Socio-economic Assessment of potential impacts of new and amended legislation on the cultivation of fish and shellfish species of current commercial importance

SARF Project 046

Final Report

Prepared by:

John Hambrey, Steve Westbrook, Tristan Southall, Richard Robinson

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Acknowledgements

The assistance of many people who gave up valuable time to inform this research is greatly appreciated.

A list of all those consulted, including those who attended a workshop in Inverness in October 2008, is presented in Annex 3

Disclaimer

The report is based in part on reported opinions and perceptions of consultees. Although the accuracy of these has been checked where possible, we cannot guarantee the accuracy or veracity of these opinions in all cases.

Executive summary

The research

1. Research was undertaken to explore the constraints affecting fish and shellfish farming in Scotland with particular emphasis on the possible effects of nature conservation and landscape designations, and the provisions for marine planning, licensing and marine protected areas under the new Marine Bill.

2. Initial research focused on marine fin-fish farming as being the most commercially important. The results of this work and the associated workshop, are summarized below, and presented in more detail in Appendices 1 and 2.

3. In October 2008 it was recognised that there was significant overlap with other on-going work relating to site availability, and the research team was asked by the SARF project steering group to focus more specifically on shellfish farming.

4. The analysis is based on desk research drawing on a wide range of existing materials, supplemented through face to face and telephone interviews with fish and shellfish farmers, industry representative organisations, and government department and agency officials. A full list of consultees is presented in Annex 3.

Summary of Phase 1: literature review and scoping consultations with industry and other stakeholders

5. No single constraint was identified as dominant by fish farmers or their representatives. A more complex picture emerged of a range of subtle and interacting constraints, varying in relative importance according to location, experience and perspective. The following were identified by consultees as issues/constraints of particular concern:

   - EIA process (cost, uncertainty)
   - Technical variations (consents required for relatively minor variations reduces production flexibility and responsiveness)
   - Dispersion modelling (accuracy)
   - Review process (cost, uncertainty)
   - Proximity of SAC and appropriate assessment (additional costs, limitations on seal audio units)
   - Landscape designations (significant restrictions on siting)
   - Medicine licensing (VMD) and use restrictions (ineffective suite of drugs; difficulties with larger cages)
   - 2,500 tonne consented biomass restriction
   - Lack of transparency about existing sites (especially for shellfish)
   - Planning consent (uncertainty; priority to tourism and other interests; vocal local anti-aquaculture groups/individuals; costs esp for shellfish farming)
   - SEPA charges (possible barrier to entry by small farmers)

Fixed Constraints

6. Regardless of any policies, regulation or processes, the Scottish aquaculture industry is constrained by a set of fixed constraints which are largely beyond the control or influence of the industry or Scottish policy makers. The first of these is

the physical / environmental capacity of the available Scottish resource; the second, the vagaries of the international global commodity market.

7. The environmental capacity for finfish or shellfish production in Scotland has not been comprehensively assessed at national level, though there are estimates for individual lochs and semi-enclosed water bodies, and much research has been undertaken on processes and methodology[1]. It is unclear exactly what the scale of production could be if the available environmental resource – and in particular its ability to adequately assimilate organic waste – was exploited to the full. It is also unclear how many more viable sites (both biologically and economically) remain undeveloped, or indeed how many existing licensed sites which are not currently under production, could be profitably operated under different circumstances. It is therefore difficult for policy makers to take a strategic position on the potential role of further aquaculture development in the economic development of Scotland.

8. Similarly, the markets which dictate global commodity prices for aquaculture products are largely outwith the control of farmers or indeed the Scottish industry, although there may be some limited scope for short term influence through management of production volumes.

Non-fixed constraints

9. Beyond these fixed constraints there are a number of other constraints which have impacted upon the industry to varying degrees. Some of these constraints are related to national or regional policy, and there may be opportunities to reduce the level of constraint.

Designations

10. The initial focus for this research was the scale of the potential constraint of nature conservation and landscape designations on the development of the aquaculture industry in Scotland. The initial scoping exercise suggested that designations *per se* were indeed seen as a constraint or potential constraint in some circumstances, but to date have been less important than many other factors. However, it is difficult to separate out nature conservation and landscape issues from planning (see below).

11. From the perspective of industry, designations are viewed as a complication. Designations lead to an increase in planning application charges, for example to cover seabed video surveys or landscape assessments. Designations may also lead to a requirement for appropriate assessments, which may add cost, delay proceedings, and increase uncertainty.

12. Where possible companies will choose to avoid new site applications in designated areas; where companies are seeking to improve efficiency and rationalise production, they are likely to increase production in the site with greatest likelihood of planning success.

13. Despite these issues, many companies pursue planning applications in designated areas, and many farms are currently located in designated areas. Companies with in-house expertise and environmental resources, supported by robust finances, are best placed to expedite the planning process. Poorly financed companies or new entrants are likely to be disproportionately affected by designations at the planning stage.

[1] See for example SARF research projects 3, 5, 9, 11, 12, 17, 30 and 53

14. This research has not been able to uncover solid evidence that designations have constrained total production from Scottish aquaculture. However there is sufficient evidence to conclude that over time there is likely to be a gradual increase in the balance of production outside of designated areas, compared to within designated areas. Furthermore, as the availability of economically viable sites becomes increasingly limited, so will the importance of a range of other site related constraints, including designations.

Planning

15. It is difficult to isolate planning as a constraint in its own right as many other factors – such as landscape, designations and public perception – all influence planning decisions. However, the most significant and often-cited (from industry) constraint on the development of the Scottish aquaculture industry was the planning system – and, in particular, the associated cost, delay and perhaps crucially – uncertainty of outcome.

16. Current procedures mitigate against a more strategic and predictable approach, despite the existence of framework plans in some areas. It is notable that industry will rarely approach a local authority early in the scoping process to help identify a site, but will instead seek to identify a site themselves, undertake scoping consultations with the other statutory consultees and only when a potential site appears viable will they approach the local authority. This is likely to vary somewhat between local authority areas – indeed the research team uncovered substantial variations in the industry's perception of different local authorities.

Conclusions from phase 1

17. In spite of the fact that salmon industry representatives indicated that – in an ideal world - the industry could have been up to 50% larger, we have been unable to find hard evidence that any non fixed constraint has prevented the industry reaching its full production potential.

18. The greatest cost to industry appears to come from the uncertainty and delay associated with the planning process and the role of a wide range of statutory and public consultation as part of that exercise – a finding mirrored in recent work undertaken for the Scottish Government (Poseidon 2008). However, in many of the examples and case studies that we encountered, where sites were appropriate, they were eventually licensed. Furthermore there is recognition on the part of industry that improvements have been made in addressing many constraints, particularly in relation to regulation, and that some *apparent* constraints have assisted the industry in avoiding the pitfalls and associated damage to reputations which have occurred in other producer countries – for example, as a result of major disease outbreak. So whilst there is clearly a cost associated with planning and regulation, there is no clear evidence that this has had a direct negative impact on local development decisions.

19. The overall burden of constraints on the Scottish industry clearly influences the relative attractiveness to do business here, influencing decisions and applies to:

- multi-national companies already in Scotland in determining company international strategy.
- Potential investors in both Scottish based or Scottish owned companies.
- New entrants – the risk is that the current constraints disproportionately affect the small scale, new entrants – particularly to shellfish production.

Summary of Phase 2: key findings of the workshop

A workshop was held at Cowan House, Inverness, on Monday 20th October 2008 to explore possible futures for the industry in terms of the interaction between development opportunity and the regulatory environment. It was attended by a wide range of government, agency and industry personnel. A full workshop report is available as Appendix 2. The following are some of the key findings:

20. Although some salmon farming companies are keen to continue expansion, the current economic situation suggests that such expansion will be modest.

21. It is unlikely that there will be significant increase in shellfish farming: investment for a 300tonne mussel farm may be several £million – and this is difficult to justify in commercial terms, given the combination of production and marketing risks.

22. Above water constraints (e.g. landscape, other users/interests) are probably greater and less predictable than below water constraints (water quality, assimilative capacity, biodiversity).

23. Special Areas of Conservation (SACs) may not be a serious constraint. The biodiversity interest is known and understood, and the farmer can therefore work around it. Outside an SAC may be less predictable from a biodiversity perspective, and there will still be the need and cost of survey for any significant expansion/development. However, it is unlikely that major expansions in SAC's would be sanctioned.

24. It is very difficult to generate standard decision criteria for biodiversity (e.g. is 5% or 10% loss of a habitat acceptable?) – conservation is very context dependent and often requires dedicated survey.

25. Landscape is a key issue, and barges have become *the* key landscape issue for marine finfish farming. As far as most of the industry is concerned, barges are a standard essential part of operations.

26. Landscape is a very local issue and may not be related to National Scenic Area (NSA) designation. Key local issues include location relative to roads, paths, views etc. There are differences between local authorities and a lack of standards.

27. Landscape can be a way in, or focus for local engagement on decision making - but local engagement increases uncertainty.

28. Case work and consenting is likely to remain the key point for decision making, irrespective of higher level strategic plans. In other words it is unclear that more strategic planning will significantly decrease uncertainty.

29. The industry is happier working with professionals. It is not clear how their relationship would develop with a group of stakeholders convened as a Regional Management Organisation.

30. Pre-consultation is a major tool for reducing uncertainty and this now generally works well in terms of water quality and biodiversity. It is less clear as to how this

can be further developed in relation to landscape, local amenity issues and planning consent more generally, or how it might work in relation to a Regional Management Organisation under the new Marine Bill.

Summary of Phase 3: Focus on shellfish farming

Historic constraints on the development of shellfish farming in Scotland

31. Shellfish farming has shown limited and inconsistent growth in Scotland over the last three decades, despite high hopes and significant public support. The main exception to this has been the more rapid growth of mussel farming in Shetland in the mid years of this decade.

32. Our analysis reveals a daunting array of constraints which explain this limited growth. They include:

    - Limited site availability (mainly related to prior use by other fish farmers);
    - Market price/production cost (the relative importance of this constraint has varied according to the interplay of production volume, market development and market demand) – and will become more of an issue as other constraints are lifted;
    - Production risks (including closures related to biotoxins, slow growth; fouling; predation; poor spatfall; storm damage in more exposed sites);
    - Planning considerations (especially in relation to navigation/recreation/fishing and landscape, and to a lesser extent nature conservation).

33. There is much interaction between these constraints. From an investment perspective both production and market risks are compounded by the combination of relatively long production cycle (2-3 years for mussels; 3-4 years for oysters) and possibility of planning delays or refusals in relation to specific sites. This also explains the difficulty farmers have in procuring finance. There are also significant regional and species variations in the manner in which these constraints come into play. Section 3 of this report explores each of these constraints and their various components in some detail.

34. Given the combination of factors noted above, nature conservation and landscape designation have probably not been a key constraint on the development of the industry, despite the fact that roughly 67% of shellfish sites lie within 2km of some identified nature conservation or landscape interest (Natura 2000 site; Sensitive Biodiversity Action Plan (BAP) species or habitat; marine consultation area).

The Marine Bill

35. The Marine Bill and the mechanisms and procedures by which it will be implemented could significantly influence the future development of shellfish farming in Scotland. The Bill makes provision for

    - National and regional marine plans
    - Marine protected areas
    - Streamlined/integrated/more centralised licensing
    - Seal conservation

36. The provisions for planning are designed on the one hand to create a more predictable investment environment, and on the other as a mechanism to take into account multiple demands on the coastal environment. Whether this eases or reinforces the "planning constraint" will depend very much on the procedures used to develop regional marine plans and the representation of shellfish farmers on any groups delegated to develop these plans. Since shellfish farmers are a minority interest in many parts of Scotland their representation and influence on such groups may be limited, and the slice of the coastal cake made available for shellfish farming may be correspondingly limited. Since significant growth in farmed shellfish production will probably be contingent on economies of scale and larger shellfish farms, this may be a significant problem.

37. The nature and extent of marine protected areas is hard to predict but could be significant. Not only will these areas be designated for rare or important species or habitats, or areas of particular diversity, they will also be designated as a representative series or network to meet commitments under the OSPAR agreements. It is likely that they will include the existing Marine Consultation Areas, several of which are coincident with potential development areas for shellfish farming. Although there has in the past been limited conflict between nature conservation and shellfish farming interests, this may change as viable shellfish farms become bigger, and their environmental effects (pseudofaeces, debris, fouling deposition; predator conflicts) become more evident[2].

38. Ultimately much will therefore depend on the interplay between the new planning and licensing regimes – but there is significant potential for increased constraint.

Market development and industry structure

39. Scottish oysters and mussels are relatively expensive, and it is to the credit of the Scottish Shellfish Marketing Group that they have achieved growth without significantly compromising price through marketing of a high quality high value product. However, the potential for further growth of this high value market is not well understood, and competition is likely to increase from New Zealand, Chile, and other emerging producers such as Vietnam for any part-processed shellfish products. The Scottish shellfish industry might go forward in two main ways:

    - Low, modest growth, retaining a small, premium, high price market;
    - More rapid growth coupled with significant rationalisation and economies of scale, associated in particular with much higher labour productivity.

Neither of these scenarios will be associated with significant growth in jobs in the growing sector, though the latter could be associated with significant growth in jobs in distribution and processing (including value added in local economies).

Section 8 of the report explores in detail the social and economic implications of four scenarios which combine alternative feasible assumptions relating to both the planning environment and market/industry opportunities.

Conclusions

If a more supportive policy environment were to be established under the evolving coastal planning and management regime (under the new Marine Bill), strong growth

[2] SARF research project 053 is currently exploring many of these issues

of the industry (75% within 10 years) might be possible. Rationalisation means that increases in employment will be modest, but such growth will nonetheless help to consolidate communities, economies and transport infrastructure especially in areas such as Shetland, Orkney and the Western Isles.

However, there is a significant danger that the new marine planning and management regime will be no more supportive than that of the past, and indeed may be more restrictive. There is likely to be intense competition for coastal resources (navigation, fishing, recreation, nature conservation, landscape) under a marine spatial planning regime. This, coupled with the on-going problems of freeing up under-utilised sites, may cause stagnation.

Without a strong positive policy steer from the National and Regional Marine Plans, shellfish farming is unlikely to expand significantly in terms of production, and employment levels may actually fall.

Major growth of the industry (in the sense of becoming a major international player) in future seems unlikely. This would only be possible through large scale developments in more exposed locations than those currently occupied by shellfish farmers. This would increase production risks (these are stormy waters) and may raise more critical landscape and/or nature conservation issues. Overall it is unclear that Scotland has comparative advantage in producing on a large scale.

1 Introduction

1.1 Background and context

Legislation relating to the marine environment is in a state of flux and uncertainty, with a large number of policy and legislative initiatives arising from international, European, UK and Scottish sources. There are likely to be significant changes over the next five to ten years which may influence the siting and management of aquaculture.

The purpose of this research is to ensure that all those engaged in the process of policy and legislation development and implementation are able to take full account of the likely social and economic consequences for aquaculture – both positive and negative.

SARF research serves a broad constituency of those concerned with the sustainable aquaculture development, and more specifically the implementation of the vision set down in the renewed Strategic Framework for Scottish Aquaculture:

> *"Scotland should have sustainable, growing, diverse, market led and profitable farmed fish and shellfish industries which promote best practice and provide significant economic and social benefits for their people, while respecting the marine and freshwater environment. The industries will contribute to the overall vision for Scotland's marine environment of "clean, healthy, safe, productive and biologically diverse seas managed to meet the long term needs of nature and people".*

This research should contribute directly to the achievement of that vision.

Throughout Europe, policy and legislation relating to the marine environment has been complex and inconsistent, and perceived by both industry and regulators as inadequate. There are now significant initiatives to improve and rationalise the marine and coastal planning and management framework, mainly by bringing forward a Marine Bill (at UK and at Scotland level). Scotland's Marine Bill has recently been introduced to the Scottish Parliament.

Key features of this Bill include:

- A new marine planning framework to promote better management of increasing levels of marine activity and create a more stable environment for investment;
- The establishment of new Marine Planning Partnerships involving local agencies, communities and stakeholders to ensure a strong local voice;
- A simpler licensing system to reduce the administrative burden and cut bureaucracy thus reducing business costs;
- Improved marine nature and historic conservation to safeguard and protect Scotland's unique habitats, wildlife and marine archaeology and wrecks;
- Full regulation of seal management giving much improved protection for seals and a new comprehensive licence system.

A new marine management organisation to facilitate implementation of the bill – Marine Scotland – was created on April 1st 2009 as a Directorate of the Scottish Government (SG). Its primary purpose is to *"integrate core marine functions involving scientific research, compliance monitoring, policy and management of Scotland's* *seas"*[3]. The organization will combine the functions and resources of the former Scottish Government Marine Directorate, Fisheries Research Services and the Scottish Fisheries Protection Agency. Its mission is "to manage Scotland's seas for prosperity and environmental sustainability - supporting the Scottish Government's overall purpose of sustainable economic growth and our vision for our marine and coastal areas**"**

This over-arching initiative will operate within the context of existing legislation, new legislation emanating from Europe, and commitments under various international Conventions. Of particular relevance are the following:

- The Shellfish Waters Directive (79/923/EEC, revised as 2006/113/EEC)
- The Habitats Directive[4] and designation of Special Areas of Conservation (SACs) (largely complete)
- The Birds Directive[5] and designation of Special Protection Areas (SPAs)(to be designated over the next few years)
- The EU ICZM Recommendation
- The Water Framework Directive
- The National Parks (Scotland) Act 2000 (with provision for the establishment of Coastal and Marine National Parks)
- The Aquaculture and Fisheries Bill 2007
- The OSPAR convention (including a commitment to establish a representative network of marine protected areas (MPAs)
- The 2008 EU Marine Strategy Directive

Over-arching policy statements which are likely to influence the implementation of these various laws and obligations include "Choosing Our Future" (the Scottish Sustainable Development Strategy); SEAS the opportunity (Scottish Executive 2005); "A Strategic framework for Scotland's Marine Environment"; "A Strategic Framework for Scottish Aquaculture"; "A Sea Change" (DEFRA 2007); and the work of the Advisory Group on Marine and Coastal Strategy (AGMACS) and its follow up the Sustainable Seas Task Force. On a more practical level the Scottish Planning Policy (SPP 22 Planning for Fish Farming) offers guidance for Local Authorities. Policy and guidance is also being developed at European and international level. FAO, for example, is currently developing guidance on the "ecosystem approach to aquaculture".

Key issues for the future of aquaculture include:

- The possible impact of the National Marine Plan (developed by Marine Scotland) and Regional Marine Plans (developed by marine planning partnerships);
- The implications of the Town and Country Planning (Marine Fish Farming)(Scotland) Order 2007;
- Several orders;
- The possible impact of further designation under the Natura 2000 series – and in particular "SPAs";
- The possible impact of Nature Conservation, Historic, and Research and Development Marine Protected Areas (MPAs) as allowed for under the new Marine Bill;
- The possible impact of local marine reserves as established by local communities;

[3] http://www.scotland.gov.uk/About/Directorates/Wealthier-and-Fairer/marine-scotland
[4] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora
[5] Council Directive 79/409/EEC on the conservation of wild birds

- The possible impact of any Coastal and Marine National Park;
- The possible impact of measures to ensure “good ecological status” of water bodies under the Water Framework Directive, and “good environmental status” under the Marine Framework Directive, and other associated water quality designations or management responses, such as those under the Shellfish waters Directive.
- The sustainability or growth of the industry’s markets, both domestic and overseas, in the context of competition from overseas suppliers and market prices.

Assessing social and economic impacts involves both quantifying the employment and income generated by aquaculture and considering qualitative dimensions – in particular, the sector’s importance in sustaining rural communities in the Highlands and Islands.

Aspects of impact include:

- Direct employment provided by farms for proprietors and staff (often including family members).
- Indirect employment generated through purchases of supplies and services, some from local businesses.
- Induced employment generated through the spending of proprietors and staff of the farms and their suppliers in the local and regional economy.
- The survival of particular businesses in a local area through the contribution of income from their supplies to fish and shellfish farms (and their staff and visitors) to annual turnover. The typical small business in a rural area is only marginally viable.
- The ability of farm owning families and their staff to obtain part-time income from aquaculture enterprise which complements other part-time employment (including crofting agriculture), and enables them to continue to live in relatively remote and rural areas or move to live in these areas. In other cases, aquaculture can provide full time work opportunities in areas otherwise dependent on seasonal tourism.
- The population impact of farms in particular rural areas that lack other employment opportunities, which helps to sustain important local services (public and private sector).
- The wider value of the infrastructure required for aquaculture to the local area, for example boat landing and berthing facilities.
- The role played by aquaculture staff in the social life of local communities, voluntary emergency services, etc. Studies have shown these impacts as significant in relatively sparsely populated rural areas.

Data for quantifying employment and income impact within an area is often inadequate without local *ad-hoc* survey (which requires business co-operation), and it is generally necessary to rely on official statistics and regionally generated estimates, which can be very approximate. Local monitoring is required to identify short term trends in an area.

Quantifying future impacts is even more difficult with any precision and will depend on:

- National and international supply and price trends.
- The financial and physical capacity of farmers to keep up with industry productivity improvements.
- The importance of the constraints that are considered in this report.

- The willingness of farmers to continue working in the industry when conditions become difficult or variable, or of younger family members to take on the business when owners retire.
- The availability of grants and other support for new investment, marketing (particularly co-operative), training, etc.
- Other employment opportunities that might emerge in particular areas that pay more than aquaculture or offer more amenable working conditions.
- The attractiveness of the sector to new entrants, and the financial capacity of potential new entrants – both for the initial investment in sites, plant and equipment and to finance the cash flow implications of the growth cycle.
- Labour productivity improvements, i.e. the extent to which the ratio of full-time equivalent employment to tonnage produced reduces – especially relevant where increased output is achieved through on-farm productivity improvements, rationalisation within the industry, and / or faster relative growth by higher productivity larger producers.

The socio-economic impacts from the different future scenarios considered in this report are therefore partly speculative – although informed by a broad range of stakeholder perspectives and best practice information.

1.2 Research approach and method

The objectives of this research were:

1. To assess the degree to which commercial aquaculture is currently constrained, in terms of location, management or both, by existing legislation and designation; and to assess the probable social and economic effects of any such constraints
2. To gain an informed insight into the scope and nature of any spatial or management restrictions on commercial aquaculture likely to arise in future, under existing or likely new legislation
3. To gain an informed insight into the likely development of commercial aquaculture over the next 10 years, in the absence of any change to the regulatory *status quo* – in terms of type, location, production, income and employment
4. To generate a set of alternative scenarios which take account of likely future trends in aquaculture development; likely changes in the regulatory environment; and likely responses of the industry.
5. To assess the social and economic characteristics of each scenario generated under 4, and compare with the base scenarios generated under 3, to gain an overall assessment of likely impact.
6. To identify areas of possible negative/positive impact that might be mitigated/promoted through guidance/protocols for the implementation of existing legislation, or through the design of likely future legislation.

In practice the research has been undertaken in three phases. The **first phase** (from Spring 2008 to October 2008) sought to establish the social and economic impacts of current regulation and management through review of available documentation, and in-depth (semi-structured) interviews with fish and shellfish farmers, and others closely associated with the industry. This work is summarised in Appendix 1 (Working Paper 1).

The **second phase** was focused around a workshop in which the industry, government and agencies were brought together to discuss and prioritise existing constraints on the industry and speculate on possible futures. This work is summarized in the workshop report (Appendix 2).

In practice the focus of research in phases 1 and 2 was primarily (though not exclusively) on salmon farming, reflecting its commercial importance, the availability of information, and the response from the industry.

Following this workshop concern was expressed that our work overlapped significantly with on-going government-industry initiatives, such as the work of the Expert Working Group on Siting Aquaculture Facilities in Scotland (EWGS), and other bilateral initiatives between the salmon farming industry and government. A decision was taken by the SARF project steering group to refocus the research on shellfish farming.

Phase 3 comprised 4 sub-components:

1. In depth discussions with two shellfish farmers in Argyll to help establish the main supply and demand factors affecting mussel and oyster farming. One of these is the current chair of the Association of Scottish Shellfish Growers, and therefore well placed to offer an industry perspective.
2. Structured telephone interviews with 23 shellfish farmers to gather information on constraints and opportunities for shellfish farm development, and the relative importance or otherwise of designation, regulation, planning and other factors (checklist at annex 1).
3. Broad analysis of the current economic structure and socio-economic characteristics of the shellfish industry in Scotland and its possible shape in future, taking into account the various constraints and opportunities identified in the other study components, and future government policy.

This report relates mainly to phase 3, although we incorporate the conclusions from phases 1 and 2 in our discussion and recommendations.

2 Current status and potential of the shellfish farming industry in Scotland

2.1 Technology

2.1.1 Mussel farming

Mussel farming is dependent upon natural spatfall, collected on coiled ropes at depths between 0 and 3m. There is a small market in “spatted ropes” but most growers collect their own.

Floated long lines, typically around 200m in length are set roughly 50m apart with 6-8m long “dropper ropes” set ½ to 1m apart in water typically more than 8m in depth. Over a grow-out period of two to three years a yield of 6kg /m of dropper rope is achievable (Holmyard 2008; Epsilon/SEAFISH 2002), corresponding to roughly 5 tonnes per ha per year – though yields of over 10t/ha/yr may be achievable in ideal conditions. Productivity and growth depends greatly on the availability and quality of natural food – primarily algae. Thinning of mussels and resetting using a net tube is done by some growers to get better growth, size and quality.

Predation can be a problem. Starfish settle out of the plankton on to ropes and can cause significant damage. Manual removal or periodic drying of ropes in the shade is required. In some areas, especially the west coast of Scotland, eider ducks can be a major problem and are capable of completely stripping a line of mussels – mainly in the size range 10-25 mm, but up to 50 mm. Damage from Eiders tends to be seasonal – mainly in spring and autumn. The preferred method of deterrence is “chasing with a boat”. Goldeneye duck may also be a local problem.

During on-growing fouling can be a significant problem in some locations. The ropes/mussels are ideal settling platforms for a range of creatures including barnacles, tubeworms, sea squirts, sponges, anemones algae and hydroids. Some are difficult to remove and affect marketability. All can be a problem in terms of weight on the ropes, reduced growth, and handling difficulties. Some trials with Spanish style rafts on the west coast sank as a result of fouling.

Mussel flesh quality is poor after spawning – typically in the late spring, although changes in food supply, salinity, wave action and temperature can all trigger spawning.

Mussels grow well in sheltered water with good water exchange. Rough seas can lead to loss of significant proportion of settlement, and poor water exchange will lead to slow growth.

Maintenance and harvesting can be done from a relatively small boat for small scale operations, but larger purpose built/fitted vessels are increasingly used for harvesting. The main processes include stripping from rope, de-clumping, grading and cleaning. Most mussels are also stored for 48 hours in a depuration plant (irrespective of water classification). Chilled transport is then required to get the product to market - mainly Belshill, Glasgow, for Scottish production.

2.2 Other Species

Oysters are usually grown in plastic trays or bags, usually on racks, at the bottom of or just below the tidal range. Growout takes 2 to 4 years. Details of cultivation techniques can be found in the “hyperbooks” produced by Seafish (Epsilon/Seafish Industry Authority).

There is insignificant production of scallop at the present time so technology will not be described in detail here. Details can again be found in Sea Fish Industry Authority hyperbooks. They are typically grown in pearl nets, lantern nets or by “ear hanging”. Princess scallop take 18 months growout, queens 2 to 2.5 years and King scallops 3-5 years.

2.3 Historic development of the industry

2.3.1 General

The shellfish farming industry in Scotland has struggled with poor or inconsistent growth over several decades, although mussel farming has shown significant growth since the millennium, mainly in Shetland.

The FRS (2007) survey of shellfish farms in Scotland showed that 170 registered companies farmed 336 active sites, of which 157 (47%) placed shellfish on the market. Seventy of these farms recorded no sales during that year. Total estimated production in 2007 was around 5,100tonnes, of which the bulk was mussels at 4,850 tonnes.

Mussel production is concentrated particularly in Shetland (2,612tonnes – 51% of the total) and the former region of Strathclyde (1,324 tonnes). Oysters (mainly Pacific oyster) are grown mainly in Strathclyde (around 3million shell, or 193tonnes) and a small amount (175,000 shell) in Highland. Around 440,000 scallops are produced (mainly Queen) in Strathclyde. Figure 1 offers a diagrammatic representation of the relative scale of production of different species in different regions of Scotland.

Mussel farming has shown a steady increase in recent years from just over 1,000 tonnes in 1998 to nearly 5,000 tonnes in 2007, mainly driven by expansion in Shetland, and a small increase in the Western Isles . Production of mussels from Strathclyde and Highland however declined slightly between 2001 and 2007.

Production of oysters also declined from around 287tonnes in 2001 to 230tonnes in 2007. Production of Queen Scallops (restricted to Highland and Strathclyde) also declined, from around 47 tonnes in 2001 to approximately 15 tonnes in 2007. It is thought that the latter is related mainly to poor spat settlement and survival (FRS).

Figure 1. Species trends for Scottish shellfish production

Trends in Scottish Shellfish Production for the Table (Key species: 1992 - 2007)

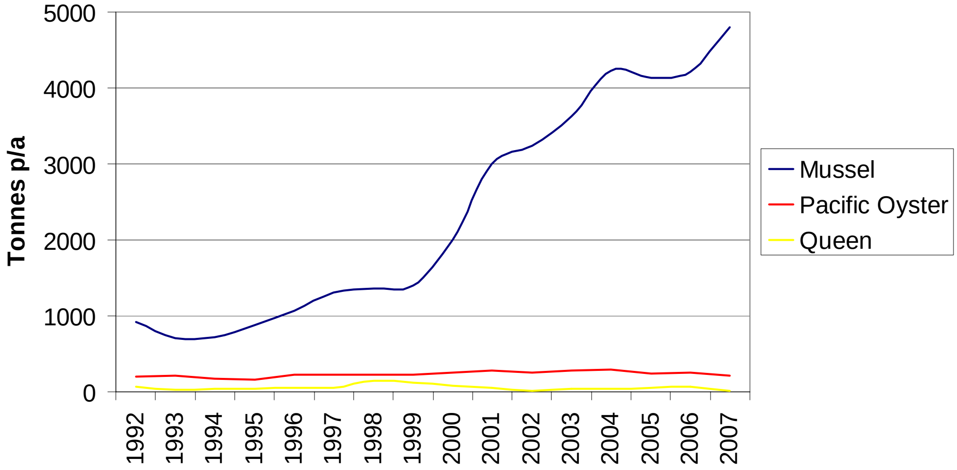


Figure 2: Regional distribution of shellfish companies

Regional distribution of active shellfish farming companies

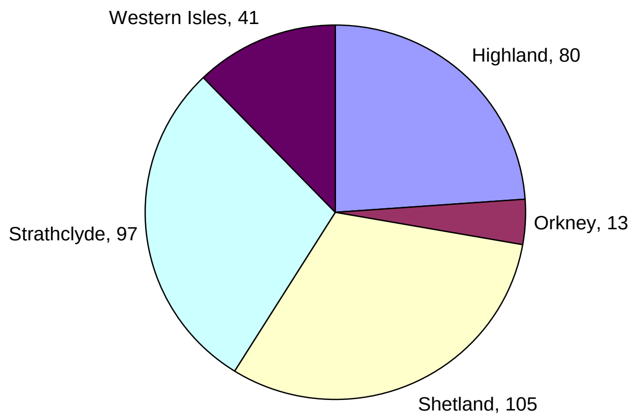
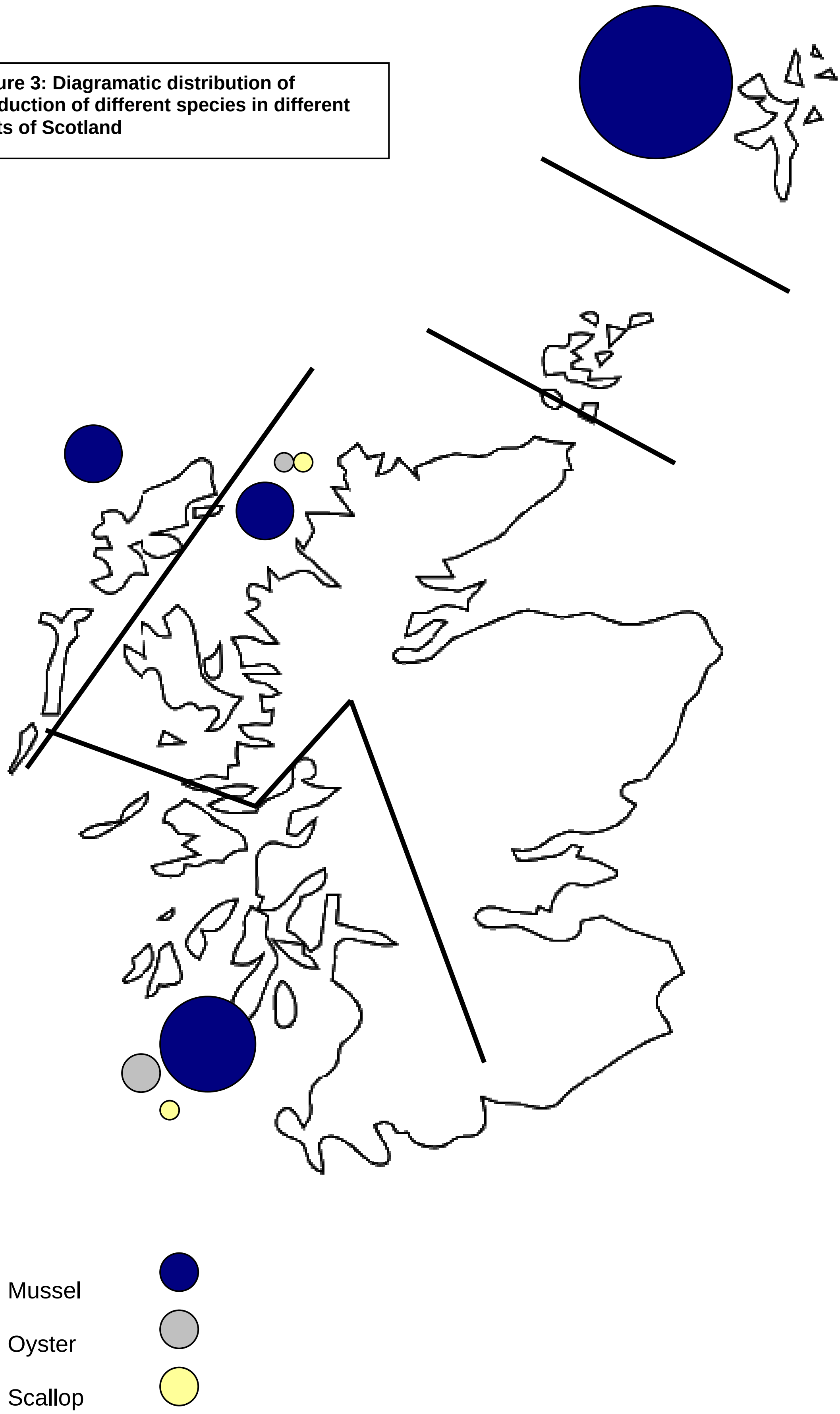


Figure 3: Diagramatic distribution of production of different species in different parts of Scotland



2.3.2 Industry structure

In 2007 there were 495 registered shellfish producing companies in Scotland of which 170 were recorded as “active”. Although the total number of registered companies has increased from 377 in 1998 to 495 in 2007 (31% increase), the total number of *active* companies has remained relatively steady over the last decade. It is also notable that Highland has more than 80 “active” companies, yet managed to produce only 450tonnes of mussels (excluding the Tain dredge fishery) and 175,000 (table) oysters (410,000 for on-growing).

Average production per registered company is very low. Most registered companies are therefore either completely inactive, or producing very small volumes on a “hobby” or lifestyle basis.

In reality production is dominated by relatively few medium sized companies as shown in Figures 4 and 5. Seventeen companies producing more than 100 tonnes of mussels in 2007 comprised 71% of the total mussel production in Scotland. It may be assumed that companies producing less than 40-50tonnes are effectively “hobby”/retirement or part time enterprises. An even more extreme pattern emerges in the case of oysters – perhaps because small quantities of seed can be purchased relatively easily, allowing very small scale enterprises to operate. Seven companies produced more than 100,000 Pacific oysters, accounting for 80% of the Scottish total.

In practice most significant shellfish producers market through the Scottish Shellfish Marketing Group (SSMG) which has a major central distribution and processing centre in Belshill Glasgow. At the present time (Spring 2009) SSMG handles 3,000-3,500 tonnes from 19 member mussel farmers operating 57 sites. They also handle 1.2 million oysters from 6 member oyster farmers operating have 13-14 sites. This represents more than 50% of mussel production and somewhat less than 50% of oyster production. Very small operations either market product themselves, direct to restaurants or supply local hotels and other small outlets.

Figure 4. Size distribution of mussel farms in Scotland (data from FRS)

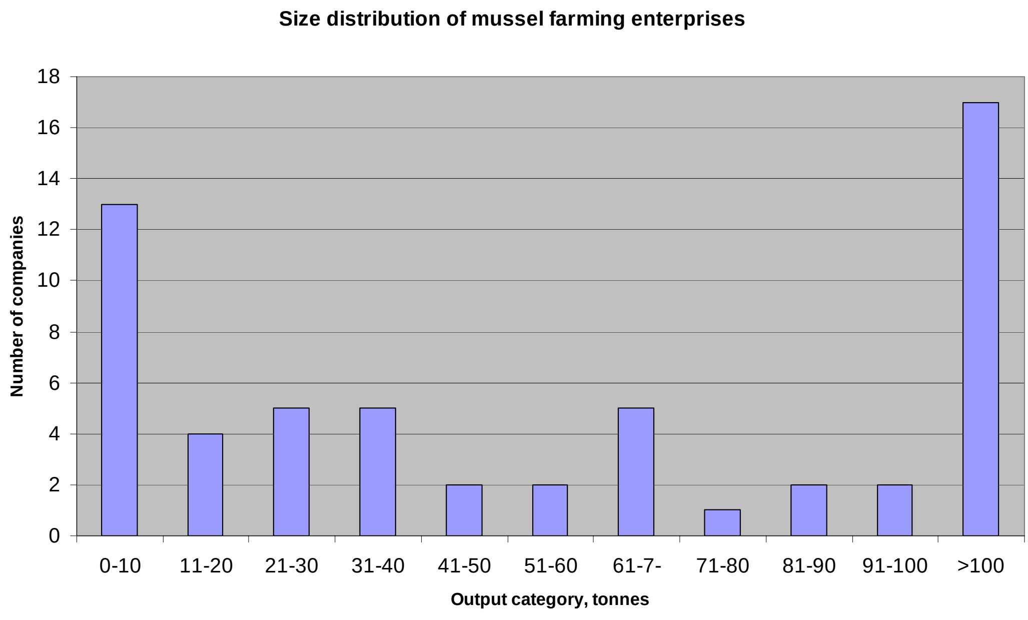
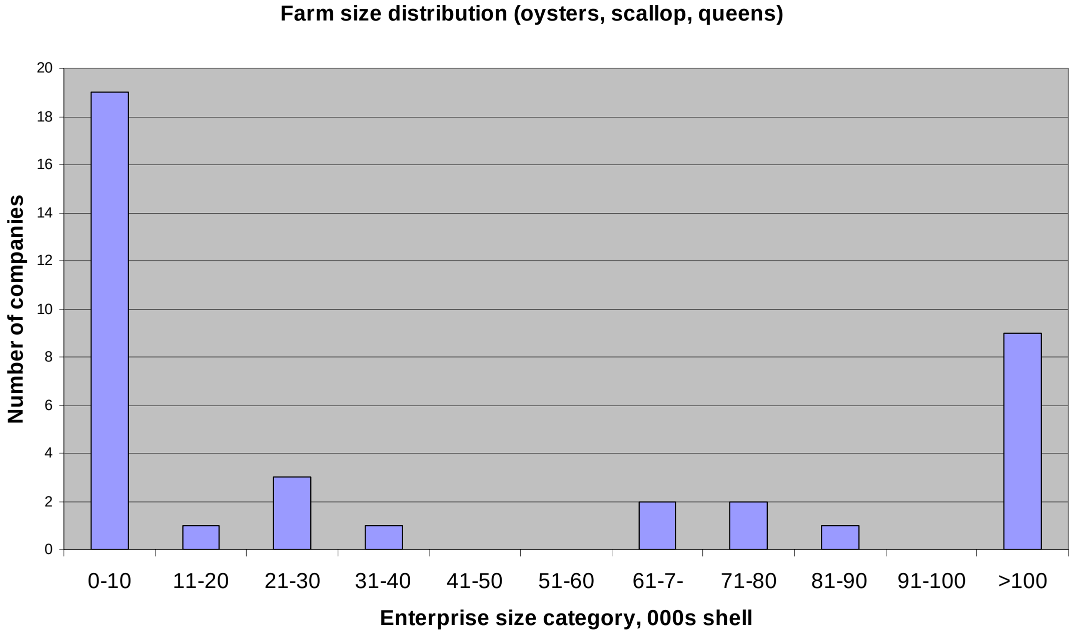


Figure 5. Size distribution of oyster scallop and queen farms in Scotland (data from FRS)



2.3.3 Rest of the UK

England produces a small amount of mussels, pacific oyster and native oyster – 2,000 to 4,000 tonnes in all. Wales produces 10-15,000t mussels mainly from a relaying operation in the Menai Straits.

Hatchery production in the UK is limited – mainly Pacific Oyster (Barrow in Furness and Guernsey), and a smattering of native oyster.

2.4 Social and economic benefit

2.4.1 Income, value added and profitability

Shellfish farming is a low input/high labour operation and, as such, contrasts with finfish farming where feed inputs represent the major proportion of costs. This also means that shellfish farming generates a good deal of direct value added per £ of sales revenue. Profitability varies enormously reflecting the scale of enterprise and the way in which costs are accounted and allocated – especially the manner in which family labour is charged on small enterprises. It seems clear however that in the case of mussels, for every kg sold, at least 50p can be allocated to labour and/or profit.

Transportation also represents a significant proportion (>20p/kg in the case of Shetland) of delivered value to Belshill in Glasgow, representing an important contribution to local freight and ferry companies.

The total first hand value of farmed shellfish in Scotland in 2007 was estimated by FRS at approximately £5.1million, comprising Mussel: £4.3 million, Pacific oyster: £0.7 million, Native oyster: £0.1 million , Scallop: £0.02 million and Queen: £0.02

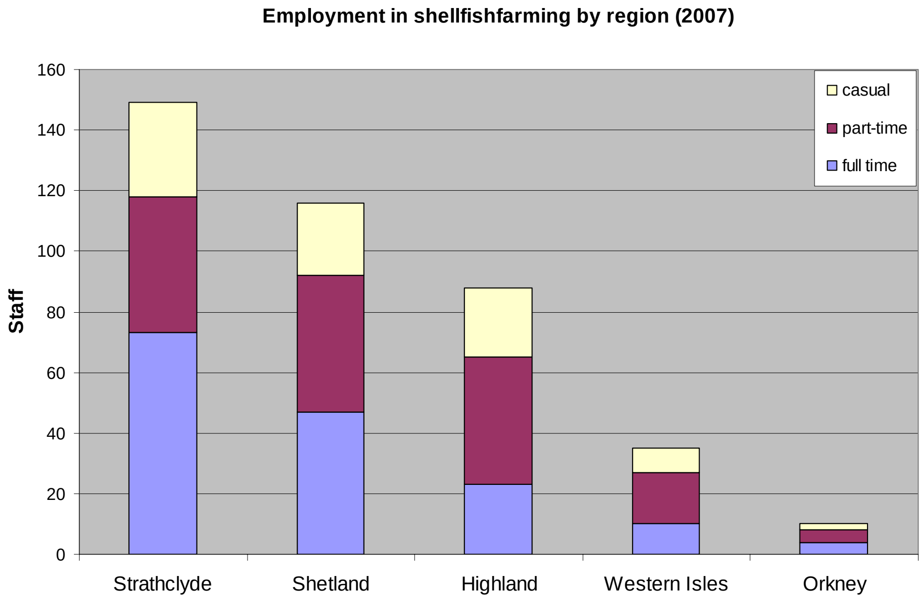
million. Value delivered to Belshill and other centres (e.g. Billingsgate) is likely to be in excess of £6.5m

2.4.2 Social issues

In national terms this is a very small industry. However, examination of the map suggests that it may be significant in terms of business activity (albeit modest) in many of the most remote West Coast and island locations.

According to the FRS 2007 Survey there were approximately 157 full time, 153 part time and 88 casual staff employed in shellfish farming. The breakdown by region is shown in Figure 6. It is perhaps notable that though Shetland is now much the largest producer, employment remains lower than for the rather more diverse and smaller scale operations in Strathclyde region.

Figure 6: Employment in shellfish farming by region



An illustration of the way in which smaller scale shellfish farming can work in more remote parts of the west coast is provided in Box 1

Box 1: Fitting into the local economy – Loch Inchard

In June 2000 there were a total of six leases for mussel culture within inner Loch Inchard: five longline sites and one raft site (see figure 4). These leases were held by five mussel farmers who work together by subcontracting the work to one Kinlochbervie based company, which undertakes all of the site management, harvesting, depuration and marketing. Many of the mussel farmers are crofters with land adjacent to the loch and shellfish farming provides valuable additional income.

Loch Inchard Aquaculture Framework Plan. Highland Council

Box 2 shows three other aspects: firstly that the contribution of shellfish is often difficult to tease out; secondly that it is seen in many parts of Scotland as a relatively minor economic activity compared with tourism; but thirdly…that it has the advantage of being less seasonal than tourism.

Box 2: Economy of a west coast sea loch

"The presence of the fish farms supports the local economy through local purchases made by the company and its employees. For example, the filling station in Strontian benefits from the purchase of fuel for vehicles and boats, and local tradesmen benefit from the need to maintain shore bases. Shore bases also generate rental income for local estates. *Equivalent figures for shellfish farming* tend to be harder to come by. At the time of writing there is only one site in the loch which is actively producing shellfish".

"Other key sources of employment in the area include tourism, crofting, shellfish processing and forestry. Tourism represents the major income to the area, and includes the sporting estates, hotels, camping and caravan sites, and bed & breakfast establishments.
This source of income is very seasonal in nature with a number of opportunities for casual employment during peak periods. Exact numbers of visitors for specific areas are difficult to assess but information for the year 2000 from VisitScotland indicates that there are 15-20,000 visitors a year to Ardnamurchan, with 88% visiting between April and September."

From Loch Sunart Aquaculture Framework Plan. Highland Council

2.5 The Market

Most shellfish, including scallops, come from capture fisheries. However, a large proportion of mussels and oysters come from farmed production. Farmed shellfish generally have a higher value than those from the capture fishery, tending to be of consistent size and quality, with little damage or breakage.

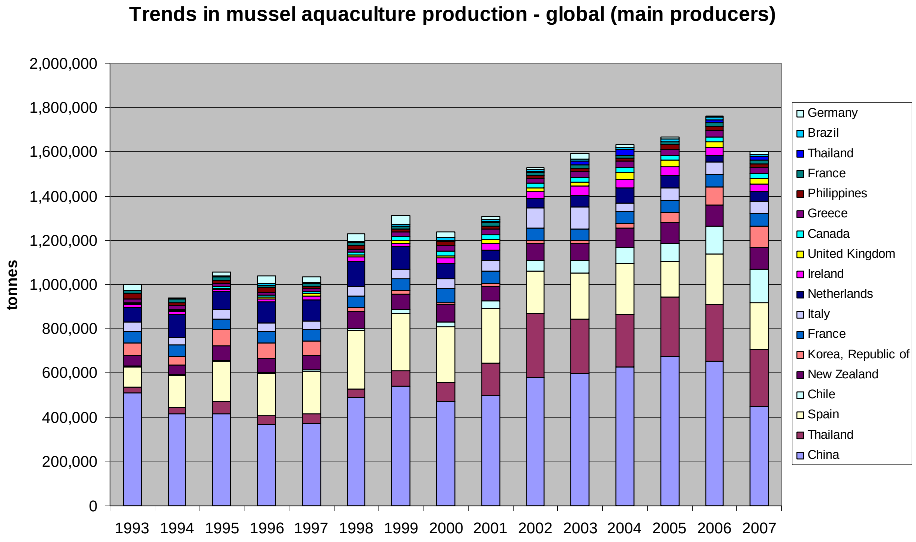
2.5.1 Mussels

Global supply and demand

Mussel production is now dominated by aquaculture – comprising roughly 90% of the total (Josupeit 2005)

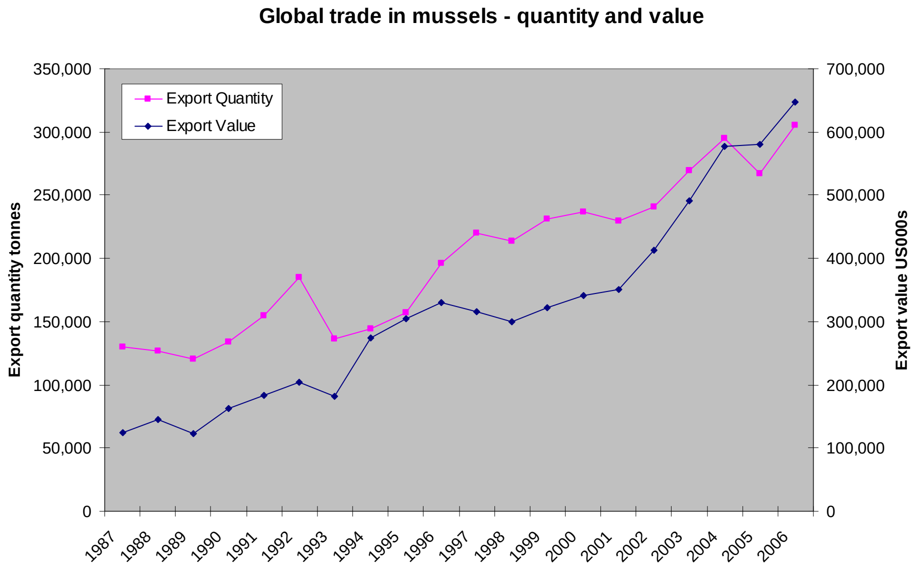
Globally mussel production is dominated by China, Thailand and Spain. China production has reduced in recent years, mainly related to intense competition for the use of coastal resources. Production from Thailand (mainly of green mussel, *Perna viridis*) increased rapidly in the early 2000s but appears to have stabilized. Production in Chile has increased rapidly in recent years and expansion is set to continue (Intrafish 2007). The UK is a relatively small producer (25,000tonnes in 2007) though ranking relatively high at 11th in global terms.

Figure 7: Global mussel production



Globally, exports have increased rapidly over the last decade, and the unit value of these exports has also increased steadily, reflecting strong demand, especially since 2001

Figure 8: Mussels: demand and supply



Note: these figures are not inflation adjusted

In practice to date, the dominance of China in terms of production has had relatively little effect on the European market which is largely self sufficient. This may change as the proportion of product with longer shelf life increases.

Trade

At global level there are several notable features and trends:

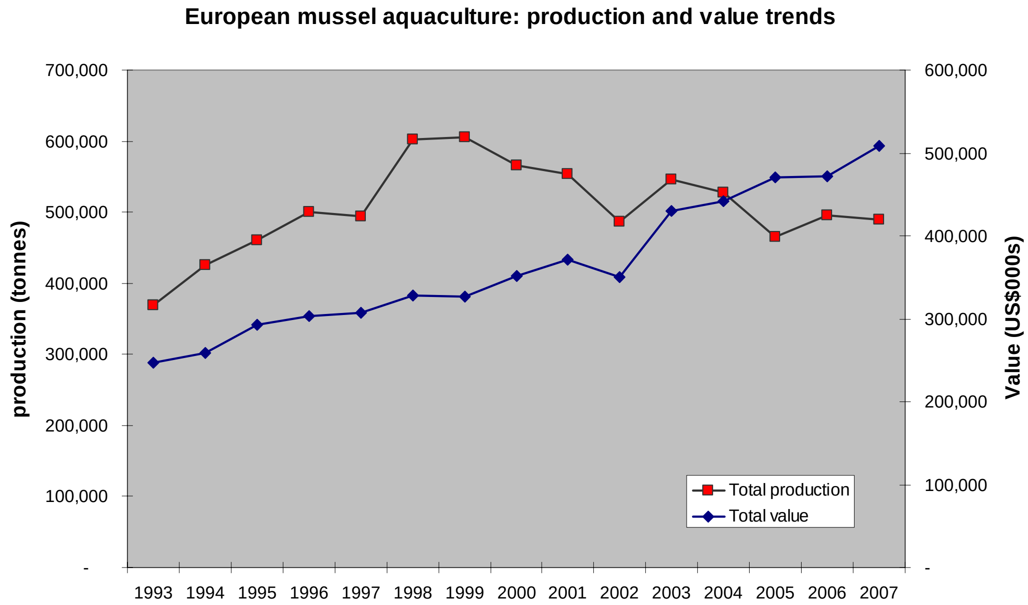
- Netherlands and Spain continue to dominate as the major exporters of live fresh mussels (41,000tonnes and 31,000 tonnes respectively in 2006)

- The steady rise of New Zealand as a major world supplier of frozen mussel meat, exporting 34,000tonnes in 2006
- The rapid increase in exports of processed mussels from Vietnam from insignificant before 2000 to 16,000 tonnes in 2006
- Rapid increase in exports from Chile

2.5.2 European supply and demand

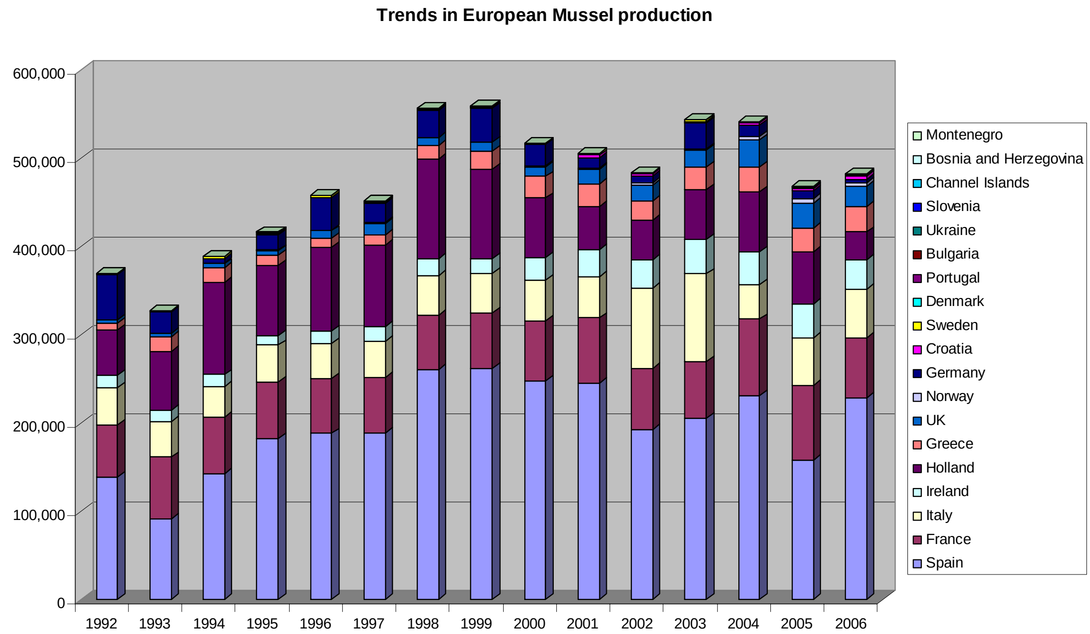
Production
This relatively positive global picture is reflected in the value of mussel production from aquaculture in Europe. Although total production has fallen in recent years, total value has increased steadily, reflecting significant price increases through to 2007, although it appears that prices have flattened out in the last year.

Figure 9



Europe is both significant producer and consumer. European mussel production as a whole stood at just under 500,000tonnes in 2006. Production is dominated by Spain (producing *Mytilus galloprovincialis* closely related to our blue mussel *M. edulis)*, mainly from raft production, France (producing on posts as well as long lines), and Italy. Ireland, Holland, Greece and the UK all produce moderate quantities. Scottish production, at around 5,000 tonnes therefore represents a mere 1% of the European total. The UK as a whole produced 24,000tonnes (around 5%) in 2006, with the bulk of this coming from the Menai Straits (a laid fishery).

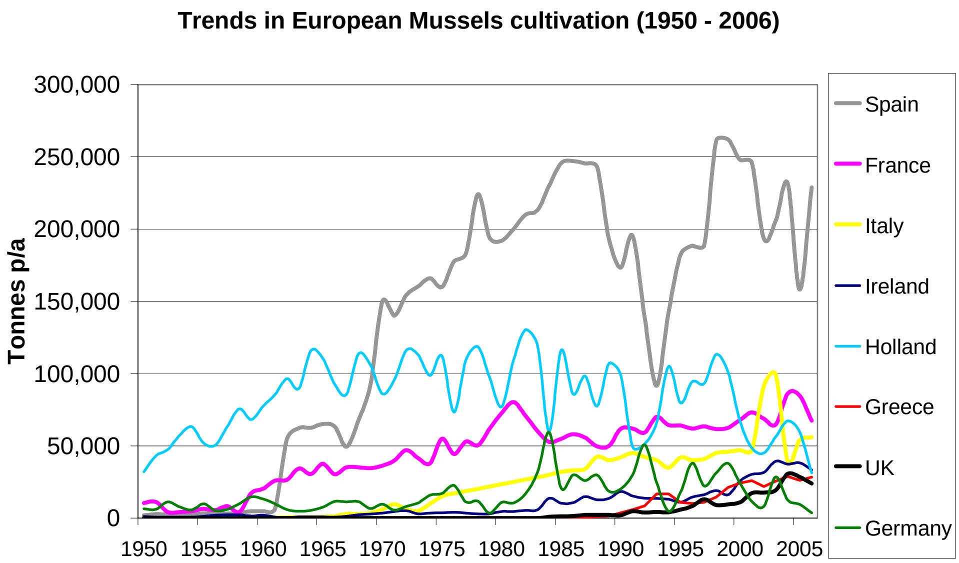
Figure 10



Overall production has declined in recent years from a peak in 1999 (Figure 7) mainly due to the decline in production from Holland – previously a major producer – and to a lesser extent Spain. There have been significant production problems on the continent related to both toxic algae and parasitic disease. Given the generally increasing demand for seafood throughout this period, this suggests a market opportunity for Scotland.

In practice, production in most countries varies significantly from year to year, reflecting variation in spat fall, problems with toxic plankton, and growth rate variation. The collapse of production in Spain in the early 90's was due mainly to problems with toxic algae.

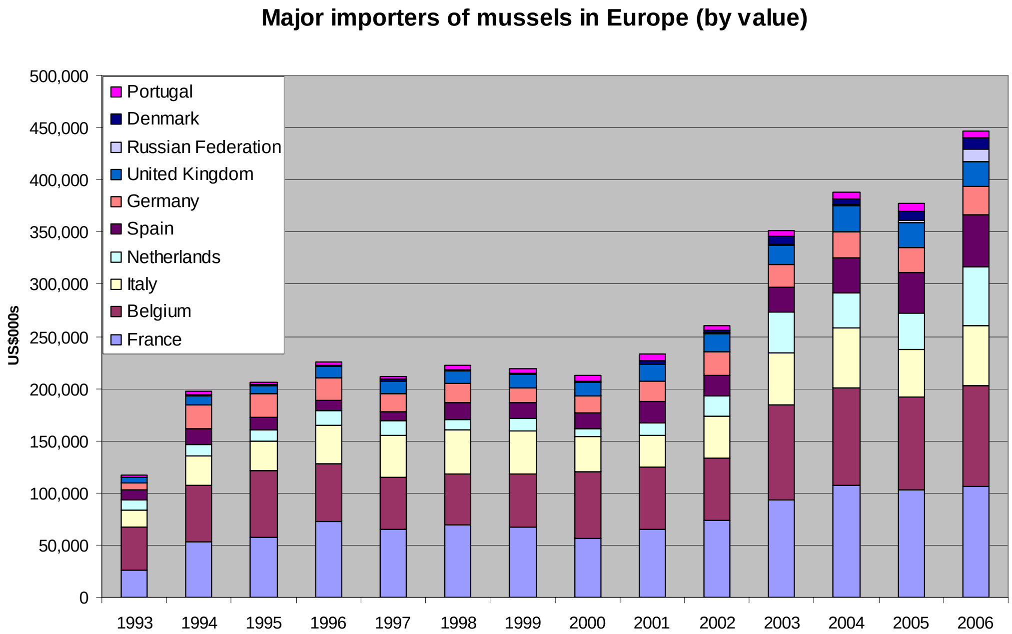
Figure 11



Markets and trade

Europe is largely self sufficient in mussels, with more than 80% of imports supplied by the EU 25 (Ranninger 2005). Denmark, Spain, Ireland and Netherlands are all significant exporters of mussels. France and Belgium are the main importers, with Italy, Netherlands, Spain and Germany also important. The UK itself is not insignificant: with imports of mussels worth US$24million in 2006.

Figure 12



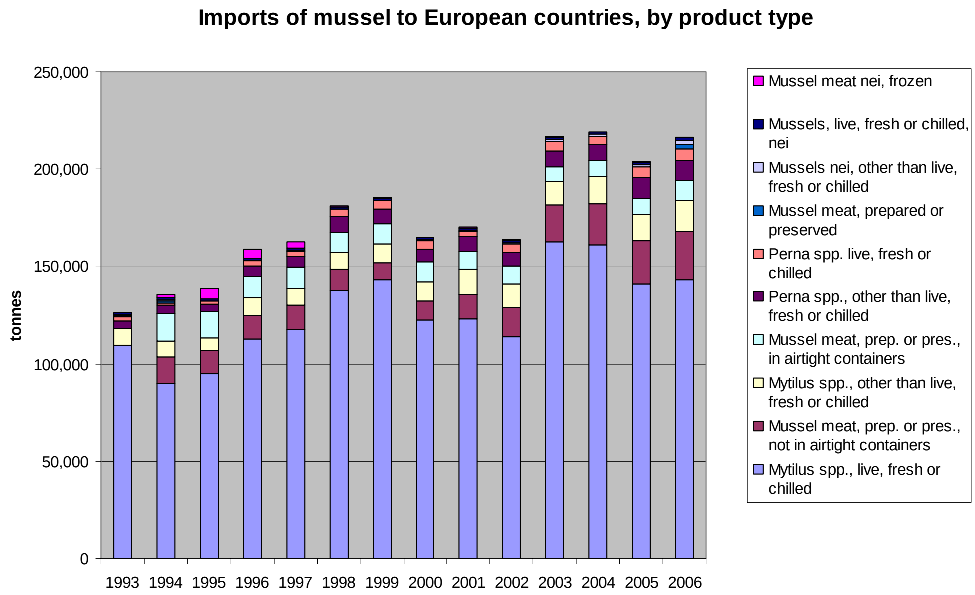
France is the biggest importer of fresh live mussels (39,000tonnes in 2006) with Belgium, Netherlands and Italy all importing more than 20,000 tonnes. The UK imported less than 3,000 tonnes. France is also a significant importer of preserved product, as are Italy and Spain.

It is notable that despite the downturn in European supply the value of imports has continued to increase, reflecting strong demand and increased imports from outwith Europe. This is illustrated further below.

Products.

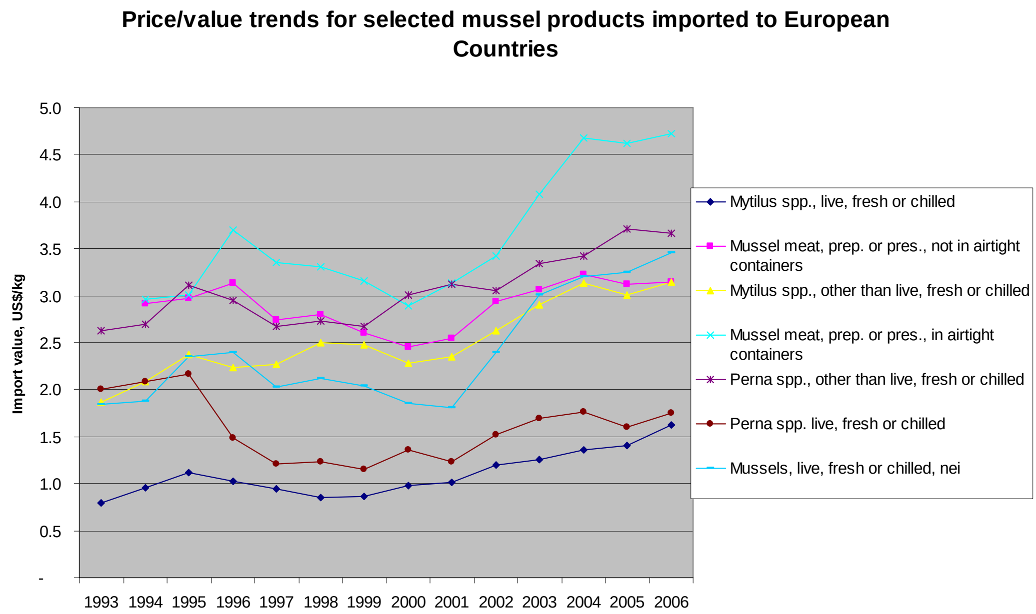
Trends in terms of quantities of different product imported to European countries is shown in figure 13.

Figure 13



By far the largest market is for live, fresh or chilled blue mussel (*Mytilus*). In recent years there has been a small market also for fresh live green mussel (*Perna* sp.) – probably imported from New Zealand or Thailand where this is the main genus cultured. The market for processed product, though relatively small, has shown steady growth in recent years. New Zealand, Ireland and Chile have begun to produce significant quantities of frozen mussel. Canned product, mainly from Spain, Denmark, Netherlands and Peru has also increased in recent years.

Figure 14



Price trends (not adjusted for inflation) are generally positive for all products, especially for some preserved products. A significant development over the last decade has been increased production of lightly processed vacuum packed products – which may also be flash frozen. These range from simple steamed products in the shell to a range of more complex dishes smoked or unsmoked in a variety of sauces and marinades. This has become an important market for Scottish mussels sold through Scottish Shellfish Marketing Group, but is also targeted by expanding exporters such as Chile, New Zealand and possibly Vietnam.

There have been relatively few in depth analyses of the mussel market over the last decade. However, fresh mussels typically suffer from significant price fluctuations related to short term price elasticity (price falls rapidly with increased supply) and price inelastic supply (supply adjusts very slowly to changes in price).

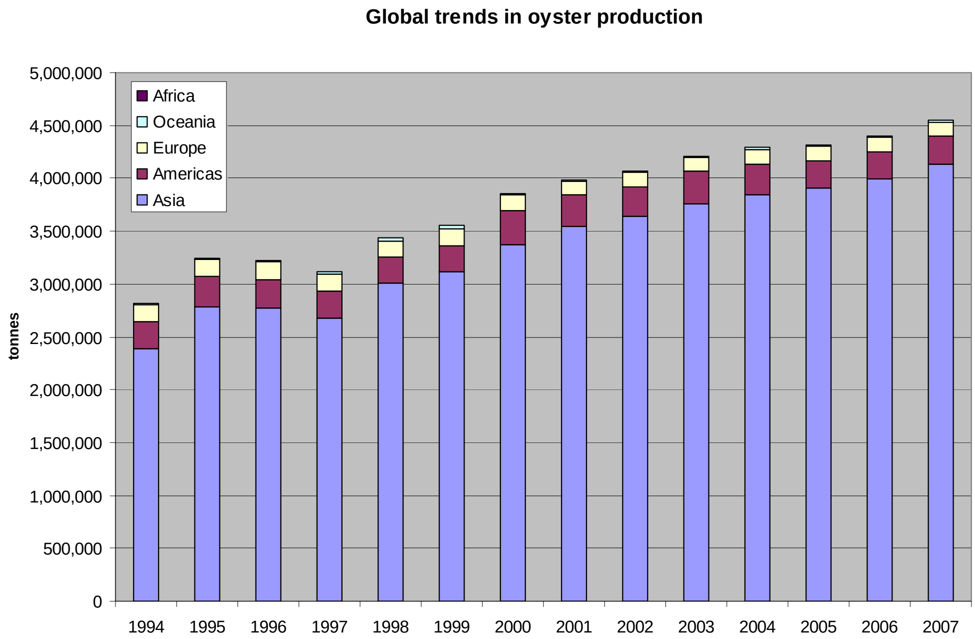
Last year saw modest falls in the price of mussels to producers in Scotland, suggesting that the price is relatively sensitive to the prevailing economic climate.

2.5.3 Oysters

Global context

Globally oyster production is dominated by Asia, and particularly China, where production continues to increase. Production from the Americas and Europe is far less, and declining slightly.

Figure 15



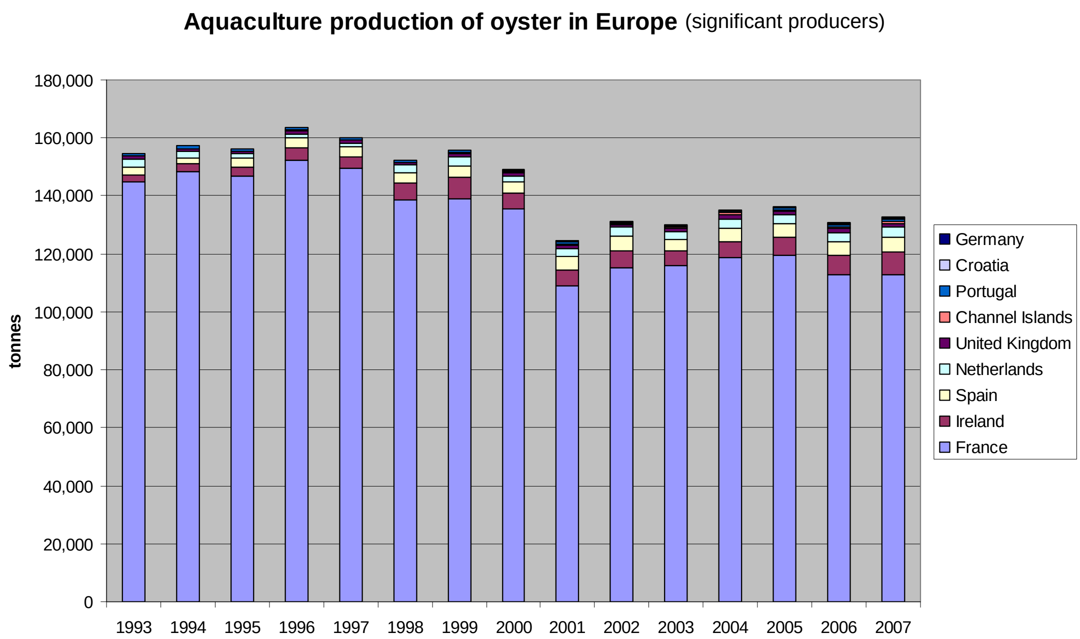
In practice the market is dominated by fresh live product and the European market is therefore relatively isolated from the Asian market. This isolation will break down to some extent should there be a significant increase in processed product.

Europe

Production

Total oyster production (fishery and aquaculture) amounted to 136,000tonnes in 2007, down from around 160,000 tonnes in the early ‘80s. Production is almost exclusively from aquaculture, with France being by far the most important producer. Ireland and Spain produce modest amounts (26,000 tonnes and 14,000 tonnes respectively in 2007). The UK produced 9,500 tonnes in 2007. Only Ireland has shown relatively steady growth over the last two decades (Figure 16).

Figure 16.



There has been a modest increase in the unit value of farmed oysters in Europe since the millennium, as illustrated in Figure 17 (although this is not inflation adjusted) and this broadly corresponds to a fall in production at the end of the '90s.

Europe is largely self-sufficient in oysters, although a significant proportion of production is traded *within* Europe. Imports to European countries (mainly from other European countries) have increased steadily in recent years (Figure 18). Unit value of imports appears to have remained remarkably stable at a little over \$3/kg - although declining slightly if adjusted for inflation.

Figure 17

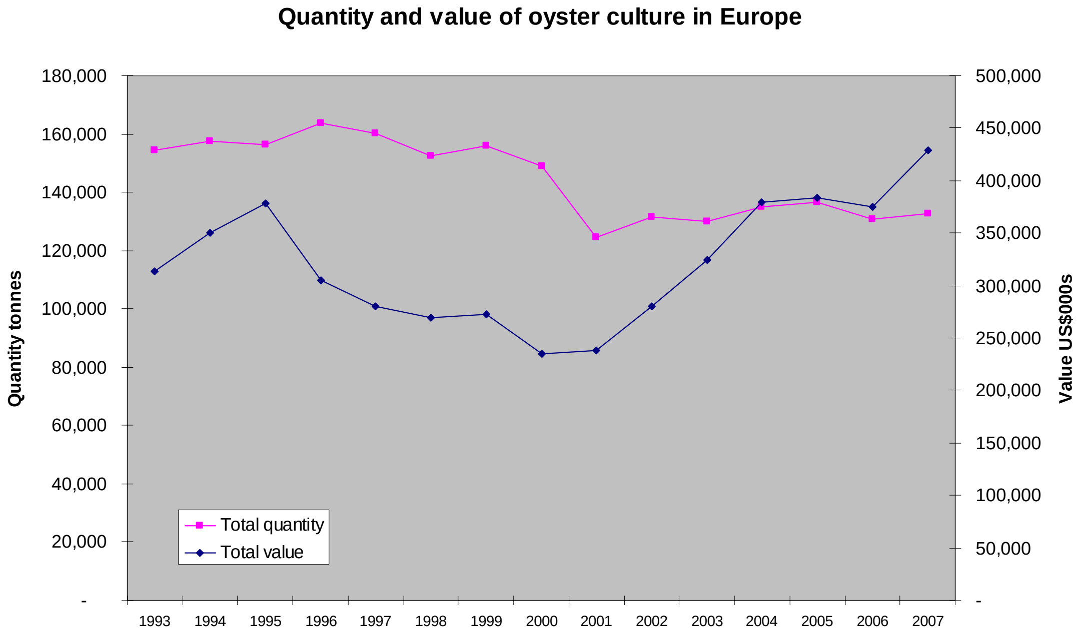
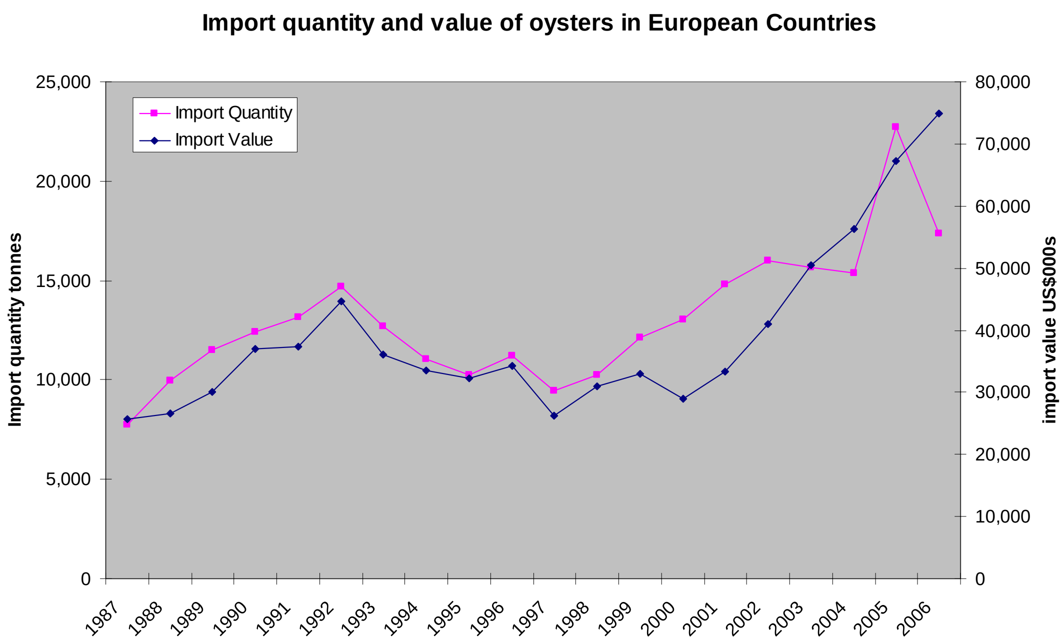
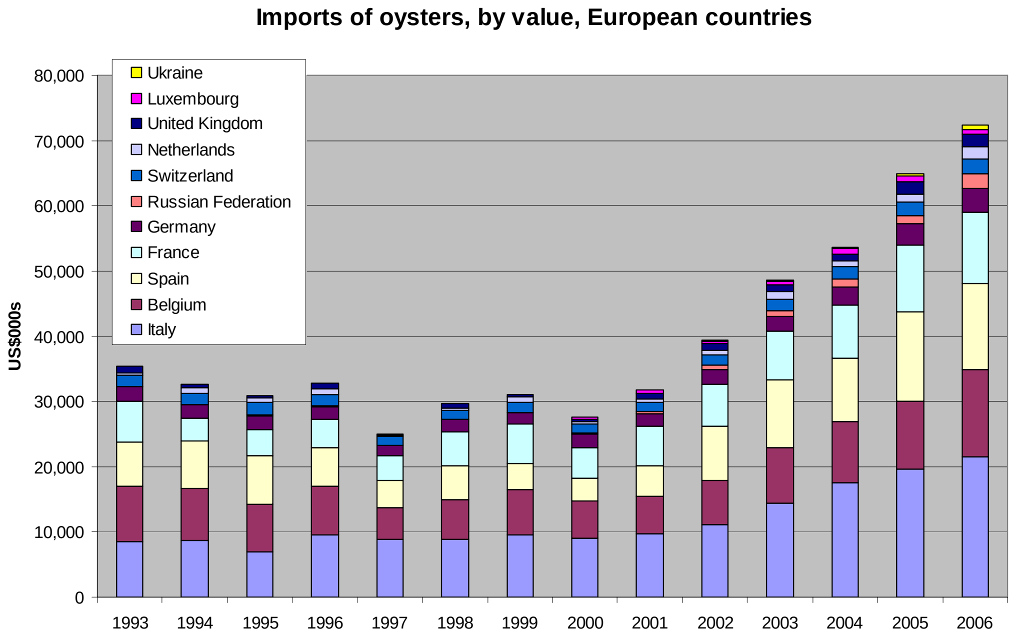


Figure 18



The major importers are Italy, Belgium, Spain and France, with smaller but increasing quantities going to Germany and the Russian Federation.

Figure 19



Imports are dominated by live, fresh or chilled product. There is insignificant trade in processed product. European imports of oysters stand at around 20,000tonnes valued at 70million.

Overall, this a much smaller market and there is less buoyant demand for oysters.

2.5.4 Future outlook

It is clear that in times of economic growth there has been a tendency for demand for farmed shellfish – and especially mussels and oyster - to grow. When recovery from the current economic down turn comes, we can therefore expect significant growth in the mussel and oyster markets. This will be both for fresh mussels for the restaurant trade and through an increasing market for high quality processed products destined mainly for the supermarket chains. Since Scotland already has a track record in the latter, it appears to be well placed to increase supply to meet this demand.

However, the recent growth of mussel farming in Shetland (rapid in percentage terms but insignificant in terms of European trade) has been largely built on the back of relatively higher prices for Scottish product mainly in the relatively small UK market and niche European markets. Competition is likely to intensify sharply for all prepared and processed products from countries such as New Zealand, and emerging exporters such as Chile and Vietnam. It is unclear whether such a large premium can be maintained, and the shift of TESCO from Scottish produced to Chilean produced prepared mussels does not bode well. Production costs are undoubtedly lower in these countries – in New Zealand because of scale, mechanisation, and the high growth rate of the green mussel; in Chile because of scale and low labour costs. The UK market for fresh chilled mussels is unlikely to grow rapidly and can, in part, be met through production from lower cost seabed laying methods. Any major expansion of mussel farming in Scotland is only likely to be viable if costs can be significantly reduced – i.e. through substantial increases in production scale and distribution/marketing efficiencies.

The market for oysters is rather different and it depends much more on strong demand from the UK and countries such as France for a high quality live product. Given some production difficulties in France in recent years there is undoubtedly a significant opportunity, as evidenced by the interest of some French companies in developing oyster farms in Scotland. However, as with mussels a competitive price in this bigger market will require production on a scale seen in France. Whether this is possible or likely in Scotland is addressed later in this report.

2.6 Comparative advantage

2.6.1 Natural conditions

The key strength of Scotland is the high quality of its shellfish growing waters, which are classified by the Food Standards Agency. For 2007/8 Scotland had 78% of its production areas in Class A, 11% seasonally in class A or B (the latter requires heat treatment or depuration), 10% Class B, and only one production area in Class C (requires finishing in class B and depuration). In contrast, England and Wales have only 3.5% Class A, 86.5% Class B and 8.1% Class C sites Some major retailers have a policy to buy from Class A waters only, and if such discrimination were to spread more widely – and especially in European markets - Scotland would have a significant advantage.

Scotland may have a disadvantage in terms of fouling and possibly predation. Growth of seaweed, sponges, hydroids, barnacles etc. are often abundant on structures set within Scottish Coastal waters, and especially in areas of high water exchange and productivity in the spring and summer months. Problems may be less severe in areas of lower salinity. Fouling appears to be less of a problem in New Zealand, and Spain. Predators are a problem everywhere, but again may be more severe in Scotland. These issues deserve further research.

2.6.2 Scale, labour costs and labour productivity

Using FRS figures suggests that, on average, production of farmed shellfish per full time equivalent (FTE) employee, amounts to around 25tonnes, which corresponds to figures suggested by the Scottish Agricultural College. Some of the larger (>200t) farms in Shetland are now achieving closer to 100t/FTE.This compares with around 618tonnes/person in Menai Strait mussel fishery and 43 tonnes/person in Northern Ireland (Bannister, 2006).

Holmyard (2008b) notes that “in New Zealand where the industry is large and geographically compact, a high degree of mechanisation is the norm, leading to lower unit production costs. In that industry a single large vessel with a 4-man crew would be expected to harvest, grade and clean 50-100 tonnes per day. While these figures will raise no eyebrows in North Wales, they are an order of magnitude higher than those found on UK rope grown mussel farms”. More information about the development of the New Zealand industry can be found in ”The Greenshell story”.

The flip side of labour productivity is labour costs. These are probably similar to those in New Zealand but much higher than those in Chile and South East Asia.

For oysters labour productivity is something in excess of 100,000 shell/FTE according to the SAC. This is probably much higher than that from the French industry for example.

2.6.3 Fuel costs

Fuel costs are still highly variable in Scottish production, dependent on the level of boat use during growout which may, in turn, be related to issues such as the degree of predation and fouling, the quality of the gear etc. Costs may be between 1 and 6p/kg of product (our survey). However, fuel costs make a significant contribution to costs of sorting, grading, depuration (where done) and getting the product to market/processing in chilled transport (see below).

2.6.4 Harvesting and processing infrastructure and market access

Harvesting, processing and getting the product to market makes up a large part of total cost, being as much as 40p/kg for farmers based in Shetland. These costs will be substantially less in countries where the industry is concentrated and large scale. At present, Scotland has a significant comparative disadvantage in this area, compounded by relatively high fuel costs. This is further compounded in the case of fresh mussels destined for live sale at Billingsgate or Rungis.

2.6.5 Product quality and reputation

Rope grown mussels, unlike those harvested from the seabed, tend to be free of sand or grit (or the associated "pearls"), and Scottish farmed mussels have established a strong brand through the Scottish Shellfish Marketing Group (SSMG). The quality of Scotland's growing waters is a particular advantage. The reputation of shellfish can, however, be damaged easily and rapidly through contamination with bacteria or toxins, and this – alongside food safety concerns – explains the rigour of shellfish testing. At present, Scotland probably has comparative advantage in this area, although the reputation of New Zealand mussels is also high.

2.6.6 Overall

The current estimated production costs for mussels grown in Shetland, delivered to Belshill are shown in Table 1. These costs are high compared with mussels dredged from beds in Ireland, Holland or the Menai Straits, and compared with greenshell (*Perna*) mussels grown (or rather harvested) at a very large scale in New Zealand and increasingly, Chile.

At the present time Scotland lacks comparative advantage in terms of labour costs, labour productivity, fuel costs and harvesting/distribution/processing infrastructure. Comparative advantage is limited to quality and reputation, and ready access to the relatively small UK market.

Table 1. Estimated cost breakdown for Mussel production – delivered Belshill Glasgow (example from Shetland)

Item	£s/kg of product
labour	0.52
maintenance	0.04
depreciation	0.04
fuel	0.06
harvesting	0.13
packing and transport	0.26
marketing	0.01
other	0.05
Total	1.3

***Note**: The figures in Table 1 are best guess based on highly variable data from producers. Capital investment is around £37,000/100tonnes/yr production (mussels) and highly variable (£2000-8000/tonne annual production) for oysters.*

2.7 Integrated aquaculture

There has been much research[6] going back to the mid '70s, and significant recent discussion about the opportunities for "integrated" finfish and shellfish culture (see for example Box 3).

In practice the evidence for synergy in terms of enhanced growth of shellfish on the one hand and water quality improvement (or "wastewater treatment") on the other is equivocal. There are several fundamental scientific and management problems. Firstly, in terms of wastewater treatment, the main mechanisms would be if the shellfish could assimilate waste food in the form of small organic particles. As feed technology has improved for finfish farming, so has the amount of such waste been reduced and there is limited practical evidence of a positive effect on shellfish growth. A secondary mechanism could be in terms of fertilisation of the water column and stimulation of (beneficial) plankton production as feed for the shellfish. This effect is only likely if nutrient levels in the water column were enhanced significantly by salmon farming – and SEPA – and salmon farmers – do their best to ensure that this is not the case.

However, there is a problem even if this does work. Instead of the nutrients being flushed out as at present, some proportion would be assimilated by the shellfish. But shellfish, like all organisms, are relatively inefficient and 80 to 90% of whatever they ingest is wasted in the form of ammonia or solid wastes. In the case of shellfish this effect is exacerbated by their tendency to be selective feeders, rejecting significant amounts of organic particles in pseudofaeces, which are deposited on the seabed. Current research under SARF 53 should cast further light on these issues.

Box 3. Integrated Aquaculture?
"Interest is also increasing in the potential for polyculture. This might involve growing a species such as mussels, or certain marine algae on the same site as finfish. The main argument for this type of aquaculture is that one species may have the potential to utilise some of the waste nutrients produced by the other, leading to less dissolved organic matter entering the water column. This is an idea which clearly requires further investigation, and at the time of writing the Council is part-funding research into finfish/seaweed polyculture. The future introduction of polyculture techniques on a commercial scale would require changes in legislation to allow more than one species to be grown on the same site. It would also necessitate a review of the indicative separation distances."

From Loch Sunart Aquaculture Framework Plan

There are also more practical issues. Scottish shellfish have a quality image because they are grown in the pure waters of the North Atlantic on natural food; grown as waste treatment systems for salmon farming does not ring marketing image bells. Shellfish farmers are in any case nervous of the chemotherapeutants that may be used by finfish farmers.

Finally there are simple problems related to biological and marketing ratios. To genuinely treat a significant proportion of the waste from finfish farms would require

[6] See Soto et al., 2008 for a recent global review of aquaculture which addresses the possible role of integrated aquaculture in promoting an "ecosystem approach". An article by Thierry Chopin (2008) illustrates the perspective of many scientists currently working in this field. The European Aquaculture Society hosted a conference dedicated to the issue: 'Aquaculture Europe 2003: Beyond Monoculture' in Trondheim, Norway, August 8-12, 2003. The Scottish Association for Marine Science is currently undertaking several research projects in this area.

some confinement of the nutrients within a water body in which shellfish were growing – which would fly in the face of the move to better flushed and more open sites. Secondly, given conversion and extraction efficiencies Scotland would need far more shellfish (and even more seaweed) than finfish to have any significant benefit in terms of waste treatment. Given existing markets and access to space this is unrealistic.

It is important that the opportunities associated with integration are more thoroughly assessed – not only from a technical perspective, but from economic, management and marketing perspectives.

3 Existing constraints on activity, socio-economic profile, profitability and growth.

3.1 Introduction

We have identified a large number of constraints which have limited expansion of shellfish farming in Scotland over the last three decades. These have been identified through desk research, analysis of published statistics and other information, together with discussions with individual farmers and workshop discussions. The constraints include:

1. Existence of suitable sites (marine site; shorebase)
2. Availability of suitable sites (prior or priority use issues)
3. Biodiversity and nature conservation designations
4. Archaeology and historic sites
5. Landscape designations
6. Water quality classification and shellfish contamination
7. Planning permission
8. Processing, distribution and markets (also discussed above)
9. Availability of finance

The following sections review existing information and draw on interviews with shellfish farmers and others associated with the industry to make an assessment of the importance of each constraint. The relative severity of each constraint is assessed as:

- Low
- Low to moderate
- Moderate
- Moderate to severe
- Severe

3.2 Existence of suitable sites

There are many dimensions to site suitability. Some of the key issues have been reviewed previously in SARF 005. Criteria can be divided into three broad groups:

- Suitable physical and chemical conditions
- Suitable biological conditions
- Suitable location for a shore base

Physical requirements

Physical requirements for shellfish farming have been well established for many years (White Fish Authority 1975) though they vary somewhat for different forms of culture (suspended, bottom, intertidal). They include:

- Natural shelter (<1 mile fetch[7])
- Depth (depending on type of culture)
- Water quality (salinity (24-34ppt depending on species),
- Temperature (between 5 & 20 ^{o}C; 50% over 10^{o}C),
- DO (>90%),
- Water current (high, but less than 65cm/sec)
- High tidal exchange
- Substrate (stable, sandy)

Broadly speaking most of these attributes can be identified through a combination of satellite imagery (including Google Earth), admiralty hydrographic and tidal information, meteorological office information and habitat and physical data to be found on MESHwebGIS.

A rapid examination of these sources, along with White Fish Authority (1975) , suggests that a great many sites on the West coast and in the islands would be suitable for shellfish cultivation in purely physical terms. Assuming at least 500 suitable sites and a modest 50tonnes per site, would result in 25,000 tonnes – five times current production. If slightly more exposed sites are included potential production would be far higher. Shellfish farming has the advantage that stock does not need to be fed and maintenance/harvesting can await suitable weather conditions to a greater degree than salmon cultivation. This may also allow for greater flexibility with respect to marketing.

Although FRS (2007) reported some losses due to storm damage and warm water temperature, this has not been a significant constraint historically. Modest overall warming of water due to global warming is unlikely to be a problem, and indeed is likely to increase growth rate of species currently cultivated commercially.

Overall we consider that there are plenty of sites in Scotland which meet basic physical criteria.

Assessment: low

3.2.1 Biological issues

In addition to physical site suitability, a site must also meet several other biological criteria, dependent again on the type of farming:

- Adequate spatfall (mussel, scallop)
- Good food supply
- Acceptable (minimal) levels of fouling
- Acceptable (minimal) levels of predation (as evidenced by abundance of eider duck, crabs, star fish, oystercatchers)
- No known disease problems

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[7] In practice acceptable fetch cannot be defined independently of technology. With modern equipment much greater fetch may be acceptable.

Although hatchery techniques are available for the production of many mollusc species, including oyster, scallop and mussel, only oyster seed is readily commercially available to Scottish growers. Mussel and scallop farming still relies on natural spatfall. This is variable, and having collectors in the right place at the right time is difficult. Monitoring can be done but is relatively expensive. One Shetland farmer suffered more than 50% reduction in production last year due to poor spat fall at his site.

Currently there is insufficient demand to justify investment in hatcheries; but the lack of seed itself is a constraint on development of the industry at some locations - which translates in turn into lack of demand. This is a classic development step or threshold and significant public and or private investment would be required to establish such facilities.

In the mean time seed collection and availability will be an uncertain affair, although a well organised monitoring programme may be undertaken to reduce uncertainty and increase supply. The North Atlantic Fisheries College in Shetland is currently undertaking research on these issues. It is notable that in New Zealand there is a significant "cottage industry" collecting spat from seaweed washed up on the shore at certain times of year.

Food supply for mussels, oysters and scallop is primarily in the form of planktonic algae, though they may also be able to assimilate some forms of suspended organic matter. In Scotland, temperature rather than food supply is likely to be the limiting factor for scallops, but the growth of oyster and especially mussel is highly dependent on the quantity and quality of food. Again this is difficult to asses – shellfish vary in their growth rate even at sites with similar levels of primary production, and this may be related to the quality of the algae and other suspended matter (Laing, 2002).

Box 4. Concerns relating to carrying capacity

"Shellfish farmers operating within the loch (Inchard) have commented that in recent years mussel growth rates have been decreasing. This is perceived as being a result of the large scale of development within the loch and the biological carrying capacity being exceeded. Although there is, at present, no empirical evidence to support this view it would be wise to adopt the precautionary principle with regard to future additional shellfish developments within the inner loch".

From Highland Council Aquaculture Framework Plan, Loch Inchard

An important issue for the future will also be the extent to which the existence of pre-established finfish aquaculture actually enhances the quality of a site in terms of the availability and quality of food for shellfish. This has been discussed in section 2.7.

Fouling (i.e. growth of barnacles, sponges, tubeworms, hydroids etc.) on bivalve shells is a serious problem at some sites and in some seasons and again is rather unpredictable. Some forms of fouling can weaken stock, hamper growth, and increase the costs and difficulty of harvesting. The problem can be addressed through mechanical removal or by drying out the ropes – but this can only be done in relatively cool conditions.

Predation is also a problem for shellfish farming in some areas. In its annual survey Fisheries Research Services (FRS) reported mortalities from predation by eider ducks, crabs, starfish and oyster catchers. These problems also fluctuate from year to year.

Few of the established farmers we talked to raised biological issues as a priority constraint. This may be because they simply accept them as a fact of life, or it may be that they have, through trial and error, found sites where these are not major issues. However, they undoubtedly represent a problem from an investment perspective. In most cases it is difficult to make prior assessment of the qualities of a site in terms of spatfall, fouling, predation and food supply. Trials or pilots are usually undertaken. This adds significantly to lead time and investment risk, and to the costs associated with planning consent, especially given the possibility of longer term variations in these factors.

Mytilus trossulus. Although *Mytilus edulis* is the endemic "blue mussel" in Scotland it is very closely related to, M. galloprovincialis (from Southern Europe) and *M. trossulus* and *M. californicus* from the Pacific*.* These species may interbreed. Recently, an *M. trossulus*-like species has been identified in Scotland. It is not clear whether this is a remnant from historic migrations or introductions, or related to more recent events. The possible spread of this species is of concern to commercial producers due to its poor yield compared to *M. edulis.* It has already caused significant problems for mussel farmers in Loch Etive and resulted in the failure of several businesses (James pers. Comm..)

Assessment: moderate

3.2.2 Disease

Shellfish are susceptible to some diseases, and oyster in particular (especially. European oyster) is susceptible to *Bonamia*. According to Fisheries Research Services (2007) *Bonamia* infection remained in Loch Sunart and was also confirmed in West Loch Tarbet during 2007. Movement restrictions are in place covering both sea lochs which prevent the relaying of *Ostrea edulis* from these sea lochs. Approved Zone status continued to protect the health of both wild and farmed native oyster stocks for the remainder of Scotland's waters.

Disease represents a local constraint. At the present time it is not a significant constraint or risk to the whole industry.

Assessment: low

3.2.3 Suitable locations for shore base

A successful shellfish business will require a shore base which will also have to meet a set of criteria, including:

- Land availability
- Ready access to and preferably observation of marine site
- Services (water, electricity, sewerage, mechanical)
- Pier or jetty
- Availability of labour, housing, community
- Road/rail/air infrastructure/distance to processing

An amenable planning regime is also important and is discussed further in section 3.9.

The combination of a high quality shore base coupled with a high quality marine site will be critical to success. Access to significant services in terms of a major centre and or processing varies significantly. Shetland, Orkney and Lewis/Harris would score relatively well compared with some of the sites in Argyll, the far North West, and the smaller Islands, but again this is quite variable.

Most of the above can be established relatively quickly with reference to maps, satellite images, national statistics and site visits. Its relative importance will depend very much on the product, market, and scale of the operation.

Although this may be a significant constraint in that it restricts the number of feasible or economic sites, it is not associated with uncertainty and investment risk.

Assessment: moderate

3.2.4 Overall existence of suitable sites in Scotland

There have been various efforts through time to identify suitable sites for shellfish aquaculture in Scotland. In practice this has always been dogged by the cost and difficulties of identifying critical local features (such as substrate, food supply, predation, susceptibility to fouling, spat-fall, other users). Nonetheless, studies have been made in relation to those features which can be determined from maps. That produced by the White Fish Authority (now SEAFISH) in 1975 remains relevant. It concluded:

> *"by using one system or another (oysters and clams) could be reared on the majority of the UK coastline. ……the most critical factor…is the availability and type of natural phytoplankton…thus requiring that the shellfish species be grown in any potentially attractive area in order to determine its suitability for growing that species".*

Despite many attempts to use GIS worldwide to identify sites suitable for aquaculture development, these can only serve as a starting point. Ground-truthing – and in the case of shellfish growth trialling – remains necessary. It is therefore impossible to assess the overall potential for shellfish farming around Scottish coasts in terms of the extent or number of suitable sites. What can be done – and what WFA did in 1975 - was identify those areas which, for purely physical reasons identifiable on maps, appear to be more or less suitable for shellfish culture. On the basis of exposure and substrate, they rated the following areas/stretches of the Scottish Coastline as of low suitability for shellfish culture:

- Duncansby Head to Dornoch
- Burgh Head to Carnoustie
- Dunbar to Berwick
- Ballantrae to West Kilbride
- Islands of Muck, Eigg, Rum, Arran, Tiree, Coll.
- Western seaboard of Inner and Outer Hebrides and and Orkney
- Tongue to Duncansby Head

They also rated the River Clyde as of low suitability on account of pollution, but since then there have been significant improvements in water quality and this may be less of an issue now.

More specifically they identified 78 areas (>3,000ha) considered suitable for cage and raft cultivation – though they emphasised that many additional areas would also be suitable. These are scattered across much of the West Coast, the Western and Northern Isles. They also identified ten areas with tidal regimes generally considered suitable for the erection of direct access sub-littoral cages and enclosures. These areas are mainly around the Kintyre peninsular and Argyll, Orkney, and in particular Shetland.

Reference to the current distribution of fish and shellfish farming in Scotland as developed by the Scottish Government Expert Working Group on Siting Aquaculture Facilities in Scotland (EWGS) (Figure 20) suggests that broadly speaking, WFA got their site assessment right. Analysis of the distribution of existing sites also shows that almost all the sites identified back in 1975 are now occupied (Table 2). Of particular note is the abundance of shellfish sites – despite the low production.

If we assume a modest total of 4000ha as suitable for shellfish cultivation (long lines), and a production of 5t/ha/yr, this would correspond to 20,000t (mussel) production – 4 times the current amount. If some slightly more exposed locations are included, the potential production is far higher.

Those in the industry are, however, cautious about expansion potential. Two of the farmers interviewed in depth were of the view that there may be site availability for a doubling of production – but only if existing underutilised sites (shellfish and finfish) could be freed up.

3.3 Availability of suitable sites (prior use issues)

3.3.1 Existing fish and shellfish farms

The FRS 2007 annual survey report on shellfish farms shows that 171 “active” companies, farmed 336 “active” sites. The map of these sites shows that many correspond to the areas identified by WFA in 1975, but with particular concentrations in Shetland, and the central part of the West coast (especially Loch Linnhe). There are rather fewer along the more isolated and exposed areas of the Northwest and North coasts. As noted above a brief examination of the EWGS map shows that most of these sites are taken. Furthermore, a brief exploration of satellite imagery on Google earth shows that most are indeed occupied and active – either by shellfish (long-lines) or fin-fish cages.

It is probable therefore that many of the prime sites are already taken and the main opportunity for expansion of the shellfish sector lies in further development of these sites. On the basis of the FRS figures, average production per site approximates to a mere 15 tonnes. This seems low, although it should be remembered that production from shellfish farms, at around 5t/ha/yr is far lower than that for salmon, and that reliance on natural food supply may limit productivity as production expands. The 3,000ha of highly favourable sites identified by WFA in 1975 might only generate 15,000 tonnes, and many of the best sites are in any case already used by finfish farmers.

Our survey of farmers confirmed that most suitable sites have now been taken, and opportunities for increased production will depend upon better utilization of existing sites or access to unused salmon sites. Only one mussel farmer (out of 11 who offered information on this) was of the view that there were plenty of sites. The others either said there were very few suitable sites and/or that prior use restricted site availability. The problem of under-utilised sites is well known, and indeed was specifically addressed by EWGS.

Oyster farmers were slightly more positive. Two (out of 6 interviewed) thought there was plenty of scope for expansion. One farmer for example suggested that Loch Creran could take 10 times current production (equivalent to 6.5m shell). Of the other 4 farmers one was of the view that there were very few sites, and the other three implied that planning issues or prior use seriously constrained expansion.

Box 5. An example of development constraint due to existing leases. Loch Sunart

"At the time the last framework plan was published 33 sites were leased for quaculture in the area by fourteen different operators. Some individual leases covered 3 kms of coast and over 60% of the coastline of Loch Sunart was leased for aquaculture in one form or another.

"Historically, many of the finfish leases operated with considerably more cages than are currently employed and on many sites permissions remain for much greater cage areas than are currently used. At least seven leaseholders operated shellfish sites in the loch with some apparently experimental and only one operator producing a significant volume.

"At the time of writing, shellfish leases within the plan area are held by eight different growers working individually who have leases for scallops, oysters and mussels. However, many of the sites leased are lying undeveloped and the only landings from the loch are of mussels from Loch Teacuis".

"there are only a limited number of sites within the inner loch which may be suitable for the longline or raft culture of mussels….. Many of the more suitable sites are occupied by existing but unutilised shellfishleases".

Highland Council Loch Sunart Aquaculture Framework Plan 2004.

Table 2 shows the proportion of sites identified as suitable by WFA in 1975 which are now occupied by a shellfish farm (active or inactive) or a finfish farm or both. Although this does not include all possible sites - and especially more exposed sites that might be developed with stronger modern equipment - it does confirm the view that most of the most suitable sites have already been taken, though a significant proportion of these are apparently inactive. 71% of previously identified suitable sites are now occupied by fish farms of some kind and 54% by shellfish farms. Furthermore the concentration of farms is notable with most occupied sites having several farms.

Table 2: Current occupation of suitable sites

	Number	Percentage
Total number of sites	77	100%
shellfish only	9	12%
finfish only	13	17%
both	32	42%
none	22	29%
any	55	71%
2 or more farms	36	47%

Data from EWGS map 2008 and WFA list of suitable sites 1975

Box 6. Scope for Development, Loch Inchard

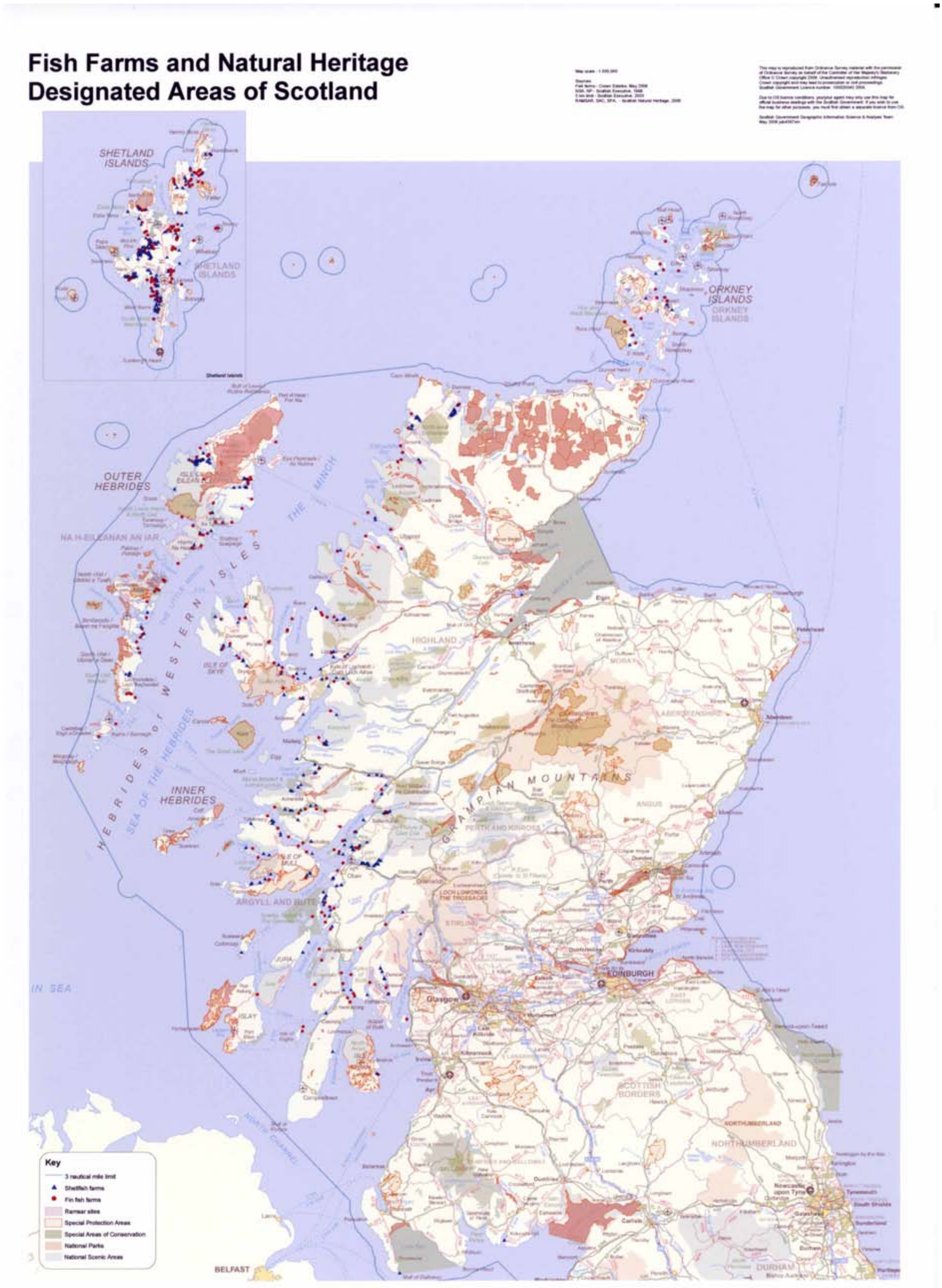
"Relative to its size, Loch Inchard is now one of the most heavily developed sea lochs in terms of shellfish farming, and the scope for further expansion is very limited".

"At the time of writing none of the existing shellfish leases was more than 0.5 km from its closest neighbour and the finfish farm at the mouth of Loch Inchard was just 0.6 km from the nearest shellfish lease. This would suggest that there should be no further significant expansion of shellfish farming in the inner loch and consideration should be given to reducing the extent of the existing installations."

Highland Council, Loch Inchard Aquaculture Framework Plan.

Assessment: high

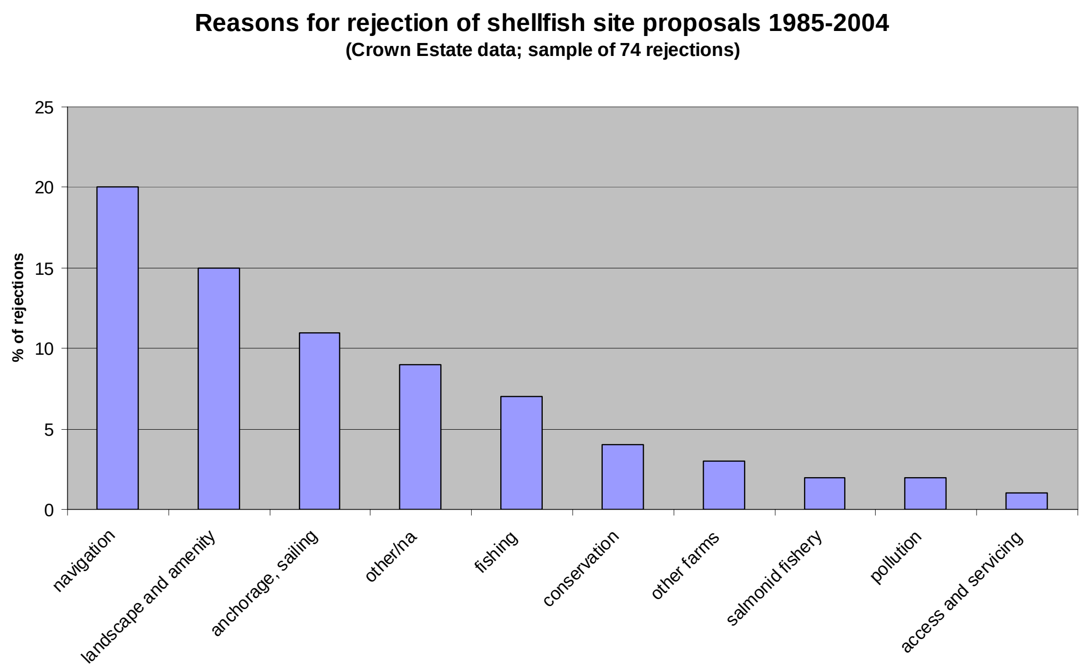
Figure 20. Map showing shellfish and finfish sites in Scotland and landscape and nature conservation designations (Produced by the Scottish Government Expert Working Group on Siting of Aquaculture Facilities in Scotland)



3.3.2 Fishing

In our previous research for SARF on site optimisation for aquaculture (SARF 005) we analysed the reasons for rejection of fish farm site applications by The Crown Estate between 1985 and 2004 (Figure 21). Unfortunately more up to date information is not readily available.

Figure 21



Fishing/salmonid fishery was one of the cited reasons for rejection of the application in 9% of cases. However, navigation (20%) and anchorages/sailing (11%) are also related to fishing, and taken together were the most important factors leading to site rejection. Box 13 illustrates the way in which fisheries interests may be taken into account in the planning process.

Shellfish farming is often assumed to be highly sustainable, in part because it depends on natural food. The flip side of this is that it needs far more space per unit production – around 10ha for a 50tonne site. This means that any significant expansion could increase levels of conflict with fishery and navigation interests.

Overall assessment: low to moderate

3.3.3 Navigation and leisure boating

A licence under the Coast Protection Act 1949 (as amended by S36 of Merchant Shipping Act 1988) is required in order to establish a shellfish farm. This ensures that all marine navigational issues are addressed and stipulates the navigational marks and lighting required – if any. The license is now issued by Marine Scotland –

formerly Scottish Government Ports and Harbours. In practice, and as for fishing, these issues are also likely to be considered as part of planning permission.

Many areas suitable for shellfish farming are also of high value for leisure boating and anchoring and this value is likely to increase as the adventure tourism sector expands. Between 1985 and 2004 about 31% of rejections of applications for shellfish sites were rejected for reasons related to navigation, anchoring and sailing – the most common reason by far. Sheltered water with depths less than 30m may become important areas for kayaking, sailing and anchoring.

"Leisure pressure" is somewhat less in the Western and Northern Isles compared with the West coast. Although dealt with primarily through the navigation (CPA or Coastal Protection Act) license, these are also important issues which may influence the outcome of planning decisions.

Assessment: moderate to high (depending on the area).

3.4 Biodiversity and nature conservation designations

The west coast of the Scottish Highlands and the islands of Shetland, Orkney and the Hebrides are areas of rich natural resources. The local marine environment is cold, clear and productive, supporting a rich and varied biodiversity, much of which is now recognised as being of high conservation value.

Sites suitable for shellfish farming are also often of high nature conservation value. This is because the richest marine life is to be found in relatively sheltered waters with good water exchange – ideal locations for shellfish farming. Furthermore, much of the richest marine biodiversity is to be found in the sub-littoral zone where – given appropriate levels of nutrients – strong light promotes significant primary production.

Box 7. Loch Sunart Aquaculture Framework Plan

"The number of sites available for new development is, however, limited either because of physical factors or because of the range of other interests in the area which have to be taken into account. A key interest in this regard is nature conservation which is reflected in the designation of the whole loch and considerable areas of the surrounding land as candidate Special Areas for Conservation under the EC Habitats Directive.

Recent work by University of Stirling shows the strong coincidence of biodiversity values with areas typically suited to fish farming (SARF03). The Expert Working Group on Siting Aquaculture facilities in Scotland (EWGS) generated a site map (Figure 20) which also highlights the relatively strong correlation between fish farming and nature conservation designations. Boxes 7 and 8 illustrates the practical importance of these issues in Loch Sunart.

The Scottish aquaculture industry therefore has to operate in an area of some of the highest concentrations of statutory conservation protection in UK waters - inevitably meaning that there is substantial overlap between these designations and farm sites.

The most important nature conservation designations which may influence marine shellfish farming are Natura 2000 sites: Special Areas of Conservation (SACs – designated under the European “Habitats” Directive), and Special Protection Areas - (SPAs – designated under the European “Birds” Directive). In addition account may need to be taken of species of conservation importance such as UK Biodiversity Action Plan (UKBAP) priority species, and those on the “Scottish List” (see planning below). In the future there will be a more comprehensive network of Marine Protected Areas (MPAS) in line with obligations under the OSPAR Convention implemented through provisions in the new Marine Bill (see below). Similar provisions are also being developed in other parts of the UK (see for example DEFRA 2009).

Box 8. Example of BAP nature conservation interest to be found in vicinity of fish farms. BAP priority habitats and other nature conservation interest in Loch Sunart
“Sea grass beds and mud habitats in deep waters are well represented within the loch. The National Biodiversity Action Plan species, tall sea pen (*Funiculina quadrangularis*) and the horse mussel (*Modiolus modiolus*) are also present. In each of the deep basins the bed rock gives way to mud sediments which form the habitat of the fireworks anemone *Pachycerianthus multiplicatus*, and burrowing crustaceans such as the Norway lobster *Nephrops norvegicus* and the angular crab *Goneplax rhomboides*. These areas are also noted by local sea anglers as being important habitats for large skate and thornbacked rays.
From Highland Council Aquaculture Framework Plan Loch Sunart.

3.4.1 Geographic Interaction

SNH offers “locational guidance” for aquaculture, by providing maps on “the sensitivity of natural heritage to aquaculture”[8]. These include information on Natura 2000 sites, National Scenic Areas, sensitive Biodiversity Action Plan species or habitats, and “marine consultation areas”. They also offer information on the qualifying features for each Natura site and the possible pressures, including aquaculture, which may impact on these features (Annex 2). We have compared these maps with fish farm locations as indicated in Figure 20 (which also shows some of the designations) and made an estimate of the number and proportion of farms to be found within approximately 2km of a conservation feature.

The results are summarized in table 3 for the whole of Scotland, and presented in graphical form to illustrate regional differences in Figure 22. Note that some farms are to be found within or close to more than 1 designation, so percentages do not sum to 100%.

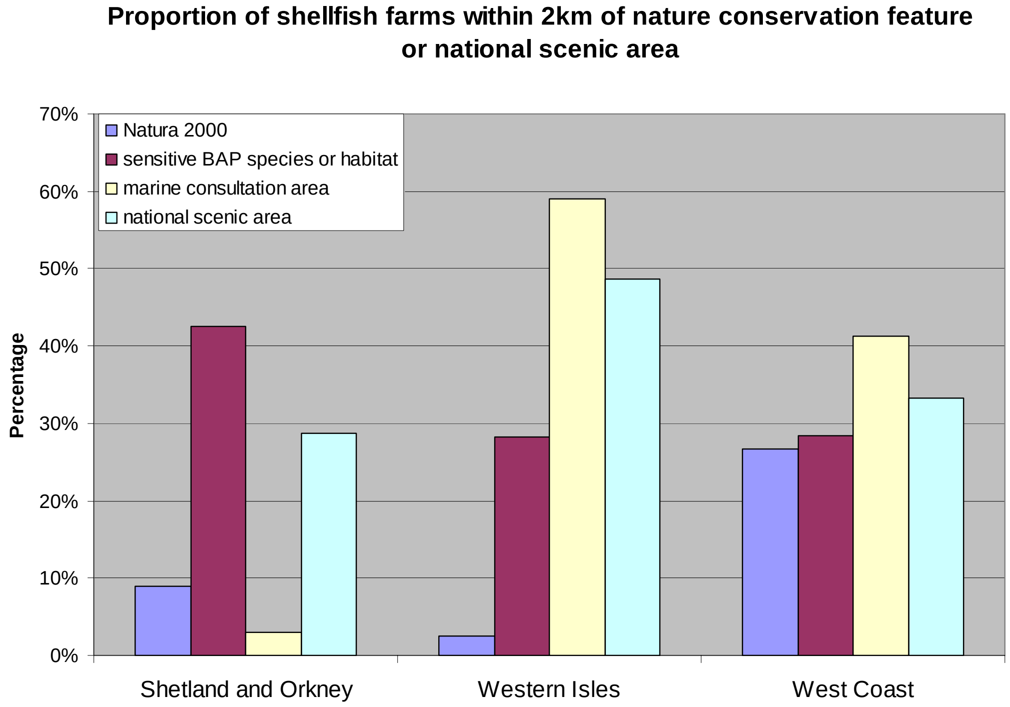
Regions used correspond roughly to the areas used in the SNH maps, but since these overlap in some areas we have assigned them arbitrarily to one region or the other. The figures are therefore indicative, but nonetheless show significant differences between different areas.

[8] http://www.snh.org.uk/strategy/sr-ac00.asp

Table 3: Number and proportion of fish farms within approximately 2km of nature conservation or landscape feature

	Number of farms	Percentage
Natura 2000	54	18%
Sensitive BAP species or habitat	101	33%
Marine consultation area	94	31%
National scenic area	103	34%
No conservation or landscape designation	100	33%
Total shellfish sites	305	

Figure 22. Geographic interaction between shellfish farms and nature conservation interest



It is notable that 77% of shellfish farms are close to some form of nature conservation or landscape interest. Perhaps unsurprisingly the largest proportion (33%) of farms are within 2km of sensitive BAP species or habitat. Also of note is the high proportion of fish farms within or close to Marine Consultation Areas. Although these have no statutory status at present, it is possible that some or all of these may be designated as Nature Conservation Marine protected Areas under the new Marine Bill (see Section 6.5).

Figure 22 shows that broadly speaking the coincidence between farms and nature conservation interest is relatively low in the Clyde and south Argyll, Orkney and Shetland, and relatively high in Benbecula and the Uists and the Northwest and Midwest coast.

There is no government or SNH policy or strategy to exclude shellfish farming from designated areas, and shellfish farming has been regarded as relatively benign from an environmental perspective. Historically nature conservation has been a relatively minor contributor to site application rejections: conservation was cited as a reason in only 4% of rejections between 1985 and 2004 (Figure 21). Nor was this raised as a priority constraint by most of the shellfish farmers we talked to. However they did regard planning as a significant constraint, and both nature conservation and landscape issues are often important issues in planning decisions. Furthermore, while there is no policy to exclude aquaculture from Natura 2000 sites, it has been made clear that the management objective for these sites is nature conservation – rather than a balance between conservation and development, or sustainable development. If the scale of shellfish farming were to increase significantly, it is likely that more issues would arise – mainly in relation to the production of waste (pseudofaeces) and predator management, as highlighted in Box 11 and Annex 2.

3.4.2 Taking into account socio-economic interests

Hatchard (2007) has specifically noted the provisions for taking account of socio-economic interests in the management of Natura sites – and the limited application of such provision to date:

The Habitats Directive (1992) makes provisions for the consideration of social and economic factors in European Marine Site management. However, there is evidence that the principle of taking social and economic factors into account in decision-making is not filtering through to the practical management of those sites and the human activities taking place within them. This is partly because the UK Habitats Regulations (1994) do not allow explicitly for the consideration of social and economic implications of decisions relating to European Marine Sites, except under particular circumstances (imperative reasons of overriding public interest). As the legislation was established to protect environmental features, it is socio-economic factors (industry) that lose out where agreement cannot be reached. (Hatchard 2007).

3.4.3 Appropriate assessment

Regulation 48 of the Habitats Regulations states that:

> "A competent authority, before deciding to undertake or give any consent, permission or other authorisation for, a plan or project which
>
> a) ***is likely to have a significant effect*** on a European site in Great Britain (either alone or in combination with other plans or projects), and
>
> b) is not directly connected with or necessary to the management of the site, shall make an appropriate assessment of the implications for the site in view of that site's conservation objectives."

The need for appropriate assessment extends to plans or projects *outwith* the boundary of the site in order to determine their implications for the interest(s) protected *within* the site. It will also apply to extensions or increases in existing activity and may therefore apply to expansion of an existing fish or shellfish farm.

Box 9. Example of possible requirement for appropriate assessment
"the marine cSAC designation requires that the potential impact of new or modified fish farm installations on the otter or reef interests should be assessed. This would apply to changes within and adjacent to the cSAC where features within the cSAC would be affected, irrespective of the requirement for an EIA".
Highland Council Loch Sunart Aquaculture Framework Plan

If this assessment cannot demonstrate that the proposal will not adversely affect the integrity of the site it should only proceed in very exceptional circumstances. It should also be recognised that significant effects on

Natura sites “may arise from development proposals located outside protected sites and any such proposals must be treated in the same way” (Scottish Executive 2007).

In practice, this is a rigorous requirement and it is likely that more thorough impact assessments will be required for shellfish farming, including (for example) the use of dispersion modelling to assess the possible effect of pseudofaeces from a large farm on a a reef, lagoon, sandbank or other sensitive habitat.

The decision about the requirement for appropriate assessment would at the present time fall to the planning authority, based on advice from SNH. SNH would also define the information and evidence/analysis required, but would expect the proposer to bear the cost of providing the information. SACs usually have management plans developed by some kind of partnership or management forum, and this plan may also influence any decisions relating to appropriate assessment.

It is to be hoped that the concordat between the ASSG , SNH and WWF, which reflects their joint commitment to water quality and low impact production, will serve as a sound basis for a positive approach to shellfish farming and nature conservation and reduce to a minimum the requirement for appropriate assessment. Nonetheless, given the geographic coincidence between nature conservation and shellfish farming interests, there is the potential for significant cost and uncertainty arising in relation to this requirement.

Box 10 Requirement for Appropriate Assessment.

A recent “pre-proposal” for a shellfish farm on the Dornoch Firth resulted in a call for appropriate assessment in relation to the Dornoch Firth SAC. While the assessment in such circumstances is undertaken by SNH, the proposer is required to supply relevant data. This may be beyond the means or capacity of a small-scale entrepreneur and serve as a disincentive to development. This particular initiative has stalled and the requirement for appropriate assessment was considered to be an important contributing issue by ASSG.

Another proposal for a shellfish farm in Argyll was flagged up as having potential to disturb waders in a nearby SAC. Although it took some time (6 weeks) to resolve the issues, the proposal was subsequently approved

Pers comm. Doug Macleod ASSG

Box 11. Non statutory advice given by SNH in relation to sensitivity and vulnerability of qualifying species/habitats in SACs to listed activities.

The following is typical of the advice offered by SNH under Regulation 33(2) of The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) in relation to the potential impacts from shellfish farming on the interests of marine SACs.

Habitats. "This activity has the potential to cause deterioration of the qualifying habitats and communities through physical damage (e.g. installation of mooring blocks and continued scouring by riser chains) and changes in community structure caused by smothering from pseudo-faeces (undigested waste products) and debris (including dead shells) falling from the farm. There is also potential for accidental introduction of new non-native species and increasing the spread within the UK of existing non-native plants and animals (e.g. *Sargassum muticum* Wireweed), through importation or translocation of shellfish stocks. Invasive species have the potential to cause deterioration of the qualifying interest by altering community structure and quality".

"The environmental effects noted above are usually localised but the reduced water exchange within sea lochs may exacerbate these effects and cumulative impacts should be considered".

"Otters: The development of shellfish farming sites has the potential to cause disturbance to resident otter individuals or populations in the vicinity of such farms, mainly through human activities such as noise and boat usage. The construction, use and maintenance of shore bases built to support shellfish farms have the potential to disturb otters and cause deterioration of their habitats through destruction and physical damage to shoreline holts".

Seals. "Shellfish farming has the potential to cause disturbance, injury or mortality to seals through entanglement in anti-predator nets. Use of acoustic deterrent devices or other predator control methods (e.g. sonic canon, boat chasing) to prevent grazing by eiders on shellfish farms have the potential to cause disturbance to seals.
Boat activity associated with shellfish farming has the potential to cause disturbance to seals, particularly during breeding and pupping and moulting."

Assessment: medium

3.5 Historic sites

To date there has been relatively little interaction between shellfish farming and historic sites, and it was beyond the scope of this research to explore geographic interactions at any level of detail. However, the West Coast of Scotland and the Islands are rich in archaeological and historic heritage, with a large number of sites associated with wrecks or human occupation going back many thousands of years. An example of the abundance of such sites in Loch Sunart is provided in Figure 21 (from Highland Council Aquaculture Framework Plan for Loch Sunart).

As part of marine spatial planning (see section 3.9.3) buffer distances from such sites may be required and this will further limit site availability.

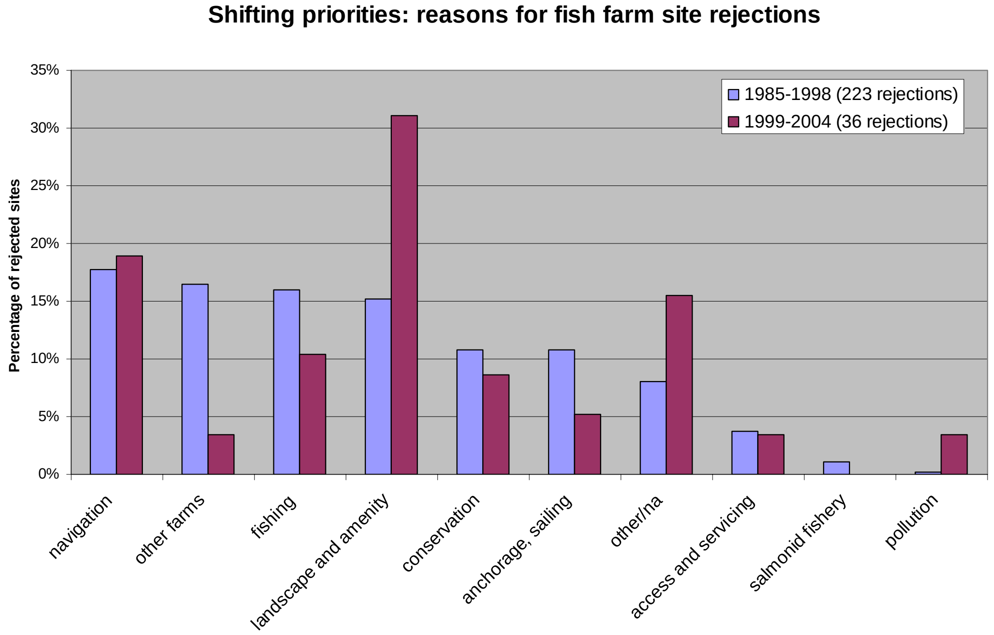
Assessment: low

3.6 Landscape Designations

There is substantial overlap between existing shellfish farms and landscape designations as is clear from Figure 22. We estimate that 34% of all shellfish farms are within or within 2km of a National Scenic Area. Local Authorities can also designate additional locally important “Areas of Great Landscape Value” (AGLVs)” and this would further increase the potential for conflict.

Historically, concerns about landscape and amenity have contributed to the rejection of a significant number of shellfish fish farm site proposals. Furthermore, reference to Figure 23 (relating to all forms of fish farming) shows that over time landscape concerns have become increasingly significant, being cited as a reason for rejection in more than 30% of cases between 1999 and 2004 – a substantially greater proportion than for any other issue.

Figure 23 Increasing concerns over landscape



In practice, landscape has been rather less significant for shellfish farming (cited in 20% of site rejections overall) than for salmon farming (cited in 31% of rejections). Increasingly the key issue for landscape is the feed barge, which has become relatively standard piece of equipment for larger finfish farms. These stand out from the background far more than do low profile cages and floats. However, as noted elsewhere in this report, significant increases in shellfish production will require large areas in sheltered waters and the potential for conflict is significant.

Concerns about landscape are not restricted to areas with landscape designations, but are an important planning consideration in all areas, and especially those areas highly dependent on tourism. SNH has developed guidance (SNH 2000; SNH 2008) for the siting and design of fish farms to minimise impacts on the environment.

This guidance makes it clear that landscape is likely to become an increasingly important issue for fish farm development:

> *"As the industry expands, it will become more difficult to identify new locations where landscape can accommodate the scale and nature of this type of development. In addition, the incremental expansion of individual fish and shellfish farms will be increasingly difficult to accommodate within the relatively intimate scale of Scotland's coastline".*

The basic 2000 guidance aims to:

- give advice on how to determine the most appropriate location for aquaculture development in relation to the landscape;
- indicate and explain issues of landscape significance which may need to be addressed in an Environmental Impact Assessment (EIA);
- explain how to assess the landscape and visual impacts of aquaculture development;
- offer guidance on how to site and design aquaculture developments to reduce both their visual impact and their impact on landscape character;
- encourage the aquaculture industry to consider landscape character and design issues during the ongoing management and development of existing sites.

In a sense, this approach – site selection starting from a landscape perspective - immediately creates a problem for fish farmers, since there are so many critical issues to consider in terms of site selection or site expansion. Realistically, very few would be in a position to prioritise landscape.

However, a more strategic approach is implicit in the more recent (2008) guidance on landscape capacity for aquaculture. Whilst this is unlikely to be implemented by farmers, it may well be used in the development of aquaculture framework plans and/or coastal and marine plans to be developed under the new Marine Bill. We consider this further below in the section on planning.

Box 12 below offers some excerpts from framework plans which illustrate the potential for site limitation or limitation on expansion in relation to landscape.

Box 12: Landscape and fish farming – a framework planning perspective

Loch Eribol Aquaculture Framework Plan:
"the exposed nature of this coast means there are few physical opportunities for development and the scenic/nature conservation interest would preclude most forms of aquaculture at anything other than the smallest scale"

Loch Sunart Aquaculture Framework Plan
"The narrow sinuous nature of Loch Sunart is emphasised when viewed from low vantage points such as the head of the loch. Most of the fish farm developments are set close to the shore and impinge very little on the open water space. The fish farm at Achleek is something of an exception to this being a large site which is overviewed at close quarters by the road to Lochaline as it passes along the south side of the loch and rises up to Liddesdale".

There is "limited potential for the development or expansion of shellfish farming in the section of the loch between Resipole and Glencripesdale on sites which do not encroach on key viewpoints or roadside picnic areas"

Overall, landscape is likely to be a minor issue for small scale shellfish farming especially if basic guidelines are followed. Given the area required for larger scale shellfish farming this could be a much greater constraint on significant expansion. This is dealt with further in the planning section.

Assessment: moderate to high

3.7 Water quality and shellfish contamination

3.7.1 Surface waters classification for shellfish

The original Shellfish[9] Waters Directive (79/923/EC) was repealed by the codified EC Shellfish Waters Directive (2006/113/EC) in 2006. The new Directive 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 in turn be repealed in 2013 by the EC Water Framework Directive, 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). Today, this 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.

The first Shellfish ***growing waters*** in Scotland were identified in 1981. Over time these have been incrementally added to, and in some cases consolidated. By 2006

[9] Relates to bivalve and gastropod molluscs, including oysters, mussels, cockles, scallops and clams but does not cover crustaceans such as crabs, nephrops or and lobsters.

there were 108 shellfish designations[10] (out of a total of 241 shellfish waters in the UK). This was recently added to (in November 2008) by a further 7 designations, including extensions to 3 existing designations. More designations may be made in the future, if necessary, to maintain the broad match between designated shellfish waters and shellfish harvesting areas (see below).

For all designated sites SEPA produces a Pollution Reduction Plan (PRP) to ensure site compliance with the minimum mandatory standards within six years. Specifically, the PRP details:

- background information,
- compliance monitoring
- point source discharges
- diffuse pollution risks
- required improvement actions.

SEPA adopts a precautionary approach, meaning that any discharger (anything from agricultural or urban diffuse sources to Scottish Water's sewerage and sewage treatment plants) must demonstrate how they will achieve the guideline status required in designated receiving water. In effect, SEPA treats shellfish ***growing waters*** as impact zones to protect the FSA ***harvesting areas*** that lie within them (see below). Water quality cannot therefore be guaranteed outside the FSA designated harvesting areas.

These regulations cannot be considered as any kind of constraint at the present time – indeed, they are intended to protect and facilitate shellfish growing in high quality waters. However, there may be issues relating to the non-native Pacific oyster under a more rigorous Water Framework Directive regime in future (see next section).

Assessment: low to moderate

3.7.2 Shellfish harvesting areas

The Shellfish Waters Directive detailed above sets environmental standards for the quality of the ***growing waters*** to promote healthy growth; however compliance with this alone will not ensure the protection of public health. The directive is therefore complemented by the EU Food Hygiene Regulations (852 / 853 / 854), which took effect on 1 January 2006 which safeguard the food quality and safety of commercially harvested shellfish intended for human consumption. In Scotland these are enacted by The Food Hygiene (Scotland) Regulations 2006 and are the responsibility of Food Standards Agency (FSA) Scotland.

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 A, B or C[11]. The degree of contamination determines the degree of depuration (purification) required before the produce may be commercially marketed. The regulations also stipulate the depuration requirements. It is of note that the harvesting areas identified for food hygiene purposes *do not necessarily*

[10] A complete list of designated shellfish growing waters in Scotland, including up to date site reports are available from the SEPA website: http://www.sepa.org.uk/water/shellfish_waters/site_reports.aspx
[11] A complete list of the designated shellfish harvesting areas in Scotland is available from the FSA website:
http://www.food.gov.uk/scotland/safetyhygienescot/shellmonitorscot/shellclassesscot/shellclassscot0708

overlap, or exist entirely within the growing waters designations identified according to water quality. The cost of official and routine control samples and the sanitary survey is covered by the FSA in association with the Local Authority (as opposed to being a cost to the producer).

Where potential new entrants to shellfish production seek to farm in unclassified or undesignated waters the FSA would not undertake any survey in support of a proposal or feasibility study. This would have to be done by the prospective farmer through production trials or sampling of wild mussels. Either way a year of monthly samples is required to gain official classification. To avoid this cost and risk new entrants are more likely to restrict themselves to selecting sites which are already classified.

SEPA and the FSA work closely to discuss issues of common interest, develop relevant research and exchange information. Since 2006 the synergy between the two Agencies has further improved to enable SEPA to input into the process of designating new harvesting areas to ensure water quality can reasonably be achieved without compromising existing and future social or economic activity.

These procedures create both opportunities and problems for actual and prospective shellfish farmers in Scotland. The coastal waters to the West and North of Scotland are of exceptional quality, and for this reason most harvesting areas are classified as A, meaning that shellfish can be marketed fresh without depuration or heat treatment. This contrasts with water in England for example where most shellfish waters are classified as B and significant areas as C, as are many of the continental waters. The English Shellfish Strategy report (Bannister, 2006) notes that some retailers already have a policy of sourcing shellfish only from Class A waters. In other words Class A affords better access to premium markets.

The down side is that the classification creates uncertainty. Periodic uncontrollable events – and in particular exceptional rainfall – may result in sudden increases in faecal coliforms from both agricultural and human sources, resulting in downgraded classification. In Scotland this is more likely to occur close to major rivers, areas of population or more intensive farming. Furthermore, occasional “rogue” results may occur and it takes time to re-establish favourable status (Bannister, 2006). Water quality has become an increasing constraint in the Western Isles, with some growing sites downgraded from A to B, although a few producers have got together to provide a depurating facility to overcome this.

There is some uncertainty about the manner in which the provisions of the Shellfish Waters Directive will be realised or modified under the Water Framework Directive when the former is repealed in 2013. In a recent study for DEFRA, James and Slaski (2009) note the concerns of the Shellfish Association of Great Britain. These concerns relate not only to the standards for shellfish waters, but also to the manner in which Good Ecological Status, and Good Environmental Status are interpreted under the Water Framework Directive and the Marine Strategy Framework Directive respectively. There is particular concern that UK Technical Advisory Group (UKTAG[12]) has recently upgraded Pacific oyster as a “high impact” or red list non-native species. Their culture may therefore represent a threat to Good Ecological Status.

Assessment: low to moderate

[12] UKTAG offers technical advice to UK Government on implementation of the Water Framework Directive

3.7.3 Periodic closures related to biotoxins

The Food Standards Agency (FSA) (Scotland) undertake routine monitoring for biotoxins associated with algal blooms including Amnesic Shellfish Poisoning (ASP), Paralytic Shellfish Poisoning (PSP), and Diarrhetic Shellfish Poisoning (DSP). Areas are closed for harvesting when thresholds are exceeded and are only re-opened once two successive samples prove negative.

This has been a particular problem for scallop fisheries and production in Scotland and there have been periodic stoppage of sales in England due to DSP in cockles, oysters and mussels. Closures are not uncommon in Scottish waters in the summer months and significant numbers of Scottish shellfish farms have been affected in recent years. The testing regime can also be burdensome and expensive for small scale producers. Our survey of farmers reveals this to be a major issue of concern – both in terms of the unpredictability of contamination and the burden of testing. It tends to be more of a problem in summer and therefore differentially affects small scale producers targeting the local tourist/restaurant market.

Closures related to biotoxins represent a considerable source of uncertainty for shellfish farmers. They also create uncertainty and concern in the consumer population and make the task of stimulating demand in the rather limited UK market for shellfish even more difficult.

Assessment: moderate to high.

3.7.4 Norovirus

There has been some discussion in recent years about the dangers to human health caused by the *Norovirus* which may be found in shellfish. There is a view in the industry that zero-tolerance of norovirus in shellfish would finish off the industry.

Assessment: requires further research.

3.8 Other Regulation

Shellfish cultivation is governed by the regulations and directives cited earlier, plus directives on movement control (EC 91/67) and monitoring and control of diseases (EC 95/70). Pests (slipper limpet) and predators (oyster drills) are not included, and therefore require local voluntary monitoring and action.

3.9 Planning permission to establish a farm or increase production

Prior to establishing a shellfish farm, planning consent must be obtained. Historically, The Crown Estate (CE) had been responsible for issuing the planning consent under the Crown Estates Act 1961. However, as The Crown Estate is also the landlord charging a rent, it was long felt that this represented a conflict of interest. Following a transitional phase under which CE continued to grant consent but largely on the basis of advice from the local authority, responsibility for issuing planning consent for fish farms has passed to the local authority[13], although until March 2010 an extended

[13] Town and Country Planning (Marine Fish Farming) (Scotland) Order 2007

transitional phase will allow some existing applications to be coordinated by Crown Estate.

Under current procedures, a completed application is passed for consideration and comment to the Statutory Consultees, who must respond within 28 days. These are:

- Scottish Natural Heritage
- Scottish Environmental protection Agency
- Scottish Government (Marine Scotland Science – formerly fisheries Research Services).
- The Crown Estate (previously the local authority was the statutory consultee when applications were handled by the Crown Estate).

The applicant must also submit a copy of the application for display in the local Post Office and newspaper. In addition the council undertakes an internal consultation to canvas the views of other departments such as transport and environmental health. An informed summary of consultation responses is then passed to the elected members who take the final decision.

A fee is required to cover the cost of the application. The cost structure for shellfish farming is the same as for other marine fish farms (including salmon):

- £145 for each 0.1 ha of water surface area
- £50 for each 0.1 ha of seabed, subject to a maximum of £14,500

Planning consent may be awarded subject to conditions. These may include:

- Exact location and e.g. number/length of long-lines
- Lighting and other navigational aids
- Restrictions on chemical use
- Colour/form of equipment to minimise landscape impact

An example of some of the planning issues and procedures is presented in Box 12 - though this relates to the “interim” phase, where consent still lay with The Crown Estate, but largely based on advice from local government. To date there has been rather limited experience of the new regime. The councils report very few new proposals for shellfish farms. However, this shift in consent from The Crown Estate to local authorities may have significant impact on the probability of consent being granted. The Crown Estate, being the landlord, and being charged to make full but sustainable use of the Estate, would be inclined to grant consent unless there were significant reasons not to do so. Local Government on the other hand varies in terms of the support it offers to fish farming and is probably more sensitive to local perspectives, especially in relation to landscape and tourism. Since landscape and tourism represent the dominant sector of the economy in many of the areas identified as suitable for shellfish farming, and since in general people will take a precautionary and conservative stance in terms of conserving the landscape for tourism, we may anticipate increasing difficulties in terms of allowing development in areas of high landscape (and tourism) value. This is reinforced since wildlife and adventure tourism are a potential economic growth area. Ideal sites for shellfish farming often correspond to areas of significant potential or importance for e.g. wildlife tours, sea kayaking, yachting etc.

Box 12. Example of planning constraint: Loch Fyne Seafarms: planning consent for extension of an existing queen scallop farm (under the "interim" arrangements)

Nature of development
Proposal for an extension to an existing farm involving submerged long lines and suspended lanterns for scallops resulting in a total area of 375x180m off Black Harbour, Loch Fyne

Time line:

Application	August 2004
Revision to accommodate fishermen's objections	November 2004
Rejection	June 2005
Approval on appeal	January 2006

Original rejection related to:
- Objection from Clyde Fishermen's Association (navigation; fishery ground)
- Comments from Royal Yachting Association, Clyde Cruising Club, Maritime and Coastguard Agency relating to navigation and recreation (including access to an anchorage) – important issues afforded priority in the Council's Structure Plan and draft local plan policies.

Conditions attached to final consent:
- 8 x 220m submerged longlines for scallops
- Dark matt colour for floats etc
- Appropriate navigational marks
- No harmful substances to be released
- Appropriate consents for shore based developments
- Anti-predator measures non lethal/non-destructive in accordance with SNH guidance

Reasons for final decision
Impact on fisheries not significant; revised location less sensitive.
Appropriate navigational lighting would address navigation concerns.
Anchorage little used; safer alternatives close by; and access still possible if more difficult.

In some cases more informal approaches to planning can work well, as illustrated in box 13.

Box 13: Informal strategic planning – Scalloway example
The Scalloway Islands in Shetland are important for aquaculture with many finfish and shellfish farms. But they are also important eider moulting grounds – in spite of not being designated as a SPA. The RSPB objected to a mussel farm application in the most important moulting area, but by working with the applicant they were able to identify alternative sites which suited both the producer and the birds.

3.9.1 Scottish Planning Policy 22 (SPP 22)

SPP 22, *Planning for Fish Farming* is the current government guidance on planning for fish farming and seeks to offer guidance on key issues to be addressed when considering proposals for new fish farms, and establish the national planning context for the preparation by planning authorities of development plans for guiding the location of future fish farms.

The document is generally positive in tone. Scottish Ministers recognise the importance of fish farming to the Scottish economy, particularly in rural areas:

> *"This SPP indicates that planning authorities should use the development plan process to support and encourage the continued growth of fish farming. Planning policies should not be used to restrict development where environmental and other impacts can be addressed satisfactorily"*

However, a balance must be struck:

> *"Plans should, however, afford protection to areas designated for their national or international heritage value, and those areas where further development would result in unacceptable significant impacts"*

The guidance emphasises the need for an inclusive planning process involving local communities and key stakeholders, perhaps through partnerships or advisory/liaison groups.

The guidance flags up a range of issues which should be considered in drawing up plans or issuing consent, including:

- The concerns of local communities
- Fishing and navigation
- Recreation and tourism
- Natural heritage
- Visual impact and design quality (including landscape capacity, especially in NSAs)
- Cumulative impact
- Historic environment
- Codes of practice

The guidance recognises that natural heritage designations may constrain aquaculture development:

> *"the prospects for further substantial new developments may be limited within or in the vicinity of SPAs and SACs, although there may be potential for modifications of existing operations or expansion of existing sites, particularly where proposals will result in an overall*

Box 14: SPP22 proposals for zonation for fish farming

"Local plans (and in future, local development plans) should identify sensitive and potential development areas.

Sensitive areas *are areas that are unlikely to be appropriate for fish farm development or further fish farm development. There is a presumption against development within these areas because they are of specific environmental, scenic or ecological importance or because these areas lie within controlled areas or that fish farming development would conflict with other uses or potential uses which are considered more appropriate and beneficial.*

Potential development areas *comprise areas within which fish farm development may be appropriate subject to detailed locational and environmental consideration. Planning authorities should be proactive in identifying areas which have the potential to accommodate fish farming developments and areas that do not".*

reduction in environmental impact".

There is significant emphasis on locational issues, spatial planning and "loch-wide" approaches:

> *"Scottish Ministers wish to promote a sustainable fish farming industry and direct new and modified development to suitable locations".*
>
> *"Development planning provides the opportunity for planning authorities to set out the locational policy framework for fish farming within the context of an overall strategy to meet the social, economic and environmental needs of an area".*

Box 15: Argyll and Bute Policy LP AQUA 1 - Shell Fish and Fin Fish Farming
"There is general support for shellfish and finfish farming subject to there being no significant adverse effect, directly, indirectly or cumulatively on:

1. Communities, settlements and their settings;
2. Landscape character, scenic quality, and visual amenity;
3. Loch Lomond and the Trossachs National Park;
4. National Scenic Areas and Areas of Panoramic Quality;
5. Statutorily protected nature conservation sites, habitats or species, including priority species and important seabird colonies along with wild fish populations;
6. Navigational interests;
7. Areas of Isolated Coast (coastal area of very sensitive countryside);
8. Sites of historic or archaeological interest and their settings;
9. Recreational interests;
10. Areas of Search for Wild Land;
11. Existing Aquaculture sites;
12. Water quality".

Steward (2008)

In support of this they make specific recommendations for the identification of *sensitive areas* (where there would be a presumption against development) and *potential development areas* where fish farming should be encouraged – *"subject to satisfactory consideration being given to material planning considerations" (Box 14)*

It is now unclear whether this policy will be implemented through aquaculture framework plans, through local development plans, or through regional marine plans drawn up under the provisions set out in the new Marine Bill.

However, implementation will vary according to local government priorities. The policy of Argyll and Bute Council on aquaculture is presented in Box 15. This may be summarized as being "highly qualified support". Several of our shellfish farmer respondents were of the view that recreation, tourism and landscape were a much higher priority than aquaculture in areas highly dependent on tourism, such as Argyll and Bute.

3.9.2 Framework Plans

Fish farming framework plans were introduced by Highland Council in the late '80s with a view to guiding aquaculture developments to appropriate locations and to help minimise conflicts of interest (Highland Council 2001a).

The Highland Framework plans are based on the following basic structure:

- Planning/policy background
- Objectives
- Features (topography, hydrography, access)

- Scale of aquaculture development and potential (historic and current development, future prospects)
- Planning issues (navigation, economic development, water quality, infrastructure, inshore fishing, landscape and amenity, nature conservation, recreation, game fisheries, archaeology)
- Strategy and area policies

Box 16. The objectives of the Loch Sunart aquaculture framework plan

- promote the operation and development of aquaculture which is environmentally sustainable and in harmony with other interests;
- sustain and if possible improve employment prospects in this area;
- raise public awareness generally of the resource value of Loch Sunart and its coastal areas and guide prospective aquaculture developers as to the various interests they should take into account;
- safeguard the key tourism and recreation assets of the loch;
- identify infrastructure investment priorities to support the development of aquaculture and to maximise the general economic and recreational value of the loch.

The nature and status of framework plans is addressed in SPP22:

> *"Non-statutory fish farming framework plans, setting out the planning authority's approach in greater detail to fish farming development in specific areas, have historically been prepared to further guide development and assist with decision making. They can provide supplementary planning guidance on fish farming and can support development plan policies on fish farming. They may also provide interim policy guidance until appropriate policies have been adopted in the relevant development plan. As supplementary planning guidance, framework plans are material considerations in determining applications and appeals, as set out in SPP1; The Planning System".*

It is clear from this that while framework plans are seen as an important tool, they are supplementary to (or serve to inform) the development plan and its implementation through planning consent policies.

The SPP22 guidance is fairly specific on issues to be taken into account in the development of framework plans:

- development plan context;
- description of the area, including hydrography;
- existing and potential development and scale of fish farming;
- area characteristics including flushing, pollution, separation, capacity,
- landscape / visual / nature conservation impact, infrastructure, other users, socio-economic interests;
- opportunities and constraints to further development;
- area policies including relocation potential and development in accordance with the industry's Codes of Good Practice.

These have been fully developed only in a few areas to date by Highland Council[14]. Shetland is undertaking this task as part of a broader coastal management initiative (SSMEI). Argyll and Bute anticipates a marine spatial planning type approach as illustrated in Box 17.

[14] Framework plans have been drawn up for Loch Bracadale, Loch Eriboll, Loch Hourne, Loch Inchard, Loch Sunart and Loch Nevis (draft)

Broadly speaking the Highland Framework Plans do not set the scene for significant expansion of shellfish farming. There are suggestions for areas suitable for “small to medium scale shellfish farming” but very little encouragement for any form of larger scale enterprise. Possible sites in more exposed or open locations are generally regarded as problematic from landscape or nature conservation perspectives.

An expert working group on aquaculture siting was convened in 2008 which commissioned a study on methodologies for the development of aquaculture framework plans (Epsilon Resource Management 2008), taking particular account of SPP22. This explored how draft or “pre-consultation” AFPs could be created relatively rapidly using a standard template. The study proposes a 3 zone approach to such plans: *no-go/sensitive* zones; *go or positive zones* with a presumption in favour of development subjective to some standard conditions, and *“current status”* zones where current (less predictable) procedures apply. A spreadsheet model/database was also developed in support of this process, but this has not been published. Overall the study suggests a more positive and pro-active approach to framework planning.

3.9.3 ICZM and marine spatial planning

Some local authorities have pursued the AFP concept through more integrated multi-sectoral marine planning approaches, as exemplified by the work of Argyll and Bute Council in Lochs Etive and Fyne, and the SSMEI initiatives in the Sound of Mull and Shetland. Broadly speaking, all of these adopt similar approaches, *i.e.*:

- Mapping the resources;
- Mapping current usage (and where possible value);
- Mapping constraints (such as designations);
- Assessing potential;
- Defining development and management policy for sub-sectors and/or specific zones.

An example of the approach being taken by Argyll and Bute Council on this is presented in Box 17.

Box 17. Marine spatial planning framework for aquaculture development – Argyll and Bute

1. Data mapped
•Aquaculture
•Recreation & Tourism
•Nature Conservation
•Sites of Historic Interest
•Marine Traffic & Navigation
•Fishing•Coastal/Marine Development
•Land Use
•Local Plan designations

2. Information ground-truthed by field assessments

3. Policy zones identified based on:
•Landscape character
•Wildlife interests
•Shoreline character & exposure
•Settlements
•Existing aquaculture
These policy zones would inform development consent.

4. Buffering distances established between aquaculture and other activities or features.

From Steward 2008

Zoning

There are widely different views about zoning and the strength of any zoning. Broadly speaking the government and SNH favours some form of zoning; many in the industry do not.

Our discussions with both finfish and shellfish farmers revealed a wide range of opinion, but general uneasiness about lines drawn on maps. There is a feeling that it is not healthy to “freeze” opportunities or constraints. Some were nervous of the cost, bureaucracy and lack of flexibility implied by any form of zonation, others were content with the idea of zonation limited to clearly defined “no go” zones, and yet others were in favour of both positive and negative zones or systems similar to that proposed by Epsilon (2008).

Separation distances or “buffering”

Irrespective of any provision for zoning, both farmers and planners are concerned about the distances between sites – there are issues of biosecurity, landscape capacity, navigation and so on. The Scottish Executive (now Government) ‘Locational Guidance for the Authorisation of Marine Fish Farms in Scottish Waters (1999)’ recommends minimum separation distances as follows:

- 8km between finfish farms
- 3km between a finfish farm and a shellfish farm
- 1.5km between two shellfish farms

The guidance advises that closer siting may be possible between small scale farms and in large loch systems or open water.

The concept of buffering distances, irrespective of any zonation, illustrates the potential effect of more integrated marine planning on fish farming. By way of example, Argyll and Bute have drawn up the following indicative guidance on separation or buffering distances as part of its ICZM approach:

New development should be
1km from other:

- discharge consents
- fish farms
- water intakes
- popular recreational areas
- tourist route roads
- trunk roads
- large and small settlements
- gardens and designed landscapes
- historical sites and settings
- wildlife interests
- wildfish rivers
- navigation buoys

500m from

- dive sites,
- anchorages,
- sub-sea cables

300m from ferry routes

In many areas, such restrictions would significantly constrain potential for new or expanded fish farming activity.

Overall

A key issue here is whether higher level strategic zoning or marine spatial planning is practicable or cost effective. There are typically many local and dynamic constraints – which may include relationships between users and between companies, changing needs and opportunities – which are already well known at local level. This makes higher level strategic long term planning very difficult unless this local understanding can be effectively fed into a higher level planning system. This in turn raises the issue of representation: the industry itself is diverse; there are many "single interest issues". It will be difficult and costly to reach agreement. More locally based decision making may open up local social wounds; more regional decision making may be inadequately informed about practical local issues.

Whatever the views of farmers and the representational difficulties, the current weight of political opinion is firmly behind some form of zoning for aquaculture developed in one of three possible ways, or through a combination of these:

- Aquaculture and other sectoral framework plans;
- Local authority multi-sectoral (integrated) marine spatial plans;
- Regional marine plans (as proposed in the Marine Bill).

Some form of ICZM will be implemented under the new Marine Bill, and it is likely that both guidance and procedures will become more consistent.

Overall assessment: moderate to high

3.10 Finance and investment (confidence)

Financing of fish farming is a major issue, and crops up repeatedly in discussions with farmers.

Bank loans

Difficulty in raising loans is unsurprising given the many constraints outlined in the previous sections. The main problems with shellfish farming from the perspective of a lender or investor are:

- Long lead time
- Variable market price
- High risk/uncertain production and marketing related to uncontrollable external factors
- Difficulties in providing collateral (the main asset (growing shellfish) is not acceptable as low risk collateral).

Grants

Funding is now available for rural businesses throughout Scotland for diversification and renewable energy projects through the Scottish Rural Development Programme (SRDP) 2007-2013. Specifically, support is delivered through Rural Development Contracts – Rural Priorities, which was launched in April 2008.

Over the same timescale, £38.83 million from the European Fisheries Fund (EFF) has been secured for Scotland, of which £12.41 million is earmarked for the Highlands and Islands.

The EFF is designed “to help modernise and secure the sustainability and international competitiveness of the fishing industry” and may apply to individual projects or sector wide initiatives. Examples of grant funding under this programme to date in 2009 are listed in Box 18

Highlands and Islands Enterprise (and its predecessor, Highlands and Islands Development Board) has provided substantial assistance to the shellfish farming sector throughout its region, although its new focus is on businesses of growth, and its future assistance will be concentrated on a limited number of companies within this sector, together with other businesses that play a role in its designated fragile areas (in which many shellfish farming businesses are located). Collaborative marketing and sub regional branding initiatives, focused on food and drink, are priorities for support from local and regional agencies, and can attract EU LEADER funding.

Overall assessment: moderate to high

Box 18. Grant aid to shellfish farmers under the EFF

Mussel Harvest Ltd, Yell, Shetland
£90,630 towards workboat modernisation and installation of additional mussel harvesting equipment (plus £4,770 other public assistance).

Blueshell Mussels, Brae, Shetland
£444,691 towards installation of new growing lines, ancillary anchors and associated equipment (plus £25,000 other public assistance).

Loch Laxford Shellfish Ltd, Scourie, Sutherland
£245,326 towards expansion of mussel farm, infrastructure upgrades, purchase of workboat, equipment and machinery (plus £124,352 other public assistance).

North Atlantic Shellfish, Walls, Shetland (processing)
£64,000 towards expansion of ultra violet water disinfection system (plus £6,080 other public assistance – to be confirmed).

Inverlussa Shellfish Co Ltd, Mull
£27,860 towards conversion to New Zealand system of mussel farming (plus £1,466 other public assistance).
The New Zealand cultivation technique uses a continuous rope system, with loops of special rope hanging down from heavy horizontal ones. Instead of pulling in single individual ropes, the continuous loops can be drawn aboard collection vessels and through harvesting machines.

Pioneer Mussels, Skye
£6,883 towards purchase of float moulding machine from New Zealand to produce floats of novel design (plus £362 other public assistance).

SSMG Ltd, Bellshill, Glasgow (processing)
£41,183 towards new chill store, steam cooker, and other equipment (plus £2,168 other public assistance).

Demlane Ltd, Walls, Shetland (processing)
£455,561 towards purchase and installation of a range of cooking, packaging and freezing equipment (mussels).

C & A Thomason, Yell, Shetland
£31,583 towards purchase of a washer, grader and

3.11 Climate change

Climate change may have advantages and disadvantages for shellfish farming in Scotland. Broadly speaking growth rates of both mussels and oysters will increase with higher temperatures, although extreme high temperatures would represent a problem. The incidence of toxic algae might also increase, which would represent a more significant problem. The impact on other biological issues such as food supply, fouling, disease and predation is unclear.

Assessment: low

4 Interviews with shellfish farmers

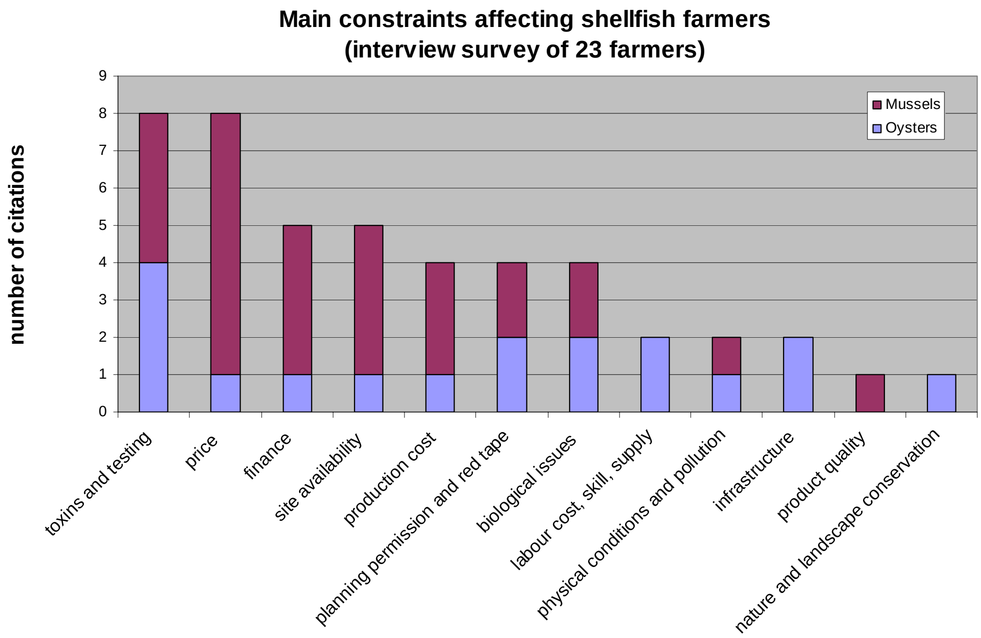
A total of 25 interviews were conducted with shellfish farmers – 23 by phone and two in depth face to face. The objective of these interviews was to understand historic, current and potential future constraints on the industry, the relative importance of designations within this wider picture and future opportunities.

Taken together our sample of farmers produced 3,795t mussels (13 farmers) and 173t of oysters (10 farmers) last year. They account for around 70% of Scottish oyster and 80% of Scottish Mussel production.

4.1 Priority constraints

Figure 24 shows the overall results in terms of the frequency with which different constraints were cited as important. Most farmers cited two or three such constraints.

Figure 24



4.2 Toxins and testing

The incidence of toxic algae and the associated sampling regime was the most significant constraint identified in the survey and was equally an issue for mussel and oyster farmers. In most cases farmers accept the need for the sampling and periodic closures and considered the regime appropriate if problematic. Two farmers felt the regime was excessively constraining. This is a particular problem for smaller farmers targeting local markets. Demand is much higher during the (summer) tourist season, and this is also the time when closures are most likely.

4.3 Market price and production cost

Market price appeared to be a particular issue for mussel farmers. Many referred to recent over-supply and a fall in prices. This is largely because Scottish (long line) farmers are targeting higher value domestic markets (restaurants) and part prepared products (supermarkets). There is a much bigger market for lower value live fresh mussels currently supplied mainly by the French, Dutch, Irish etc. from dredged mussel beds – either natural or laid. To compete in this market would require far greater scale and highly mechanised production.

Several farmers suggested that there were "too many small farms", and there was a need for more scale and mechanisation. It is notable that the Scottish Shellfish marketing Group do not want small scale (<100tonnes) producers as members.

The current farm gate price is around £650/tonne. Cleaned and packed Glasgow the wholesale price is around £1.30/kg. Production costs are highly varied, but probably in the region of £450/kg for a farm of more than 200 tonnes and substantially more for smaller farms.

4.4 Finance

Historically it has been very difficult for shellfish farmers to borrow from financial institutions. The two biggest assets of a farm are not on the balance sheet: the site and the stock. Put together with the production and market uncertainties looking well into the future…*this would class as high risk, low return investment, with limited realisable assets in case of failure.* Finance has therefore usually come from private individuals with a particular interest in shellfish farming, sometimes supplemented by regional investment (grant/low interest loan from HIE, Local Government etc).

The recent growth of the industry in Shetland may, in part, be explained by availability of local private sector financing (e.g. from salmon farm rationalisation and some sectors of the fishing industry) coupled with strong local government support.

4.5 Site availability

This is a complex issue and is closely related to planning permission, biological issues, physical issues, nature conservation etc. Taken together with planning permission this was identified by farmers as the most significant constraint on the expansion of the industry. Of the 25 shellfish farmers interviewed only 4 (mainly oyster farmers based in Argyll) said that there were plenty of sites still available. Thirteen farmers said that sites were very difficult to find, unless existing underutilised sites and/or salmon sites could be brought into shellfish production.

Site availability is a major issue affecting new entrants or those with ambitions for serious expansion, as was made clear in our interview with a farmer actively seeking new larger sites. For mussel farming the problem is to find relatively large sites in sheltered but relatively open water; for oyster culture the problem is finding sheltered areas with extensive sandy substrate at low water – many such areas are of recreational importance. It is worth repeating the point previously raised in relation to landscape. A 200tonne mussel farm will require approximately 40ha. This does not chime particularly well with, for example, the existing Highland Framework plans, nor with the approach advocated by SNH in relation to landscape capacity. It would appear that there are few sites available for new medium-large scale enterprises.

Site availability will therefore depend to a significant degree on rationalisation of, or a market for existing sites. Two factors militate against this:

1. Many existing sites are for enterprises close to the homes of “lifestyle” farmers. It is unclear that they would wish to give them up and have much larger enterprises operating close to their homes;
2. A change of owner would probably imply a change in consent conditions and in particular quantity of production/length of lines etc. This is likely to result in a new round of planning uncertainties.

4.6 Planning permission, red tape

Planning permission was seen as a significant constraint by many farmers and is closely allied to site availability issues. Taken together these issues would exceed toxins as the key issue of concern. Of particular note, one farmer who wishes to expand into larger scale production has given up on finding suitable sites in Scotland. He considered there is too much red tape in Scotland and is currently looking to invest in England. He believed that there is no real room for expansion, at an appropriate scale, in Scotland, unless problems of "prior use" can be overcome. Most locations, he suggests, are overly tourist industry orientated and there are too many landscape objections, especially from second home owners.

One farmer noted the problem of needing to put in a full planning application costing £7,000. Given the uncertainties associated with site performance (growth, predation etc.) it would be better to allow for a cheaper (say £1,000) “testing of the waters”. Another suggested that planning costs may be as high as £20-30,000 in total (see box 19).

Other farmers noted the interaction between the problems of long lead time (growing) and delays related to planning permission. This creates significant financing and

Box 19. Perspective of Association of Scottish Shellfish Growers (ASSG) on planning for shellfish farm development
(Under Phase 1 of this research an in depth interview was conducted with Doug Macleod, at that time representing ASSG. The following summarizes his perspective)

The new application process to the local authority planners is expensive and the formula to calculate costs does not seem to be universally applied. Estimates of the cost for a pilot farm application from his members has varied between £3,000 and £11,000 – irrespective of the success or otherwise of the trial. This is a significant disincentive to new applicants. The new process is also much slower (6 months as opposed to about 2 months previously). He also suggested that local authority planners lack the resources and expertise to properly evaluate applications, so are often overly influenced by objection letters.

A key issue here is the nature of decision making institutions. Under the new regime the final decision maker is the planning committee – a group of politicians responding primarily (and rightly) to the interests of local constituents. Since most established constituents do not wish to see development - because of the high numbers in the tourist industry, B&B etc - the dice is loaded against planning approval, especially where only a small number of jobs is involved.

The power of SNH is also significant. Though local government is not obliged to take its advice, it would feel vulnerable standing against such advice, especially where the proposal related to an SAC, or where local support for nature conservation was strong.

There is a need for a standard protocol which would facilitate low cost pilot trials prior to any more formal and expensive planning application.

logistical problems. For an oyster farm we may be looking at two years to find a site and get permission and a further four years before any marketable product. This is not attractive to most investors and certainly not for a bank loan. One farmer noted that , the delay and red tape makes entry to the business by young local people very unlikely.

There was significant regional variation in terms of attitudes to planning permission. Broadly speaking Shetland farmers considered the planning environment to be supportive of aquaculture, while farmers from the west coast were more negative. One farmer from Skye described the planning system as “horrendous”; another from Argyll described planners as “hostile”. Yet another suggested there was “not a hope in hell” of starting a new farm in the area.

2.4.1 Uncertainty

It is worth here referring to the phase 1 research (Appendix 1) in which we scoped some of the key contraints facing the aquaculture industry as a whole in Scotland through discussions with farmers (mainly salmon farmers). A repeated message was that the greatest concern in relation to planning is the degree of uncertainty over potential outcomes.

There have been several recent planning applications which have run into difficulties, which were unforeseen, although legitimate. To an extent the degree of uncertainty can be reduced by increased pre-application screening and consultation with both statutory consultees and wider stakeholders (including the general public). Uncertainty may also be reduced through adhering closely to locational guidelines, and known areas of potential difficulties. However, this is not always straightforward. For example, it is not always clear to applicants whether conservation designations, or national scenic areas should be avoided. In these cases the legislation and the application of the law does not rule out economic activity taking place, but experience on the part of the applicants suggests that such designations are, at the very least, likely to add to the cost and to the degree of uncertainty over the eventual outcome of the planning process.

Perhaps the single biggest cause of uncertainty in planning applications is the response to a development proposal from the wider public. This is also the area where pre-consultation is most difficult.

4.7 Biological issues

Growth rate and food availability appears to be more of an issue with oyster farmers than for mussel farmers. This reflects the fact that oysters are more often produced in very sheltered intertidal/subtidal areas where water exchange may be less effective than in deeper channels and somewhat more open locations used for mussel farming. It is also related to the fact that oysters may take 4 years to reach marketable size. This is already a major drawback from an investment perspective and the possibility of slow growth greatly increases investment risk.

Predation was flagged as a major issue at some sites and this may become more of a problem as scale increases and predators adapt to the location of a major food resource. One mussel farmer noted that a significant local Eider duck population can wipe out a farm. Eiders are not by any means rare around Scottish coasts. While there are a variety of anti-predator devices (nets, curtains, sonic boom, chasing) these are all methods of concern to Scottish Natural Heritage, especially near seal and otter sites.

Seed availability did not figure as a major constraint, although it is a significant factor when seeking suitable sites. Only one farmer mentioned this as a variable problem which adds to the uncertainty of production. There is good spatfall for mussels at many locations around the coast. Oyster seed is available from hatcheries in England.

4.8 Labour

Several respondents raised the issue of the difficulty of attracting or keeping young skilled local labour, or attracting young local entrepreneurs into the business. This raises questions about both the practicalities of significant expansion and potential social and economic contribution.

4.9 Physical conditions and pollution

Pollution was raised as an issue by only one farmer, reflecting the generally pristine waters in which shellfish culture takes place in Scotland. Physical conditions in terms of water temperature, storm damage was raised by one other.

4.10 Infrastructure

Two mussel farmers specifically raised the issue of getting the product to marke, and specifically ferry timing/cost/availability.

4.11 Product quality

Only one farmer mentioned product quality as an issue (other than in relation to toxins).

4.12 Nature conservation and landscape

Again this cropped up specifically only once, though it plays a significant role in planning. As for some of the other contraints this is less of an issue for incumbent farmers than it would be for new entrants, or in relation to major developments.

4.13 Future development

Of 7 mussel farmers who provided information on future planned production, 3 planned to expand, 1 anticipated somewhat lower but variable production in future, and 4 planned no change in production. The total anticipated increase over the next 5 years corresponded to a 14% growth.

Of 7 oyster farmers who provided information on future production plans, 2 planned significant expansion (these were the larger farms), 4 anticipated no change, and 1 expected decrease. The total anticipated increase over the next 5 years corresponded to a 69% growth.

5 Overview and summary of constraints

Taking into account both the desk analysis and the interviews with farmers, we have made the following assessment of the relative severity of the various constraints as they affect shellfish farm development at present.

Table 4: Summary of constraints on shellfish farm development

Constraint	Relative Severity	Comment
Existence of suitable sites – physical (temp, salinity, depth, exposure, water exchange, current, substrate)	**	Analysis of maps and physical data reveals large numbers of suitable sites
Existence of suitable sites - biological (food, predators, fouling, disease)	***	Mussels and scallop dependent on natural spatfall
Suitable location for shore base	***	Many suitable marine sites rather isolated
Site availability: Prior use by other fish farmers	*****	Most of the best sites have already been taken
Site availability: Prior use for fishing	**	Historically significant
Site availability: prior or preferred use for navigation and recreation	****	Historically significant; recreation issues increasing. Particular problem with large shellfish farms
Site availability: nature conservation	***	SACs/SPA cover relatively small proportion of suitable sites but many in close proximity
Site availability: historic sites	I*	
Site availability: landscape designation and protection (overlaps with planning)	****	Historically significant
Shellfish growing waters classification	*	
Shellfish harvesting waters classification	**	No classification until operation established; classification may be seasonal and may change
Closures relating to biotoxins	****	Necessary evil
Planning permission to establish	***?	Very dependent on local government priorities and social-economic structure. Closely linked to site availability issues
Planning permission to expand	***	Rather unclear?
Obtaining a lease	I*	but see availability above
Market access, processing, logistics	***	Aggregation of sufficient product and processing significant problem for many locations
Market demand/competition	**	Strong demand for relatively small quantities of premium Scottish mussels but uncertainty about potential size
Finance	****	Not an attractive investment (high risk; low return).
The overall weight and uncertainty associated with consents and regulation	*****	

= low; ***** = high

Note that planning permission encompasses and overlaps a range of subsidiary constraints, including designations, other users, local interests etc.

Broadly speaking, these constraints apply to mussel, oyster and scallop farming, although there are local differences in terms of the severity of these various constraints on the different species. Taken together, these constraints are highly significant, and many are difficult to address. This largely explains the limited development of the industry over the last two decades.

6 The emerging marine management framework

6.1 The international context

2002 World Summit on Sustainable Development (WSSD)

The UK and Scottish Governments are both committed to delivering the outcomes of this summit. For the oceans these are "to promote integrated sustainable management….at all levels in order to help maintain the productivity and biodiversity of marine and coastal areas and help secure a significant reduction in biodiversity decline by 2010". These will be delivered through the:

- introduction of various policies, measures and tools such as the ecosystem approach, marine protected areas (MPAs) and the incorporation of coastal interests in watershed management; and
- introduction and development of effective machinery of oceans governance and partnerships.

6.2 OSPAR commitment.

Originating from the Oslo Convention of 1972 and Paris Convention of 1974, OSPAR has become the primary focus for international agreements relating to the protection of the marine environment in the North East Atlantic region. An early initiative was to determine the pollutant load to the marine environment, now formalised through the Water Environment and Water Services Act of 2003. OSPAR commitments dating from 1998 include the precautionary principle, the polluter pays principle, best available techniques and best environmental practice. OSPAR now also plays a significant role in coordinating and standardising national monitoring and assessment initiatives. The convention has agreed several long term strategies, addressing hazardous substances, radioactive substances, eutrophication, protection of ecosystems and biodiversity and environmental goals and management mechanisms for offshore activities.

Of particular relevance to aquaculture are commitments:

- To reach concentrations of hazardous substances equivalent to near background levels for naturally-occurring substances, and close to zero for man-made synthetic substances in the marine environment by 2020.
- To eliminate eutrophication where it occurs in the North-East Atlantic and to prevent further occurrences.
- To manage human activity and support the ecosystem approach, make assessments of species and habitats and develop an ecologically coherent network of marine protected areas.

OSPAR publishes a set of "Quality Status Reports" on the quality of the marine environment of the North East Atlantic. The relevant reports for Scottish Aquaculture are for region II (the Greater North Sea) and Region III (Celtic Seas). An updated report will be produced in 2010.

6.3 European Marine Strategy Framework Directive (2008)

This Directive is effectively the marine extension of the approach developed under the Water Framework Directive (WFD). The aim of the EU Marine Strategy Framework Directive (adopted in June 2008) is to protect more effectively the marine environment across Europe. It aims to achieve good environmental status of the EU's marine waters by 2021 and to protect the resource base upon which marine-related economic and social activities depend.

> **Box 20. Definition of Good Environmental Status – Marine Strategy Framework Directive**
>
> "good environmental status" means the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations, i.e.:
> (a) the structure, functions and processes of the constituent marine ecosystems, together with the associated physiographic, geographic, geological and climatic factors, allow those ecosystems to function fully and to maintain their resilience to human induced environmental change. Marine species and habitats are protected, human induced decline of biodiversity is prevented and diverse biological components function in balance;
> (b) hydro-morphological, physical and chemical properties of the ecosystems, including those properties which result from human activities in the area concerned, support the ecosystems as described above. Anthropogenic inputs of substances and energy, including noise, into the marine environment do not cause pollution effects

The Marine Strategy Framework Directive (MSFD) establishes European Marine Regions on the basis of geographical and environmental criteria. These are largely consistent with the OSPAR regions. Each Member State - cooperating with other Member States and non-EU countries within a marine region - are required to develop strategies for their marine waters. These strategies must contain a detailed assessment of the state of the environment, a definition of "good environmental status" at regional level and the establishment of clear environmental targets and monitoring programmes.

Each Member State must draw up a programme of cost-effective measures to ensure that good environmental status is achieved. Prior to any new measure an impact assessment which contains a detailed cost-benefit analysis of the proposed measures is required. Where Member States cannot reach the environmental targets specific measures tailored to the particular context of the area and situation will be drawn up.

In terms of the effects of all of this on fish farming, much depends upon the interpretation of Good Environmental Status (GES). The definition in the MSDF is presented in Box 20. In practice this is rather similar to good ecological status under the WFD – and it is likely that it will be taken into account in much the same way as the existing WFD requirements as they already apply to marine fish farming in coastal waters.

6.4 Landscape capacity

Scottish Planning Policy 22 and other guidance documents highlight the need to take account of cumulative impacts on the environment and landscape. The former is largely dealt with by Scottish Environmental Protection Agency (SEPA) and ongoing work on carrying capacity. It may also be addressed through an extension of marine protected areas as proposed under the new Marine Bill (see section 6.5). Cumulative impact on landscape has been discussed for many years and there is now a major guidance document available, produced by SNH (2008). The proposed approach or procedure is summarized in Box 21.

It is clear that this is a relatively rigorous and technical process, informed by subjective assessment. A key feature, however, is that it starts with landscape as the priority, effectively leaving or defining areas that may be suitable for fish farming: *"To assess the character and visual qualities of coastal areas to determine where aquaculture development may be best accommodated"* (Counsell, 2008). Such an approach is likely to further reduce site availability. It is notable that Local Authorities such as Argyll and Bute are considering using this as a starting point for defining marine spatial plans in relation to aquaculture. A more integrated and compromising approach would bring together plans for sector development alongside landscape plans with a view to identifying either win-win or best compromise sites.

Landscape may be a particular problem with regards to the further development of the industry. Larger farms are likely to be best located in more open areas with higher flushing rates and therefore higher capacity. Production of mussels is likely to be around 5 tonnes/ha/year (Holmyard 2008a). A viable commercial mussel farm is probably more than 200tonnes in size, corresponding to 40ha. With conventional floats this would be a significant intrusion into the seascape from the perspective of many. Although submerged lines can be used, this in turn raises issues about visibility and navigation). It is therefore difficult to conceive of major developments of this kind meshing in well with the landscape capacity approach described above, and in those areas where tourism is important and fish farming a lower priority, problems with planning permission seem likely.

There are, however, other views – and, in particular, the desire for a "working" landscape. A recent SARF study (SARF 045) shows that tourists in general are not averse to fish farms in the Scottish coastal landscape. Overall impressions were more positive than negative with more than 40% of respondents considering them to have a slightly or very positive impact on their experience of the Scottish coastline, compared with just under 20% considering them to have slightly or very negative impact.

"The overwhelming majority of respondents agreed that:

- Fish farms contribute to the livelihoods in coastal communities;
- Fish farms do not spoil the appearance of the coast; and
- Tourists would not be less likely to visit those places in Scotland where fish farms are sited."

However, approximately one third of respondents "had some form of negative response to the impact of fish farming on the scenery and natural environment at current production levels" and the possibility of further expansion of fish farming elicited a negative response (in terms of effect on scenery and natural environment) in almost half of visitors at a case study site. Amongst tourism businesses interviewed there was no suggestion that aquaculture has a negative impact on tourism in Scotland.

There is ammunition for both sides here. It shows that a "working landscape" is enjoyed by most visitors - the study also showed that a majority of people like to see fishing boats, yachts, marinas, angling and commercial shipping. Equally it shows that people (including visitors) do not like the prospect of change, and some are aware of possible negative impacts associated with fish farming – although it is unclear whether or not this applies to the same degree to shellfish farming.

Box 21. SNH Guidance on landscape/seasacape capacity for aquaculture. Summary of procedures

Preliminary desk study: Preparation of the brief

- Choose the study area
- Allocate the timescale
- Identify a working map scale
- Decide on development scenarios

  Output: A finalised brief

1 Make the initial site visit: *Decide on Coastal Character Areas*

- Undertake a strategic assessment of character during a car based survey of the study area
- Identify Coastal Character Areas which have geographical integrity and recognisable identity

  Output: A map showing the Coastal Character Areas

2 Undertake detailed survey and analysis: Decide on Local Coastal Character Areas and key Features

- Survey and analyse the seascape character
- Identify key characteristics, experiences, features and visual qualities
- Identify Local Coastal Character Areas which have consistent character and integrity
- Identify key viewpoints and take photographs if required

  Output: A map showing the Local Coastal Character Areas and key features. Key characteristics within each Local Coastal Character Area should be listed using bullet point style text, accompanied by photographs if required.

3 Identify opportunities and constraints: Analyse the survey work to:

- Decide which characteristics or features of the seascape are likely to be helpful in accommodating aquaculture development
- Identify which qualities and characteristics are likely to be compromised or detrimentally affected by aquaculture development
- Assess the potential impact of aquaculture on visual amenity and key viewpoints to contribute to the opportunities and constraints analysis

  Output: Identified opportunities and constraints within each Local Coastal Character Area should be presented as bullet pointed text. Key features mentioned in this text should be mapped.

4 Undertake sensitivity assessment: Assess and rate sensitivity and then prepare justifications for sensitivity ratings

- Carefully analyse the sensitivity of each Local Coastal Character Area to aquaculture development, using the six criteria listed in this guidance
- Allocate sensitivity using the five point rating for each of the criteria
- Prepare explanations and justifications to be included in the matrix

Output: Your rating and justifications against each of the six relevant criteria within each Local Coastal Character Area should be recorded in matrix format

5.0 Present conclusions: Draw up recommendations and guidance
study area.

- Drawing on the sensitivities identified, prepare written recommendations on the potential to accommodate aquaculture development in each Local Coastal Character Area
- Write up guidance and advice on accommodating new development if relevant
- Prepare strategic conclusions which draw out over arching themes and general findings which will accompany a composite map of all the recommendations within the whole study area

Output: Recommendations are presented in the form of text, with any guidance included as bullet point advice. An accompanying map brings together all the recommendations across the whole study area.

6.5 *The Marine Bill*

Partly in response to its international commitments described above and also in response to a series of analyses and initiatives relating to the management of the marine environment in Scotland over the last decade[15], the Marine (Scotland) Bill was introduced to the Scottish Parliament on April 29, 2009. Key measures include:

Part 2: Provision for the preparation of a National Marine Plan (NMP) and Regional Marine Plans (RMPs)
Part 3. New provisions for licensing of marine activities
Part 4: Marine protection and enhancement: the Scottish Marine Protection Area
Part 5: Conservation of seals
Part 6: Common enforcement powers
Part 7 General Provisions

The following summarizes some of the key provisions which may have relevance to shellfish farm development.

6.5.1 Marine Plans

Part 2 of the Marine Bill makes provision for the preparation, review, amendment and withdrawal by Ministers of national and regional marine plans. Section 8 allows for the preparation of these plans to be delegated to either:

- A designated public authority; or
- A group of persons nominated by relevant Public Authorities and/or Ministers

The Bill does not define in any way the composition of any regional group or "partnership" which might ultimately be responsible for the preparation of RMPs, and specifically (Section 9) allows for variations between different areas or cases in the nature and degree of delegation. Ministers retain significant powers in terms of determining procedure (and, in particular, public consultation), directing delegates, amendment, adoption, and withdrawal of a plan.

Section 11 sets out mechanisms for implementation of marine plans in terms of the responsibilities of public authorities. A public authority must take any authorisation or enforcement decision "in accordance" with marine plans, unless relevant considerations indicate otherwise, in which case it must state its reasons. More generally, a public authority "must have regard" to the appropriate marine plans in making any decision capable of affecting the whole or any part of the Scottish marine area.

6.5.2 Marine Licensing

Part 3 of the Bill addresses marine licensing. Section 16 sets down a general requirement for a marine license for any of the following activities:

- To deposit any substance or object in the sea, on or under the seabed
- To scuttle any vessel or floating container
- To construct, alter or improve any works within the Scottish marine area in or over the sea, or on or under the seabed.
- To remove any object or substance from the seabed
- Dredging

[15] Including for example the working groups associated with AGMACS and the more recent Sustainable Seas Task Force

- Use of explosives
- Incineration or loading for incineration at sea

Scottish Ministers may (by order) add or remove any activity from this list. Clearly, all forms of marine fish farming are subject to licensing under this section.

The bill addresses issues of procedures in granting a license and the setting of any conditions; enquiries; variation, suspension, revocation etc. It specifically allows for *exemptions* (by Ministerial order) and licensing *thresholds*. Thus Ministers may (by regulations) provide that licensable activities below a specified threshold of environmental impact are not to need a license but are instead to be **registered**. It remains to be seen whether this might apply to small scale shellfish farming.

Section 42 of the Bill allows for Ministers to delegate some functions relating to marine licensing to either:

"(a) a public authority, or
(b) a group of persons comprising (either or both)—
  (i) persons nominated by such public authorities with an interest in the Scottish marine area as the Scottish Ministers consider appropriate,
  (ii) persons nominated by the Scottish Ministers."

Section 54 has particular relevance since it amends the Town and Country Planning (Scotland) Act 1997. It allows Scottish Ministers to provide by order – and for particular water areas and/or planning authorities - that marine fish farming is not "development", and that Section 26 (6) of that Act does not apply.

6.5.3 Marine Protected Areas

The Marine Bill confers powers on Ministers to designate any area within the "Scottish Marine Protection Area" as Nature Conservation Marine Protected Area (NCMPA), as a Demonstration and Research MPA (DRMPA), or as a Historic MPA (HMPA). This may include islands.

The purpose of NCMPAs is to conserve marine flora and fauna, habitats or habitat types (including conservation of rare or threatened species, and diversity of flora, fauna and habitats irrespective of rarity), and features of geological or geomorphological importance. The features conserved should also be "representative" of their type. An NCMPA would be defined by its "protected features" and conservation objectives.

The site selection process will be technically driven with a priority on nature conservation. Section 59 (5) makes it clear that social and economic criteria would only be considered where there was a choice between areas of similar nature conservation value.

6.5.4 Research and demonstration MPAs (RDMPAs) and Historic MPAs

The purpose of RDMPAs is:

(a) demonstration of sustainable methods of marine management or exploitation,
(b) research into such matters.

Regard must be paid to the views of relevant delegates and social and economic consequences when selecting these sites.

An area may be designated by a designation order as a historic MPA if the Scottish ministers consider it to be desirable to do so for the purpose of preserving a marine historic asset of national importance.

6.5.5 General Provisions and implementation

Various provisions are set down in terms of public notices, requirement to consult those affected prior to making a designation, provisions for urgent designations, opportunities for representation and hearing, role of Scottish Natural Heritage (SNH) as advisors and so on.

Public authorities are required to *further* or where necessary *least hinder* conservation/preservation objectives of NCMPAs and HMPAs (Section 71). If least hinder, they must inform ministers/SNH and have regard to advice given by SNH/ministers. Under section 72, they have more specific duties in terms of decision making (consents and authorisations), being required to ensure that consented activities do not hinder the achievement of MPA purpose or objectives. If there is a risk that a consent decision will hinder these objectives the public authority must inform Ministers/SNH. Consent should only be considered if the applicant can demonstrate there is no significant risk, or:

- there is no better (lower risk) means of proceeding with the activity; and
- public benefit would outweigh any risk of damage; and
- arrangements will be made to generate environmental benefit equivalent to that lost

In the case of HMPAs, a developer in such circumstances may be required to undertake detailed archaeological survey as a condition of authorisation.

In all cases the Public Authority must have regard to advice from Ministers and/or SNH. Section 73 sets down the consequences/sanctions associated with any failure to comply with the duties set down in section 72.

Under Section 74 Marine Conservation Orders may be issued by ministers to further the purpose or objectives of MPAs and/or associated with European Marine Sites.

6.5.6 Potential implications of the Marine Bill

The Bill as it stands is not especially precise about the procedure for the development of regional marine plans, and in particular, the nature of any public authority or any group of appointed delegates who may be charged with the development of these plans. This is a crucial issue to be resolved, since the balance of interests on any such body will have a significant influence on the nature of the plans, as will the ability of representatives of commercial interests (such as aquaculture) to find the time to attend meetings, respond to lengthy draft documents, etc. vis-à-vis the time that others (perhaps retired) who might be anti-development might commit. Also, where there might not already be a shellfish enterprise within a local area, there might be nobody to represent a potential new site opportunity prior to a business proposition emerging.

Much will also depend on the extent to which local authority ICZM plans or sectoral framework plans are developed and their relationship with regional plans.

Broadly speaking the plans may either facilitate or further constrain shellfish farm development *depending on the manner in which priorities are established, and the representation of various interests and stakeholders in this process*. If the clearly stated policy in both national and regional marine plans is to expand shellfish farming by identifying suitable locations (from an aquaculture perspective) and promoting/facilitating aquaculture in those areas, then this should help development. However, the guidance would have to be clear that other interests – and in particular, landscape - may have to be compromised in the best locations for aquaculture. If fish farming is left to use what is left when all other interests are accommodated, very few economically viable sites will be available.

7 Discussion

The constraints
It is clear that shellfish farming faces a formidable array of constraints, including in particular, markets, site availability, toxic algae - and possible constraints on new sites or expansion of existing sites related to landscape, nature conservation, navigation and recreation. From an independent business perspective, investment in shellfish farming in Scotland at the present time is not particularly attractive, with significant planning uncertainties, long lead time, high labour costs, high production risk, and probably a relatively small market (at attractive prices) – although this requires further research.

Escaping the constraints: Shetland's "mini-boom".
A key question that arises is therefore the reason for the "mini-boom" in mussel farming earlier in the decade in Shetland, as illustrated in Figure 1. Discussions with those in the industry suggest that several factors were at play:

- The freeing up of unwanted salmon farm sites as part of the rationalisation of that industry;
- A well developed seafood infrastructure, including piers and jetties, a range of readily available work boats, chilled transport and a supportive council;
- Investment finance available from local interests, including salmon farm businesses which had been sold to larger companies, fishing companies, and support from the local council;
- An emerging market for high quality pre-packaged convenience "home cooked" *moules mariniere* and similar products

The flip side of this question is why the industry in the rest of Scotland has neither expanded nor contracted. This seems to be related to two issues: first that two or three companies have expanded to a reasonable size but are aware of significant market constraints and have no reason or desire to risk over-supply of a relatively small niche market, especially if such expansion is going to be costly for logistical or planning reasons; and secondly that many of the smaller farmers are "lifestyle farmers" – shellfish farming offers a decent supplement to a family or retirement income in a relatively isolated locations where there is little alternative opportunity. But they have no desire – and possibly limited opportunity – to expand into a major business.

The role of designations
Across all of this is the question as to whether designations have been a significant factor constraining the industry in the past, or might become a constraining factor in the future. Our analysis suggests that by far the most important constraints in the past (other than purely economic) have been prior use issues i.e. existing farms or leases, or planning objections relating to fishing, mooring, and navigation. Landscape has also sometimes been an issue, and occasionally nature conservation designations, but these have not been the most serious constraints.

A changing policy environment
For the future there remains much uncertainty. The new Marine Bill (now with Parliament) seeks to establish a more predictable investment environment through the development of a National Marine Plan and Regional Marine Plans. It also allows for the establishment of three types of Marine Protected Area (MPA) and for a more integrated licensing system. The objective in the new MPAs – as for Natura sites -

will be the conservation of designated features. It will not be "sustainable development". With regards to landscape it is possible that the "landscape capacity" approach advocated by SNH will become a key process in the development of regional marine plans and/or local government development plans. Although small scale shellfish farming in most cases will be compatible with conservation and landscape objectives, larger scale developments may well not be. Although the investment environment in the future may be more predictable, it may not be conducive to significant further development of the industry.

There must be concern therefore that under the new regime – and despite the support of government for shellfish farming - aquaculture will get "*whats left*" once a range of well organised interest groups have had their input to some form of marine spatial plan at regional or local authority level. The existing examples of framework plans presented in section 3 already illustrate the likelihood of significant restriction – or at least very limited encouragement - associated with such plans. The Sound of Mull SSMEI pilot was also instructive in this regard. Very limited areas were identified as being open for fish farm development, and some of these turned out to be unsuitable for fish farming because of the presence of *Modiolus* mussels. But the mode of development of these marine spatial plans is still unclear, and the implications for shellfish farming remain uncertain.

Integration and representation

This raises the issue of where to start. If all existing uses and needs for protection are mapped, very little will be left. A more pro-active approach by fish farmers – to identify areas for rationalisation and expansion – which can then be fed into marine spatial planning - would seem to be the best way to accommodate a reasonable level of development. But many fish farmers are surprisingly resistant to such an approach. They would rather the apparent flexibility of "*tell us where we can't go*" – then we can select from the rest. This is dangerous: there may be little left over, once the range of other interests have had their say. Shellfish farming is a minority interest and there is increasing competition for coastal resources.

This highlights the importance of representation and procedure in the development of regional marine plans. Since shellfish farmers are a minority interest, this will translate into minority representation and a very small slice of the coastal resource cake. If shellfish farming is to retain the right or the opportunity for further expansion, it will require higher level strategic input to RMPs. This might be achieved through clear policy statements in the National Marine Plan and strong pressure on RMPs to deliver expansion irrespective of local interests. Much will also depend on the areas covered by RMPs. This study has highlighted significant differences across Scotland.

The market

Whatever the future policy environment, the ultimate driver of development in the industry will be the market. There has been surprisingly little analysis of this in recent years but one or two features are abundantly clear:

- The bulk market for fresh chilled mussels in Europe is for a relatively low value product – with prices significantly lower than the Scottish industry is used to;
- Production from mussel beds – whether from Tain, the Menai Straits, Ireland or the Netherlands is cheaper than from Scottish long-lines;
- High quality mussels are also being produced using suspended culture techniques in New Zealand, Chile, Spain, and emerging economies such as Vietnam – and these are beginning to penetrate the "prepared high quality seafood meal" market so successfully exploited by the Scottish Shellfish

Marketing Association in recent years. Economies of scale in production, harvesting, distribution and processing – and in some cases very low labour costs - mean that these countries can produce more cheaply than Scotland at the present time;

- The downturn in the economy will hit all seafood products and especially those which are considered slightly exotic to the UK consumer.

This has significant implications for industry structure and social and economic benefit.

Industry structure and social/economic benefit
Depending on perspective, the industry either generates significant social and economic benefit relative to output (it generates high value added per unit production or per unit revenue) or suffers from low labour productivity and distribution inefficiencies. On the one hand the industry generates important social benefits for remote rural areas; on the other it may not be competitive in international terms and can only access a very small premium market.

Any significant expansion would involve rationalisation: fewer, larger sites; fewer companies; less labour per unit production. Only in this way can it compete in a bigger market. As expansion takes place, prices will fall and smaller scale companies may go out of business. A doubling or trebling of production may be accompanied by a doubling or trebling of labour productivity – or in other words very little increase in employment on the production side (although significant increases in processing labour may be anticipated). Total income will however increase, with benefits to the wider economy, though probably not in proportion to increased output.

Industry confidence
Our survey of farmers showed some optimism, insofar as several farmers (both oyster and mussel) intended to expand significantly over the next five years. Furthermore, it is clear that the European Fishery Fund is being directed at the industry, suggesting also that shellfish farming is seen as a viable growth area within the fisheries sector.

Futures
In order to explore the possible future interaction of these factors further, we offer four scenarios based on alternative assumptions about the implementation of the Marine Bill, market development, and industry structure.

8 Future Scenarios

On the basis of the various issues identified above, it is possible to speculate on alternative futures in which some of the conditions and constraints change. Clearly there is a great range of possible combinations. Below we assess the potential socio-economic impacts of four production scenarios (for both mussels and oysters), all of which are considered possible:

1. No or minimal change
2. Decline
3. Modest Growth
4. Strong Growth

The interplay of the factors discussed in previous sections will determine which of the above scenarios occurs and to what extent and at what speed (on the decline and strong growth scenarios). The following factors are taken into account in the scenarios – positive, negative or limiting:

- UK market growth – influenced by new products, competitive pricing and marketing by Scottish producers and representative organisations.

- Penetration of the UK market by overseas producers – influenced by growth in overseas production for export, development of longer shelf life value added products, and sterling's exchange rate.

- Development of export markets, particularly in neighbouring EU countries – influenced by quality premium, development of distinctive value added products, degree of commitment to overseas marketing, and degree of competition in these markets from other countries.

- Aspirations of existing (and potentially new) Scottish producers to grow – influenced by market expectations, scope for production and scale economies, and the development of value added products (by individual businesses or in co-operation, e.g. through the SSMG).

- The financial capacity of Scottish producers to expand output and invest in new processing capacity – influenced by grant availability, the confidence of investors, the availability of credit, and commitment of own resources by small producers (or re-investment of profits by larger producers).

- Production capacity – influenced by the scope to increase production from active sites, utilise inactive shellfish sites, utilise inactive salmon sites, and develop new sites.

- Planning and site designation constraints – influenced by Local Authority policy, Government policy (mainly through the new Marine Bill), EU and UK designations, local acceptability of development, and the extent of competing uses.

- Harvesting constraints due to toxic algae and other biological factors.

The socio-economic impacts projected in the different scenarios are based on the following baseline outputs and impacts (2007). Indirect impacts relate to Scotland only.

Mussels

No of producing mussel farming enterprises	58	*(2007 FRS)*
Production	4,806 tonnes	*(2007 FRS)*
First Sale Value (delivered)	£5.77 million	*(HC Survey estimate)*
Direct Employment	140 ftes	*(2007 FRS, adjusted)*
Indirect Employment	140 ftes	*(HC estimate)*

Oysters

No of producing oyster farming enterprises	33	*(2007 FRS)*
Production ('000 shells)	2,876	*(2007 FRS)*
First Sale Value	£0.78 million	*(2007 FRS derived)*
Direct Employment	80 ftes	*(2007 FRS, adjusted)*
Indirect Employment	40 ftes	*(HC estimate)*

The direct employment in mussel and oyster production assumes that a part-time job is equivalent to a third of a full-time job and a casual job a quarter.

The indirect employment assumed above is based on our survey evidence. 56 people are employed at the processing/packing plant at Bellshill (included under indirect).

Further employment will be generated through the induced multiplier, i.e. through the spending of direct and indirect employees in Scotland.

In regional economies, sales of farmed shellfish to local hotels and restaurants will also have a positive economic value – contributing to the tourism industry through providing quality local food. This is not valued here.

For the purposes of this exercise, Scotland is taken to comprise four types of coastal/marine region, for which somewhat different Regional Marine Plans (RMPs) are likely to be produced:

- ***Type 1.*** Island regions with tourism significantly constrained by distance, and strong economically active communities with fishing, aquaculture and entrepreneurial traditions
- ***Type 2.*** Island regions less constrained by distance, and where tourism is a major economic activity
- ***Type 3.*** Mainland coastal and small island regions where the economy is dominated by tourism, second homes and retirement.
- ***Type 4.*** Large Firths close to significant urban conurbations

The future policy context, to simplify, could be one of the following:

(i) No or little change – i.e. the future marine spatial planning regime in different parts of Scotland results in little or no change.

(ii) Positive – i.e. aquaculture takes more precedence than currently over landscape and other planning concerns in prime locations for significant development.

(iii) Negative – i.e. aquaculture has a lower priority than currently in regional marine planning, constraining the development of new sites and preventing optimal utilisation of existing sites.

Our analysis suggests that positive policy will be required for very strong growth, but that strong growth could be achievable through no change policy in Type 1 areas.

Our consultation suggests that negative policy would be very unlikely to have a significantly negative effect and that modest (but not strong) growth would still be achievable, principally through developments in Type 1 areas. The key factor is the growth impetus in Shetland (a Type 1 area), which has become the principal mussel producing area. Modest growth in oyster production, however, might not be possible under a negative policy regime as new or unused sites would be required and oyster production is low in Type 1 areas – although strong underlying market growth (possible if not likely) would incentivise producers to combat this constraint.

8.1 Scenario 1: No or Minimal Change

There is no significant change in the planning, management or regulatory environment and no significant change in market demand (with a pick-up after the recession).

Although Marine Scotland is responsible for issuing marine licenses, including the Coastal Protection Act (CPA) navigation license, farms still require planning permission from local authorities. Regional Marine Plans offer limited guidance on development beyond offering better information on existing interests and usage, although the Scottish Government's contention that current or increased aquaculture activity is compatible with environmental sustainability is acknowledged at regional level. Existing locational guidance is incorporated in these plans, and there are some indicative "no-go areas". Most other areas are classed as "multi-use zones". Local authorities continue to grant planning permission in line with recent trends. Obtaining a new site for a medium-large farm is difficult in Type 3 areas, driven mainly by a precautionary conservative approach, with sympathetic consideration given to a range of objections related to landscape, navigation, fishing and nature conservation interests. Consent is easier in Type 2 and especially Type 1 areas, but site availability remains a constraint.

The UK market continues to develop relatively steadily at up to 3% per year, with Scottish production meeting a similar (or only slightly reduced) share of this than currently. There is also some (though limited)year on year increase in demand for "premium" Scottish Mussels on the continent, mainly as part processed in the shell vacuum packed products.

The projections in the Scenario 1 model (and in the other models) take account of the current imbalance between the production and sales of mussels – i.e. over the next two-three years, it is assumed that production will adjust to actual demand (but that availability to consumers will not be constrained by an over-reaction to the current imbalance by producers).

Several of the larger mussel farms consolidate their position through modest expansion of existing sites and takeover of smaller companies already farming high quality sites. In 2007, 17 companies each producing more than 100 tonnes of mussels, were responsible for 71% of the total mussel production in Scotland. By

Year 10, there will have been further rationalisation, with 80% of production expected to come from farms producing more than 200tonnes. There will also have been some further rationalisation in oyster production, with 90% of production expected to come from farms of more than 20 tonnes (equivalent to roughly 235,000shell)

Oyster markets and production will grow similarly to mussels. Although market prices will remain favourable, investment will be limited because of the long growout period and high risk. Some existing “hobby” farmers cease production but are replaced by others – some farming the sites of those leaving the sector and others developing new sites.

The extent to which production growth is concentrated in larger enterprises will tend to affect overall labour productivity, and our projections of future employment levels draw on our survey evidence from producers of differing scale.

Scenario 1: Industry Structure and Performance over 5 and 10 Years

	Year 5	Year 10
Mussels		
Compound total growth	+2%	+7%
Production (tonnes)	4,902	5,142
No of producing businesses	54 (-4)	50 (-8)
Sales revenue	£5.89m (+2%)	£6.17m (+7%)
Value added in Scotland (90%)	£5.30m	£5.56m
Direct employment (ftes)	140 (no change)	140 (no change)
Direct plus indirect employment (ftes)	280 (no change)	280 (no change)
Oysters		
Compound total growth	+4%	+8%
Production (‘000 shells)	2,991	3,106
No of producing businesses	32 (-1)	31 (-2)
Sales revenue	£0.81m (+4%)	£0.84m (+7%)
Value added in Scotland (90%)	£0.73m	£0.76m
Direct employment (ftes)	82 (+2)	84 (+4)
Direct plus indirect employment (ftes)	123 (+3)	126 (+6)
Totals		
Sales revenue	£6.70m	£7.01m
Value added in Scotland	£6.03m	£6.32m
Direct employment (ftes)	222	224
Direct plus indirect employment (ftes)	403	406

Value added in Scotland as a proportion of sales revenue is relatively high as the sector is highly self contained – imported feed is not required and the main “leakage” from Scotland is the fuel required to transport the shellfish. A more detailed study, including a close inspection and interpretation of company accounts, would provide a more accurate estimate of its direct and indirect value added. This high level of “containment” contrasts with salmon farming, which incurs high expenditure on feed with a large import component and remits profits to Norwegian parent companies.

8.2 Scenario 2: Decline

Decline would continue the trend (although with annual variability) in oyster production since 2000, but reverse the strong upward trend in mussel production. Marine spatial planning becomes more rigorous and restrictive despite general policy statements by government supporting the growth of marine fish farming and especially shellfish farming. Recovery from recession is slow, and UK demand for shellfish grows only very slowly (if at all) and is largely met from Welsh and Irish supplies.

A significant number of nature conservation and historic MPAs are established in or close to high quality aquaculture sites. In Type 3 areas, Regional Marine Planning partnerships are established with strong representation of SEPA, SNH, environmental NGOs, tourism, fishing and navigation interests. Regional Marine Plans are developed by starting with historic use, landscape and nature conservation interests. What (limited) area remains is assigned as “multiple use” subject to local authority planning consent and a range of best practice guidance. Local authorities use SNH landscape capacity assessment guidelines as a starting point to inform locational strategy for marine fish farm development. This further restricts site availability for aquaculture. Water/coastal based adventure/wildlife tourism continues to increase in economic importance, and operators generally argue against further aquaculture development. Local government (especially in Type 3 areas) take objections to fish farm development from these emerging commercial interests seriously, further restricting development at the planning consent stage.

Mussel farming continues to grow modestly in Type 1 and 2 areas until 2012, but fails to achieve the economies of scale required to compete in the larger European and global market for fresh live mussels and high quality processed product. New Zealand, and especially Chile, continue to make inroads into the European market with a range of high quality products. Other countries in Southeast Asia also begin to export increasing volumes of the green Mussel (*Perna spp*). Prices for all mussel products fall in the UK and Europe, and (by Year 10) Scottish companies are bought up by a few large companies which can achieve the economies of scale to continue to compete for the bulk of UK demand and offer small volumes of product to niche European markets.

The frequency of harvesting closures due to toxic algae increases slightly, which causes particular problems for small scale producers targeting the Scottish tourist and restaurant market. Small scale oyster producers are particularly badly hit and, following modest growth in the period 2010-2013 after the recession, production declines again.

Scenario 2: Industry Structure and Performance over 5 and 10 Years

	Year 5	Year 10
Mussels		
Compound total growth	-5%	-25%
Production (tonnes)	4,566	3,605
No of producing businesses	45 (-13)	25 (-33)
Sales revenue	£5.19m (-10%)	£3.46m (-40%)
Value added in Scotland (90%)	£4.67m	£3.11m
Direct employment (ftes)	126 (-10%)	91 (-35%)
Direct plus indirect employment (ftes)	252 (-10%)	182 (-35%)
Oysters		
Compound total growth	no change	-15%
Production ('000 shells)	2,876	2,445
No of producing businesses	31 (-2)	26 (-7)
Sales revenue	£0.78m (no change)	£0.62m (-20%)
Value added in Scotland (90%)	£0.70m	£0.56m
Direct employment (ftes)	79 (-1)	64 (-16)
Direct plus indirect employment (ftes)	119 (-1)	96 (-24)
Totals		
Sales revenue	£5.97m	£4.08m
Value added in Scotland	£5.37m	£3.67m
Direct employment (ftes)	205	155
Direct plus indirect employment (ftes)	371	278

8.3 Scenario 3: Modest Growth

Several factors would underpin modest growth:

- A modest upturn in the UK economy from late 2009 or early 2010
- Strong support for expansion of shellfish farming in Type 1 and Type 2 areas, reflected in very positive Regional Marine Plans
- Some rationalisation of mussel production in Type 3 Areas, with Regional Marine Plans promoting site transfers and rationalisation
- Steady growth in the UK and overseas markets for both mussels and oysters, with value added production an increasing proportion of sales (principally through supermarkets)
- Competition in UK markets by overseas producers only modestly aggressive, with their main focus on expanding overseas markets

Growth in both the UK and European economies after the recession is on average slower than pre-recession, both over 5 and 10 years, as China and other emerging economies compete for scarce natural resources, further diversifying their economies to compete with Western Europe, and obtain an increasingly higher share of profits from enterprise in Western Europe through inward investment and share ownership.

The National Marine Plan sets out a specific policy for the growth of shellfish farming and makes it clear that this policy must be reflected in Regional Marine Plans. In Type 1 and Type 2 regions, local government plays the lead role in the development of Regional Marine Plans for their areas, and these place strong emphasis on promoting and supporting shellfish farms in the most favourable areas. Landscape and nature conservation concerns are addressed primarily through design guidelines and codes of practice, though a limited number of classic landscapes are defined as no-go areas.

The Regional Marine Plans in Type 3 regions continue the basic policy of supporting shellfish farming where appropriate and where it does not seriously affect landscape or prior use. Although this significantly limits potential for further expansion, an active policy to free up existing underutilised sites allows some existing medium scale producers to expand modestly.

The incidence of toxic algae closures decreases slightly, and larger companies cope better with these problems through strategically located multiple sites.

There is some modest expansion in both oyster farming and seabed (dredge) laying of mussels in Type 4 regions.

Scenario 3: Industry Structure and Performance over 5 and 10 Years

	Year 5	Year 10
Mussels		
Compound total growth	+10%	+30%
Production (tonnes)	5,287	6,248
No of producing businesses	56 (-2)	50 (-8)
Sales revenue	£6.06m (+5%)	£6.63m (+15%)
Value added in Scotland (90%)	£5.45m	£5.97m
Direct employment (ftes)	133 (-5%)	133 (-5%)
Direct plus indirect employment (ftes)	273 (no change indirect)	280 (+5% indirect)
Oysters		
Compound total growth	+10%	+25%
Production ('000 shells)	3,164	3,595
No of producing businesses	33 (no change)	35 (+2)
Sales revenue	£0.82m (+5%)	£0.98m (+15%)
Value added in Scotland (90%)	£0.74m	£0.88m
Direct employment (ftes)	84 (+4)	88 (+8)
Direct plus indirect employment (ftes)	125 (+5)	130 (+10)
Totals		
Sales revenue	£6.88m	£7.61m
Value added in Scotland	£6.19m	£6.85m
Direct employment (ftes)	217	221
Direct plus indirect employment (ftes)	398	410

8.4 Scenario 4: Strong Growth

A number of factors in combination would stimulate and support higher growth:

- A stronger upturn in the European economy after the recession than under Scenario 3.
- A clear policy steer in the National Marine Plan for significant expansion of shellfish farming.

- A clear steer in the National Marine Plan that medium to large scale shellfish farming should be accepted within or close to MPAs and NSAs unless the evidence for potential damage is strong.
- A lighter touch (less precautionary) approach to landscape capacity planning in type 3 regions.
- Strong support for expansion of shellfish farming in Types 1 and 2 regions, reflected in very positive Regional Marine Plans plus grant funded initiatives related to infrastructure, processing, distribution and marketing.
- A major national programme to re-vitalise and rationalise existing leases in all areas, reflected also in Regional Marine Plans.
- Demand for shellfish continuing to rise in the UK and Europe, mainly through the appeal of mussels and oysters as healthy alternatives and convenience in preparation and cooking.

Scottish mussels, supported by a major seafood marketing campaign, establish a very strong brand as a premium product from the pure waters of the North Atlantic.

The National Marine Plan places strong emphasis on the growth of shellfish farming:

- In support of a global image of Scotland as a maritime nation with the highest quality food products;
- As an example of sustainable low carbon footprint food production;
- As part of a policy to improve the quality of tourism in Scotland through wider availability of fresh seafood;
- In order to inject entrepreneurial and economic dynamism into relatively isolated rural communities.

The Plan makes it clear that there should be a presumption in favour of further shellfish farm development at sites which are most suitable for its development, unless counter-arguments are exceptionally strong.

A National Policy, implemented through The Crown Estate, seeks to ensure that most leases which are/have been unused for more than three years, or for which the area in active operation is less than 10% of the original proposal, are given up. At local level, the Councils actively work with The Crown Estate to facilitate the implementation of this policy, supported by appropriate Regional Marine Plans.

In Type 1 and Type 2 regions, the development of Regional Marine Plans is led primarily by the Councils. They place significant emphasis on shellfish farm development in line with the National Marine Plan. These include proposals to support and facilitate development of the industry through:

- Identification of priority areas for further development and site rationalisation as noted above;
- Infrastructure improvement (piers, roads, ferries, services, support for processing) in key strategic zones;
- Support for marketing campaigns;
- Support for local value added initiatives.

The industry expands rapidly in Type 1 and Type 2 regions, although it encounters significant short term marketing problems due to periodic oversupply and poor prices in the UK. This leads to significant further rationalisation of the industry and concerted efforts to develop niche market on the continent. Unit production costs fall significantly as scale increases, and these shellfish farmers are able to compete effectively in the UK and gain a fair slice of the premium market on the continent.

In Type 3 regions, Regional Marine Plans are developed by partnerships with strong user representation. Well sited (from technical as well as landscape perspectives) shellfish farming is regarded as an important contribution to a working coastal landscape, and underpins a growing high quality seafood restaurant and local food products trade. Working groups which bring together fish farmers, landscape, navigational and nature conservation interests are specifically charged to identify areas and strategies that will allow for growth in "premium product" shellfish farming. Shellfish farming expands modestly in these areas, targeting mainly local and premium UK markets.

Scenario 4: Industry Structure and Performance over 5 and 10 Years

	Year 5	**Year 10**
Mussels		
Compound total growth	+20%	+75%
Production (tonnes)	5,767	8,411
No of producing businesses	56 (-2)	50 (-6)
Sales revenue	£6.35m (+10%)	£8.08m (+40%)
Value added in Scotland (90%)	£5.72m	£7.27m
Direct employment (ftes)	140 (no change)	154 (+10%)
Direct plus indirect employment (ftes)	280 (no change)	308 (+10%)
Oysters		
Compound total growth	+20%	+50%
Production ('000 shells)	3,451	4,314
No of producing businesses	35 (+2)	37 (+4)
Sales revenue	£0.86m (+10%)	£0.98 (+25%)
Value added in Scotland (90%)	£0.77m	£0.88m
Direct employment (ftes)	86 (+6)	92 (+12)
Direct plus indirect employment (ftes)	128 (+8)	136 (+16)
Totals		
Sales revenue	£7.23m	£9.06m
Value added in Scotland	£6.49m	£8.15m
Direct employment (ftes)	226	246
Direct plus indirect employment (ftes)	408	444

On this higher growth scenario, the degree of expansion and profitability in the industry in Scotland is not sufficient to attract a major investor (e.g. a Dutch business or a salmon farming conglomerate), which could lift mussel production (in particular) on to a higher plane (e.g. through establishing a hatchery and / or utilising deeper water further offshore). This, in our view (within a ten year timescale), would require a major boost in the UK consumer's interest in eating mussels and / or oysters, both in restaurants and at home. An imaginative initiative, rather than incremental growth, might be required to spur this.

9 Conclusions

Shellfish farming in Scotland faces a formidable set of constraints and these largely explain the lack of steady growth in the industry over the past three decades.

Though very small in national terms, the industry makes a significant contribution to isolated rural and island communities, and insofar as it generates a high proportion of value added it punches above its weight in socio-economic terms – helping to maintain transport and distribution infrastructure for example.

If a more supportive policy environment were to be established under the evolving coastal planning and management regime (under the new Marine Bill), strong growth of the industry (75% within 10 years) might be possible. Rationalisation means that increases in employment will be modest, but such growth will nonetheless help to consolidate communities, economies and transport infrastructure especially in areas such as Shetland, Orkney and the Western Isles.

However, there is a significant danger that the new regime will be no more supportive than that of the past and indeed may be more restrictive. There is likely to be intense competition for coastal resources (navigation, fishing, recreation, nature conservation, landscape) under a spatial planning regime. In this case the industry may stagnate or decline.

Major growth of the industry (in the sense of becoming a major international player) in future seems unlikely. This would only be possible through large scale developments in rather more exposed locations than those currently occupied by shellfish farmers. This would increase production risks (these are stormy waters) and may raise more critical landscape and/or nature conservation issues. Overall, it is unclear that Scotland has comparative advantage in producing on a large scale.

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Most of the following appear as specific references in the text. Also included are references to some additional materials which have served to more generally inform this research

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SARF 009. Coastal assimilative capacity for amalgamated fish farm. http://www.sarf.org.uk/Project_index.htm

SARF 011. Review of environmental quality standards (EQS) for use in assimilative capacity model development. http://www.sarf.org.uk/Project_index.htm

SARF 012. The development of modelling techniques to improve predictions of assimilative capacity of water bodies utilised for marine cage fish farming. http://www.sarf.org.uk/Project_index.htm

SARF 017. Identifying the risk of de-oxygenation in Scottish sea lochs with isolated deep water. http://www.sarf.org.uk/Project_index.htm

SARF 30. Benthic recovery process. http://www.sarf.org.uk/Project_index.htm

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Annex 1: Shellfish farmers: interview checklist

1 Location (map reference if possible)
2 Name of company
3 Species produced
4 Production last five years
5 Turnover last 5 years
6 Employment (FTE)
7 Start-up investment in site, boat, buildings, equipment and stock etc
8 Cost breakdown (percentage or actual)
   (depreciation; maintenance; seed; fuel; labour; harvesting (if separate from labour); marketing; other)
9 Anticipated production next five years

10 Constraints on increased production: past, present, future (unsolicited)
a Extent/nature of constraints
b Ask respondent to rank these constraints in terms of impact on business development

11 Constraints on increased production: past, present, future (prompt)
a Market/market price; break even price
b Distribution, storage, processing
c Site suitability
   are there plenty of suitable sites?
   where?
   what are the key criteria? (ranked if possible)
d Planning permission (local interests/other users)
e Planning permission (conservation designations; appropriate assessment)
h Planning permission (landscape designations)
i Environmental and other technical consents (SEPA)
j EIA (not yet an issue?)
k Other?

11 Main areas of opportunity
12 Economies of scale - existence, shape, viability thresholds
13 Status of shellfish industry in Scotland in 10 years time
14 Reasons for this scenario

Annex 2 Nature of existing SACs and concerns relating to fish farming

Natura 2000 Marine Site	Qualifying species and habitats (marine)	Potential damage from shellfish farming
Dornoch Firth and Morrich More SAC	Otter, Common seal, estuaries, mudflats and sandflats not covered by seawater at low tide; reefs and sandbanks which are slightly covered by water at all time	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum); Disturbance to otters and seals from ADDs, sonic canon, predator chasing
Loch Creran SAC, Argyll	Reefs	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum);
Firth of Lorne Marine SAC	Reefs	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum);
Eileanan agus Sgeiran Lios mor SAC	Common seal	Disturbance, injury, mortality to seals in anti-predator nets, ADDs; sonic canon and boat chasing of eiders can disturb seals.
Loch nam Madadh (Loch Maddy) SAC Western Isles	coastal lagoons, large shallow inlets and bays, mudflats and sandflats not covered by sea water all the time, reefs, sandbanks which are slightly covered by water all the time, otter	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum); disturbance to otters from noise, boats, effects on shoreline holts
Sound of Arisaig SAC	sandbanks which are slightly covered by sea water at all time	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum);
Loch Laxford	Reefs; large shallow inlets and bays	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum);
Ascrib, Islay and Dunvegan SAC	Common seal	Disturbance, injury or mortality to seals through entanglement in anti-predator nets. Use of acoustic deterrent devices or other predator control methods (e.g. sonic canon, boat chasing) to prevent grazing by eiders on shellfish farms have the potential to cause disturbance to seals. Boat activity associated with shellfish farming has the potential

		to cause disturbance to seals, particularly during breeding and pupping and moulting seasons
Lochs Duich, Long and Alsh Reefs	Reefs	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum);
Solway European Marine Site	estuaries (atlantic salt meadows; Salicornia communities; intertidal mudflats and sandflats; subtidal sandbanks; rocky scar communities)	
Southeast Islay Skerries SAC	Common seal	Disturbance, injury or mortality to seals through entanglement in anti-predator nets. Use of acoustic deterrent devices or other predator control methods (e.g. sonic canon, boat chasing) to prevent grazing by eiders on shellfish farms have the potential to cause disturbance to seals. Boat activity associated with shellfish farming has the potential to cause disturbance to seals, particularly during breeding and pupping and moulting seasons
The Vadills SAC	Coastal lagoons	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum); carrying capacity – effects on other filter feeding organisms
Yell Sound Coast SAC	Common seal; otter	Disturbance of seals and otters through boat activity, general noise, ADDs and e.g. sonic canon or boat chasing to deter eider. Shore based development effects on otter habitat and holts Restriction of forage habitat for otters and seals
Sullom Voe SAC	Coastal lagoons, large shallow inlets and bays, reefs	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum);
Sanday SAC	Common seal; Mudflats and sandflats not covered by seawater at low tide; sandbanks which are slightly covered by water at all time; reefs	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum) Disturbance, injury or mortality to seals through entanglement in anti-predator nets. Use of acoustic deterrent devices or other predator control methods (e.g. sonic canon, boat chasing) to

		prevent grazing by eiders on shellfish farms have the potential to cause disturbance to seals. Boat activity disturbance of seals esp. during breeding, pupping and moulting seasons
Papa Stour SAC	Reefs and submerged or partially submerged sea caves	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum);
Mousa SAC	reefs; submerged or partially submerged seacaves; common seal	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum) Disturbance/injury to seals through boat activity, antipredator netting, devices and activities
Moray Firth SAC	Bottlenose Dolphin; sandbanks which are slightly covered by seawater at all time	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum)
Luce bay and sands SAC	large shallow inlets and bays; sandbanks which are slightly covered by water all the time; mudflats and sandanks not covered by seawater at low tide; reefs	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum)
Sunart SAC	Otter; reefs	Physical damage from moorings; smothering with pseudofaeces and shell debris; introduction/spread of aliens (e.g. sargassum) Disturbance to otters from noise, boats, effects on shoreline holts

Annex 3: Consultees

Phase 1: Telephone and face to face discussions

Doug Macleod	(Association of Scottish Shellfish Growers)
Suze Henderson, Katie Gillam, Carol Daniels	(Scottish natural Heritage)
John Rea, Sally Davies	(Scottish Seafarms)
Rebecca Dean	(Lighthouse Caledonia)
John Webster, David Sandison	(Scottish Salmon Producers Organisation)
Colin Wishart, James Bromham	(Highland Council)
Ian Sutherland	(Highlands and Islands Enterprise)
Alex Adrian	(The Crown Estate Commission)
David Palmer	(Scottish Government Marine Directorate)
Douglas Sinclair	(SEPA)
Grant Cumming; Rachel Hope	(Hjatland)
Martin Holmes	(Shetland Island Council)
Peter Ellis	(RSPB Shetland)

Phase 2: Attendees at Inverness Workshop (for full workshop report see Appendix 2)

Richard Slaski	BMFA
John Webster	SSPO
Rebecca Dean	Lighthouse Caledonia
Sheena Warnock	Lighthouse Caledonia
Sally Davies	Scottish Seafarms
Penny Hawdon	Marine Harvest
Karen Hall	SNH (Shetland)
David Palmer	SG Marine Management
Jude White	SG Aquaculture
Ian Sutherland	HIE
Douglas Sinclair	SEPA
Janet Davies	SEPA
Andy Rosie	SEPA
Alex Adrian	The Crown Estate
Mark James	SARF

Phase 3: Interviews with shellfish farmers

Walter Speirs (Muckairn Mussels)
Roger Thwaites (Shian Fisheries)
Blushell Mussels, Shetland
John Holmyard (Cadderlie Mussels)
Isle of Mull Oysters
James Gisbies (Celtic Sea)
P McGlynn (Isle of Skye Oysters)
Frank Mowen and Sons, Tain
Stephen Anderson (Sandsound Mussels, Shetland)
Richard Tait (North Atlantic Seafood, Shetland)
Caledonian Oyster Company, Argyll
Donald McDougal (Ardencaple Oysters, Argyll)
Measan na Mara (Oysters, Moray/Moidart)

J Howard (Oysters, Mull)
Isle of Islay Oysters
Angela MacKay, Isles of Tongue Oysters
Maurice Fraser, Langsound Mussels, Shetland
Andrew Abrahams, Isle of Colonsay Oysters
John Robertson, Island Oysters, Shetland
Milovaig Mussels, Skye
Olnafirth Seafarm, Shetland (Mussels and Oysters)
Gilbert Clark and Erland Smith (C&S Mussels, Shetland)
David Niven, Unst Shellfish (mussels) Shetland
Derek Hunter Hunter Shellfish (mussels)
Lindsay Angus, Cribba Sound mussels

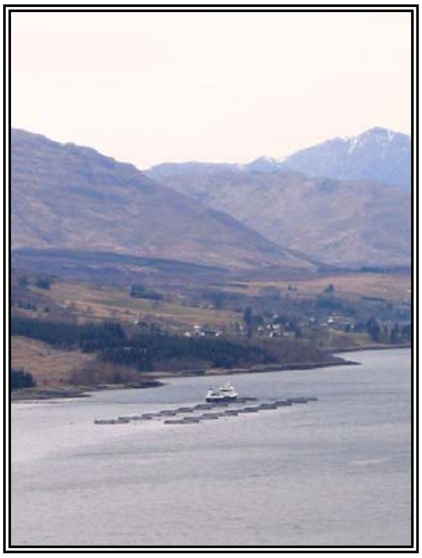
General assistance/advice at various times

Richard Slaski (BMFA)
Brian Dornan (Scottish Government)

SARF 046

Socio-economic Assessment of potential impacts of new and amended legislation on the cultivation of fish and shellfish species of current commercial importance

Appendix 1



Working Paper : Social and economic impact of current regulation/management
October 2008

Study funded by:
Scottish Aquaculture Research Forum (SARF)
SARF Project 046
Co-sponsors: Highland Council and Highlands and Islands Enterprise

Undertaken by Hambrey Consulting
www.hambreyconsulting.co.uk

1 Introduction

This report is the first working paper from the: 'Socio-economic Assessment of potential impacts of new and amended legislation on the cultivation of fish and shellfish species of current commercial importance'. Hambrey Consulting were commissioned to undertake this study by the Scottish Aquaculture Research Forum (SARF).

SARF is an independent company formed to fulfil one of the 33 industry priorities identified in the Strategic Framework for Scottish Aquaculture, which was published by the Scottish Executive in March 2003. The main aim of SARF is to support research into aquaculture and related areas to contribute to the on-going development of an aquaculture industry guided by the principles of sustainable development, balancing economic progress with social justice and environmental responsibility.

The aims and objectives of the research project are set down in the main project report. This working paper seeks to address the first research objective, namely:

To assess the degree to which commercial aquaculture is currently constrained, in terms of location and management, by existing legislation and designation; and to assess the probable social and economic effects of any such constraints

The report provides a review of the overall existing constraints that have shaped the development of aquaculture in Scotland - and their relative importance. The study also provides a factual account of the current level of interaction between designations and aquaculture. This includes a summary of the types of designations, and the location and evolution of the Scottish aquaculture industry. The report then goes on to examine the operational restrictions as a result of these interactions, and finally examines the likely socio-economic consequences.

Methodology

This is the first working paper of the project and as such serves as a scoping report, outlining key issues and areas of discussion in order to provide a platform for more work in the remainder of the project. It is firstly informed by a review of the most recent reviews, consultations and strategy papers – including:

- The Scottish Government marine bill consultation ("Sustainable Seas for All"),
- The consultation on a renewed strategic framework for Scottish Aquaculture ("Scottish Aquaculture – A Fresh Start")
- EU Marine Strategy Directive
- Recent outputs from the Scottish Government Sustainable Seas Taskforce, the Scottish Parliament's Environment and Rural Development Committee and the report of the Advisory Group on Marine and Coastal Strategy.

Secondly the report is informed by initial discussions with representatives of both the Scottish aquaculture industry and those bodies that regulate the development and operation of the industry.

Discussions with the industry began by scoping the overall constraints shaping the industry's development in Scotland. Discussion then focused in greater detail on the current practical constraints on new site applications and site amendments in or adjacent to designations, and associated operational constraints (and where applicable benefits). This included industry providing examples of situations where interactions had a perceived direct economic or socio-economic consequence. Where possible quantitative detail was sought to support these examples. Discussions of the potential shape and impact of future marine management legislation, in some cases provided the industry with its first opportunity to examine in detail the proposals, and consider the consequences.

Discussions with regulators sought to pin down the practical realities of operational restrictions which are imposed on companies as a result of current environmental or nature conservation interests – in particular to get an understanding of the existing restrictions associated with designated areas. Discussions with regulators about the future direction of the marine legislation in Scotland were inevitably broad, reflecting the fact that consultation and high level discussion is yet to finalise new procedures and initiatives, and it is impossible at this stage to give a definitive steer. None the less these meetings did provide the project team with further understanding of the possible marine management legislative initiatives which are likely to influence the on-going development of the aquaculture industry in the future.

1.2.1 Mapping

In the research proposal it was stated that that the team would re-visit a mapping exercise undertaken by the team on a previous SARF project in 2005 (SARF 004). This mapped the location of active salmon and shellfish farms, along with Natura 2000, National Scenic Areas and Biodiversity Action Plan species hot spots. This mapping exercise was done in Corel Draw at a relatively small scale – with positional data transposed manually.

In order to revise and add value to this work, it was proposed to put together a simple, but accurate GIS, mapping active marine finfish farm sites and designations. We also sought to extend this to include active and inactive shellfish sites. Prior to undertaking this exercise, the team confirmed that no such up to date GIS was publicly available. In the current data rich, transparent climate these data should be available at a country-wide level to map all marine activities. This would provide an invaluable tool for planning, strategy development, research and analysis and simply for general interest.

In seeking to put together a simple aquaculture / designation specific GIS, it was discovered that obtaining the required GIS-compatible shape files for designations was relatively straightforward. By contrast, obtaining accurate and up to date positional data for active finfish and shellfish farms was less straightforward. At a small scale the information is available graphically from the FRS annual finfish and shellfish production data. However, the team were refused access to the positional (longitude & latitude) data behind this, in spite of a formal application under the Freedom of Information Act (see Appendix 4 for details of the exchanges relating to this).

Finally positional information for active fish farms was obtained by an inquiry to the SEPA Scottish Pollutants Release Inventory and this has been used in the GIS produced by this project.

Subsequent to our initial work on this it was established that the Expert Working Group on Siting Aquaculture facilities in Scotland (EWGS) had begun to undertake a similar exercise. The outcome of this work is now publicly available as a map, but the spreadsheet data base, which also includes positional data and information on site activity (or otherwise), is not publicly available - though it was made available to us shortly before the completion of the research project.

1.2.2 Industry Consultation

In seeking to inform the initial findings of this research, considerable effort was made to discuss current restriction and potential future legislation with companies operating within the Scottish Aquaculture Industry – both shellfish and finfish.

These consultations were an opportunity for useful and informative discussions which have contributed to this report. However, there was a clear and unavoidable sense that some companies are relatively reluctant to invest time in these types of wider policy research activities. Drawing on many years consultation experience with the Scottish industry, it can be concluded that there is currently less willingness to cooperate in this type of research than in previous years. To a certain extent this is understandable and there are a number of possible explanations for this.

It appears likely that the industry has a certain amount of ‘consultation fatigue’, having contributed to studies in the past, which the industry perceives has failed to achieve stated aims, or made a worthwhile difference to the industry. One industry representative stated that it was tiring responding to an “endless stream” of requests to contribute to studies or various strategy committees[1].

With the competitive pressures on cost of production (COP), it is probable that companies are busier and seeking to operate with a highly dynamic and efficient workforce and may therefore have less available manpower than in the past to contribute to such studies. It may also be possible that the industry prefers to undertake its own lobbying direct to policy makers, on issues of real concern, rather than relay messages via policy research.

Face to face consultations were held with the following companies and individuals:

Suze Henderson	SNH
Carol Daniels	SNH
Katie Gillam	SNH
Andy Rosie	SEPA
Douglas Sinclair	SEPA
David Palmer	Scottish Government

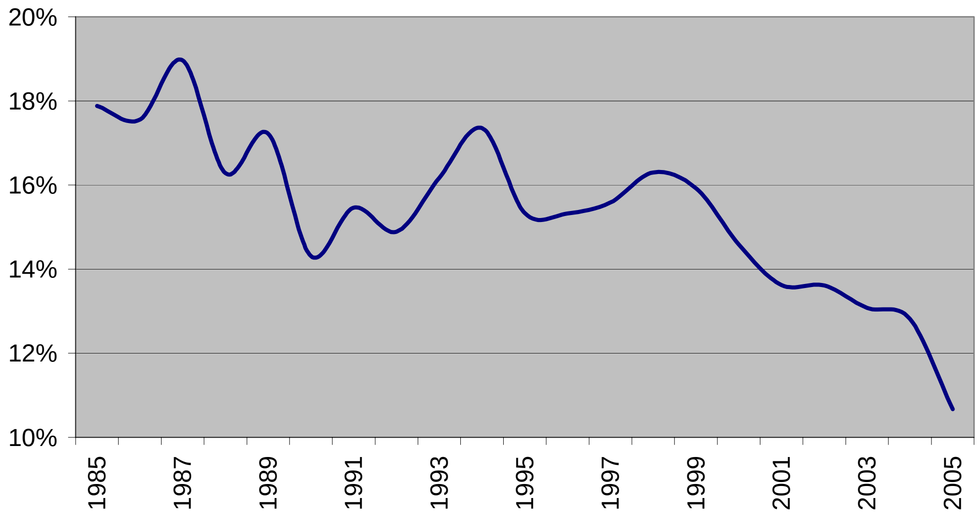
[1] The Scottish Executive’s Environment and Rural Development Committee’s Inquiry into the Marine Environment referred in its final report to the “bewildering plethora of initiatives, strategies and pilot projects” in relation to marine management in Scotland, and the “pressing need for coordination and an over-arching vision”.

Alex Adrian	Crown Estates
Colin Wishart	Highland Council
James Bromham	Highland Council
Martin Holmes	Shetland Isles Council / NAFC
Ian Sutherland	HIE
John Webster	SSPO
Julie Edgar	SSPO
David Sandison	SSPO / Shetland Aquaculture
Sally Davies	Scottish Sea Farms
John Rea	Scottish Sea Farms
Rebecca Dean	Lighthouse Caledonia
Grant Cumming	Hjatland
Rachel Hope	Hjatland / Shetland SSMEI project.
Doug MacLeod	Association of Scottish Shellfish Growers
Pete Ellis	RSPB Shetland

2 Constraints on industry expansion

The initial focus of this research is to quantify the potential costs and associated constraints that nature conservation designations and more general spatial planning issues have placed on the development of the aquaculture industry in Scotland. Prior to exploring this in detail (in section 3) it is important to place these in the proper context of other constraints which have also shaped the industry and contributed to limiting the industry to its current size – and reducing its share of the global aquaculture market.

Fig. 1: Scottish share of Global Atlantic Salmon Production



Source: FAO Fishstat Plus

In discussions with members of the aquaculture industry – both shellfish and finfish – a number of industry constraints are often highlighted which, it is argued, impact upon the industry's ability to maximise its potential. Some of these are common to all the farmers interviewed, whilst others are more specific to particular cases.

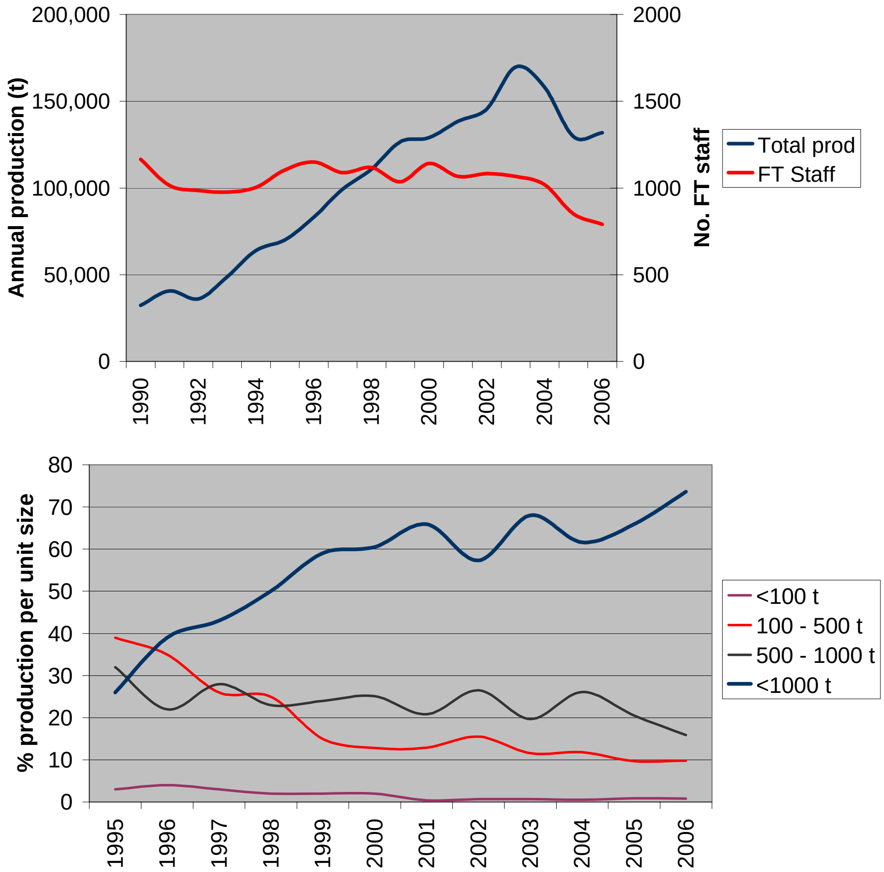
2.1 *Physical Constraints*

It is sometimes easy to assume that given a sympathetic regulatory regime and perfect market conditions, that aquaculture production in Scotland could be substantially greater than it is today. It is therefore useful, before exploring the constraints on the industry, to briefly examine the physical potential for aquaculture in Scotland.

The temperature profile and topography - in particular the deep sheltered sea lochs and plentiful clean fresh water resources to support smolt production - mean that the Scottish industry was well placed to be a pioneer in the development of global temperate finfish aquaculture. However, in an increasingly globally competitive commodity market, any physical limitations of Scotland's natural potential for aquaculture inevitably come under greater scrutiny – particularly when compared with competitor countries such as Chile and Norway (in the case of Atlantic salmon).

The global industry – including Scotland - has moved steadily toward increased production per farm (and production per employee), taking advantage of economies of scale through the adoption of large plastic circular pens, automated feeding systems, supported by feed barges and other advances, such as in-feed treatments which reduce the reliance on bath treatments. This has also enabled more efficient use of manpower.

Fig. 2: (a)Total Scottish Atlantic Salmon production, and numbers of full time staff. (b)Proportional of production in Scottish Atlantic Salmon Production Sites of different sizes



Source: FRS Production Surveys: 1990 – 2006
Addendum – for <1000 t read >1,000t

Average farm sizes for Atlantic salmon in Scotland are now around 1,250t compared with 2,880t in Norway and 4,220t in Chile[2]. The largest sites now operating in Scottish waters are typically around 2,500t, although one site has a consented biomass of 3,500t[3].

In the early 1990s Scottish Atlantic salmon production sites were more typically around 100t. These smaller sites were well suited to the relatively shallower, sheltered waters at

[2] Based on the findings of a recent survey undertaken in comparative economic research, commissioned by the Scottish Government.
[3] According to SEPA's Scottish Pollutant release Inventory

the heads of sea lochs. As farm sizes increased many of the original smaller sites ceased to be viable, both economically and biologically. Even without regulatory restrictions, large biomasses contained within low energy shallow systems, would have quickly exceeded the carrying capacity of surrounding waters – rapidly impacting on fish health and growth. In addition sea lice infestations are often worse toward the head of sea lochs. As a result these small original sites are no longer considered viable. In total there is currently around 370,000t[4] of consented production biomass in Scottish waters. When compared to the annual production of around 130,000t, it is clear that the majority of the consented biomass – and in particular that associated with older smaller units – is no longer used.

Scotland's sea lochs are shallower than the Norwegian fjords. The deeper more hydrodynamically active sites in Scotland – capable of holding larger biomass - are typically in more exposed locations compared with the equivalent areas in Norway. It can be said that the physical characteristics of the Scottish west coast were better suited to aquaculture production when smaller production units were more typical. The movement toward larger sites has increased the advantage enjoyed by Norway.

There appears to be some recognition of this within the Scottish industry and although there are calls to increase the upper farm size which can be modeled[5], there is no great clamour for the large size of farms more typical in Chile and Norway. This represents a tacit recognition that few, if any, locations on the Scottish west coast could effectively accommodate and assimilate such large farms.

In Scotland, Shetland perhaps has the best natural growing conditions for Atlantic salmon with deep water and high rates of water exchange which could perhaps enable larger farms. However, there is a view amongst some farmers that even in the absence of regulations it is unlikely that much over 3,000t is biologically feasible. Due to the generally shallower waters in acceptably sheltered locations, it is likely that the anoxic layers would build up below pens and hydrogen sulphide would ultimately impact on the growing conditions[6].

2.1.1 Site Availability

Finfish

Although substantially less than half of the licensed biomass in Scotland is currently in active salmon production, it is recognized that the majority of these unused sites are now no longer suitable for production, as a result of the reasons outlined above. Undoubtedly, however, some of the inactive farms could be used for production, even within the current market climate. A review of the licensed biomass from the Scottish pollutant release inventory reveals that there are around 20 farms with licensed biomass in excess of 1,000t (representing some 30,000t in total production) which have not been in active production in any of the last 4 years.

Without examining each site in detail it is difficult to summarise the reasons why these sites are not in current use. The majority of these consented but inoperative sites are owned by large companies still in active operation – the assumption being that they have determined that other sites are preferable, for whatever reason. However, it is also likely

[4] SEPA: Scottish Pollutant Release Inventory
[5] the AUTO DEPOMOD environment modeling software is currently limited to 2,500t
[6] Shetland farmer *pers. comms.*

that some of the valid consents are held by companies which are no longer active in the industry.

Discussions with the industry suggest that there may be a small amount of potential production sites which have not yet been taken for aquaculture production – although there are not many, and there is little sign of moves to try and obtain consent for these virgin sites. Analysis later in this report will explore some of the reasons why these potential sites have not yet been targeted for production.

It appears that site availability is not a problem for large established companies. A quick comparison of total consented company biomass against actual production suggests that the company production typically represents less than half of the consented biomass on the company books. However, it is likely that in the current market conditions that these farms are considered less economically viable, or less compatible with company strategy.

Shellfish
The situation regarding site availability appears to be slightly different for shellfish. A major problem preventing the further development of shellfish industry in Scotland is the lack of available, suitable sites. In part this is because many have already been taken – but remain unoccupied or inactive. It is probable that in many cases this is to prevent others from farming a particular site. The Association of Scottish Shellfish Growers (ASSG) have been working with The Crown Estates and with the new Scottish Government administration to introduce a ‘use it or lose it’ policy to make more sites available for new lease applications. This is particularly pressing for shellfish aquaculture, as the relatively smaller levels of initial capital investment make it more likely to attract new entrants.

2.1.2 Infrastructure

The infrastructure available to the Scottish aquaculture industry has sometimes been cited as a constraint to the industry.

The feed delivery costs are higher in Scotland than Norway as the Norwegian maritime infrastructure is better, and it is often easier and more efficient to make sea deliveries of feed to Norwegian farms with appropriate infrastructure. The fact that Norwegian feed mills are typically located on the western seaboard, allowing raw materials to arrive by sea, further adds to the feed price advantage enjoyed by the Norwegian industry.

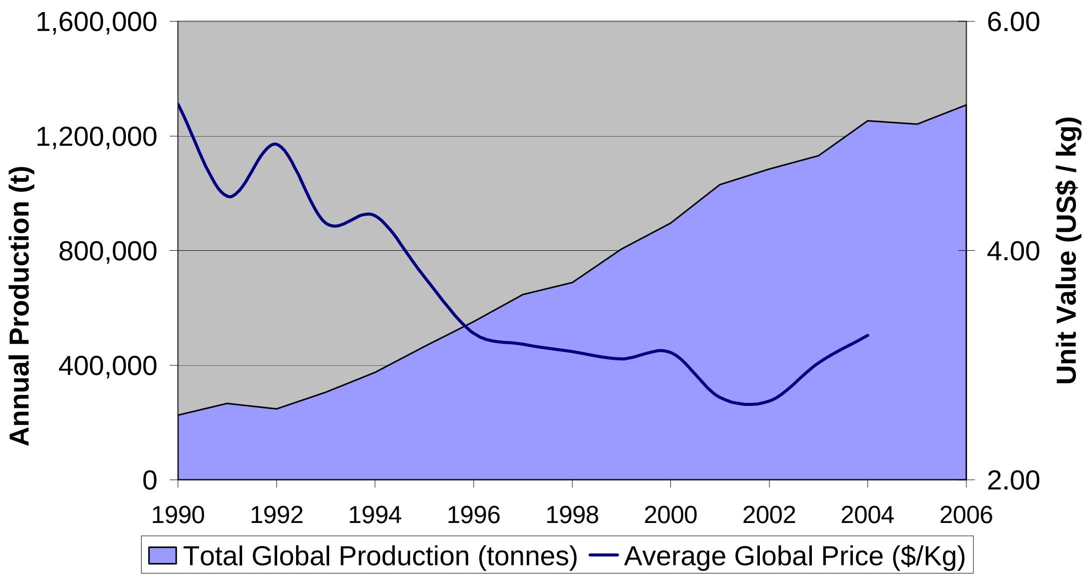
As the aquaculture industry generally takes place in relatively sparsely populated areas of Scotland, it might be expected that factors associated with operating large industry in rural areas may present a significant constraint. It is therefore notable that the rural communications networks, including road, rail and sea links were rarely referred to as a constraint to the development of the industry in Scotland.

2.2 Market Constraints

The market price of salmon has dropped steadily during the development of the aquaculture industry, and as a direct result of increased supply. The major driver for the decline in Scottish production, following the peak year of 2003, was the low price of salmon. The cost of production in Scotland is higher than both in Chile and Norway and it was particularly the small Scottish producers which were badly hit by low global commodity prices. The long term effect of the low price in 2002, 2003 was the consolidation of the Scottish industry – both at site level and company level. A number of mergers and acquisitions took place, and some companies folded. Within companies production was increasingly focused around more cost effective and historically strongly performing sites. In short, the response sought to streamline the industry and reduce the cost of production.

When considering the constraints on the Scottish aquaculture industry it is therefore also important to consider the global market constraints. The industry is not immune to downturns in price brought about by over-supply. And even the often-quoted price premium enjoyed by Scottish producers, does not insulate from the ever increasing pressures on cost of production. It is therefore clear that even if the physical or regulatory restrictions discussed in this report were removed, the market would act to determine an appropriate level of global production. The only additional consideration is that although the global market may be limited, were the Scottish industry more competitively placed it could, perhaps capture a larger share of this market.

Fig. 3: Global commodity trends in Atlantic salmon production and price.



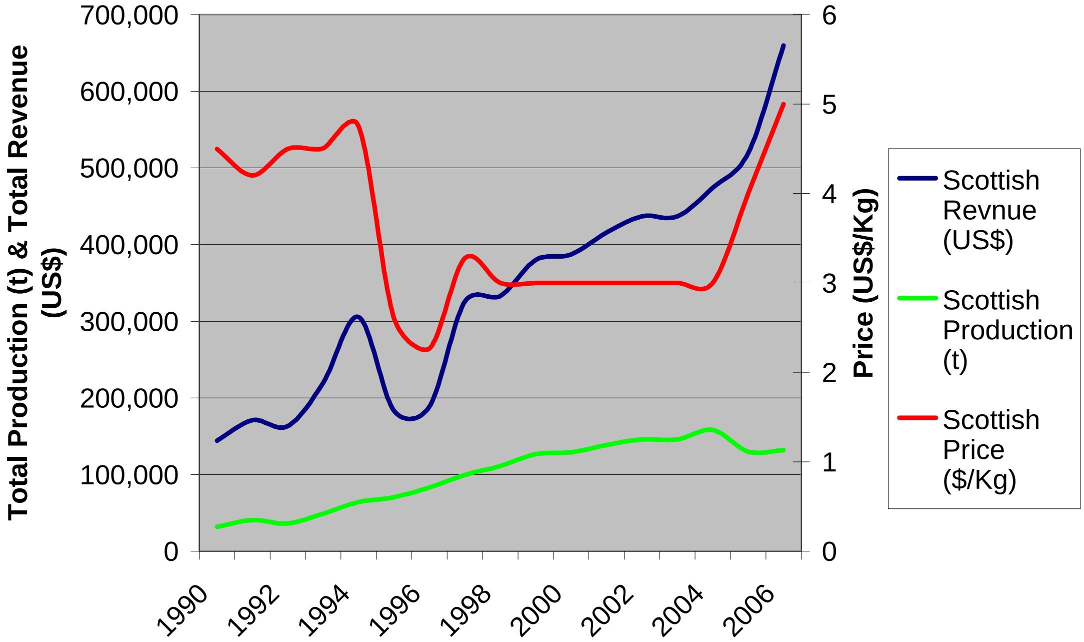
Source: FAO Fishstat Plus

A further rough analysis of the production, revenue and price trends within the Scottish industry was undertaken using FAO Fishstat data[7], as illustrated in figure 4. This clearly illustrates the decline in Scottish Atlantic salmon production, following a prolonged period of low prices. The decline in production coincided with a substantial increase in prices. Before interpreting this as a direct connection, it is important to bear in mind that the price is globally influenced, so is not simply affected by Scottish production. It is also

[7] There are some questions about the absolute accuracy of some of FAOs economic data – none the less, its inclusion in this research is justified as it gives a clear picture of the relative trends within the Scottish industry. These figures have not been adjusted for inflation.

of note that overall revenues from the Scottish industry did not fall in spite of a substantial drop in production.

Fig. 4: Trends in Scottish Atlantic salmon production, revenue and price.



Source: FAO Fishstat Plus

2.3 Regulatory Constraints

Although it is not the remit of this report to examine the overall regulatory controls on farm production and operation, it is relevant to the overall scope of the project to highlight those areas of regulation which do impact upon the total scale and location of the industry in Scotland – in short those regulations which impact upon overall company strategy and investment decisions.

In discussions with fish farmers – both salmon and shellfish, it is clear that industry is keen to see further refinement in some areas of regulation, to ensure that the regulatory regime is ‘fit for purpose’. That said, there is acknowledgement that there have been considerable recent improvements. Below we outline some of the outstanding areas of regulatory concern which are perceived as industry constraints.

2.3.1 Limit on Farm Size

Although there is no stipulated regulatory limit on farm size, there is an implicit restriction. In particular, the Auto Depomod II modelling software used in support of the application to SEPA for a licence to discharge (CAR licence) only models up to a maximum farm size of 2,500t. At the time of model development, this appeared to be a reasonable ceiling, given that few, if any companies were seeking sizes in excess of 2,500t. In recent years however, further technological advances (in particular, in cage design and feeding systems) and the ever present pressure to reduce cost of production through economies of scale, now mean that some companies would wish to see sites in excess of the 2,500t effective current limit. Notably, the salmon farming industry in both Norway and Chile routinely operate farms well in excess of 2,500t.

2.3.2 Restrictions on medicinal licensing

Although some constraints with regard to medicine are still referred to by the industry, it is clear that improvements have been made. For example:

- a recent change to the modelling approach for Excis (*cypermetherin*) now allows farmers to use almost 3 times as much – meaning that for most farms it is now possible to treat the whole farm in a short time.
- When processing new applications for the newly available *deltametherin*, the need to submit new modelling data and advertise was wavered for sites which were already licensed for *cypermetherin*.

In spite of these recent improvements, in discussions with farmers it is clear that one of the persistent perceived areas of regulatory restriction relates to the limited availability of sea lice treatments, compared to those available in competitor countries. Additionally, due to the low doses permitted as a result of chemical environmental quality standards (EQS) compliance, the efficacy of treatments are reduced, and the frequency of treatments are therefore increased - perhaps to the point of resulting in increased toxins entering the marine ecosystem - than if a single larger dose were permitted. The rules regarding medicinal use therefore serve as a constraint on cage size and contribute to the overall disincentive to apply for larger sites.

2.4 Planning Constraints

There have been considerable recent changes in the planning process for fish farming with responsibility for planning applications passing from The Crown Estates to the Local Authorities[8]. The new procedures are at a relatively early stage, with industry and local authorities alike, still adapting to new procedures. Looking ahead it is also conceivable that the planning and licensing procedures may again change with the advent of the Scottish Marine Bill – an issue explored in much greater detail in the main project report.

The planning system has the task of enabling economic development and the reasonable enhancement of local businesses, whilst also safeguarding the wider interests of the region and local stakeholders. What may therefore be referred to as constraints by the industry may be viewed as reasonable and sensible safeguards on the part of other stakeholders who seek to be represented in planning deliberations. Local Authorities have the challenging task of striking a balance between these two, sometimes conflicting goals.

In interviews with the aquaculture industry - both finfish and shellfish – a number of constraints have been identified in relation to the planning system – these can be summarised as relating to:

- Uncertainty
- Delay
- Direct cost of applications

[8] As a result of the implementation of the Planning etc (Scotland) Act 2006, and the amendment to the Town & Country Planning (Scotland) Act 1997.

- Lack of flexibility
- Role of public consultation

2.4.1 Uncertainty

The message which repeatedly comes from consultations with industry is that the greatest concern in relation to planning is the degree of uncertainty over potential outcomes. There have been several recent planning applications which have run into difficulties, which in many instances were unforeseen, although legitimate. To an extent the degree of uncertainty can be reduced by increased pre-application screening and consultation with both statutory and wider stakeholders (including public). Uncertainty may also be reduced through adhering closely to locational guidelines, and known areas of potential difficulties.

As will be seen in the next section of this report, avoiding known areas of potential difficulties is not always straightforward. For example, it is not always clear to applicants whether conservation designations, or national scenic areas should be avoided. In these cases the legislation and the application of the law does not rule out economic activity taking place, but experience on the part of the applicants suggests that such designations are, at the very least, likely to add to the degree of uncertainty over the eventual outcome of the planning process.

As will be discussed further in 2.3.5, perhaps the single biggest cause of uncertainty in planning applications is the response to the application from wider public consultation, and pre-application screening and consultation is particularly difficult in this area.

2.4.2 Delay

Closely allied to the uncertainty of the planning process is the delay of the procedure. If all runs as smoothly as possible it is theoretically possible for a successful outcome to be achieved in less than 12 months. However, those companies interviewed suggested that achieving planning consent in under a year was rare. In applications where particular issues have arisen it is not unusual for applications to take several years. Often this delay may undermine company strategy, making it harder for companies to keep pace with a rapidly developing international market. In other cases the delay will result in capital lying inactive.

The Association of Scottish Shellfish Growers reports that for shellfish applications, the new planning process is also much slower than the old system (6 months as opposed to about 2 months previously). In this instance, it is claimed that local authority planners lack the resources and expertise to properly evaluate applications so are often too influenced by objection letters.

2.4.3 Direct cost of applications

Shellfish

The Association of Scottish Shellfish Growers reports that the new planning application process to the local authority planners is expensive and the formula to calculate costs does not seem to be universally applied. Estimates of the cost for a pilot farm application varied between £3,000 and £11,000, irrespective of the outcome. This is a huge disincentive to new applicants to apply for shellfish sites, especially in areas of uncertain spatfall, where the applicant is only seeking to put out a small amount of equipment initially.

Finfish
There are direct costs associated with planning application – both in terms of the preparatory work and the actual submission. For large farms (in practice virtually all new farm applications) a full Environmental Impact Assessment (EIA) and environmental statement (ES) is typically required to support a planning application. Some of the costs incurred in preparing the environmental information in support of a planning application are outlined below:

- Collecting hydrographic information: £3,500
- Modelling £4,500
- Wave / Climate analysis £2,000
- Landscape analysis £3,000
- Benthic Survey £3,500
- Video Survey £7,000
- Drafting EIA / ES £10,000 - £20,000

In practice not all of the above may be required. Additionally these figures will vary between companies, with some able to negotiate favourable fees or able to make a cost saving through undertaking the work in-house. Companies that undertake all EIA work in-house are likely to budget around £12,000 in actual costs over and above the costs associated with staff time.

There is an application fee under the Town and Country Planning (Marine Fish Farming) (Scotland) Order 2007 payable to a Local Authority. The main objective is full cost recovery so the fee levels are being reviewed regularly for all local authorities, although there are not many applications coming through to see if fees are set appropriately. Current costs are £145/0.1ha of surface structures plus £50/0.1ha for additional seabed area used (i.e. for mooring lines etc.).

Planning approval is now granted in perpetuity rather than the 15 years that The Crown Estate lease was for. This has implications for the confidence of the sector, banks and investors in particular enterprises.

2.4.4 Lack of Flexibility

Delay and uncertainty in the planning process combine to reduce effective operational flexibility for farmers. Due to the level of technical detail which is considered within the planning process – in particular, cage design, size and configuration, any minor change in these technical details results in the requirement for a submission of a *technical variation*, which is then subject to a similar level of scrutiny and consultation.

As a result of this, one company pointed out that if company strategy, or even customer company strategy changed rapidly, the farm would be unable to adapt in the time frame required by the market – therefore risking the farmers market (see Box 1).

2.4.5 Role of Public Consultation

The degree to which public consultation should shape planning applications, how local democracy should be incorporated into planning considerations and where should be the limits on consultation are hotly debated topics within the Scottish Aquaculture industry. At present planning applications are advertised in the local media and members of the public have an opportunity to comment. Typically, this results in a range of objection letters. Letters of support are less common.

The degree to which the local authority mail bag is representative of public opinion is questionable and an examination of the demographic of objection letters is likely to reveal that not all interests or sections of population are represented. This is particularly the case in many of the more scenic areas of Scottish aquaculture production, where farms are in popular locations for tourism, holiday homes and retirement.

It is sometimes argued that the onus should be on the applicant, not the planning authority to gather endorsements for applications. Exactly how this should be done, is down to the applicant and there is at least one example of an applicant taking a straw poll of local opinion outside a supermarket, which was subsequently used in a planning appeal process.

Box 1. Example of problems caused by lack of flexibility – Freedom Foods

Farmers currently feel vulnerable in event of a supermarket, responding to consumer pressure and requiring a rapid change to the operational practices of their suppliers. For example, were a supermarket to require that all farmed salmon supplied to them comes from farms which have been certified by the RSPCA Freedom Foods standard, this would immediately require a reduction in stocking density to 15kg/m^3. In order for the farmer to meet this requirement a larger volume of pens is required – unless overall production levels are to be reduced. In order to increase cage volume it is likely that surface area would increase and a technical variation to the planning application would be required. The length of time required to undertake the application and for it to be processed is likely to be between six months and a year, and the real concern on the part of the farmer is that commercial consumer pressure may result in the supermarket switching suppliers before the application has been successful – therefore threatening the entire economic viability of the operation.

Without more effective procedures to address these public consultation and representation issues, there is likely to remain much inconsistency and unpredictability in the planning process which can only harm fish farm development in Scotland.

2.5 Additional constraints

2.5.1 Locational Guidelines

The Scottish Government has produced locational guidelines for aquaculture based upon modelling the existing likely levels of enrichment, to determine areas where capacity remains in surrounding waters to assimilate waste. In short, these guidelines identify areas where poor flushing and / or high levels of enrichment militate against further development. There has been some criticism of the validity in the model, in particular, in Shetland where it is viewed by some farmers as being more suited to loch systems than to Shetlands sounds and voes. The limitations with the model were identified as:

- Assumes all farms operate at maximum capacity (licensed biomass) all the time
- Uses outdated (or overly precautionary) nitrogen/feed ratios (uses 7.2% but 5.4% more usual nowadays)
- Does not adequately account for tide – a particular feature for Shetland's sounds and voes.

It is argued that as a result of these issues the locational guidelines artificially constrain the industry in Shetland. However, the overall impact of any such inadequacies appears to be limited, given that both regional producers and the local authority indicated that few biological or economically viable sites remained untapped – regardless of regulatory constraints such as the locational guidelines.

2.5.2 Finance

None of the company's interviewed as part of this (phase 1) study identified availability of finance as a constraint on the development of the industry. However, those companies were typically listed on the Norwergian stock exchange where investors are knowledgeable about the industry. The situation may be more difficult for independent Scottish-owned companies and shellfish producers (see main project report). It is also likely that the current global economic downturn will have a knock on impact on the ability of the Scottish industry to secure requisite finance in the future.

Finance is likely to be a far greater constraint in terms of restricting the likelihood of new entrants gaining a foothold in the industry in Scotland. This is applicable to both shellfish and finfish. It is recognised that a mussel farm needs to produce several hundred tonnes per annum in order to be economically viable. In order to achieve this level of production an initial capital investment of several million pounds may be required. This effectively reduces the likelihood for new entrants joining the industry as it would be difficult to raise the finance for the initiative, with UK banks and investors unlikely to invest.

2.5.3 Workforce and Expertise

It is generally not considered that the availability of workforce – or indeed the expertise of the available workforce – has constrained the development of the aquaculture industry in Scotland. The Atlantic salmon industry, in particular, was pioneered in Scotland, and much of the expertise has been retained within the industry – and complemented by expertise from other producer nations, since the arrival of multi-national company ownership. Generally speaking farm companies have been able to find employees, although in areas like Shetland where aquaculture has had to compete with the oil industry for staff, higher salaries are paid.

2.5.4 Perception

The aquaculture industry in Scotland has received, on balance, relatively poor press for many years, which has affected the wider perception of the industry. As far as the research team is aware, the scale of negative perception of the industry has never been accurately quantified. It is therefore unclear whether this can be regarded as a widespread problem of 'public' perception, or if it is more limited and associated with certain campaigners, pressure groups and journalists.

What is clear is that there has been considerable negative publicity in the national press over many years and much of this, however spurious, has gone unanswered or unchallenged. It would be surprising if this had not had some kind of effect of the national opinion of the industry. A more relevant question in the context of this research is whether any negative perception of the industry has had a constraining impact on the development, or profitability of the industry in Scotland.

Although there is little evidence that negative perception has had a direct impact on sales or indeed profits, it is conceivable that the there has been a more indirect constraining effect on the industry as a result of its wider perception. In particular, it is likely that there has been an impact on the ease of planning applications. It is probable that the failure to adequately address the negative perception of the industry over many years, now results in increased objections to proposed developments and a desire on the part of democratically elected politicians to give due consideration to the perceived opinion of the electorate to such developments. This probably contributes to a slowing of the planning process, increases uncertainty, and leaves the industry to feel inadequately supported by local authorities.

3 Existing interactions between Aquaculture & Designations

Having reviewed the wider constraints on the development of aquaculture in Scotland, this section now addresses the interactions between aquaculture and nature conservation and scenic designations and the possible constraint that this interaction causes for the industry.

The west coast of the Scottish Highlands and the islands of Shetland, Orkney and the Hebrides are areas of rich natural resources and outstanding landscape. The local marine environment is cold, clear and productive, supporting a rich and varied biodiversity, much of which is now recognised as being of high conservation importance. These same waters are also well suited to enable local social and economic benefit to be derived from a thriving aquaculture industry – in particular, for Atlantic salmon and shellfish species such as mussel and oyster.

Understanding the interactions between the Scottish aquaculture industry and the natural world around it and managing this balance is vital to ensuring the continued good ecological status of the area's seas whilst supporting the long term economic viability of an important regional industry. These are potentially compatible goals.

In meeting UK conservation commitments these waters often provide the best examples of important habitats. Additionally, even outside of designated areas, the local marine environment often supports species of conservation importance such as UK Biodiversity Action Plan (UK BAP) priority species, and those on the "Scottish List". The Scottish aquaculture industry therefore has to operate in an area of some of the highest concentrations of statutory conservation protection in UK waters - inevitably meaning that there is substantial overlap between these designations and farm sites. As a result marine farmers must give substantial consideration to the implications and requirements of local conservation objectives, whilst the statutory conservation agencies pay close attention to the potential impact of the industry on those same objectives.

Box 2: Example of interactions between aquaculture and nature conservation: Scalloway
The Scalloway Islands in Shetland are important for aquaculture with many finfish and shellfish farms. But they are also important eider moulting grounds – in spite of not being designated an SPA. The RSPB objected to a mussel farm application in the most important moulting area, but by working with the applicant they were able to identify alternative sites which suited both the producer and the birds. This demonstrates the benefit of being able to take a proactive / strategic / collaborative approach.

3.1 Types of Designations

When considering the spatial planning information for the areas used by the Scottish aquaculture industry, a number of designations are encountered. The main designations which are most often cited by fish farmers, as being relevant to their siting any planning application processes are:

- Natura 2000 sites (Special Areas of Conservation (SACs) and Special protection Areas (SPAs) – including recent coastal extensions of SPAs

- Sites of Special Scientific Interest (SSSI)
- National Scenic Areas (NSA)
- Coastal and Marine National Parks
- UK BAP species

Further brief explanation of these designations is supplied as Annex 1 to this report:

3.2 Geographic Interaction

The map of site location and designation shows that there is substantial overlap between farm location and designation. The greatest overlap is with NSAs – as these are typically the largest of all designations. However, as will be explored later in this paper smaller designations such as SACs, although less prevalent, may be of greater concern to the industry.

A rough analysis of the mapped data suggests that:

- around a third of all Scottish salmon production takes place in National Scenic Areas;
- around a quarter of production takes place is close proximity of areas identified as important for BAP habitats or species; and
- around 10% of production takes place in close proximity to Natura 2000 sites

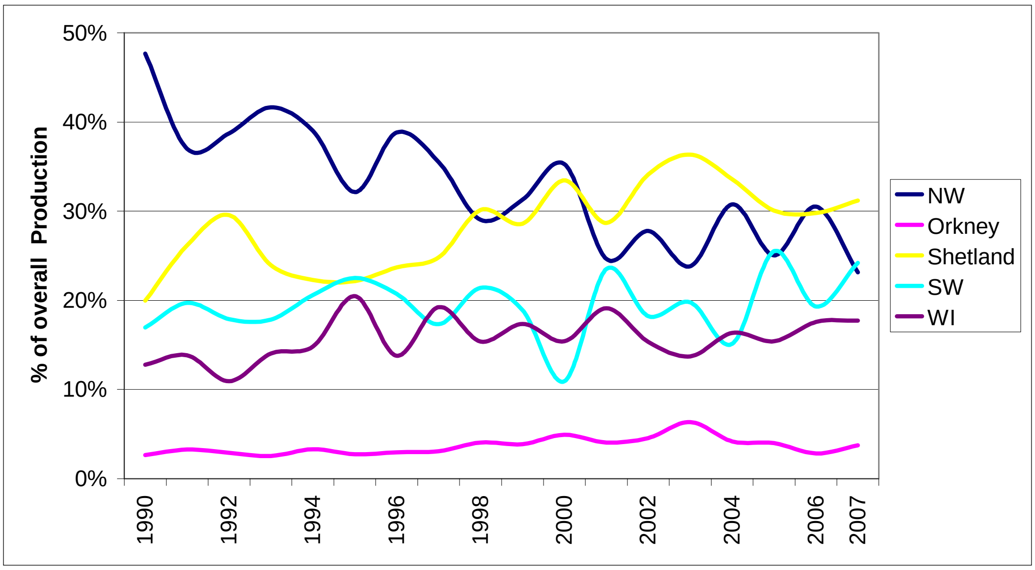
Overall it is therefore likely that almost half of Scottish salmon production is in areas either overlapping or immediately adjacent to designations. The figures are broadly similar for shellfish production.

Fig.5: Proportion of farms in designations.

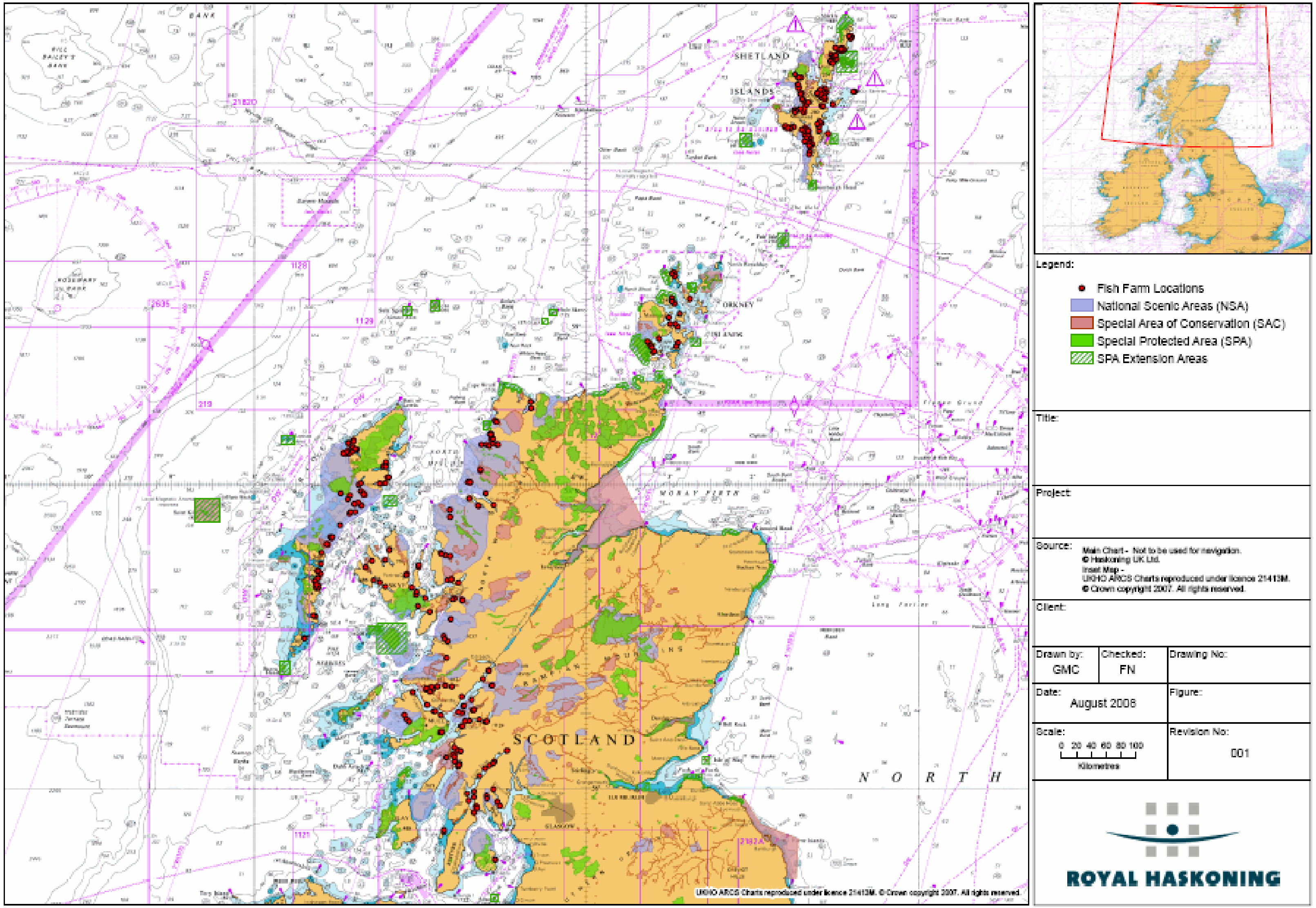
		NSA	**Natura 2000**	**BAP**
Shetland	Salmon	24%	4%	27%
	Shellfish	30%	5%	25%
Orkney	Salmon	14%	10%	45%
	Shellfish	25%	0%	0%
Western Isles	Salmon	52%	4%	33%
	Shellfish	43%	0%	21%
Highlands	Salmon	58%	15%	28%
	Shellfish	39%	14%	22%
Argyll & Bute	Salmon	17%	8%	12%
	Salmon	27%	8%	6%
	Total Salmon	***33%***	***7%***	***27%***
	Total Shellfish	***32%***	***8%***	***15%***

It appears that in the Highland region there is both the highest level of aquaculture production, and the highest level of designation. Highland region produces approximately a third of all salmon in Scotland in spite of almost 60% of those farms being in NSAs, or some other form of designation. This reflects comments from the industry suggesting that what is good for growing fish and shellfish is also good for species and habitats of national importance, and the topography and geography which provides for sheltered but well flushed waters ideal for farming are the same features which give the coastline its intrinsic beauty. This appears to provide a preliminary (albeit weak) indication that designations have not significantly constrained production to date.

Fig.6: Regional proportion of Scottish salmon production – by local authority area.



Further inspection reveals a more complex picture. For example, analysis of the relative regional proportion of overall production suggests that the share of salmon production in the Highlands has fallen in the last 15 years relative to other regions. By contrast the relative proportion of production has increased in other regions – most notably in Shetland which is now responsible for 31% of Scottish salmon production – more than any other region – compared to 20% in the early 1990s. This may be an indication that development opportunities are greater outside of designations, although other factors may also be at work – such as site availability and growing conditions, local attitudes and ease of planning.


SHETLAND
ISLANDS
ORKNEY
ISLANDS
MORAY FIRTH
SCOTLAND
N O R T H
Legend:
Fish Farm Locations
National Scenic Areas (NSA)
Special Area of Conservation (SAC)
Special Protected Area (SPA)
SPA Extension Areas
Title:
Project:
Source: Main Chart - Not to be used for navigation.
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Client:
Drawn by: GMC
Checked: FN
Drawing No:
Date: August 2008
Figure:
Scale: 0 20 40 60 80 100 Kilometres
Revision No: 001
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4 Operational Restrictions

4.1 Designations

None of the designations encountered in Scottish waters automatically carry a presumption against development. It is, however, likely that the designation will be taken into account and may be of influence when assessing farm applications. In practice, this means that statutory conservation bodies (in the case of Natura sites and BAP species & habitats) or the local planning authority (in relation to national scenic areas) are likely to place a stronger demand on farms to demonstrate that environmental impacts have been considered and where possible mitigated, and / or that landscape issues have been fully considered.

Where either a new site application or an amendment is within or adjacent to a designation a full environmental statement will almost certainly be requested as part of new site applications (in fact this is likely to be requested anyway for most modern farms with biomass in excess of even 500t). Furthermore, should it be deemed necessary a further 'Appropriate Assessment' will be required to support the application where the interest of an SPA/SAC may be affected. The Appropriate Assessment examines in detail the specific interactions between the proposed activity and conservation feature of note and must demonstrate that the proposed activity will have no detrimental impact. An Appropriate Assessment is therefore more focused and more stringent an assessment than an Environmental Statement (or EIA).

Box 3: Example of effect of Natura Designation on fish farm development: Dornoch Firth

A private individual sought planning consent for an oyster farm in the Dornoch Firth SAC. After extensive consultations, and mitigations to meet concerns of local stakeholders and SNH, his application was refused – principally on the basis of concerns raised by SNH. SNH requested an *Appropriate Assessment*, which would have had to be funded by the applicant. Eventually after extensive effort the applicant abandoned the proposal, due to apparently insurmountable obstacles – many of which were a direct result of the SAC designation. It is thought that the applicant will re-apply elsewhere – outside of an SAC.

Information/perspective from ASSG

4.1.1 Company Strategy

At the company scale when looking at overall locations for farms, deciding where to apply for new sites or when looking to consolidate production in fewer larger sites (in pursuit of economies of scale), it is clear that statutory designations influence strategic decisions. Companies are fully aware that where there is a relevant statutory designation – either NSA or SAC whose characteristic has the potential to be affected by aquaculture – there is increased uncertainty over both the length of process and the outcome of applications. In short, companies recognise that applications associated with designations carry some form of increased risk and financial penalty. These factors are accordingly weighed up when companies develop strategy.

In some cases companies have made investments in initial scoping before finally abandoning the application, having concluded that the presence of a designation presented too significant a risk to a successful application. One company interviewed reported that under normal circumstances, when looking for a new site a company would make an initial scoping assessment of site suitability in the order presented below[9]:

1. Suitable physical characteristics
2. Conformity with company strategy / logistics
3. Absence of other companies and/or a suitable Area Management Agreement (AMA) in terms of stocking strategy (e.g. Spring or Autumn).
4. SEPA modelling
5. Presence or absence of designations.

In practice, the above order is likely to be more fluid and vary on a case by case basis. This does suggest that designations do not yet serve as an effective *veto* – otherwise companies would first seek to find undesignated waters before proceeding with the scoping exercise. However, given the comments obtained from the industry it is reasonable to assume that the presence or absence of designations is, at the very least, likely to be considered earlier in the scoping exercise.

Designations do not automatically rule out new applications, but companies may prefer to invest elsewhere with less uncertainty, or simply choose not to invest. The Scottish aquaculture industry is a close-knit community and companies will quickly hear of difficulties experienced by others elsewhere in Scotland. Consequently, even if a company does not have personal experience of increased costs, delay and uncertainty associated with designated sites, it is highly likely that the company will be aware of such instances and will seek, where possible, to avoid such difficulties.

Where companies are consolidating production around fewer larger sites - with increased discharge license and production based around automated feeding and large circular plastic pens – companies have stated that they are more likely to concentrate production in non-designated sites, assuming the logistical and growth penalties are not too severe.

Box 4: Example – Designation as disincentive to development

During discussions with the industry a number of possible sites have been referred to which companies would have considered, with a view to submitting a full application for a new site, but where the presence of a designation contributed to the decision not to go forward with the application. These sites include:

- Outer Loch Kishorn – due to the close proximity of the Wester Ross National Scenic Area
- Geometra – Due to the presence of the Loch Na Keal National Scenic Area.

A contrasting example comes from Shetland where there is a high concentration of industry around the Scalloway Islands, within the West of Shetland NSAs. Both companies and council indicated that this status rarely interferes with aquaculture planning applications. This may indicate that the interpretation on NSAs varies between local authorities.

However, this is not always possible. It is increasingly the case that some designation or nature conservation interest will be encountered wherever the farm is sited – this is particularly the case for NSAs which cover large areas. As a result farms have to work within the restrictions that result and seek to make applications which are sensitive to the features described in the designation. Even where this is done, there remains an

[9] Order obtained via consultation with salmon production company with multiple sites.

uncertainty about the interpretation that will be applied, meaning that farms are often unsure how long applications will take or what is the likelihood of success.

From a regulators perspective, reviewing applications on a case by case basis ensures a thorough approach, however, the lack of uniform guidance – or rather interpretation of that guidance to date - means that applicants can not be sure of an outcome until statutory authorities have had an opportunity to comment.

4.1.2 Site operation

Once a farm is licensed there appear to be relatively few examples of operational restrictions placed on farms as a result of designations – although the size of the licence may itself have been influenced by the designation. However, more specific issues did occasionally arise in discussions with industry and there were examples of designations and protected species status impacting upon micro-management of site.

In some areas close to seal or cetacean SACs it is not possible to use seal scarers. If these can not be used the company has to regularly repair holes in nets, use predator nets, risk escapes, and may have to shoot, all of which are bad for company reputation.

If a company wishes to make small changes to cage configurations, for example as a result of new lice treatment protocols, or wanting all farms to have the same size pens (for economies of scale) then these must be again subject to planners view of landscape impacts and submission of a *technical variation* – in the case of sites within or adjacent to designations, the anticipated problems associated with such technical variations may cause farmers not to make changes – or in some cases, make minor changes (for example of cage or mooring configuration) without going through the appropriate planning re-applications.

4.1.3 Commercial benefits of designation

The research team were not able to identify many examples of producers feeling that there was any commercial advantage to be gained through operating in a designated area. However, it is notable that one large multi-national does highlight the conservation features of an SAC in which it farms on its web site – clearly believing that there is a marketing benefit to be derived from highlighting the conservation characteristics that the company is sympathetic to.

It is perhaps surprising that more effort is not made to derive a commercial or marketing benefit from the high conservation and scenic value of the waters in which Scottish farmers operate. This perhaps reflects the perception of the industry (see 2.5.4) and a concern that highlighting the interaction with designations may be viewed with cynicism in some quarters and may therefore be more likely to create a negative backlash.

4.1.4 A hierarchy of designations

Based on our discussions with farmers, it is difficult to state clearly which type of designation is of greatest concern to the industry. It is likely that individual company experience has shaped their perspective on the subjective question of aquaculture compatibility with designations. The research team's consultations have certainly highlighted that industry perspectives of designations vary regionally. For example, in the Highlands the research team uncovered real industry concern about the potential threat of NSAs – they are seen widely as part of the "planning problem". By contrast in

Shetland, NSAs were of no concern at all to the industry and would be unlikely to affect a decision of where to seek new site applications.

Special Protected Areas were more likely to be of concern for shellfish farms – and mussels in particular. RSPB indicated that they would be unlikely to object to a salmon farm in a SPA (although this is relatively unlikely in the SPA coastal extension areas that have been identified), but would seek to see substantial mitigations where shellfish farms were proposed close to SPAs.

SACs were of concern to salmon farmers, but most felt that given a well argued case, it was possible to secure planning approval within SACs. However it was likely that the application would take longer and require more resources. For smaller, less well funded applicants, lacking in-house expertise SACs are likely to present more of a problem.

5 Implications for Industry

5.1 Overall industry range and extent

In undertaking this initial research, no concrete evidence was obtained to suggest that the presence of designations in Scottish waters has significantly impacted on the overall production levels of Scottish aquaculture. At first there also appears to be little evidence to suggest that the overall pattern of locations and concentrations of Scottish aquaculture have been substantially influenced by designations. However, it is thought likely that this is partly because many farms pre-date the designations. A trend pattern may show a slightly more complex picture with farms beginning to gradually re-locate away from most sensitive designations.

Perhaps a more pressing question, particularly given the globally competitive nature of the salmon growing industry – is what effect (if any) do the presence of designations and scenic areas have on the willingness to invest in the Scottish industry.

5.2 Socio-economic Impacts

Socio-economic impact is taken to mean impact on:

- Profitability; competitive and comparative advantage
- Employment (direct and indirect)
- Income (direct and indirect)
- Viability, and social and cultural vibrancy of communities

There are several possible areas of socio-economic impact associated with the close proximity between Scottish aquaculture facilities and marine conservation and landscape designations. These vary in their scale and the degree of ambiguity of the cause and effect relationship. The many areas of potential impact can be summarised as:

- Impact of those existing farms forced to close as result of review process, or as a result of failed applications to renew licences, as a result of the presence of designations.
- Failure of applications for new farms either in or adjacent to designations

- Direct cost of applications – further increasing Scottish cost of production, reducing profitability and eroding investor confidence (although some investors may be attracted – if it can be linked to a clear market benefit).
- Localised impact of company strategy to move away from designated areas (although in most cases this will be linked to socio-economic benefit elsewhere).

These areas of potential socio-economic impact are now explored in further detail.

5.2.1 Closure of existing farms

We have been unable to uncover clear examples of designations clearly and unambiguously resulting in the closure of an existing farm due to a failure to meet with planning approval, either at the time of licence renewal, as a result of the on-going review process, or as a result of a subsequent application for a technical variation. However, there have been several cases where designations have threatened the closure of existing farms at the point of review or re-application. Some farms in designated areas are still to undergo the formal review process, so this may change in the near future.

5.2.2 Failure of new applications

Again, the research has not uncovered any clear examples where the presence of a designation has directly led to the failure of a new site application. However, there are a number of examples where the presence of a designation has greatly complicated the process of new applications.

Box 5: Costs and scale effects related to designations - Yell Sound Example (industry sources)

The Yell Sound SAC was originally planned for Otters, the aquaculture industry objected to the setting up of the SAC, but withdrew objection having been reassured that it would only apply to 10m offshore. However, at the 11th hour, common seals were added to the SAC (in spite of the fact that the main common seal grounds are outside the SAC). This change meant that a new 2,200t farm application was objected to, triggering a string of appropriate assessments, which held up a £2.5 million capital expenditure project by 2 years. In the broadest terms this cost:

- £200,000 – the increase in equipment costs
- £400,000 – profit margin on one complete cycle
- £10,000 – staff time.

The application was eventually passed, once SNH had withdrawn application and with little or no requirement for alteration or mitigation.

A small scale mussel farmer also received the same objections in Yell Sound. Without the financial clout or technical expertise to tackle the objection the applicant was forced to withdraw. However, once the process referred to above had been successfully completed by his large salmon farming neighbour, the mussel farmer was able to resubmit, and received consent without difficulty.

This suggests that SACs are likely to have a disproportionately large impact on smaller-scale, locally owned operators, unable to devote the requisite resources to achieve consent.

5.2.3 Cost of applications

Applications for new sites, or for technical variations to existing sites, or for submission of evidence to the review process are more expensive in event of a local designation. The increased costs associated with such applications are incurred as a result of:

- Direct costs (increased surveying requirements)
- Delay

If putting together a new planning application or an application to change farm layout / CAR technical variation, then, according to one farmer interviewed - the presence of an SAC or other designation in the vicinity will “easily” add £15,000 extra costs:

- Full landscape / visual analysis (external consultants) - £6k
- Video survey (including for presence of UK BAP species) – £2k
- Considerably more consultation – staff time

Additionally a habitat and species assessment is done – which will go on to contribute to the EIA process. Resources such as MarLin and Marine Nature Conservation Review (MNCR) enable a good description of not only the main species of concern, but also their tolerance to any disturbance. This exercise often serves to satisfy any concerns that may be raised about SACs and other designations.

5.2.4 Socio-economic impacts of Company Strategy

The combination of the above mentioned potential costs of operating sites within or adjacent to designated sites is likely to impact upon overall company strategy and siting considerations (as highlighted already in section 4.1.1). As a result the likelihood of new socio-economic benefits resulting from aquaculture is less likely in areas within or adjacent to designated areas. This means that smaller sites in or adjacent to designations are more likely to close as a result of company rationalisation. Over time it is therefore likely that the amount of aquaculture related activities in designated areas will reduce, with a knock on consequence to local society and economy.

6 Summary

In the scoping consultations for this research project, no single constraint was seen as dominant - having a substantially adverse affect on the industry's development, over and above any other. Instead a more complex picture emerged of a range of more subtle constraints, varying in their scale and relative importance – depending on both location (at both loch and local authority scale) and industry perspective.

6.1 Fixed Constraints

Regardless of any policies, regulation or processes, the Scottish industry is constrained by certain fixed constraints which are largely beyond the control or influence of the Scottish industry or Scottish policy makers. The first of these is the physical / environmental capacity of the available Scottish resource; the second, the vagaries of the international global commodity market.

The total environmental capacity for aquaculture in Scotland – either for finfish or shellfish – has not been properly assessed – either nationally or regionally. As a result it is unclear exactly what the scale of production could be, if the available environmental resource – namely its ability to adequately assimilate organic waste – was exploited to the full. It is also unclear how many more viable sites (both biologically and economically) remain undeveloped, or indeed how many existing licensed sites which are not currently under production, could be profitably operated under different circumstances.

Whilst it is therefore accurate to say that the total potential for aquaculture in Scotland is a fixed constraint – it is not clear where existing production is relative to this fixed maximum production. Without an evaluation of this overall picture, it is difficult for policy makers to take a strategic position on the potential role of further aquaculture development in the economic development of the Highlands and Islands.

Similarly, the markets which dictate global commodity prices for aquaculture products are largely outwith control of the industry, although there may be some scope to influence price through adjusting production volumes or capture an increased share of the global market.

6.2 Non-fixed constraints

Beyond these fixed constraints there are a number of other constraints which have impacted upon the industry to greater or lesser extents. These constraints may be the result of national or regional policy and there may therefore be increased scope to take these into consideration in shaping future policy in Scotland. These constraints include planning, regulation, designations and infrastructure.

6.2.1 Designations

The initial focus for this research was the scale of the potential constraint of nature conservation and landscape designations on the development of the aquaculture industry in Scotland. The findings of this initial scoping exercise suggest that such designations are indeed a constraint, but the effect is probably relatively modest and less significant than the cost and uncertainty associated with planning procedures.

Designations do lead to an increase in planning application charges, for example to cover seabed video surveys or landscape assessments. Designations are also likely to require appropriate assessments, which although not typically costing the applicant money, do delay proceedings and add uncertainty. From the perspective of industry, designations are viewed as a complication. Were it possible, companies would choose to avoid new site applications in designations. Where companies are deciding which sites to expand and which sites to mothball, as part of efficiency exercises to achieve economies of scale, the presence of a designation may influence company strategy with applicants likely to increase production in the site with most likelihood of planning success. In spite of this, many farms are in designations and many companies do pursue planning applications in designated areas. Where this is the case, companies with in-house expertise and environmental resources, supported by robust finances, appear to be best placed to expedite the planning process. Poorly financed companies or new entrants are therefore likely to be disproportionately affected at the planning stage by designations.

This research has not been able to uncover evidence that designations lead to a reduction in the total production of Scottish aquaculture or an overall constraint on the industry. However there is sufficient evidence to conclude that overtime there is likely to be a gradual increasing balance of production outside of designated areas, compared to within designations.

6.2.2 Planning

It is difficult to isolate planning as a constraint in its own right as many other factors – such as landscape, designations and perception – all influence planning decisions. However, according to the scoping consultations undertaken as part of this research project, the most significant and often-cited (from industry) constraint on the development of the Scottish Aquaculture industry in Scotland is the planning system – and, in particular, the associated cost and delay.

Additionally, there is little scope for an overarching or strategic view of the industry and its development to be taken at the planning stage. For example, it is notable that industry will not approach a local authority too early in the scoping process to help identify a site, but will instead seek to identify a site themselves then undertake scoping consultations with the other statutory consultees, and only when a potential site is looking viable will they approach the local authority. This is likely to vary somewhat between local authority areas – indeed the research team uncovered substantial variations in the industry's perception of different local authorities.

6.2.3 In Conclusion

Taken individually and in the context of the overall Scottish aquaculture industry, it is difficult to argue that any single constraint has formed a particular barrier to the development of the industry. Were a constraint, which could be influenced or changed by either industry or policy makers, to have substantially impacted on the development of the industry, it is clear that the industry would have been more vocal in addressing it. The relatively muted response from the industry to requests to respond to this research offers an indication that there is a not strong perception that there are constraints which could and should be easily changed. This viewpoint was largely corroborated by the responses to consultations.

In the main, there was a recognition that improvements had been made in addressing many constraints, particularly in relation to regulation and that some perceived constraints have assisted the industry in avoiding some of the pitfalls and associated damage to reputations which have occurred in other producer countries – for example, as a result of major disease outbreak. There is not a strong desire to see a wholesale change to the system but the industry remains of the view that some scope still exists to further streamline the planning and regulatory system to make it more 'fit for purpose'.

In spite of the fact that salmon industry representatives indicated that the industry could have been up to 50% larger, we have not uncovered evidence of a single constraint which has prevented the industry reaching its full production potential – other than the fixed constraints of market and the available resource (suitable growing area).

Of the constraints identified, the greatest cost to industry comes from the uncertainty and delay associated with the planning process, and the role of a wide range of statutory and public consultation as part of that exercise. However, in many of the examples and case studies that we encountered, where sites were appropriate, they were eventually licensed. So whilst there was clearly a cost, this does not appear to have lead to a reduction in the total size of the industry.

Although taken individually, the remaining constraints have not had a significant socio-economic effect, it is important to consider the overall impact of a wide range of perceived constraints on the industry as a whole. The overall burden of constraints on the Scottish industry clearly influences the relative attractiveness to do business here, influencing decisions, and applies to:

- multi-national companies already in Scotland in determining company international strategy.
- Potential investors in both Scottish based or Scottish owned companies
- New entrants – the risk is that the current constraints disproportionately affect the small scale, new entrants – particularly to shellfish production.

There are many advantages to undertaking aquaculture in Scotland. If policy makers are keen to ensure that these advantages are not outweighed by the cumulative impacts of many small constraints, then future policies must strive not to add further complication and administrative layers, unless there is a clearly justified and well argued reason for doing so. If policy-makers determine that an appropriate expansion of aquaculture (in all its forms) is to be used to support the economic development of the Highlands and Islands then it is clear that a mechanism to allow for a more strategic development of the industry, which addresses some of the constraints, will be beneficial in the long term.

Annex 1 – Explanation of Designations

Natura 2000 (SACs and SPAs)

Special Areas of Conservation (SACs) are areas designated under the European Directive commonly known as the 'Habitats' Directive. Together with Special Protection Areas, which are designated under the Wild Birds Directive for wild birds and their habitats, SACs form the Natura 2000 network of sites.

Scottish coastal waters include a number of the marine habitats and species listed in Annexes I and II of the Habitats Directive. Sites for candidate SACs were initially proposed by SNH, in wide consultation with stakeholders. In 2005, 34 marine sites were designated as SACs with all candidate sites upgraded to full status by the EU. In these cases, SNH advises other relevant authorities as to a) the conservation objectives for that site, and b) any operations which may cause deterioration of the sites target conservation interest.

Special Protection Areas for birds have been terrestrial designations to date but 31 seabird SPAs will be extended from 1 – 2 km to seaward. Further SPA designations may also be possible as either Inshore Feeding Aggregations or Offshore Aggregations and 'loafing' areas.

Even before these additional SPAs it was the bird, rather than the areas that was protected. In that sense it is unlikely that new designations will cause a particular consequence for aquaculture.

SSSI

In Scotland, 6 of the 34 marine SACs have purely intertidal marine interests and are fully underpinned by the SSSI mechanism. For these sites, the duties imposed on SNH by Regulation 33 are discharged by SSSI protective measures and notifications. The remaining 28 sites contain significant subtidal areas (i.e. lying below Mean Low Water Springs) which cannot be notified under the SSSI system. Documents containing the Regulation 33 advice for each of these 28 European marine sites are available via SNHs web site (SNHi and SNH sitelink);

National Scenic Areas

This is Scotland's only national landscape designation for areas considered of national significance on the basis of outstanding scenic interest which must be conserved as part of the country's natural heritage. They have been selected for their characteristic features of scenery comprising a mixture of richly diverse landscapes including prominent landforms, coastline, sea and freshwater lochs, rivers, woodlands and moorlands.

There is a concentration of NSAs in areas used by the Scottish Aquaculture industry. Designations are typically very large – for example the largest in Scotland (Wester Ross) covers 145 300 ha, taking in a number of areas already used for aquaculture. NSAs do not automatically prevent development. It is stated that changes in NSAs should be consistent with their scenic interest whilst allowing for the social and economic needs of communities. Where unresolvable conflicts arise however, the interests of long term conservation *should take precedence*.

Coastal and Marine National Park

In 2006 the Scottish Executive consulted on proposals to establish one or more Coastal and Marine National Parks. Following the 2007 election, the new administration decided not to pursue these proposals – at least until the other marine management initiatives referred to in this report, in particular the Marine Bill, have been clarified at which point proposals for a Coastal and Marine National Park in Scotland may be revisited.

The majority of the areas on the long list of potential CMNP sites which was circulated at the time were in areas which are important for aquaculture production. Additionally the areas are large and extensive. It is therefore likely that any proposals would be significant for the aquaculture industry – although the details of the requirements of operation within a CMNP had not been stipulated. For the purposes of this project, as a result of the current position of the Scottish Government, CMNPs are not referred to in detail.

UK BAP Species

One of the key agreements adopted at the 1992 Earth Summit in Rio de Janeiro, was the Convention on Biological Diversity, which establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources.

In April 2002, the Parties to the Convention committed themselves to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth. This target was subsequently endorsed by the World Summit on Sustainable Development and the United Nations General Assembly and was incorporated as a new target under the Millennium Development Goals.

The UK is fully committed to these goals and has implemented a UK Biodiversity Action Plan. This lists priority species and habitats and provides a detailed plan for their protection. There are a number of species and habitats which are likely to interact with the Scottish aquaculture industry, and which may therefore influence planning applications – and therefore overall industry strategy. These include species such as maerl, Atlantic salmon and a variety of dolphin species[10] and habitats such as sub-tidal sand and gravels, mud habitats in deep water and various mussel beds and *sabellaria* reefs.

In many cases the commitments for habitats will have been addressed by inclusion within recently designated SACs. However, for species, these are less likely to have a clear geographic dimension and may therefore be raised as a relevant concern for aquaculture anyway.

[10] A full list of UK priority marine species is available at: http://www.ukbap.org.uk/PrioritySpecies.aspx?group=5

Annex 2. Summary of constraints and impacts as identified by consultees

a,b,c etc refers to different fish farm companies/consultees

Planning/management process	**Practical constraint**	**Social and economic impact** Methods, evidence, sources, cases, models	**Relative importance**
Standard EIA process	• Cost is a disincentive to invest in new sites or expansion of existing in any areas where significant doubt about planning consent (b) • Repetition – explore similar issues at similar sites.(d) • Focus on significant issues improving – in practice landscape is rising on agenda since other issues dealt with through standard consents. • Complete new EIA required for modest increase in production.	General disincentive to change or development. Examples/case studies; Company questionnaire?	*
Technical variations	• Requirement for complex and delaying procedure for relatively minor changes in production configuration (e.g. size of cages? Still an issue?) reduces flexibility and responsiveness (a)(d) • Review of proposals for change may result in re-examination of existing activity	General disincentive to change or development, and restricts responsiveness to market demand. Examples/case studies; Company questionnaire?	**
Dispersion modelling	• Inadequate/inaccurate at high energy sites and effectively limits both cage/site size and medicine treatment efficiency (d)	Reduced competitiveness and performance Examples/case studies; Company questionnaire?	?
Review process (one-off?)	• Staff time • Costs – especially for small sites	Extra staff member for larger companies. Closure of smaller and less viable farms (b)Examples/case studies; Company questionnaire?	**
Proximity of SAC and appropriate assessment	• Increased cost for planning/CAR (b) • Presence of an SAC may be used in sales and image building? (a) • Seal or cetacean SAC prevents use of audio scarers – with a variety of	Adds £15,000+ to new planning application or CAR technical variation (landscape	**

	consequences (a) • Shellfish proposals in SACs unlikely to succeed (c) despite concordat • Appropriate assessment may be required – funded by applicant. • Steady strengthening of Habitats Directive through test cases • Lack of involvement of fish farmers in SAC management	consultants; video survey; habitat and species assessment; staff time).(b) • Disincentive to establish new sites or change/develop existing (b). Dornoch Firth oyster farm application. Ian Ross/SNH Dingwall. Abandoned mainly related to SAC Shetland Hjatland example of involvement of fish farmer in SAC management. Examples/case studies; Company questionnaire?	
Landscape designations	• Significant restrictions on siting (farms should not be seen?) (a,b). • Tendency not to pursue new sites related to this.	Specific examples where new sites have not been pursued because of landscape (a) Examples/case studies; Company questionnaire?	**
Licensing (VMD) and use restrictions (SEPA) on medicines	• High continuous use of ineffective medicines and chronic sea lice (v. effective blitz?) (a, d) • Rules disadvantage/restrict use in larger cages	High costs and poor performance. Examples/case studies; Company questionnaire? Some proportion of 3-4p/kg	**
2,500 tonne consented biomass restriction	• Significant constraint on efficiency (a). • But means higher labour requirement (JH).	Examples/case studies; Company questionnaire?	*?
Lack of transparency about existing sites	• Farmers must apply to Crown Estate for a particular site in order to establish if a seabed site is available. No maps of existing leases or available sites.	Examples/case studies; Company questionnaire?	** (shellfish)
Planning consent	• Unpredictable. Generally negative. Driven by NIMBY agenda and priority afforded to tourism interests in local council planning committee. • Public consultation usually elicits vocal opposition, but does not take account of wider non-vocal support. Benefits from fish farming typically at	Examples/case studies; Company questionnaire? Wester Ross Salmon – straw	***

	regional/national level not effectively represented in local decisions. • Landscape objections irrespective of compliance with SNH landscape guidelines. • Given the uncertainties, local government inclined to take SNH advice. • Cost recovery rates significant and inconsistent for small scale shellfish (£3-11K for a pilot farm application. But *de minimus*?). • Role of framework plans?	poll at supermarket v. balance of letters to planning committee. Others?	
SEPA charges	• Barrier to entry by small operators • Increased production cost	Poseidon report	*
Altogether	Death by a thousand stings (c)	Lack of expansion of shellfish farming? Scottish salmon farming smaller by 50% than would otherwise be the case?	***

Future issues, impacts and methods

Issue	Social and economic impact	
Marine Scotland	• Loss of stepwise adaptive approach to permitting procedures; • Payment levied from industry? (b)	
	• More efficiency re e.g. chemical and nutrient impacts (FRS, SNH, SEPA)(b)	
Marine spatial planning	• Cumulative layers on a map add up to greater likelihood of site restriction unless effective trade-off protocols or presumptions (b) • SSMEI Sound of Mull: no suitable areas for aquaculture without issues • Creation of uncertainty about role of local government in planning • Positive development zones or no-go areas or both?	
Nature conservation (wider environment)	• Lists constantly getting longer and species/sites constantly being identified (e.g. horse mussel in suitable sites in Sound of Mull (a)	
More MPAs	• Of great concern to Shellfish growers – given SAC experience	

Annex 3: Our research: focus for further work

The issues associated with chemicals, dispersion modelling, EIA, CAR variations etc. are largely a matter for the industry to thrash out with the regulators – and they are already doing that. We could provide more evidence on social and economic impact of these constraints, but this would require substantial cooperation from the industry in terms of returning questionnaires and/or informing detailed case studies. From our discussions with SSPO, an adequate level of cooperation seems unlikely using questionnaires.

The issues that we might more usefully focus on include:

1. Existing decision making for planning consent, with particular reference to landscape, biodiversity and local interests. (sources: *procedures* (interviews with LG); *impacts*: local government records, crown estate records, SNH records?. Wester Ross Salmon and Arran case studies)
2. SACs and potential impact of appropriate assessment and the current review process (Shetland Hjatland case study? Nos of farms affected from industry or SNH? Map analysis?)
3. Potential impact of more extensive MPAs and other spatial planning initiatives under Marine Bill (more detailed analysis of maps and potential sites? Workshop scenario building)
4. In depth examination of alternative decision making procedures and protocols for balancing nature conservation and development interests (workshop exercise; international examples (e.g. my Swedish case study on decision making/marine parks)
5. The nature of the Scottish premium – links with landscape and biodiversity. (Interviews with buyers (5) and possible a small consumer survey in eg TESCO.)

Annex 4: Correspondence relating to the release of positional data on Scottish Fish Farms

From: Tristan Southall [mailto:tristan@tdsouthall.co.uk]
Sent: 05 June 2008 15:19
To: 'fishhealth@marlab.ac.uk'
Subject: Fisheries GIS files - Freedom of Information

I am undertaking a study, in association with Hambrey Consulting for the Scottish Aquaculture Research Forum. The study is entitled "Socio-economic Assessment of the potential impacts of new and amended legislation on the cultivation of fish and shellfish species of current commercial importance".

We hope to map the location of current active (or temporarily fallow) farm sites, against the location of existing marine nature conservation (Natura 2000) designations. The data required for the location and shape of the designated areas is available from the Joint Nature Conservation Committee, and we hope to combine this with the data on fish farm locations from FRS.

I would like to make a formal application, under the Freedom of Information, to obtain the geographic position data for the active salmon and shellfish farms included in the most recent Scottish aquaculture production surveys carried out by FRS.

Ideally, we hope to receive the data in a form where it can readily be integrated with GIS software.

Many thanks

Tristan Southall

Our ref: FOISA 2008/34
18 June 2008
Dear Mr Southall
Thank you for your request of 5 June 2008 for geographic position information relating to active salmon and shellfish farms in Scotland. We are dealing with this under the Freedom of Information (Scotland) Act 2002 ('the Act').

In our view we are unable to release this, since **Section 26** of the Act: **Prohibitions on Disclosure** provides to the extent that *information is exempt information if its disclosure by a Scottish public authority (otherwise than under this Act) –*
(a) is prohibited by or under an enactment
The information you requested is collected under the terms of the Diseases of Fish Act 1983. Section 9 of this Act prevents the release of this information with the exception of three specific circumstances. These are: where the information is to be used in criminal proceedings; where the provider of the information has given written permission for its release; or, in summary form, where the data pertaining to an individual cannot be identified. Since we are not required under the Act to seek permission from the data providers on your behalf, it is not our practice to do so. We are able, however, to supply

a direct link to the following maps via web links (see covering e-mail) which we hope you will find useful.

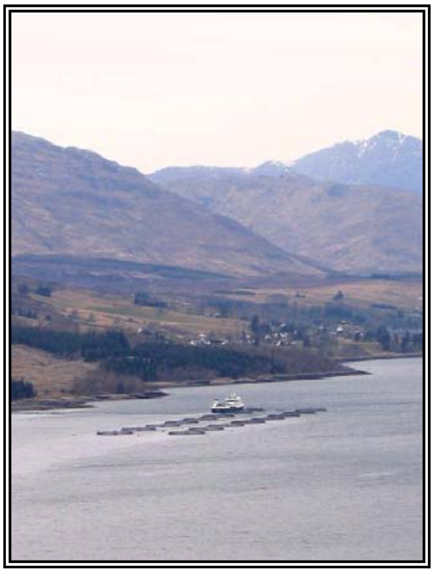
You could contact the Crown Estate (The Crown Estate 6 Bell's Brae Edinburgh EH4 3BJ Tel: 0131 260 6070**, or** www.the**crownestate**.co.uk , as they may be able to help you. If you are unhappy with the way we have handled your request, you have the right to request us to review it. You should address your request to:

Professor Robin Cook,
Chief Executive
FRS Marine Laboratory
P.O. Box 101 Victoria Rd
Aberdeen
AB11

SARF 046

Socio-economic Assessment of potential impacts of new and amended legislation on the cultivation of fish and shellfish species of current commercial importance

Appendix 2



Aquaculture planning and management
Report of a workshop to explore possible futures

Cowan House, Inverness, Monday 20th October

Study funded by:
Scottish Aquaculture Research Forum (SARF)
SARF Project 046
Co-sponsors: Highland Council and Highlands and Islands Enterprise

Organised by Hambrey Consulting
www.hambreyconsulting.co.uk

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Background

SARF research serves a broad constituency of those concerned with sustainable aquaculture development, and more specifically the implementation of the vision set down in the Strategic Framework for Scottish Aquaculture: a “sustainable, diverse, competitive and economically viable aquaculture industry”. SARF 046 should contribute directly to the achievement of that vision.

Legislation relating to the marine environment is in a state of flux, with a large number of policy and legislative initiatives arising from international, European, UK and Scottish sources. There are likely to be significant changes over the next five to ten years which may influence the siting and management of aquaculture, and possibly generate marketing opportunities.

The purpose of the research is to ensure that all those engaged in the process of policy and legislation development and its implementation are able to take full account of the likely social and economic consequences for aquaculture – both positive and negative.

This purpose of the workshop was to present some initial findings, and to get the industry, regulators, and other concerned parties together to discuss some of the key management issues which are having, or may in future have significant social and economic impacts on the industry, so that these can be examined in more detail in the second phase of the research.

Research undertaken so far suggests the following as issues of particular concern to the industry and to planners where there is a need and opportunity for more focused research:

- Appropriate assessment in relation to Natura 2000 sites.
- Further designations (e.g. MPAs) or “use zones” in the marine environment under the proposed Marine Bill.
- Balancing resource use and biodiversity conservation in the wider environment.
- Ecosystem management.

The following delegates attended the workshop:

Delegates

Richard Slaski	BMFA
John Webster	SSPO
Rebecca Dean	Lighthouse Caledonia
Sheena Warnock	Lighthouse Caledonia
Sally Davies	Scottish Seafarms
Penny Hawdon	Marine Harvest
Karen Hall	SNH (Shetland)
David Palmer	SG Marine Management
Jude White	SG Aquaculture
Ian Sutherland	HIE
Douglas Sinclair	SEPA
Janet Davies	SEPA
Andy Rosie	SEPA
Alex Adrian	Crown Estate
Mark James	SARF

Consultants
John Hambrey
Tristan Southall
Richard Robinson
Steve Westbrook

A full list of organisations invited to the workshop is included at Annex 1.

Disclaimer

This report seeks to offer an unbiased and non-attributable representation of the views and opinions expressed at the workshop. It makes no claims about the accuracy or veracity of those opinions.

Presentation: Historical Constraints on the developments of the Scottish Aquaculture Industry.
This presentation by Tristan Southall summarised some of the initial findings from the consultations undertaken on the project to date – including a summary of historical constraints on the industry. .

Exercise 1 – Prioritisation of Development Constraints

Following the initial presentation the delegates were asked to prioritise the historical constraints on the development of the industry in Scotland. Each delegate was asked to assign five stars in total, with a maximum of 3 allowable against any one constraint. The table below summarises the outcome of this exercise.

Constraint	**Explanation / covering**	**Score (no. stars assigned)**
Planning (including consents, designations etc)	Delay / uncertainty etc	18
Market	Global / local / research	13
Perception (public, official)	Impact on market / planning	12
Physical	Environmental capacity / site availability	11
Regulatory	Limitations of models	8
Finance	Availability, flexibility, especially for start up; small/medium enterprise; cash flow associated with variable market price	8
Landscape	Impact on planning	7
Infrastructure	Road / rail / sea linkages	3

It should be emphasised that this exercise was intended as a stimulus to debate and as a means of assessing the interests of participants. It was not a rigorous technical exercise. This would have required much more time spent on defining and separating categories. In particular there is overlap between planning and several other categories.

Nonetheless the exercise confirmed earlier conclusions that delay and uncertainty associated with the planning system is a major problem for the industry. There are many dimensions to this, in particular, impact of local opinion, landscape concerns and designations in gaining planning consent. Several other factors were, however, also significant including market, public and institutional perceptions, site capacity and availability and finance.

This exercise was followed by a second presentation by John Hambrey addressing the possible future changes of the marine planning and management framework and the implications for aquaculture.

Presentation: Planning and management futures.

A presentation by John Hambrey summarised some of the initial findings from the review and consultations undertaken on the project to date – including initial assessment of the implications of the proposed Marine Bill.

Break-out group 1 – Industry potential development trajectory

The purpose of this first break out group was to determine the likely future development trajectory for the industry, on the one hand assuming status quo, and on the other taking account of possible changes under the new Marine Bill. This would provide a baseline for any future scenarios later in the project. The following is a summary of discussions in this break out group.

It was noted that recent global economic changes (substantial falls in stock markets, difficulty obtaining credit, unpredictable fuel costs, and the prospect of recession) would place renewed pressures on the industry in Scotland, and that issues such as energy consumption and maintaining market share may become increasingly important for the Scottish industry. In spite of this there was a reasonable level of optimism, with increasing demand anticipated following the continuing reduction in capture fisheries. There was also a view that large multi-nationals will probably remain in Scotland; if the were inclined to pull out, they would have done so by now.

It was noted the Scottish salmon industry is no longer looking for large expansions in production, and the figures of a 50% increase, or 200,000t total annual production, are no longer thought to be appropriate. Instead, the new focus for the industry is on supplying existing customers and modest sustainable growth, with minimal impact on price. The exact point at which an increase in production might begin to impact on price was unclear, although it was thought that lessons from the past had now been learned - notably from 2004 when low price led to the contraction of the industry in Scotland..

Two of the large multi-national companies, both indicated that they were looking to increase production. Both thought a 10% increase was not unreasonable. In order to achieve this they would focus on maximising production in existing sites but supplemented by an on-going search for new virgin sites. However, they were not too optimistic about the prospect of being successful.

It was suggested that salmon will remain the main focus for the Scottish industry, with limited immediate prospect of much growth or development in:

- **Offshore production** – technology is still someway off and too expensive.
- **New species** – failure of cod in Shetland has damaged short term prospects.
- **Shellfish** – a 300t site is required to be economically viable, which requires several million capital investment. Multinationals are unlikely to invest in large scale shellfish production.
- **New entrants** – either to finfish or shellfish production, due to initial investment required and planning obstacles.

Looking ahead from a strategic point of view, it was felt to be important to seek to identify the *scale of the resource* i.e. the capacity for aquaculture production in Scotland, and use this to inform a clear national strategy. SARF is undertaking some work to identify the total assimilative capacity for aquaculture in Scottish waters, and the Scottish Government is examining site availability issues. Results are expected in the next couple of years.

The future development of the industry may also be greatly influenced by the content and wording of the new Scottish Marine Bill. Furthermore, the new Strategic Framework for Scottish Aquaculture has already introduced new language which is still to have a knock on effect.

Break-out group 2 – Future Legislative / management trajectories

The purpose of this breakout group was to gain a better understanding of likely future changes to planning and management responsibilities and procedures.

The likely changes under the marine bill remain unclear and are subject to on-going analysis of responses to the Marine Bill Consultation. However some key elements are likely to be realized:

- Spatial planning at regional/local level, informed by national marine plan, but with significant stakeholder input at a more local level;
- Streamlined licensing, probably by Marine Scotland, consistent with national policy and local/regional plans.

Spatial planning is likely to be more than just information based GIS – it should have some level of strategic zoning, probably including multi-use zones.

Overall it is anticipated that decision making would become more "bottom up" – i.e. be more stakeholder/user driven. However, it is not yet clear who would be represented on any regional management organization, or who would be the lead partner – this should be an outcome of the consultation. However, some Local Authorities are unenthusiastic about significant planning responsibilities in the marine environment.

One issue for aquaculture is the need to recognize that many fish farms pre-dated designations – and the rights/philosophy associated with this.

There are widely different views about zoning and the strength of any zoning. Broadly speaking SNH favours zoning; many in the industry do not. Indeed the industry is generally uneasy about lines drawn on maps; it is not healthy to "freeze" opportunities or constraints. However, the industry is not necessarily averse to strong planning constraints – so long as this leads to clarity of procedure and outcome, and high standards.

A key issue here is whether higher level zoning is practicable or cost effective. There are typically many local and dynamic constraints – which may include relationships between users and between companies, changing needs and opportunities – that make higher level strategic long term planning very difficult. Furthermore, the process of agreeing a strategic plan is very costly and if it is to be useful has to be regularly reviewed and adapted.

In practice, many of the constraints are already known at local level and the industry knows where it wants to go – the key will be to feed this information into a higher level spatial plan.

The question was raised as to whether new arrangements will reduce the casework, or make the casework more predictable and routine. This was thought to be questionable; the casework will always be there and will have to be at least as thorough.

The industry (and other stakeholders) would have a strong input to any zoning. This raises the issue of representation: the industry itself is diverse; there are many "single interest issues". It will be difficult and costly to reach agreement. More locally based decision making may open up local social wounds; more regional decision making may be inadequately informed about practical local issues.

The level of spatial planning is also critical from the data perspective. While it may be straightforward to collect the necessary data for a particular bay (or in relation to a particular proposal) to do this for a larger area or region will be difficult.

The data requirements are constantly increasing. The proposals relating to landscape capacity assessment for example are data hungry and would be a major task for a local authority. The Shetland Scottish Sustainable Marine Environment (SSMEI) pilot project has highlighted the inadequacy of existing data for strategic decision making. However…much can be done in terms of better data access and sharing.

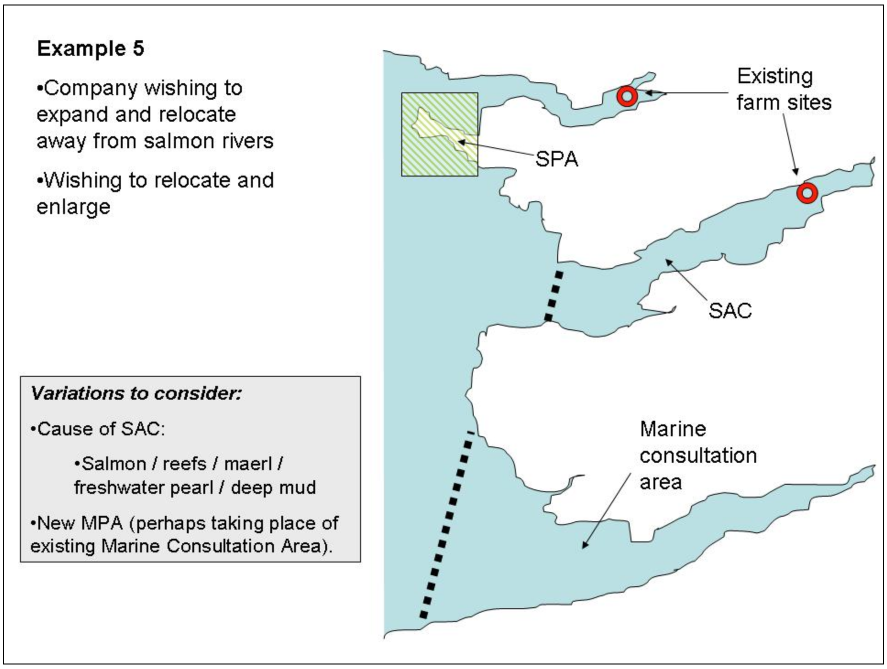
There was a clear view amongst participants that parallels with land based planning are limited and that procedures are likely to be different.

With regard to species protection it was noted that Environmental Quality Standards (EQS) used by the Scottish Environmental protection Agency (SEPA) are already designed to protect all sensitive species, and therefore should serve effectively in terms of conservation in the wider environment.

Working Group 1 – Scenario Exercise – Current & future decision-making in relation to nature conservation / biodiversity

The aim of this working group was to generate a better understanding of the interplay between biodiversity conservation measures and fish farm development in the short and long term – both at the micro (site level) and at company strategic level.

A basic scenario was presented (Figure 1) and built on through further discussion.



Assumption 1: Special Area of Conservation (SAC) interest is primarily otters and deep mud with Seapens

Nature conservation designations and siting/expansion decisions
Initial discussion centered around the extent to which an SAC designation might be a disincentive to development, and how it would influence a company's siting, expansion and production allocation decisions. The following is a summary and interpretation of the main points raised, without attributing positions or opinions to particular individuals or organizations.

When considering applying for expansion at an existing site or developing a new site key issues are:

- The quality of the site;
- The likely costs of collecting required information;
- The risk of the application being delayed or refused.

Risks (from a biodiversity perspective) depend on:

- The quality and availability of existing information about biodiversity;
- The sensitivity of any specific biodiversity interests to fish farming.

In practice, an SAC is not necessarily a disincentive, despite a requirement for more rigorous (and costly) survey. Existing information on biodiversity interest and its sensitivity is likely to be better within an SAC. Thus, if the designation is related to the presence of otters and if the shore base is not going to be expanded significantly, then the designation is unlikely to be a problem. If the designation is related to sea-pens, and if the existing information on the distribution of seapens is of high quality it might enable the farmer – through pre-consultation - to plan a location within the designated area but with minimal impact. Equally it might be apparent that approval was unlikely.

Whilst SAC designation will clearly involve some no-go areas and therefore reduce overall site availability, in so far as it increases the quality of information and reduces uncertainty, its overall impact is not necessarily negative. In some ways a greater problem for the fish farmer is to identify an ideal site outwith any designations, only to find through expensive survey that it coincides with important and sensitive habitats or species and has to be abandoned.

Designated interest also allows SEPA to refine and focus its survey requirements. It was agreed that the increased coordination between SEPA and Scottish natural Heritage (SNH) with respect to ecological/biodiversity survey, and relating DEPOMOD assessments to ecological interest, now makes life simpler for developers.

Notwithstanding these points, most companies would still have reservations about further development within or close to an SAC even where modeling/pre-consultation suggested little concern - especially in terms of longer term or significant expansion. It all comes down to the commercial gains of expansion. If these are marginal, a company would only consider risk-free planning (i.e. a well surveyed site outside of any designation with limited biodiversity interest).

The biodiversity database being developed by the Scottish Association for Marine Science (SAMS) under another SARF project should help increase knowledge and reduce uncertainty outwith SACs.

The possible costs to the industry of designations, such as SAC, is therefore extremely difficult to identify in general terms. It would be necessary to look in detail at specific cases, or possibly generate best and worst case scenarios.

Appropriate assessment (AA)
SEPA/SNH are the bodies that undertake appropriate assessment, and it is they who decide whether to ask the developer for more information. They have a set of categories for likely impacts that indicate whether appropriate assessment is needed, or whether conditions on licence would be sufficient. An assessment of how much larger a new acceptable zone of effect (AZE) will be in relation to original DEPOMOD study will also influence need for AA.

Pre-consultation
Both within and outwith designations, *pre-consultation* is the key to reducing uncertainty and avoiding unnecessary cost followed by rejection. 75% of SNH case load is now related to pre-consultation. It is usually possible to give pretty good steer on what the issues are, and the level and quality of information. Pre-consultation should flag up the need or otherwise for AA.

An applicant is likely to have done DEPOMOD themselves before they start discussions at all. If industry follows guidelines on pre-consultation things go well; if they jump straight to application it creates problems. SEPA checks much data at the pre-application stage.

Shetland Local Government strongly advise applicants to talk to SNH at the pre-application stage.

Pre-consultation does not necessarily pre-empt conflict at a later stage – especially with respect to local issues and concerns.

For companies the key issue is the balance between financial incentive and risk of failure. If financial incentive is strong they will pursue opportunities even where there is some risk. If benefit is marginal then even modest uncertainties may be sufficient to make them give up. Predictability of process is a major issue affecting the costs associated with development, and is a major consideration in the business's original "shall we do it?" decision. Pre-consultation informs a company's assessment of risk.

Arbitrary thresholds set in the past may be a stumbling block and very inflexible, therefore case-modelling is much more attractive to the developer.

Initial survey costs are not usually particularly high. A video transect is a good start and costs a few hundred pounds. A seabed survey is a few thousand pounds. If concerns arise, more detailed and costly surveys will be required. Everyone knows which types of site are likely to be of more concern and therefore generate more costs.

If problems/issues arise from AA.
Site integrity is a key consideration. This is difficult to define in terms of standard criteria – in other words this is an area where it is difficult to reduce uncertainty without detailed analysis. It is not possible, for example, to say that in general loss of a small proportion (e.g. 5%) of Seapen would be acceptable. It would depend on the

structure and distribution of the population, on the level of risk to the rest etc. However there are some general pointers. For example, impacts at the edge of a site are likely to be more acceptable than those in the centre.

Landscape issues
The discussions around priority constraints earlier in the workshop suggested that landscape issues and public perception were at least as important – if not more so – than nature conservation designations. More specifically, there seems to be more uncertainty in the planning system associated with landscape issues, especially since pre-consultation procedures have reduced uncertainty associated with nature conservation in recent years.

Sub-scenario: If National Scenic Area (NSA) covers lower loch (Marine Consultation Area)

Key factors affecting landscape sensitivity (and therefore uncertainty with regards to planning approval) include presence of settlements, roads, recreational areas and walks. These may be more important than landscape designation *per se*, and certainly increase sensitivity within a landscape designated area.

Almost all proposals are around existing sites. If expansion leads to bigger but fewer pens the landscape impact should be positive.

There was some discussion about the need for consistency and common standards on the one hand, and the need to respond to local values and opinion on the other. Clearly the latter presents the industry with problems in terms of planning uncertainty, but standardizing landscape assessment is fraught with difficulty and expense.

Landscape may serve as a stimulus and vehicle for local engagement. Communities may find it is their first chance to get involved in for example, an historic site that has been ignored for generations. They will become galvanized by the issues and raise objections.

Barges are now a major landscape issue. Their appearance may resemble a shed, a boat, a crane etc. Different people respond in very different ways. Although SNH offers some guidance on assessing landscape effects, and minimizing landscape impact (e.g. colour, location), it is unclear that planners always take this advice, and may lack confidence in determining these issues. This relates in part to the fact that they have only had responsibility for a couple of years, so they’re still learning.

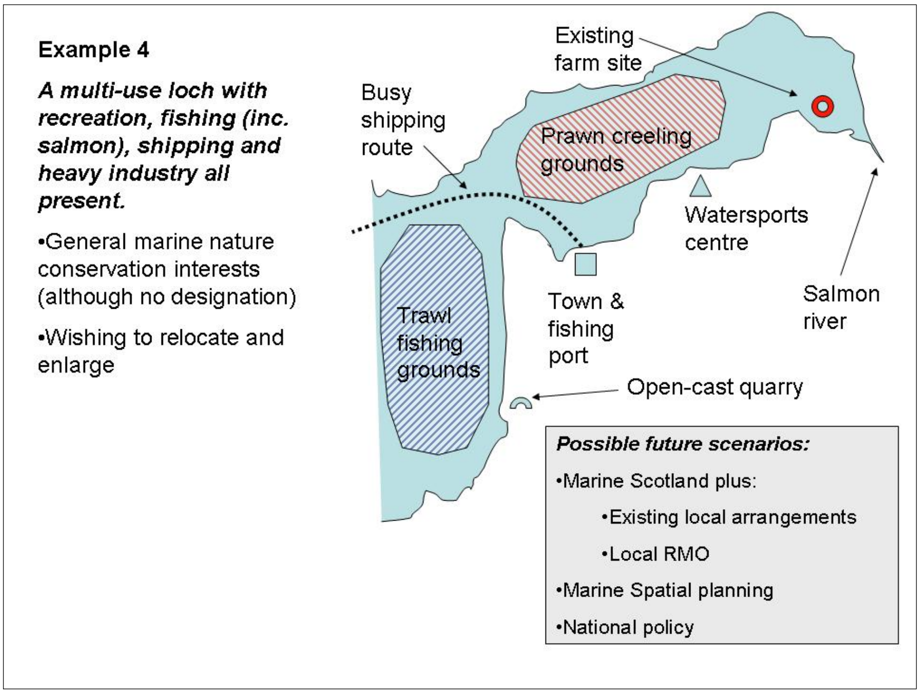
Landscape is particularly difficult for the industry, especially as regards pre-consultation. The industry is not sophisticated about landscape issues, finds them hard to deal with, and therefore gives them rather limited attention. In other words, despite the risks, uncertainties, and associated costs they are not pro-active in seeking to reduce these uncertainties.

Landscape concerns have become more pressing now that planning consents are permanent and poor decisions cannot easily be reversed.

Development of guidelines or standards for landscape is likely to be a part of a Marine Management Organization remit. The Shetland SSMEI already includes such guidance.

Working Group 2 – Scenario Exercise – Decision-making under alternative planning and management scenarios

Objective: better understanding of the likely practical implications for fish farming of changes in the planning and management regime, and in particular possible changes in decision making powers and decision making criteria.



This was a familiar scenario to several participants.

Industry representatives said that they would consult with interested parties before spending money on hydrographic and modelling trials. Creel fishermen might be sympathetic; trawl fishermen less so. SNH would be asked about the presence of other species in the loch.

There was discussion about whether Planning Departments should be consulted first – this would depend on the Local Authority. From some, a useful response would be unlikely without having been given evidence. Planners need to be able to screen for EIA, and would benefit from the training that is being introduced.

In Norway, there is more zoning within multi-use lochs. There is a lot of very local consultation before Plans are drawn up – although it may be necessary for final decisions to be made at regional level because of local family ties/conflicts.

There are many examples where there is initial investigation which isn't taken any further – the advice is to "choose your battles". There is no data available on the costs of these initial investigations, and this would be difficult to obtain. Can we distinguish between valid and invalid objections? How these are weighed is very subjective at the present time.

The picture around Scotland differs – for example co-existence with prawn fishermen can be the issue in Argyll and Bute, and with wild salmon interests in Highland.

There was discussion on why fish farm companies tend not to give up unused sites. One reason is competition, but biosecurity is perhaps the main reason. Another salmon farm, cod farm, etc could be established at the existing site on the map and cause disease problems for the relocated farm.

A farm company would need reassurance that the site vacated would not later be used by another company – but how would future flexibility be built in? (e.g. if the company were to stop its operations in the loch at some future stage). There was a general view that zoning should have a review mechanism (e.g. after 5 years), but this is a very difficult issue.

Integrated Coastal Zone Management (ICZM) can make it easier for alternative uses with no biosecurity risks to replace a given-up farm site. An Area Management Agreement on issues such as biosecurity, though voluntary, can work if there is a good consensus.

A relocation with greater output (e.g. +50%) using modern technologies would not tend to increase direct employment, and this reduces the relative attractiveness of the development in terms of a planning consent decision. However, medium term job security would improve, and indirect employment would tend to increase, and these should be taken into account.

Sub-scenario: NSA Variant

Development within NSA would still be considered, although there are likely to be some costs. The use of the Landscape Capacity Assessment Tool would be an option at Plan creation stage, and would cost around £15,000. The Expert Working Group advises that Planning has to be inclusive.

Experienced local farm staff know local areas and their resources through operational experience and previous exploration of potential sites around the lochs in which they are active.

Areas adjacent to existing farms should generally be acceptable for expansion ("why not?").

Sub-scenario: Marine Scotland with Local Management Body Variant

It is assumed that there will be some form of ICZM (i.e. an agreed strategic plan with spatial dimensions). Creating a new plan could take a long time *[raising the question of how an application for a new site would be handled in the interim].* We would need to move forward quickly. There was a "Free for All" between 1999 and the 2007 Town & Country Planning Act.

A national policy for how much fish farming output there should be would be needed to balance the possible risk that the aggregate of local Plans would not provide enough site capacity. A consultant's report has shown that Local Framework Plans in Highland have tended to give this result (*i.e*. if used comprehensively around the coast would significantly constrain production). A socio-economic input when Plans are being drawn up would be important.

In Norway, although the planning process is quite rigorous, there is a different attitude. Aquaculture is considered more important than holiday cabins and this is reflected in the final plans.

For larger aquaculture developments, it is important not to plan out in detail, but rather to negotiate.

Norway has a two zone system – "No Go" / "Go or maybe Go". Norway is very strict on exact location – with monitoring after two years.

There is a significant issue of whether fish farms have the resources to do all the consultation and trials for a detailed zoning exercise. In other words full engagement in the process will be costly for the industry. A preference from the farmers' perspective is for zoning relatively extensive areas for potential farm development (equivalent to Norwegian "Go or maybe go".

There was concern that pressure groups rather than professionals might have the upper hand on contentious issues. It was agreed that once Plans are in place, applications should be dealt with by professionals.

Feedback by reporters: main messages from working groups

Working group 1: Biodiversity

Predictability and understanding of process are fundamental to whether proposals for expansion are developed and pursued:

- Availability of information and access to it;
- Who will do what (costs, developer/agency);
- Opportunities for pre-consultation.

In relation to SNH and SEPA responsibilities, and particularly the modeling and SPA/SAC requirements, these are fairly well clear so developers can make their own decisions, based on risk and financial benefit. Surprises are now relatively uncommon. SEPA/SNH now have more coordinated response so there is less confusion about survey requirements, and less duplication.

In the case of planning and landscape the situation is very different. Local variation, local community interest/attitude, and planning authority processes are very variable. Guidelines and standards are relatively few, unclear, or poorly observed. Barges cause a great deal of concern and debate.

Any moves to improve predictability of the process would therefore be helpful. Will some form of Regional Management Organisation and Marine Scotland help? This is unclear at present. The new Bill does however represent an opportunity to increase knowledge of issues and appropriate responses in both planning authorities and the aquaculture industry.

Despite local opposition from some accommodation/holiday providers, it is unclear that tourism is impacted by fish farming (this is the subject of current SARF research).

Plenary discussion – key points raised and discussed

- There is a need to draw on findings of other SARF research (SARF 24, 26: GIS database – existing sites and habitats). These are nearing completion.

- Predictability remains a key concern of the industry – but this is now less to do with SNH and more with local planning.

- The Norwegian planning model quite good, but is probably very expensive.

- A trade-off for the industry? Increased level of restriction balanced by reduction in uncertainty under strategic planning?

- It is vital that we move forward in a pro-active way and do not simply respond to European Case law which is increasingly onerous.

- The key is to conserve natural capital (yes but this is a tough concept to apply; and we have always converted natural capital)

- There is no balancing duty within SACs. Only over-riding public interest – and a fish farm is unlikely to come into that category.

Overall – some key findings

1. Although some salmon farming companies are keen to continue expansion, the current economic situation suggests that such expansion will be modest.

2. It is unlikely that there will be significant increase in shellfish farming: investment for a 300tonne mussel farm may be several million – and this is difficult to justify in commercial terms, given the combination of production and marketing risks.

3. Above water constraints (e.g. landscape, other users/interests) are probably greater and less predictable than below water constraints (water quality, biodiversity).

4. SACs may not be a serious constraint. The biodiversity interest is known and understood, and the farmer can therefore work around it. Outside an SAC may be less predictable from a biodiversity perspective, and there will still be the need and cost of survey for any significant expansion/development. However, it is unlikely that major expansions in SAC's would be sanctioned.

5. It is very difficult to generate standard decision criteria for biodiversity (e.g. is 5 or 10% loss of a habitat acceptable) – conservation is very context dependent and often requires dedicated survey.

6. Landscape is a key issue, and barges have become the key landscape issue. As far as most of the industry is concerned, barges are a standard essential part of operations.

7. Landscape is a very local issue and may not be related to NSA designation. Depends on the roads, paths, the views etc. There are differences between local authorities and a lack of standards.

8. Landscape can be a way in, or focus for local engagement on decision making. But local engagement increases uncertainty.

9. Case work and consenting is likely to remain the key point for decision making, irrespective of higher level strategic plans. In other words it is unclear that more strategic planning will significantly decrease uncertainty.

10. The industry is happier working with professionals. It is not clear how their relationship would develop with a group of stakeholders convened as a Regional Management Organisation.

11. Pre-consultation is a major tool for reducing uncertainty, and this now generally works well in terms of water quality and biodiversity. It is less clear as to how this can be further developed in relation to landscape, local amenity issues and planning consent more generally, or how it might work in relation to a Regional Management Organisation under the new Marine Bill.

Annex 1: Organisations invited to the workshop

Representative organisations
Scottish Salmon Producers Organisation
British Marine Finfish Association
Association of Scottish Shellfish Growers
British Trout Association

Commercial aquaculture companies
Marine Harvest
Lighthouse Caledonia
Scottish Seafarms
Mainstream
Loch Duart
Shetland Aquaculture
Hjaltland Seafarms
Wester Ross Salmon
Blueshell Mussels

Government Bodies
Directorate for Marine
Scottish Natural Heritage
Scottish Environmental Protection Agency
Crown Estate
Highlands and Islands Enterprise
Highland Council
Argyll and Bute Council

NGOs
Scottish Wildlife and Environment Link

Scottish Aquaculture Research Forum (secretariat)