venture with a Spanish company in Chile known as Blueshell SA which also claims to have the largest single mussel farm in South America. Certain Chilean products including frozen meats and whole shell are available through Bantry Bay.

The presence of Irish product from Bantry Bay Seafoods in the UK market is thought to be mainly in the foodservice sector, where the frozen format offers significant advantages and it is able to offer competitive pricing. However, the very low level of frozen sales in UK retailers as indicated by the data from Nielsen suggests that Bantry Bay Seafoods is not a major threat in the retail sector at present, although there appears to be no reason why it could not enter the UK retail vacuum packed market in the future. Its involvement in Chile does however illustrate the wider competitive threat in the EU market of the Chilean industry, which is clearly not only able to sell meats but also whole shell products which are more likely to pose a threat to the UK frozen whole shell market which at present is mostly foodservice.

6.3 The European market for Scottish mussels

As alluded to in Section 5, declining EU production of mussels appears to offer an opportunity for UK producers to make up the deficit. In reality, that is already happening given that most of the UK production of bottom grown mussels is exported to the Netherlands (20-30,000t a year). Much of that then finds its way into Belgian and French markets via Dutch processors, although it will be branded as Dutch.

In addition, around 75% of Spanish production i.e. around 150,000t which was traditionally used by the Spanish canning industry has now been displaced by Chilean supply, and is now targeting new fresh live markets elsewhere in the EU.

Although some efforts are being made by the Scottish industry to find outlets on the continent, such efforts are still at an early stage, and it is by no means clear how much of an opportunity exists. For example, a closer look at some features of the Dutch/Belgian mussel trade helps to illustrate this (Jaap Holstein, pers com):

- 2010 production in Holland is likely to be 30-40,000t, low by historical standards
- maximum future production capacity is thought to be around 60,000t
- the domestic market is around 7,000t
- home production in Holland is more expensive than in other EU states, so it makes sense to import
- imports come mainly from Germany, Ireland, UK, Denmark
- the Dutch processing industry is highly mechanised, with some plants able to process 40t an hour; this however can only be achieved with bottom cultured mussels which have thicker shells
- there is little interest in rope cultured product as the shells are too weak for the Dutch processing lines
- the only period that rope cultured stock is imported is during the Dutch spawning season (April to June) when local meat yields are too low (meat yields need to be in excess of 20% and preferably 25%)
- rope cultured stock is bought from Canada, Norway, Ireland, Greece and Italy, peak demand being in June
- prices paid for Irish rope grown mussels Euros400-600/t "free on truck"; Euros600-700/t delivered?
- imports require a license because of the risk of importing non native species, and have to be held in quarantine facilities
- exports from Holland are 60-70% to Belgium, 10-20% to France, and 5-10% to Germany
- exports for Belgium are branded as "Zeeland" regardless of source
- the colour of Scottish mussel meats is too dark for the Dutch/Belgian market – prefer a light colour; difference said to be due possibly to feeding and genetics; Spanish meats (also rope cultured) are also too dark
- Belgians prefer bottom cultured mussels, with thick shells and light meats
- French and Belgian retailers, which command 70% of the EU market, are geared up for large volumes and just-in-time delivery; orders are placed on the internet at 1130am and have to be bid for, with the lowest

bidder getting the order; delivery has to be made by 3-4am without fail; most EU retail buying decisions are in the hands of just 5 buyers and there are no strong loyalties
- the main suppliers and distributors to this market are Dutch and based in Holland; they are the only ones having the necessary economies of scale and location for just in time delivery
- distance from market is a problem for producers such as the Irish given the just in time delivery requirements and the high cost of transport; in addition, all imports have to be quarantined which involves additional water treatment and waste disposal costs (e.g. Euros800/t for disposal of mortalities graded out)
- nevertheless, the only realistic route into the volume French/Belgian retail markets is through Holland
- the Belgian market is changing; a recent study by a Dutch marketing institute concluded that the market is declining, partly due to the large number of ready to eat products on the market; for younger people mussels are not very attractive as they don't know how to prepare them; the Dutch are therefore planning a new promotional effort with EU and Govt. funding in 2010, one element of which would be "mussel parties" in the peak summer season
- half of all sales in Belgium are made in July and August; when the Belgian market falls in September, the French and Dutch markets increase.

From this it might be concluded that the opportunities for large scale exports of rope grown mussels to the Belgian/French retail trade are limited. However, the size of the market is such that even a doubling of Scottish production would make little impact. There are also some indications that this market is changing in favour of rope cultured mussels, and may offer at least niche marketing opportunities:

- the Belgian market is becoming more eco conscious, and the balance is starting to change between bottom and rope grown mussels; provenance is crucial; there is said to be a big opportunity to replace bottom grown mussels with rope grown over the next 7-8 years
- Delhaize, a Belgian multiple retailer selling 50t mussels a week, is said to be considering using only rope grown mussels, and only accepting mussels as "Dutch" if they are held for 12 months or more in Dutch waters
- One UK company selling a MAP product to Delhaize, said to be scope to increase
- the Shetland product is said to be better than W Coast for the Belgian market on account of meat yield and size
- the barrier however still remains in weaning traditional consumers off the bottom grown mussels to which they have become accustomed.

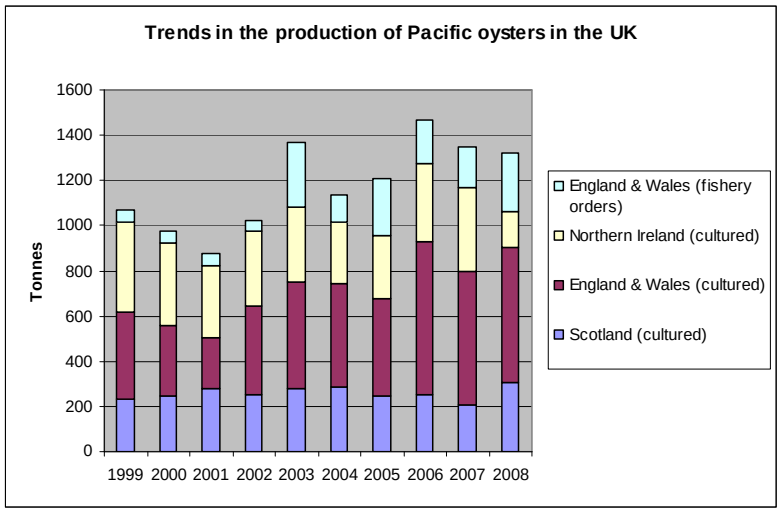
The other common route into the continental market is the sale of mussels in bulk to France, a route that accounts for a significant proportion of Irish rope grown mussels and one which has been tried on a small scale by Scottish producers from time to time. Demand is however limited to filling the gap between the end of the French bouchot production season and the start of the new season, this typically being for a 2-3 month period early in the year, but the timing is uncertain and depends on the success of the bouchot production for the year in question. The prices offered are presently around £600 to £700/t delivered and are thus not attractive to most Scottish producers, particularly when taking into account the practical difficulties.

6.4 The market for Scottish oysters

6.4.1 UK supply of oysters

Production of Pacific oysters in the UK has fluctuated between 800 and 1400t p.a. over the past 10 years (see Figure 6-5). Production in 2008 was 1,300t and came from a variety of sources including farms in Northern Ireland (160t) (28%), Scotland (300t) (15%), and England and Wales (600t) (44%). In addition, a further 250t (19%) came from Fishery Orders.

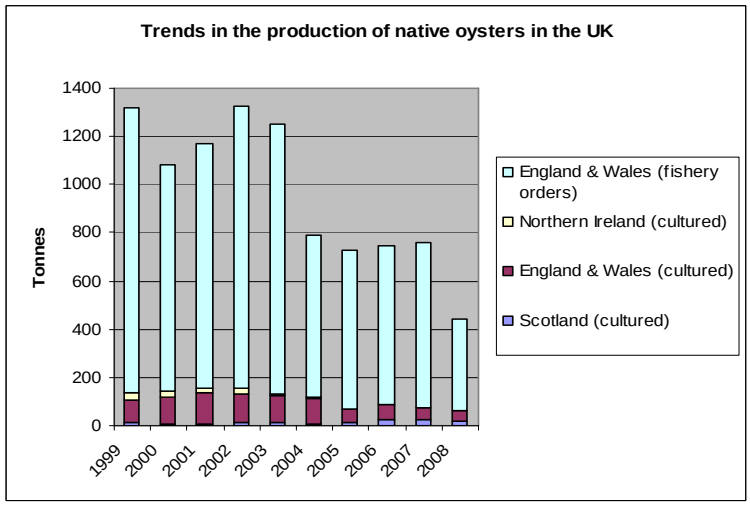
Figure 6-5. Trends in the production of Pacific oysters in the UK



Source: Cefas, 2009

Production of native oysters has declined over the past 10 years and in 2008 was 444t, of which 380t came from Fishery Orders, principally in the Solent (see Figure 6-6). Scottish production amounted to 20t, coming exclusively from the managed fishery in Loch Ryan, SW Scotland.

Figure 6-6. Trends in the production of native oysters in the UK

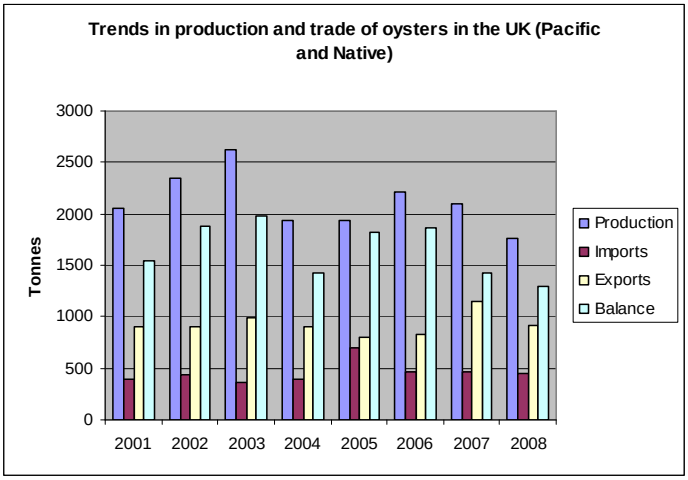


Source: Cefas, 2009

6.4.2 UK trade in oysters

Trade figures for native and Pacific oysters are not recorded separately, although the export trade is mostly of native oysters. Over the past 10 years exports have exceeded imports by around 2:1 (see Figure 6-7) and have been relatively constant. Oyster exports and imports in 2008 were 916t and 450t respectively, with the main export markets being France (40%) and Spain (26%), whilst imports came mainly from Ireland (34%) and South Korea (23%), the latter being in preserved form.

Figure 6-7. Trends in the production and trade of oysters in the UK (Pacific and native)



6.4.3 Size of the UK market for oysters

Taking into account production, imports and exports, the apparent availability of oysters to the UK market is between 1000 and 2000t p.a. (see Figure 6-7), of which most are thought to be Pacific oysters. This equates to 12.5 to 25 million shells at an average weight of 80g. Very few Scottish oysters are exported, thus in 2008 Scottish production of 323t represented around 25% of UK supply.

From this point on in this section with regard to Scottish oysters, "oysters" will be taken to mean Pacific oysters, whilst natives will be referred to as "native oysters".

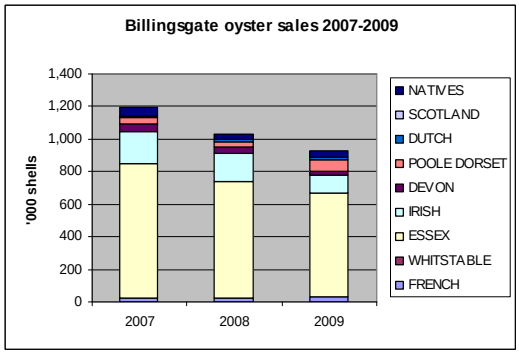
6.4.4 Channels to market for Scottish oysters

Loch Fyne Oysters (LFO) and SSMG are the main channels for the sale of Scottish oysters, accounting for 25-40% of overall Scottish supply each. LFO mainly supplies the foodservice sector, and SSMG the multiple retail sector. The greatest demand is from foodservice. Both these organisations perform a vital function in pooling supplies from small and medium scale growers in the Highlands and Islands, grading, depurating and packing them ready for market. Oysters from LFO are marketed under the Loch Fyne brand. Both companies take in additional supplies from outwith Scotland to meet demand.

The balance of supply not passing through the above channels is sold directly to restaurants, fishmongers, farmers markets, and events.

The wholesale market for oysters is limited. Billingsgate takes around 80t a year, with a declining trend the last 3 years but virtually none from Scotland (see Figure 6-8).

Figure 6-8. Billingsgate oyster sales 2007-2009



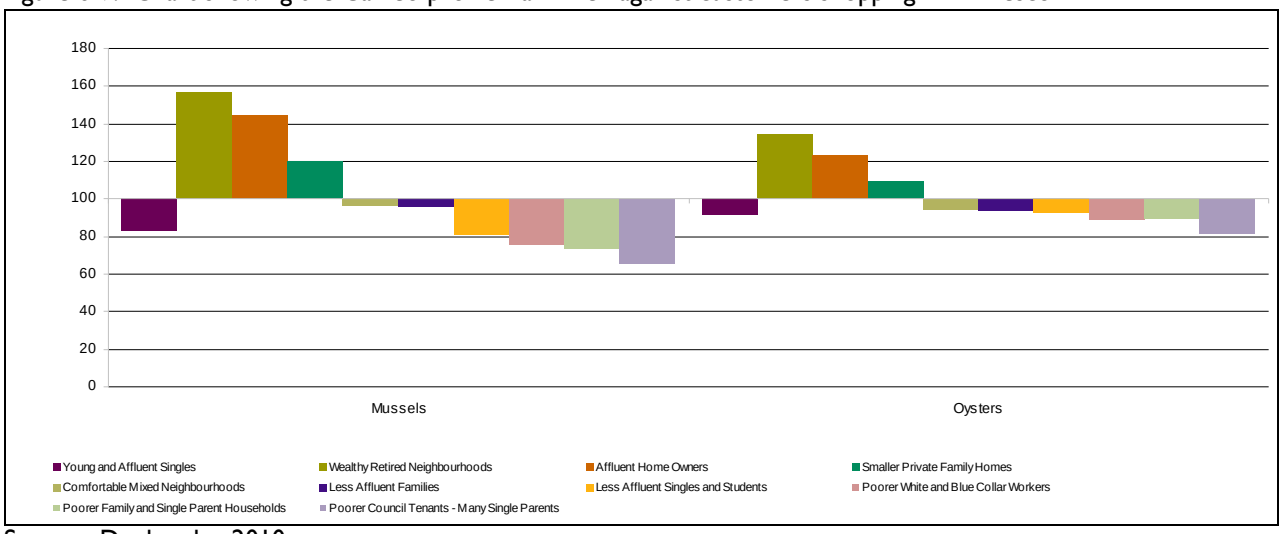
Source: Fishmongers Company

6.4.5 Consumption trends and consumer profiles for oysters

Demand for oysters in the UK is generally thought to be static, although recent data from Dunhumby shows that oyster sales by Tesco increased 41% by value and 37% by volume in the year to 31 Jan 2010 compared with the year before, with average unit price increasing 3% in the same period.

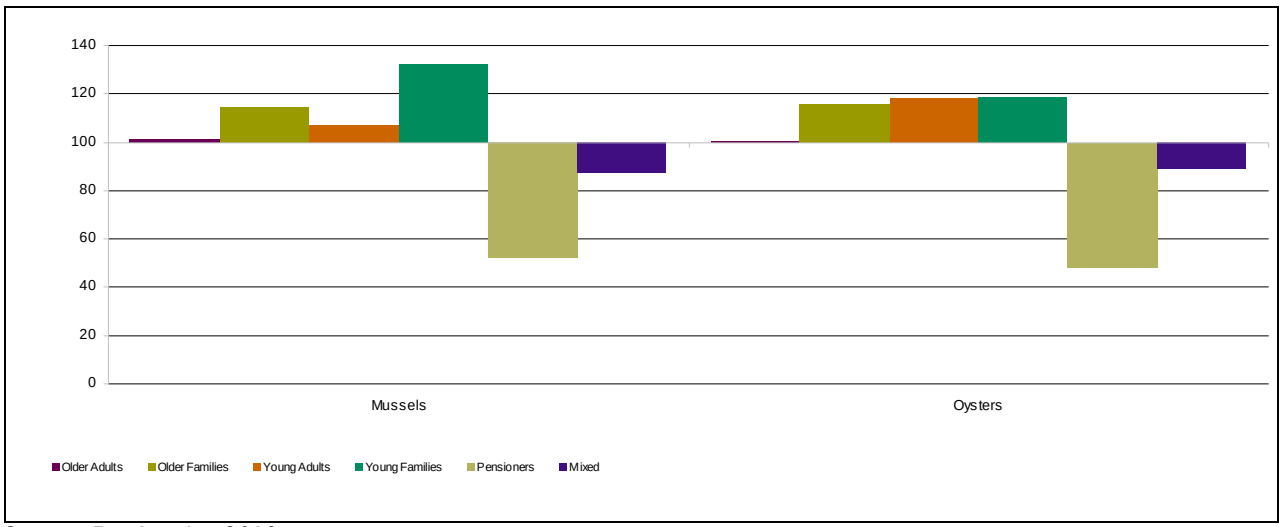
The profile of the typical oyster consumer is similar to that of mussels i.e. middle aged and older, upmarket traditional but with some significant seasonal peaks,e.g. Valentine's Day, and reaching other consumer groups (see Figure 6-9 and Figure 6-10). The typical restaurant customer is said to be relatively knowledgeable about product quality in terms of provenance and taste.

Figure 6-9. Chart showing the Cameo profile - an index against customers shopping in All Tesco



Source: Dunhumby, 2010

Figure 6-10. Chart showing the Lifestage profile - an index against customers shopping in All Tesco



Source: Dunhumby, 2010

6.4.6 Sources of supply for Scottish oysters

Scottish production of oysters was 303t or 3.8million shells in 2008, of which 95% came from 19 growers in Strathclyde, with the balance mostly from 9 growers in Highland region. Only very small volumes (<1%) come from Shetland, Orkney, and W Isles.

Both SSMG and LFO also buy in stock from Ireland and/or England, all of which could be replaced by Scottish stock if available, possibly as many as 2 million shells p.a.; both these buyers would however prefer to sell only Scottish oysters if available.

6.4.7 Product characteristics and regional differences

As with mussels, the taste, meat yield, and shell appearance of oysters varies according to local growing conditions. Indeed, given that oysters are typically consumed raw, any potential regional difference is more noticeable. At present, any opportunity to exploit subtle local differences from a promotional angle is to some extent lost for product passing through LFO and SSMG given that supplies from different areas are pooled, but this option is still available and used for producers selling individually.

6.4.8 Product forms and packaging

Scottish oysters are sold whole fresh live packed in varying numbers typically within an outer waxed cardboard box, or in MAP for export. Size for Standard grade is 75-90g, anything over 90g is classed as Regal.

Half shell products have been tried in the past but there was insufficient demand from consumers and retailers. MAP products have also been tried for UK retailers with limited success.

The pressure treated banded whole oyster seen in the US has been considered but the cost is prohibitive for all but very large volumes and the UK customer expects a fresh product.

6.4.9 Distribution logistics and costs

One of the issues that has arisen from interviews with some smaller scale oyster growers on the West Coast is the difficulty associated with transferring product to distributors such as LFO. Such growers typically undertake such transport themselves, which involves time away from the business, problems getting labour to undertake transport and significant cost for small loads. What would help from their point of view is some form of organised collection service by distributors, even if from regional transport hubs such as Oban.

6.4.10 Product pricing

The ex-farm price in Scotland is typically around 24p/shell, up from 18p 5 years ago. Volume purchases of oysters from larger growers in Ireland and England can however be bought for around 20p/shell. A recent retail value seen in Morrisons was 55p/shell.

6.4.11 Feedback from growers on the market for Scottish oysters

Discussion with growers concerning the market for Scottish oysters raised the following points:

- All growers report a strong market and good demand, reflected in the past 5 years in increasing price
- French and Irish disease problems are relieving pressure on the UK market
- Current prices are acceptable but do not provide much incentive for investment for small to medium scale operators
- Growers selling through LFO and SSMG oyster grower members both consider their buyers are doing a good job on the marketing front
- Customers are starting to understand the difference between good and bad quality oysters and are prepared to pay a premium for Scottish
- One grower reported increasing local sales, associated with tourism and a local food initiative
- Scottish oysters are seen to be better quality than French and Irish, which are more of a faster growing "bulk" product.

6.4.12 Scottish native oysters

Scottish production of native oysters comes almost exclusively from Loch Ryan, the only remaining commercial fishery in Scotland. Production from Loch Ryan has gradually been increasing (see Table 6.4), reaching something of a plateau over the period 2006 to 2008 with output between 20 and 24t. Ex-farm value was reported to be £0.38/shell in 2008 (FRS, Scottish Shellfish Farm Production Survey 2007). Most of the Loch Ryan production is sold to top end UK restaurants and hotels.

Table 6.4. Trends in native oyster production for the table in Scotland 1998-2008 ('000s)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Nos ('000)	87	142	51	103	191	161	105	162	300	273	250
Weight (t)	7	11	4	8	15	13	8	13	24	22	20

Source: Marine Scotland, 2009

Whilst the prospects for increased production in Loch Ryan are favourable, the unique provenance and quality of the oysters and the relatively limited supply are likely to ensure strong continuing demand. Natural beds of native oysters are also present elsewhere in Scotland, but the emphasis there is on the preservation and enhancement of stocks rather than exploitation. There is limited interest in culture in some areas, but shortage of seed stock, slow growth rates and higher mortality than Pacific oysters do not encourage investment.

6.5 The market for Scottish farmed scallops

Production of scallops in the UK is almost entirely from the wild fishery, recorded as 4,673t queen scallops and 24,125t king scallops in 2008. Exports and imports in 2008 (both species) were 10,436t and 2,457t respectively, the main export markets being France (60%) and Italy (28%).

The only farmed production of scallops in the UK comes from Scotland, with 27t of queen and 2t king scallops in 2008. Production has declined in recent years due mainly to problems with spat collection. In addition, production from Several Orders has been severely curtailed due to the difficulties of protecting stock from theft.

Production of queen scallops comes mainly from one farm in Argyll, and king scallops from one producer in Highland region. Queen scallops may be sold fresh whole or IQF frozen on the half shell, the latter format being popular with upmarket restaurants.

Production of king scallops from Highland region is from one producer with a Several Order, and is based on the collection and ongrowing of dived young stock from the surrounding area. Sales are to local top end restaurants, live in shell, for a premium price. Produce is marketed as "hand dived, shallow water finished", the latter term emphasising the high meat yield (20%) achieved by relaying in shallow water compared with the wild dived product (16-17% meat yield). The business is part of a local food network which arranges collection and delivery of produce1-2 times a week.

6.6 General shellfish market issues

6.6.1 Trends to sustainable sourcing

Mike Berthet, speaking at the 2009 ASSG conference, highlighted the growing importance of sustainability issues to consumers, particularly in the foodservice sector. Research undertaken by M&J found that when caterers were asked the question "how often do your customers ask questions about the sustainability of fish and seafood on your menu?", only 15% responded "never", compared with 50% two years ago, whilst 25% responded "weekly" compared with 4% two years ago. The shift was most marked in the restaurant and hotel sector.

This rapid change in consumer attitude should favour farmed shellfish, which can demonstrate strong sustainability credentials. In particular, it should favour rope cultured mussels over bottom cultured, given some of the practices associated with the latter in certain areas. There is already reported to be evidence of this in Belgium, which has a strong green lobby and is calling for changes in the sourcing of farmed mussels, which traditionally in Belgium have come from bottom culture in the Netherlands. Delhaize, one of the largest Belgian retailers, said to use 50t mussels a week, is said to be planning to replace all of its bottom cultured supplies with rope cultured due to environmental pressures, in the meantime insisting that any mussels described as "Dutch" are relaid for no less than one year in Dutch waters, to avoid the current practice of importing stocks from other countries which are then held only for a short period in quarantine facilities before being processed and sold as Dutch.

The trend for sustainable sourcing in the foodservice sector has been supported by a network of conservation bodies which have jointly established the Good Catch website (www.goodcatch.org.uk) which aims to guide foodservice companies on the issue of sustainability.

6.6.2 Accreditation

The ASSG published a Code of Good Practice (http://assg.org.uk/cgi-bin/download.cgi) in 2005 setting out the standards expected of the industry. This however is a voluntary code and it is up to individual growers/processors to apply for accreditation under whatever scheme is relevant.

The need for accreditation is being driven by retailers and foodservice customers, with two of the most commonly quoted schemes being those offered by the Marine Stewardship Council (MSC) and Friends of the Sea (FOS). There is however a certain amount of ambivalence in the industry as to which of the different schemes to apply for, given the time and cost involved. One company considering MSC certification is faced with an up front cost of £35,000, followed by a premium on all product sold. The Dutch mussel industry and the closely associated Welsh industry (both supplying bottom cultured mussels) have both applied for MSC certification in response to retailer demand, and Seafood Shetland and SSMG are applying for MSC pre-assessment for rope grown mussels.

A further scheme under development is the Bivalve Aquaculture Dialogue coordinated by the World Wildlife Fund, which in due course will be managed by the Aquaculture Stewardship Council.

The Irish mussel industry has its own quality schemes sponsored by the Irish Sea Fisheries Board, Bord Iascaigh Mhara (BIM) (O'Brien, 2009), an example of which might also be an option for Scotland.

It is clear that buyers are increasingly making accreditation a condition of supply, and the Scottish industry needs to decide which route to take. In the short term, however, this is likely to be decided on a company by company basis according to customer requirements. In the longer term, questions may arise as to whether it is realistic or likely that consumers will continue to delve into the finer discrepancies of the various certification schemes available. It seems reasonable to suppose that consumers may revert back to the more standard position of expecting the outlet, be it retail or foodservice, to do the necessary checks on sustainability and place their trust accordingly.

6.6.3 Provenance and branding

The need for greater emphasis on provenance has been raised a number of times during this study. Points raised and observations made include:

- On continental markets the only meaningful provenance for mussels at present is said to be "Scottish"; regional differences e.g. Shetland are said by one source not to be recognised
- In the UK, Shetland mussels are separately recognised (for example Billingsgate mussel sales are defined either as "Shetland" or "Scotch")
- SSMG sells fresh mussels as both West Coast and Shetland, the latter sometimes labelled with grower identity
- Sainsbury sells fresh mussels from the Western Isles as "Loch Roag"
- There may be further scope for premium branding associated with regions e.g. Sainsbury's Isle of Skye salmon
- Consumers want information on provenance (see also trends to sustainable sourcing)
- Oysters sold by the large distributors are not separately identified by grower due to the need to pool oysters to make up orders and the lack of a price incentive
- Definite scope to make better use of provenance as demonstrated by the SAGB oyster tasting guide.

Provenance and branding are clearly already being used to a greater or lesser extent, and it should be recognised that any further effort in this respect would come at a cost and would not necessarily drive further sales or increase unit values. However it may also be contended that such emphasis upon provenance, where backed by perceivable positive product attributes, as said to be found in molluscs, can provide a significant unique selling point (USP) which is challenging, and conceivably impossible to imitate.

With further regard to provenance, it has been suggested that specific segments of the Scottish shellfish industry might benefit from designation under an EU Protected Food Name scheme, in the same way that other Scottish food products have benefited e.g. Scottish farmed salmon, Arbroath smokies. The most appropriate designation is likely to be Protected Geographical Indication (PGI), which requires that a product be produced, processed or prepared in a certain geographical area, and have a specific quality, reputation or other characteristic attributable to that area. Whether the potential benefits of such a designation would outweigh the time and cost involved in applying and ongoing monitoring would need to be carefully assessed by the relevant industry sector. The Scottish Government has a unit specialising in this scheme and is able to assist with applications (www.scotland.gov.uk/Topics/Business-Industry/Food-Industry/PFNs).

6.6.4 Promotion

Much has also been said during this study regarding promotion. Some of the points raised (relating mainly to mussels and mostly during interviews with producers) include:

- Generic promotion is the role of Seafish, but there is little specific promotion of Scottish shellfish
- The recently produced Seafish heart "muscle" poster has not been well received (it could put people off), and was made without consultation with the industry
- There needs to be much better coordination between industry, Seafish, Seafood Scotland and Scotland Food and Drink on promotion
- There needs to be more joined-up thinking on promotion with other sectors e.g. salmon
- There is a need to educate the younger generation (as proved successful in increasing consumption in New Zealand)
- There is a need to focus on the benefits of Scottish shellfish e.g. taste, meat yield, quality, freshness
- For every £1 awarded on EFF grants, the same amount should be spent on export promotion
- The industry needs a strategic marketing plan
- The industry itself needs to put funds into marketing; there should be an obligatory levy of 5p/kg paid monthly, with a management committee deciding how funds are spent and representation on the committee in line with regional contributions
- Funding of promotion should be split 50% industry, 30% Seafish and 20% from grants
- The shellfish industry has a great story to tell, it needs to get out there and tell it e.g. McDonald's potato market story (seed to factory to chip!)
- Key attributes to be communicated include health benefits, sustainability, carbon sequestration, Scottishness, the culture process
- Generic promotion is notoriously difficult to target, costs can be excessive and funds easily wasted.

Whilst some funds for promotion are raised from the Scottish shellfish industry by means of the Seafish levy, this is relatively insignificant in terms of what might be needed to fund generic promotion. Most producers when asked have said they would be prepared to pay for generic promotion providing all producers contribute equitably. The French oyster industry and the Spanish mussel industry both have compulsory schemes which allow them to fund promotion, but these industries are the biggest of their kind in the EU and even a small levy results in a substantial promotional fund (see also Section 13). A 5p/kg levy over the Scottish mussel industry if enforceable would however result in a not insignificant £300,000 fund, albeit quite small in relation to the tasks and media space that might be required.

Moreover it should also be noted that promotion can only be effective if targeting appropriate objectives as determined by consumer research of which there appears to be something of a dearth. It may be argued that prior to any consideration being given to possible promotion activity, generic or otherwise, more attention would be better placed in trying to develop a clearer understanding of what the market wants.

Despite the expressed desire of the industry for more generic promotion and assuming a funding mechanism could be agreed, once an understanding of what the market wants has been realised the emphasis should, from a marketing perspective, focus upon delivery of these values. Quite simply if customer expectations are not for any reason being met, then no amount of promotion is going to help.

The case for first ensuring that the needs of the indigenous market are met is heightened when the potential impact of generic promotions is also considered. Generic promotion attempts to increase the demand for the product, through some combination of either more product or a willingness to pay a higher unit price. Any such achievement will of course make the market more attractive to competitors, thus generic levies can be seen as a tax on domestic producers and serve as an incentive to imports.

6.7 Conclusions regarding the market for Scottish farmed shellfish

The general climate for seafood consumption is positive, and Scottish farmed shellfish in particular tick all the right boxes regarding health benefits, sustainability, provenance, and convenience. UK consumption of farmed shellfish is very low compared to other EU countries and clearly has scope to grow. The typical shellfish consumer is middle-aged or older, "upmarket and traditional", a sector that is growing in size and living longer. As with most seafood, consumption amongst younger age groups is low, although there are recent indications of increased consumption of chilled seafood by the 16-24 age group. Prospects for individual species can be summed up as follows:

Mussels

- The overall UK market is small but growing, with apparently great scope to develop further
- Present per capita consumption is less than 0.3kg pa, compared with around 2kg in France and 4-5kg in Belgium
- Recent evidence supports increasing consumption (retail sales, predominantly of fresh/chilled product, were up 28% by volume in the past year)
- Existing product forms appear to meet market requirements; there are no obvious opportunities or needs for new products
- In the retail sector there are two principal product forms: live fresh mussels in net bags for the wet fish counter, and cooked vacuum packed mussels for the chill cabinet; sales of each are around 50/50 by volume, but the balance is changing in favour of cooked product
- MAP for fresh live mussels is not widely used but is available if needed
- The retail sector accounts for around 80% of sales and is the main outlet for Scottish mussels
- This is likely to remain the case given the strong position SSMG has developed as the main retail supplier
- Strengths of SSMG in this regard include proximity to market, good track record for service, quality and limited recalls
- Competition in the retail sector is however intense, and whilst Scottish product is favoured that is only the case if it is equal in terms of quality and price to competing supplies
- The main competitive threat in the retail sector is from Dutch suppliers, particularly for cooked vacuum packed product. The fresh live sector is thought to be less vulnerable given that the Dutch product is predominantly bottom grown and thus typically has lower meat yield (arguably more of an issue than with vacuum packed product), and is supplied in MAPs, a format not currently in great demand in UK retail.
- The foodservice sector accounts for around 20% of sales and is growing, with the major UK foodservice buyer reporting doubled sales in the last 2 years
- Foodservice product forms are either fresh live mussels or cooked vacuum packs, chilled or frozen
- Live mussels are supplied mainly by the Scottish industry, either through the wholesale market or directly; there appears to be no reason why this should not continue
- Shetland product is favoured (USPs compared with Irish or Dutch product are high meat yield and good shelf life)
- Frozen cooked vacuum packed mussels, may come from a variety of sources, but a key supplier is Bantry Bay Seafoods in Ireland
- Foodservice price levels are generally lower than for retail for frozen product, thus at present there is limited incentive for Scottish suppliers to compete in this sector
- There may be an opportunity for a MAP fresh live debyssed product for foodservice, where better meat yields than say a competing Dutch product might give it an advantage
- Further sales to middle and upper tier restaurant chains may offer the best foodservice opportunity.
- There is some interest in promoting sales to the school meals sector, tied in with healthy eating initiatives
- Despite the generally positive UK market outlook, supply side difficulties remain, chiefly that of balancing overall supply and demand. Producers outside established marketing networks find it hard to secure outlets, and Shetland producers are increasingly dominating the wholesale markets, traditionally the main outlet for such unattached producers
- It is likely that small producers will continue to struggle unless they can link in with larger companies with established markets or join SSMG
- With regard to continental markets, the Belgian/French multiple retail market is volume driven and dominated by the Dutch processors supplying mainly bottom cultured mussels
- There are however indications that consumer sentiment is changing in favour of rope grown mussels which may offer niche opportunities for Scottish product
- The seasonal bulk French market offers a volume outlet for product that cannot be sold readily in the UK, but timing is uncertain, price relatively low, and subject to practical and logistical difficulties

Oysters

- Strong market demand at present, with prices having risen over the past 5 years to an acceptable level
- The UK market is thought however to be relatively static; the strong market may be partly due to the lower presence of Irish oysters which are now being exported to France instead in view of the production problems there due to disease
- The 2 largest Scottish distributors are having to buy in up to 2 million shells a year from outwith Scotland to satisfy demand, but would much prefer to source Scottish stock if available; there appears to be a clear opportunity to source increased production of Pacific oysters from Scotland to fill this gap
- There appears to be scope to make better use of provenance and quality as a promotional tool at local and national level (in conjunction with accreditation?), and to improve the role of oysters in local food and drink initiatives

Scallops

- There is good demand for king scallops at premium prices for niche growers who are able to protect Several Order stocks
- For queen scallops, there are niche opportunities serving high end seafood restaurants for the limited supply.

All species

The trend towards sustainable sourcing is positive for all farmed shellfish, and represents an opportunity to firmly lay the industry's green credentials on the line. This can however only be done through accreditation, which is in any case increasingly required by buyers. Choices will have to be made regarding the best accreditation route. Accreditation will not necessarily give the industry a marketing advantage, given that bottom growers are also going down this route, so thought needs to be given to how best to use it as marketing tool.

There is clear feedback from consumers, especially of oysters, of the desire for information on provenance. The Scottish and Shetland "brands" are already widely used, as well as more distinctive regional and company identities, for both oysters and mussels. There would appear however to be scope for further promotion of provenance in oysters, although this is most likely to be of benefit to growers selling their product directly. For the larger distributors any further effort to promote individual farm provenance would come at a cost and would not necessarily drive further sales or increase unit values.

There has been much discussion particularly amongst mussel growers about the need for increased promotion. There is a genuine belief on the part of producers that they have a great product to sell which ticks all the right boxes (health, sustainability, convenience, carbon capture), but a sense of frustration concerning poor relative UK consumption. The New Zealand example of success in boosting the domestic market by encouraging consumption in the younger generation is often quoted. All growers have indicated that they would be prepared to contribute to promotion and some ideas about how such an initiative could be organised have been put forward. An appraisal of the experience in other countries such as New Zealand would be a useful starting point.

Despite all the discussion about promotion, the first priority in increasing sales should be greater understanding of the consumer, assess whether his/her needs are being met, and make sure that expected levels of quality are being consistently delivered. Only then can promotion play its part. The first step therefore in this process should be a detailed market appraisal assessing such factors. Once deficiencies or opportunities have been identified as a result of such research, strategies for increasing sales can be formulated. Such strategies may or may not include various forms of promotion, generic or otherwise.

This study has only been able to touch on the general characteristics of markets for Scottish farmed shellfish. It is clear that existing consumption in the UK is very low when compared with other EU countries and has great scope to grow. However, much more detailed market information is required to make informed decisions about marketing strategy, particularly for continental markets. Such information needs to include:

- detailed customer profiles
- gaps in such profiles and regional differences
- consumer perceptions of shellfish (especially non consumers e.g. children)
- customer preferences for different product forms
- the extent to which quality expectations are being met.

7 Production factors

7.1 Mussels

7.1.1 Production methods

Most mussel production in Scotland is now done using longlines, although rafts are still used in some areas. A typical longline is 200m long and on the surface consists of 2 x 32mm parallel headropes separated at intervals by buoys of 200-400litres capacity (see Figure 7-1). Buoyancy is adjusted according to the weight of stock carried. The traditional and still widely used culture medium is a 13mm rope "dropper" of variable depth (typically 6-8m) with plastic pegs inserted every 30cm and weighted at the bottom. Such droppers are hung vertically from the headropes at intervals of around 0.4m. Other forms of dropper include netting strips, hairy rope and ladder. Longlines are typically moored at each end with a rope and chain leg leading to a high holding power anchor.

Figure 7-1. Longline mussel farm in Loch Striven, Argyll

Longlines are serviced by 12-20m dedicated workboats with the necessary gear for working the lines, and represent the single biggest investment for most farms. Equipment for grading and sorting is typically in separate facilities ashore but can also be located on workboats or dedicated harvest rafts.

Spat collectors (which may be pegged rope droppers which remain in place until harvest, or media such as hairy rope or net which is later stripped and the stock reseeded) are installed in the spring, typically in the period April to May, depending on the time of spatfall which can vary from location to location. Traditionally, pegged ropes are left in place until mussels are big enough to harvest, typically between 2 and 3 years later in Scotland. It is important that all stock is harvested from lines by March/April of the third year to allow installation of new collectors for the next production cycle. Any stock below market size is typically put back onto droppers for ongrowing in a process known as "retubing", "reseeding" or "resocking", using a cotton or synthetic sock to bind the mussels to the rope, the sock later rotting away to leave the mussels attached by their own byssus threads. The most commonly used technology for this process in Scotland is provided by the Spanish company Aguin, the equipment being inexpensive and effective, albeit slow.

Rather than leaving stock from settlement until harvest, which may result in over crowding and drop-off of stock especially during the second winter, some farms strip some or all stock after 6-12 months growth and reseed at lower densities. The logistics of this operation have however in the past acted as a deterrent.

7.1.2 New technologies

7.1.2.1 New Zealand system

Whilst single pegged rope droppers are tried and tested, they are difficult and slow to handle and attention is increasingly being given to so called "continuous" systems such as those used in New Zealand (NZ). With such systems a continuous rope is looped up and down from the headrope (see Figure 7-2) so that handling procedures such as seeding and harvesting can be accomplished at a much faster rate than with single pegged droppers. This opens up the possibility of different culture strategies which could potentially shorten overall production cycles and thus improve the productivity of equipment employed. Different types of rope are available depending on particular requirements e.g. spat collection, reseeding density, stock size.

Figure 7-2. NZ continuous system

Source: Franklin (2009)

The potential attractions of the NZ system include:

- better use can be made of spat; in traditional systems where stock is untouched between collection and harvest, a high proportion of stock can fall off and be lost (usually the largest mussels on the outside of the dropper) and final yield is very variable; with the NZ system, spat can be stripped off lines at an early stage in the production cycle before it is lost and reseeded onto new lines at the rate of 3or 4 new lines to 1 spat line
- there is more flexibility to use different sites for different purposes; e.g. a good spat collection site perhaps of limited size can be used to provide seed for ongrowing in a different location with poor spatfall but good water exchange and food supply
- if spat is graded at the same time as being thinned, larger stock has the opportunity to reach market size much earlier, potentially in less than 2 years
- by reseeding at specific densities and sizes, the final harvest outcome is more predictable and consistent in terms of overall yield/m, meat yield, size and growth
- if there are problems with predators such as starfish, lines are easier to lift and treat
- reseeding can be accomplished at the rate of 6-8,000m a day, compared with around 800m (100 x 8m droppers) using the Aguin reseeder
- harvesting can be carried out more easily and rapidly e.g. 5-15t/hour (Franklin, 2009)
- the work is easier on staff

The use of the NZ system in Scotland is still at an early stage. One or two companies have been running trials for the past 2-3 years with mixed results, one problem encountered being the gradual "drop-off" of stock after reseeding, in some case up to 50%. The ideal would be to strip and reseed spat after the first summer when water temperatures are still high enough to encourage good attachment, but growth in Scotland is rarely good enough to get stock up to a large enough size by that time. Another concern is whether stripping and reseeding of stock at lower density

increases the risk of shell fouling, given that by reducing the density it exposes more of the shell of the mussel to settlement.

Many farms in Ireland are now said to be successfully using NZ technology. However, the industry there has traditionally been based on a culture strategy already involving the reseeding of stock during the culture cycle, so the move to the NZ system was a more natural progression. A further incentive was to eliminate the use of the traditional culture media, a disposable plastic mesh tubing known as "pergolari", which posed a major waste disposal problem.

Despite uncertainties regarding the NZ system, several farms have made significant investments in NZ rope and handling equipment, aided to a great extent by EFF grants. If successful, there is no doubt that it could greatly improve productivity and thus lower production costs.

Given the potential benefits of the system and the significant investment made, there would appear to be a strong case for supporting applied research into factors affecting the use of it in Scottish conditions, in particular the reasons for post seeding drop off and ways to mitigate it.

7.1.2.2 Other mussel farming technologies

The NZ system is not the only continuous system in use in Scotland: the Spanish company Aguin now supply a continuous reseeding machine adapted for use with continuous pegged rope, and at least one Scottish company is known to be successfully using this method, an advantage being that the equipment is inexpensive and can be used with existing culture media.

Another continuous technology which has been developed and proven in Scotland is that offered by the Scottish company Xplora Products Ltd, a specialist Scottish provider of equipment for the mussel industry. In this case the culture medium is a rope "ladder" consisting of two 13mm ropes 150mm apart joined at 30cm intervals with a plastic peg, which can either be handled as a roll or loose in bulk bags (see Figure 7-3). The main benefit is the high holding capacity without slippage, with yields of 100t per line possible, and the potential for rapid harvesting. Harvest can either be through a dedicated catamaran harvest raft supplied by Xplora which strips both sides of a longline at once or by conventional means. Best results have been achieved by leaving the ladder undisturbed throughout a 3 year production cycle, rather than by thinning part way through. At least three large Scottish farms are using ladder as their main culture medium, and another uses it for spat collection and first year growth before stripping and reseeding onto continuous pegged rope.

Another type of technology is that offered by the Norwegian firm Smart Farms AS. Buoyancy is provided by plastic pipe of the type used in salmon cages arranged in 100m lengths. From this is hung netting to a depth of 2-3 m which forms the culture medium. Stock is harvested from the net either as spat or market product by means of a special stripping machine. This system has been tested in Ireland and Shetland but is not considered to be viable for ongrowing. Its main benefit is most likely for spat collection, and it is being used for this purpose in the Netherlands and elsewhere.

Figure 7-3. Mussels growing on ladder showing high holding capacity

7.1.3 Mussel seed supply

In view of the difficulties of obtaining regular spatfall in some areas, or in being assured of seed of known speciation to avoid the difficulties associated with settlement by *M trossulus*, it has been suggested that there might be a case for a mussel hatchery in Scotland. Additional benefits might be out of season production to improve growth cycles and maximise site use, production of triploids to allow marketing of stock during the normal spawning season, and breeding programmes to select for positive traits such as better growth rates, higher meat yields etc. The technology for spawning and rearing mussels is known and in active use in some parts of the world e.g. by Taylor Shellfish Farms in the USA (www.taylorshellfishfarms.com). An EU funded CRAFT project ("Blueseed") concluded in 2008 and looked at the development of hatchery technology for mussels in the EU (www.blueseedproject.com). Whilst the hatchery technology for mussels is thus relatively well known, the main barrier is the cost of production when compared with the alternative of free wild spatfall, and is only likely to be viable if some of the aforementioned added value benefits e.g. triploidy can be exploited.

In the short to medium term at least, the solution to seeding areas with poor spatfall will be to bring in stock from areas with known good spatfall, either on spatted ropes or using reseeding methods.

7.1.4 Production problems

7.1.4.1 Uncertainty of production

Mussel farming suffers from a greater degree of production uncertainty than other forms of aquaculture, given the range of factors outwith the control of the grower (see Table 7.1). This is the case even when compared with other shellfish such as oysters.

Table 7.1. Essential differences between mussel farming and other forms of aquaculture, illustrating the greater degree of uncertainty attached to the former

Factors	Mussel farming	Other forms of aquaculture
Seed supply	Wild supply, abundance, quality & timing varies year to year; may fail some years	Hatchery supply, known source, timing, quality, genetic strain
Stock control	Numbers and final yield uncertain throughout (thinning & reseeding may help)	Numbers are known from start and can be monitored throughout
Containment	Containment not possible, reliance on byssal attachment, vulnerable to drop-off, highly vulnerable to predation	Stock contained throughout and thus more easily protected

These uncertainties relate mainly to the difficulty of stock control and lack of containment, but are compounded by other factors such as variation in characteristics of local strains of mussel, variable feed supply and growth, shell fouling, water quality, toxins, and organisms that compete with mussels for space on the culture medium e.g. sea squirts.

The importance of such uncertainty relates to the impact it has on the ability to consistently and predictably achieve budgeted production targets in terms of yield per longline year after year, and it has a major impact on business viability. In addition, it creates difficulties in being able to accurately predict harvest yields for marketing purposes, with both over and under production scenarios on an industry wide basis being possible.

Yield can vary greatly between locations depending on local environmental conditions and the production strategy employed, and from year class to year class. Lines left untouched for the 2-3 year period between spat settlement and harvest are more likely to suffer from unpredictable yield, influenced by factors such as initial spat settlement density, competition from other organisms e.g. sea squirts, predation by starfish and ducks, and drop off during bad weather. On the other hand, yields from lines that have been reseeded tend to be more predictable as the influence of many of these factors is reduced. This is one area in which the use of NZ continuous technology could make a significant difference.

A further consequence of uncertainty is the difficulty it imposes on being able to replicate production processes from one site to another. It can take years to learn how to get the best from a site, and the knowledge so acquired will not necessarily apply to other sites, even in the same loch. This again marks a major difference from other forms of

aquaculture where the blueprint for a production process can generally be transferred from one site to another and one person to another assuming certain common criteria. This may help to explain why mussel farming has not expanded as rapidly as it might have, certainly in some areas of Scotland.

7.1.4.2 Predation

The main predation threat comes from eider ducks, which in some areas e.g. SW Shetland number several thousand and can cause considerable damage. Other areas to suffer include the west coast of Mull and certain parts of Argyll. Preventative methods include the use of chaser boats and the placing of nets around rafts or longlines. Nets are generally effective but are difficult to deploy and maintain.

The other threat, again more serious in some areas than others (especially those with higher salinity), is that of starfish, which settle as juveniles from the plankton several weeks after mussel spatfall. In serious cases, if no action is taken, whole year classes can be lost. Treatment is possible by dipping droppers in a bath of hydrated lime or concentrated brine solution.

7.1.4.3 Fouling

Shell fouling organisms include barnacles, sponges and tubeworm, of which the most serious is the latter. Grade A mussels must typically have no more than 7% of the shell covered with fouling, whilst those additionally intended for vacuum packing should have none due to the added risk of puncturing the vacuum.

Barnacles can generally be removed by grading, whilst tubeworm cannot. Some farms have had to discard up to 50% of their production due to tubeworm, and have been brought to the brink of business failure. Not only is that proportion of the crop lost, but the need to employ significantly more staff to remove the affected mussels adds greatly to the financial loss.

Severity appears to be worse on inshore sites with poor water exchange and higher salinity, and can be exacerbated by thinning and reseeding, the latter process risking damaging the surface of the shell which together with the lower resulting density making it more susceptible to settlement.

Other than avoiding susceptible sites (which for established businesses is rarely possible), control methods include avoiding thinning or carrying out the process when the tubeworm larvae are settling, although neither of these is sure to work.

Affected farms are not only impacted by the loss of marketable stock, and the higher cost of sorting, but also by increased market pressures when selling the balance of crop. If demand is low and supply plentiful, mussels with the cleanest shells are naturally favoured by buyers, so that even if fouling levels are below 7% they may still not be accepted.

The tubeworm problem appears to be a greater threat on farms that have been established some time, probably due to the increasing stock of spawning tubeworm building up on the site, whether on the culture ropes themselves or on stock that has fallen to the seabed. The Shetland industry has to date been relatively free of the problem, but there are now said to be signs of increasing incidence.

The uptake of NZ technology may offer some opportunity to mitigate the problem, in that there is greater flexibility to handle stock rapidly at key points in the production cycle e.g. when tubeworm larvae are settling. At the same time, there is also a possibility if done at the wrong time that it may make matters worse.

There is no question that tubeworm is one of the most serious problems in mussel farming, and one that could get worse especially in areas that are relatively new to production such as Shetland. As such, it is one of the main issues flagged up for further research.

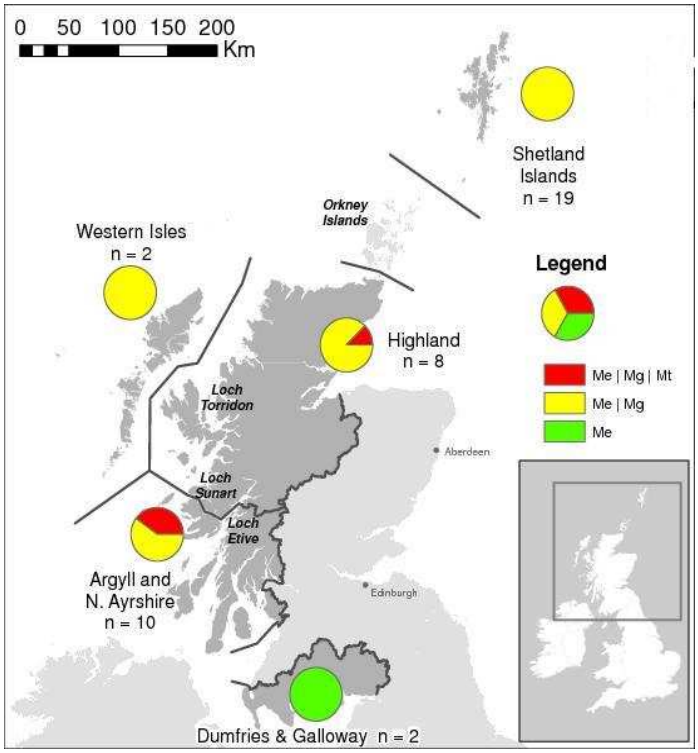
7.1.4.4 Mytilus trossulus

M. trossulus is one of 3 closely related species of mussels found in the North Atlantic, along with *M. edulis* and *M. galloprovincialis*, and hybridisation is possible between all three.

Following several years of increasing problems with poor meat yields and weak shells in farmed mussels, *M. trossulus* was first officially reported from Loch Etive in 2005, having hitherto been unknown in Scottish waters. The dominance of this species on mussel farm structures in Loch Etive is now so great that stock is not marketable and

production has fallen to zero. Surveys by Marine Scotland since 2005 have determined that *M. trossulus* (or hybrids of) is restricted to Argyll and south Highland (see Figure 7-4). Incidence on beaches is very low, but more obvious at marinas and farms, suggesting a preference for settlement on artificial structures. Research carried out on the life cycle of *M. trossulus* shows that there is insufficient difference between it and *M. edulis* to allow management strategies favouring the latter. A strategy to control *M. trossulus* in Loch Etive based on the removal of all stock from farm structures is being prepared, one of the key issues being what to do with affected stock once it is stripped from lines. SARF are currently funding an 18 month study to develop a science based approach to controlling the problem.

Figure 7-4. Incidence of M. trossulus at mussel farm sites in Scotland



Source: Dias, 2009. Number of aquaculture sites sampled (n), and detections obtained for these sites of the *M. edulis* (Me), *M. galloprovincialis* (Mg) and *M. trossulus* (Mt) species-specific alleles at the Me 15/16 locus, are given per local authority area.

Certain growers contacted during the course of this study have reported increasing incidence of *M. trossulus* on their farms and concern about the impact. Affected areas include Loch Leven, Loch Fyne and Loch Eil. One grower reported plans to catch spat in another loch for transfer back to the affected loch for ongrowing.

Clearly *M. trossulus* has the potential to cause major loss outside of Loch Etive, and it is to be hoped that ongoing research will result in practical control measures.

7.1.5 Business viability

Business viability is to some extent dependent on economy of scale, with growers producing more than 200t pa generally considered better off. Much also however depends on end markets, with growers producing more than this but without a secure market still finding it difficult to survive, whilst those producing less than 100t but with a secure outlet can still be viable.

Production levels for Scottish mussel farming companies are shown in Table 7.2, compiled as a result of interviews with producers. The similar data given by Marine Scotland in their annual survey presently gives a breakdown of company production levels for various sizes below 100t, with only one category for more than 100t and is thus no longer representative. When considering estimated production potential for 2010, 75% of prospective Scottish production is in the hands of 11 companies producing more than 200t each, thus the majority of production is from companies operating at a reasonable economy of scale.

Table 7.2. Mussel farming company production levels

			Company production levels (tonnes)				
	Potential 2010 production	**No. of producers**	**0-100**	**101-200**	**201-500**	**501-1000**	**>1000**
Shetland	4,250	12	4	3	4		1
W Isles	950	10	9			1	
Highland	1,000	8	6		2		
Strathclyde	1,180	5	2		2	1	
Total	7,380	35	21	3	8	2	1

Source: producer interviews; the number of producers relates only to those accounting for the estimated 2010 production, and does not equate to the total number of producers (given as 52 in 2008 for all of Scotland (Marine Scotland, 2009))

However, there is also scope for smaller growers if they are able to buy in harvesting, grading and packing services from a bigger operation. This model appears to work well in Shetland, where two of the largest companies provide such services to a number of smaller growers. This is similar to the successful NZ model, where virtually all the services needed to run the farm can be bought in from specialised and highly efficient sub contractors, including line cleaning, reseeding, and harvesting. In Shetland as in NZ, this practice is greatly facilitated by the relative proximity of farm sites.

When business viability was discussed with producers, it was clearly more of an issue for the smaller producer (see Table 7.3). However, both large and small growers outwith Shetland considered the contracting model used there as beneficial, or in the absence of a large producer in the area offering contract services, an alternative would be the establishment of a machinery ring for the sharing of a boat and other equipment.

Table 7.3. Mussel producer comments on business viability

Producer comments on viability	**Size of producer**
Market, quality and production need to grow together	Large
Would love to see contracting out model as in Shetland, feels out on a limb	Large
Tough business to be in, not viable unless large scale; if employ people must provide right kit and working conditions which increases cost	Large
Need to improve the way things are done, get production costs down, increase quality - big range in quality of product on the market e.g. gaping, size; need better infrastructure, bigger volumes, better marketing e.g. NZ	Large
Good business at 600t pa but then got tubeworm and production fell by 50% - touch and go	Large
Made a profit last year, this year less, depreciation a big cost	Large
Main constraints: poor price, production problems especially lack of boat; have site capacity to expand significantly but lack finance to develop and no market	Small
Only way a small producer can survive is to sell "off the ropes" i.e. have larger company as contract harvester	Small
Investigating cooperative with other growers for equipment share e.g. boats, similar idea to agricultural machinery ring	Small

In conclusion, it would appear that the Scottish mussel industry is presently operating with individual economies of scale sufficient for business viability (providing there are no production problems), and even smaller growers can be viable if they are fortunate enough to be able to tie in with a larger operator to provide harvesting and marketing services. For those not in such a position, which relates to most smaller scale producers outside Shetland, the prospects are not good unless better efficiencies can be achieved through cooperation with equipment sharing and in particular with marketing. It has not been possible to look into existing support mechanisms and cooperative arrangements for equipment sharing e.g. agricultural machinery rings, but this is one area where valuable efficiencies could be achieved. The question of viability is further assessed under costs of production (Section 7.1.6) and finance and investment (Section 9).

7.1.6 Costs of production

7.1.6.1 Introduction

Although cost of production was a specific subject in producer interviews, few growers were able to provide a ready answer as to what their costs were. Identification of production costs is complicated by the wide range of business models in the industry, ranging from small part time operations to large scale companies producing over 1000t pa and also harvesting and marketing product from smaller growers. Factors influencing cost of production include:

- scale of production
- length of production cycle
- yield achieved per longline
- availability, cost and productivity of labour
- extent of infrastructure available e.g. piers, harbours, access roads
- whether shore based processing facilities are purchased or rented
- proximity of sites to shorebase
- extent of mechanisation both on service vessels and ashore
- whether packing and depuration facilities are required (can these be provided by others?)
- extent of grant aid received
- the availability of other income streams e.g. use of workboats to provide services to salmon farms
- critical mass of local industry players (mutual support system)

Apart from the smallest growers outwith Shetland having marketing difficulties, and those suffering from specific production problems such as tubeworm, none of those interviewed appeared to be under obvious pressure on grounds of business viability, the main concern being to make sure there was an outlet for the production they had. Thus at a typical ex-farm price of £800-£900/tonne it is assumed that the majority of businesses are profitable. Very limited feedback on production costs suggested a figure of £600-700 a tonne for a medium to large scale operation producing 4-600t pa with a competent workboat and onshore grading/rewatering facilities.

7.1.6.2 Costs for a model 500t farm

Given this background, a financial model (see Appendix 3) has been prepared to examine the costs of production from first principles to illustrate where the main costs lie and what scope there might be to reduce them. The base case has been taken as a 500t p.a. stand alone farm using single droppers e.g. pegged ropes with a 3 year production cycle, with all product harvested out by the end of the third year. It has been further assumed that the farm has a shore base with facilities for grading and depuration, and that all product is sold ex-farm in bulk bins for onward processing by another party.

A 500t production level has been chosen as it is often considered to be the limit serviceable by one workboat, which represents the single biggest item of capital investment in the business. In practice a 500t farm would typically operate with 2-6 sites, depending on local conditions, so such sites would need to be close enough to the shorebase to be readily accessible by the workboat.

Financial projections have been based on a start up situation in which a new year class is started each year, with first harvest commencing in year 3. The costs of production have been taken from the profit and loss account for year 5, once the business has (in theory at least) achieved steady state production. The investment case is considered separately in Section 9. The key assumptions used in the base case are summarised in Table 7.4.

Table 7.4. Key assumptions for model 500t farm

Key assumptions - base case	
Production p.a. (t)	500
Yield/longline (t)	40
Production cycle (years)	3
Price (£/t)	800
EFF grant rate (%)	60%
Labour (t/employee)	70
Annual wage cost/person (£)	22,000
Capex/t of production (£)	2,203

The yield per longline of 40t is based on average industry figures (see Table 7.5). Yields can vary widely, and there is no agreed protocol as to whether yield relates to the gross weight harvested or the net weight that is paid for by the processor, which can vary by as much as 30% depending on quality and the amount of grading done on farm. The yield assumed in the base case is net weight paid for.

Table 7.5. Mussel farm yields reported by growers in different parts of Scotland

Location	Media	Avg. yield (tonnes/200m longline)	Range (tonnes)	Comments
Shetland	Pegged rope/net	48-50	15-100	Budget 40t
Shetland	Pegged rope	45		Reseeded
Shetland	Pegged rope	50-80		Reseeded
Lochaber	Ladder	50	Up to 120	
Western Isles	Ladder	56-70		
Mull	Pegged rope	50	Up to 67	
Argyll	Pegged rope	40		Reseeded
Skye	Pegged rope	30		
Sutherland	Pegged rope	16		

The ex-farm price has again been based on industry feedback, and allows for a certain proportion of B grade mussels. The 60% EFF grant rate applies to the Highlands and Islands Convergence area, which covers most production areas of Scotland, but only the Highlands and Islands area of Argyll and Bute. The rate for the rest of Scotland (Lowland Non-Convergence) is 40%. Labour productivity has been based on industry feedback for this scale of operation. Typically the workboat would be operated by 2-3 staff for harvesting, with an onshore crew for grading, sorting, and depuration/rewatering. The labour rate is based on an hourly rate in Shetland of £9.50/hour, which may be higher than elsewhere due to competing industries (salmon, oil, SIC) but has nevertheless been assumed given that the majority of Scottish production is coming from Shetland.

Capital expenditure is given in Table 7.6. Longlines are based on the standard industry format of 200m parallel headropes supported by an average of 50 x 400 litre buoys with rope/chain/anchor mooring legs either end in a water depth of no more than 30m and not requiring cross moorings. The workboat cost is based on a 15m x 5m Alnmaritec aluminium vessel of the type widely used in the industry. The costs for shorebase and depuration are more tentative given the range of options available in practice e.g. whether buildings can be rented or need to be built from scratch. Other equipment includes forklift, a Voe boat, pick up truck, and processing equipment (grader, inspection belt etc).

Table 7.6. Summary of capital expenditure for model 500t farm

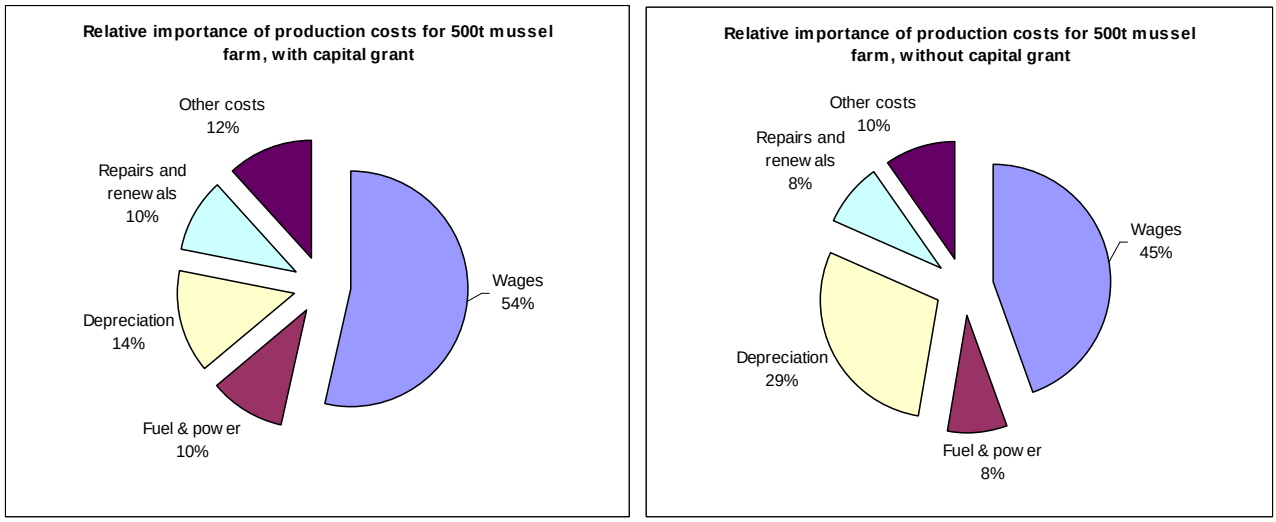
Item	Cost (£)
Lines and moorings	355,475
Shorebase grading	145,000
Shorebase depuration	156,200
Workboat (15m)	300,000
Other equipment	92,380
Contingency (5%)	52,453
Total	1,101,508

The results of the production cost analysis are given in Table 7.7. In the "with grant" case, wages are by far the greatest cost component at 54%, with depreciation the next greatest cost at 14%. Overall cost of production is estimated to be £586 before finance. The high capital costs associated with mussel farming and therefore the importance of EFF grant funding are illustrated in the "without grant" case, where depreciation assumes 29% of the overall production costs of £709 (see Figure 7-5).

Table 7.7. Results of production cost analysis, model 500t farm, before finance

	With 60% EFF grant		Without grant	
	Cost/t	% of costs	Cost/t	% of costs
Wages	314	54%	314	44%
Fuel & power	60	10%	60	8%
Depreciation	82	14%	206	29%
Repairs and renewals	60	10%	60	8%
Other costs	69	12%	69	10%
Total	586	100%	709	100%

Figure 7-5. Relative importance of production costs and effect of EFF grant, model 500t farm



These costs, i.e. £590-710/t before finance, appear to tie in with industry feedback received. The main cost is clearly labour, especially in the "with grant" case, making up 54% of all costs.

Mussel farming is labour intensive, even with the latest boats and handling equipment. Typical routine tasks on the farm include:

- installing new droppers each spring (April/May)
- treating for starfish (July/Aug) (if needed)
- adding extra buoyancy to lines (June/July)
- servicing moorings (summer)
- harvesting (depends on toxins and region, often Sep-Mar, or later in Shetland)
- grading, cleaning and depuration of harvested product
- reseeding of harvest grade-outs (if practised)
- reseeding of spat after 6-12 months (if practised)
- eider duck control (chaser boat, netting etc)(peak Feb-Mar)
- cleaning lines post harvest
- general maintenance of boats and machinery

Of these tasks, harvesting and post harvest handling account for around 60% of labour costs, requiring a boat crew of 2-4 to remove and strip droppers, and a shore crew to grade, sort and depurate/rewater.

An attraction of the NZ system is that it offers scope to reduce such labour costs. The culture medium is a continuous rope and is much quicker and easier to handle than pegged ropes, whether it be at initial deployment for spat collection, thinning or harvesting. Tasks associated with deployment and maintenance of lines, buoys and

moorings should be significantly reduced given the potentially lower number of lines needed for the same production. In addition, a more even harvest size should make grading less onerous. The scope for reducing production costs using the NZ system is examined below.

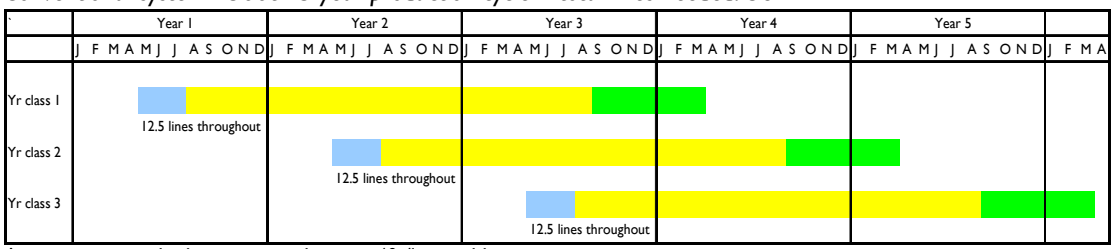
7.1.6.3 Costs for a 500t farm using NZ technology

The main attraction of the NZ system lies in the potential to reduce the length of the production cycle and improve labour productivity. For example, if the growth cycle could be reduced to 2 years (as in Ireland), and 1 spat line is used to seed 3-4 production lines, then it is theoretically possible to produce double the tonnage from the same number of longlines as used in the model 500t farm (see Figure 7-6). The key to this is having spat of sufficient size 6-9 months after spatfall for the reseeding process. In Ireland, where NZ technology is widely used, spatfall occurs earlier in the year, water temperatures are warmer, and spat are consequently of a large enough size. Whether this can reliably be achieved in Scottish conditions (especially more northerly areas) remains to be seen.

Assuming reseeding after 6-9 months and a 2 year production cycle, the number of lines required and associated capital expenditure could be reduced by half. At the same time, greater expenditure would be required for the equipment needed to use the continuous system, so overall capital expenditure would be similar to the traditional model (see Table 7.9). Final harvest yield has been kept the same at 40t/line. Although yields for reseeded lines are often higher, the holding capacity of NZ rope (which is unpegged) has not yet been widely proven in Scottish conditions.

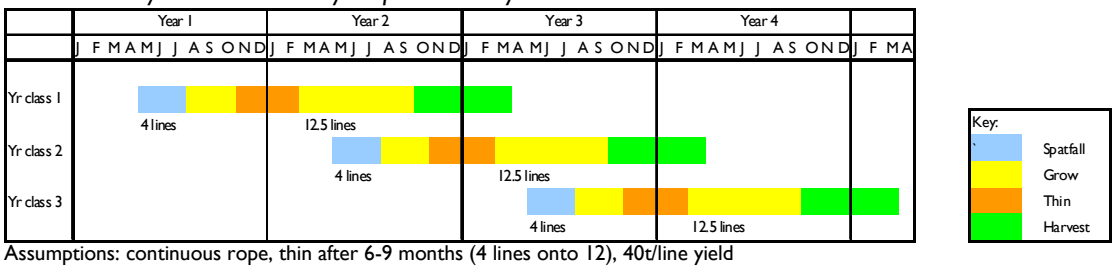
Figure 7-6. Comparison of production plans for conventional and NZ systems

Conventional system - 500t - 3 year production cycle - total lines needed: 38



Assumptions: single droppers, no thinning, 40t/line yield

Potential NZ system – 500t – 2 year production cycle - total lines needed: 17



Assumptions: continuous rope, thin after 6-9 months (4 lines onto 12), 40t/line yield

Table 7.8. Key assumptions for 500t farm using NZ system

Production p.a. (t)	500
Yield/longline (t)	40
Production cycle (years)	2
Price (£/t)	800
EFF grant rate (%)	60%
Labour (t/employee)	100
Wage cost/person (£)	22,000
Capex/t of production (£)	2,032

Table 7.9. Summary of capital expenditure for 500t farm using NZ system

Item	Cost (£)
Lines and moorings	184,656
Shorebase store/office	145,000
Shorebase depuration	156,200
Workboat (15m)	300,000
NZ equipment	100,000
Other equipment	81,964
Contingency (5%)	48,391
Total	1,016,210

Table 7.10. Results of production cost analysis, 500t farm using NZ system, before finance

	With 60% EFF grant		Without grant	
	Cost/t	% of costs	Cost/t	% of costs
Wages	220	45%	220	37%
Fuel & power	60	12%	60	10%
Depreciation	74	15%	185	31%
Repairs and renewals	60	12%	60	10%
Other costs	72	15%	72	12%
Total	486	100%	597	100%

Although the labour saving potential of the NZ system has not yet been proven in Scotland, it seems reasonable to assume a productivity gain from 70t to 100t per person, which could result in labour costs being reduced by £100/t with a similar impact on overall production costs (see Table 7.10). Other costs are likely to stay much the same. Again, the lack of grant has a similar impact as with the base case, with depreciation assuming a much higher proportion of costs.

Although there are clearly productivity gains to be made from the NZ system, the main potential benefit would be in the greatly improved cash flow as a result of a 2 year rather than 3 year production cycle, which has a direct impact on payback period and Internal Rate of Return (IRR). This is examined further in Section 9.

7.1.6.4 Other ways to reduce production costs

Apart from the potential benefits of the NZ system previously discussed, the other key area for cost reduction in both 500t models assessed above is through making better use of fixed resources such as workboats and shorebase facilities which make up such a high proportion of capital costs. This is possible in areas such as Shetland where the proximity of farms allows larger operators to provide contract services to other farms. In addition, in some areas the possibility also exists to generate extra income from workboats by providing other services e.g. salmon farm feed supply, ferry services.

7.1.6.5 Costs for a 100t farm selling "off the line"

Another model which appears to be successful is that seen in Shetland whereby some smaller farms sell product "off the line" to a larger company which takes responsibility for harvesting and marketing. In view of the possibility of this model being used elsewhere in Scotland, the costs and viability of such an operation have also been assessed.

Such a farm would typically have 6-9 longlines and a Voe boat for servicing, but otherwise no other significant capital costs. The main labour requirement would be the seasonal installation of new droppers, adjusting buoyancy and protecting the crop (ducks, starfish), this being met by the sole owner/operator with some additional seasonal labour. The ex-farm price for mussels sold off the line in Shetland is understood to be around £500, and this has been assumed in the model.

The results of the analysis are summarised in Table 7.11, Table 7.12 and Table 7.13. Even with 60% grant on equipment, production costs are still £467/t before finance, suggesting that the main benefit of this type of operation is the provision of an income to the owner/ operator, with limited scope for a return on investment at the ex-farm price assumed. Without grant, such an operation is not apparently viable, returning a production cost of £527.

A further development of this model might be the use of NZ technology, with spat collection, reseeding and harvesting again being provided by a larger company, and potentially offering a much better return to the small farm operator.

Table 7.11. Key assumptions for model 100t farm

Production p.a. (t)	100
Yield/longline (t)	40
Production cycle (years)	3
Price (£/t)	500
EFF grant rate (%)	60%
Labour (t/employee)	70
Wage cost/person (£)	22,000
Capex/t of production (£)	996

Table 7.12. Summary of capital expenditure for model 100t farm

Item	**Cost (£)**
Lines and moorings	71,095
Workboat (Voe)	20,000
Other costs	3,750
Contingency (5%)	4,742
Total	99,587

Table 7.13. Results of production cost analysis, model 100t farm, before finance

	With 60% EFF grant		**Without grant**	
	Cost/t	**% of costs**	**Cost/t**	**% of costs**
Wages	314	67%	314	60%
Fuel & power	20	4%	20	4%
Depreciation	40	9%	100	19%
Repairs and renewals	30	6%	30	6%
Other costs	63	14%	63	12%
Total	467	100%	527	100%

7.1.6.6 Comparisons with Ireland

As already indicated, the NZ system has been successfully adopted in Ireland, and this success has largely been the reason for the recent interest in Scotland. However, there are important differences between the two countries. In Ireland:

- water temperatures are warmer, growth better and spat settlement earlier, thus spat for reseeding are of a large enough size
- the production cycle is 2 years on better sites (spat settle April, thinned over 1st winter, harvest after 18-24months)
- unlike Scotland, production has always been based on thinning stock after 6-9 months, thus growers have built their operations around this process
- final harvest is geared mostly to the processing sector (vacuum packs) with a relatively small preferred harvest weight (80-90/kg)

As already emphasised, the use of NZ technology in Scotland is at an early stage and much remains to be proven.

With regard to production costs in Ireland, a report on the state of the Irish industry in 2006 (Price Waterhouse Cooper, 2006) found that at that time viability both for processors and producers was marginal. At the time, the price paid by processors was €762 (equivalent to £522), suggesting a cost of production of around the same figure. This however would have been mostly for a bulk product sold off the quay with no onshore grading or depuration. This may therefore not be too far removed from typical Scottish ex-farm prices given that Scottish product also typically has to be graded onshore and depurated/rewatered. The assumed benefits of better growth and productivity in Ireland may thus in practice be offset by particular problems of the industry there such as biotoxins and over-crowding of production areas.

7.1.6.7 Conclusion

Indicative production costs for the model 500t farm using conventional methods on a 3 year cycle are between £580 and £700/tonne depending on the extent of grant received. This appears to tie in with the limited feedback received from growers. This cost is before finance and does not take into account cash flow implications and rates of return on investment, which are considered separately in Section 9. For the model 100t farm selling "off the line", production costs with grant are around £470 before finance. In both these cases, the main production cost is labour, which is the primary focus for cost reduction and where continuous technologies such as the NZ system hold promise.

In addition, there is scope for cost saving at the larger scale if the fixed costs of workboat and shore based facilities can be spread over a greater production by buying in stock from other farms as done by some of the larger farms in Shetland. However, in most other parts of Scotland where farms are more widely dispersed, this is clearly more difficult to achieve.

For the 500t model using the NZ system, the potential benefits are clear, but it must be emphasised that this is speculative given the present state of development and experience to date in Scotland. However, even if the benefits can only be partially realised, there is scope for improved efficiency and some cost reduction.

One of the purposes of analysing cost of production is to determine the extent to which the price paid to growers could be reduced. It should be emphasised however that the cost of production before finance as analysed here does not allow for the return on investment needed by the grower to make the venture worthwhile. For example, for the "with grant" 500t base case analysed above, indicating a nominal production cost of £586t, an average ex-farm price of £800 gives an internal rate of return (IRR) of 17%. To achieve an IRR of say 3%, roughly equivalent to the present "risk free" savings rate, the ex-farm price would need to be £680/t, suggesting that this is the minimum to which ex-farm price could be reduced for that type of operation and to still in any sense be viable. In reality, it is suggested that an IRR of at least 17% (and thus an average ex-farm price of £800/t) is needed to make the business sustainable given the high risks involved.

With regard to comparative costs of production with other industries, it must be accepted that Scotland will never be able to compete on price with the likes of low cost rope producers such as Chile, or the bottom producers of the EU, even if the full benefits of NZ technology are achieved. The emphasis will need to be on defining and promoting the unique product attributes of Scottish mussels and retaining the present relatively high value niche currently occupied.

7.2 Oysters

7.2.1 Production methods

The standard approach to Pacific oyster culture is the purchase of seed from dedicated hatcheries, followed by ongrowing in flat plastic oyster bags secured to steel trestles on the foreshore (see Figure 7-7), at or just above mean low water spring tide level. The bags are thus submerged for most of the time except at spring tides, when access can be made.

Oysters are stocked at different sizes typically ranging from 0.5g to 10g, "shore hardened" seed of the latter size often being most preferred but not always readily available. Growers in a start up situation may buy in half grown stock of 40-50g if available to ease cash flow.

Figure 7-7. Oyster bags and trestles, Loch Fyne, Argyll

Growth from 10g to a market size of 75-90g varies greatly between sites. On one "low energy" inshore site with limited water exchange it can take up to 4 years, whilst on one "high energy" offshore site with good water exchange 25% are ready after 1 year, 50% in the second year and 25% in the third year. One grower describes Scottish water as "thin" i.e. lacking in food and having lower temperatures than elsewhere and thus slower growth, and the need to adjust stocking densities to suit. One grower in Colonsay reports an increase in growth rate of around a year over the past 20 years, thought to be due to average sea water temperatures rising by 1-2°C.

Operations during the ongrowing period include grading, thinning, removal of mortalities, turning of bags, and removal of weed.

7.2.2 New technologies

The trestle and bag system is the one used by the majority of growers in Europe and has been tried and tested over many years. A different system has however been developed in Australia, whereby mesh bags are hung from fence like structures (see Figure 7-8). This system is said to offer scope for deployment in more exposed locations, reduced handling costs, and improved growth. The system is however said to be significantly more expensive than traditional methods, and most established growers cannot justify the cost of changing. In addition, there have been mixed results with trials to date in Scotland. On Islay, one trial is said to have resulted in the system being washed up on the shore in gales as a result of excessive weed deposition, and another in the Solway is said to have met with a similar fate. Growth however is reported to have been better than in the trestle and bag system, and spat are also said to do well. Clearly further work is needed to demonstrate viability in Scottish conditions.

Figure 7-8. Australian hanging oyster bag system

Source: Boddingtons (www.boddingtons.com.au/aquaculture/bst-oyster-bag.htm)

7.2.3 Seed supply

Seed supply is the single biggest concern for Scottish oyster growers, and potentially the greatest constraint. There are presently only two hatcheries able to supply seed to the Scottish industry, but the recent spread of disease (Ostreid herpesvirus) in Europe has led to increased demand and doubts about availability.

The two hatcheries are Seasalter (SS) at Walney Island, Barrow, and Guernsey Sea Farms (GSF), the former being the main supplier and more able to supply a range of sizes due to its proximity. Seed from GSF is typically bought at a small size e.g. 0.5-1g due to transport cost, but this requires the extra effort to bring stock on during the first year, when more frequent grading and splitting are necessary. Most growers would prefer to have two suppliers for security of supply, but in practice are typically tied to one because of concerns about quality and/or service of the other. This then leaves them in a vulnerable position should their own supplier for any reason be unable to supply, with the alternative supplier likely already having committed his stock.

Recently, there was considerable concern that supply from GSF would not be possible due to the recently proposed EU Council Directive 2006/88/EC, which stipulates restriction on shellfish movement from disease-affected to unaffected areas. The Directive made no separate mention of Jersey and Guernsey, only of the Channel Islands, implying that both are subject to restriction (Jersey has a disease history, Guernsey does not). However, whilst there is understood to be no plan to change the wording, import of oysters to the UK from Guernsey is understood to still be possible.

In addition to the concerns regarding seed supply from Guernsey, SS has faced increased demand from France due to the disease situation there, meaning there is less stock available for Scottish buyers.

With such uncertainty regarding seed supply, there has been discussion about the case for a Scottish based hatchery. Whilst this would undoubtedly help ease seed supply pressures and provide a fall-back position in the event of other hatcheries failing, the business case is not necessarily clear. Reasons for this include:

- hatcheries such as GSF and SS produce many millions of seed a year for a variety of established markets, have good economies of scale, and many years of expertise; any new stand alone hatchery would be faced with having to compete with such existing suppliers
- the Scottish industry presently only has a requirement for up to 5 million seed a year, with a value of around £110,000 assuming 50% at a size of 0.5-1g and 50% at 10g; any new stand alone supplier entering this market could only expect to supply a proportion of it, and indeed would need to secure significant alternative markets in the UK and elsewhere in the EU to achieve the economies of scale needed for financial viability
- both SS and GSF have unique sites allowing them to utilise algal-rich sea ponds for low cost upwelling nursery systems, difficult to replicate in other locations
- lower water temperatures in Scotland would mean slower growth and higher energy costs
- hatchery production is a skilled business, needing time and finance to develop
- there have been past attempts at hatchery production in Scotland (Orkney; Scottish Sea Farms) which have not lasted

One circumstance in which seed production in Scotland might make sense is for it to form part of a wider enterprise with compatible facilities and expertise. Indeed, Viking Fish Farms at Ardtoe has such facilities and skills, has expressed an interest in shellfish seed supply and is already engaged with trials for the production of *Ostrea edulis* seed. Their efforts should be encouraged and supported. In addition, the North Atlantic Fisheries College in Shetland has presently unused marine hatchery facilities which could potentially be used for shellfish culture, subject to sufficient demand.

7.2.4 Production problems

Oyster farming is labour intensive, physically demanding and may involve unsocial hours, and finding staff is often difficult. The work routine is governed by the tides, with peak workloads thus occurring every 2 weeks. If the tidal regime is upset by abnormal weather conditions, this can affect access and the time of day it can be made. The effects of sea water on vehicles and equipment mean that maintenance is a continuous and time-consuming task.

Overall, however, despite the labour intensive nature of the work, there are fewer uncertainties in the production process than with mussels, given the much better scope for stock management and containment. As yet, there have been no disease problems for Pacific oysters in Scotland, although this must remain a major threat in view of

developments in the rest of Europe. There is some predation by oyster catchers but this is not considered a major problem.

7.2.5 Business viability

One of the key areas for discussion during producer interviews was that of business viability. Many oyster growers refer to the difficulties of the business and the challenge of making a reasonable financial return. Whilst this is especially the case for small producers, it can also be a problem for larger operations.

Economies of scale, good growth rates and the ability to mechanise grading and handling operations are regarded as the key to viability. One large Irish farm supplying oysters to Scottish distributors is said to produce nearly 4 million shells a year, more than the entire Scottish production. In contrast, all except one Scottish producer is producing less than 500,000 shells (see Table 7.14), and even at that level the business is considered borderline.

All operations are owner operated and most cannot afford to employ outside labour other than seasonally, if at all. Despite an uplift in market price over the past 5 years, the returns are sufficient only to provide a modest income for the work involved, and allow little scope for a return on capital invested. At the scale of production in Scotland, it is therefore very much a "lifestyle" business and for the smallest operations of which there are many, it is a part time marginal activity (the average production of 21 smaller producers in 2008 was around 20,000 shells).

Table 7.14. Scottish Pacific oyster farming company production levels, 2008

Region	2008 production	No. of producers	Company production levels ('000 shells)			
			0-100	101-300	301-500	500-1000
Shetland	20	2	2			
Orkney	2	1	1			
W Isles	4	1	1			
Highland	271	9	8	1		
Strathclyde	3,488	19	9	8	1	1
Total	3,785	32	21	9	1	1

Source: FRS, producer interviews

Despite the fact that most operations appear to be of modest scale and questionable viability, there are nevertheless a number of examples of successful production: In one case, a production of around 150,000 shells pa for wholesale and local markets provides a valuable part time activity run in conjunction with another part time food-related business. At the other end of the scale, the largest Scottish producer (>500,000 shells), operating on a good site with scope for expansion, markets product to a variety of wholesale and retail sources and also supplies stock for ongrowing to farmers starting up. In another case, one relatively early stage estate-based operation with a target production of 300-400,000 shells is considered large enough to make a useful profit contribution to overall estate income, no doubt benefiting from being able to share estate resources and overheads.

The perceived viability of the business depends to some extent on the stage of business development and the age and aspirations of the owner. Experienced growers nearing retirement (of which there are a significant number) tend to have a more measured outlook, whilst those relatively new to the business are more optimistic.

One of the difficulties for those nearing retirement and wishing to hand over the business is the uncertainty associated with transferring foreshore access agreements, which may not always be assignable. In addition, the transfer value of a farm is likely to be negligible given the marginal nature of the business. For younger family members who might be in a position to carry on a business, there is again little incentive given the much better returns available from other activities such as fishing.

Despite the questionable viability of smaller operations, there is no doubt that they provide valuable sources of income in rural areas where there are often few alternatives, especially if they can be linked in with local food initiatives realising better margins.

7.2.6 Costs of production

An indicative profit and loss account for a medium scale (by Scottish standards) oyster farm is shown in Table 7.15, with further details in Appendix 4. This assumes all stock is sold undepurated to a wholesale distributor with depuration facilities. As suggested earlier, at this scale there appears to be little scope for a return on investment, with the principal benefit being provision of employment to the business operators. The costing assumes no grant is received. If 60% grant is obtained on new items of capital expenditure, depreciation costs are reduced by around 50%.

Table 7.15. Indicative profit and loss account for medium scale oyster farm, excluding finance

Income		£
350,000 shells at 24p each		84,000
Expenditure		
Direct		
Seed (10g)	11,667	
Labour (2 full time owner operators)	44,000	
Fuel & power	1,750	
Total		57,417
Gross margin		26,583
Indirect		
Repairs and renewals	3,500	
Shorebase ground rent	1,680	
Crown Estate rent	1,218	
Misc. costs	1,750	
Depreciation (no grant)	18,330	
Total		26,478
Total expenditure		83,895
Profit (loss)		105

NB These costs are indicative only and may vary widely between operations. See Appendix 4 for further details.

8 Production potential for shellfish farming in Scotland

8.1 Introduction

The potential for the Scottish shellfish farming industry has sometimes been viewed in terms of the relatively long length of its coastline when compared with the smaller coastlines yet substantially greater shellfish production of some of its EU neighbours, in particular France and Spain. The reality however is that whilst there may in theory be many physically suitable sites in Scotland, growth is significantly slower due to lower water temperatures and food supply, and planning and regulatory constraints suggest that in many areas there may be little scope for further development.

There are significant differences in the overall prospects for the main farmed species, based on a variety of factors such as availability of suitable sites, scope for increased production from existing sites, and seed supply (whether bought or collected from the wild as spat), with some of these factors more critical to some species than others.

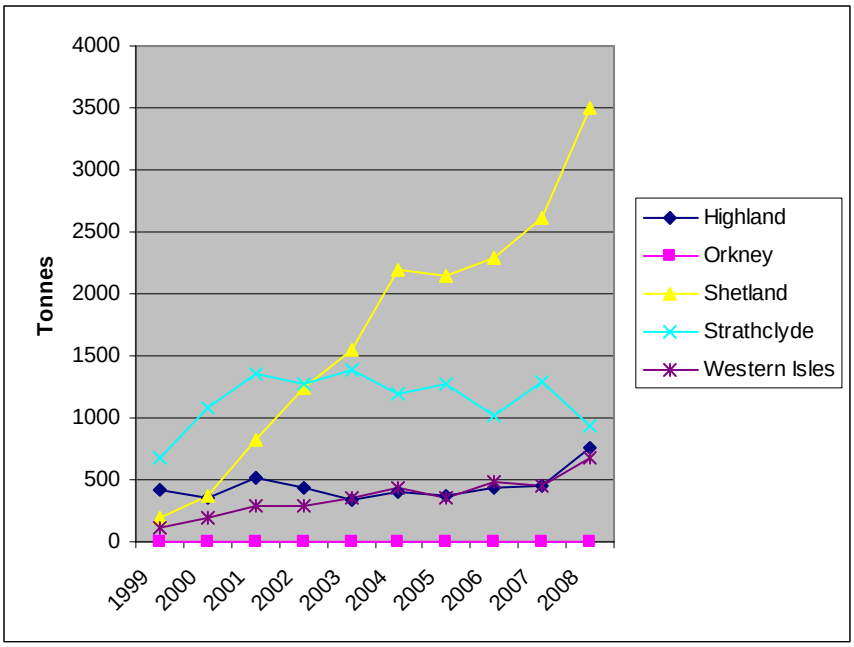
8.2 Mussel production potential

8.2.1 Introduction

It is clear that the regions of Scotland have demonstrated dramatically different capabilities with regard to mussel production, and it is likely that the factors that have contributed to this in the past will continue to influence future growth. It is also clear that whilst site capacity may well prove to be a barrier to further development in the future, our discussions with growers suggest that at the present time availability of sites is not a major constraint, with many companies having sites in hand but not yet developed, awaiting such time as markets and finance allow them to be brought into production.

Whilst the overall trend for mussel production in Scotland has been sharply upwards over the past 10 years (see Figure 4-1), this disguises highly divergent trends in the different regions (see Figure 8-1). The reason for these trends and further production prospects are examined in the following sections.

Figure 8-1. Farmed mussel production in Scotland by region, 1999 to 2008



Source: FRS

8.2.2 Shetland

8.2.2.1 Background

The mussel industry in Shetland has developed very rapidly compared with other parts of Scotland (see Figure 8-1), from less than 200t in 1999 to 3,500t in 2008. This has been due to a number of favourable factors, with the availability of suitable sites being amongst the most important. There are around 20 active producers, with the largest producing over1,000t (see Table 7.2). Other reasons for the rapid growth of the industry in Shetland include:

- the industry started later than on the West Coast and benefited from lessons learned elsewhere
- some operators moved out of salmon and thus had sites and boats available
- favourable sites in terms of shelter, depth, growth, infrastructure
- favourable strain of mussel (growth, meat yield, keeping quality)
- favourable finance (ex salmon farm entrants, oil fund grants/loans)
- strong industry representation (Seafood Shetland) and technical support (NAFC)
- favourable planning environment; SIC has clear guidelines on carrying capacity and siting; NIMBYism as on West Coast not a problem
- proximity of sites allows contract operations by larger operators (cf NZ model), benefiting both them (economies of scale) and smaller operators (no need to invest in costly workboats and processing operations)
- Shetlanders are seafarers by tradition, working the sea comes naturally; many mussel farmers are ex salmon or fishing industry
- around 20 farmers are members of SSMG, so that marketing arrangements are relatively secure.

However, despite these apparent strengths, Shetland also has weaknesses/concerns:

- dependence on ferry link to mainland, concerns that level of subsidy might diminish
- ferry link/distance from market seen to be a key constraint in basing value-added operations in Shetland, especially if targeting UK retail multiples
- Unst and Yell producers face extra transport costs
- DSP is a major problem in summer, much more so than in other regions of Scotland
- eider ducks are a major problem in the south west
- labour is costly due to limited supply and competition from other employers (oil, salmon, SIC)
- shortage of housing and thus labour limits production on outer islands e.g. Yell.

Other important features of the Shetland industry include:

- 3 larger companies dominate production and 2 also provide a harvesting, grading and marketing service for smaller producers
- on-shore grading and handling facilities are well mechanised and efficient
- farmers are actively exploring improved production techniques and strategies to reduce production costs e.g. separate sites for spat collection/ongrowing, reseeding using continuous technology (both NZ and otherwise)
- product not marketed through SSMG is sold to wholesale markets where the Shetland product is favoured due to keeping quality, meat yield and size; the debyssed format is increasingly being offered
- farmers are now wary of over production having seen the same situation with salmon and recognise that site development must proceed at the same pace as increased sales.

8.2.2.2 Future prospects

The SIC has done more than any other Local Authority in attempting to determine the carrying capacity of its voes (sea lochs), and although the model used is fairly crude it has at least given some guidance on the volume of production allowed in any given area, and the mussel industry appears to be happy with the approach taken. Specific zoning of areas for aquaculture is not favoured as it is felt to be too restrictive and that it is better to deal with applications on a case by case basis. The SIC is supportive of aquaculture and this combined with a greater acceptance of the industry by local communities than on the mainland makes for a favourable outlook on sites and production.

The general consensus amongst producers is that most potential inshore sites have been taken up. Some unused salmon farm sites could be used, but the salmon companies generally don't want to give them up unless they can be

used in negotiating a move to more favourable sites. There has been some recent site swapping activity between mussel and salmon farming companies in this respect.

Production in Shetland in 2008 was 3,500t. Feedback from growers suggests that production in 2009/10 could reach 4,000-4,250t, with medium term production aspirations being around 5,300t, and longer term around 7,000t largely from existing sites, subject to market demand and other constraints (see Section 8.2.7).

This longer term potential would appear to be at least theoretically possible if the capacity of existing sites is considered: according to SIC, as of April 2009, there were 128 licensed mussel sites, of which 94 were classified as active. Typical site size in Shetland is between 6 and 9 200m longlines. Assuming that all licensed sites became active, a 3 year production cycle and an average yield per line of 40t, maximum production potential could be between 10 and15,000t. Even assuming half of this is realised still gives a figure of 5-7,500t p.a.. As elsewhere, some Shetland farms are investing heavily in continuous culture technology which if successful could improve productivity.

8.2.3 Orkney

There has been little or no mussel production in Orkney and this appears likely to continue. Some of the reasons for this include lack of suitable sites, very strong currents, and a high incidence of toxic algal blooms.

8.2.4 Western Isles

The mussel industry in the Western Isles (WI) has a much longer history than in Shetland, having originally had financial support through the Agricultural Development Programme in the 1980s, yet production had only reached 930t by 2008, despite having potentially favourable sites for mussel farming. There are around 10 active producers, of which one produces over 700t and the remainder mostly produce less than 100t pa (see Table 7.2).

Other features of the industry include:

- One long established company dominates production, supply agreement with IOS
- Small producers supply wholesale markets or sell locally; marketing difficult
- Need for improved production efficiency; NZ system under trial
- Significant issues regarding inability of small producers to cooperate (market, transport, purchasing)
- Significant issues regarding new start ups (initial investment, identification of suitable sites, ability to supply markets consistently)
- Inter island transport an issue due to length of islands
- Road Equivalent Tariff scheme has improved ferry costs over last year
- Opportunity for better use of space & cooperation with salmon farms (multi-trophic approach)
- The Western Isles Aquaculture Association was recently disbanded

Western Isles Council (WIC) is supportive of the industry, and as with the SIC has not developed specific plans for aquaculture for similar reasons. Again, there is greater acceptance of aquaculture by local communities, and shellfish farming is regarded as environmentally benevolent compared with salmon farming, the main cause for complaint being visual impact. There have been few if any shellfish planning applications recently. With regard to unused inshore salmon sites that could be used for shellfish, the companies concerned are reluctant to part with them.

Feedback from growers suggests a slight increase in production from existing sites since 2008, with scope to reach 1,700t in the long term if productivity gains can be realised. Whilst the number of suitable sites is not as great as in Shetland, one local source nevertheless considers that there may ultimately be scope for 3,000t production or more in Lewis/Harris, and for 1,000t or more in the Uists, subject to overcoming production and marketing difficulties.

8.2.5 Highland

Highland has the longest coastline of all Scottish regions and potentially the greatest physical number of sites. Despite that, production only increased from 415t in 1999 to 760t in 2008. There are two large operators, one producing around 400t but hoping to increase to 5-600t, and one producing 300t but hoping to grow to 500t. There are a number of smaller operators producing less than 100t. Short-term production aspirations from existing sites are for 1,000t production, with scope longer term for around 1,400t.

Highland Regional Council (HRC) was the first Local Authority to develop coastal zone plans for aquaculture, and now has a number of such plans covering the main aquaculture areas. Feedback from growers with experience of dealing with HRC suggest that they are not as supportive as they might be regarding shellfish farming. For example, the recently completed Loch Nevis Aquaculture Framework Plan is said to be relatively negative towards new shellfish farming opportunities despite it being a designated Shellfish Growing Water. In addition, Homarus Ltd (2008), in a study carried out for the EWG on sites, found that Highland AFPs were not generally positive about aquaculture.

The future production potential for Highland is unclear. Growth and yield in the north west do not appear to be as good as elsewhere e.g. average line yield may only be 18t compared with 40t elsewhere, and access to more remote sites may be an issue. At present, there are only 2 large operators and their aspirations are for modest expansion. All other production is presently from smaller scale operations whose future will depend very much on their ability to reach a viable business size, or form cooperative working arrangements for production and marketing. Some consolidation in the area has already taken place, with a larger operator taking on sites from smaller operators who were not able to make a go of it due to persistent spatfall failure. Assuming such consolidation continues and some of the smaller businesses are able to grow, then eventual production potential (10 years plus) might be in excess of 3,000t.

8.2.6 Strathclyde

Strathclyde was originally the main mussel producing region in Scotland, accounting for 55% of production in 1999. Production peaked in 2003 at 1388t, thereafter declining to 930t in 2008 (see Figure 8-1). This decline was largely due to the demise of the industry in Loch Etive due to the dominance of another less favourable mussel species, *Mytilus trossulus*. At one time Loch Etive alone produced around 1,000t and was the mainstay of the Scottish industry, but output has now dropped almost to zero. At the same time, other companies in Strathclyde have increased production in partial compensation.

There is one large scale producer, normally producing over 500t but with no expansion plans, and 2 medium scale operations (200-500t), one of which has scope to produce up to 1,000t from existing sites. There are 2 smaller operations producing around 90-100t pa, neither of which have major expansion plans, one of which has secure marketing arrangements in the upmarket foodservice sector, and one of which has established wholesale market outlets but is finding it increasingly difficult to compete with Shetland product. The larger producers are using or trialling continuous technology (ladder or NZ rope), but the latter is still not proven.

Argyll and Bute Council has also been active in the development of Marine Spatial Plans, which it now has for the Sound of Mull and Loch Fyne. A plan for Loch Etive is in preparation, and 4 other key areas have been identified for future plans. The planning environment in Argyll and Bute is generally seen to be more restrictive than elsewhere due to the greater emphasis on tourism, recreation, shipping, and defence activity (Clyde). How restrictive can perhaps be assessed by reference to the Loch Fyne ICZM plan which was completed in November 2009. The loch has been divided into 19 zones, each of which has a presumption in favour or against different forms of aquaculture. Whilst such presumptions are only to be used as a guide in planning decisions, they do nevertheless give an indication of the scope for development in any given area. For Loch Fyne, there is presumption in favour of 4 medium and 2 small scale mussel (or scallop) sites. Medium scale is defined as 6 lines or less (200-440m long) and small as less than 4 lines (100-200m long). The production potential of these sites for mussels might thus be 400-500t pa, but this assumes planning permission is granted and that they can be operated as viable units on a stand alone or more likely a combined basis.

Over the past 3 years A&BC has only had 2 shellfish farming applications, both of which related to existing sites. So as in some other areas, there is no obvious drive from new or existing entrants to obtain new sites. With regard to change of use applications, there have been more relating to the transfer of mussel sites to finfish sites than the other way round.

With regard to future production potential, there is scope in the short to medium term to reach 1,200-1,300t and in the longer term1,500t, largely from existing sites. If production in Loch Etive recovers and some new sites are developed, in Loch Fyne for example, then eventual production could reach 3-3,400t.

8.2.7 Summary of mussel production potential in Scotland

The future production potential alluded to under the regional assessments is summarised in Table 8.1. This assessment is based on interviews with growers and Local Authorities in the regions of Shetland, Western Isles, Highland and Strathclyde, such regions being as defined in the Marine Scotland annual survey of shellfish production. It is largely based on the assumption that any increase in production over the next 10 years or so is most likely to come

from existing producers and existing sites, with only limited development of new sites, and thus planning issues should not necessarily be a major constraint in that time frame. Of greater importance will be constraints such as market demand, production problems, business viability and economies of scale. The assumptions used in Table 8.1 are as follows:

Short term (2010): anticipated production levels for the 2009/10 season, as related in interviews (subject to market demand)

Medium term (3-5 years): takes into account additional production to which producers actively aspire both from existing active and inactive sites

Long term (5-10 years): estimate based on existing line capacity and a higher level of productivity

Maximum area potential: takes into account limited development of new sites, industry consolidation, improved productivity from new technology, relative planning sentiment, or as further discussed in text

Table 8.1. Summary of existing and potential production capacity for Scottish mussel farms

	Historic production		Short term	Medium term	Long term	Max area potential?
Region	**1999**	**2008**	**2010**	**3-5 yrs**	**5-10 yrs**	**10 yrs plus?**
Highland	415	760	1,000	1,320	1,420	3,060
Orkney	3	0	0	0	0	0
Shetland	196	3,506	4,250	5,351	7,052	10,000
Strathclyde	670	932	1,180	1,330	1,530	3,430
W Isles	116	671	950	950	1,700	4,000
Total	1,400	5,869	7,380	8,951	11,702	20,490

Source: Marine Scotland; Local Authority and producer interviews; production potential relates only to site capacity, and would be dependent in practice on market demand and other constraints

8.2.8 Further perspective on mussel production potential in Scotland

At a late stage in the study, after interviews were held with growers to arrive at the conclusions in the previous section, data on shellfish leases became available from The Crown Estate allowing an analysis to be made of mussel farm site capacity in different regions. A summary of this analysis is provided in Appendix 5. Owing to the disparate nature of the data, especially for older leases, it has been necessary to make certain assumptions to convert it into a meaningful form. Capacity is thus classified in terms of longline equivalent (LLE) in metres. Raft capacity has been converted to LLE at the rate of 2.5m^2 of raft to 1m longline.

The total leased capacity for mussel farms in Scotland as at October 2009 is given in Table 8.2. From this it can be seen that Shetland has nearly 50% of overall capacity, with Argyll and Highland regions 23% and 18% respectively. These findings broadly mirror the summary presented in Table 8.1.

Table 8.2. Summary of total leased mussel farm capacity in Scotland as at October 2009

Region	LLE (m)	No. of sites	Avg. m/site	% of capacity
Argyll	91,012	84	1,083	23%
Highland	70,900	68	1,043	18%
Orkney	5,220	32	163	1%
Shetland	198,307	118	1,681	49%
W Isles	36,351	39	932	9%
Total	401,790	341	1,178	100%

Source: The Crown Estate

Given that a great many sites are of a small size and may well be considered economically unviable, the data has been further analysed to omit any sites of less than 750m LLE, such sites having a production capacity of 50t p.a. assuming a

3 year production cycle and a yield per 200m line of 40t. This effectively removes most raft sites which are typically of small size. The results of this further screening are given in Table 8.3.

Table 8.3. Summary of leased mussel farm capacity for sites over 750m LLE

Region	LLE (m)	No. of sites	Avg. m/site	% of capacity
Argyll	72,639	30	2,421	21%
Highland	58,988	39	1,513	17%
Orkney	3,080	17	181	1%
Shetland	182,960	82	2,231	53%
W Isles	28,320	19	1,491	8%
Total	345,987	187	1,850	100%

This capacity could be considered to be the true economically viable capacity for mussel farming in Scotland, upon which estimates of potential production could be based. Whilst there is not much difference in the balance of capacity between regions compared with the all site scenario, the average site capacity changes markedly, from an average of 1,178m for all sites to 1,850m for sites over 750m.

Further analysis based on Table 8.3 indicates the relative productivity of capacity between regions. Taking 2008 production from the annual Marine Scotland survey and assuming that Argyll is broadly equivalent to Strathclyde, suggests that the Western Isles is presently making best use of its leased capacity with a production of 14t/200m, followed by Shetland at 11t (see Table 8.4). It should be emphasised however that these figures are not a guide to the actual productivity of lines in use, which cannot be determined at present from Crown Estate lease data. It is likely that in practice the high figure in the Western Isles is due to more sites being in production than say Shetland.

Table 8.4. Comparison of regional productivity based on 2008 production

Region	LLE (m)	2008 production (t)	Annual yield/200m line
Argyll	72,639	932	8
Highland	58,988	760	8
Orkney	3,080	0	0
Shetland	182,960	3,506	11
W Isles	28,320	671	14
Total	345,987	5,869	10

A final extension of this analysis examines the production potential of different regions based on sites over 750m LLE at different yields per 200m longline (see Table 8.5). From this it may be seen that an average yield of 10t/line gives production of around 5,800t, equivalent to production in 2008. The potential for future production from existing leased capacity at higher yields is clear, and quite closely ties in with the summary of production potential given in the previous section. For example with a doubling in yield to 20t/line, overall production could increase to 11,500t, equivalent to the long term (5-10 year) potential indicated in Table 8.1.

Table 8.5. Estimate of production potential based on sites over 750m LLE at different yields (t)

Yield (t/200m)	10	20	30	40	50
Argyll	1,211	2,421	3,632	4,843	6,053
Highland	983	1,966	2,949	3,933	4,916
Orkney	51	103	154	205	257
Shetland	3,049	6,099	9,148	12,197	15,247
W Isles	472	944	1,416	1,888	2,360
Total	5,766	11,533	17,299	23,066	28,832

Analysis of site data such as this would be a very useful addition to the annual Marine Scotland survey, giving valuable guidance as to the progress in developing production efficiency in different regions (see also Appendix 6).

8.2.9 The potential for offshore mussel farming

Given the pressures on inshore waters, and the need for economies of scale in mussel farming, some thought is now being given to the possibilities of moving into more exposed waters where space and planning constraints may not be so much of an issue. Offshore culture is being successfully used in many different countries including France, Italy and New Zealand. The attractions of moving offshore are summarised by Holmyard (2008):

- inshore production has a limited capacity for growth
- growing market demand for fresh mussels in EU
- opportunity for reduced production costs due to economies of scale (large site areas)
- better growth rates and meat yields, thus better return on capital employed
- good market image due to clean offshore environment.

The technology is well established, and a typical system consists of a submerged single headrope supported by pencil floats, which minimise the transfer of wave action to the culture ropes, thus reducing the risk of stock loss. Both headropes and moorings however have to be significantly more substantial than inshore locations to withstand the higher loadings from currents and wave action and the need to support a substantial work vessel.

Disadvantages of going offshore include:

- higher costs of equipment per unit of production due to more extreme conditions
- workboats need to be big enough to work safely in exposed conditions and have the capacity for high throughput given more limited weather windows offshore
- the need for a substantial service vessel requires large scale of operation requiring significant investment and increased risk; Holmyard (2007) suggests capital investment requirements of £5 million.

At the present time, only one Scottish based company has explored the possibility of going genuinely "offshore", but its efforts are now focussed on the south coast of England.

There is presently no particular interest from existing Scottish growers in moving offshore. Reasons include:

- there is enough inshore capacity to meet production requirements at the present time
- new technologies such as the NZ continuous system offer scope for increasing productivity on existing inshore sites
- it is difficult enough trying to grow mussels inshore without the added complications of going offshore
- the higher costs of lines, moorings and boats are a deterrent
- doubts about stock survival and growth; it would be more difficult to protect stock against predation e.g. ducks; food supply may be insufficient - one grower has much better growth in a productive inshore loch than in a more exposed location with high currents.

Perhaps the greatest constraint however relates to planning. Holmyard (2007) suggests that an area of 1,000ha (10km2) is needed for a production of 5,000t pa, the scale of offshore operation seen for example in New Zealand. Whether a physically suitable area could be found on the West Coast is not clear, and even then significant planning constraints exist. Whilst visual impact can to some extent be mitigated through the use of submerged headlines, exclusion of other users e.g. fishing and leisure boats over a large area, is likely to be highly contentious.

The use of more remote areas for large developments is also not necessarily likely to mean better acceptance with regard to visual impact. The recently completed Loch Fyne ICZM plan states a presumption against aquaculture in an exposed coastal zone that might suit offshore culture on grounds of the need to preserve "wildness".

One opportunity that has been suggested for offshore culture is a link with the offshore renewables sector, in particular wind farms. A major advantage to such a link might be that a wind farm is already out of bounds to other users. Doubts remain however as to whether the culture environment would be suitable (high currents, turbulent water, lack of depth for adequate submersion), or whether the companies concerned would entertain large scale deployment of structures between windmills given the possible obstruction to service vessels. Nevertheless, the sheer volume of offshore development proposed in Scotland suggests that such an opportunity is worth further investigation.

If the possibility of offshore culture in Scotland is to be pursued, a number of different issues need to be addressed, including:

- areas with suitable physical and environmental conditions need to be identified
- planning constraints need to be overcome
- technology needs to be proved in Scottish conditions
- stock growth and survival need to be assessed
- financial viability needs to be demonstrated.

Offshore culture could be encouraged through more favourable grant support whether through EFF or Government funds, and through assistance with technology transfer and pilot operations, as done by BIM in Ireland.

8.3 Oyster production potential

8.3.1 Site potential for oyster farming

The site requirements for oyster farming include: a sufficiently large area of relatively level foreshore (of a minimum size for business viability), with the right tidal characteristics, substrate, shelter, productivity, water quality, and access rights. The archetypal ideal is the vast sandy expanses of foreshore with large tidal range found on the north coast of France, and on which the massive French oyster industry is partly based. By these standards, and indeed those of Ireland, the west coast of Scotland offers relatively few opportunities given the often steep rocky foreshore and limited tidal range found in many sea lochs.

Discussions with oyster growers on the West Coast confirm that lack of suitable sites is a major constraint to growth outside of existing production areas, and that any growth is most likely to come from existing sites and producers, although many are already operating at full capacity. Most good sites are now in production, and whilst there may be small areas of suitable foreshore available, these are mostly not big enough to support a viable business.

Aside from the lack of physically suitable sites, access to the foreshore is a further major constraint. Those who own access rights, such as estates, have little incentive to offer such rights given the limited financial benefit and a general desire for privacy. In addition, planning applications for new or existing sites are often subject to objections on conservation or visual impact grounds

Significant survey work on suitable oyster sites on the West Coast was carried out in the 1990s for Highlands and Islands Enterprise (HIE) under the Agricultural Development Programme. Should the results of this work still be accessible, it would be a useful starting point for evaluating further site potential.

The only other region in Scotland that may offer significant potential is the Solway estuary, which has the large expansive areas of foreshore and big tidal ranges found in Ireland and France. A recent study (Huntington *et al*, 2007) suggested the physical site production potential of oysters might be as much as 14,000t on the Scottish side of the estuary alone, although site constraints would reduce this to a much lower level. Trials carried out on the English side of the estuary using hanging bags are said to have met with difficulties due to site exposure, although growth is said to have been good. A further factor is that most sites in the Solway are classified as Grade B for water quality and stock for sale would need depuration, which might affect marketability given that some retailers insist on Grade A. The real potential of the Solway, if any, is still not clear.

The East coast Firths have never been seriously considered for Pacific oyster culture, despite the fact that at one time the Forth held one of the largest populations of native oysters in Europe, at its height producing around 30 million shells p.a.. Reasons for this are thought to include lack of shelter, conservation designations, and colder water temperatures and poorer water quality than on the West Coast.

8.3.2 Pacific oyster production potential

Pacific oyster production in Scotland has remained fairly constant over the past 10 years at around 3 million shells, reaching a peak in 2008 of 3.8 million. Of this, over 92% came from 19 growers in Strathclyde, with most of the balance coming from 9 growers in Highland (see Table 7.14). Nearly 80% of production came from 11 farms producing over 100,000 shells pa, suggesting that the average production of the remaining 21 producers is around 20,000 shells.

Interviews with growers suggest that most existing sites are at or near capacity. If known spare capacity were fully utilised, there may be scope for a further 750,000 shells, of which 500,000 might come from Strathclyde and 250,000 from Highland. What is not clear is what further potential might come from the many smaller producers should they gear up their operations assuming they have the capacity to do so. Any growth is highly dependent on a variety of constraints, in particular the economy of scale needed for business viability, a subject which is covered in Section 7.2.5.

8.3.3 Native oyster production potential

The only commercial production of native oysters in Scotland comes from Loch Ryan, where the enclosed nature of the loch, large expanse of level seabed and relatively shallow waters offers ideal spawning and growing conditions. The oyster fishing rights are privately owned and the management of the fishery is under the control of one company, which has taken great care to husband the stocks and build them up to a sustainable level. Although present production levels are not great (250,000 shells or 20t in 2008), there is scope for significantly increased production in the future if stocks continue to do well.

There is no other exploitation of native oysters in Scotland, the emphasis being on conservation of existing wild stocks on the West Coast, the greatest challenge being prevention of theft. There is significant interest by SNH and others in restoration given the status of native oysters as a Biodiversity Action Plan species, and a recent project (Brown *et al*, 2009) looked at the possibility of setting up pilot scale restoration at a number of locations, but as yet there have been no major initiatives in this regard.

There is interest from existing Pacific oyster growers in farm cultivation of native oysters, and trials are currently underway on the West Coast using suspended culture, which is reported to have been more successful than the bag and trestle culture widely used for C.*gigas*.

8.4 Scallop production potential

Queen scallops are typically collected and grown on long lines, thus site requirements are similar to those for mussel farming. The main constraint is the unpredictability of spat fall from year to year, and once consistently good collection areas have now become unreliable. Production of queen scallops in 1999 approached 3 million shells, but by 2008 had declined to 670,000.

King scallops are collected as spat in the same way, and after a period in suspended culture are best transferred to the sea bed for ongrowing. Protection of stock on the seabed is theoretically given by the granting of a Several Order, of which there were 11 in Scotland in 2008 for scallops (2 of which can also be used for native oysters). Only one company is active in the farming of queen scallops in Strathclyde (Loch Fyne), and only one for king scallops in Highland, despite there being 21 companies registered as having king scallop and 7 queen scallop interests in 2008 for the whole of Scotland.

One company growing king scallops dives for young stock and transfers them to a Several Order for fattening, but this company and most others attempting the same strategy have had serious problems with theft, despite the supposed protection given by the Several Order.

The future prospects for scallop culture therefore appear limited unless the problems of spat collection and theft can be resolved.

9 Finance and investment

9.1 Introduction

Finance has a key role to play in industry development, whether for established companies or new entrants, and the type of finance will depend on individual circumstances. For established growers, such circumstances might include grants and loans for expansion or an increased overdraft facility to meet short-term cash flow difficulties in the event of a lost crop or a delayed harvest due to toxins. For new entrants, the requirements would typically be for a combination of equity, grants, loans and overdraft.

Some of the issues likely to be faced, especially by new entrants, include

- Limited availability of equity
- Poor understanding of the sector by banks/financiers
- Farm assets (excluding land) are typically not acceptable as security by lenders

This section assesses the sources of funds available, potential constraints and future investment prospects.

9.2 Sources of funds

9.2.1 Grants

The single most important form of financial support available to the industry is that of grant funding from the EFF. Eligible capital expenditure qualifies for 60% grant for businesses in the Highlands and Islands Convergence area, which covers most production areas of Scotland, but only the Highlands and Islands area of Argyll and Bute. The rate for the rest of Scotland (Lowland Non-Convergence) is 40%.

Given the high capital costs associated with both mussel and oyster farming, the importance of such grants cannot be overstated. Most of the growers interviewed cited past and present examples of grant applications and made it very clear of the vital nature of such grants to future plans. Recent applications ranged from a £100,000 investment by an oyster grower in depuration and grading facilities to a £1 million expansion plan by a mussel grower to include upgrading of depuration facilities, workboat, and NZ technology.

Just how vital such grants are is made clear in the production costs analysis shown in Section 7.2.3, given that without it most start up situations and expansion projects would not be viable.

9.2.2 Bank loans

The first port of call for loan finance is most likely to be the bank. The main stumbling block with bank finance is the lack of suitable farm assets against which security can be taken. Most equipment with the exception of workboats only has a limited market and a nominal resale value. Land and buildings if owned are more acceptable but again if equipped for a certain purpose and in a remote location may only have limited value.

For cases where security is an issue the Enterprise Finance Guarantee facility offered by the Government provides a valuable option in improving the availability of working capital through term loans and consolidation of overdrafts. The facility is available through the borrower's normal lender and is subject to a 2% interest premium and any additional charges the lender might impose.
(http://www.businesslink.gov.uk/bdotg/action/gsdDetail?type=GSD&itemId=1081834978)

One issue that arose during interviews with growers related to differences in the level of funding agreed between local bank managers, with knowledge of the applicants and their businesses, and their remote head offices, a particular problem at the present time given the tightening of credit generally.

9.2.3 Local Enterprise Companies (LECs)

Growers with past experience of seeking finance often cited their LECs as being supportive, not necessarily with offers of finance but with help and advice. Such help in the case of one established grower extended to providing a consultant to prepare an EFF application and to funding various business development courses. In another case, a start up oyster farm in a fragile area received help with business planning and obtained a small start up loan of £8,000. Clearly LECs are an important first port of call in seeking finance and advice.

9.2.4 Regional differences in availability of finance

9.2.4.1 Shetland

The greater availability of finance in Shetland has often been quoted as one of the reasons why mussel farming there has expanded so rapidly, and there is certainly evidence to suggest that this is the case, whether it be private equity or loans/grants from local agencies. A number of the present growers came from a salmon farming background, thus having had access to sites, boats and shorebase infrastructure from an early stage. This perceived advantage represents a significant "hidden" equity element i.e. if it had not already been there, it would have required finance to create it.

With regards to agency finance, the beneficial situation in Shetland relates to revenues derived from the oil industry via the Oil Fund. This has benefited every part of the economy in Shetland, and has resulted in greatly improved infrastructure such as roads, piers and harbours, and the availability of finance to commercial enterprise. In addition, core funding is provided to the North Atlantic Fisheries College, a major provider of services such as training, research and quality control to the aquaculture industry.

From the mid 1990's until around 5 years ago, start up grants of £50,000 were available to growers through SIC, and around 20 such grants were awarded to shellfish growers, giving a major boost in the early days of the industry. Such grants are no longer available given that "State Aid" rules now have to be complied with.

Loans are however available through the Shetland Development Trust on more favourable terms than from banks, although the "soft" element must be under a certain threshold to comply with State Aid rules. Such loans are intended to fill the gap between bank finance and private equity providers, ranking second behind the banks. An important feature of such loans is that farm assets such as sites are considered as security.

A further source of support is also thought to be available through Seafood Shetland in the shape of short-term loans to fund working capital requirements. Seafood Shetland also has considerable experience and expertise in preparing grant applications on behalf of growers.

Local banks are also said to be supportive, having had a history of investment in the fishing and seafood sector and being familiar with its constraints.

9.2.4.2 Western Isles

The Western Isles has also set up a Development Trust, to be funded by revenues from the renewables sector. This however is at a very early stage and is unlikely to be able to provide significant support to aquaculture, the emphasis being mainly on community developments.

In other respects, the Western Isles are similar to other parts of Scotland with regard to support through the LEC.

9.2.5 Private equity

For established businesses with a proven track record wishing to expand, a combination of grants and loans may be sufficient to cover requirements. In most cases however it is likely that a significant private equity component will also be needed, and this may prove difficult for companies that have not been able to build up reserves.

The main requirement however for private equity will be for new entrants, whether small one person operations or large scale businesses. It must be said that most of the established, successful businesses seen today started from humble origins and have arrived at their present state through organic growth and as a result of many years of

experience. The few instances of companies attempting to make a grand entrance backed with considerable funds have generally not met with success due to the difficulties of the business and the long learning curve.

The availability of private equity generally depends on the perceived investment case presented by shellfish farming. As already indicated, oyster production is unlikely to be attractive to a large investor at the scale likely to be possible on remaining West Coast sites, although a case could possibly be made in locations such as the Solway given a suitable site and an experienced operator.

The investment case for a new entrant in mussel farming is also far from certain. The analyses presented in Section 7.2.6 provide an indication of production costs, and the investment case for the same models is analysed further here in terms of funding requirements and internal rate of return (IRR) (see Table 9.1).

Table 9.1. Indicative funding requirements and IRRs for model 500t mussel farm

	10 year IRR	**Max. funding requirement**
500t conventional farm (see section 7.1.1.2)		
Base case, 60% grant	17%	876,000
No grant	-2%	1,275,000
500t farm, NZ technology (see section 7.1.1.3)		
Base case, 60% grant	41%	718,000
No grant	11%	1,052,000

Further assumptions: IRR assumes no residual value after 10 years

The maximum funding requirement is indicative only and refers to maximum cash flow requirement, which occurs prior to receipt of income from the first harvest and the final tranche of grant (if awarded). In practice, this would normally be met through a combination of private equity and loans. In all cases at the 500t level, the funding requirement is substantial at between £700,000 and £1.3 million, depending on receipt of grant, and likely to be beyond the average single private investor. The 500t conventional farm is only viable with grant, and even then an IRR of 17% could be considered poor given the high risks of the business and the likelihood of production shortfalls especially in the early years of the business. Such shortfalls could be due to a variety of factors including spatfall failure, toxins, predation, storm loss, and fouling, any one of which has the potential to cause major loss of income and/or cash flow difficulties. Furthermore, unlike most other aquaculture businesses, such production risks cannot be mitigated through stock insurance, which to date has not proved viable given the difficulty of stock assessment and proving loss.

The 500t farm using NZ technology shows a much more promising proposition with an IRR of 41% (with grant), but again it should be emphasised that this model is still speculative in Scottish conditions and represents a best possible case.

9.3 Future investment prospects

Given the general views on business viability and the analysis presented above, it is proposed that future investment in the sector is most likely to come from established operators with a strong track record, rather than from new entrants, whether with vested interests or not.

It has been suggested that there may be interest in investment in the sector from salmon farming companies, but no evidence of such interest from an investment standpoint has been found. What interest there is appears to be to make use of sites that are no longer suitable for salmon, one benefit being the potential for the nutrient extractive capabilities of mussels to balance out nutrient enrichment from nearby salmon sites, and another for such sites to be used for mussels to act as disease "buffers" between salmon sites by excluding their use by other salmon growers.

It has also been suggested that there may be interest from overseas mussel growers, in particular the Dutch, in buying into the Scottish mussel industry. The Dutch already have a very strong presence in growing operations outwith the Netherlands. For instance, German bottom culture is 100% Dutch owned, and in Denmark, UK and Ireland up to 50% of the industry is Dutch owned or influenced. However, all such ownership relates to bottom culture, as the mussels so produced fit with their existing processing operations in the Netherlands. There is said to be little or no interest in rope grown mussels given the relative weakness of the shells and their inherent unsuitability for the large scale mechanical processing in which the Dutch specialise. In addition, the production costs associated with bottom culture are much lower than for rope culture. It would appear therefore that there would be little or no incentive for Dutch processors to buy into the Scottish industry. The only exception to this might be should the environmental

tide turn more fully against bottom cultured mussels, increasing demand for rope cultured stock in traditional Dutch markets.

The continuing availability of EFF grants will be fundamental to the further development of the sector. It has been reported that applications from shellfish growers in the early phase of the current funding initiative have been under-represented and that more could have been approved if forthcoming. The lack of applications perhaps reflects the current state of the industry: small scale operators outside Shetland are hard pressed to survive let alone consider investment in expansion; many of the larger operators with expansion plans and established markets have already taken advantage of grant funding, and those not planning to expand clearly have no need.

10 Regulatory factors

10.1 Introduction

The diverse and apparently complex nature of regulation is considered to be a limiting factor to expansion for some operators and may be serving as a deterrent to new entrants in a sector that is already seen as high risk. Regulatory factors impact the industry in two main ways: planning/siting considerations and water quality issues.

With regard to planning considerations, a recent SARF project (Hambrey Consulting, 2008) looked at the potential impact of legislation on the Scottish shellfish industry, in particular the Marine Bill. It concluded that only with a very supportive policy environment under the new Bill did the industry have any chance of growth, and that there was a significant danger that it might stagnate or decline if the policy environment was no more supportive or indeed more restrictive than in the past. A key issue was the level of support likely to be given to aquaculture by Local Authorities when drawing up Regional Management Plans if faced with competition for coastal resources from other interests e.g. initial indications suggest that tourism interests are likely to be more favoured in mainland areas such as Argyll and Bute. Whilst this study considers site availability unlikely to be a constraint on production in the short term, in the medium to longer term full participation by the industry in the new marine planning process will be essential to ensure sufficient future site capacity is not jeopardised.

With regard to water quality issues, there continue to be major concerns within the industry regarding the interpretation and implementation of legislation by regulators. Whilst such issues are at present mostly an irritation rather than an overriding constraint, they nevertheless need to remain at the top of the agenda with a view to achieving a balance that is acceptable to both industry and regulators, and in preventing changes to existing monitoring protocols which could pose very serious threats to the industry.

One issue that has arisen during discussions with industry is the need for a joined-up approach amongst Government regulatory bodies e.g. SEPA, SNH, Local Authorities. On the one hand the Government appears to be keen to help the industry develop (e.g. the Renewed Strategic Framework for Aquaculture, this study) but on the other is considered to be holding the industry back through the actions of the various regulatory bodies in areas such as conservation, planning, and water quality. Each department is seen as protecting its own corner. In this respect, the recent establishment of the Shellfish Forum, bringing together regulators and growers round one table, has been a very positive development in helping to iron out some of the anomalies of the often complex regulatory regime. With regard to water quality, it has lead to proposals for a Shellfish Hygiene System, which should lead to the gathering together for the first time of all water quality data for any particular area, allowing growers instant access to the latest results.

This section considers both planning considerations and water quality issues, examining current and prospective issues that might affect the industry, and highlighting items of particular concern.

10.2 Planning considerations

10.2.1.1 Marine Bill

The recently proposed amendment in the Stage 3 debate to take planning powers for aquaculture off Local Authorities did not succeed, and it appears unlikely that any will voluntarily cede control to Marine Scotland. Under the Marine Bill, it will become a requirement for Local Authorities to prepare Marine Spatial Plans (MSPs). Such Plans will be overseen by Marine Planning Partnerships (MPPs) which should include shellfish farming interests, although it will be important for growers to make sure they are represented and to take part in discussions from an early stage. Whilst the ASSG has potential for representation at the national level, strategic inclusion (invitation to) of someone to represent shellfish should be required for each MPP, even where shellfish is not currently considered an activity. Seafood Shetland is already involved in discussions for the Shetland MSP. The aim to have a single marine licence for all permissions including Section 34 consent is to be welcomed.

10.2.1.2 Aquaculture Framework Plans and SPP22

It is understood that MSPs will supersede Aquaculture Framework Plans, building on the few that have already been developed. Scottish Planning Policy 22 (Aquaculture) has been absorbed into the all encompassing Scottish Planning Policy that will also guide the development of MSPs.

10.2.1.3 Planning control

The transfer of responsibility for aquaculture planning applications to Local Authorities was made in 2007, although in Shetland the SIC has had such responsibility since the enactment of the Zetland County Council Act 1974. The main implication for applicants has been the increased cost of new applications. Although most existing sites should get planning permission subject to audit, some may need Appropriate Assessments if in conservation areas. It is hoped that with the added implied security once planning permission has been granted, sites will come to be seen as a more valuable asset and more likely to be accepted as security by banks.

The costs associated with shellfish farm applications are widely regarded as inequitable when compared with salmon farm applications, given the far greater value of production derived by the latter for a given area of sea. Cost for mussel farms is typically £500-600/200m longline based on recent applications made. This acts as a deterrent to new applications given that the outcome is uncertain.

10.3 Water quality issues

10.3.1 Classification of shellfish harvesting waters

The EU Food Hygiene Regulations (852/853/854) are enacted by The Food Hygiene (Scotland) Regulations 2006 and are the responsibility of Food Standards Agency Scotland (FSAS). These regulations stipulate the classification of harvesting areas based on the presence of faecal indicator organisms in the flesh of harvested shellfish, with waters classified as either Class A, B or C. The degree of contamination determines the degree of depuration (purification) required before the produce may be commercially marketed.

The classifications are based on the following criteria:

Class A – an area in which molluscs contain consistently less than 230 *E. coli* per 100g of flesh
Class B – an area where 90% of samples have less than 4,600 *E. coli* per 100g of flesh; the remaining 10% of samples must not exceed 46,000 *E. coli* per 100g of flesh
Class C – an area where molluscs must contain less than 46,000 *E. coli* per 100g of flesh
Prohibited area – an area where levels are higher than 46,000 *E. coli* per 100g of flesh.

Most waters in Scotland are classified A or B, whilst in England many are B or C. The latter designations are restrictive in the market with many suppliers insisting on Class A status, sometimes refusing to take depurated (and therefore cleaned) product originally from Class B waters.

Classification decisions are also affected by the results of the risk assessment process, the so-called 'Sanitary Survey'. This process aims to identify potential pollution sources, thereby allowing a programme of risk management to be put in place, including monitoring frequency (relating to rainfall) and infrastructure improvement (ranging from septic tank improvements to fencing livestock away from streams/rivers flowing into harvesting areas).

It is of note that the harvesting areas identified for food hygiene purposes do not necessarily overlap, or exist entirely within, designated shellfish growing waters. The cost of official and routine control samples and the Sanitary Survey is covered by the FSAS in association with the Local Authority (as opposed to being a cost to the producer). Currently the classification of new harvesting waters comes at the expense of a new producer, requiring one year of sample analysis before being allowed to sell.

10.3.2 Depuration

In Scotland, the enforcement of the EU Food Hygiene Regulations is the responsibility of the FSAS. This includes responsibility for the designation of harvesting areas and the reporting of the classification of harvesting areas according to the presence of faecal indicator organisms (*E. coli*). The degree of shellfish contamination determines the degree of depuration (purification) required before the product may be commercially marketed. To protect human

health, all molluscan shellfish must meet an end product standard of less than 230 *E. coli* per 100g of flesh before they can be placed on the market. Indeed, animals that have been through an approved depuration unit that is operated to EU standards should achieve a microbiological level of 75 *E. coli* or less. Whilst depuration has a role in the removal of bacterial contamination, there are many questions about the effectiveness (and value) of depuration as a process to remove viruses (see section 10.3.3).

In a recent publication (Seafish, 2010), Seafish indicated that installing and operating depuration units requires significant investment. For example, oyster and mussel producers harvesting 250 tonnes of oysters or mussels per year would need to factor in a minimum of £400 per tonne operational costs for a depuration unit. This would be on top of the initial capital outlay and installation for a depuration unit of sufficient size. The cost of this could be anything from £50,000 to £150,000 depending on specific site constraints.

The requirement to depurate (due to a downgrade in classification from A to B waters) clearly has significant financial implications for producers and processors. Producers are clearly concerned about the protocol for classification as implemented, because it draws on historical data and often means that waters are continuously downgraded because of links made between months and years. Whilst producers clearly recognise the need to protect consumer safety, a more supportive and constructive mechanism for classification is required. This issue is so critical to business models that some producers are even conducting their own investigations into the validity of classifications.

A further burden appears to be the apparent influence of so many regulatory and non-regulatory bodies in the process of depuration e.g. Local Authority environmental health officers approve the premises; FSAS is responsible for certifying the holding system; and technical advice is provided by the Marine Lab, Cefas and Seafish.

10.3.3 Norovirus

Norovirus (NV) is the most common virus causing gastroenteritis from consuming shellfish, and contamination of shellfish growing areas is usually from sewage treatment plants (STPs) or inadequate septic tanks, while discharges from boats can also play a role in certain locations. A number of studies have shown that proximity to human habitation, particularly STP facilities, can lead to NV contamination, despite installation of tertiary treatment at the STPs. The only sure way to avoid such contamination is to cultivate shellfish in clean areas, far from human contamination, including any downstream effects.

There are two issues connected with NV: 1) Its threat to human health 2) How to use the level of NV contamination as a direct measure for shellfish harvesting area classification (as opposed to an indirect indicator species such as *E.Coli*, which is presently used). Resolution of both issues is contingent on the development of a valid method for detecting NV.

NV is a particularly serious issue in oysters which are typically eaten raw, and incidence increases markedly during the colder winter months when the passage of food matter through the gut is slower and viral particles accumulate. The current test for contamination of shellfish that threatens human health (not including biotoxins) under EU Regulations is the measurement of the presence of *E.coli*; but this is only as a convenient indicator of viral contamination. The use of these bacteria has many flaws, but perhaps the greatest drawback for the Scottish shellfish industry is that because their growing areas tend to be in remote areas, there are high populations of wild animals and agricultural livestock, creating a substantial source of *E.coli* contamination that is unrelated to viruses. There is at present no Regulatory level for NV contamination in shellfish, largely because of the lack of a credible method of testing, as NV has not yet been successfully cultured, and there are many doubts concerning the usefulness of surrogates. Nonetheless Codex has an Expert Working Group assessing the risk and potential methods, while In Europe, there is already a reference in the hygiene Regulations to future regulation on the basis of viral contamination, essentially saying that once a validated method is available, a Maximum Permitted Level (MPL) will be mandated (a level that could be very low, as the presence of even small numbers of viruses can cause illness).

Recent developments utilising real time reverse transcription PCR techniques (RT-PCR) are likely to become an approved method within a few years. This work has been pioneered in Europe by the EU Community Reference Laboratory for shellfish viruses, Cefas at Weymouth, and can detect the presence of NV. However, it is unable to differentiate between infectious and non-viable viral particles. Nevertheless, RT-PCR is a potentially useful tool for management of shellfish harvesting areas, although it would be a poor method for Regulatory requirements due to this inadequacy. Despite this, Cefas appear confident that once the method is approved by CEN, the validation and accreditation organisation for European methods, it will be adopted by the EC in some form in the shellfish Regulation. It appears that some oyster growers and purchasers in Scotland are already using the method to build up a database of background levels of the presence of NV, correlated with *E.coli* results.

A rapid, low cost quantitative method of measuring the presence of NV in shellfish would be a tremendous advantage for the Scottish cultivation sector, as the growing waters are amongst the least polluted in Europe in terms of human pathogens. In 2007/08, 78% of Harvesting Areas were classified by FSAS as Class A, 11% seasonally in Class A or B, 10% Class B and 1 site in Class C. The England and Wales Classification was 3.5% Class A, 86.5% Class B and 8.1% Class C. In addition, to escape from the use of *E.coli* as an indicator species would create a further significant marketing edge.

However, the introduction of the Cefas RT-PCR method as a regulatory tool (classifying areas on the basis of results which do not differentiate between inactivated and viable viruses), once successfully validated, would cause problems for all European shellfish industries, including Scotland, and so it is essential to continue to lobby vigorously against such a development.

10.3.4 Biotoxins

The biotoxin monitoring programme is determined by the requirements of the relevant EU Legislation, namely Regulations 852, 853, 854/2004, in particular the levels established in Chapter V (2), (c) and (e) of Section VII of Annex III to Regulation 853/2004, and the proscribed Reference testing methods.

As a result of DG Sanco requesting a series of 'Scientific Opinions' on the groups of marine biotoxins in shellfish from the 'European Food Safety Authority' (EFSA), this whole area of methods, Action Levels and threat to human health is in a state of flux. The majority of the EFSA 'Opinions' conclude:

- The Mouse Bioassay (MBA), where currently the Reference Method, is 'not fit for purpose'
- Action Levels/Maximum Permitted Levels are too high to protect human health.

While the first conclusion reflects the general view of the scientific, regulatory and industry communities around the world, the second is an extreme position largely based on the use of an excessive portion size of shellfish meal for risk assessment.

This was chosen as 400g, the 95th percentile level, without discounting 'outlier' data of consumption of 1,000 to 1,500g per portion – even while acknowledging that these probably were shell-on weights! In contrast, the FAO/IOC/WHO expert consultation group risk assessment (Ottawa, 2006) cited three consumption levels/portion sizes, namely 100g (standard portion, used in risk assessment), 250g (97.5th percentile for most countries) and 380g (97.5th percentile for The Netherlands).

As examples of the proposed reductions in Action Levels, the EFSA Opinion on the saxitoxin (STX) group (PSP) recommends that the MPL should be reduced from 800µg STX eqivalent/kg to 75µg STX equivalent/kg (NB Level of Detection is 350 – 380µg/kg), while for domoic acid (DA) the recommendation is for a reduction from 20mg DA/kg to 4.5mg DA/kg.

If adopted by Regulators these significantly lower levels would essentially decimate the majority of shellfish production sectors across Europe, including the Scottish cultivation industry, without any clear gain to human health protection.

Currently in Scotland FSAS enforces the EU Regulation, through Local Authority support and contractual testing services from Cefas, Weymouth, by:

- HPLC for domoic acid (re ASP)
- HPLC (Cefas adapted 'Lawrence Method') as a screening test for saxitoxin (PSP) in mussels
- MBA for PSP in other molluscs (and mussels that fail the HPLC screen)
- MBA for DSP (including Yessotoxins and other okadaic acid equivalents despite the 'unbundling' of these analogues in Commission Decision 2002/225/EC, reportedly due to the lack of available Certified Reference Standards).

There are clear indications that, following the EFSA Opinion that the MBA should be supplemented by chemical methods (LC –MS), European Regulators will move to substitute the MBA for regular testing. Although the formal change in EC Regulation is unlikely for some time (mid 2010 is a best estimate), monitoring authorities in France have already moved to implement greater dependence on LC-MS analysis for DSP toxins, although 'MBA tests will continue to be used as back up' (Ministry of Agriculture). France continues to use the MBA test for PSP.

Bizarrely, FSAS almost simultaneously announced the introduction of the more stringent 24h MBA test (24 hours observation versus the previous non-approved 5 hours) for DSP, but this has now been abandoned due to unforeseen problems. The FSAS expect to move to LC-MS by April 2011 for mussels ('followed by the other [species] thereafter'), following Cefas validation of the method.

In organising the monitoring programme, FSAS has identified groups of growing sites that fall within common hydrographic areas (called 'pods'), where samples for the pod are taken from a Representative Monitoring Point (RMP). In some cases mussels are used as samples at RMPs, even where some sites are cultivating oysters. This has the potential to unfairly penalise oyster growers, as the mussel 'sentinels' will uptake toxins more rapidly (so the oyster site will be closed earlier than if oysters were sampled), while oysters will retain toxins for a longer period (so the oyster site will remain closed for a longer period).

In terms of the most recent Annual Biotoxin Monitoring Programme results for Scotland (Cefas Reference: C3161; 1/4/08 – 31/3/09):

DSP:

- 2,406 tests performed; 77 samples (c. 3%) from 28 sites recorded DSP positive (54 in mussels, 22 in Pacific Oysters, 1 in Razors
- Worst affected area: Shetland, with 13 areas closed

PSP:

- 2,837 tests performed; 3 samples by MBA exceeded the Action Level (0.001%), 2 in Razors, 1 in Surf Clams, all from the Forth Estuary
- PSP was detected (HPLC) at 26 - 66µg/100g in 4 mussel samples
- Trace (by HPLC) levels in 220 samples (below limit of detection of MBA)

ASP:

- 1843 tests performed; 4 samples exceeded the Maximum Permitted Level (MPL) of 20µg/g
- ASP toxins were detected at less than the MPL in 55 samples (51 in mussels, 3 in King Scallops, 1 in Pacific Oysters).

In comparison, the Irish monitoring programme for 2007 tested 1,891 samples for DSP and AZA (211 positive results, all in mussels), 158 samples for PSP (no positives) and 506 for ASP (6 gonad samples above MPL, 12 other and total tissue samples above MPL).

Overall the biotoxin monitoring programme in Scotland appears extremely comprehensive – some would argue excessively so in light of the low level of positive results from last year's monitoring, however history is not always the best guide with regard to plankton blooms and future toxin events. There is a need for a more transparent risk assessment process as well as more information for growers concerning the risk management of possible biotoxin events. Improved communication would help to minimise friction between growers and FSAS/Local Authorities.

10.3.5 Designation of shellfish growing waters

The EC Shellfish Waters Directive (2006/113/EC) seeks to protect or improve shellfish waters in order to support shellfish life and growth, therefore contributing to the high quality of edible shellfish products. In order to do this physical, chemical and microbiological water quality requirements are set for designated shellfish waters (both 'mandatory' and 'guideline). The Directive also lays out monitoring and assessment requirements. This Directive will be repealed in 2013 by the EC Water Framework Directive (WFD), which must also provide the same level of protection to shellfish waters (which the WFD classifies as protected areas).

The original Shellfish Waters Directive was transposed into Scottish law in 1997 (The Surface Waters (Shellfish) (Classification) (Scotland) Regulations 1997) and is administered by the Scottish Government and implemented by the Scottish Environment Protection Agency (SEPA). The Scottish regulations establish classification and sampling criteria, and confer a duty on SEPA to investigate and adopt appropriate measures where designated waters do not meet the quality standards specified.

Management of water quality by SEPA under the WFD will be undertaken through River Basin Management Plans (RBMPs) which have a predominantly environmental focus and which should offer better protection for shellfish culture e.g. through better control of diffuse pollution. A number of such plans are already in the process of being adopted throughout Scotland.

Despite the supposed protection offered by the Shellfish Waters Directive, feedback from growers suggests that in practice there may be little protection. In one example in Loch Leven (a designated shellfish growing water), an application by Scottish Water for a Water Treatment Works (WTW) upgrade that would have significantly improved water quality in the loch was turned down on appeal by the Government Reporter. In another example on Mull, Scottish Water upgraded a WTW but not to the level considered necessary to deal with norovirus, thus again apparently failing to protect a designated shellfish water. These are major issues for the growers concerned, and in reality Shellfish Waters Designation did not appear to help in either case.

10.3.6 Summary of water quality issues

10.3.6.1 Classification

Although the proportion of Class A (and B) Harvesting Areas is relatively high in Scotland, the approach of basing classification on extended historical results dilutes the positive impact of any recent water quality improvements. In addition there have been a number of incidents in the past where samples were taken from locations which were not being used for producing marketable product. A greater degree of communication and discussion over the details of the procedure of sampling and assessment between growers and authorities might reduce such causes of friction, without endangering consumer health and maximising the proportion of Scottish waters that satisfy Class A criteria. Discussions between growers and FSAS on the final Sanitary Survey report, and any proposed programme of improvements, would help fine tune the proposals through the input of local knowledge and positively engage the local industry in the Classification process.

10.3.6.2 Depuration

The requirement to depurate is clearly an incremental financial burden that growers would wish to avoid – but perhaps of even greater concern is the uncertainty associated with the 'advice' from the various authorities involved (Seafish, Marine Scotland, FSAS, Cefas, Local Authorities). There is a clear requirement for unambiguous criteria regarding throughput of water and product according to system types, UV power, oxygen levels, etc.

10.3.6.3 Norovirus

NV is the main reason for the 'high risk' categorisation of molluscan shellfish, and direct assessment of the contamination of product with infectious viral particles is the single most important issue facing the sector worldwide. But in the absence of a credible, repeatable, quantifiable, rapid and low cost method of measurement, regulators are forced to compromise, either using indicator species such as *E.coli* (as at present under EU legislation) or inadequate methods such as the Cefas-proposed Real Time RT-PCR method (as likely to supersede the bacterial standard within 2 – 3 years). Whatever approach is taken, the industry should ensure that it participates in the discussions between the scientific community and the Regulators, at all appropriate levels, from Codex Alimentarius to DG Sanco to FSAS.

10.3.6.4 Biotoxins

Biotoxin issues that impact upon the industry in Scotland include:

- The continued use of MBA for lipophilic toxins (DSP), when it is clearly recognised by world experts as 'unfit for purpose' (unlike for PSP toxins) and its replacement by chemical methods is being recommended by the leading European advisory body (EFSA) and indeed in the process of being replaced in France;
- The continued use of 'DSP – no presence' rather than the specific testing for ocadaic acid and analogues (160 microgram/kilo MPL, as per CD 2002/225) and failure to test for Yessotoxin separately;
- The lack of urgency in extending the use of HPLC or LCMS for PSP detection for other species than mussels;
- Rather than using an 'indicator' or 'sentinel' species, the species being farmed should be the species tested for the presence of toxins;
- There is a clear requirement to work with colleagues across Europe to lobby against any reduction in Maximum Permitted Levels as per EFSA 'Opinion' recommendations;
- There is a need to review and improve the extended and flawed process for reporting biotoxin monitoring results, particularly positives (clear need to improve electronic reporting direct to producers); moves by FSAS are however underway to create a database of results with web access and allowing automatic text alerts to be sent to mobiles;

- There should be high level consideration of the creation of the equivalent of the 'Management Cells' that have proved a valuable tool in reducing conflict between industry and regulators in Ireland;
- Need to align UK systems with European best practice, to ensure the 'level playing field';
- Need for the industry representative body to connect more closely with the biotoxin scientific research and regulatory communities e.g. participation at the 'International Conference on Molluscan Shellfish Safety' (ICMSS) in order to become aware of issues before they become established views.
- Minimisation of the impact of biotoxin events through a more transparent implementation of risk assessment, and a clear description of the resulting risk management approach adopted by FSAS, would reduce potential conflicts between the Regulator and growers.

10.3.6.5 Designation of shellfish growing waters

Designation has not proved to be the protective legislative power that was expected, largely due to the limited resources available to SEPA combined with the apparent limitations inherited from previous 'environmental protection' legislation, and a lack of interest in the sector. There is a need to ensure that the potential of the Water Framework Directive to protect marine water standards is harnessed effectively to support and protect the water quality of shellfish cultivation areas, starting with the formal incorporation into Scottish legislation of, as a minimum, a bacterial standard equivalent to the Class A Harvesting Area criterion.

Water quality is the foundation stone of any molluscan cultivation, and in the light of the perceived current low pollution level of Scottish waters, it should be a policy priority to improve on this high quality, thereby creating a premium platform for marketing products across Europe and ensuring a profitable industry for future generations of shellfish growers.

11 Site related issues

11.1 The Crown Estate and leases for shellfish farming

The Crown Estate is the landlord for all aquaculture activities in Scotland, with the exception of certain areas granted rights from the Crown historically.

The recent 2010 rent review (The Crown Estate, 2009) demonstrates a positive commitment to the industry and has been welcomed by it. Recommendations to be adopted include:

- new leases from 2010 to be of 25 years duration with more flexible assignation rights
- a 15% reduction in rental charges
- extension of the existing start up discount in recognition of the additional costs now required to secure planning consent

Now that planning decisions are outwith its remit, The Crown Estate has greater scope to engage with and support the industry, a development which is to be welcomed.

11.2 Unused sites

The issue of unused sites has often been flagged up as a lost opportunity for increased production by the industry and regulators. However, in discussions with existing growers, such sites are often the basis of future expansion plans, awaiting use when finances and market conditions permit development. Such unused sites are regarded as assets even by small operators who have not yet got off the ground, and leaseholders are reluctant to give them up. Changes to The Crown Estate lease terms allowing assignation under certain conditions may promote the better use of such sites. Government sentiment on unused sites is that it is up to individuals looking for sites to negotiate directly with lease holders.

Analysis of Crown Estate lease data for mussel farms indicates that around 45% of all sites are of a scale unlikely to be economically viable, and in practice it is likely that many will be unused. In areas where there are a number of such smaller sites, it would make sense to encourage consolidation into more economically viable units (subject to carrying capacity). In Argyll and Bute, planners are understood to favour such an approach.

11.3 Links with salmon farming

There has been some discussion regarding the use of vacant salmon farm sites, perhaps as a result of a move from inshore to offshore sites, theoretically freeing up sites for mussels. However, according to one Local Authority, change of use is mostly from shellfish to finfish rather than the other way round. Sites are regarded as trading assets, and mussel farmers generally don't have much to offer in site rationalisation programmes. Most recent site swapping activity between salmon and mussel farms has been in Shetland.

On the other hand, there has reportedly been some interest from salmon farm companies in diversifying into mussel farming, making use of redundant sites, either on their own account or sub letting to mussel growers. One incentive for this might be to make use of the nutrient extractive capabilities of mussel farming to compensate for the nutrient additive effects of salmon, thus potentially giving more freedom for increased production of the latter.

11.4 Carrying capacity

The ASSG Code of Good Practice (http://assg.org.uk/cgi-bin/download.cgi) sets out the background case and work done on carrying capacity up to that time. Research undertaken since then includes the Shellsim programme (*http://www.shellsim.com*) regarding shellfish growth in different areas e.g. on oysters in Loch Creran, and another on mussel growth in Loch Spelve. More work is needed on modelling and linking of the same to the planning process as in Shetland, of potential benefit to farmers themselves as well as to planners. There is some evidence of mutual benefit when finfish and shellfish farms are sited together in an enclosed area e.g. Loch Spelve – the mussels grow well and there are reported to no longer be any red tides affecting the salmon.

12 Other issues

12.1 Shellfish health issues

Scotland has enjoyed a reputation for disease-free status for a long time and has long held Approved status for freedom from the major notifiable diseases, bonamiasis and marteliosis. This however changed with the first report of native oysters *Ostrea edulis* infected with *Bonamia ostreae* the causative organism of bonamiasis in Loch Sunart in 2006 under the routine surveillance programme and the subsequent discovery of infected wild stocks in West Loch Tarbert in 2007. There are therefore 2 non-approved zones within Scotland, which has implications for the movement of shellfish stocks.

Threats of new disease are always a worry and it has been part of the ASSG Code of Good Practice to discourage imports of *C. gigas* despite its derogation from controls against the spread of the 2 diseases named above – because "it is virtually impossible to exclude "hitch hikers" of other species" (ASSG, 2005). Imports have however been taking place from the Channel Islands and Ireland but do require health certification under the legislation The Shellfish and Specified Fish (Third Country Imports) Order 1992 (No 3301) (MAFF, 1992).

Recent problems experienced in France and Ireland with "unexplained mortalities" affecting particularly young *C. gigas* since 2008 are thought to be largely due to infection with a herpes virus, Ostreid herpesvirus 1 µvar (OSHV-1 µvar). Initial efforts by the UK to prevent import of the disease from affected countries were deemed to be not in accordance with EC legislation but the current control, enacted under EC Council Directive 2006/88/EC on animal health requirements for aquaculture animals, SANCO 6463/2009 (rev 5) only places restrictions on movement of oysters from areas where mortalities are actually occurring, which many consider to be too late for effective control. SAGB and ASSG are advising against imports from France and Ireland under such circumstances. This disease does however highlight the acute dependence of the Scottish oyster industry on a relatively small number of sources of spat and more particularly part grown oysters and with greater pressure from all regions to access disease free stocks this pressure can only increase (see also section 7.2.3 regarding oyster seed supply).

12.2 Non native species issues

Non native species (NNS) issues of relevance to Scotland can be divided into those regarding species that have been intentionally introduced for culture purposes, as in the case of Pacific oysters, and those that have been accidentally introduced.

12.2.1 The Pacific oyster

The Pacific oyster (*C.gigas)* forms the basis of the current UK oyster industry but is a species introduced by Government scientists under strict quarantine conditions in 1965 with subsequent additional introductions in 1972 and 1978. It was introduced to augment the dramatically reduced production of the native oyster *Ostrea edulis,* landings of which had dropped dramatically and also as a measure to control imports of shellfish for restocking which were sources of pests and disease (Utting and Spencer, 1992).

Since these introductions the production of *C. gigas* has been significant with production as high as 1,000t in England and Wales and with steadily growing production in Scotland to the current level of 300t p.a..

In recent years its feral spread in parts of France and the Wadden See in the Netherlands has alerted UK regulators and growers to the potential of such an occurrence in the UK where this was never previously considered possible because of the temperature requirements for breeding in *C. gigas*. Populations had however been recorded naturalised as early as 1990s but were not then expected to settle (Spencer *et al* 1994). They are now however established in some parts of the South of England particularly the South East.

An in-depth study of this situation was carried outwith FIFG funding by Syvret *et al* (2008) and this sets out very clearly the main issues in relation to legislative changes that could affect the well-established farming of this species. The main legislation covering this is the Wildlife and Countryside Act of 1981 (http://www.jncc.gov.uk/page-3614), which states that release of a non-native species to the wild is an offence. This Act was further amended by the Nature Conservation (Scotland) Act 2004 which also includes hybrids of NNS under Schedule 6 of the Act

(http://www.opsi.gov.uk/legislation/scotland/acts2004/asp_20040006_en_9#sch6). The same Schedule allows Scottish Ministers to both issue an order to prevent the sale of any specified species and also to issue guidance as required for a given species. Further legislation highlighted of relevance by Syvret *et al* (2008) is the EC Council regulation no708/2007 concerning the use of alien and locally absent species in aquaculture which could potentially be used to restrict aquaculture of *C. gigas* in new areas under the Water Framework Directive.

While the legislation is effectively much the same throughout the UK, the situation in Scotland is to some extent different in that all *C. gigas* culture is carried out in confinement. Scotland shares this specific restriction with just one other European country, Denmark. At the time of the Wildlife and Countryside Bill UK becoming law, there was discussion as to the situation re *C. gigas* but 3 reasons were forwarded to allow its continued culture: 1) that it was already established as a cultured animal, 2) that it was contained within equipment, and 3) that it could not reproduce in ambient conditions. However, in England there were already areas where there was established culture of *C. gigas* on the sea bed, mainly the ongrowing of adults on Several Orders.

Syvret *et al* (2008) make it very clear that temperature may be the most relevant factor in whether the species breeds and spat fall results. The report identified areas of high, medium and low risk of wild settlement and Scotland and North East England were both in the low risk category. They also provide some evidence that bottom cultured or parc cultured oysters do tend towards greater reproductive activity than oysters in bags on trestles. It is however worth pointing out additionally that as a reef building species, any spat production will tend to favour settlement of spat on adults of the same species. Therefore presence of adults on the sea bed could provide a focus for such settlement, not all of which will be harvested each year. On the other hand if oysters are confined in bags any spat settlement on adults will be removed with the harvest. Thus while feral population establishment is not impossible the chances of it becoming established will be very much reduced.

12.2.2 Non-native species accidentally introduced

One other reason for the formal introduction of Japanese oysters into the UK was to help prevent the continual introduction of shellfish stock from abroad with its high risk of associated disease and non- native species that could be pests to shellfish or the marine environment at large. Up until then the pests that had been introduced were mostly shellfish pests such as the America oyster drill and the slipper limpet *Crepidula fornicata.* The risks of these are dealt with in Brown *et al* 2006.

The main risks of spreading such pests further round the UK is through the movement of mussel seed. A case of this was the introduction into the SSSI Menai Strait of *C. fornicata* in 2006 with a batch of mussel seed from the south coast of England. This is not such a risk in Scotland as bottom culture relying on import of mussel seed is not a current activity.

12.2.3 Colonial tunicates

One of the risks highlighted in the Brown *et al* 2006 report was that of *Didemnum* spp. at that time reported on the East Coast of Ireland. This species, now more precisely identified as *Didemnum vexillum,* was found in Holyhead harbour in 2008 and has now been reported from a yacht marina in the Firth of Clyde at Largs. This is a species which can blanket settle on all types of artificial floating structure and has proved to be a major pest on mussel lines in New Zealand. Unlike shellfish pests that have been a problem before, this is clearly not being moved with shellfish but by pleasure craft and this represents a significant threat to shellfish aquaculture as indeed to fish culture, as cages could also be smothered. The impacts of this species' introduction can be seen at http://woodshole.er.usgs.gov/project-pages/stellwagen/didemnum/. This development is of the utmost severity and should be tackled with urgency. It is understood that SNH and Marine Scotland are planning to set up a unit specifically to act on this problem.

12.3 Alternative species

There are a number of shellfish species that could be cultivated in Scottish marine environments, some of which are already successfully cultivated elsewhere, whilst others would require innovation:

Abalone are a high value species, and already successfully cultivated in South Africa, Australia, China, France , Spain and many other countries. The wild fishery still outweighs the cultivation sector in weight terms, but the main constraint on investment in Europe into this sub-sector of molluscan cultivation appears to be market limitations. The

average export value (abalone, winkles, conches) as reported by FAO for 2007 was US$20.39/Kg (FAO, 2007), higher than any other shellfish (the closest being lobsters at US$15.24), so there is a clear economic incentive.

The main global market is China, absorbing large quantities of live blacklip abalone from Australia, and canned greenlip abalone from Australia and South Africa. There is currently only marginal consumption in Europe – however, this indicates that Europe is a market awaiting development, and a regionally produced product, especially under the controlled conditions of cultivation, would be a marketing plus.

There is a growing body of temperate water cultivation expertise, particularly from Northern France where the company 'France Haliotis' is pursuing an aggressive development plan, while pilot projects have been running in Ireland for some years.

There appears no environmental reason why abalone could not be cultivated in Scotland. However, there are no native species of abalone found in Scotland so it is understood that this species could only be grown subject to a special licence.

Sea urchins are a potential 'Integrated Multi Trophic Aquaculture' (IMTA) candidate, and the 'Scottish Association for Marine Science' (SAMS) at Dunstaffnage has carried out a number of research projects on sea urchins (*Paracentrotus lividus*) in salmon cages. The economics are believed to look positive, but in such an association there is a risk that they would not get the attention required for success, and would be better cultured as a stand alone species. Viking Marine Farms at Ardtoe has also carried out work on sea urchins and has expressed interest in working on other alternative species also.

Lobsters are an eternal object of cultivation interest; discussions with the 'National Lobster Hatchery' in Padstow, Cornwall and the 'Orkney Lobster Hatchery' would be instructive in gaining a greater appreciation of the difficulties that have been the signature cultivation characteristic of this species for over 20 years.

Clams, in the form of Manila Clams (*R. philippinarum*), are a popular, high volume product, for both cultivated and capture fishery supplies. It is unclear whether the rate of growth in Scottish waters would be commercially viable, however the environmental impact of the standard method of cultivation (nets and hand raking across sandy intertidal beaches) means that approval by environmental agencies and planning authorities in Scotland would be unlikely.

Other species, such as horse mussels (*Modiolus modiolus*) and razor clams (*Ensis* spp) are of more marginal interest, but should not be ruled outwithout surveys of exotic markets. The latter are currently being diver collected and exported to Hong Kong and Spain. The former are subject to studies in Northern Ireland with a view to restoring reefs of this species and they are sold commercially in Scotland.

12.4 Training

The Marine Scotland 'Scottish shellfish farm survey' indicated that total employment in 2008 was around 149 full-time, and 199 part-time/casual workers, a marginal reduction over 2007 (some 14%). However, the majority of the full-time workers were probably also owner/managers, operating typically one or two man SMEs. The small scale of employment means that it is always difficult to 'free up' employees to enable them to attend training courses, no matter how important such training may appear.

The foundation of aquaculture vocational training qualifications in the UK is the National Occupational Standards (NOS) and the associated Qualification Structures and Assessment Strategies for Scottish Vocational Qualification (SVQ – for Scotland) and National Vocational Qualification (NVQ – for England and Wales). In Scotland there is also the Scottish Progression Award, an introduction to the industry aimed at secondary school students and career changers.

The majority of SVQ effort has been in workplace qualification as opposed to classroom education, although a significant number of students have combined both workplace competence assessment and classroom education through the Kishorn facility of Inverness College.

Specific courses, leading to credits as part of the SVQ Qualification, are available from a number of training providers, both on site and at central locations (Inverness, Fort William, etc).

Lantra is the Sector Skills Council responsible for vocational training development for the aquaculture sector, supporting the development of courses and qualifications, from Level 2 to University equivalent. Industry operators participate in the Lantra Scotland Aquaculture Industry Group and contribute to identifying projects that will support the improvement of training for the sector.

Other training initiatives include the Shetland Fisheries Training Association, which was set up in 1989 to meet the training needs of the fisheries and aquaculture industries, and those available through Highland and Islands Enterprise.

On the European scale, AquaTT, originally an EC sponsored University-Enterprise training organisation but now a not-for-profit company with wider ambitions, creates project partnerships within the aquaculture educational and industry sectors and promotes itself as an expert in dissemination which leads to its participation in third party projects. Projects range from large scale finfish focused teams to smaller scale shellfish oriented groups.

Training remains an area of strategic concern, as improved handling and monitoring is central to raising the standard of final product supplied to the market, however there is an almost universal view amongst employers that (a) when business is brisk, there is no time for training, and (b) when business is poor, there is no money for training! These views are compounded by an employer concern that supplying training to staff merely improves their opportunity to move to alternative employment.

The availability of qualifications and training do not appear to act as constraints on the development of the shellfish cultivation sector, although the absence of innovative courses could restrict future improvements to the sector.

There is a particular need to improve the flow of information relating to novel technologies and skill sets. The introduction of efficient oyster cultivation technologies from Australia and improved rope types and mussels culture techniques from New Zealand has been extremely slow, reflecting a reliance on private companies expanding their sales and marketing efforts to the UK, and as the potential market for these products is relatively limited Scotland has not been perceived as a priority.

12.5 Industry representation

Representation of the shellfish cultivation industry in Scotland started in the 1970s, with informal gatherings of operators in this novel activity, mostly based in Argyll & Bute. Twice yearly meetings were held in the function rooms or lounge bars of hotels in Oban, Lochgilphead and Cairndow, and issues of current significance were discussed. Representation consisted mainly of correspondence from volunteer 'officers' (Andy Lane, Norrie Etherson, Janet Church, Neil Duncan and Alan Berry are names of note during this era) of the group with relevant officials at the Scottish Office in Edinburgh and with appropriate Councils.

The group finally formalised its structure in the early 1980's, and selected the name of the 'Scottish Shellfish Growers Association' (SSGA) – unfortunately this generated the same acronym as the salmon farmers association, which inevitably led to confusion! In the late 'eighties, after much debate, the current title of 'Association of Scottish Shellfish Growers' (ASSG) and the current logo were adopted (funding gratefully received from the HIDB).

The Association became an acknowledged national player in the policy and regulatory arena during the period of consultation and debate leading up to the finalisation of EC Directive 91/492. Around the same time The Crown Estate decided to formalise shellfish lease rentals and end the moratorium on rents, so the ASSG was called in to negotiate on behalf of the sector. Thus the four main pillars of ASSG operations were established:

- to represent grower views on legislative and regulatory issues
- to channel authorities' views to members to elicit responses (whether the authorities were Scottish, UK or European)
- to inform members of changes in legal requirements of planning and regulation
- and to represent members' interests in negotiations and discussions with relevant agencies such as environmental, seafood and water authorities.

A fifth pillar emerged later, namely the creation and development of ties with fellow representative grower organisations, ranging from the 'Shellfish Association of Great Britain' to European and other national associations, including participation at international fora of relevance to the industry. In 1999 this role became more formalised, with the ASSG being one of the founding members of the 'European Mollusc Producers Association' (EMPA) and its

Chair being elected First President of this new European organisation. Finally, a sixth activity emerged, namely the production of a quarterly Newsletter, a tangible version of communication and representation for the sector.

In Shetland, the emerging shellfish cultivation sector elected to align itself with the other aquaculture and fish processing interests of the archipelago, and throughout the 'nineties and early years of the 21st Century essentially confined its activities to issues of island concern. With greater involvement in the national marketing activities (the 'Scottish Shellfish Marketing Group'), there has been a commensurate increase in participation in wider issues and concerns. Seafood Shetland is now the body representing the interest of Shetland growers.

For both groups, but particularly for the ASSG, the lack of funds has been a major constraint – the inability of members to fund a significant annual fee, the lack of interest from many growers in joining a representative organisation when there was no immediate threat to personal economic survival (ASSG Membership peaked at the time of the final discussions over the terms of 91/492 and its implementation) and the move from HIDB to the Enterprise Network (and the associated demise of 'core funding' and its replacement by limited 'project funding') resulted in an association that was dependant on personal financing by those committed growers who recognised the importance of representing sectoral interests at national and European levels.

Over the past 5 years, the need for a representational organisation has become even stronger than previously. As has been said many times:" If the ASSG didn't exist, it would have to be created"! And as the potential for legislative and regulatory impact on the sector has grown exponentially – there are, as examples, strategic documents, strategic groups and strategic discussions at Scottish, UK and European levels, ever expanding potential additional environmental restraints, plus overarching initiatives such as the international 'Mollusc Aquaculture Dialogue' initiative of WWF - there is a demand for professionally presented industry views, reflecting coherent positions cogently argued.

The general trend towards increased consultation, expanded and more detailed regulation of the sector, additional opportunities to contribute to the definition of European policy making and enhanced access to legislative decision makers strongly supports the need for a well funded representative for the sector or a well funded organisation which could support the participation of a number of subject specific experts rather than the traditional 'jack of all trades' executive officer.

The long term benefits from international collaboration all combine to indicate the need for an improved and higher level of funding for the national representative organisation, however it is structured (and whatever the acronym!), especially on the European stage.

ASSG representatives to EMPA have always noted with interest the status of the equivalent organisation in France, the 'Comite National de la Concyliculture' (CNC); in France all producers are required to be members of CNC, thus guaranteeing both a secure funding base and a requirement for CNC to represent the interests of all growers. An equivalent situation in Scotland would revive the national representational structure, and bring in the majority of growers who historically have enjoyed a 'free ride' from the core membership funding of the ASSG.

Equally the model of the Galician mussel industry representation organisation – OPMEGA - has many attractive aspects, but the self-funding is only an effective approach as a result of the scale of the industry (200,000t of mussels, 6,000t of other molluscs) which generates some €250 Million (2005).

Alternatively, some form of funding, similar to the coastal network of environmental organisations or via Marine Scotland, could be pursued, in order to maintain a high level of representational activity. However this model has the drawback of forcing the organisation to continually seek project funding on a case by case basis.

However it is funded, there is a clear need for a substantial (a minimum of 1 – 2 Full Time Equivalents) representational presence, with a substantial degree of core funding. Achievement of funding at such a scale will require a combination of political will, creative conceptualisation and - most of all - a firm financial commitment from the industry participants.

It has been suggested that the Scottish Government should also be prepared to support industry representation given that much of the time spent on such representation relates to the red tape emanating from government at EU, national and local levels. It is understood that other industries e.g. sheep, beef, benefit from such support, with for example dedicated staff in Pentland House acting in a support capacity.

12.6 Research and Development

There are two main areas of research required to support industry development: the first, and considered to be the most important, market research, is covered in section 0, the other concerns relating to production. The main desire is to see practical, applied research responding to industry-identified needs rather than researcher-led desires.

The R&D needs given here have been identified as a result of discussions with producers. Whilst the need for research is not always at the top of the list of producer priorities, and it is not always agreed on the best way to approach particular problems, research nevertheless has a key role to play in improving industry competitiveness.

Possible subjects identified for research include:

Mussels

- preventing predation by eider ducks e.g. how deep do duck nets need to be?
- strategies to combat tubeworm fouling
- strategies to combat other settlers e.g. starfish, sea squirts
- strategies to optimise use of continuous technology
- strategies to prevent post-seeding mortality/"drop off" on continuously seeded mussel lines
- site assessment for offshore mussel farming
- practical guidance for growers on site carrying capacity (including influence of line placement, dropper density etc)
- environmental impacts of mussel farming (already underway)
- disposal of grading residues
- factors influencing spatfall
- making use of B grade mussels (shucking methods, end uses etc)
- use of MAP packs (optimal preparation strategies, gas combinations etc)
- alternatives to polystyrene boxes
- carbon footprinting (one issue: can carbon sequestration compensate for use of plastics (buoys, ropes) in production?)
- strategies for control of trossulus
- in Shetland, the industry has a particular interest in development of a biological and environmental monitoring programme; this is a direct response to the issues raised in Section 7.1.4.1 (uncertainty of production)

Oysters

- definitive trials comparing traditional and novel culture systems e.g. Australian hanging bag system
- the performance of triploids in Scottish conditions, given concerns about the NNS agenda
- selection for improved meat yield cf Australian work
- guidance on site carrying capacity
- reasons for intra- site and intra- bag variations in growth rate
- risk of Ostrea herpes virus in Scotland – is temperature a factor?

Scallops

- development of a non harmful tagging method for king scallops to deter theft from Several Orders.

How research on such subjects should be conducted is a matter for debate. At one time, Seafish was the main party responsible for applied research, through its facility at Ardtoe. However, this is now in the private sector and it is no longer the remit of Seafish to carry out such work. The main focus for aquaculture research in Scotland is now the Scottish Aquaculture Research Forum (SARF), which is an independent company established in 2004 with charitable status. Most of the main stakeholder organisations, including the ASSG are members, and are able to influence how research funds are allocated. Core funding is provided by the Scottish Government and The Crown Estate, with co-funding for many projects obtained from organisations such as Seafish, Highland Regional Council, Defra and Food Standards Agency Scotland. Most funding is allocated on an annual cycle with research providers invited to tender for specific projects. Given the mix of SARF members (different aquaculture sectors, environmental bodies and government organisations), common interests have tended to focus on broader environmental and policy issues with rather less emphasis on production-oriented technical matters. Arguably it might also be the case that projects have

been identified with a view on what expertise and resources currently exist within the Scottish research community rather than what might be stimulated by new research agendas and funding.

To date, the main research providers for SARF have been Marine Scotland (FRS), Scottish Association for Marine Science (SAMS), University of Stirling (Institute of Aquaculture), Napier University, and private consultancy groups such as Hambrey Consulting, Aquatonics Ltd, RPS Planning and Development Ltd, Royal Haskoning, Poseidon, Thistle Environmental Partnership, ABP Marine Environmental Research Ltd, and Watts & Crane Associates.

A new academic initiative under the Scottish Funding Council (SFC) that could have some impact, is the "Marine Alliance for Science and Technology for Scotland" (MASTS). This is a coordination action to improve collaboration between nine Scottish institutions (mostly universities) in the area of marine science. The initiative is organised into nine key research themes, including: Sustainable Mariculture, Marine Predators, Biodiversity and Ecosystem Functions, and Coastal Zone. Initial SFC funding is limited, but the aim is to increase Scotland's capacity to compete for UK and international research funding and increase efficiency and effectiveness of research inputs.

Aside from the individual areas of research identified above, there is also a wish to see the results of previous and current research made more readily available to producers and processors. The NZ Mussel Industry Council website (http://www.nzmic.co.nz/Index.aspx) or the European AquaFlow project (http://www.aquaflow.org/) give examples of how such research can be made available. The recently revitalised ASSG website could equally be developed in such a way. In addition, a noticeboard/forum facility would encourage the sharing of ideas and information between growers. Maintenance of the ASSG website is presently done on a voluntary basis, so any further development would require additional funding for set up and maintenance.

A further means to conduct and disseminate production information for the benefit of the industry would be via the setting up of demonstration or monitor farms, as sponsored by SAC in the agricultural industry.

12.7 Equipment supply

For mussel farming, the main items of specialist equipment include: buoys, pegs, rope, moorings, harvest and processing equipment, and workboats. For oyster farming, specialist items include trestles, oyster bags, and graders. For both species, holding tanks and depuration facilities are a common requirement.

All such equipment is readily available either through Scottish or overseas suppliers. In the UK, mooring equipment is available through companies such as Gael Force Marine and FPM Henderson, and workboats from companies such as Nobles of Girvan, Alnmaritec, and Malakoff. More specialist equipment such as graders and processing equipment comes from companies in countries which have large well established industries where such equipment has been developed and refined over many years e.g. Cochon in France, Aguin in Spain and Ansco in NZ.

The only specialist company in Scotland manufacturing equipment specifically for the mussel industry is Xplora Products based in Glasgow. Products include buoys, cushion floats, pegs, ladder, and harvest and installation rafts. The company is the main supplier of mussel floats to the industry, although this position has come under threat recently by the Irish supplier Gem Plastics, which obtained substantial backing from the Irish government for the development of its product. Whilst there are understood to be various avenues available to equipment manufacturers in the UK for product development, feedback suggests that these are difficult and time consuming to find out about and apply for.

13 Benchmarking of the Scottish industry with others

13.1 Introduction

The Scottish industry clearly operates in a specific environment of physical geography and marine influences, but there are a number of characteristics that allow a comparison with other national shellfish cultivation sectors, including special development agency support, governmental policy underpinning, financial incentives and grants, banking system, modes of industry representation and marketing promotion. Four industries in different countries (Ireland, France, New Zealand and Chile) are evaluated to highlight such characteristics.

13.2 Ireland

This is a clear candidate for comparison, having similarly a relatively small shellfish cultivation sector located at the periphery of Europe, with new entrant status and attempting to grow an industry. There are, however, major differences with the Scottish industry:

- Close ties in the Irish mussel sector between processing companies and farming operators (much of the growing activity is funded directly or indirectly by processors)
- The Irish shellfish sector (rope and bottom culture) represents a greater proportion of national aquaculture than in Scotland
- Production of rope grown mussels appears to have reached a plateau of around 9-10,000t p.a., while bottom 'ranched' mussel production ranges between 25 and 30,000t p.a.
- Production of oysters in Ireland has varied widely over the past decade, only surpassing the peak of 7,300t achieved in 1999 in 2007; the drop to little more than 5,000t between 2000 and 2004 reflects a decline in profitability for the *C.gigas* sector, and the spread of Bonamia, which impacted upon the *O.edulis* sector
- Helped by strong and focused advocacy from the dedicated marine sector development agency (BIM), the industry has an impressive history of accessing European funding for development projects. Although this has faded in recent years, along with the contraction in EC funding – it will be interesting to compare Irish and Scottish success in utilising the European Fisheries Fund (EFF) in future years
- A high level of practical support from BIM, ranging from field officers assisting in form filling, through training courses and collateral assistance (e.g. complementary laptop computers for course attendees) to real-time market intelligence from BIM offices in major markets e.g. Paris/Rungis market
- BIM have also been instrumental in supporting technology transfere.g. Smart farm, NZ continuous methods and the development of moulds for a new float design
- Shellfish aquaculture is an integral and high profile dimension of both national/governmental development strategies and BIM sectoral plans
- Local producer involvement in the 'Co-ordinated Local Aquaculture Management System' (CLAMS), the system used to implement single bay management practices and integrated coastal zone management, generating an agreed strategy for the development of aquaculture in each bay/inshore water area
- Producer involvement, through the Irish Shellfish Association (ISA), in the high level 'Molluscan Shellfish Safety Committee' (MSSC); other members include Food Safety Authority of Ireland, Sea-Fisheries Protection Authority and the Marine Institute
- Producer involvement, through the ISA, in the 'Management Cell', operated by the MSSC, which proactively manages the risk presented by biotoxins in non-routine situations, considering borderline and out of character biotoxin results. The Management Cell can be convened at the request of any of its members, and decisions are expected to be reached by consensus
- A willingness by Irish operators to take a 'higher risk' approach to shellfish cultivation, e.g. importing *C.gigas* from Bonamia-prone areas in France, probably the reason for the spread of Bonamia on the west coast and a willingness of oyster producers to act as growing agents for French companies and accepting large scale supplies of juveniles
- Production costs are broadly similar in both countries, although costing of 'time' is always a grey area in assessing true costs, and appears to be lower valued in Ireland. The technologies used are also similar, although Ireland is understood to have adopted New Zealand continuous longline rope methods for mussel culture on a much larger scale
- Industry representation has changed over the years, with the original ISA imploding through in-fighting for control, followed by a revived Association that merged into the Irish Farmers Association (IFA) as part of the Irish Aquaculture section. Such merging into an 'aquaculture' representative association has frequently been

proposed for Scotland, however, as shellfish are a more significant player in the Irish situation, the molluscan interests have always been a high priority for the combined operation. However, when the Irish agriculture industry suffered major financial traumas in the mid-2000's, the IFA budget was severely cut back, and representation on behalf of the aquaculture sector was significantly constrained

- BIM continues to promote the industry and its products at all marketing levels (multi-lingual brochures, offshore offices, national stands at significant Exhibitions, support for the annual ISA Conference, etc); in Scotland, the 'Seafish Industry Authority', the nearest equivalent to BIM, is constrained by funding (the Seafish levy) and its overall UK remit
- BIM's budget has reportedly been significantly reduced in recent years, however the impact on support for the shellfish cultivation sector to date appears somewhat limited.

13.3 France

In France, the main difference from Scotland is the scale of the industry; however, in addition:

- France is a major importer of mussels, in the range of 45 – 50,000t p.a., as well as producing between 65 and 80,000t p.a.
- Production of oysters (mostly *C. gigas*) in the past decade has stabilised in a range of 110 – 120,000t p.a., after a decline from historic levels around 150,000t p.a.; these levels of production enable France to be traditionally almost self-sufficient in oyster supplies, with imports limited to a few thousand tonnes per year
- However, the major impact of the virus pandemic which has decimated seed and juvenile oyster populations over the past two years has led to expectations that French imports will have to rise significantly in 2010 and 2011
- There are major differences in representational arrangements between the two countries, where in France it is a legal requirement for all shellfish growers to subscribe to the national representative organisation, 'Comite National de la Conchyliculture' (CNC). In effect CNC carries out a lot of the roles that BIM executes for the Irish industry, such as market intelligence, promotional activities, negotiations with governmental authorities, etc
- The scale of production, despite the equivalent characteristic of small-scale SME operations being the norm for the industry, generates significant economies of scale in equipment purchase, depuration, packaging and transportation, resulting in lower costs of production than Scottish producers for both mussels and oysters
- The powerhouse in the French industry appears to be the intermediaries, the wholesalers who buy from the SME growers and sell on to retailers (multiples, fishmongers, etc)
- Both the scale of production and the tradition of production give the sector a degree of 'weight' in opposing 'environmental' efforts to restrict their operations, benefits that do not accrue to the industry in Scotland.

13.4 New Zealand

This is another 'small' country - resource rich but relatively low population - that has focused on exports generated from its natural geographic/demographic advantages (sheltered coastline, low population), but nevertheless there are differences from the Scottish experience:

- The main bivalve produced in New Zealand is the 'Greenshell Mussel' (*P.canaliculus*), representing almost 93% of molluscan export revenues (the balance being *C.gigas*) and 77% of total aquaculture export value
- The domestic market for 'Greenshell Mussels' is highly significant in scale, absorbing around half of total production (estimated at some 52,000t of the 99,500t produced in 2007), with a population of some 4 million.
- Nevertheless, the driver for the expansion of the industry has been the development of an export trade which reached over 36,000t in 2007 ('fresh weight' equivalent of 47,000t)
- Export revenues are responsible for around 80% of total mussel sector revenues, despite representing only half of production volumes; in 2008 export revenues increased by 17% to NZ$204 million, despite a decline in volume of 8% to 33,300t ('fresh weight' equivalent of 43,000t), indicating a strong price effect from the continuing international marketing effort
- Total mussel exports appear reasonably stable at around 30 - 36,000t p.a. (40 – 46,000t 'fresh weight' equivalent) in recent years, and are also being supplied to a large number of overseas markets
- The main export markets are USA and EU which each take 30% with the balance going to Australia and Asian countries
- The majority of exports are processed, with around 85% being in the half shell frozen format and 9% as frozen meats, with less than 2% being in live form
- There are a number of large corporate players in the industry, reflecting a significant amount of capital investment, a situation that would not exist without the higher valued export markets; many of the small scale growers operate as suppliers to the processing industry (especially for exports), with the purchasing process

based on a clear tariff relating to size, colour, meat content, etc. and a schedule of harvesting (peripatetic assessors visit contract harvesting areas on a weekly basis during the harvest season)

- There is a strong incentive for growers to expand their operations, as the downstream processing, marketing and exporting are taken care of by the highly capitalised processors, and collaborate on issues such as equipment purchase, insurance and research, which, in combination with the scale of farming operation, enables efficiently sized vessels and a high degree of mechanisation and consequently lower costs of production from economies of scale
- In addition, every aspect of the production process including line installation, cleaning, seeding and harvesting can be sub-contracted to highly efficient specialist operators, thus bringing down costs of production and making the business profitable even for relatively small farmers
- First practical moves to farming locations further offshore are the confirmation of the perceived lack of site availability in the traditional Marlborough Sounds area of South Island. The move to new areas is accompanied by an increase in the scale of farming unit – the first application that has recently been approved for a site some 10 km from the coast of the east of North Island in the Bay of Plenty, will be the largest mussel farm in New Zealand at 3,800 ha. The owners have a declared objective of exporting mussels to the value of NZ$250 million by 2025, (a fifth more than the total Greenshell mussel export value in 2008). A second application for a 4,000 ha farm in the Bay has also been submitted
- The industry places a great emphasis on research and development, ranging from growing technology and techniques to biotoxin testing methods
- The industry pays for the biotoxin monitoring programme and has a clear interest in optimisation of the operation, and participates fully in the management of the commercial programme through the 'Marine Biotoxin Technical Committee' (MBTC)
- The shellfish sector – mussel and oyster associations – participates fully in the recently created (2006) common sectoral representative organisation, 'Aquaculture New Zealand'; this association of sectoral interests believes strongly in national level marketing and branding.

13.5 Chile

Chile enjoys a remarkable coastline of 5,000 km in overall north-south length, and has developed into one of the top ten aquaculture producers of the world within little more than a decade, producing salmon, mussels, oysters, scallops and abalone, mainly for the international export market. With a population of some 14 million, it is more populous than the other resource rich/low population exporters assessed here, however it is similar in that export markets have been the main driver for developing the industry:

- Production of mussels has expanded dramatically in the current decade, rising from around 50,000t in 2003 to over 80,000t in 2005 and 150,000t in 2007
- New Zealand longline technology has been introduced and widely adopted
- As in New Zealand, the industry funds the biotoxin monitoring programme and participates in managing the implementation of the monitoring regime and testing methods
- 'ProChile', a development agency for Chilean exports sponsored by the Ministry of Foreign Relations, has supported the sector through funding, market intelligence, marketing studies, identification of technology, etc
- Exports have risen in line with production, although the data is difficult to correlate with production, because 95% of Chilean mussel exports are in the form of IQF meats. Exports are reported to have risen from a total value of around €15 million in 2003 to some €32 million in 2005, and reaching over €63 million by 2007
- Within this total, exports to the EU have risen marginally in percentage terms, reaching 87% by 2007, with the only other significant market being the USA. In weight terms, exports to the EU have virtually doubled in recent years, from 15,300t in 2005 to 29,600t in 2007, with the main markets in the latter year being Spain and France, at around 7,000t each, Italy at 5,000t, Germany at 2,800t, Netherlands at 2,400t and Belgium at 1,500t
- Although the weight of exports to the EU might not appear at first to be significant, the live weight equivalent of 2007 exports would have been around 114,000t (assuming a 25% meat yield)
- In 2006 the price to the producer was estimated (Roberto Flores, Los Lagos University, Puerto Montt; ASSG Conference October 2006) at US$0.20/Kg (£110/t) delivered to the processing plant, emphasising the very low cost of production in that country
- Although Chile also produces and exports other shellfish (scallops and abalone), the mussel sector remains the most significant in scale and export earnings
- The mussel industry in Chile is understood to be sited in close proximity to the salmon industry and may thus benefit from the nutrient enrichment provided by the latter. If this is the case, there may be some impact on mussel productivity given the sharp fall in salmon output due to current disease problems there.

13.6 Conclusions

All of the 'benchmarking partners', whether a large scale producer/consumer like France or a small scale resource rich/low population exporter like New Zealand, exhibit characteristics that could successfully be applied in Scotland to enhance the development of the shellfish cultivation sector:

- One common element is the presence of a strong, well funded national champion:
    - In Ireland, a combination of BIM and ISA/IFA (although the financial difficulties in agriculture sector have diminished the power of IFA in recent years)
    - In Chile, ProChile has similarly supported the sector from early development to market access
    - In New Zealand, well funded industry associations ('New Zealand Aquaculture Council', 'New Zealand Mussel Industry Council', 'Seafood Industry Council', etc) participate in developing strategies, the implementation of legislation and planning arrangements, marketing initiatives, statistical collection and dissemination, etc. There are close relationships established with the NZFSA, Ministry of Fisheries and other relevant government Departments
    - In France, CNC and associated industry bodies representing fisheries interests are well funded and actively promote the molluscan shellfish sector's interests with national, regional and European authorities (NB CNC hosts/provides the Secretariat for the 'European Molluscan Producers Association' (EMPA))
- Close involvement with and direct participation in the implementation of the biotoxin monitoring regimes (e.g. New Zealand's MBTC, Ireland's 'Management Cell')
- In all the benchmarking partner countries there are well funded (by levy or subscription) industry representational organisations; it appears extremely important that the industry has a strong, professional and representative body – which means an effective funding strategy by the industry - to gain insight into markets, legislative developments, competitive forces, and to speak on its behalf with governments at all levels and relevant agencies – whether supportive (SFIA, BIM, etc) or with different agendas as their priorities (SNH, SEPA, etc, in Scotland)
- An additional common characteristic of the resource rich/low population exporters is the close links, whether contractual or direct ownership, between processors and growers:
    - In Ireland, many growers are contractually tied to processors, while many others were originally set up by the processors; a negative aspect of such a relationship is that the ex-farm price tends to be lower than a free market level, in order for the transformation sector (with high capital investment requirements) to generate a reasonable rate of return. Nevertheless, it creates a unified industry, one which can offer a portfolio of products from fresh/live through simple IQF products to ready-to-serve meals;
    - In Chile the relationship is more arms length, however the processing sector is, in essence, the only outlet for mussel growers who would be unable to access the profitable export market (given the distances involved) without accepting the 'frozen option' for their product;
    - In New Zealand there are both integrated and arms length relationships, but processor competition for supplies has been sufficient to ensure that farmgate prices have been profitable for the growers; and, as with Chile, distance from world markets has required a processing of raw product in order to achieve market access (again, the frozen option).
- The resource rich/low population producers also share a common market objective, namely expansion from the domestic to the international, with the latter offering higher values for appropriate products selected after study of the global marketplace:
    - In Ireland, the primary target market for mussels and oysters has been Europe, with a particular focus on France (proximity and scale); marketing has not been narrowly focused, with BIM promoting both fresh sales for the two species and processed product for mussels
    - In Chile, a strategic choice was made, probably based on the low level of cost of production (US$0.20/Kg delivered to the processing plant), to concentrate on IQF mussel meats, which although placing the exports onto a commodity footing also gave the product a global reach for the processed meat market as well as the supermarket freezer segment
    - In New Zealand, the decision for mussels was again to invest heavily in the export market and to follow the frozen route, but not to 'go commodity'. Instead there was a conscious decision to retain a distinctive retail product identity which could be supported by effective national branding ("New Zealand Greenshell® Mussels") both at the restaurant level and direct to consumers at the supermarket freezer or chill cabinet ("thawed for your convenience"). For oysters, the decision was to target the Japanese market (high price, quality conscious) with a joint venture ('Jemco') of a limited number of growers who would apply extremely high quality parameters for the product – oyster qualities (shape, shell appearance, meat content, colour, texture, taste, etc.), quality packaging and delivery to airport and international transportation.

- Relatively low production costs, through low labour costs (Chile, Ireland) and economies of scale (New Zealand) enable exports at competitive prices, whether fresh/live (Ireland) or frozen (Chile and New Zealand).

How such characteristics can be translated into a successful Scottish formula, in the light of specific national characteristics, should be considered in the development of future policy and strategy.

14 Summary of prospects and opportunities

14.1 Introduction

This study has sought to identify the prospects and opportunities for shellfish farming in Scotland in terms of a number of major themes, namely markets, competitive production, production capacity, finance and investment, and regulatory constraints. In this section, the prospects for each species sector are summarised, followed by identification of the opportunities for mussel and oyster farming and the sector as a whole. Such opportunities have been prioritised and linked where possible with thematic objectives in the Strategic Framework and stakeholder roles. Whilst it has not been the remit of this study to develop an industry strategy, the themes for a potential industry roadmap are indicated together with the possible role of key organisations. Finally, recommendations to government are given with respect to priorities for support, and to the industry with respect to future development.

14.2 Prospects

14.2.1 Mussels

The mussel sector has seen the strongest growth in Scotland over the past 10 years. Current production is approaching 6,000 tonnes, representing a near fivefold increase on 1999 production. This represents around 3% of cultured European blue mussel production, 1.2 % of all cultured European mussels and 0.37% of global cultured mussels. There is therefore substantial scope for increasing production without significantly impacting on total market supply, but pricing will need to be increasingly competitive if higher volumes are to be sold on the market.

The UK market for mussels is understood to be between 15 and 20,000t p.a., with annual per capita consumption less than 0.3 kg, compared with 2kg in France and 4-5kg in Belgium. The UK market thus has considerable further potential for growth. The present market is split 80% retail and 20% foodservice. The higher value retail sector is presently the outlet for 80-90% of Scottish mussels. Within the retail sector, volumes are split 50/50 between live and cooked (vacuum packed) product, a balance that is soon likely to become 40/60 in favour of the latter. Live retail sales are static, typically only of interest to the traditional consumer familiar with preparation of live product, whilst vacuum packed sales are increasing, key attributes being convenience, shelf life, and versatility, and are the most likely to attract new consumers. It is this latter market segment that offers the best immediate prospects for Scottish product. Strong recent growth in the retail sector has however been driven by price promotions resulting in reduced unit prices and this is likely to continue.

The SSMG is the main UK supplier to the retail sector and accounts for around 70% of Scottish production. It does however face competition from other Scottish suppliers especially in live sales, and from Dutch producers for vacuum packs. A key defensive strength of SSMG is its proximity to market and ability to service customers quickly and efficiently with cooked and live product, whilst product from overseas e.g. Netherlands and Ireland has further to travel. This limits competition mainly to the cooked sector, but the lower raw material costs of such producers allows them to undercut Scottish suppliers on price.

The foodservice sector is also growing, but the price disparity with retail makes it less attractive for Scottish suppliers, especially in the frozen sector. In the live wholesale sector, the Shetland industry has an increasingly dominant position, due to economies of scale in serving markets and strong product attributes. Such dominance is at the expense of smaller (non SSMG) mainland producers, who are likely to find it increasingly difficult to compete.

The continental market is very much larger than that in the UK but is already well supplied despite the decline in production over the past decade. This decline has to a large extent been made up for by the rapid increase in Chilean meat imports and associated displacement effects throughout the European market. The opportunities for Scottish suppliers are by no means clear, although there are some indications in the Belgian market of a swing towards more sustainable sourcing, with rope grown mussels likely to be favoured over bottom grown. The seasonal post Bouchot demand for bulk supplies from France is likely to continue and will remain an important although unpredictable outlet for larger producers needing to sell stock at that time of year. For the continental market in particular, further information on markets will be essential to identify opportunities for Scottish product.

With regard to production capacity, growth is most likely to come from existing sites either those in hand with larger producers or through consolidation of smaller sites into more economically viable clusters. With regard to new sites,

the best ones are mostly already leased and planning constraints, as evidenced by the marine spatial plans already in existence, suggest significant barriers to new development especially for sites of any significant scale. Offshore development is unlikely in the short term given planning uncertainties, higher costs, greater risks, and the greater scale needed for viability, such scale also posing challenges for marketing of the much greater volumes involved. Feedback from Local Authorities suggests there is no major clamour for news sites and there have been few if any recent applications. Thus lack of sites is not considered a constraint to growth at the present time. The production capacity of existing sites based on current Crown Estate leases is considered to be at least double present levels and possibly up to 4 times greater. Whether such capacity can be exploited depends on a host of factors including market demand, gains in production efficiency, site suitability, carrying capacity, and no worsening with regard to water quality and regulatory issues.

Further gains in market volume will depend to a great extent on improved competitiveness. Scotland to date has been a relatively high cost producer given the slower growth rate compared with elsewhere and the form of production, rope culture being more costly than bottom culture. The cost of production for rope grown mussels in Scotland is estimated to be in the region of £600-700/tonne before finance for a relatively large scale (500t) operation with significant investment in workboat and onshore facilities, the main costs being labour and depreciation. There is scope to reduce such costs through the adoption of NZ continuous technology, although this has yet to be proven in Scottish conditions. In addition, further cost savings are possible through economies of scale with regard to workboats and on shore facilities. This can be achieved by increased production within individual companies and/or through the processing of product on behalf of other growers, facilitated in geographically compact areas such as Shetland. Overall, however, it is likely that costs of production in Scotland will remain high compared with other industries, which generally benefit from shorter production cycles, lower unit labour costs, and better economies of scale, especially in the bottom culture sector.

With regards to finance and investment, high capital costs, extended working capital requirements due to the three year production cycle, relatively poor investment criteria, the risks and uncertainties associated with production, the esoteric nature of the farming process, and the lack of stock insurance, act as major barriers to new entrants, especially those seeking to enter the business at a significant scale. The availability of EFF grants for capital expenditure will be critical to the further development of the industry, given the capital intensive nature of the business and the negative viability of business plans without it. Loan finance is likely to remain difficult to procure given the lack of suitable assets that can be offered as security, although in Shetland funds arising from the oil industry will continue to exert a favourable influence.

There has been some discussion regarding the prospect of salmon farming companies taking an interest in the industry, but given the relatively poor investment criteria of mussels compared with salmon this is much more likely to be due to potential multi-trophic benefits. Likewise, Dutch mussel processors have been touted as possible investors given their extensive investment in production outwith the Netherlands, but such investment has been exclusively in the bottom culture sector with which they are most familiar, producing a much lower cost and more robust product for which their high volume processing facilities are designed. In contrast, the weak shelled higher cost rope cultured product from Scotland is said to be of limited interest, and Dutch investment in the sector is thus considered unlikely, in the short term at least. With regard to other large scale new entrants with no sector experience, the investment case as already discussed is far from clear, and past efforts in this respect have met with limited success.

The future prospects of the industry are therefore considered most likely to be in the hands of existing growers. Only they have the experience, facilities, market access and incentive to take the industry forward. Further development will however be very much the province of well established larger growers with proven business models and strong track records. Such growers will seek to optimise their operations within their own geographical spheres of operation, either through consolidation or via contract harvesting and marketing arrangements as seen in Shetland. The prognosis for smaller growers outwith Shetland without the benefit of such arrangements is poor other than for limited local and wholesale sales, unless they can somehow emulate the Shetland model.

As well as the basic considerations of market prospects, production capacity, competitiveness and investment potential, is the overriding issue of regulation. This impacts the industry in two main ways, site availability and water quality issues. As already discussed, site availability is considered unlikely to be a constraint on production in the short to medium term, although it will be vitally important for the industry to play a full part in the changes to the marine planning process arising as a result of the Marine Bill. With regards to water quality issues, notably classification, depuration, norovirus, biotoxins, and designation of shellfish growing waters, there continue to be major concerns within the industry regarding the interpretation and implementation of legislation by regulators. Whilst such issues are mostly an irritation rather than an overriding constraint, they should nevertheless remain at the top of the agenda with a view to achieving a balance that is acceptable to both industry and regulators, and in particular to iron

out any anomalies between the UK and other countries, both in the EU and elsewhere. With the recent establishment of the Shellfish Forum, there are encouraging signs of progress on a number of regulatory issues and it is very much hoped that such progress will continue.

Perhaps the greatest challenge the industry faces is to improve the productivity of existing sites. For successful growers on favourable sites with reasonably consistent yields from year to year this challenge has to a large extent already been met. But for a significant number of other growers, regardless of size, the uncertainties of the production process continue to be a major issue, whether due to irregular spatfall, predation losses, inexperience, labour problems, or water quality issues. The prospects for the industry thus depend to a great extent on how individual growers are able to overcome such uncertainties. It is likely that production will become concentrated in those areas with the best overall characteristics for viability, and in this respect it is likely that Shetland will continue to dominate production at least in the short to medium term.

The overall prospects for mussel farming are considered to be cautiously optimistic, with ample capacity for growth from existing sites, and potentially also new sites subject to better recognition of shellfish farming in the evolving planning process. Development of such capacity will have to go hand in hand with market development, where despite the positive outlook for seafood consumption generally, carefully targeted efforts will be needed to continue to secure premium outlets in line with the higher cost base and particular attributes of Scottish rope grown mussels. As production grows, further price erosion is likely, and an equivalent response in the reduction of the cost base through consolidation, economies of scale, and adoption of new production technologies will be essential. At the same time, improvements to the regulatory environment particularly with respect to water quality issues will remain a top priority.

14.2.2 Oysters

As with mussels, Scotland is a minor producer in global terms (less than 0.01% of global farmed oyster production and 0.3% of European production), and even a significant increase in production would have a negligible impact on overall supply. The industry has grown only slightly during the past ten years and in 2008 still only produced 300t (3.8 million shells), compared with overall UK production which has fluctuated between 800 and 1400t.

For the immediate future, market prospects for Scottish oysters are however very positive, with strong demand reported throughout the industry and prices having risen by around 20% over the past five years. This is due in part to reduced pressure on the overall EU market due to disease problems in France and Ireland. Scottish distributors are importing around 2 million shells per year from England and Ireland to meet demand, which could preferentially be sourced from Scottish growers. The greatest demand for Scottish oysters is from the upmarket seafood restaurant sector, with more limited sales to retail outlets.

Competition on quality is a viable option for the Scottish industry with factors such as cooler waters, lower food supplies and higher energy environments leading to different taste and texture combinations. There appears to be scope to make better use of provenance and quality as a promotional tool at local and national level (in conjunction with accreditation), and to improve the role of oysters in local food and drink initiatives. Competition on price in the higher volume commodity segment of the market would be much more difficult given generally slower growth and particularly limited opportunities for scale economies. Indeed, shortage of available sites, especially in Western Scotland, is the major constraint on this industry. This is followed by concern over seed supply as this is currently only available from two hatcheries (England and Guernsey), and there is doubt over the viability of a potential Scottish hatchery given the small size of the industry and less favourable conditions for hatchery development. One possibility that does deserve further consideration and potentially support is the combination of an oyster hatchery with existing Scottish marine fish hatchery facilities.

Apart from the very real concerns over seed supply, there are also a number of other threats to the industry. The first of these is the possibility of the disease problems (thought to be due to a herpes virus) currently affecting Pacific oysters in France and Ireland moving to the UK; there is some hope that the cooler water temperatures in Scotland may limit any impact, but this is by no means certain. Native oysters are also highly susceptible to a different disease, bonamiasis, and movement restrictions already apply in two areas of Scotland. The second concern for Pacific oysters is that relating to its non-native status, and the possibility of its spread in the wild. Although there is no evidence of this yet in Scotland, increasing water temperatures as a result of climate change are likely to mean that this issue will remain on the regulatory agenda. Finally, oysters in particular are vulnerable to contamination by enteric pathogens from sewage discharges, and existing protection measures such as shellfish waters designation are no guarantee that those charged with improving water treatment facilities will do so to a high enough standard to prevent such contamination.

Supply of Scottish oysters is mostly from small and medium size growers, at which scale financial viability is marginal even with an ex-farm price some 20% higher than volume producers in England and Ireland. Yet the scope for developing larger sites with better economies is limited, the only possible exception being in the Solway. In addition, whilst new technologies which could potentially reduce costs are available, they are not yet proven in Scottish conditions. However, despite the questionable viability of smaller operations, it is clear that they provide valuable sources of income in rural areas where there are often few alternatives, especially if they can be linked in with local food initiatives realising better margins, and/or combined with other compatible enterprises.

With regard to native oysters, Scotland has a unique resource in the Loch Ryan oyster fishery. Although the volumes currently produced are small (20t in 2008), surveys in the mid 2000s showed the beds to have the highest density of oysters of any in Europe, with great future potential. However, in view of past over exploitation, the present management emphasis is on preservation of stock and only limited additional exploitation is foreseen in the immediate future. Nevertheless, despite the limited volume, such oysters will continue to form an important high value niche product serving top end restaurants and hotels throughout the UK. Elsewhere in Scotland, the emphasis will continue to be on conservation and if possible enhancement of existing stocks.

In overall terms, therefore, the prospects for the Scottish oyster industry are likely to remain somewhat fragile, but if some of the current limitations can be addressed, in particular site availability and seed supply, further development of the industry should be possible.

14.2.3 Scallops

At 27t of queen and 2t of king scallops, Scottish scallop production is very small in global terms, representing less than 0.002% of global production from aquaculture. However, (according to FAO statistics) it is the only European producer of farmed queen scallop, and mainly competes with Ireland for farmed king scallops. However, the market in Europe is dominated by supply from the wild fishery (and also imports) so again, only niche markets are available for a highly differentiated product. For queen scallops, this is for fresh whole or IQF frozen on the half shell, the latter format being popular with upmarket restaurants, whilst for king scallops, the preferred format is hand-dived in-shell.

With regard to production, the main problem the industry has faced in recent years is erratic or inadequate spatfall, affecting both queen and king scallops. Areas that were once prolific and reliable spat collection areas, such as the Sound of Raasay on Skye, have produced nothing for a number of years. The reasons for this are not known, although increasing water temperatures may be contributory.

For those growing scallops on Several Orders (of which there are 11 in Scotland), the main concern is protecting them from theft, despite their supposedly protected status. This is ironic given the original difficulties in obtaining such Orders and which at the time appeared to offer such great promise. Although a major constraint to the use of such Orders may well be lack of seed, concern regarding theft is likely to remain the principal barrier.

The only known existing example of successful king scallop culture in Scotland is based on the collection of wild stock and transfer to a Several Order for fattening. Sale of product to local high end restaurants through a local food network ensures premium prices and a viable business contributing to the local economy. As with other Several Order holders however, theft has been a major problem and the difficulty of proving loss has meant difficulties in bringing a case. There is therefore a need for an easily applied non harmful "tag" which allows stolen stock to be identified.

Overall the scallop sector does not appear to have sufficient critical mass for it to be a major focus for further development, but this could pick up if some of the fundamentals change, such as the development of one or more shellfish hatcheries in Scotland, greater priority for integrated aquaculture operations, innovations in culture technology, or greater willingness by the authorities to protect Several Orders.

14.2.4 Other species

Although there is interest in cultivation of alternative shellfish species, and indeed already culture activity for some e.g. sea urchins and lobsters, there are no obvious prospects for the culture of an alternative species on the same scale as mussels or oysters. Lobsters will continue to be an important candidate for restocking programmes as in Orkney and Shetland, and sea urchins have potential, either cultured in combination with other species or on a stand alone basis.

14.3 Opportunities

The opportunities for shellfish farming in Scotland are seen mainly as building on industry strengths and addressing the needs and constraints that have been identified throughout the study. Such opportunities are summarised in Tables 14.1 to 14.4 for individual species and for the sector as a whole. For each opportunity, the relevant Strategic Framework thematic objective is identified where obvious. For a number of opportunities, especially if related to production, there is no obvious position in the existing strategic framework, suggesting the need for the creation of an additional category specifically for shellfish. Each opportunity identified also carries with it the suggested participation of key industry stakeholders, and the level of priority (high (H), medium (M) or low (L)).

Table 14.1. Opportunities for the development of mussel farming in Scotland

Key to thematic objectives: H: health, M: markets, L: licensing, F: finance

Development theme	Opportunity	Priority (High, medium, low)	Strategic Framework Thematic objective	Stakeholder roles					
				Mar. Scot. & assoc. agencies	Food and drink promoters	ASSG/Seafood Shetland	SSMG & other mkt. cos.	Growers	R&D funders
Market development	1. Further development of the UK market with the primary focus on cooked convenience products for the retail market aimed at the "grey pound" consumer	H	M		x	x	x	x	
	2. Continue to seek higher value niche opportunities in the foodservice sector e.g. middle to upmarket restaurant chains	M	M		x		x	x	
	3. UK consumer survey to better understand the wants of target market and current perceptions of Scottish and competitor mussel products, including premium (if any) available for key attributes such as sustainability and locality	H	M			x	x		x
	4. Research among non-consumers, especially young people, to establish whether they might be receptive to mussel consumption given appropriate products and promotion	H	M			x	x		x
	5. Evaluate how significant domestic mussel consumption in NZ was developed from scratch and what lessons can be learned for Scottish/UK consumption	H	M			x	x		x
	6. In-depth study of the European market for mussels and identification of opportunities for Scottish mussels	H	M			x	x		x
	7. Development of mechanisms to allow a better match between supply and demand and avoid under/over supply situations	M	M				x	x	
	8. Study to evaluate the carbon footprint of mussels, with a view to promoting potential carbon sequestration benefits	M	M			x			x
	9. Establishment of a mussel industry promotional body, funded by levy (ideally tied in with industry representation)	M	M	x		x	x	x	
	10. Investigate benefits of a PGI designation for Scottish farmed mussels	M	M		x	x	x		

Development theme	Opportunity	Priority (High, medium, low)	Strategic Framework Thematic objective	Stakeholder roles					
				Mar. Scot. & assoc. agencies	Food and drink promoters	ASSG/Seafood Shetland	SSMG & other mkt. cos.	Growers	R&D funders
Product development	11. Innovation in packing for live mussels – e.g. MAP for foodservice, continental retail markets	L	M				x	x	
	12. Innovation in traceability information – e.g. farmer profiles and individualised culture story on packs (or via weblinks)	L	M				x	x	
	13. Source alternative forms of packaging to polystyrene boxes (disposal problem) to expand market opportunities	L	M					x	
	14. Investigate scope for use of quality rejects e.g. new products utilising meats from tubeworm affected mussels	M	M				x	x	x
Production technology and efficiency	15. Adoption and refinement of new technologies to reduce costs, increase site productivity and maximise investment potential	H						x	
	16. Facilitate exchange of knowledge on best practice and different production strategies/technologies e.g. through farm visits & ASSG website forum	M				x		x	x
	17. Industry benchmarking programme to allow assessment of individual farm performance	M				x			
	18. Collation and publication by Marine Scotland of mussel farm capacity and productivity (link to annual survey)	M		x					
	19. Creation of producer co-operatives for equipment or facility sharing	M						x	
	20. Contract services in areas with sufficient farm density	M						x	
	21. Development of strategies to combat tubeworm fouling	H	H?					x	x
	22. Development of better strategies to combat eider duck predation	M	H?					x	x
Production capacity	23. Opportunity to significantly increase production from existing sites, especially in Shetland	M	L					x	
	24. For new sites, identification of areas offering best opportunity for cultivation (spatfall, food supply, carrying capacity, freedom from predators/ fouling etc)	M	L	x		x			x
	25. Seek recognition of optimal cultivation areas in Marine Spatial Plans	H	L	x		x		x	
	26. Better understanding of individual site carrying capacity to maximise production; development of carrying capacity models for on-farm use	M	L			x			x
	27. Assess existing Crown Estate leases and determine scope for consolidation/ rationalisation of smaller uneconomic sites	L	L	x		x			x
	28. Investigation of potential sites for offshore farming, taking into account planning constraints, seed/food supply and infrastructure requirements	L	L	x		x			x

Key to thematic objectives: H: health, M: markets, L: licensing, F: finance

Table 14.2. Opportunities for the development of oyster farming in Scotland

Key to thematic objectives: H: health, M: markets, L: licensing, F: finance

Development theme	Opportunity	Priority	Strategic Framework Thematic objective	Stakeholder roles					
				Mar. Scot. & assoc. agencies	Food and drink promoters	ASSG/Seafood Shetland	SSMG & other mkt. cos.	Growers	R&D funders
Market	29. Production of up to 2 million additional oysters p.a. to satisfy market demand	H	M					x	
Production technology and efficiency	30. Develop Scottish seed supply from existing marine hatchery operators	H				x		x	x
	31. Further evaluation of new technologies in Scottish conditions e.g. hanging bags to reduce production costs	M				x		x	x
Production capacity	32. Expansion of existing sites where possible and production economically viable	H	L					x	
	33. For potential new sites, identification of areas offering best opportunity for oyster cultivation (tidal regimes, foreshore area and access, carrying capacity etc)	M	L	x		x		x	x
	34. Review past site survey reports and determine to what extent suitable sites are utilised	M	L			x			x
	35. Further assess true potential of the Solway	M	L					x	
	36. Assess existing Crown Estate leases and determine scope for rationalisation of smaller sites	L	L			x			x
Other	37. Collection service for oysters from smaller producers on the West Coast	L	M				x	x	

Table 14.3. Opportunities for the development of scallop farming in Scotland

Key to thematic objectives: H: health, M: markets, L: licensing, F: finance

Development theme	Opportunity	Priority	Strategic Framework Thematic objective	Stakeholder roles					
				Mar. Scot. & assoc. agencies	Food and drink promoters	ASSG/Seafood Shetland	SSMG & other mkt. cos.	Growers	R&D funders
Production	38. Ensure greater protection of Several Orders by the relevant authorities	H		x		x			
	39. Development of an easily applied non harmful "tag" to allow identification of stolen stock	M						x	x

Table 14.4. Opportunities for development of the overall shellfish sector in Scotland

Key to thematic objectives: H: health, M: markets, L: licensing, F: finance

Development theme	Opportunity	Priority	Strategic Framework Thematic objective	Stakeholder roles					
				Mar. Scot. & assoc. agencies	Food and drink promoters	ASSG/Seafood Shetland	SSMG & other mkt. cos.	Growers	R&D funders
Production efficiency	40. Revision of the annual Marine Scotland shellfish survey to give improved level of production information (see Appendix 6)	H		x		x			
Regulation – planning	41. Recognition of and support for shellfish farming in the Marine Bill	H		x					
	42. Recognition by LAs of the need for site rationalisation/consolidation in accordance with carrying capacity and economic viability constraints	M	L	x					
	43. Establish more equitable basis for costs of shellfish planning applications (compared with e.g. salmon)	H	L	x					
Regulation - water quality issues	44. In the light of the perceived current low pollution level of Scottish waters, it should be a policy priority to improve on this high quality and thereby create a premium platform for marketing shellfish products across Europe	H	H	x					
	45. Ensuring continuing protection of designated shellfish growing waters under the Water Framework Directive	H	H	x		x			
	46. Improved mechanism for classification of shellfish harvesting waters to ensure a level playing field with the rest of the EU and that food safety risks are realistically assessed	H	H	x					
	47. Greater engagement between FSAS and local industry to fine tune the classification process	H	H	x		x		x	
	48. Development and adoption of a better method for measuring norovirus in shellfish, with a view to replacement of *E coli* as an indicator species; this would give a significant advantage to Scottish growers given Scottish waters are amongst the least polluted in Europe with regard to human pathogens	H	H	x			x		x
	49. Removal of uncertainties associated with the depuration process with clear and unambiguous criteria; clear agreement between all interested parties (Seafish, FSAS, Cefas, LAs, Marine Scotland)	H	H	x					
	50. Greater flexibility in depuration requirements to reduce unnecessary costs	M	H	x					
	51. Improvement of the biotoxin monitoring regime with greater industry participation	H	H	x			x	x	
	52. Replacement of the MBA test with LC-MS for DSP	H	H	x					

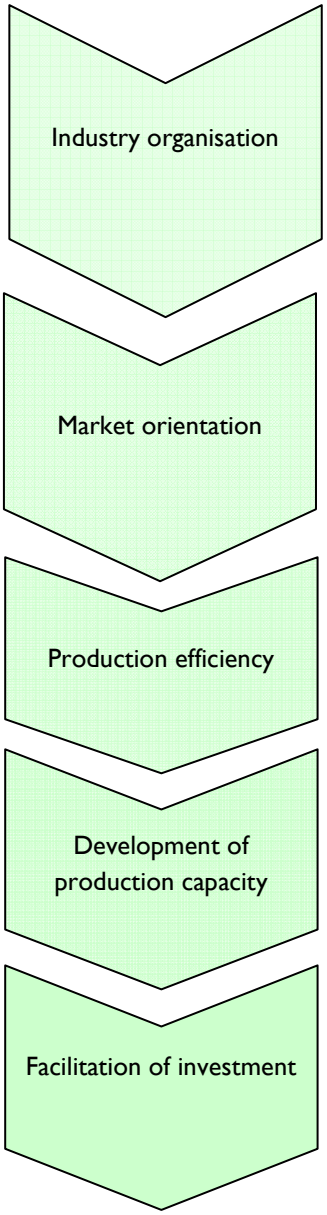
Development theme	Opportunity	Priority	Strategic Framework Thematic objective	Stakeholder roles					
				Mar. Scot. & assoc. agencies	Food and drink promoters	ASSG/Seafood Shetland	SSMG & other mkt. cos.	Growers	R&D funders
Financing	53. Clarify options for business advice and support for new entrants (LECs, Seafish, private etc)	M	F	x			x		
	54. Optimise uptake of EFF funds for industry development	H	F	x				x	
	55. Use of Enterprise Finance Guarantee for loan finance security	M	F					x	
	56. Support to producers/marketing companies in making EFF applications	M	F	x		x			
	57. Better characterisation of different business models and associated business plans to highlight investment potential (mussels and oysters)	M	F	x		x			x
Industry representation & cooperation	58. Well funded professional industry body with a wide remit to deal with marketing initiatives, legislative developments, water quality issues, advisory service etc	H		x		x	x	x	
	59. Further develop industry cooperation through the Shellfish Forum	H		x		x		x	
Policy	60. Ensure full recognition of positive benefits of shellfish farming in policy development (see Table 3.2)	M		x					
R&D	61. SARF and other funders to support R&D needs as identified in this study	H		x					x
Other	62. Staff development programme to improve capacity for innovation (link between ASSG and FE/HE providers?)	M				x			
	63. Study tours for producers to other industries/markets – e.g. Ireland, Netherlands, Spain, New Zealand (SDI support?)	M		x				x	
	64. Establishment of a "one stop shop" for new entrants with regard to applications for consents and grants, and technical advice	M		x		x			

Key to thematic objectives: H: health, M: markets, L: licensing, F: finance

14.4 Future industry development

It is not in the remit of this study to develop a strategy for the Scottish shellfish industry. However, our findings suggest that the industry will need to develop a more coherent and strategic market focus coupled with a drive to improve production efficiency and competitiveness if it is to continue to grow and play an important role in the Scottish coastal economy. The opportunities identified suggest ways in which the development of the industry could be facilitated, together with the associated Strategic Framework thematic objectives, and the stakeholders likely to play a role in that development. However, strategic development will require further work by industry stakeholders to find the best way forward, as suggested by the draft industry road map presented in Figure 14-1. The possible role of different organisations in developing such a road map are given in Table 14.5.

Figure 14-1. Draft "roadmap" for shellfish industry development indicating priorities



Effective strategic development of the industry will be difficult without a higher degree of cooperation between existing industry associations, cooperatives and producers. Ideally there needs to be a single, well funded professional industry body with a wide remit to deal with marketing initiatives, legislative developments, water quality issues, advisory service etc.

Industry development must be based on a thorough understanding of shellfish markets and marketing strategy. This will require further research and mechanisms for ongoing monitoring. Strategy may vary between products but requires identification of unique selling points, strict control of quality and other standards and investment in value-added processing/packaging and promotion.

Whilst full exploitation of niche market opportunities is recommended, overall sector growth will require improvements in production efficiency through the introduction of new technologies and scale economies.

There is scope for growth in production from existing farm sites, particularly for mussels, but rationalisation of legislation with a clearer priority for shellfish farming in the planning and regulatory process is required to facilitate more substantial expansion.

With the right marketing strategy, technology mix and potential for expansion, commercial investment should be easier to attract. Nevertheless, as a high-risk sector (due to high reliance on environmental factors) in peripheral regions, continuing support through EFF grants and other mechanisms will be essential to provide incentive and confidence.

Table 14.5. Role of different organisations in improving competitiveness

Stakeholder organisation/ category	Industry organisation	Market orientation	Improving production efficiency	Development of production capacity	Facilitation of investment
Scottish Government & associated agencies	Foster industry cooperation through recognition of cooperatives and associations and their representation within policy development processes (e.g. Shellfish Forum); Support for a properly funded industry representational body	Support for market research and domestic and export promotion (e.g linked with health messages and introduction to young people); Support for detailed market research including certification options	Support for technology transfer and applied research;	Support for research on carrying capacity; Positive policy for shellfish aquaculture in other relevant policies such as Marine Bill and River Basin Management Plans	Support for sector through EFF and LECs; Prioritise cooperative use of production equipment between smaller producers
Scotland Food and Drink; Seafood Scotland	Liaise closely with shellfish industry bodies to support strategy development	Include Scottish shellfish as integral to Scottish food promotion	n/a	n/a	Promote awareness of, and confidence in Scottish shellfish produce
Association of Scottish Shellfish Growers/ Seafood Shetland/Shellfish Association of Great Britain	Strengthen portfolio of services to producers; Enhance representation to policy bodies	Research on certification options; improved market information systems	Provide benchmarking tools to members; dissemination of research findings; Best practice guidelines; Provide technical and planning advice to new entrants	Represent the industry to policy organisations to lobby and inform; presence on Marine Planning Partnerships to ensure positive acceptance of shellfish	Provide information hub on funding and finance and support business plan development
Scottish Shellfish Marketing Group/ Other future Co-ops	Provide access to market; value add innovations; coordinate promotion	Implementation of market innovations	Feed market information to producers for better production/ harvest planning; potential for co-operative ownership of production equipment	Feed market information to policy organisations	Attract funding and investment for value added and marketing
Companies	Support for representative organisations and cooperative initiatives	Participation in producer profiling and traceability schemes	Involvement in benchmarking activities and willingness to invest in proven technologies; participation in information sharing activities e.g. demo days	Responsible site management and observation of codes of best practice; Improve productivity from existing sites	Make use of grant assistance and other support schemes; Seek/consider investment finance where business plans support

14.5 Recommendations to government

Whilst the Scottish shellfish industry is small in overall economic terms (£7.55 million in 2008), it operates in the most economically fragile rural coastal regions of Scotland and so has significant impact at the local level. Responsibility for commercial success ultimately rests with the industry, but given its make up by small businesses, the need for supporting services and especially for simplification of the regulatory burdens is considerable. Despite its present relatively small size, the industry does have significant scope for growth especially in mussel farming, but such growth

will only be achieved with the continued backing of government at national and local level. The Strategic Framework for aquaculture and associated working groups including the Shellfish Forum are all very positive developments and are to be applauded, but much further work needs to be done to ensure that regulatory issues particularly those relating to planning and water quality do not hold the sector back. There needs to be greater recognition in policy development of the ecosystem goods and services provided by shellfish culture, and less emphasis on perceived negative traits such as visual impact.

The key areas for government support in the development of the industry are indicated in Tables 14.1 to 14.4 under stakeholder roles. In addition, all opportunities identified as having a role for R&D funders are likely to require funding or other inputs from government.

Finally and perhaps most importantly is the overriding need to secure ongoing funding support for industry representation. Whilst this is partly met in Shetland through local funding, it continues to be a major issue for the rest of Scotland. The small size of the industry makes it difficult to generate sufficient funding from growers alone, and given the disproportionate and often complex volume of legislative and other matters that have to be dealt with, emanating from government at local, national and EU levels, there would appear to be a strong case for ongoing funding support from government.

14.6 Recommendations to industry

As indicated in Section 14.4, our findings suggest that the industry will need to develop a more coherent and strategic market focus coupled with a drive to improve production efficiency and competitiveness if it is to continue to grow and play an important role in the Scottish coastal economy. It is therefore recommended that the industry prepare an over-arching development strategy based on the findings of this study, covering both marketing and production and tying in with the Strategic Framework for Scottish Aquaculture, SIDS and other relevant initiatives. Within such a strategy, there is a specific need to carry out further research on markets, both in the UK and on the continent.

The key opportunities for growers to participate in the development of the industry are indicated in Tables 14.1 to 14.4 under stakeholder roles, and come under the headings of market development, product development, production capacity, production efficiency, regulation, financing, and R&D.

There is scope for the Scottish industry to learn from practices in other shellfish industries relating to representation, biotoxin monitoring, processor/grower links, marketing, and production methods, as highlighted by the benchmarking exercise in Section 13.

The recently established Shellfish Forum is a major advance in bringing together industry and regulators and should continue to be actively supported.

With regard to industry representation, there is a clear need for a substantial (a minimum of 1-2 Full Time Equivalents) staffing input, with a high degree of core funding. Whilst local core funding already supports local representation by Seafood Shetland in Shetland, funding for the rest of Scotland is presently only short-term and only supports part time representation. Achievement of ongoing funding at the required scale will require a firm financial commitment from industry participants.

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Appendix 1: Brief for the study

Summary of Requirement

1. Scottish Ministers want an aquaculture industry that is ambitious, thriving, growing, diverse, profitable and sustainable. The shellfish sector is of significant policy importance because, although relatively small in scale, mollusc aquaculture has been steadily increasing for the last ten years and has widely acknowledged potential. It provides much needed employment in the remoter parts of Scotland where alternative opportunities are limited and for which the press is clamouring (Oban Times 19 March 2009 "Argyll's jobs despair"). The former Minister for Environment Michael Russell MSP publicly stated his recognition of the sector's potential and his wish to see it expand. Roseanna Cunninghame MSP is similarly committed.

2. Scottish shellfish farming currently produces around 5,000 tonnes a year (just over half from Shetland) with a total first sale value in excess of £5 million and it is believed there is potential to greatly increase production. The Association of Scottish Shellfish Growers has claimed there is sufficient space to increase production to tens of thousands of tonnes a year.

3. Employment in the shellfish sector is largely part-time and casual working which fits in with the tradition of plural occupations in the crofting areas but in recent years the proportion of full-time jobs has increased to around 40%, out of total of around 400.

4. Shellfish production is characterised by a substantial number of small enterprises operating alongside a few larger ones that have increased in importance in recent years. If the industry were to grow markedly, its profile would change, possible bringing in multinationals.

5. The potential for the shellfish sector to grow is undeniable given the coastal waters of Scotland but raises all sorts of questions for which the study is intended to provide answers. There is a huge market for Scottish mussels in Belgium that can take all Scotland can produce but the infrastructure to collect output from small growers to bulk up to shipping quantities for export is very under developed. Marketing difficulties therefore exist. The Scottish Shellfish Marketing Group (SSMG) cannot take all the mussels its members produce and non-members are in a more difficult position.

6. The requirement is for a study that will identify the prospects and developmental opportunities for the shellfish farming sector, covering issues such as merchanting infrastructure, markets, planning/siting and water quality. The investigation proposed will help develop policy thinking necessary to aid the implementation of a new Strategic Framework for Scottish Aquaculture best suited to delivery of policy aims. The study will help pave the way for Scottish Ministers' declared objective of profitable aquaculture businesses which make best use of our aquatic resource, underpinning a peopled landscape.

7. In addition to clarifying policy thinking, the study will assist businesses with their own development efforts by identifying where their own investment and grant aid can be used to optimal advantage. In identifying the best way forward the study will help industry deliver Ministers' over-riding objective of sustainable economic development.

8. The need for the study arises because shellfish businesses are of widely differing scale and business model, extensively scattered geographically and changing in response to all manner of pressures. Shellfish operations range from those producing a few shells to highly integrated businesses incorporating sophisticated secondary processing and marketing, home and abroad. It is so varied and subject to change that government policy makers know little about it beyond the bare statistics of the production survey and even less of the opportunities.

9. This need for knowledge is the bottom line link to the policy context. Facts and figures of successful business models and opportunities will provide evidence for the strategic framework shellfish sub group and can be used to develop policy priorities for EFF (European Fisheries Fund) funding and Research and Development. The proposal would take cognisance of developments in the marine environment such as the Marine Bill. This study will link to the wider policy context of economic development in remote rural areas.

10. The study will be potentially very influential as it comes at a critical juncture for the Strategic Framework refresh and the industry. It will contribute to the foundation of evidence underpinning the new Strategic Framework and provide direction for the industry which needs to produce its own development strategy.

11. The shellfish sector meets the Scottish Government's five Strategic Objectives in full measure. The study will be an excellent fit with the five Strategic Priority Channels through which growth is most effectively driven, majoring on provision of a supportive business environment and infrastructure development as called for in the Economic Strategy.

Objectives

12. The principal objective of the proposed study would be to investigate the prospects for shellfish aquaculture, built around SWOT (Strengths, Weaknesses, Opportunities, Threats) and PEST (Political, Economic, Sociological, Technological) type analysis. This should build on work undertaken by the Shellfish Association of Great Britain Ltd in the English Shellfish Industry Development Strategy. The study should cover issues of site availability (including where the different size and species elements are and where they need to go and shore base availability), market size and location, market development and competitive production and water quality issues. These are issues which the Scottish Government has indicated as the main challenges for the industry as a whole and are central to the renewed Strategic Framework. The study should also take into account developments within the marine environment, e.g. Marine Bill.

Approach

13. The study would entail desk research, the analysis of published data, accessing dispersed sources and company annual reports. It would involve extensive discussion by face to face interviews with stakeholders, the growers themselves (Association of Scottish Shellfish Growers (ASSG) and Shetland Aquaculture should be approached for names), customers (particularly retail multiples), financiers, trade associations, regulators including SEPA, Marine Scotland Science (previously FRS) and SNH, the Sea Fish Industry Authority, the Enterprise Network and Local Authorities.

14. The study will need to consider the supply chain for the industry as well as downstream links involving the distribution network, final markets and transport, the limitations of which have been alluded to above. The nature of the study means it would be very cost effective and in view of its potential influence, excellent value for money.

Outputs

15. The output would be in the form of a written report, including a literature review. We would expect the contractor to make presentations of their findings to the Steering Group, the ASSG annual conference and other interested parties.

Project Management

16. A Project Manager within the Scottish Government Aquaculture, Freshwater Fisheries and Licensing Policy Division will be appointed.

17. A Steering Group would be established to manage the project, which would be undertaken by a contractor, following competitive tendering. This would include representatives from the policy and analytical services divisions, the ASSG, Highlands and Islands Enterprise, and other nominated organisations which have an interest in the development of the shellfish sector.

18. Project management would begin with a steering group meeting for final scoping of the project with the contractor and include a mid term review. Additional Steering Group meetings would be called as the project manager thinks appropriate.

19. A Scientific Adviser from the Scottish Government will provide the economic advice to the project.

Duration of project

20. It is expected that the project would last 4 months.

Sustainable Development

21. Shellfish farming is in the forefront of environmentally friendly and sustainable industry. Molluscs are filter feeders, feeding themselves, with no feed sustainability issues. No veterinary medicines and minimal antifoulings are used. Stock recruitment for mussel farming is an entirely natural process. It would be hard to find more sustainable primary production of valuable healthy eating low fat animal protein.

22. While it will be largely a desk study, some travel throughout Scotland will be necessary and undertaken in a sustainable way. For Steering Group meetings, it is hoped that members located outwith the central belt will join by audio or videoconference.

23. The study should also indicate any investment needs from Scottish Water to ensure water quality and the emissions likely to be generated from operation of these facilities.

Risks

24. Risks include failure on the part of the consultants to deliver a report of the desired quality and on time.

25. Risk management will be by on-going review by the project manager and steering group which will help address report quality and timeous delivery. As the study benefits the industry it is felt that cooperation can be assured and preliminary discussion with the ASSG supports this view.

Appendix 2: List of consultees

List of consultees

Industry Associations

Walter Speirs, Association of Scottish Shellfish Growers
Ruth Henderson, Seafood Shetland

Mussel growers

Michael Laurenson, Blueshell Mussels
Michael Tait, North Atlantic Shellfish
Christopher and Marvin Thomason, C and A Thomason
Andrew Tait, A and C Tait
Peter Tait
Kenny Pottinger, East Voe Shellfish
Lyndon Mouat, Selivoe Shellfish
Stephen Anderson, Demlane
Lindsay Angus, Cribba Sound
Keith Robertson, Olnafirth Sea Farm
Cree MacKenzie, Hebridean Mussels
Donnie Gillies, Isle of Shuna
Walter Speirs, Muckairn Mussels
Douglas Wilson, Inverlussa Shellfish
David Attwood, Loch Fyne Oysters
Jim McLachlan, Loch Striven Mussel Farm
Gitte Salvarli, Glencoe Shellfish
Alan Byrne, Fassfern Mussels
Iain Mackinnon, Lochaber Shellfish
John Ross, Loch Laxford Shellfish
Robert Kelly, Isle of Skye Mussel Co
James Bromham, Highland Fresh Mussels
James Wilson, Deepdock Mussels

Oyster growers

Roger Thwaites, Shian Fisheries
Nick Turnbull, Isle of Mull Oysters
David Attwood, Loch Fyne Oysters
Andy Abrahams, Isle of Colonsay Oysters
James Colston, Arisaig Estate
Gerard Macdonald, Isle of Barra Oysters
Alan MacFadzean, Port Lismore
John MacNaughton, Kyles of Bute Oysters

Scallop growers

David Oakes, Oakes Marine

Hatcheries

Tim Atack, Viking Fish Farms

Local Authorities

Martin Holmes, Coastal Zone Manager, Shetland Islands Council
Neil Grant, Economic Development Unit, Shetland Islands Council
Peter Middleton, Economic Development Unit, Western Isles Council
Cathy Leary, Planning Department, Western Isles Council
Mark Steward, Marine Coastal Unit, Argyll and Bute Council

Markets

Stephen Cameron, Scottish Shellfish Marketing Group
Donny Gillies, Isle of Shuna
David Attwood, Loch Fyne Oysters
Chris Leftwich, Chief Inspector of Fisheries, Billingsgate
Karen Galloway, Seafish
Craig Burton, Seafish
Kirsten Beddows, Food and Drink Industry Division, Scottish Government
Jim Tait, Seaspray
Rogano's Restaurant, Glasgow

Regulators

Paul Shave, Marine Scotland
Brian Dornan, Marine Scotland
John O'Brien, Marine Scotland

Landlords

Alex Adrian, The Crown Estate

Equipment suppliers

Jim McLachlan, Xplora Products
Joe Franklin, NZ Rope and Twine (NZ)
Dave Hockey, Ansco Engineering (NZ)
Cochon sarl
Jock Fleming, FPM Henderson Ltd

Others

Iain Sutherland, Highlands and Islands Enterprise
Pam Taylor, Solway Firth Partnership
John Webster, Scottish Salmon Producers Organisation
Jaap Holstein, Dutch Mussel Processors' Association
Andrew Rodger, Western Isles

Appendix 3: Financial projections - mussels

Financial projections - 500t traditional pegged rope farm

Assumptions

General

Annual production (t)	500
Yr class 1 prod (t)	500
Yield/longline (t)	40
Production cycle (yrs)	3
Avg. ex-farm price (£/t)	800
Grant rate (% of capex)	60%
Labour productivity (t/man)	70
Avg. wage/head (£ p.a.)	22,000
Fuel (£/t)	30
Electricity (£/t)	30
Consumables (£/t)	10
Misc p.a.	10,000
Rep & ren p.a.	30,000
Crown Estate rent	1537.5
(£/metre of longline)	0.205
Shorebase rent % of T/O	2%
Office p.a.	7,000
Prof. services p.a.	3,000
Planning fees (£/longline)	500
Avg. depreciation (str line, yrs)	10.72

Summary of capex (see separate table below)

Lines and moorings	355,475
Shorebase grading	145,000
Shorebase depuration	156,200
Workboat (15m)	300,000
Other equipment	92,380
Contingency (5%)	52,453
Total	1,101,508

Cash flow

Year	1	2	3	4	5	6
Production (t)			500	500	500	500
Income						
Sales	0	0	400,000	400,000	400,000	400,000
Cap. Introduced	0	0				
Grants	137,014	261,586	262,306			
Loans						
Total	137,014	261,586	662,306	400,000	400,000	400,000
Expenditure						
Direct						
Wages	52,381	78,571	157,143	157,143	157,143	157,143
Fuel	5,000	7,500	15,000	15,000	15,000	15,000
Electricity (depuration)	1,000	2,000	15,000	15,000	15,000	15,000
Consumables	1,667	2,500	5,000	5,000	5,000	5,000
Indirect						
Misc	3,333	5,000	8,333	10,000	10,000	10,000
Rep & ren	10,000	15,000	25,000	30,000	30,000	30,000
Rent	384	769	9,153	9,538	9,538	9,538
Office	2,333	3,500	5,833	7,000	7,000	7,000
Prof. services	3,000	3,000	3,000	3,000	3,000	3,000
Bank charges/int.						
Capex	228,356	435,976	437,176			
Total exp.	307,455	553,816	680,639	251,680	251,680	251,680
Inc-exp	-170,441	-292,231	-18,333	148,320	148,320	148,320
Balance	-170,441	-462,672	-481,005	-332,685	-184,365	-36,046

Profit and loss account

Year	1	2	3	4	5	6
Income	0	0	400,000	400,000	400,000	400,000
Expenditure						
Direct						
Wages	52,381	78,571	157,143	157,143	157,143	157,143
Fuel	5,000	7,500	15,000	15,000	15,000	15,000
Electricity	1,000	2,000	15,000	15,000	15,000	15,000
Consumables	1,667	2,500	5,000	5,000	5,000	5,000
Opening stock	0	60,048	150,619	113,086	115,286	115,286
Closing stock	60,048	150,619	113,086	115,286	115,286	115,286
Total	0	0	229,676	189,943	192,143	192,143
Gross margin	0	0	170,324	210,057	207,857	207,857
Indirect						
Misc	3,333	5,000	8,333	10,000	10,000	10,000
Rep & ren	10,000	15,000	25,000	30,000	30,000	30,000
Rent	384	769	9,153	9,538	9,538	9,538
Office	2,333	3,500	5,833	7,000	7,000	7,000
Prof. services	3,000	3,000	3,000	3,000	3,000	3,000
Bank charges/int.	0	0	0	0	0	0
Depreciation	8,521	24,789	41,101	41,101	41,101	41,101
Total	27,572	52,057	92,421	100,639	100,639	100,639
Total expenditure	27,572	52,057	322,097	290,581	292,781	292,781
Profit (loss)	-27,572	-52,057	77,903	109,419	107,219	107,219

Balance sheet

Year	1	2	3	4	5	6
Fixed assets						
Equipment	82,822	232,424	366,193	325,092	283,991	242,890
Current assets						
Stock	60,048	150,619	113,086	115,286	115,286	115,286
Debtors						
Cash						
	60,048	150,619	113,086	115,286	115,286	115,286
Current liabilities						
Creditors						
Bank overdraft	170,441	462,672	481,005	332,685	184,365	36,046
	170,441	462,672	481,005	332,685	184,365	36,046
Total assets	-27,572	-79,629	-1,726	107,692	214,911	322,130
Capital account						
Opening balance	0	-27,572	-79,629	-1,726	107,692	214,911
Capital introduced	0	0	0	0	0	0
Profit for year	-27,572	-52,057	77,903	109,419	107,219	107,219
	-27,572	-79,629	-1,726	107,692	214,911	322,130

Stock valuation

Direct prod. costs	60,048	90,571	192,143	192,143	192,143	192,143
Allocation of dir.prod. costs between year classes						
1st yr class	100%	60%	60%			
2nd yr class		40%	20%	60%		
3rd			20%	20%		
4th				20%		
Allocation						
1st yr class	60,048	114,390	229,676			
2nd yr class		36,229	74,657	189,943		
3rd			38,429	76,857	192,143	
4th				38,429	76,857	192,143
5th					38,429	76,857
6th						38,429
7th						
Opening stock	0	60,048	150,619	113,086	115,286	115,286
Closing stock	60,048	150,619	113,086	115,286	115,286	115,286

NB Stock valuation is based on direct costs of production; these are split between 3 yr classes on farm, LESS costs of prod. of any stock harvested

Sensitivity analysis (before finance and corporation tax)

	10 yr IRR	**Max funding**	**Yr 5 prod. cost (£)**
Base case	17%	876,644	586
No grant	-2%	1,275,243	709
Price +10%	24%		587
Price -10%	8%		584
Yield/line 48t, overall 600t	23%		555
Yield/line 32t, overall 400t	9%		632
1st yr class only 250t	9%		586
+10% on capex	15%		586

Max funding assumes delay in 3rd yr grant and only 2/3rds of inc received
IRR assumes no residual value after 10 years

500t traditional farm - indicative capital expenditure

Item	Notes	Quantity	Unit	Unit price	Cost	Total cost	Life (yrs)	Depn.
Longline equipment and moorings								
Assumptions								
No cross moorings								
Avg 6 lines/site to spread cost of 2 nav buoys								
Buoyancy/t of final prod	500 litres							
Water depth	>30m							
Max length mooring legs	4x depth							
Droppers/longline	1000 x 8m							
Costs for one longline								
Anchors	FPM	2	300kg	562	1,124			
ground chain	FPM	2	12m	130	260			
32mm rope	polyprop	3	220m	300	900			
Penants	FPM	2	30m	35	70			
Shackles	FPM	6		22	132			
6mm rope	polyprop	2	220m	5	10			
Buoys	Xplora	50	400l	70	3,500			
Nav buoys	FPM	0.33		1300	433			
Pegged droppers	12mm polyprop	8,000	metre	0.3	2,400			
Labour to make up line		1	days	200	200			
Contractor to install		0.5	days	500	250			
Delivery of equipment		1	sum	200	200			
Total cost/longline					9,479	**(NB see note 1 below)**		
Yield/longline (t)	40							
No. of longlines	37.5							
Total						355,475	9	39,497
Shorebase facilities - land rented, buildings constructed								
Building for grading, office etc								
Building for grading line	Estimate	100	m2	750	75,000		20	3,750
Grading and inspection line	Cochons	1	sum	70,000	70,000		7	10,000
Total						145,000		
Depuration/rewatering system (500t/6 months=20t/week=10t system at 250kg/bin=40 bins=100m2)								
Building for dep sys	Estimate	100	m2	650	65,000		20	3,250
Equipment/pipes	Comp. Env. Sys.	1	40 bin syst	72,000	72,000		10	7,200
3 phase power	Scottish Hydro	1		11,640	11,640		20	582
Bulk bins	Palletower	120	tanks	63	7,560		7	1,080
Total						156,200		
Other items								
Planning fees		37.50	longline	500	18,750		25	750
Voe boat	Voe boat	1		20,000	20,000		10	2,000
Workboat	Alnmaritec 15m	1		300,000	300,000		15	20,000
Folklift	Manitou	1		36,000	36,000		10	3,600
Pick up		1		17,630	17,630		5	3,526
						392,380		
Total						1,049,055		
Contingency (5%)						52,453	7	7,493
Total planned costs						1,101,508	10.72	102,729

Notes

1. The cost of a longline given here of £9,500 is for a relatively low energy site not requiring heavy duty moorings. In higher energy sites, such as some found in Shetland, there is a trend towards heavier duty moorings which can increase longline costs to around £14,000 each. This however is compensated to some extent by yields greater than the 40t assumed in this model.

Appendix 4: Financial projections – Pacific oysters

Financial projections - Pacific oysters

(Medium scale Pacific oyster farm, Scotland)
NB These costs are indicative only and may vary widely between operations

Assumptions

Income		Notes
Annual production (shells)	350,000	
Ex-farm price/shell (£)	0.24	1
Stock		
Starting seed size (g)	10	2
Harvest size (g)	85	
Mortality	10%	3
Time to harvest	25% yr 2, 50% yr 3, 25% yr 4	4
10g seed cost (£/1,000)	30	
Total seed required	388,889	
Growing capacity		
Length of trestles/1,000 shell production (m)	12	5
Oyster bag dimensions (m)	1 x 0.5	
Bags/1,000 shells production	24	
Cost of trestles (materials & labour)(£/m)	10	
Cost of bags and ties (£/bag)	2.5	
Other costs		
Crown Estate rent (£/m of trestle)	0.29	
Shorebase ground rent (% of T/0)	2%	6
Labour productivity (shells/person)	175,000	
Wage/head (£ p.a.)	22,000	7
Fuel & power (£/1000 shells)	5	8
Repairs and renewals (£/1000 shells)	10	9
Miscellaneous costs (£/1000 shells)	5	10
Finance	Not included	11

Capital expenditure (no depuration)

No grant		**Life (yrs)**	**Depn.**
Trestles	42,000	7	6,000
Bags etc	21,000	10	2,100
Shore vehicle e.g. tractor and trailer (2nd hand)	10,000	5	2,000
Grader etc	20,000	7	2,857
Forklift (2nd hand)	10,000	5	2,000
Shed, 100m2 @ £500/m2	50,000	20	2,500
	153,000	8.8	17,457
Contingency 5%	7,650	8.8	873
Total	160,650		18,330

With 60% grant on new items	After grant	Life (yrs)	Depn.
Trestles	16,800	7	2,400
Bags etc	8,400	10	840
Shore vehicle e.g. tractor and trailer (2nd hand)	10,000	5	2,000
Grader etc	8,000	7	1,143
Forklift (2nd hand)	10,000	5	2,000
Shed, 100m2 @ £500/m2	20,000	20	1,000
	73,200	7.8	9,383
Contingency 5%	3,660	7.8	469
Total	76,860		9,852

Indicative profit and loss acount (excluding finance)

Income		
350,000 shells at 24p each		84,000
Expenditure		
Direct		
Seed (10g)	11,667	
Labour (2 full time)	44,000	
Fuel & power	1,750	
Total		57,417
Gross margin		26,583
Indirect		
Repairs and renewals	3,500	
Shorebase ground rent	1,680	
Crown Estate rent	1,218	
Misc. costs	1,750	
Depreciation (no grant)	18,330	
Total		26,478
Total expenditure		83,895
Profit (loss)		105

Notes

1 All stock sold undepurated to wholesale distributor with depuration facilities

2 In practice many farms also buy in smaller seed

3 Mortality can vary significantly between farms depending on site conditions and predation

4 Growth varies significantly between farms depending on water exchange, food supply and temperature

5 Capacity required varies depending on stocking size, growth, mortality, and site conditions

6 Some farms may have their own land for shorebase facilities, nevertheless a rental figure of 2% of turnover to some extent reflects the opportunity cost of such an investment

7 In reality, an operation of this scale would typically be run by 2 owner operators e.g. as a partnership, with no employed labour, and any " profit" as such would be distributed between the operators

8-10 Approximate costs only; may vary widely between farms

11 Costs exclude finance, which will vary between farms depending on business model

Appendix 5: Analysis of mussel farm production capacity based on analysis of Crown Estate leases

Analysis of mussel farm production capacity in Scotland by region and site size

NB Capacity is expressed in terms of "long line equivalent" (LLE) in metres

		Capacity by site size					
Region	**LLE (m)**	**<750**	**750-1500**	**1500-3000**	**3000-4500**	**>4500**	
	Production potential (t)	**<50t**	**50-100t**	**101-200t**	**201-300t**	**>300t**	**Total**
Argyll	LLE (m)	18,372	13,119	11,920	14,400	33,200	91,012
	No. sites	54	13	7	4	6	84
	Avg. m/site	340	1,009	1,703	3,600	5,533	1,083
Highland	LLE (m)	8,002	21,488	15,800	0	0	45,290
	No. sites	20	18	7	0	0	45
	Avg. m/site	400	1,194	2,257	0	0	1,006
Highland	LLE (m)	3,910	9,900	11,800	0	0	25,610
(Sutherland)	No. sites	9	8	6	0	0	23
	Avg. m/site	434	1,238	1,967	0	0	1,113
Orkney	LLE (m)	2,140	0	0	3,080	0	5,220
	No. sites	15	8	8	1	0	32
	Avg. m/site	143	0	0	3,080	0	163
Shetland	LLE (m)	15,347	39,700	68,620	25,200	49,440	198,307
	No. sites	36	34	33	7	8	118
	Avg. m/site	426	1,168	2,079	3,600	6,180	1,681
W Isles	LLE (m)	8,031	14,060	8,100	0	6,160	36,351
	No. sites	20	14	4	0	1	39
	Avg. m/site	402	1,004	2,025	0	6,160	932
Total	LLE (m)	55,802	98,267	116,240	42,680	88,800	401,790
	No. sites	154	95	65	12	15	341
	Avg. m/site	362	1,034	1,788	3,557	5,920	1,178

Assumptions

1 Based on analysis of Crown Estate lease data as at October 2009

2 Relates only to those leases identified as for mussels or most likely to be used for mussels

3 Raft capacity has been converted to longline equivalent (LLE) at rate of 500m2 = 1 x 200m longline

4 It is assumed that all longlines consist of 2 parallel headropes as is the industry norm

5 Analysis of site size by tonnage has been based on a yield of 40t/200m longline and a 3 yr production cycle, thus a 50t site has 750m longline capacity

6 The total mussel farm capacity for Scotland of 401,790m LLE is equivalent to 2009 x 200m longlines

7 Regions based on old county boundaries and do not necessarily match those given in the Marine Scotland annual survey

Appendix 6: Suggested changes to the Marine Scotland annual survey

Suggested changes to the Marine Scotland annual survey

The shellfish industry has grown significantly over the past decade, particularly for mussels, and the annual survey is no longer considered as informative as it might be in reflecting the character of the industry and possible future growth. Some of the changes that have been suggested include:

- clearer statement of assumptions used for determining market prices; the ex-farm price for Pacific oysters in 2008 appears particularly high
- classification of mussel farms needs to be changed; presently this only goes up to 100t, whereas the largest farm now produces over 1,000t
- there needs to be an analysis of volume of stock (or installed capacity) by year class to allow better prediction of future production for marketing purposes, including market ready stock still unsold, especially for mussels
- the definition of active/producing sites needs to be clarified and refined; for each species and region, need to know the number of companies, number of sites, and capacity (m of longline or trestles, both licensed and installed)

Any amendments to the survey should be discussed with industry representative bodies beforehand. See Section 8.2.8 for analysis of Crown Estate lease data, some of which might usefully be included in the survey.